HERITAGE 2022 INTERNATIONAL CONFERENCE

VERNACULAR HERITAGE: CULTURE, PEOPLE AND SUSTAINABILITY

Eds. C. Mileto, F. Vegas, V. Cristini, L. García-Soriano

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Universitat Politècnica de València

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HERITAGE 2022
International Conference on Vernacular Heritage: Culture, People and Sustainability

Preface

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"HERITAGE2022, International Conference on Vernacular Heritage: Culture, People and Sustainability" is organized in the framework of the "VerSus+ | Heritage for PEOPLE" project, co-funded by the Creative Europe Program of the European Union (grant 607593-CREA-1-2019-1-ES-CULT-COOP1) and led by Universitat Politècnica de València (Spain) in partnership with Università degli Studi di Firenze and Università degli Studi di Cagliari (Italy), CRAterre – ENSAG (France) and Universidade Portucalense - Departamento de Arquitetura e Multimédia Gallaecia (Portugal). The "VerSus+ | Heritage for PEOPLE" project focuses on the transmission of knowledge to communities and the general public. It pays special attention to the society of the future (children and young people), as well as local, regional and national authorities in charge of heritage management, and includes specialists and experts in the field of architecture (architects, engineers, cultural managers, historians, ethnographers, university students, etc.) together with craftsmen and companies in the construction and tourism sectors, cultural and social associations, and educational institutions.

Vernacular heritage is a tangible and intangible heritage of great importance to European and global culture. This architecture, born from the practical experience of local inhabitants, makes use of local materials to erect buildings taking into consideration the climate and geography, developing cultural, social and constructive traditions based on the conditions of the surrounding nature and habitat. Above all, it plays an essential role in contemporary society as it is able to teach us important principles and lessons for a respectful sustainable architecture. These lessons from vernacular heritage for contemporary architecture have been extensively studied in the "VerSus: Lessons from Vernacular Heritage in Sustainable Architecture (grant 2012-2792/001-001 CU7 COOP7)" project, co-funded by the European Union between 2012 and 2014, and the "VerSus+ | Heritage for PEOPLE" (2019-2023) project, which follows on from the previous project, focusing on the transmission of this knowledge to society, as seen earlier. The wisdom of vernacular architecture in the field of environmental, sociocultural and socioeconomic sustainability is increasing both in interest and significance in the world today. Climate change, depopulation and the pressure of tourism all pose major challenges, as do the increasingly rapid social changes and loss of traditional trades resulting from the industrialization of the construction process. These challenges alert us to the pressing and growing need for education and increased awareness in society and for the documentation and conservation of architecture within a framework of up-to-date integration into contemporary life, managing territory and heritage assets for the sustainable development of society in the future.

The second project involved in this conference is "RISK-Terra. Earthen architecture in the Iberian Peninsula: study of natural, social and anthropic risks and strategies to improve resilience" (RTI2018-095302-B-I00) (2019-2022), funded by MCIU (Ministerio de Ciencia, Innovación y Universidades), AEI (Agencia Estatal de Investigación), FEDER - UE (Fondo Europeo de Desarrollo Regional, Unión Europea). This project is geared towards the conservation of earthen architecture in the Iberian Peninsula, both monumental and vernacular, which continues to be undervalued and barely recognized. The RISK-Terra project aims to provide scientific coverage of the study of natural threats (floods, earthquakes, climate change), social threats (abandonment, social discredit, demographic pressure, tourist development), and anthropic threats (neglect, lack of protection and maintenance), as well as the mechanisms for deterioration and dynamics and transformation (replacement, use of incompatible techniques and materials, etc.) to which architecture is exposed. The objective of the project is to establish strategies for conservation, intervention and rehabilitation which allow the prevention and mitigation of possible damage through compatible actions and/or actions to increase resilience.

As these two projects have major points of contact, particularly in relation to the challenges mentioned above, with potential for common reflection, their main themes have been combined in this Heritage2022 conference. The topics established for the conference are: 1. vernacular architecture: matter, culture and sustainability (study and cataloging of vernacular architecture; urban studies of vernacular architecture; studies of traditional techniques and materials; sustainability of vernacular architecture); 2. heritage education (research in heritage education; heritage education and social inclusion; heritage communities; creativity and heritage education); 3. artisans and crafts of traditional construction (intangible heritage: the management of know-how and local construction culture; training in traditional construction crafts; tradition and innovation in traditional construction crafts; plans and experiences for the recovery and maintenance of construction crafts); 4. conservation, restoration and enhancement of vernacular architecture (conservation and restoration projects of vernacular architecture; materials and intervention techniques for vernacular architecture; difficulties and possibilities of using traditional crafts in conservation; management and maintenance of vernacular architecture).

The scientific committee was made up of 102 outstanding researchers from 24 countries from the five continents, specialists in the subjects proposed. All the contributions to the conference, both the abstracts and the final texts, were subjected to a strict peer-review evaluation system by the members of the scientific committee. Out of the 200 proposals submitted, 134 papers by 254 authors from 25 countries from the four continents were chosen for publication. All the articles have been published in print and online in the two-volume book "Vernacular Heritage: Culture, People and Sustainability".

"HERITAGE2022 (Versus+ | RISK-Terra), International Conference on Vernacular Heritage: Culture, People and Sustainability" was held from 15 to 17 September 2022 in in-person and online modality at the Universitat Politècnica de València. The conference was under the aegis of: ICOMOS-CIAV (International Scientific Committee of Vernacular Architecture); ICOMOS-ICICH (International Scientific Committee on Intangible Cultural Heritage); IEB (Instituto Español de la Baubiologie). The organization, publication and implementation of the conference have been made possible thanks to co-funding of the Creative Europe Programme of the European Union for the project "VerSus+ | Heritage for PEOPLE" (grant 607593-CREA-1-2019-1-ES-CULT-COOP1); and the MCIU, AEI and FEDER - UE for the research project "Risk-Terra. Earthen architecture in the Iberian Peninsula: study of natural, social and anthropic risks and strategies to improve resilience" (ref.: RTI2018-095302-B-I00). Furthermore, Escuela Técnica Superior de Arquitectura and PEGASO - Research Centre for Architecture, Heritage and Management for Sustainable Development of Universitat Politècnica de València have also contributed to the whole project.

Finally, we would like to thank all the authors who contributed to the quality, range, diversity and richness of these publications with their articles. We give special thanks to all the partners of the European project "VerSus+ | Heritage for PEOPLE" and the national research project "Risk-Terra" for participating in the conference and helping to spreading the word about it worldwide. We are grateful for the aid of all the members of the advisory committee and the scientific committee for their work throughout the process of revising the abstracts and papers. And, above all, we thank the organizing committee for the complex setting up of the whole conference, the style and language reviewers for their corrections, and all the collaborators for their invaluable work in the management and organization of all stages of the process.

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A Vision for CIAV. Addressing the challenges facing the ICOMOS International Scientific Committee on Vernacular Architecture

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Topic: T.4. Conservation, restoration and enhancement of vernacular architecture

Abstract

While the debate continues on what exactly is vernacular architecture, what are its values and significance, how could it be conserved and revitalized, some pressing questions must be addressed without delay. Sustainable Development Goals (SDGs), climate change, the pandemic, armed conflicts, displacements and other disasters such as fires, floods and earthquackes are some of the main challenges that have been recently escalating and must be addressed collectively by all humanity without any delay. These challenges that do impact the cultural heritage greatly. On the other hand, cultural heritage should play a key role in addressing these challenges. ICOMOS, as the leading international organization in the field has an important role to play. The ICOMOS International Scientific Committee on Vernacular Architecture (CIAV) endeavours to fulfil its duty in addressing these pressing issues and their impact on the protection, conservation and management of the built vernacular heritage. The specificity of vernacular architecture raises particular challenges as well as offers opportunities that are particular to CIAV. This paper proposes a vision for CIAV that aims to include its new duties, which were not as urgent in the initial vision at the time of its foundation and during the drafting of the Charter on the Built Vernacular Heritage, 1999 in Mexico. The ideas expressed in the paper aim to raise discussions not only among the members of CIAV and ICOMOS but also for all those who are interested in the built vernacular heritage. As a result, CIAV may need to revisit its charter or issue a declaration to include the proposed new vision in its activities and discourse through its newsletter, conferences, publicaitons, webinars and other events.

Keywords: *vernacular built heritage; conservation of built heritage; ICOMOS; CIAV.*

1. Introduction

CIAV's objective is to promote the identification, evaluation, protection, conservation and revitalization of vernacular architecture, in keeping with ICOMOS' objective to foster international co-operation. CIAV forms an international network that defines, improves and promotes conservation principles, standards, research, responsible practice, innovation and knowledge about the built vernacular heritage. According to its strategy established in the year 2000, CIAV's aims are: to offer a global view on the conservation of the vernacular tangible and intangible heritage, to provide a forum for the examination of the built vernacular heritage and to provide specialists with advice on its conservation.The current CIAV Strategic Plan 2021/23 states the following "Vision":

"As an ICOMOS Scientific Committee, CIAV aims to bridge the gap between academic research and professional practices in the field of built vernacular heritage study, conservation and management. The 'new normal' during and after the corona virus pandemic opened a new window of opportunity for CIAV by the normalization of virtual meetings, webinars, and conferences, which permitted more members to participate and brought to the fore impressive contributions from emerging professionals, promising a more dynamic future for CIAV."

Today, cultural heritage throughout the world is facing challenges that are not new but have become pressing. ICOMOS endevours to bring them into the focus and so is CIAV. These are:

- United Nations Sustainable Development Goals (SDGs)
- Climate change
- Natural disasters
- The Covid-19 pandemic
- Wars and displacements
- Fires
- Human rights

In addition, special attention should be paid to working to reach a balanced representation of different regions of the world in CIAV's membership as well as the subject of its work.

In it's declaration of Climate and Ecological Emergency, ICOMOS 20th General Asembley opened the declaration by stating that "The planet is at a crossroads where business as usual is no longer an option." This could be said for all the above issues. It is therefore, the author's suggestion that CIAV has to specifically aim to address these issues in the Committee's work and include them in the Charter on the Built Vernacular Heritage (1999), which CIAV sets as the guidelines for international best practices for the study and conservation of built vernacular heritage. The paper addresses each of the identificd issues and concludes by the proposal to integrate them in CIAV's vision, work and activities, which may require an update to its Charter.

One common characteristics of the issues identified by this paper is that they are a common challenge to all humanity. They, therefore, should be addressed collectively. This is why this is a paper addressed to the field of vernacular built heritage and not as an internal document for CIAV members. There is a pressing need for collaboration and coordinating efforts by all institutions, groups and individuals who work in the field.

2. Sustainable Development Goals

Culture is the absent presence in sustainable development endeavours. Sustainability is often measured by three indicators: social, economic and environment. Culture is not included. Nonetheless, it is a crucial indicator for sustainability. The United Nations Agenda 2030 focus on the five Ps: People, Planet, Prosperity, Peace and Partnership. Once more, culture is not mentioned even if it is present. None of the seventeen UN Sustainable Development Goals is on culture, even if culture is present directly or indirectly in all of them. In 2020 the British Council issued its important report *The Missing Pillar. Culture's Contribution to the UN Sustainable Development Goals.* As for cultural heritage, the only mention of its protection is *Target 11.4 "strengthen efforts to protect and safeguard the world's cultural and natural heritage to make our cities inclusive, safe, resilient and sustainable"*, under Goal 11 'sustainable cities and communities'. In 2021 ICOMOS issued the important report *Heritage and the Sustainable Development Goals: Policy Guidance for Heritage and Development Actors.* The report is based on the conviction that the role of cultural heritage in achieving the SDGs is crucial. The report proposes the slogan 'heritage: driver and enabler of sustainability' with an accompanying promotional graphic similar to the graphics for the seventeen SDGs, featuring elements representing culture, nature and people (Fig. 1).

Fig. 1. The promotional graphic for the role of heritage in achieving the SDGs (ICOMOS, 2021)

The SDGs should be in the heart of CIAV's work. Not only because the vernacular built heritage contributes directly and indirectly to most of the SDGs. But also because the SDGs offer a great opportunity for championing the conservation and revitalization of vernacular built heritage as living heritage that is closely connected to people and to the nature as well as the carrier of age old wisdom in responsible relationship with the environment.

3. Climate change

The declaration by the 20th ICOMOS General Assembly of Climate and Ecological Emergency brought climate action to the heart of all the work and actions of ICOMOS. The theme for ICOMOS International Day for Monuments and Sites for both 2022 and 2023 is "heritage and climate". This is very important for CIAV. The vernacular built heritage is a living heritage that connects people with their environment and manifests their traditional wisdom in adapting to climatic and other environmental conditions. Traditional communities understood and observed sustainability well before the notion was highlighted and the term was coined in recent times.

Professionals of heritage conservation and sustainable development could learn lessons on sustainability and mitigating the impact of climate change from the built vernacular heritage. On the other hand, professionals could assist local communities and traditional master builders in sustaining livelihood for the future and mitigating climate change adverse impact by introducing innovative methods and tools that enhance the efficiency of the vernacular built environment. The role of CIAV is to offer the platform and guidance for climate action for the conservation and management of vernacular built heritage and to facilitate cooperation and exchange of ideas and expertise on regional and international levels.

4. Natural disasters

Earthquakes, floods, droughts, heatwaves, storms and cyclon winds have left their marks on many historic buildings and settlements over time. The different historic layers and patinas of historic buildings may tell stories about natural disasters and in some cases they show evidence of traditional strategies and methods for post-disaster reconstructions. The built vernacular heritage in different parts of the world manifest techniques, materials, architectural typologies and collective communal traditions that prevent or mitigate the impact of predicted natural disasters of the specific regions. We see, for example, tie beams applied to arches, ring beams to domes, buttresses to values and wooden cushions to columns in the vernacular built heritage of earthquake-prone regions. And we see elevated ground floors in regions that witness recurrent floods. These and many other methods and techniques offer useful resources for resilient new architecture.

On the other hand, modern scientific research, analysis and methods could enhance the resilience of vernacular buildings and settlements. For example, earthquake shaking table tests and seismic performance analysis could inform the implementation of protective retrofitting of vernacular buildings in earthquake-prone regions.

Today emergency preparedness, risk reduction and disaster management are most pertinent to the protection and conservation of the built vernacular heritage as climate change has caused and is expected to cause a rise in the number and intensity of natural disasters. The work of CIAV should therefore include special attention to natural disasters and their impact on the vernacular built heritage.

5. The pandemic

The Corona Virus (COVID-19) pandemic is another challenge that threatened the whole humanity and hit hard the culture sector, particularly the cultural heritage as most museums, sites and historic buildings had to close their doors for months. In some cases closure lasted more than a year. In other cases closure became permanent, with many jobs lost and development plans cancelled.

In 2020 ICOMOS issued a study on "the impact of COVID-19 on heritage", which was the result of a survey of ICOMOS national committees reporting on the impact of the pandemic on the cultural heritage in their countries as well as their views on ideas for achieving resilience and recovery. The topic was also covered by many webinars, the "new normal" during the high waves of the pandemic, total lockdowns and the ban on big gatherings and meetings.

Despite its negative impact, the pandemic was a wake up call for all humanity to rethink our mode of work, study, shopping, travel and almost all aspects of modern life in the globalized world of today. The concept of "living locally" became a necessity and not a luxury during the lockdowns. We all had to live the concept of "20-minute neighborhood", meaning a walkable neighborhood or settlement, where all basic needs of the community should be available. No travelling long distances for work, scools, shopping or any other activity was possible. The positive impact on the environment during the lockdowns was evident as the air, seas and rivers became cleaner and cities became greener and heltheir.

Many lessons could be learned from the built vernacular heritage not only on how to live locally but also on how to build a home, manage a settlement locally and lead a full life locally. This is a role that CIAV should play by introducing to architects, planners and decision makers case studies, the philosophy, materials, techniques and approaches from built vernacular heritage around the world. Also, this is an opportunity for CIAV to raise awareness and pride of the guardians and local communities who live, maintain and keep alive the built vernacular heritage.

6. Wars

ICOMOS, UNESCO and many other international organizations as well as conventions, declarations and initiatives were established as a reaction to the destruction and loss caused by the two world wars of the twentieth century. Unfortunately, today and after a few decades we find ourselves in no better situation. Wars and displacements of millions of innocent civilians and the destruction of whole cities, villages and countless historic buildings and sites have become an everyday reality of our world. For some it is an unpleasant item on the news headlines. For others, it is their very lives being totally shattered.

Wars and displacements create great challenges and also opportunities for the built vernacular heritage. While the restoration or reconstruction of a historic monument may help in curing the damage caused by war, vernacular buildings are only the tip of the iceberg. A vernacular building could be restored or reconstructed, but what about the traditions of living in and maintaining such a building? Would a family who grew up in exile or a refugee camp return to their family earthen house and know how to live in it? How to maintain it? How to make their own bread using their traditional oven? What about the local culture and social structure and traditions within the village and the city? Would the local oral history, stories, songs, dances and handicrafts survive the war?

These are great challenges that are facing the built vernacular heritage not in one or two countries but unfortunately many more. It is therefore the duty and role of CIAV to address these challenges and also to identify opportunities that may arise from wars and displacements. For example, certain vernacular settlements that were deserted by the youth who have migrated to big cities in search for opportunities could be adapted for receiving displaced people from other regions. Such an opportunity would come of course with its own challenges. Which traditions and identity would prevail? That of the place or of its new community?

7. Fires

It was heart-breaking to see live on tv very important historic buildings destroyed by fire. This included the roof of Notre-Dame Cathedral in Paris in 2019, Shuri Castle in Japan in 2019, the National Museum of Brazil in 2018, the Glasgow School of Art in Glasgow twice in 2014 and 2018, the New Delhi National Museum of Natural History in 2016, the Duchess Anna Amalia Library in Germany in 2004 and Windsor Castle in the UK in 1992. Many other historic buildings were destroyed by fire but did not make it to the international news headlines.

All these buildings were covered by the highest level of protection and enjoyed the best care that was available on national level, and for some on international level by being designated World Heritage Sites. Nevertheless, the protection was not enough to predict, prevent, mitigate or reduce the damage by fire. Actually both Notre-Dame Cathedral and Glasgow School of Art were under restoration at the time of the fire with all conservation personnel, equipment and accessibility scaffolding in place. Yet, the fire was not put down before it caused huge irreversible losses.

For such damage to occure to these high profile historic buildings in our day and age tells us that we are not prepared enough to protect our built heritage from the threat of fire. The threat to built vernacular heritage is even much greater. As most vernacular buildings and settlements are built with flammable materials and in remote locations with poor accessibility to emergency services. CIAV should therefore address this threat by research and guidance for best practices. Traditional methods for mitigating and fighting fires should be studied and modern methods should be adapted and included in the conservation and management plans for built vernacular heritage.

8. Human rights

In 2007 ICOMOS started an initiative with the aim of "building awareness of rights issue in World Heritage and heritage management in general", which led in 2011 to the establishing of "Our Common Dignity" Rights-Based Approaches Working Group (OCD-RBA). This is an important milestone in the decolonization and the freeing of the international conservation movement from its Eurocentric attitudes. Earlier milestones include Burra Charter that was initially issued by ICOMOS Australia in 1979 acknowledging the value system and worldview of the indigenous peoples in the field of cultural heritage and its conservation. Another milestone is the Nara Document on Authenticity in 1994, acknowledging that the European notion of authenticity is not universally valid and that authenticity is a culture-specific concept. There is still a long way to go as the establishment of the OCD-RBA indicates.

More recently the Black Lives Matter movement and Rhodes Must Fall movement highlighted the centuries-long oppression of people based on the colour of their skin and the insensitivity of the current views on cultural heritage with regards to racism, slavery and their legacy that continue to undermine black people and the people of color implicitly and explicitly. The anger and the violence that these movements showed towards the establishment and towards monuments, some of which, were listed as national heritage indicate that there is a lot of work to be done regarding human rights and human dignity.

The built vernacular heritage is produced, maintained and lived in by local communities many of whose dignity and rights are not always respected. In many cases, the conservation, interpretation and presentation of their own cultural heritage are imposed by outsiders without their full participation and collaboration. Human rights must therefore be explicitly in the heart of CIAV's work.

9. Integration and synergy

The above mentioned issues, challenges and opportunities should be integrated into CIAV's work. CIAV members should discuss a possible update that could be made to the "Charter on the Built Vernacular Heritage (1999)". The Charter is organized under four headings: "Introduction", "General Issues", "Principles of Conservation" and "Guidelines of Practice".

The "Introduction" states that "Due to the homogenization of culture and of global socio-economic transformation, vernacular structures all around the world are extremely vulnerable, facing serious problems of obsolescence, internal equilibrium and integration." A paragraph could be added on the escalating challenges of wars, fires and natural disasters. And another paragraph on the challenges and opportunities by the SDGs, climate change and the pandemic. The issue of human rights is well covered under "General Issues", article 3:

"Governments and responsible authorities must recognize the right of all communities to maintain their living traditions, to protect these through all available legislative, administrative and financial means and to hand them down to future generations."

Separate articles could be added under both "Principles of Conservation" and "Guidelines in Practice" on SDGs and climate change as well as the mitigation and management of the threats of wars, fires and natural disasters. What is more important than including these issues in the Charter is to effectively include them in CIAV's work.

Another level of integration and synergy should be aimed at bridging the gaps created by institutional structures and mandates, such as:

- Cultural and natural heritage
- Tangible and intangible heritage
- Movable and immovable heritage

CIAV should endeavor to collaborate with the relevant institutions and other ICOMOS international scientific committees and working groups to bridge these gaps and to ensure a holistic and balanced approach to the built vernacular heritage.

10. Balanced representation

A balanced representation of members and also topics of research and discussions on the cultural heritage from different regions of the world is a difficult objective that ICOMOS aims to reach. The majority of members and thus studies and discussions are from Europe, North America and Australia.

For CIAV, the importance of a balanced representation cannot be overemphasized. Some of the most significant built vernacular heritage sites in the world are located in the least represented regions by CIAV members, such as Africa and also Asia and Latin America. This is the reason that the present CIAV Bureau endeavors to hold 2024 CIAV conference and annual meeting in

Africa, hoping to create opportunities of collaboration with African colleagues and relevant institutions.

11. Conclusion

As the ICOMOS International Scientific Committee on Vernacular Architecture, CIAV is in a position to address the escalating challenges that face the protection and conservation of the built vernacular heritage and to capture the opportunities to influence the design and building of new more resilient buildings and settlements. However, in order for CIAV to assume such a role, there is a need to develop an articulate vision that identifies the following priorities and integrates them into its work:

- United Nations Sustainable Development Goals (SDGs)
- Climate change
- Natural disasters
- The Covid-19 pandemic
- Wars and displacements
- Fires
- Human rights

To do so, there is a need to work towards a balanced representation in CIAV's membership, to collaborate with the relevant entities within ICOMOS and beyond and to revisit the "Charter on the Built Vernacular Heritage (1999)".

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The National Plan for Traditional Architecture as a safeguarding tool. Action programmes and projects

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
The National Plan for Traditional Architecture is presented as a safeguarding tool shared by the Spanish National Government, the Autonomous Communities, and local and documentation bodies at the service of society. This presentation details the concepts and elements which define and characterize traditional architecture by establishing a correlation in the spheres where it is found in Spain. Equally, it identifies the current risks and threats to this heritage, which has deteriorated rapidly since the last third of the 20th century and is facing a wide range of factors threatening its survival. Finally, the four lines of action established in the Plan are presented, emphasizing the criteria and methodologies in place which can be used as points of reference by specialists, academics and society in general, and showcasing some pilot projects carried out within this framework.

Keywords: *management; vernacular architecture; popular architecture; action criteria; methodology.*

1.Introduction

National Plans are tools for management and coordination which are shared between the Spanish National Government, Autonomous Communities and other public and private bodies. From a multidisciplinary perspective they establish the criteria, methodologies and lines of action needed to safeguard the different forms of cultural heritage. These plans are therefore considered collaborative instruments promoting protection in the widest possible sense through the knowledge, legal protection, conservation and dissemination of all the tangible and intangible cultural assets which make up our cultural heritage, allowing part of society to access and enjoy it.

The legal basis of the National Plans can be found in *Law 16/1985, of 25 June, on Spanish Historical Heritage* and *Royal Decree 565 of 24 April 1985 establishing the basic organic structure of the Ministry for Culture and its autonomous bodies*, which set up the Institute for the Conservation and Restoration of Cultural Assets, now the Cultural Heritage Institute of Spain (hereafter IPCE). These plans are the product of combining the National Information Plans stipulated in the law and the Conservation and Restoration Plans set out in the Royal Decree.

They can be set up at the request of any Autonomous Community and are managed by the Directorate General of Cultural Heritage and Fine Arts of the Ministry for Culture and Sports through the IPCE. To date, the Heritage Council has passed 14 National Plans, each of which provides a response to the needs arising in the different spheres or areas of specialization of heritage under threat at any given point. Although traditional architecture has proven to be one of the most diverse fields of heritage, strongly linked to identity, it has been under severe threat since the last third of the 20th century. This is due, among other reasons, to the transformation of ways of life, the lack of appreciation and awareness of the traditional context, the homogenization of construction systems and materials, and the lack of established suitable intervention criteria and methodologies. This last aspect is closely linked to the disappearance of traditional trades, bringing about the staggering loss and degradation of a large part of the tangible and intangible assets which make up traditional heritage.

In fact, this fragile situation has brought about an increasing valorization of this heritage, which has gone from being internationally considered "the picturesque view of monuments" (Sociedade das Nações, 1931) to become the "expression of cultural diversity of the world" in the Charter on the Built Vernacular Heritage (ICOMOS, 1999). The delicate situation affecting Spanish traditional architecture led a group of experts, headed by Félix Benito Martín and María Pía Timón in the IPCE, to draw up the National Plan for Traditional Architecture, hereafter PNAT, passed by the Heritage Council in 2014.

2. Basic aspects of the PNAT

One of the main motivations for the PNAT was the need to develop a tool which structured the participation and development of the actions promoted by different administrations and bodies. It also aims to halt the risks threatening the integrity of this architecture, including the establishment of globalizing regulations; the loss of specificity resulting from globalization processes; the fossilization, museumization and dramatization of iconic complexes; risks generated by local groups or agents with different or opposing interests to those of the community; offensive or demeaning uses; difficulties in perpetuation and transmission; social, territorial, urban and constructive decontextualization; and the lack of awareness and appreciation.

The criteria and methodologies applied to all these factors are adapted to the specific nature of this architecture, its surrounding landscapes, the activities which shape it, and associated intangible cultural manifestations. Safeguarding actions and strategies are proposed, encouraging access to these to be enjoyed and to increase the feeling of belonging within the community. The PNAT is also set up as a collaborative tool which civil society can take part in, either protagonists acting as informants, or through civil associations. The Plan follows a different perspective to generate a series of documents which can be consulted for reference. It serves as a guide for society, for researchers, specialists and local administrations, and it can also be used as a professional support tool and used by associations and the actual communities.

2.1. Definition and characterization

The National Plan defines traditional architecture as "the range of constructions derived from the rooting of a community within its territory, revealing in its diversity and evolution a process of ecological adaptation both to natural resources and factors and to the historical processes and socio-economic models which have developed in each location" (Ministerio de Educación Cultura y Deporte, 2014), forming a heritage of great importance for our culture.

This architecture characteristically represents an account of unique ways of life in the community from which it originated, generating architectural models characteristic to each place, with unique personalities, awarding them a high sense of identity and of belonging to a territory and community.

It is dynamic and linked to the socio-economic processes of the community which gave it life, sustainably expanding and shaping the landscape according to needs and resources.

It generally has no specific architect or author, and does not follow the architectural trends of the time, although it can occasionally incorporate some unique elements of refined architecture into its creations. Among other characteristics, it is linked to the natural conditioning factors of the territory and responds to a specific climate, sustainably using and even reusing the material available in its surroundings, and adapting to the morphology of the place depending on the factors which have conditioned its use.

2.2. Areas of development

Traditional architecture covers a vast wealth of terms, which led the Drafting Commission of the Plan to establish a grouping system for the different typologies depending on their use. Three major flexible blocks were established: residential, architecture for work and venues for socializing and collective use.

a. Residential architecture: its main use is housing, although it can be combined with other uses, albeit secondary ones. This category includes fishermen's housing, *pasiegos*, *masías*, etc.

b. Architecture for work: although there can be associated living spaces, it is conceived as an architecture of production. It covers infrastructures (banking, pathways, canalizations, fences, wharfs, drinking troughs, laundries, fountains, etc.); constructions associated with primary activities, either livestock farming (beehives, temporary shelters, farmhouses, drying facilities, pigsties, goat sheds, etc.), or mining activities (lime kilns, gypsum quarries, salt flats, etc.); constructions linked to transformation activities of food (oil presses, flour mills, refrigerating chambers, wine presses); fabrics (fulling mills, tanneries); woodwork (carpentry workshops, riverside carpentry workshops, sawmills, barrel workshops); and metals (blacksmith's workshops, forges, foundries, etc), among others. The fourth group within the category of architecture for work is that of buildings devoted to distribution and services (markets, shops, pharmacies), as well as those providing hospitality services (thermal baths, inns, hostels, etc.).

c. Venues for socializing and collective use: this third sector covers all the spaces used for gathering or coexistence actions within the community, or those which reflect its collective beliefs or values. Based on these guidelines this category also includes squares, cemeteries, *rollos* or administrative columns, bowling alleys, pelota courts, etc.

3. General criteria

Criteria can be grouped according to two major principles. The first refers to guaranteeing a central role to the user community in all processes as these people have created this architecture, live with it and transmit it. Documents of reference for this principle worth mentioning are the "Istanbul Declaration" (UNESCO, 2002), the "Convention for the Safeguarding of the Intangible Cultural Heritage" (UNESCO, 2003), and the regional laws of Galicia and Baleares (Law 5/2016, of 4 May, on cultural heritage in Galicia and Law 18/2019, of 8 April, on the safeguarding of intangible cultural heritage in the Illes Balears), as well as Law 10/2015, of 26 May, for the safeguarding of Intangible Cultural Heritage. The second principle examines the need to respect all its cultural values and guarantee its recognition at all levels, from local individuals to professionals, new inhabitants and authorities, ensuring that the population does not feel out of place or marginalized in an abandoned setting or alienated by new activities imposed.

a. Identity value: this is an extremely diverse architecture with a unique character swiftly identified as belonging to a given territory or community. This is the case of the earthen architecture in Tierra de Campos, Segovian tiles, and buildings such as *hórreos*, *barracas*, *masías* and *cortijos*. Therefore, safeguarding strategies must aim to protect the identity of the population, increasing and reinforcing these values, helping to make the community more dynamic by including the active participation of the user community.

b. Intangible value: intangible and symbolic values linked to traditional architecture are essential, both in terms of the functions and symbolisms of individual spaces within the dwelling and in terms of the urban spaces linked to social activity, religious practices and other intangible manifestations. The spatial framework is essential when maintaining itineraries or their associated symbolism.

c. Scientific value: traditional architecture is a scientific repository of knowledge on the specific qualities and benefits of the local traditional materials and techniques subsequently verified in scientific studies. Its application is not limited solely to the restoration of traditional architecture but also covers monumental restoration and new architecture. This gives rise to a wide field of research on the application of these techniques to the design of contemporary architecture.

d. Territorial and landscape value: traditional architecture is perfectly inserted within the landscape thanks to the use of local materials of the territory, and to its scale, made to measure by humans to suit their needs. However, it also interacts with its environment, for example as a way to conserve biodiversity, to combat erosion, and to regenerate the soil through traditional farming activities such as transhumance or extensive stockbreeding. This balance must be one of the objectives of sustainable development to ensure that current society is better adapted to the surrounding territory.

e. Ecological value: traditional architecture becomes an example of ecological and bioclimatic solutions. In terms of environmental sustainability, the material and human resources of the region are managed responsibly, ensuring a low-emission ecological proximity architecture. Furthermore, passive energy solutions are proposed which are based on orientation, location, cross-ventilation, solar exposure or the thermal inertia of its walls. However, its sustainability also stems from its durability and it is easily maintained thanks to the simplicity of its constructive systems, as well as the reuse of materials and underutilized constructions. All this allows us to relearn in a moment defined by the fight against climate change, and the ecological values of this heritage are presented as necessary tools to minimize the consequences, reducing the impact of the environmental footprint in construction.

f. Assessment, recording and application of traditional constructive techniques: knowledge and traditional trades must be safeguarded. This will allow us to record and protect them, above all guaranteeing their continued existence and transmission to younger generations, preventing their disappearance, maintaining artisanal activities and favouring the professional development of young entrepreneurs.

4. Programmes and lines of action

Given the vulnerability of this fragile heritage it becomes essential to establish safeguarding mechanisms to actively guarantee its continuity. To do this it is necessary to assume a holistic interpretation of the values which are part of it and which affect it. That is to say, it must address cultural aspects (jointly integrating tangible and intangible dimensions), territorial aspects (in terms of the articulation of territory and landscape), and socio-economic aspects (paying attention to the needs and sustainable development of local communities). Therefore, it must accommodate the multiple inherent elements which define and characterize it, paying special attention to those transmitting wisdom and knowledge, the population which lives with this Cultural Heritage and the traditional activities it has been used for. At the same time, the physical, formal and aesthetic features of the materials used, and the architectural, symbolic and environmental characteristics of the landscapes it has created, should also be remembered. This should be combined with a multidisciplinary vision with the collaboration of specialists from different disciplines involved, including the user community, who should ultimately accept any initiative, inevitably becoming indisputable central figures as the people who have created, conserved and lived in this heritage. Public administrations play a key role in the management of these strategies and take on a true effective commitment, establishing priorities, supporting, promoting, subsidizing, recognizing and awarding any initiatives favouring its safeguarding.

Thus, the PNAT proposes a multidisciplinary methodology based on four lines of action: documentation and research; protection; intervention; and finally, training, dissemination and socializing.

4.1. Documentation and research

Based on the premise that it is impossible to protect, restore or valorize anything which is unknown it is clear that knowledge must play an initial key role in any action. The main reason for this is that it is a tool of prior knowledge which makes it possible to make more informed decisions. However, the documentation process provides an account of ways of life that are part of our culture, so that and we are therefore transmitting the legacy received from our ancestors to future generations. Furthermore, the completion of these actions requires recognition from institutions and the community coexisting with this architecture, forming the first phase of its assessment and protection. This documentation process must incorporate new technologies as a medium for research and documentation in order to increase efficiency, benefiting from the use of new techniques for representation and incorporating the results obtained into the digital cataloguing or geographical information databases. It is important to fill any existing gaps, as well as to use a suitable methodology which allows information to be homogenized and facilitates its complete upload to accessible databases.

In this regard, the PNAT was used to develop a study on *Documentación e investigación para conocer la situación actual de los sistemas de inventario y protección de la arquitectura tradicional en España [Documentation and research to identify the current situation of systems for the inventory and protection of traditional architecture in Spain]*, which listed the main inventories and catalogues of traditional built heritage on a national scale, while also establishing a documentation methodology and a unified model for an exhaustive Inventory Fiche. In order to test the viability of this fiche it was implemented in two very different pilot case studies: in the region of Los Pedroches (Córdoba) and the underground dwelllings of Caravaca de la Cruz (Murcia).

The Plan also establishes the chief line of action for research to build on knowledge for the development of research work expanding on that compiled since the early 20th century. Each author, depending on their profession or socioeconomic context, provides nuances and meanings which enrich and promote the heritage value of this type of architecture. It was therefore deemed necessary for the Plan to include a bibliographical or historiographic study, collecting this wealth of research and compiling the work of the most renowned authors in the field in a reference document. Following on with this work the PNAT recommends carrying out specific studies, avoiding fragmenting information and focusing on certain typologies that are considered iconic. It encourages research in less widely studied fields, including management, the conservation of traditional structures, new compatible uses, etc. An example of this is *Estudio y documentación sobre las arquitecturas y paisajes del arroz en España [Study and documentation of rice architectures and landscapes in Spain],* which includes the characteristic constructive elements of the rice-growing territory from a landscape perspective. Another notable example is *Estudio del yeso tradicional en España: yacimientos, canteras, hornos y la arquitectura tradicional, su estado de conservación y propuestas de itinerarios visitables para su revalorización y difusión [Study of traditional gypsum in Spain: sites, quarries, kilns and traditional architecture, its state of conservation and visitable itinerary proposals for revalorization and dissemination]*. Finally, *Estudio del uso de la caña en la arquitectura tradicional y de su recuperación para la construcción contemporánea [Study on the use of reed in traditional architecture and its recovery for contemporary construction]* has provided a detailed list and analysis of raw materials, and the different traditional constructive techniques using reeds in Spanish traditional architecture, as well as those which can be applied to new constructions.

4.2. Protection

Recognized as an asset, the Plan proposes a second programme dedicated to the protection of this architecture from different angles, making it necessary to provide legal protection to constructions and spaces identified as traditional architecture in order to guarantee its conservation, taking formal and aesthetic values as well as spatial, constructive and intangible values, into consideration. The challenge also lies in ensuring its coherent and flexible application, protecting cultural diversity and allowing it to adapt to the new ways of life and current comfort conditions, preventing it from fossilizing and promoting the revitalization of traditional urban centres and planning resources to add dynamism to heritage, ensuring that the economic wealth of a locality is proportional to the conservation of its heritage.

This protection must incorporate a territorial approach in the framework of truly effective cooperation between the different stakeholders involved. The point is to combine different legislations to agree on policies rather than to develop parallel protection policies. Thus, legal protection must be provided in the framework of heritage regulations (in natural and cultural terms), ensuring the use of specific legislations which employ different degrees of protection to safeguard the representative heritage, as well as more monumental and unique examples of heritage; of territorial planning, both on a territorial and local planning scale, but incorporating the development of long-term strategic plans that can predict and adapt to the social, cultural, economic and environmental needs of the local population; of the protection of traditional activities which have brought about these architectures and landscapes, promoting the sustainable development of the farming, food or artisanal sectors as profitable activities which generate wealth and employment while maintaining our traditional landscapes; and of protection in tourist development policies, which must respect the harmony and identity of the towns, of their capabilities and interests, preventing scenarios which do not consider the population and ensuring that benefits are felt in the local community, improving both the economy and the quality of life. This second Protection programme incorporates several notable projects which fall within the framework of the Plan. One of these, *Estado actual de los sistemas de protección en España [Current condition of protection systems in Spain],* has shown the evolution of the different values of this type of architecture and how these are incorporated into our legal system. Another project, *Ánalisis sobre los principios de ordenación y los instrumentos urbanísticos para la protección de la arquitectura tradicional en pequeños municipios de España [Analysis of the principles of planning and urbanistic tools for the protection of traditional architecture in small municipalities in Spain]*, examined how urbanistic regulations affect traditional architecture. This was carried out through the analysis of 16 municipalities from scattered mountain locations and livestock villages in the foothills as well as agricultural municipalities where the population concentrates in cereal-growing plains or areas with rural farming economies.

The following study, *Plan de Gestión para el desarrollo de estrategias de actuación para compatibilizar el impacto del turismo con la arquitectura tradicional a través de un estudio piloto en la isla de Formentera, (Illes Baleares) [Management Plan for the development of action strategies for the compatible impact of tourism and traditional architecture through a pilot study on the island of Formentera, (Balearic Islands)],* identified the weaknesses, strengths and opportunities for safeguarding traditional architecture with the synergy resulting from controlled tourist activity.

Finally, a project was carried out on the *Estudio de viabilidad para hacer visitables las "corralas" de ganado porcino y su paisaje cultural en la dehesa boyal de Torrequemada (Caceres) [Feasibility study to the make the "corralas" of pig cattle and the cultural landscape in the Dehesa Boyal in Torrequemada (Caceres) visitable],* as this type of landscape is considered a driving force for rural development.

4.3. Intervention and recovery of traditional construction systems

The Plan includes a series of specific intervention criteria to be taken into account:

a. Conservation of the material nature and significance: the material form must be conserved as much as possible, although it is understood that materials are perishable and can be replaced by other similar ones which respect their constructive significance, while leaving documented evidence of the replacement of elements.

b. Ensuring the use of compatible constructive and structural materials and systems: this means excluding any materials which might negatively affect the salubriousness of the existing materials and do not follow their constructive or structural principles. An example of this is avoiding the use of cement due to its rigidity, salt attraction and poor breathability.

c. Seeking uses that are compatible with values and adapting architectures to the current ways of life, preventing excessive museumization which makes them lifeless stage settings.

d. Maintaining symbiosis with the landscape where it is found, integrating volume, colour and texture.

e. Taking into consideration aspects of sustainability, economy and development, using and managing the material, technical and human resources of the region.

f. Prioritizing preventive conservation actions. Although they require a regular effort from users, carrying out maintenance tasks at a low cost allows us to prevent health or safety issues which could lead to more costly restoration work, while also revalorizing the heritage, first among users and later in the community. These minor maintenance tasks could be promoted by the town councils, highlighting the importance and benefits they provide and setting a priority scale for tasks such as maintenance actions, occasional repairs, restoration work, rehabilitation work, and finally, museumization.

Based on this it was felt that it was firstly necessary to carry out the *Estudio de buenas prácticas en las intervenciones de arquitectura tradicional Española [Study on good practices in interventions in Spanish traditional architecture]*. This study reflected the different constructive typologies and techniques, the pathological processes, and examples of interventions requiring assessment.

The recovery of traditional trades also depends on the population who hold the shared knowledge, on the processes for the extraction, production and distribution of materials, on the constructive techniques and their use, as well as on the characteristics of materials. For this reason, the work mentioned above was completed with a study on the *Documentación e investigación para conocimiento de la situación de los sistemas tradicionales de construcción, así como de la extracción, utilización y puesta en obra de los materiales tradicionales en España [Documentation and research to learn about the situation of traditional construction systems, as well as the extraction, use and execution of traditional materials in Spain]*, including technical fiches and mappings on the process and use of materials and techniques with a record of companies and bodies involved in this[1].

4.4. Dissemination, awareness and cooperation

Finally, the Programme for dissemination, awareness and cooperation must act transversally in all phases to ensure that awareness is raised of the heritage value of this architecture in society, subsequently developing coherent safeguarding strategies.

[1] The list of professionals was updated and revised by INTBAU in the National Network of Traditional Building Masters available online.

Dissemination. It is necessary to find mechanisms for the more effective collective dissemination and construction of knowledge to transmit the knowledge generated to society in an ordered way adapted to the different audiences, making use of new information and communication technologies to be heard in a modern society which wants to participate and be valued. Society must take on a major role in dissemination and successful safeguarding. The communities themselves have created this heritage, providing a medium for it and keeping it alive. Therefore, they should play a key part in its recovery, as they are in the best possible position to protect it. But there are also people who - although they are not users - identify with this architecture, understanding and supporting it, or simply act as observers, playing a key role in its conservation.

Transmission. Traditional architecture is a scientific repository of knowledge about the specific qualities and benefits of local traditional materials and techniques, as shown in subsequent scientific studies. Its application is not limited to the restoration of traditional architecture, but is also used in the restoration of monuments and new architecture, giving rise to a wide field of research on the application of these techniques to contemporary architectural design. It is therefore necessary to safeguard traditional knowledge and trades, allowing us to record and protect them, and guaranteeing their continuity and transmission to future generations.

Awareness. We must not forget that a large part of traditional heritage, for which there is still a complete lack of regard, is privately owned. Therefore it is essential to raise awareness to ensure that these actions come from the population itself. To do so we must rely on education, incorporating this subject at all levels, from schools to professional and university training. For this an *educational kit* was designed for children aged 8 to 10 to learn about typological characteristics, materials and techniques of construction and the values of traditional architecture in Spain. Work is also carried out continuously on specialist training through practical courses and workshops.

Cooperation. We should not forget the support and establishment of common policies between neighbouring regions in order to share enriching experiences by developing interregional and cross-border plans which enable closer cooperation.

5. Conclusions

There is still much to be done, but with the correct tools, this heritage can become a sustainable cultural, social and economic resource, especially now that the health, climate and socioeconomic crisis we are experiencing is driving us to seek a more sustainable development model by involving society in the recovery, rehabilitation and regeneration of our towns. The PN will work on all these aspects to ensure it is included effectively, safeguarding it to recover knowledge, techniques and materials which are disappearing, to relearn from ecological and bioclimatic solutions, and to readapt to current ways of life improving the quality of life of inhabitants while preserving cultural heritage.

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VERNACULAR ARCHITECTURE:
MATTER, CULTURE AND SUSTAINABILITY

STUDY AND CATALOGING
OF VERNACULAR ARCHITECTURE

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The standardisation of vernacular architecture. Wine buildings in Andalusia

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract

Production buildings constitute a specific section of vernacular architecture, with distinct characteristics. In Andalusia, within this group, the architecture of wine, acquires an important relevancne, the wine cellars. They are a large number of buildings, which were built in the 18th, and 19th centuries. This happened when traditional Andalusian wine production was transformed into a modern wine industry. An industrial development generated a vast architectural ensemble of unique characteristics. This has been studied especially in the Sherry wine region, but it is also present in other regions such as Montilla-Moriles or El Condado de Huelva. The architectural, and industrial wine development in the 19th century was fundamentally based on the repetition of a specific model: the basilica cellar. A simplified formal, and constructive system that comes from the standardisation of the vernacular cellar, and that establishes early points of convergence with the industrial building. A model that continues the tradition in terms of construction, and structure, but conceptually modern in its modular, and repeatable condition. Its reiteration, and extreme simplification made possible the construction of large industrial complexes, and the city transformation. The industrial importance achieved by the wine agro-industry, and the vernacular quality of its architecture introduce different references in Spanish industrial historiography.

Keywords: *Wine cellars; wine architecture; pre-industrial architecture; sherry wine.*

1. Introduction [1]

Within what the National Plan for Traditional Architecture calls ‘Arquitectures for work’ are buildings related to processing activities. Those buildings intended for the processing, and preservation of food, beverages, processing, etc (MECyD, 2015, pp. 15-17). Their vernacular condition has not always been enough prominent. For this reason, they belong to the pre-industrial constructions. They are related to agricultural exploitations, especially traditional oil mills, and wine cellars. These buildings incorporate functional factors, scales, and formal references that differ from vernacular residential buildings, but they share their essential defining parameters (MECyD, 2015, pp. 8-14).

In addition to their rural variants, there is evidence of the existence of oil mills or traditional mills, and wine cellars in Andalusian cities since medieval times (Aladro-Prieto, 2021b, pp. 178-182, 206-209). Although the presence of the former would begin to decline with the arrival of industrialisation, wine warehouse reached their maximum expansion in this period.

During the 18th century, wine production was the most dynamic sector of Andalusian agricul-

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ture and agro-industry (Maldonado Rosso, 2020, p. 38). Between the second half of this century, and throughout the following century, the traditional Andalusian wine production underwent an important transformation that turned it into a modern agro-industry of national importance (Maldonado Rosso, 2006, pp. 15-28). This phenomenon of agricultural industrialisation reached its maximum expression in the "Marco de Jerez" (Sherry wine region)[2]. It would become one of the main references in the Spanish foreign market in the central decades of the 19th century (Montañés Primicia, 2000, pp. 25-47).

The industrialisation of the traditional production system led to the construction of a vast architectural ensemble based on the vernacular winery model. These traditional constructions had evolved as autonomous buildings, from a common trunk, parallel to other rural, and urban vernacular references (estates, barns, warehouses, port warehouses, ...) (Aladro-Prieto, 2010, pp. 278-279). Related to these traditional cellars, the building expansion of the 18th century was fundamentally a quantitative leap in size, and number. Although it was based on the esta-blished traditional constructive, and typological parameters.

The "industrialisation" of the traditional wine cellar has been studied mainly in the Jerez Region, specifically in its three main cities: Jerez de la Frontera (Aroca Vicenti, 2007; Aladro-Prieto, 2012, 2021a), Sanlúcar de Barrameda (Gómez Díaz-Franzón, 2002; Aladro-Prieto, 2010), and El Puerto de Santa María (Murillo-Romero, 2018a, 2018b). In the absence of further work on other Andalusian wine regions, we believe that what happened in Jerez can be extrapolated to other regions, especially to Montilla-Moriles (Torres Luque, 2008), and Condado de Huelva (Espina Boa, 2014, 2015; Raposo González, 2014; Rosado, et al., 2020).

2. The typification of the basilica wine cellar

The development of the sherry wine house in Jerez was based on a main logical model: the basilica cellar. A prismatic volume, with a gabled roof, internally made up of parallel longitudinal naves divided by structural porticoes (Fig. 1, 2, 5). A highly standardised model, which was the basis of hundreds of industrial buildings built in the Jerez Region. These buildings had to respond to the standardisation efforts made by the industry itself. During the 19th century, the sherry firms succeeded in establishing a pro-duction method, the Criaderas and Solera System[3]. They made possible the production of a natural, and heterogeneous product such as wine in a standardised manner.

Fig. 1. “Bodegas en Jerez de la Frontera”, ca. 1869 (Source: Institut Cartogràfic y Geològic de Catalunya. ICGC).

During the generation of this singular industry, the traditional wine cellar was subjected to a similar process of standardisation, and serialisation. This endowed it with formal, functional, and, conceptual values. They were close to the benchmark par excellence of industrial architecture, the warehouse. Both models arise from the simplification of the architectural fact to its most basic formalisation. In this way, it also derives its capacity for modularisation.

2 The region in which sherry wine is produced is made up of the cities and towns of Jerez del Frontera, Sanlúcar de Barrameda, El Puerto de Santa María, Chiclana, Chipiona, Puerta Real, Rota, Trebujena, and Lebrija.

3 “The Criaderas and Solera System is a dynamic system, where wines from different stages of the ageing process are blended together in order to perpetuate specific characteristics in the wine, which is finally sold on the market, and it is a result of combining all the different vintages”.https://www.sherry.wine/sherry-wine/production/ageing (Consulted 23/01/2020)

Fig. 2. Sequence of basilica cellars defining the space of the Vallesequillo neighbourhood, Jerez (Source: Author, 2012).

Throughout the century the new industrial typology moved “from the factories resolved with the inertia of classical or acade-mic composition to the concept of the abstract, homogeneous and neutral space of the great industry at the end of the 19th and 20th centuries” (Corredor-Matheos y Montaner, 1984, p. 31). From the factory with floors, it would evolve to the warehouses model. This could create, in shorter time, independent, modular, and easier repeatable pavilions. The growth of the factory, and an unknown flexibility were completely solved.

Likewise, the spread of the basilica cellar meant the abandonment of other cellar models, whose formal references remained anchored in the principles of classical composition. This ha-ppened especially with the cloister model, which took the courtyard as its formal, and functional structure. That was common during the modern age, when some of the largest cellars were built in the first decades of industrialisation (Aladro-Prieto, 2010, pp. 281-282; 2012, pp. 192-201). They were cloistered cellars that were conceptually close to the Royal Factories, and the factories of floors, in terms of finished, and closed buildings. Like the industrial warehouse, the basilica cellar would make possible to fragment, and modulate the industrial space in terms of construction, and time.

The case of Tarrasa, Corredor and Montaner offer an expressive description of the modular production system of the industrial complex: “The naves had a single rectangular floor plan, which dimensions depended on those given to the knives and the size of the available land. They were buildings assembled from a module - made up of four pillars, two trusses and two windows - they could be repeated boundless” (1984, p. 40). Once the cross-section, the number of naves and, the height had been determined, the Sherry building could be extended in an unlimited way. It must only follow a process of prismatic extrusion, which is limited only by the urban conditions.

The Sherry house is generated from the section. It would be codified as a clearly recognisable, modulated and easily repeatable model. It is valid for the construction of large industrial complexes. There, new buildings would gra-dually be incorporated in an organic manner, until they fill the urban plot (Fig. 3, 4). At the same time, the sherry companies managed to extend and reform the existing city (Fig. 9). A single industrial and urban reference, where its homogeneity is also indicated for the textile factories of the 19th century by Selvafolta. They can also be seen as the product of an ideology and an economic organisation (1985, p. 56). A codified expression of the wine bourgeoisie.

Fig. 3. Sherry building complex made by the basilica model reiteration (Source: Saldaña Trigo & Repeto Prieto, 2009, p. 130)

The basilica winery eliminates the courtyard as a structuring element, while it consolidates the "*almizcate*" as an industrial and urban space. The "*almizcate*" is the longitudinal area between two parallel cellars (Fig. 4). A space that guarantees the functional and constructive individuality of each cellar and provides the necessary ventilation and lighting. From the "*almizcate*"-winery duality derives the specific organisation of the sherry building complexes and the functional flexibi-lity that characterises them. (Aladro-Prieto, 2021a, pp. 180-189).

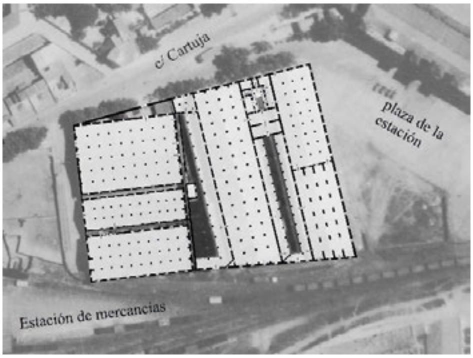

Fig. 4. Block made up of basilica cellars and "almizcates". Jerez, 19th century. Planimetry from the mid-20th century (Source: Aladro 2021a, p. 50).

3. Determinism of the construction system

Despite the high level of industrial and technological development in the Jerez region in the 19th century, the constructive resolution of the wine warehouses will be continuing very similar to the existing descriptions of wine cellars from the 16th, and 17th centuries. The main differrence will be the use of walling, which practically disappeared in the 18th century, but it was still frequent in the two previous ones (Guerrero Vega y Romero Bejarano, 2006).

The importance of the construction conditions for the microclimatic, and oenological functionning of the cellars was well known by the winemakers since ancient times. In this sense, Maldonado confirms that, at the end of the 18th century, the construction characteristics that these buildings had to have were stipulated to the master builders by a notary (Maldonado Rosso, 1999, p. 174).

These ancient characteristics would have been refined over centuries of experience storing wine, and the different technological and formal parameters (aeration, height, orientation, etc.) were gradually refined. This happened while the wine production was evolving. In the 19th century, these constructive-formal models were defined even before the consolidation to the great commercial expansion of wine types. Therefore, they were prior to any knowledge of their micro-climatic requirements. The buildings could have been participating agents, inducers, of this oenological evolution, active elements in the production process.

The traditional structural system significantly conditions the wine cellar spatiality, which is fractioned and qualified by the internal porticoes (Fig. 4, 5). The cellars are not open spaces, they do not meet the requirements of flexibility, and variability that should characterise the contemporary industrial space. Qualities that the warehouses architecture would achieve by supporting the roof exclusively on the perimeter, freeing up all the space below.

Fig. 5. “Bodegas Pedro Domecq” (Postcard. Source: Author’s collection) .

Despite the technological advances of iron architecture, and the steam engine were incorporated in Jerez at an early stage, the sherry architecture maintained the traditional structure of interior pillars up to the second half of the 20th century. Only in two known cases, the wineries with four naves decided to eliminate the central portico with different solutions (Fig. 6). However, in Sanlúcar de Barrameda, from the 1970s onwards, it became widespread the constructive solution eliminating these porticoes. In a group of warehouses of different sizes, the roofs are resolved with wooden or metal trusses, which totally or partially free up the space underneath (Aladro-Prieto, 2010, pp. 282-283). Innovative proposals, which have common points outside Andalusia with the wine cellars in Castilian-la Mancha. They were also built at the same time as those in Andalusia (Peris Sánchez, 2006). Moreover, these common points are found in cellars of th Montilla region, which were generally later built (Torres Luque, 2008).

Fig. 6. Interior of a four nave cellar in which the central portico has been removed (Source: Author, 2010).

The current image of these pillarless cellars graphically explains the continuous spatiality (Fig. 6). There was simply no need for more lights or greater diaphanousness. Because of the very arrangement of the "*andanas*"[4], it would end up generating identical passageways and identical lines of occupation. What was the point of making the cellar construction more complex and expensive? The "*andanas*" located under the ridge virtually restore the replaced pillar lines. The absence is more striking than the spatial and constructive achievements obtained. Maintaining the traditional structure was also, in last years, a business choice, not an imposition due to construction constraints.

4. The boundaries of the urban

The ideal basilica model would have to confront its validity in the particularity of the place, and in the urban circumstances of a city with a medieval and modern layout. In this dialectic between type, and place, architecture is truly forged (Martí Aris, 1993, p. 93). According to a normal guideline, the ideal “extrusion” of the cellar will frequently be interfered with the urban conditioning factors. In this situation, the basilica typological model shows all its flexibility, and capacity for adaptation.

In contrast to the autonomous referent, with a rectangular ground plan, and normal directrix, we find other examples. They show the "extrusion" process, which is guillotined by the urban alignments, and the pre-existing buildings. In the other hand, the encounter between the formal autonomy of the built volume, and the urban irregularity generates surplus spaces as access or service courtyards (Fig. 7). These spaces, despite their residual condition, are a determining factor in the city construction.

Fig. 7. Small complex articulated by the marginal spaces generated by the formal autonomy of the basilica cellars (Source: Google Earth, 2008).

4 “Arrangement of a row of butts placed contiguously, one-deep, and with their long axis horizontal, with other superimposed rows whose butts rest in the angles between the butts in the layer below”. https://www.sherry.wine/sherry-wine/production/ageing (Consulted 23/01/2020)

In other conceptually opposite situations, the sherry building complex takes the complexity of the city. It absorbes it through the deformation of its own geometric principles. In these examples, the tipology of the city prevails over the geometric logic of the buildings. They are subordinated to the urban form, and partially renounce the achievements obtained through standardisation. In some of these cases, this formal conditioning refers to the preservation of urban continuity. In others examples, it exemplifies the ductility of the formal construction system of the warehouses, and their capacity for deformation-adaptation.

5. The metric concreteness of the module

The use of wooden wine butts for storage, and transport has been documented in Jerez since the 15th century. The size of these containers, and their traditional arrangement in "*andanas*" establish a series of dimensional parameters. These establish the content, the wine, and the production system, the Criaderas and Solera System, entering into resonance with the container, the sherry house. According to these relationships, three types of cellars have traditionally been established. They depend on the width of the naves related to the size and availability for racking the butts[5].

If the above classification were decisive for the dimensioning of wine cellars, the modulation of 19th century cellars is the representation of a complex set of dimensional relationships, that were originated several centuries earlier. However, the large number of sherry houses studied and the recognised casuistry force us to relativise this assertion. The "*andanas*" are not always arranged parallel to the porticoes. There are constructions that repeat the same dimension in both directions, regardless of the arrangement of the "*andanas*". The size of the butts has varied over time, and the cellars have traditionally housed other types of vessels (Fig. 8).

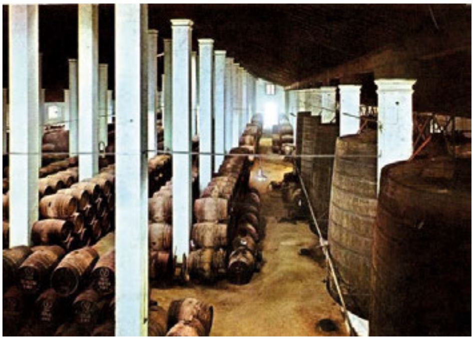

Fig. 8. Traditional layout of "andanas" and large truncated cone-shaped tanks (Source: Author's collection. Postcard).

It is necessary to read winery modulation from other perspectives far removed from immediate possibilisms. Without asking the philosophical bases of architectural modulation, A. Martínez establishes examples. They allow us to understand how the construction systems, and the availability of material could explain the modulated architectural systems from "easier" points of view: "they may have their origin in the accumulated experience of these small solutions applied against the difficulty. It may have its origin in the character that each material accumulates in the singularity of its construction system. Or it may be the mark left by that anonymous hand that left the cave to build itself a shelter and it turned out to be a temple" (2005, p. 758). From this perspective, the construction parameters of the industrial cellars could be understood as the distillation produced over centuries of immemorial construction procedures, and standards. These standards were conditioned by the local availability of materials, and contrasted in daily practice with functional, and microclimatic requirements. Only the arrival of new technologies generated the appearance of new modules and standards. However, these did not have a decisive effect on cellar architecture, which remained within the parameters of traditional construction.

5 In winemaking jargon, is said that a sherry house have "dos ruedos" if between two "*andanas*" there is space for two butts across; "ruedo y bretona" if there is space for one butt in parallel and one butt across; and "bretona" if it allows the passage of one man and one butt in parallel. (García del Barrio Ambrosy, 1984, pp. 14-15).

6. Dimensional control

In the simplicity of the basilica model, the metric variations can be infinite. Inside the group of sherry houses analysed from the 18th and 19th centuries, constructions from two to eight naves, and from three transverse modules to twenty-nine have been documented (Aladro-Prieto, 2012, pp. 232-239). There is a wide range of dimensions. Paradoxically, it seems to be a proportional inversion between the number of large establishments built, and the volume of wine produced at any time. More than half of the very large wineries, with six or more warehouses, were built in the first phase of the sector. All of them before the half of the 19th century, and only a quarter of them in the decades of export groth (1860-1875).

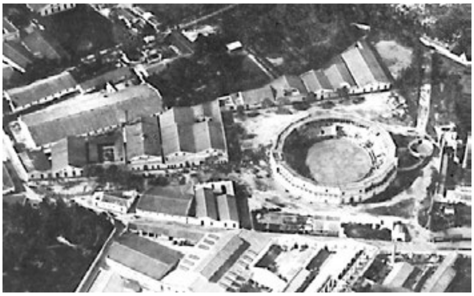

Fig. 9. Surrounding area of the bullring made up of wine cellars. Jerez, 1910-20 (Source: Author’s collection).

This apparent paradox is reaffirmed in the two specifically winery-specific urban sectors built in Jerez in the final stage of expansion: the area around the bullring (Fig. 9), and a timid hypodamic extension called Vallesequillo, with industrial character (Fig. 2). Between these areas, the first one had not wine cellars which exceed four naves, and most of them had only two; in the second one, except for those that adopted positions of urban relevance, all the others were small, most of them with two or three naves.

In addition to other issues related to the business idiosyncrasies, the reduction of warehouses should be seen as a step forward in the modernisation process of cellar construction. Downsizing speeds up construction and reduces the initial investment costs, and the company's dependence on building. Moreover it also increases the flexibility and versatility of the industrial space.

7. Conclusions

The architecture of the sherry wine houses is an exponent of the ideological and economic transformations. They arose in the chronological and conceptual context of the Industrial Revolution, but not of its technical innovations.

The basilica cellar is not a new architectural prototype, but it has been backed by centuries of traditional building experimentation. However, it will be radically new how the production system will take it as a modular, and repeatable building, with capacity of adaption in different business and urban conditions. A typological model of the "sherry industrial nave" that would remain almost unalterable until the middle of the 20th century.

While the adoption of modular typologies in industrial architecture took place in the second half of the 19th century, the first sherry building complexes adopted them at the end of the 18th century, quite early on. Some of the architectural assumptions would later become the basic principles of the new industrial architecture.

The codification of this "sherry industrial nave" would come through the standardisation of a vernacular model of extensive experimentation. A parallel, and similar process to the one that turned wine, also "vernacular", into an industrial product, also standardised. In both processes, it must have been a phenomenon of feedback between container and content, where the constructions went from being containers to becoming inducers of industrial processes.

The industrial, and urban importance of the wine sector was extremely high in the Spanish 19th century. Due to this reason, the cellar construction of this period must be considered as a relevant exponent of Spanish industrialisation. An industrial architecture, with fully vernacular roots, which requires us to ask some of the parameters that define the traditional historiographical archetypes.

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Vernacular architecture in Brazilian semiarid region: survey and memory in the state of Sergipe

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract

Buildings with earth in their composition have been common since the beginning of the Brazilian territory's settlement. Until this day, wattle-and-daub homes are frequent in the Northeast region of the country. This technique uses a structural cage made of the weft of woods whose interlocking voids are covered with thrown wet clay. Due to the current association of these buildings as shelters for insects that may contain Trypanosoma cruzi (which transmits the Chagas disease) numerous public policies guide eradication and replacement of these buildings by others built with masonry. Due to the destruction of these buildings, built with vernacular earthen techniques, this research aims to survey buildings that still resist in the semiarid region of Sergipe state. Therefore, literature review was carried out on architecture in the semiarid region and building investigation techniques using digital tools. Considering Sars-Cov-2 pandemic as a prohibitive condition that caused difficulties in collecting data in the field, it was necessary to seek out methods that could be used for a remote survey. Furthermore, an exploratory analysis was carried out with digitally available tools in which it was possible to observe popular buildings built with earth in the legal semi-arid region. Initially, data was collected from the latest demographic censuses carried out by the Brazilian Institute of Geography and Statistics (IBGE), as well as the socioeconomic data of Brazilian families in poverty situations registered with the government. This initial data, however, did not present information on geographic positioning of the dwellings, making it necessary to conduct a survey through Google Street View software, allowing the visualization of images at ground level, being effective on searching for wattle-and-daub residences. From these data, a catalog of the constructions found was generated and, by georeferencing these dwellings, the documentation produced may contribute to the preservation of vernacular constructive memory of this study's location object.

Keywords: *Earthen Constructions. Google Street View. Wattle-and-daub. Semiarid.*

1. Introduction

Earth based construction techniques were widely used when building popular residences throughout Brazil. On the countryside of Sergipe state, the most widely used technique is wattle-and-daub. Wattle-and-daub consists on a structural cage with vertical and horizontal timbers in a grid. The filling of this cage is done with loam, which is usually mixed with fibers. The technique is known in Brazil as "taipa de mão", in the rest of South America as "bareque", "bahareque" or "bajareque", "quincha" in Spain, and "lehm-bewurf" in Germany.

These buildings have been going through a process of destruction driven by several public policies. Those policies have, as sole objective, the eradication of these dwellings due to an ideal hygienist history and media pressure that propagates the use of industrialized materials as progress and modernization (Vieira, 2017). This process takes place in greater intensity on rural areas, due to the concentration of houses built with vernacular techniques and actions of public policies, as well as housing programs, such as the National Rural Housing Program of Federal Government. In the last two decades, state and municipal governments have implemented programs such as "*Casa Nova, Vida Nova"* (2007), and *"Casa de taipa nunca mais"* (2018) that have the objective of tearing down wattle-and-daub houses to replace them with masonry built houses, using standardized projects that do not correspond to the individual needs and opinions of each family.

Moreover, there is an increasing dissemination that wattle-and-daub residences are sub dwellings, and that they present risks to public health. That's because they would serve as accommodation for insects, such as *Triatoma cruzi,* vector of Chagas disease and, therefore, the need of their urgent destruction.

On the other hand, there are studies, such as Silva (2000), who indicates that these insects lodge in the cracks of the walls due to ecological imbalances that make so that wild animals get closer to human dwellings. This environmental imbalance have been occurring since the colonization, by the destruction of forest areas, thus causing insects to seek alternative shelters when losing their natural habitats.

On rural areas and the countryside, it is common that, even by receiving masonry houses through housing programs, residents of wattle-and-daub accomodations still have the desire of maintaining their old houses (Vieira, 2017). Recently, this desire is being ignored by the government. They do not present public policies that aim to maintain and improve these buildings, which are in precarious conditions, as an alternative to their replacement. The replacement by standardized houses generates a drastic change in Sergipe's landscape since dwellings with different characteristics are loosing their originality.

One of the main difficulties for the implementation of public policies, aiming to reform wattle-and-daub buildings, is the scarcity of information about current conditions, mainly, their location.

1.1 Google Street View as an emerging data collection technology

Schootman, Nelson, Werner, Shacham, Elliott, Ratnapradipa, Lian, & Mcvay. (2016). treat the use of tools such as Google Street View (GSV), drone aero photography, monitoring cameras, and social media, as emerging technologies that can effectively and inexpensively serve to analyze a changing environment.

Regarding Google Street View and based on previous studies in the health area, authors reckon that it can serve as a good tool for analyzing the built environment, especially when conditions make it difficult to collect on-site data, such as studies that evaluate large regions, several areas, or distant locations.

Google Street View is a feature launched in 2007 that offers panoramic views from around the world. Images are captured with the aid of 360º cameras coupled on vehicles. In a search carried out by using *Portal Capes* periodicals, it was found the existence of about 169 published and peer-reviewed articles that have the keywords Google Street View, and their abbreviation, GSV.

They also have relation to the following areas of knowledge: history and archeology, anthropology, geography, sociology, and engineering. Within these articles, 28 stand out because they have subjects closer to this study. It can, then, be noticed that the use of this tool is increasing, especially in the last decade, in countries of North America and Europe (Nesse, & Airt, 2020).

Nesse and Airt (2020) conducted a systematic review of the subject, reinforcing that Google Street View is being increasingly used in research within the areas of public health, architecture and urbanism. Their study aimed to verify the use of GSV in place of face-to-face field research in contexts where there are prohibitive conditions for the execution of such.

Nesse and Airt (2020) also draw attention to some criteria that should be analyzed in the research using GSV: 1. The scale of the object to be searched needs to be compatible with the quality of images. Transience also needs to be taken into account, so that a research aiming to map, for example, the pollution of streets of a large city, will probably not succeed using GSV as a tool; 2. Attention and accounting are required in dating of images available in GSV, the year of capture must be flagged in the research; 3. Observers need to be specifically trained so that they can find exactly what is being sought.

As the time of GSV images is outside the researcher's control, close attention should be paid to the time they are taken and thus incorporate it into the research project and report it in the study. In addition, training observers to observe through GSV requires different instructions. In summary, GSV can be a useful tool to replace face-to-face observations of street environment characteristics if classic parts of the survey research project (research time and researcher training) are carefully considered (Nesse & Airt, 2020).

Furthermore, Google Street View is being used in studies that aim to verify its feasibility to verify changes caused by environmental disasters, such as hurricanes (Zhai & Peng, 2020), and vulnerability in floods (D'Ayala et al., 2020) as well as accidents with nuclear power plants (Mabon, 2016). In the area of architecture and urbanism, there are studies focused on the detection and analysis of urban art in facades, such as graffiti (Novack et al., 2020), urban landscape analysis (Hong, 2020), and (Kim et al., 2021), among others. Despite the increasing use of GSV, few studies yet use it to analyze the existence of building's materials and housing conditions.

In some locations, GSV has a function that allows for the recovery of images taken at different times. By default, the tool shows the latest images, but it is possible to select other times in the web viewer. It can also be done through programs that use the *Application Programming Interface* (API) in free translation – made available by Google.

The GSV image API is also being used in programming-focused studies. Those studies use the concept of deep learning, that consists on programming computers to perform tasks normally done by humans, in which case computers analyze images and identify the criteria previously established as urban vegetation cover (Lu, 1994), presence of traffic signs (Zhang et al., 2018), abandoned houses (Zou & Wang, 2021), and others.

In light of this, the general objective of this paper was to create a survey of vernacular constructions built with wattle-and-daub houses in the semiarid region of the state of Sergipe, aiming to obtain a mapping of the general situation. Only digital tools were used in this survey, due to Sars-Cov-2 pandemic's locomotion impediments.

2. Methods

To search the vernacular architecture in the legal semi-arid region of Sergipe, an exploratory analysis was carried out with digitally available tools, which made it possible to observe popular vernacular buildings.

2.1. Area of study

Through previous research, it was possible to delineate a diagnosis about wattle-and-daub occurency on houses, in a few localities of Sergipe. Those localities include Mem de Sá Island, in the city of Itaporanga d'Ajuda/SE (Andrade, 2020), as well as in cities that were part of the sugar economic cycle (colonial times) as Estancia, Santa Luzia do Itanhy, Santo Amaro, Itaporanga d'Ajuda, São Cristóvão e Laranjeiras (Maia et al., 2020). Also a short study regarding residences built with earth located in villages in the cities of Lagarto and Itabaiana was conducted (Santos, 2020).

In addition, no studies were found in other municipalities, therefore, this research intends to adhere to the semiarid region of the state.

The first intention of this study was to relate to "polygon of droughts" appointed by the Superintendence of Development of the Northeast (SUDENE) and used in *the Digital Atlas on Water Resources of Sergipe* (2016), provided by the Secretary of State for the Environment and Water Resources of Sergipe (SEMARH).

The delimitation of the polygon of droughts is exceeded due to the new scope approved by the Resolutions of the Deliberative Council of Sudene of No. 107, of 07/27/2017, and of No. 115, of 11/23/2017, which names the region as "Legal Semiarid" (Fig. 1).

The choice of geographical scope takes into account the absence of previous studies and also that it is a relatively homogeneous region regarding climate, population, and economic characteristics. In addition, the region comprises 29 of the 75 municipalities of Sergipe, thus being a very significant portion of the state.

2.2. Data collection

At first, data from demographic censuses elaborated by the Brazilian Institute of Geography and Statistics (IBGE) were used, but they are not clear about the predominant constructive technique in buildings, since the summary tables published have an inefficient classification system. That because, masonry not coated is in the same category as the uncoated wattle-and-daub, making it impossible to differentiate the specific amount of houses in which each technique was applied.

In light of this, a consultation was carried out using a digital tool called CECAD Tab 2.0, which made publicly available socioeconomic data of people inserted in the Single Registry of Federal Government in Brazil. This tool is also available to municipal and state managers, so that it may be used as basis for public policies.

With CECAD, data on predominant material in the external walls of registered households was collected. The platform provides data specific of each municipalty and allows for additional filters, such as urban or rural areas as well as traditional and specific population groups that reside in such dwellings.

However, data collected from IBGE and CECAD are not georeferenced and, when studying vernacular architecture, it is important to know the location of these buildings and the specificities regarding their geographic context. In some situations, buildings may be found in different conditions than those originally expected, or even not be found at all (Carter & Crowley, 2005).

Due to the limitations related to Covid-19 pandemic, it was necessary to perform a digital survey, in order to have an overview on buildings found in the study area and better direct field research. This survey was carried out using Google Street View (GSV) *software*, which consists of a virtual representation that allows for user to travel, as if in a vehicle, through available routes. Another *software* used was Street View Download 360 Pro which uses the API provided by Google to enable the acquisition of panoramic images available in a given region, ensuring files with higher resolution quality.

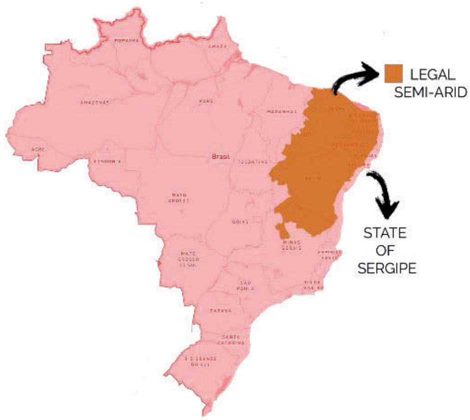

Fig. 1. Location of the Brazilian semiarid region and the state of Sergipe (Map prepared by the author, 2021).

3. Vernacular Architecture in the Semi-arid region of Sergipe

During September, October, and November, 2021, virtual investigations were carried out through roads that have GSV images and data, every 200 meters. Although the region of Sergipe's legal semiarid encompasses most municipalities of the state, it can be noticed that routes with GSV images are not present in all roads of the region. Thus, only routes that had GSV images were covered. Some regions have not been analyzed by the existence of GSV routes and other impediments such as demarcated indigenous territory (Caiçara/Ilha de São Pedro) in the municipality of Porto da Folha. Due to the situation of Covid-19 pandemic it was also not possible to conduct a face-to-face survey of this region. Therefore, this article deals only with the digital survey carried out at GSV.

In municipalities of Sergipe's legal semiarid region, there are GSV images captured in the years of 2012, 2015, 2018, and 2019, being all of those used in this study.

Fig. 2. Example of a wattle-and-daub dwelling in Porto da Folha, Sergipe, Brazil (Source: Google Street View, 2019).

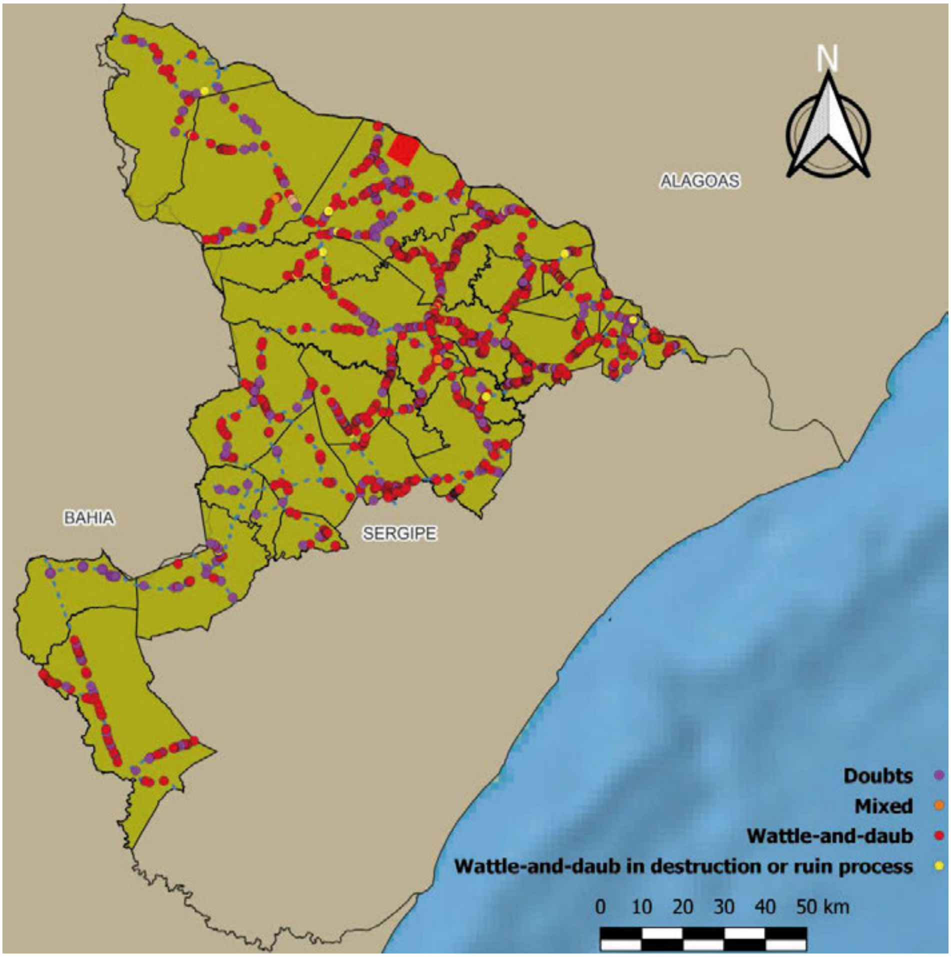

Fig. 3. Survey of the vernacular architecture of the semi-arid region of Sergipe (Map prepared by the author, 2021).

In this virtual investigation, dwellings were marked where it was possible to identify the constructive technique used (Fig. 2), but there were also buildings in which it was not possible to visually identify external coating on the external walls in good condition.

In orther to compose the synthesis map (Fig. 3) four identification categories were created: i) red for houses in which it was possible to identify wattle-and-daub; ii) purple for dwellings that have characteristics that may indicate the use of wattle-and-daub on external walls, but that could not be confirmed; iii) yellow for houses in wattle-and-daub that, at the time of the GSV images, were in destruction or ruin process; and iv) orange for mixed-use of wattle-and-daub with other construction techniques.

In total, 1,394.52 km were covered and 1,810 dwellings (Fig. 4) were marked in the categories reported above. After this survey, it was possible to show data in an overview table (Table 1) and, through that, understanding which municipalities of the legal semi-arid have a large number of buildings in wattle-and-daub, possible to identify under visual analysis.

Fig. 4. Example of a wattle-and-daub dwelling in Gararu, Sergipe, Brazil (Source: Google Street View, 2019).

City Name	Year of Data	Wattle-and-Daub	Doubts	Mixed	Total
Amparo de São Francisco	2012 e 2019	3	7	0	10
Aquidabã	2012, 2015 e 2019	189	27	10	226
Canhoba	2015 e 2019	6	7	0	13
Canindé de São Francisco	2012 e 2015	18	13	0	31
Carira	2012, 2015 e 2019	44	9	0	53
Cedro De São João	2012, 2015 e 2019	25	5	0	30
Cumbe	2015	16	2	0	18
Feira Nova	2015 e 2019	51	15	1	67
Frei Paulo	2012 e 2015	13	7	1	21
Gararu	2012, 2015 e 2019	166	39	1	206
Gracho Cardoso	2012, 2015 e 2019	121	19	0	140
Itabi	2012, 2015 e 2019	56	16	0	72
Macambira	2012 e 2015	29	12	0	41
Monte Alegre de Sergipe	2015 e 2019	17	4	0	21
Nossa Senhora Aparecida	2015	81	15	2	98
Nossa Senhora da Glória	2015 e 2019	38	19	0	57
Nossa Senhora das Dores	2012, 2015 e 2019	89	27	5	121
Nossa Senhora de Lourdes	2019	55	5	1	61
Pedra Mole	2015	0	1	0	1
Pinhão	2015	0	4	0	4
Poço Redondo	2015 e 2019	46	12	1	59
Poço Verde	2012 e 2015	0	6	0	6
Porto da Folha	2012, 2015 e 2019	136	51	3	190
Propriá	2012 e 2019	33	2	0	35
Ribeirópolis	2012 e 2015	65	14	0	79
São Miguel do Aleixo	2015	2	3	0	5
Simão Dias	2012, 2015 e 2019	13	17	1	31
Telha	2012, 2015 e 2019	18	5	0	23
Tobias Barreto	2012, 2018 e 2019	70	21	0	91
Total					**1810**

Table 1. Synthesis of data collected

4. Conclusions

Although wattle-and-daub is a vernacular technique applied in popular dwellings of Sergipe's semiarid since the beginning of settlement, over time it began to be associated with poverty and disease spread and, therefore, these dwellings began to be replaced and vernacular architecture rejected in these communities. Thus, the absence of in-depth studies on these buildings.

This study fulfills its purpose of being an initial diagnostic of the current situation on vernacular buildings built in wattle-and-daub in the semiarid region of Sergipe. The research, using data from IBGE and CECAD, allowed, on one hand, to perceive the existence of data related to the number of dwellings and who are the specific families and groups living thereof. On the other hand, however, it was noticed the lack of georeferenced data, which is of fundamental importance to delineate investigation of this architectural production.

To fill in this gap, a survey with Google Street View allowed to aggregate the location of buildings, as well as the physical conditions in which their external walls are. This association of quantitative, qualitative, and georeferenced data has given an overview of the conditions in which these buildings are found.

Thus, a considerable amount of popular housing was found, some in precarious conditions of maintenance of their external structures. This initial survey is then, necessary to suggest changes and improvements to them, as well as to help governments understand this housing production, that, at the same time, needs to be preserved because of the historical-cultural value and its relationship with the natural landscape of backcountry, and also to develop public policies focused on providing significant improvements to housing quality and, consequently, the quality of life of the population.

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Knowledge and conservation of Mediterranean spontaneous architecture: some of the villages of the northern Tyrrhenian coast of Calabria

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract

The paper proposes a reading of the rural architectures of the northern Tyrrhenian coast of Calabria, where structures linked to the agricultural activities and residential buildings coexist side by side. Knowledge about local constructive culture and the conservation of rural emergencies allows to highlight variations of base principles of Mediterranean architecture, in which specific typologies are created spontaneously as a solution to constructive problems and in which anthropic and geomorphologic values are entwined creating deep relationships with the environment and the identity of local communities. The paper analyses the residential types that, through the variety of architectural responses, reveal a sensitivity that can be reconnected to an attitude common to the entire geographical area, related to the place, to its morphological and environmental characters, produced by plans based on rational and geometric principles. All this finds validation in a landscape designed by almost spontaneous buildings that are placed in a scattered but rational way among the territory. Therefore, the paper proposes the understanding of rural architectures, nowadays often abandoned, that can give birth to actions of recovery and to the conservation of ancient knowledge.

Keywords: *Knowledge; Mediterranean; rural architecture; identity.*

1. Introduction

The essay focuses on some of the most noteworthy instances of rurual architecture in the northern part of Calabria, exactly on the Tyrrhenian coastal area. This geographical space is distinct for its strong landscape value, whilst still poorly investigated. This scenery is punctuated by a series of mountain villages currently depopulated and risking abandonment. In their built fabric, these hamlets show the signs of a building knowhow that derives from a rural matrix common to the entire Mediterranean area.

Through a methodological process of understanding, historical-critical readings and different analytical procedures have been carried out to recognize the identity characters (formal, typological, materic-constructive) of these villages.

The aim of this paper is to analize the different types of housing that testify a building sensitivity common thtoughout the entire area, despite the diversity of architectural outcomes. Owing to the consciousness of the morphological and environmental characters of these places, we can highlight the rational and geometrical principles on which these structures were built.

2. Territory and historic settlement

This paper analyses the rural building types of the northern Tyrrhenian area of Calabria, a territory enclosed between the sea and the Appenine mountain chain, known by the toponym of *Riviera dei Cedri*.

This territory includes the municipalities of Scalea, San Nicola Arcella, Santa Domenica Talao, Santa Maria del Cedro, Orsomarso, Grisolia, Maierà, Diamante, Buonvicino, Belvedere Marittimo, Sangineto, Bonifati and Cetraro and is at the same time manifold and homogeneous. Many are the shared elements and exceptions that can be traced in these very ancient settlements. Topographic and orographic features of these hamlets have been influenced by their role of economic connection between the mountains the valley, due to their barycentric position in this territory.

Fig. 1. Map of northern Tyrrhenian area of Calabria. Study area (Source: Bilotta, 2022).

The geographical position and the relevant presence of the sea, has made this area the setting of commercial exchanges, but also of raids and invasions. The indigenous culture, influenced by different foreign ones, together with the need of protection and livelihood of the locals, has produced a vast and diversified built environment that is however adherent to the Mediterranean architecture types. The simplicity of the shapes, pure volumes and poor decoration are the unmistakeable invariants of this cultural area. This results in a fabric made of base buildings that might appear spontaneous and random, while actually answering to the specific needs of a geographical region and its inhabitants.

Rural, agricultural, and spontaneous architecture are always the result of local resources, both in terms of labour and materials. According to the environmental, social and cultural conditions of an area, this architecture becomes flexible, evolving and adapting itself to the context. In most of Southern Italy's historical centres, rural and base architectures are the product of the layering of signs and languages that are deeply linked to the morphological, climatic and environmental features of a place, from which constant and variable elements derive. The ensemble of the traces and the evolution of this landscape and architecture define the identity of these locations, reflecting the needs of its populations and becoming the image of a specific way of living[1]. Consciousness about this heritage allows to preserve knowledge, memoires and ancient know-hows that are the consequence of the relationship between nature and built environment, between human and anthropized space[2].

In the examined area, the layout of the built environment is complex and deeply linked to the morphology of the landscape, made of mountains, a hilly intermediate area and narrow coastal plains. In this orographic scenery, settlements are arranged harmoniously from upstream to dowstream. The historical centres are several and placed on ridges, plateaus and steep mountainsides. This means that although they might seem close in planimetric terms, the con-

[1] Mario Brunati, *Architettura senza architetti*, in «Casabella», n.297, settembre 1965, p. 90.

[2] Lucio Gambi, *Una geografia per la storia*, Torino, Einaudi editore, 1973.

nection between them might be quite difficult because of the harsh landscape[3]. Usually, these settlements stand a few kilometres from the coastline, following the slope and occupying coastal areas, promontories, hillsides, and the hinterland. Along with the natural morphology of the landscape, the foundation sites of these settlements were defined according to defensive purposes, also resulting in an intricate system of defensive constructions. Built since the 12th century and thriving during the 15th and 16th centuries, towers and castles are mostly erected on prominent places together with monastic complexes and villages, from which the first forms of settlements historically stemmed.

The shape of buildings and streets in these historic centres is related to the orography as well. The village, in which the matrix and implant routes can be easily identified, is made of curvy streets that follow the natural elements on which they stand. This model should be intended not only as an adaptation to the territory, but also as a voluntary act of not imposing the presence of man in the natural context.

Fig. 2. Historic settlement. San Nicola Arcella and Belvedere Marittimo (Source: Bilotta, 2016).

[3] Rosario Chimirri, *Architettura popolare in Calabria: tradizione ed innovazione* , in Saverio Mecca (a cura di), *Architectural Heritage and Sustainable Development of Small and Medium Cities in South Mediterranean Regions*, Pisa, ETS edizioni, 2004, pp. 408-422.

The medieval villages are characterized by a mainly pyramidal structure in which defensive buildings, boundary walls, castles, towers and city gates are always placed on one of the vertexes. Beside these relevant elements, minor constructions are widespread and show basic characters, repeating themselves along the narrow alleys, interrupted by small widenings that become the centre of the social life of the hamlet.

Invariant elements that Mediterranean settlements derive from Oriental culture are the sudden changes of directions and frequent angulations of the streets, the consequent angulation and rounded angles of buildings, streets covered by buttresses, arches, external stairways, bayonet streets, and abrupt widenings.

Very few are the erudite exceptions that can be identified in these systems. These urban agglomerations are grown and matured by a continuous sum of housing units, typologically retracing the typical characters of the villages of Southern Italy, mainly inhabited by farmers and shaped as rural, agricultural or artisan settlements. The buildings derive their organisation from their functional purpose, which commonly is a mix of residential and productive, therefore lacking of geometrical schemes and precision.

The most common type is the terraced house, characterized by a limited surface and usually developed on two levels, in which the ground floor is used as a workshop, a storage or an animal shelter, and the upper floor is the actual house. The attic sometimes features the wood-oven for baking, but more commonly, it becomes a storage space. The blocks of houses are compact and usually all four sides are built; therefore the units are unified in a single line, sharing the side walls while the other two sides overlook the street or private courtyards. Variations of this type are obtained by connecting horizontally two units and others by building against rock walls.

2.1. Example of rural village

Santa Domenica di Talao is one of the most representative villages of the northern Tyrrhenian area of Calabria because of its location between the coastline and the Pollino National Park. Calabria is a Region made of the unceasing succession of mountains and coasts, between two seas (Tyrrenian and Jonio). Santa Domenica di Talao is placed in the North-West, a unique setting where the landscape of the Pollino Massif meets that of the Riviera dei Cedri. This small settlement stands on the side of the karstic mountain of Serra la Limpida, in the lowest part of the course of River Lao.

Fig. 3. Continuous curtain. Scalea (Source: Source: Bilotta, 2016).

The urban and architectonic history of this rural village is deeply linked to that of Scalea, not only for of their proximity, but also because it once was part of the possessions of the Spinelli, princes of Scalea, along with San Nicola Arcella. The historic core of the village was built in the 17th century, when the Spinelli family wanted to extend and reorganise their land, exploiting this area traditionally used for grazing.

According to Lamboglia «Giovanni Andrea La Greca from Mormanno and a certain "Sergio" from Lauria, a "sharecropper of ox and cows", during the winter would have brought their herds towards the Lao valley to avoid the rigid cold of Mormanno»[4].

[4] Saverio Napolitano, *La formazione di un borgo nuovo nella Calabria moderna: il caso di Santa Domenica Talao* in « Archivio storico per la Calabria e la Lucania», 2005, p. 155.

Later on, the prince assigned to La Greca some houses to settle in that territory and start populating the area, with a timid action of urbanization.

As it commonly happens in the mountain centres castled around the fortress or religious buildings, the settlement will be built near the Mother Church dedicated to Saint Giuseppe.

The structure of the historic centre is typical of the villages built on slopes, with a spontaneous development that mainly follows the different height leaps with streets partly made of stairs and with suggestive buttresses, similar to those found in the nearby Scalea.

Fig. 4. Rural village. Scalea (Source: Bilotta, 2016).

Albeit it was born as a rural settlement devoted to agriculture and pastoralism, Santa Domenica has enriched its built fabric through time. Along with the two storey terraced houses, slope houses sometimes erected against rock walls and *profferlo* (external staircase), many *case palaziate* (the Campagna, Perrone, Schiffino, La Greca palazzos) were added. This type features a limited architectural lexicon, characterized by finely moulded stone portals on the main facade. Similarly to the modest peasant houses, noble dwellings comply with the rural vocabulary as well, especially in the fact that the ground floor mainly hosted utility spaces such as stables, cellars, furnaces for baking, rooms devoted to dairy production, etc.

The building material used for these structures was local stone in different shapes and dimensions, mixed with river pebbles and interspected with beddings of bricks. The roofs were commonly made by a wooden structure and a cladding made of roof tiles. In the lowest part of the historic centre, there still is a sequence of rural houses with essential features, made of a single room, storages for the farming tools, and shelters for the animals.

Fig. 5. Profferlo house. Santa Maria del Cedro (Source: Bilotta, 2016).

It is easy to understand that the settlements scattered in the rural landscape, full of vegetation and overlooking the sea, often crossed by small watercourses, is one of the identity features of this area. Until the 17th century, along with the aforementioned cedar tree, this area was richly cultivated with *cannamelo* (i.e. sugar cane), cotton and mulberry, mostly used to nourish silkworms. Thus, many were the factories for the processing of these products. In spite of these crops and related activities, agriculture was severely hampered both by feudal tyranny[5] and by the geographical conformation of the land, which often meant that cultivated plots were far from inhabited centres. This resulted in numerous residential and productive buildings scattered among the countryside, reflecting different ways and places of living and following precise architectural and technical rules. Their simple compositions and peculiar solutions were determined by environmental and natural factors typical of sustainable buildings.

[5] For example, on this territory there could not be any olive-presses other than those of the area's lords.

Fig. 6. Streets stepped. Santa Domenica di Talao (Source: Bilotta, 2016).

These architectures are spread across this territory in a jagged and apparently disordered way, but they define a permanent relationship between character and background, between natural and artificial, in which built elements and natural landscape give birth to a system that is structured, balanced and deeply adapted to the territory.

Fig. 7. Rural settlement. Belvedere Marittimo (Source: Bilotta, 2016).

These spaces, both built and unbuilt, urban and rural, are characterized by the use of specific materials and building techniques, but also by physical, functional and visual relations typical of a rational architecture that links form and function, developed as the expression of living needs[6]. The area is characterised by the presence

[6] Giuseppe Pagano, Guarniero Daniel, *Architettura rurale italiana*, in «Quaderni della Triennale», Milano, U. Hoepli, 1936.

of small settlements and isolated scattered houses, which in both cases refer to the composition and development of rural houses, namely dwellings that reflect adherence and functionality to the productive type. They mirror the essentiality and uncertainty of a living space.

Fig. 8. Rural house with oven. Santa Maria del Cedro (Source: Bilotta, 2016).

Generally, the buildings are very simple, lacking in decoration and featuring few small openings. Beside rare moulded stringcourses, vertical bands and frames around the openings, there is not a modularity in the definition of the spaces. When present, balconies are very narrow.

2.2. Examples of rural architectures

Regarding the prototypes of the rural houses in the surrounding districts, studies have shown that they are mainly made of two floors and built in masonry (Belvedere), stone and mortar (Bonifati), stone and sand (Majerà), and stone and lime (Sangineto). The most common rural stone buildings used quite regular and medium sized material retrieved in the surroundings. These constructions have a quadrangular shaped plan with sides long 4-5 meters. Usually built facing towards north-west and with the entry placed on the shortest side. Roofs, covered in roof tiles, are slope and have the eaves line orthogonal to the entry side. A window is usually placed above the entry door and all openings have wooden jambs.

There also are architectures made of stone and clay (in particular in the area between Bonifati and Cetraro), in which stones were hewn as much as possible to make them easily tessellate, and were lined up alternating layers of horizontal and transversal stones. External plaster, when present, was made of clay of mortar or with *rapillo* crushed into dust[7].

Fig. 9. Isolated dwelling. Santa Maria del Cedro (Source: Bilotta, 2016).

A peculiar declination of the type can be found in Cetraro, in the locality called Sant'Angelo. Here, in an ancient village inhabited by farmers since the Turkish raids in the 16th century, the built fabric is compact and homogeneous, made mainly of two storey rural houses with an external stairway.

The dispersed isolated dwellings appear to be shaped according to their temporary use as daytime houses[8]. The typical base organism was used as a shelter during transhumance. Small sized, elementary buildings made of just one room. They generally were rectangular and built with irregular dry-laid stones, had roofs made of boards of poor wood, on which rocks were placed to contrast the action of the harsh wind. These rural buildings can be found throughout

[7] Rapillo is a stone taken from ditches and tunnels similar to calcium carbonate and used as construction method in all of Southern Italy. Rossella Agostino, Francesca Lugli (a cura di), *Esempi di architettura rurale nella Calabria tirrenico settentrionale*, Reggio Calabria, Soprintendenza per i Beni Archeologici della Calabria, 2005.

[8] The isolated types scattered in the territory out of the urban centres are already recorded in the Catasto Onciario: for example, as concerns Bonifati, we read of many possessions placed out of the centre, made of hamlets and lands farmed with olive, mulberry and fruit trees. Archivio di Stato di Cosenza (A.S.Cs) *Catasto Onciario di Bonifati*, 1753.

Calabria and in general among the entire Mediterranean area, where transhumance has been one of the most ancient forms of rural economy[9]. Examples of these simple constructions can be seen in Scalea, in the locality called Petrosa, where a settlement dated back to the 7th-6th century BC has been found on a hilltop. It is made of shelters built in perishable materials, reinforced on the basis with unrefined stones and walls and roofs are plastered with mud, usually mixed with rocks, reeds or breccia. Moreover, in Santa Maria del Cedro there is a small built area with buildings made of limestone and breccia.

Fig. 10. Shelter for transhumance (Source: Magarini, 2021).

The base types of isolated rural dwellings usually consist of one floor and two rooms, one used to cook and rest, the other used as a storage for tools or a shelter for the animals. Frequently, the combination of different functions and the small rooms could have lead to conditions of insalubrity[10]. These constructions often have a square plan and are built in lime or clay.

The main element of the house is the hearth: long three palms and covered at the top[11], it was the main element of the room in which they lived. Around Diamante there are many examples of simple architectures. Lacking of esthetical vestments, they were built in dry-stone with pieces chosen carefully to line-up precisely and reduce gaps, eventually filled with chips of stones. The most regular ashlars were used near openings, finished with wooden jambs, or in the corners to improve the connection between walls. Floors were made of beaten earth.

Over time, in changed conditions and needs, buildings devoted to agriculture, artisan and productive activities became more specific, giving rise to more complex types of dwellings. Beside the residential and rural types described above, there are several other buildings scattered through this territory, often in isolated areas and mostly away from urban centres. These buildings, because of the functions they accommodate, can be defined specialized, built on the need to have structures devoted to production and processing local goods.

An example can be seen in the farms made of different rustic buildings, functionally connected although not adjoined, devoted to the processing of agricultural products, to store goods, shelter animals and host seasonal workers. In the area of the Northern Tyrrhenian Coast of Calabria it is easiest to find farms that stand out for their compositional regularity, such as the structure located in Tortora known as “giardino di Julia” (Julia’s garden). This kind of buildings recall the rare model of the farmstead, like the property of the Leporini family in Diamante. In the same area, the groups of farmhouses are widespread. Significant is the one in the Fontanelle district in Belvedere, which shows a tower from the 17th century included in one of the buildings and a rural church, other feature quite common in the farming landscape.

Mills and olive presses are some of the productive buildings that can be easily found by streams in the outskirts of the villages. These structures commonly stood where the water could be channelled to obtain the power to move the mechanisms. The canal system, generally consisting of arched structures made of stone and lime, can be seen nowadays in the

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9 Piero Bevilacqua, *La transumanza in Calabria*, in «Mélanges de l’Ecole française de Rome Moyen-Age Temp-modernes», n.2, tome 100, 1988, pp. 857-869

10 Ottavio Cavalcanti, *Architettura spontanea nella fascia tirrenica cosentina*, in «Calabria Sconosciuta», n. 11-12, 1980, pp. 61-64.

11 Umberto Caldora, *Statistica Murattiana nel Regno di Napoli: le relazioni sulla Calabria*, Messina, Facoltà di lettere, Istituto di Geografia, 1960.

remains of curved aqueducts or in the ruins of some factory. The sizes of these constructions can vary widely: the mills, mostly with horizontal wheels, can reach 20 square meters, while the olive presses are usually three times bigger, although consisting of just one floor. The materials used for the masonry and vaults are stone and lime; wood was used for the roof, windows and doors; clay was used for roof tiles and occasionally for the flooring in the mills.

Findings of the remains of olive press buildings can be seen in the area around Scalea and Bonifati. By contrast, in the territory of Cetraro there are many examples of farmhouses with mills, olive presses and other storage rooms outbuildings, as reported already in the second half of the 18th century in an illustration of the Fella Feud[12].

3. Conclusions

The diversified architectural landscape that has been examined, describing the considered macro area, is today strongly deteriorated and in some cases abandoned. This condition should rise questions about the need to preserve and reuse these assets rich of traces, knowledge and identity.

The understanding of local building culture and the safeguarding of rural landmarks allows to highlight the variations on the basic principles of Mediterranean architecture. Principles based on specific typologies generated spontaneously as a solution to the building problem and in which anthropic and geomorphological values are interwoven, establishing strong links with the environment and the identity of local communities. Thus, the building characters suggest the direct and reciprocal relationship between construction and environment, responding to fundamental and recurring questions: climate, locally available and economically accessible materials, and the morphology of the territory.

The bioclimatic nature of these buildings is obvious in the form, but also in the materials and the technological procedures adopted. All this highlights a deep adherence to the principles of energetic sustainability, central in the modern debate about architecture.

Therefore, it is necessary to rediscover the meaning and the values that can trigger recovery actions in these villages and buildings, in order to safeguard an identity heritage made of stones and men, of an architecture that shapes the territory and is shaped by it, and is expression of sustainability and Mediterranean-ness.

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12 As already mentioned, olive presses could be incorporated in the ground floor of the dwellings, as seen in *Palazzo Giunti* in Sangineto, or in *Palazzo del Trono* in Cetraro, which is currently used as a museum.

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Architectural and constructive characteristics of vernacular settlements in southern Italy: the Esaro's valley and the popular identity of some exemplary cases

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
The paper proposes the analysis of a significant portion of the territory of southern Italy and, more precisely, that in Calabria within the Esaro river valley, characterized by a wide hilly area that hosts numerous small ancient centres. The analysed territory, which for centuries has had a strong agricultural and pastoral vocation, presents a varied range of case studies typical of popular identity and vernacular culture but different in morphologies, construction techniques, materials and types. Through a comparative reading of some examples, therefore, the paper aims to highlight the architectural and construction features typical of the local architecture, underlining their spontaneous and identity character. Not only sporadic and isolated episodes are taken into consideration, but also entire portions of the inhabited area, which in structure and building fabric reflect the traditional life of the past. The territory's variety allows us to analyse different types of architecture through which the vernacular culture is manifested. In addition to the most valuable examples such as farms, country houses, farmhouses, in fact, there are also examples of more modest architecture (ovens, stables, oil mills, mills, clay buildings) that express, even more, traditional and popularaspects. The study, therefore, through the analysis of the formal, functional and constructive characteristics, has made it possible to define variants and invariants of an architectural heritage with a strong identity value to protect and preserve.

Keywords: *Knowledge, vernacular architecture, popular identity.*

1. Introduction

This paper is an introduction to the knowledge of the landscape and the architecture of a beautiful natural and built environment placed in the northern-central part of Calabria, in the province of Cosenza. We are talking of the Esaro valley, crossed by the homonymous river and dotted with several villages. The essay's aim is to focus on the heritage of rural architecture through an overview of emblematic types of local vernacular culture. These buildings, of agricultural and pastoral tradition, are typical of this part of Calabria and can be considered expression of the specific peculiarities of local cultural identity. Therefore, this study wants to re-consider these assets as a cultural and/or economic resource for contemporary society, combining the reasons of conservation with those of the re-usage of these existing values.

In order to achieve an architectural and urban knowledge of the area, various analytical protocols have been carried out, highlighting the specific features of local building culture. All these analysis (historical, architectural, material, tecnological, typological, social) have allowed to collect data on the settlements' structure, on the autochthonous architectural lexicon, on the recognisability of primitive systems, on the evolution of the base-type, on the building systems, and on the exploitation of resources. Therefore, it was possible to define the variant and invariant features of base and outstanding architectures in this area. More than just focusing on popular identity and the spontaneous way of building of those who lived in these places, this cognitive process has led to foreshadowing scenarios of valorization for these potentialities. All this, in order to bring these places back in the circuit of social life, to promote the conservation of its specific features and encourage the repopulation of the area.

2. Esaro valley: invariant charaters and examples

At present, Esaro valley renders the image of a unique landscape, albeit affected by marginalization and depopulation and waiting to enhance its architectural and economic resources. Esaro River crosses northern Calabria, originating from the eastern side of the coastal mountain chain, near the Passo dello Scalone, a mountain pass of the Southern Apennines that represents the border point between the Lucanian and Calabrian ranges. It furrows a territory of over 600 square kilometres and ends its course in Coscile River (in the proximities of the plateau of Torre Mordillo), a tributary of Crati River, a few kilometres before its delta in the Ionian Sea. Therefore, this watercourse flows through an uncontaminated landscape characterized by mountains and hills with a strong environmental value, dotted of small waterfalls and speleo-archaeological sites, together with the fertile valley. This geographical area is marked by numerous medieval settlements placed within the drainage basin of Esaro River.

In a central position to the entire region (Fig. 1), the Esaro valley is limited to the North by the Pollino Massif, with the villages of Mottafollone, Acquaformosa, San Donato di Ninea, San Sosti, Sant'Agata d'Esaro; to the East by the Presila Mountain Range; to the south by the urban centre of Cosenza and from San Marco Argentano, the main centre of the area; to the west by the coastal range with the centres of Fagnano Castello, Malvito and Santa Caterina Albanese. The latter is one the many small villages (together with Spezzano Albanese, Acquaformosa, Firmo, etc.) belonging to the *Arbëreshë*[1] ethnic group. These settlements preserve the urban structure[2], language, customs and traditions, and the Greek-Byzantine rite, typical of this ethnicity.

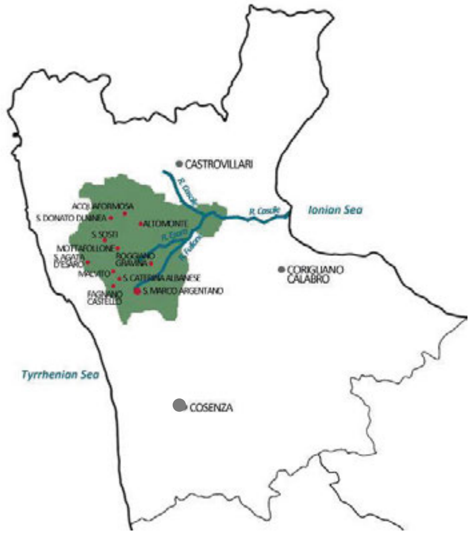

Fig. 1. The Esaro valley: in blu the Coscile, Esaro and Fullone Rivers, in red some of the named nucleos, in gray some important centres in northern Calabria.

The villages located in the Esaro valley have small historic nucleos in which rural buildings coexist with examples of outstanding architecture. Apart from San Marco Argentano, the largest centre in the valley, close to the urban area of Cosenza, none of these villages has urban territorial functions. While the settlements are remarkable for the landscape values, their urban and architectural structures have not been sufficiently examined. Their aspect is usually defined by spontaneous rules and influenced by

1 The *Arbëreshë* are the Italian Albanians, also called Italo-Albanians, the Albanian ethno-linguistic minority historically settled in southern and insular Italy.

2 The *Arbëreshë* centres show a concentric urban layout named *gjitonia* in which buildings are placed in a circle around a central square that is the hub of social life, just like the villages in Albania.

the rough orography and the need to spare land for agriculture and pastoralism. Most of these centres originated spontaneously, clinging to cliffs or hills for defensive reasons. These settlements show a pyramidal urban structure, with an intricate system of narrow streets that, from the ridge to the valley, follows the contour lines on which also the buildings stand. The built fabric is characterized by single-family rural types, often showing a *profferlo*[3], attached to other terraced houses. The ancient centre revolves, for most part, around outstanding buildings such as a castle, a cathedral, defensive towers overlooking the valley, from which the core path often develops.

In the lowest parts of the valley, we find small productive activities: farmhouses, mills, sheds for agricultural tools, shelters for the sheep, frequently built with unbaked bricks, a construction technique widely used in Calabria and throughout the Mediterranean area. In the nearby Crati valley, this particular unbaked brick was known as "*mattunazzu*". For the Calabrian populations, this technique was a way to build using local, versatile and low cost materials, employing natural elements such as earth, small river pebbles and mud as a binder. In the analysed area, for example, the mud was mixed with vegetable aggregates such as straw and wheat chaff, therefore assuring also thermal insulation for both winter and summer. At the present in Calabria, few examples of these constructions remain: houses made of unbaked clay bricks and straw can be found in the hamlet of Sartano, which represents the last centre built with this technique, in San Marco Argentano and in San Donato di Ninea, two centres in the Esaro valley.

In the studied area, the typical rural house is generally a single-storey building, made of one room, rarely of two, with flooring in beaten earth or bricks, slabs made of wood or woven reeds, and roofs covered with a mantle of irregular handmade tiles. The façade, developed horizontally, is very simple, characterized only by an entrance door and a small opening from which daylight could enter. The masonry made of rough irregular red earth bricks is noteworthy. The kitchen represented the principal interior space and showed the typical *focagna* (fireplace), the real core of the house. Furnishing was sober; a fundamental role was held by the *cascia* (portmanteau) where the groceries were stored. Furthermore, each house had its own votive aedicule, a niche in the wall holding the statue of the Saint, to protect and bless the family.

Among the villages in which these characters still remain legible, there is San Donato di Ninea (Fig. 2) presumably founded by the Enotri with the name of Ninea. The original nucleo must have been located not distant from Mount Serra di Santa Croce. To escape from the frequent Saracen invasions, the inhabitants later decided to move to the Motta area, on the top of the mountain.

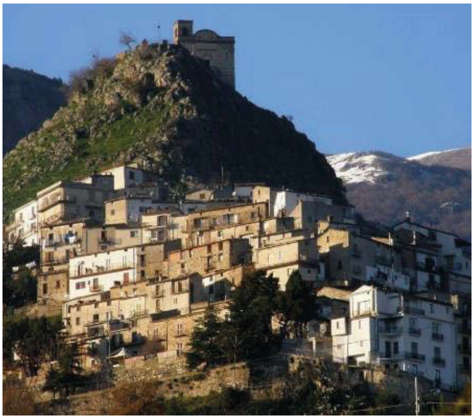

Fig. 2. San Donato di Ninea: view of the historic centre.

The settlement stands on a rocky spur with a terraced built fabric, founded on the contour lines. At the top, in the highest part, there is the Romanesque church of the Madonna dell'Assunta, welded to the rock and with its façade overlooking the Esaro valley and the

3 The *profferlo* is a type of medieval external staircase, ending with a gallery supported by an arch.

Ionian Sea in the extents. Behind the church, stands a maze made of attached houses.

The streets create a labyrinth, frequently interrupted by stepped alleys that connect different levels, and small urban spaces where the social life of the centre is set. The built fabric, made of base-types, is shaped in blocks of attached housing units that follow an oblique position. The most widespread building types are the single-family house with *profferlo* together with terraced houses and tower houses. However, there also are examples of more sophisticated architectures such as wealthier dwellings.

Buildings are usually made of stones of different sizes, sometimes mixed with river pebbles. Roofs are generally gable or hip, covered in roof tiles held down by stones, a spontaneous device used to assure greater stability in harsh and windy climate conditions during the winter.

Outside the centre, in the nearby rural areas, there is a widespread presence of *catuoi*, small single-storey buildings of modest size, used as shelters for the animals. These stables, whose name in dialect derives from the Greek κατα’ οἶκος, were placed near the houses, at their service.

Furthermore, in the area of San Donato di Ninea there are remains of ancient mineral mines[4] in which, in addition to the more common iron, gold, silver and copper, also cinnabar was extracted, probably used as a dye (Arthur, Imperiale, 2015). This tradition is still alive in the locality of Bocca della Cava where there is the Casino dell'Oro, a modest building made of a single room and an elementary pitched roof, placed near the mine and used as storage and shelter for the miners.

On the slopes of Mount Pellegrino, not far from the historic centre, there are the rock caves of Sant'Angelo, testament of the Basilian tradition in Calabria, used as an underground place of cult (Roma, 2010). The locals continue to value the caves, holding religious events, processions, folk festivals in them, to honor the memory of the typical events of local vernacular tradition.

The historic centre of Altomonte also shows similar features in the shape of the built centre and the presence and diffusion of base-type buildings. This village of aincent foundation adapts its layout to the ridge, tracing with its streets, with its defensive buildings (the Pallotta Tower and the Castle) and its base-building fabric, the typical medieval fortified structure.

The diffusion of tower houses is more evident than in San Donato di Ninea. These buildings, with their single-cell system, developed on several levels and placed in a continuous attached sequence, almost resemble a defense "wall" in the lowest part of the centre (Fig. 3).

Fig. 3. Altomonte: view of tower houses.

The case of Altomonte is also interesting because of the combination of productive and residential areas. In this village there is the emblematic case of the castle that has an underground oil mill, an element that becomes recurring in many historic centres of Calabria. In the countryside, next to the modestly built houses there often was an oven for making bread. Water mills were often used to ground the wheat from the croplands: on the Grondi river there were at least four mills of which only few unrecognizable ruins can be seen today. The Mill of Frati Minimi, instead, preserves noteable remains and also the two underpasses for the water can be recognized.

4 The village is surrounded by an extensive mountain area rich of metals, as attested in a document dated 1195 which recalls an iron mine granted to the Cistercians in a farm-house called *Sanctus Donatus*.

3. The case of San Marco Argentano

The centre of San Marco Argentano is the most remarkable instance of local vernacular culture, because of its size and because of its deep connection to the aptitude of the area. In fact, better than any other settlement in the Esaro Valley, this town presents both modest and outstanding features that highlight how the culture of spontaneous building does not necessarily have to be "poor".

The existence of the centre is documented since the Sybaris dominion under the name of *Argyros*. Later it became *Argyrano* under the Lucanians and *Argentanum* under the Romans, because of the presence of a small mine for the extraction of silver. Placed on the isthmian route that connects the Ionian and the Tyrrhenian seas, this village detained great importance throughout numerous dominations and hegemonies, including those of Lombards, Saracens and Swabians. The Normans enriched the centre, increasing its economic and artistic importance and ensuring the highest period of prosperity of its history. The village still shows the vestiges of past times: the urban structure composed of narrow, twisted and labyrinth-like alleys that wind from a long transversal road, several outstanding brick buildings, decorated and crowned by noble coats of arms.

Even though noble examples of architecture can be found in the dense urban nucleus, it is in the countryside that the local vernacular features appear more strongly. The practice of living in rural areas, even when isolated, spreads the landscape of numerous scattered houses and small or medium-sized cultivated plots of land. In fact, by moving away from the urban centre and down towards the plains, more than sixty districts can be counted, once populated mostly by farmers, shepherds and woodcutters.

Among these, Iotta is significant for unbaked clay brick buildings, one-storey huts constructed in simple clayey earth, with a bright red color, mixed with water and vegetable elements, mostly straw (Fig. 4). Some of these buildings show an outer layer of lime to protect the masonry from rainwater. Similarly, others are protected by *incannucciate*[5] (Fig. 5) and shrubs. The wooden roof is simply interlocked in the brick walls.

Fig. 4. District Iotta: house with raw clay bricks.

Fig. 5. District Iotta: example of *incannucciata*.

Noticeable are also elements that underline the self-sufficient character of these houses. The district is rich of small family ovens (Fig. 6), simple constructions with a dome shape and a single opening. This emphases the importance, in the past, of producing everything that was needed for daily sustenance.

5 The technique, already known by the Etruscans and widely used in Southern Italy certainly up to the mid-nineteenth century, originates from the *Opus craticium*, that is, a self-supporting wooden frame whose squares are padded with materials of different nature according to the available resources. It is defined as *incannucciato* when the infill is made up of a mixture of raw clay degreased from straw, spread on a micro frame made up of woven reeds.

Fig. 6. District Iotta: domed family oven.

However, the rural landscape surrounding of San Marco Argentano is diverse: beside small country houses and agricultural building utilities, bigger farmsteads can be widely found. They embody a more erudite example of countryside architecture, presenting two or three storeys and outstanding decorative elements (Fig. 7).

Fig. 7. District Mancino: example of country house.

Some examples of farmsteads can be found even in the Iotta district. In one case, within a large garden, there is a trilithic structure with niches placed before a long colonnade, of which few remains can still be admired.

Another case (Fig. 8) shows small circular windows placed just below the eaves, revealing the presence of well-ventilated rooms planned for the storage and drying of food goods, commonly called *cannizzi*[6] in local dialect.

Fig 8. District Iotta: example of country house.

More examples of farmhouses can be also found in the Scarniglia district, some of which date back to the sixteenth century (Fig. 9).

Fig 9. District Scarniglia: examples of farmhouse.

The most important seems to be composed of two buildings: while one shows noble features, the other has a more humble structure. The first one, a three-storey building with basement warehouses, in the façade shows all the features of the Calabrian stately home: large windows, balconies and two arched portals surmounted by the the noble coat of arms. The entire building is painted in a faded coral red and mouldings, string

6 The dialectical name refers to the tradition of drying food on frames made with reed.

courses and corners highlighted in white. Next to the stately home stands the building for of the service personelle, visibly poorer in materials and structure. The façade, in fact, appears to be a simple sequence of square windows, without evoking any particular architectural lexicon.

An even more important instance of rural house in San Marco Argentano, ascribable to the farm type, is the building that currently incorporates the ancient Cistercian Abbey of Matina, of which only the windows and the pointed arch portal remain visible from the outside (Fig. 10).

Fig 10. The rural farmhouse Matina and the remains of the Abbey.

The farmhouse in composed by many different buildings: the noble palace, the church, the stables and the houses for the peasants. The farm shows the characters of vernacular architecture not only in the plan layout but also in the decorative elements: large geometric motifs made of red rectangles and triangles (Fig. 11), in fact, embellish the buildings, underlining the prominence of the family even if in a rural context.

Fig 11. The rural farmhouse Matina: decorations' particular.

Lastly, also the numerous water mills that mark the medieval faded mule tracks are significant evidence of popular identity. In the area there are seven, perhaps eight, mills of which today just simple disfigured ruins can be seen.

Three ancient watermills built along the course of the Santa Venere stream used to be connected by an ingenious system of Cistercian epoch: the Mill of Santa Venere, which still preserves the ancient stone sajitta to make the water fall from above, the Mill of Calcara in the locality of Acquafredda and the Mill of Galera.

In the valley of the Fullone river, instead, we find the Mill of Fazzullo, the Mill of Fra Cicco and the Mill of Frati, probably built in the Norman period and directly connected to the Abbey of Matina.

Near the confluence of the Santa Venere and Fullone rivers, there is the only mill that is still undamaged: the mill named Mulino di Mezzo, dating back to 1771. The three attached structures (Fig. 12), of which the mill was composed, are still visible. Two are taller because built on different levels. It is interesting to notice that one of the tallest buildings shows dovecotes, breaches in the masonry used to shelter and for the breeding of pigeons: animals closely connected to agriculture but also widely used in traditional cuisine of the locals. In the remains of this mill, it is possible to admire some faded ornamental angular bands, colored in white, with geometric motifs in shades of red (Fig. 12). Hence, it can be affirmed that these decorative elements represent a distinctive feature of popular culture in the considered area.

Fig. 12. The mill named Mulino di Mezzo as appears today: decorations' particular.

4. Conclusions

The proposed essay, through the comparative analysis of the features of some ancient centres placed in the Esaro valley, wanted to highlight the vernacular culture of a large area of northern Calabria.

The conducted process of knowledge, undelined the variant and invariant characters of this territory, highlighting how the popular and spontaneous tradition has defined, over time, the development of unique urban centres and buildings, not only for their aspect but also for their technological, material, typological and functional characteristics.

The review of the proposed cases, at times unknown to most people, at times left in their deterioration and decay, highlighted how the historical landscape is the result of an inseparable connection between natural forms, human needs and architecture, a palimpsest of traces of culture, tradition and memory. This heritage needs to be rediscovered and enhanced with conservation and restoration actions and, above all, re-connected to the contemporary world, that would surely receive a future social, cultural and economic benefit.

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Spanish traditional architecture abandonment and destruction: an initial analysis of social risks, phenomena, and effects in earthen architecture

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Topic: T1.1 Study and cataloguing of vernacular architecture

Abstract
Throughout the last century, Europe's traditional architecture has been affected by a severe and widespread trend of decline and abandonment. These are the result of worldwide cultural, social and technological modifications which have noticeably changed society, lifestyle and economy. These transformations are reflected directly in built heritage and places, often struggling to adapt to the new habits and needs and thus prone to disuse and destruction. The same processes and phenomena also affect intangible culture, such as traditional construction know-how, causing the loss of another essential part of the population's heritage and identity. Spain is no exception. Due to industrial advances and the rural crisis which brought about major changes in lifestyle, culture and population, the country is now facing various critical situations connected to this trend. These include depopulation, overpopulation, tourist exploitation, and social discredit, which are a stark warning to the conservation of its traditional architecture, now in jeopardy. The following paper focuses on identifying the most important social phenomena within Spain in relation to the transformation, abandonment, and destruction of traditional architecture. Through this analysis, the study aims to provide an initial evaluation of their effects on Spanish earthen traditional constructions and so highlight the crucial aspects to be considered for the formulation of proper and effective strategies for conservation, management and valorisation.

Keywords: *Spanish traditional architecture at risk; earthen architecture; social risks in earthen architecture; RISK-Terra research project*

1. Introduction

1.1. The bond between places and human populations

Landscapes, territories, and architecture are closely connected to human culture as they are used and transformed to create their habitat. The technological and social evolution witnessed in the last century severely modified society and culture throughout Europe, with major repercussions on architecture and urbanism.
Among these, the system of traditional architecture, especially vernacular architecture, appears to have suffered greatly. It is often considered outdated, inefficient, and inappropriate in aesthetic terms compared to contemporary standards.
This work aims to provide an initial assessment of the phenomena involved in this situation in order to evaluate the influence of social and anthropological components in the conservation of built heritage. The main goal is to understand which aspects most affect the survival of traditional earthen architectural heritage. This in turn allows proper actions and strategies for enhancing its preservation to be established.

1.2. Methodology

The work is based on bibliographical analysis and field research carried out between March and October 2021 and exploring several earthen settlements in the regions of Murcia, Andalucía, Valencia and Aragón. During these explorations, local earthen architecture was catalogued, compiling information from some of the stakeholders involved in its use and conservation through communication and interviews with administrations, inhabitants and technicians.
Initially, a general analysis was carried out of the phenomena detected, examining causes, effects and geographical localization, based on data from Spain's National Statistics Institute (INE) and National Geographic Institute (IGN).
The results of this first evaluation were then applied to Spanish traditional earthen architecture, cross-referencing the data collected to detect critical factors which should be taken into consideration in promotion, valorisation, and conservation strategies.
The conclusion section provides a brief reflection on some of the actions which should be promoted to enhance the conservation of Spanish traditional earthen architecture.

2. Social phenomena in traditional architecture

2.1 General cultural and economic context

In the last century, Spain went through difficult and complex situations, including a civil war, two dictatorships and important major political, economic and technological changes. These modifications especially affected the production system, the population "topography" and the structure of society, with lingering results for the country. The most important repercussions for traditional urbanism and architecture are the phenomena of depopulation, overpopulation, tourist pressure and social discredit, which seriously jeopardize their existence. The following paragraphs provide individual analyses aiming to paint a general picture of their dynamics and effects. However, often some of these circumstances coexist, mutually influencing each other.

2.2. Depopulation

Depopulation is defined as the loss of inhabitants which usually causes the complete or partial abandonment of a given area, region or town. It is mostly caused by the decreased capacity to attract and retain inhabitants, due to the loss of different services. This phenomenon usually concerns areas affected by lack of employment and education opportunities, and poor infrastructures and services. In some cases, depopulation is also observed in areas with harsh climates which make it challenging to live there.
Spain is one of the most depopulated European countries, with some areas with very low-density thresholds[1]. The lowest ones have been registered in:

- Castilla y León (25.34 people per Km^2)
- Extremadura (25.41 people per Km^2)
- Castilla La Mancha (25.79 people per Km^2)
- Aragón (27.90 people per Km^2) (INE, 2022)

Many of the most affected areas are inland or in communities heavily reliant on agriculture and seriously compromised during the agrarian system crisis (Fig.1). The reduction in services funding further hinders the capacity of these areas to attract people, especially young ones. It also entails the ageing of the few remaining inhabitants, subsequently leading to issues with lack of structures and resources for their care, falling into a dangerous vicious cycle. In terms of consequences for architecture, buildings in depopulated areas suffer the most from abandonment and lack of maintenance, gradually

[1] Depopulation is usually expressed by the ratio of the number of inhabitants to the area of the inhabited surface. Europe sets different indexes, depending on the NUTS analysed, which are periodically upgraded. Values of 10 or 8 people per Km2 are considered critical thresholds for municipal areas1, while 12.5 people per Km2 is used for provincial extensions (Burillo-Cuadrado et al., 2019; Pinilla & Saéz, 2017).

leading to their destruction or major transformation. These consequences are felt even more in vernacular architecture, whose structure and use might be considered unsuitable within contemporary society. Furthermore, higher costs for maintenance and repair (compared to those of more modern techniques) could result in increasing destruction and substitution.

2.3. Overpopulation

Overpopulation is the concentration of large numbers of inhabitants and users in the same area. Although this phenomenon shares many causes with depopulation, the effects and results are diametrically opposed. Regions and cities affected by overpopulation offer greater employment opportunities and better services (Bazant, 2010). In step with the development of the metropolitan model, the evolution of industries and the growth of tourism and real estate sectors (Barke, 2007), some Spanish areas and cities such as Madrid, Barcelona and Valencia grew exponentially in a very short period. This growth also attracted residents from surrounding areas. This led to a vertiginous increase in population, with inhabitants concentrating in small portions of land, giving rise to an increase in urban density and real estate speculation (Arellano & Roca, 2010) (Fig.1).

This phenomenon greatly affects architecture and urbanism: a large number of services and residences are concentrated in areas of high architectural density often sprawling over unbuilt land or destroying low-density settlements. Furthermore, since this growth occurs in very short lengths of time, the expansion is not always planned, especially in fringe areas, where buildings and services are added almost spontaneously. This frequently leads to the spread of low-quality urbanization, both in terms of building construction (poor standardized architecture with little relation to local landscapes and identity) and urban planning (poor quality in terms of infrastructures, spaces, service facilities and circulation), bringing about the creation of weak settlements. Traditional architecture especially struggles to adapt in this situation, since lifestyle and social structure have evolved considerably, giving rise to serious incompatibility. Furthermore, technological advances establish new standards that are difficult for traditional architecture to satisfy, so that it may be considered obsolete

As a result, traditional buildings usually undergo huge transformations which often lead to the partial or complete destruction of their original basic features.

2.4. Tourist pressure

In the 1970s, Spain's tourism sector grew exponentially, causing a surge in demand for tourist facilities and accommodation, leading in turn to the phenomenon of residential tourism (Hof & Blázquez-Salom, 2013). As a result, most of the Mediterranean coastal areas underwent important economic growth and urban expansion. Many new architectures and services were rapidly established to meet the new demand, with major financial repercussions. This also affected historic cities and later, rural settlements when the rural tourism trend took off (Barke, 2007) (Fig. 2, Fig. 3).

In tourist areas, the population tended to grow, partly because of immigration from countries such as Germany, the Netherlands, and the UK (Hof & Blázquez-Salom, 2013). Often, these foreign nationals chose to establish their second or retirement residences in these locations, at times even building new neighbourhoods. However, tourist communities have an irregular impact on population and use, since their irregular presence is usually seasonal.

Due to these circumstances, traditional architecture in tourist areas tends to suffer from extreme exploitation, transformation (especially when adapted for tourist or aesthetic ends) and is frequently affected by changes in use. The architecture of historic cities and towns centres is also affected by this phenomenon, which can partially contribute to gentrification (Cócola-Gant, 2015).

2.5 Cultural changes (loss of cultural relevance, "social discredit", cultural contempt)

"Social discredit" is used to describe the cultural discrimination that frequently affects traditional architecture. Construction and urban processes changed greatly due to globalization and technological advances. The new technological systems available, such as modern facilities, newer high-performance construction materials, structural improvements and other innovations, have gradually been incorporated into buildings.

Fig. 1. Population distribution in Spain (2020). (Map based on GIS data from the IGN)

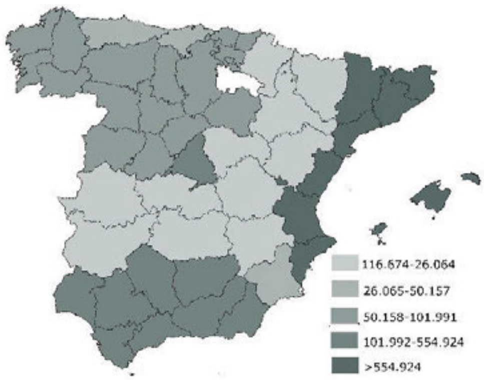

Fig. 2. International tourists by destination, July 2021. (Source: INE, 2022)

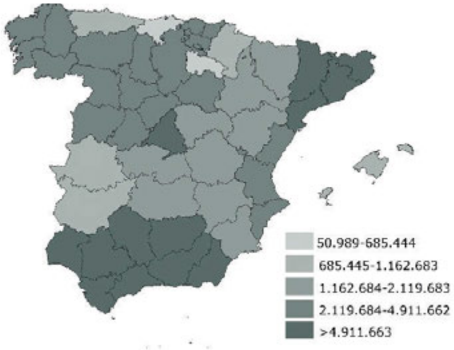

Fig. 3. Resident tourists by visits, 3rd trimester of 2021. (Source: INE, 2022)

People have adapted to these new and higher standards of comfort, which significantly enrich their way of life, and progressively incorporated them into new aesthetic trends, also contributing to major changes in the physical appearance and operation of towns and cities. Consequently, traditional architecture, especially vernacular architecture, is increasingly considered obsolete, since its values in terms of performance and aesthetics are no longer valid.

This kind of phenomenon is the main reason for actions such as demolitions or interventions which destroy the authentic character of traditional architecture, either fully or in part, in terms of structural operation as well as built material.
These actions also cause serious damage to local construction identities, as well as issues with landscapes and sustainability.

Furthermore, social and cultural discredit lead to the fall in numbers of expert craftsmen (a result of the reduced use of traditional techniques), directly harming and jeopardizing building know-how.

3. The situation of earthen architecture

Earthen architecture is one of the most important traditional architectural heritages of the Iberian Peninsula but it is also one of the most endangered (Maldonado & Vela-Cossío, 2011). Its widespread presence throughout Spain is related to geographical and climatic conditions, the avai-

lability of materials and construction know-how (Mileto et al., 2020, 2021). Spain has many earthen buildings, both monumental and vernacular. Although monumental architecture has gained greater recognition in recent decades, vernacular typologies are still more likely to suffer from abandonment and transformation, especially due to phenomena such as cultural and social discredit (Mileto et al., 2021) which, together with extreme demographic situations, jeopardize its conservation.

Earthen architecture is closely linked to geographical and geological features such as altitude, lithology, presence of stones, presence of timber and rainfall. Although found all over Spain it is especially prevalent in inland areas affected by depopulation (Mileto et al., 2021) (Fig. 4). Monolithic structures, built using the most widespread technique, are also largely present in south-east areas (Mileto et al., 2021), affected by overpopulation and tourist pressure (Fig. 4, 5 and 6). It can therefore be stated that the four phenomena previously analysed affect this heritage in different ways, leading to a range of effects and scenarios. Earthen architecture is frequently prone to abandonment, changes in use, significant transformations and destruction. Phenomena of this kind have been found both in situations of overpopulation and depopulation. In fringe areas connected to areas with high population densities, many small villages or rural contexts recorded a drastic reduction in the number of earthen buildings (Cazorla-Marín, 2015), sacrificed or transformed to make space for urban expansion (Fig. 7). Furthermore, many earthen structures connected with traditional agricultural and domestic activities fell into disuse due to the modernization of the agricultural system (Castilla-Pascual et al., 2020) and became obsolete. As a result of this, the remaining earthen structures in these contexts suffer mostly from lack of maintenance, which severely endangers their conservation (Fig. 8).

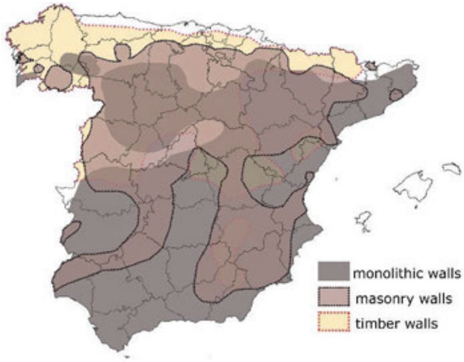

Fig. 4. Geographical distribution of earthen heritage techniques (Elaboration based on Mileto et al., 2018).

Fig. 5. Earthen architecture and population density.

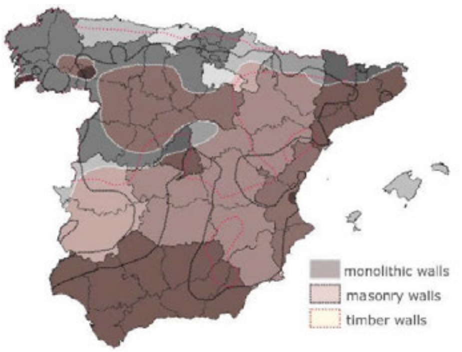

Fig. 6. Earthen architecture and tourist areas.

Fig. 7. Isolated Valencian *barraca*, in a distric of *Valencia*. This traditional local architecture is made of adobes, and it was once primarily spread around the city's territory. Today only a few examples have endured, and most of them are surrounded by the presence of modern buildings which have no connection with the traditional architecture and urban morphology (Source: Caruso, 2018).

Previous research projects demonstrated that continuous and programmed maintenance is essential for their survival, although most of the time unsuitable systems are employed (Mileto et al., 2020), further damaging the architecture. Consequently, the lack of proper know-how should be considered another crucial aspect given the potential ravages it can cause. It can also lead the costs of appropriate repairs to increase, due to the need to provide masons with extra training before starting the work (Jímenez- Delgado & Cañas-Guerrero, 2006). The use of earthen techniques both in pre-existing and new constructions is additionally hindered by the lack of regulations, which makes it difficult to fulfil legal and insurance requirements, as well as regulations (energy, structural, etc.) (Jímenez- Delgado & Cañas-Guerrero, 2006). This last aspect, which is related to technical issues, is proof of an alarming lack of interest in earthen architecture shown by the administration and different professions, possibly as a result of social and cultural discredit.

4. Conclusions

4.1. Overview of social risks for earthen architecture

The widespread presence of earthen architecture throughout Spain means that it has been subjected to different effects of the social phenomena analysed.

Fig. 8. Rammed earth abandoned building in Chodes, Aragón Community (Source: Caruso, 2021).

In settings of rural depopulation, earthen architecture is more likely to be affected by abandonment and lack of maintenance, while in settings of overpopulation and tourist exploitation it is particularly affected by alterations, transformations, and destruction. Furthermore, prejudices connected with social and cultural discredit frequently lead to the assumption that earthen architecture is structurally and aesthetically unsuitable and obsolete.

All these situations have caused a reduction in use of earthen techniques, leading in turn to a fall in the number of trained masons and professionals. This puts construction know-how and its transmission at risk of disappearing altogether. Furthermore, the lack of interest from administrations also has severe repercussions, affecting technical-constructive regulations and urban and architectural planning.

In recent decades numerous studies, projects and cultural actions have focused on earthen architecture, particularly in academic, cultural and some professional contexts (Mileto et al., 2020). However, the knowledge acquired has not yet reached the social spheres and categories which are most vital to its survival.

Residents play a major role in this regard, as they have the choice of whether or not to inhabit earthen buildings, ultimately determining their disuse or use. Furthermore, they also play an important role in actions of transformation and maintenance. In addition, administrations hold special powers as they are in charge of establishing the laws and regulations which can determine to a great extent the promotion and conservation of earthen architecture. Administrative technicians, planning and regulations also heavily influence costs, feasibility and, consequently, the complexity of projects. All these aspects actively shape people's choices.

4.2. Possible strategies

The above paragraph highlights the desirability for a good balance of the needs, social context and cultural values of the population.

Inhabitants and users should be properly trained and educated to promote regular maintenance which in turn will yield benefits in terms of economy and comfort. Practical workshops directed by suitably trained professionals could help greatly. However, cultural education is still vital to guaranteeing the survival of earthen architecture. Bottom-up actions could be key to involving more people from a very young age. This way, users become familiar with earthen heritage by directly interacting with it. When cultural educational activities are aimed at children, heritage values are more likely to be absorbed and retained and easier to acknowledge and appreciate (Caruso & García-Soriano, 2020).

Some activities which could serve this purpose are workshops, practical demonstrations on maintenance practices, open days and guided visits to heritage sites, all of which can be organized by universities, private specialist centres and associations. In addition, activities with children, including summer schools or extracurricular courses and activities at all education levels could have a good impact, especially on early awareness.

Nevertheless, it is also important to foster maintenance and earthen architecture through the implementation of the appropriate legal safeguard measures, which should guarantee and promote appropriate interventions. Financial support is also desirable, especially in the most economically deprived areas, with incentives and subsidies playing an important role.

Finally, it is important to stress that use is fundamental for the conservation of architecture, especially earthen architecture, whose maintenance is vital to its survival. Therefore, while strategies and incentives for repopulating rural contexts could be vital, they also require proper regulation and supervision, establishing limits and conditions which promote and demand correct use and actions.

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A taxonomy of vernacular heritage in the mid-Adriatic: Landscape relations and architectural characteristics of the farmhouses in Tronto Valley (Italy)

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
The hilly area of Central Italy represents one of the most original characteristics of Italian agrarian system distinguished by a particular form and technique of land management, la Mezzadria (sharecropping), which was a contract stipulated between a landowner and the farmer, reflected in the construction of open space as well as artifacts. The structure of rural settlements typical of sharecropping is a mosaic of terrains with scattered farmhouses (case coloniche), connected by a dense road network. The architecture of these structures is always the same with only slight variations articulated by the form of the terrain and in relationship with their use and the road pathways, and is characterised by a rectangular plan with the rooms dispersed on two floors and an external staircase which is the prevalent distinguishing trait. Sharecropping rural heritage represents an important case study for the analysis and cataloguing of vernacular architecture since artifacts come from precise needs linked to the social and cultural life of the farming family. This paper investigates vernacular rural architecture in Central Italy, particularly in the mid-Adriatic in the southern Marche Region, by building up an investigative and categorization method: selecting precise geographical areas where the original farmhouses have first been identified by studying historical maps of the 19th century before moving on to in situ exploration. Photography has also been a useful instrument for constructing the taxonomy of rural ruins which today are in a state of total abandonment; showing the photographs next to each other allows us to more clearly identify and understand subtle differences and suggest a reuse of the buildings.

Keywords: *rural heritage; Mezzadria (sharecropping); cataloguing; re-use.*

1. Introduction

The volume 'Architettura rurale italiana' by the architects Giuseppe Pagano and Guarniero Daniel published in 1936 for the 'Quaderni della Triennale' investigated the rural house in the entire Italian peninsula and it represented one of the most erudite references in existence, perhaps the only one, in vernacular rural heritage in the discipline of architecture. Including over two thousand photographs, it documented, with acute awareness, the aesthetic value of rural buildings in relation to their function and technical necessity. In confronting such an imposing and widespread heritage, the authors spoke of an actual 'dictionary of constructive logic' that had evident ties with the ground, the climate, the economy, and technology therefore revealing itself as an important testimony to the history of civilization albeit little known (Pagano & Daniel, 1936). The profound ties to rural artifacts, to place and human activity nurtured the design process, entirely spontaneously, aimed at the development of specific solutions to satisfy the exigencies of each zone. In the Pagano and Daniel investigation, the hilly areas in Central Italy represented an important case study since in those zones it is possible to identify one of the most characteristic motifs of the rural house: the external staircase that connects the ground floor, where the work spaces and stables are found, to the dwelling which is separated onto the first floor. The farm house in Central Italy was in fact the place where the farming family lived as well as the site where productive activities were carried out so dwelling and workplace were divided yet never separable (Anselmi, 1987).

Further research emphasized the rural landscape and its architecture as an expression of a society. In Central Italy the typical farmhouse and surrounding terrain were a unique system, testifying to a particular form of land management, the Mezzadria (sharecropping), which was a contract stipulated between a landowner, the grantor, and the tenant farmer, called the sharecropper, where both parties had committed themselves to share the crops and the profits of the farm which take place on that very site. Such researchers on the subject as Henry Desplanques, Emilio Sereni, Marco Moroni, and Sergio Anselmi expressed profound and ample considerations on the relationship between hill, society and constructions. The farmhouse was included as the founding element of humanised landscape, symbol of the garrison as the solution for keeping man on the land, working it (Desplanques, 1979). In relationship to the environment, the farmhouse was a 'synthetic entity' thanks to its dominant position which assumed a privileged role of control as well as being a unit connecting other units in a dense road network that crosses and overlaps giving form to the open space of the farmyard as a sort of 'plaza' (Anselmi, 2000), around which other smaller constructions gravitate such as the pigsty, the well, and hay sheds, tool and storage sheds. The farmyard was an element of mediation between the cultivated fields and the farmhouse, an expression of work and social life itself, the site for the relations which surround the house itself, often tracing the roundish form of the knolls.

Previous research on Central Italy's rural farmhouse underlined the anthropic value of vernacular architecture. Particularly, the studies carried out by Pagano and Daniel stressed the architectonic quality of plastic forms, and emphasized the strict interconnectivity between aesthetics and functionality. Studies on sharecropping on the other hand enhanced the system of relationships and construction of a territory and the society which inhabits and works the land there, made up of thousands of economically independent points which are however integrated with each other to form a highly complex organism.

This research focuses on architectural quality and relationships in the rural architecture of Central Italy and is centred on a very precise area of investigation, the mid-Adriatic, by constructing a study and cataloguing method always with reference to the geography particular to the area.

Fig. 1. Sharecropping rural landscape, Marche Region (Source: Cipolletti & Guaiani, 2020).

Albeit sharecropping represents the landscape unity there are differences so the paper explores a reading of the subtle variances in the rural architecture found there and is not only finalised in new knowledge of the heritage but unites the findings in function of a possible recovery and reuse of these architectural artefacts.

2. Methodology

The territory of the mid-Adriatic is characterized by a ‘comb structure’[1] of hydrography, where rivers and valleys alternate, orthogonally positioned to the Adriatic coast, furrowing the hilly mass, shaped by the millenary agriculture activity and by the sharecropping process, recorded in these areas as early as the 15th century and definitively structured between the 18th and 19th centuries (Moroni, 2003).

The working method first of all builds a geographical reading, identifying precise portions of rural territory within the intervals between the river courses. Areas are indicative of sharecropping characteristics, but bearers of possible elements of variation or repetition that can be detected. The rivers and valleys run from West to East coinciding with the slope of the reliefs towards the Adriatic Sea. This allows the identification of three distinct rural segments, mountain-high hill, hill and coast useful for theobservation of variations in relation to altitude and climate. The identification of the roads, which cross hills from South to North, connecting the valley infrastructures with the historic centers and the dense network of scattered farmhouses, can constitute a further condition for recognizing local specificities; in fact the districts branching off from the main road are filaments which connect the architectures following the ridges.

Having identified the areas and constructed a cross-geographic reading according to the West-East and North-South trend, the observation of the rural heritage focuses only on the most original artifacts which today have been reduced to a state of ruin. After the 1964 Law, which prohibited the application of sharecropping contracts, the countryside underwent an exodus with the progressive abandonment of the structures. A comparison between the historical maps of the Gregorian Land registry of the 1800s and a verification in situ allowed the identification of the most interesting architectures. In the rural landscape the ruins are extremely fascinating objects, suspended in time, not manipulated by the most recent transformations having to do with agritourism or new country residences. They are expresssions of their qualities, of essential and primitive forms, of materials, of relationships with the open space and the landscape and in them it is possible to distinguish the theme of the external staircase, but also the enlargements, the added volumes.

Finally, photography was chosen as a cataloguing tool for building a taxonomy of architecture. By varying the point of view with which the objects were looked at and placing the shots next to each other, constructed in the same way, interpretations were developed following the criterion of grouping.

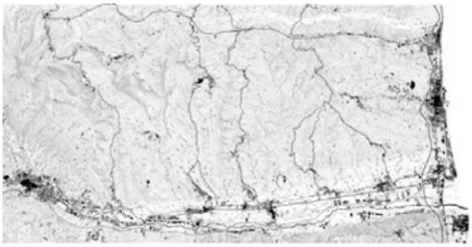

Fig. 2. The rural territory between Tesino and Tronto rivers and the roads which cross the hills (Source: Cipolletti, 2021).

3. The case of Tronto Valley

Of the territorial portions of the Mid-Adriatic, the hilly zone found between the Tronto and Tesino rivers, the southernmost part of the Marches Region, was the area with the highest percentage of farmhouses; the 1934 census registered over 100.000 (Moroni, 2012). The rolling hills zone is furrowed with various connecting roads covering the highgrounds, the most well-known being ‘la Mezzina’ in a barycentric position linking to the historical centre of Offida, and coinciding with the recently created touristic wine itinerary. The roads running across the hills are territorial scans coinciding with the degradation of altitude in the

1 The Adriatic comb structure along river valleys and coast coincides with the phenomena of contemporary urban transformation. A linear sprawl was recognized by most researchers as continuous city called the Adriatic city.

high ground near the sea which is characteristic of the Mid-Adriatic; to the west, the mountains and to the east, the coast.

Evidence of the more or less unchanged road structure of the hills, and the presence of the scatterings of rural architecture are to be found in the Gregorian land registry of the 19th century. The extremely synthetic maps are planimetrically elaborate and subdivided into fields and constructions of both the walled historical centre and the sparse rural settlement. The precious geometric-parcelled documents originating from the fiscal needs of the Pontifical State during the 1830s, were indispensable for an understanding of the disposition of this centuries-long stratified territory and the successive transformations taking place there. The 19th century represents in fact an extremely important period when sharecropping consolidated definitively with an increment in productivity as well as inhabitants, when the farms estates fractured and increased in number and the weave of the scattered settlements was clearly delineated along the hillcrests and the rural districts, in relationship to the compact urban tissue of the historical centres (Anselmi, 1978). So, the Gregorian Land registry fixed mapping the rural landscape of sharecropping before the abandonment and the important post-war transformations of urban sprawl in the valleys and along the coast.

Rural buildings were identified in the registry manuscripts either as ‘house with farmyard’ or ‘farmhouse’ or simply as ‘house’. The difference was found in the economic relations, dimension and complexity of the open space farmyard since the buildings in this specific territorial portion were always of the same rectangular shape.

3.1 Architectural characteristics of the farmhouses in relation to the landscape.

The farmhouses have a rectangular shape elongated with a succession of juxtaposed rooms organised on two levels and protected under one gable pitched roof. The dwelling and all work spaces were contained in one and the same construction; the stable, the cellar, and the farm equipment storage rooms well all found on the ground floor for maximum efficiency and accessibility to the cultivated terrain. The central kitchen with a large fireplace and the bedrooms were located on the first floor to be isolated from the damp ground while benefiting from the added warmth of animals in the stable below.

The stairway, primary and defining characteristic, in the rural portion of the Tronto Valley is always found on the outside without distinction in either the higher hilly regions or those nearer the sea[2]. It connects the two levels and was built directly against the building with a covered loggia. When the loggia was lost, the marks of its existence are visible on the wall. Meanwhile subtle differences are seen in the position of this architectural element though it is always juxtaposed to the farmhouse longitudinally and never orthogonally, more often than not on the longer side of the farmhouse rather than on the gabled short side. The motif resides in the relation in respect to the cardinal points and the open space of the farmyard, the stairway and the longitudinal façade which address in fact the social and work spaces, as the meeting place for the farmers and the members of the family.

2 Pagano and Daniel argued that the characteristics of the staircase changed with climate and geography conditions. This feature is not detectable in the case of the Tronto Valley, where the architectural element is always external. However the staircase remains an identity element, always it was used as the background for photos of the peasant family during ceremonies.

Fig. 3. Comparison of the staircase (Source: Cipolletti & Guaiani, 2022).

In all the cases examined, the longitudinal façade principally faces the south or the southeast. In this way the structure, along its entire length would benefit from the sunlight and the sea breeze and this is why the presence of a façade with the access to the farmhouse, are most representative. Later variations which have been detected originate from round arched, segmented, or rectangular openings, but it is the presence of an oven under the staircase in front of the entrance to the stable that characterises some districts rather than others. This derives from the existence of microeconomics and particular crops such as hemp which necessitated specific treatments.

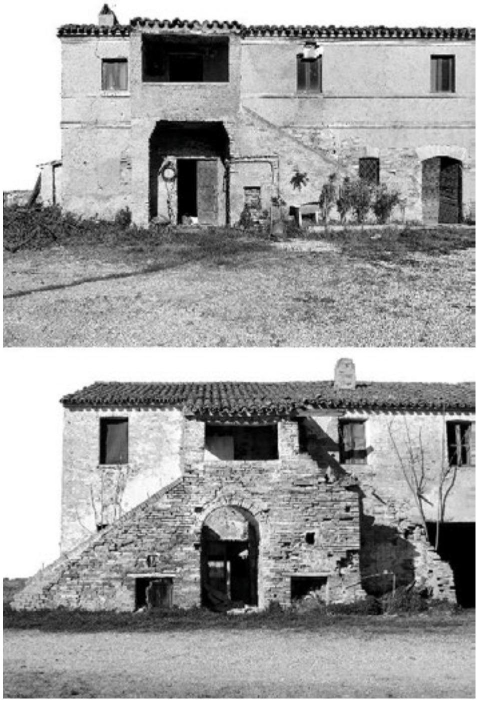

Fig. 4. Comparison of the staircase along the longitudinal façade (Source: Cipolletti & Guaiani, 2022).

Furthermore farming and crops generated characteristic brickwork which fostered simple decorative motifs elicited by their different dispositions. In some districts the ventilation windows of haylofts or barns have vertical brickwork whilst in others pigeon or dove breeding structures are recognisable by brickwork with small, altering peep holes for the the birds to access, or rest, in the form of small rosettes or ledges, both elements which were adopted even in the most modest structures, derivative of precedent, and more costly rural tower-house.

Fig. 5. Comparison of brickworks (Source: Cipolletti & Guaiani 2022).

3.2 Transformations of the rural heritage.

With the definitive abolishment of sharecropping, from 1964 the farmhouses were progressively abandoned leaving traditional farming practices. The advent of extensive viticulture and the subsequent birth of tourism in the rural hills produced widespread agritourism, wine cellars, holiday farms, restaurants, and B&Bs, all housed in these former farmhouses, now tourist attractions in relation to rural landscape. Buildings become ruins or they have been completely altered. The specific changes to the farmhouses were seen in two important and distinct historical moments; those changes made during the sharecropping period, and those made later when the main function of farming had ceased to exist and the new exigences related to tourism and leisure time were emerging.

An ulterior subject for investigation is related to the possibility to study the numerous farms left in ruins in view of their volumetric composition and subsequent modifications. The effects of time and the dilapidated state exult the disconnect of the added structures, the additions, annexes, the traces of which are found on the brick walls. In observing the buildings it is clear that the construction of modest architectural elements proceeded by simple volumetric built-on additions where the new elements would have been added onto the minimal unit of the main rectangular structure with the external stair found along the wall.

In some cases the built-on bodies are small annexes such as a stall or an oven. On the other hand there are more complex situations where the pre-existing building has been maintained and amplified in equal volumetric form and dimension. These circumstances are extensions which are downright duplications reinforcing the length of the rectangular buildings and the length of the façades. The presence in a building complex of more than one staircase was originate from successive expansions which were undergone due to the presence of more than one family working an extended farm which was later divided up.

Fig. 6. Transformations of farmhouses. The construction of extensions in different time is clearly visible in several examples. (Source: Cipolletti & Guaiani, 2022).

Fig. 7. Transformations of farmhouses. The construction of extension followed height and volume of the origin building, emphasizing the longitudinality of the façade. (Source: Cipolletti & Guaiani, 2022).

The alteration of the original volume over the years has produced suggestive and entirely spontaneous rhythms in the openings, which are however of great aesthetic value and appealing to contemporary perception. Rectangular windows alternate with recognisable elements in straight brickwork, carefully handled arched or more essential square openings next to small holes.

In only a few cases are the built-on elements of a façade, where the orientation is different to the original one, clearly discernible in the pattern of the openings, altering the relation to the road and the view of the landscape. Depending upon the necessity, generally dictated by the work conditions and number of inhabitants, the farmhouse is therefore a highly adaptable organism.

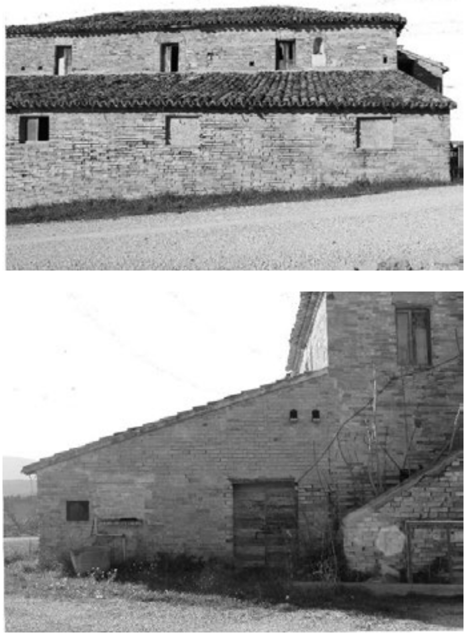

Fig. 8. Transformations of farmhouses. The construction of a new added volume changed the façade in the relation with the road (Source: Cipolletti & Guaiani, 2022).

Fig. 9. Transformations of farmhouses. The construction of small annex (Source: Cipolletti & Guaiani, 2022).

4. Conclusions

The study of the rural farmhouse in the Mid-Adriatic area and in the Tronto Valley confirms how profound the ties between the earth and man, who works the land, were.

The need to control the land while holding a visual relationship with the farmhouse, the admixture of production and living functions, and the adaptation to the scarce local resources available for construction were all factors which lead to the diversification of one and the same building scheme. While being a simple project, the planning and architectural choices were linear and logical, contributing to render the rural farmhouse as ‘honest architecture’, nearer to contemporary taste in its relationship between utility, technology, form, and aesthetics as asserted by Pagano and Daniel in their research.

But it is in the transformation, the amplifications, and the additions that these farmhouses demonstrate important ulterior suggestions on how to comprehend a re-use project for these ruins. The variations made in fact do not immediately or totally cancel the precedent phases. These transformations are still internal to the culture of the earth and to the life of the peasant family, so the farmhouse is a living body which is modified or modifies itself, growing with the support of parasites, in juxtaposition with the main body. These are ‘additionings’ from which to intuit that, by grafting, amplification, extension, and doubling a dialogue can be opened up between new intervention and ruins.

The possibility to work in juxtaposition with the volume of the farmhouse using contemporary materials is suited to creating new possibilities in how to look at and experience vernacular rural architecture that permits the exaltation of the abstract and primitive forms of the ruins rather than a mere restoration or total recuperation project which would only annihilate both human presence and effects of time on these artifacts.

It is not by chance in fact that recent tourism has intensified the tourist experience around this heritage in ruins with the creation of sharecropping architecture itineraries[3]. This experience opens up new opportunities in architectural design and re-use for the completation of food and wine offering and is very different to an overnight stay in a rehabilitated farmhouse.

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3 Refers to 'Mezzadria stories', a research conducted by Gianluca Vagnarelli, who collects hundreds testimonies on sharecropping through interviews with farmers and he organizes visits to the ruins farmhouses owned by a prestigious wine cellar.

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Traditional houses in the South-Western Iberian Peninsula: Themes for a cross-border comparative typological study

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
Up until the 13th century, the South-western Iberian Peninsula shared the same cultural and political conditions under the rule of garb-Al-Andaluz. The administrative separation of this territory between two different kingdoms led to deep changes in the culture and daily life on either side of the border, which may have reflected on housing structures. Did the 13th-century border between Spain and Portugal trigger divergent paths in housing types? Or has the previous common background prevailed in shaping house models in the territory around the Guadiana Valley? This paper proposes a set of themes to begin a cross-border study on the traditional house, its changes and continuities. The research is based on in loco *architectonic surveys of common houses in the Algarve, Alentejo (Portugal) and Andalusia (Spain). The buildings are analysed as regard their spatial organizations, constructive techniques and urban implantation allowing some themes of change and continuity to emerge. This then allows comparisons between the types of traditional houses in these border regions, their common characteristics, differences and evolution paths. It is noticeable that, given how the South-western Iberia represents the same territorial unit in terms of climate and orography, and – until the 13th century – shared the same historical context, the urban similarities were profound. It is therefore almost surprising how divergent the housing evolution between the two sides would become. The study of housing architecture is of particular relevance to the history of people as the variations reflect how the habits and customs of societies. Especially in societies sharing the same starting point, it shows how habits and customs may diverge after separation into two different administrative entities.*

Keywords: *Housing; themes; affinity; South-western Iberia.*

1. Introduction

Bibliography on vernacular architecture usually devotes extensive introductory chapters to the description of the environment in which this architecture is set. The geophysical, productive, climatological, demographic realities are analysed based on the conviction that these parameters are the defining ones of vernacular architecture – fundamentally the climate and the geological composition of the soil – when establishing the housing needs, as well as the resources available for construction. While it is true that these parameters condition the material configuration of vernacular architecture, on an architectural, formal and typological level, there are factors of identical relevance: the cultural ones. These are particularly evident in the border regions, where, with a common geology and climate, different responses can be observed in vernacular architecture regarding the social, family and economic needs of the people who build and inhabit it (Feduchi, 1978).

The southwest of the Iberian Peninsula is a clear example of the profound influence of cultural factors on vernacular architecture, and the transition from Muslim to Christian domination in the 13th century clearly demonstrates this. During the period of Almohad domination, religious and socio-cultural traditions were reinforced, with significant influence on the house, which has a clear typology based on simple rooms arranged around a central courtyard that acts as a distributor and which is accessed through the entrance vestibule with a right angle turn that does not allow to see the domestic space. It is a purely interior house, which can be found throughout the south of the Iberian Peninsula, from Mértola (Alentejo) to Siyãsa (Cieza, Murcia), via Saltés (Huelva).

However, from the time the territories were taken over by the crowns of Portugal and Castile in the 13th century onwards, profound changes were observed in the vernacular house, which embarked on very different paths on either side of the Guadiana.

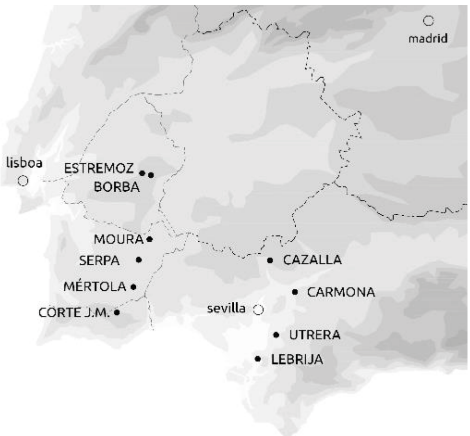

Fig. 1. Location of case-studies. Alentejo: Estremoz, Borba, Moura, Serpa, Mértola. Algarve: Corte João Marques. Andalucia: Cazalla de la Sierra, Carmona, Utrera, Lebrija.

Some themes of affinity and divergence in housing models appeared after detailed studies of cities and towns in the regions of Alentejo, Algarve and Andalusia, detailed below (Fig. 1).

2. Themes of affinity and divergence in Southwestern Iberian vernacular houses

2.1. Composition of adjoined rooms

The traditional architecture of the southwestern Peninsula is characterised, in many of its territories, by a cell composition, in which structural walls delimit each space of the dwelling. In terms of the organisation of domestic space, this model means the successive crossing of compartments that almost always have identical dimensions. This solution is particularly fit to the growth of housing over time, encompassing the change in the family nucleus and available resources.

In rural areas, this transformation process tends to result in a morphology with irregular contours, not determined by the property structure, associated either to disperse buildings or small settlements. Sometimes it may combine large-diameter building complexes associated with different roofing systems, as occurs, in a similar way, in the small mountain villages of the Algarve mountains in Portugal (Fig. 2) and the Aracena mountains in Andalusia (Costa, 2014; Cáscales Barrio, 2017).

In the urban context of the border regions, the emergence of this model appears associated with the medieval Christian period, and the narrow plots characteristic of foundation cores and the two-compartment dwelling developed in-depth (Costa, 2016). In any case, there was a a progressive transformation of domestic architecture in the more noble urban areas – keeping the same compositive principles – associated with buildings of wide façades, with storage or commercial spaces on the ground floor and housing on the upper floor. If in pre-existing neighbourhoods, this typology often resulted from the combination of several narrow plots, as was confirmed for Mértola (Costa & Rosado, 2021), in the areas of expansion, it derived from the alteration in allotments (Rosado, 2022). An example of the importance of the cell composition in wealthier houses of the modern period is, for example, in the urban nuclei of the southern Portuguese coastline, with the characteristic dwellings with multiple four-sloped roofs – *telhados de tesouro* – which record, through their morphology, the structural geometry of the building.

In this way, the transformation of domestic architecture during the modern period resulted in a greater diversity of architectural solutions, in some cases of regional expression, in terms of, for example, the organisation of domestic activities, the relationship with the exterior space, the emergence of vaults, especially on the ground floor, the importance and design of the chimney, as well as in the design of the window frames, and other.

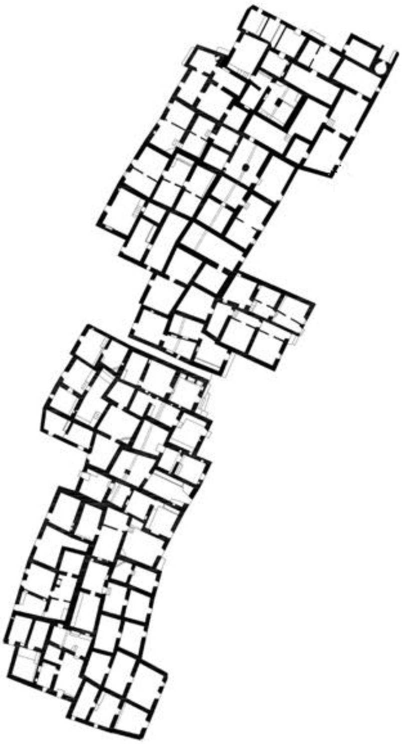

Fig. 2. Corte João Marques. Serra do Caldeirão, Algarve, Portugal (Source: Costa, 2014).

Altogether, these specificities tend to emphasise the role of the border as a line of differentiation of the wealthier house, which will be accentuated later in the contemporary era. Also contributing to this was the gradual loss of importance of the cell composition in domestic architecture, associated with the emergence of more complex roof solutions and with larger spans and the growing importance of partition walls in the organisation of interior space, as we shall see later on.

2.2. Crossing and corridors

A different internal organisation seen in some regions on both sides of the border is the one based on the crossing pathways of the house, and where the corridor's appearance is a key element of the house's structure. The corridor would have emerged as a space dedicated solely to circulation around the beginning of the 17th century, as *in loco* surveys and historical documents seem to indicate.

In the houses with adjacent rooms, the existence of two rooms in the second section of the building allowed the easy introduction of paths to cross the house without compromising the private domestic spaces. The transformation of one of the two rooms of the second section (frequently referred to as chambers or attics in the historical documentation) into a circulation space was possibly the origin of the corridor as we know it today. In the city of Serpa, historical records (AMS/SCMS/M/E1/1673) show how the circulations spaces (corridors) were akin in shape and dimensions to the other rooms in a mistake in a house description entry (AMS/SCMS/M/E1/fl10/nº24) that reads "(…) another room in front of the door, I mean, the corridor (…)". The fact that the circulation space was simply one more room is explicit in another entry of the same document (AMS/SCMS/M/E1/fl24/nº64) reading "(…) another room that serves as corridor (…)".

Over time, the crossing of the house is no longer done through the "rooms that serve as corridors", as a new space of different dimensions appears. It had the sole function of circulation, and it was used to connect the house with the backyard, separating the living spaces and working spaces of the house. A probable use would be crossing the house by animals (horses or donkeys for example) without them accessing zones of family uses such as the food preparation area or resting zones.

In fact, the division between "clean zone" and "dirty zone" is defined with some clarity. There is the possibility that the allocation of an entire room for circulation began to be felt as excessive (even though it could be combined with other uses such as storage), and it may be from the need to optimise the space that the circulation spaces reduces its width, assuming a width/length ratio that today we identify as corridor proportions. In other cases, the corridor is subtracted from a room, so its width would have to be the minimum necessary otherwise, it would impede the use of the adjoining room (Fig. 3, Fig. 4).

This spatial innovation manifests itself either as a lateral or central corridor, in the second section of the house between the entrance room and the yard, or between the entrance room and the rooms of the third section, when these exist. In the Alentejo archive cases, there seems to be a predominance of the corridor in a lateral position, next to the two chambers of the second section that are accessed from the entrance room (Fig. 5). However, in the cases identified today, the corridor assumes a central and structuring position on the axis of the house, combining the function of crossing the house with independent access to the interior compartments, both in Alentejo and Andalusia cases. Thus, it is the corridor that centralises the house's circulation and not the entrance room.

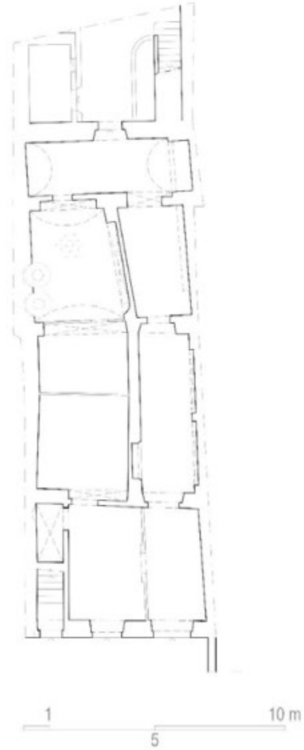

Fig. 3. Groudfloor plan. Terreiro das Servas 13, Borba (Source: Rosado, 2021).

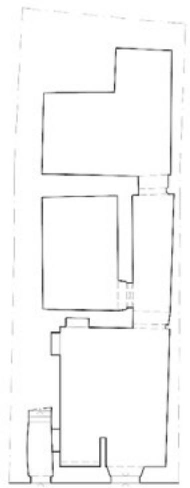

Fig. 4. Groudfloor plan. Rua do Afã 12, Estremoz (Source: Rosado, 2021).

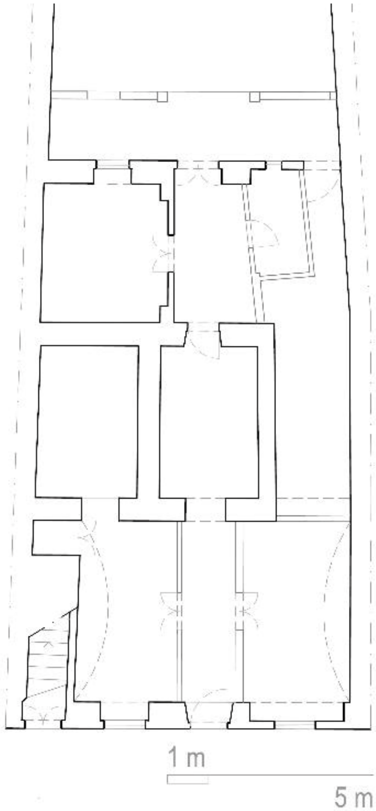

Fig. 5. Groudfloor plan. Rua de Santa Catarina 13, Moura (Source: Rosado, 2021).

The 19th century corresponds to the change in construction materiality in the division between compartments, which would be, from then on, made by thin partitions that allow the maximisation of inner areas. The major change in the organisation of inner circulation is the extension of the corridor to the first section, placed in a central position and adjacent to the door. The direct access to the corridor transforms the entrance in the house, which is made directly to the circulation space and not through an entrance room or hall. The centralisation of the circulation space achieved by placing the corridor at the axis reinforces the trend of façades with a central door flanked by two symmetrical windows. The communication between the various rooms is no longer direct but done through the axis of circulation.

Although the evolution of the corridor is shown here as a consequential process, increasingly leading to a greater specialisation of rooms and avoidance of direct room-to-room circulation, nowadays there can be seen movements in the opposite direction, in the demolition of load-bearing walls between corridors and rooms to enlarge the room area.

In the Andalusian cases, the crossing pathway through the house is much more marked in plan than in Alentejo's cases, either because of the plots' greater depth or because of the consequent succession of covered and void spaces. In the Andalusian home, void spaces (yards) are frequently found in greater numbers – often two empty spaces per dwelling – and structure the pathway through the house.

Although sharing the same backyard with the Alentejo's cases, the Andalusian houses often present a central patio-shaped void separating the house's first two sections from the compartments between patio and yard, almost always reserved for agricultural or productive functions (Gómez Martínez, 2017, p. 206). Due to its direct relationship with the voids, the corridor, although covered, does not constitute an interior compartment of the house, and the route through the Andalusian house has an exterior character as opposed to the Alentejo's interior pathway (Fig. 6).

2.3. Courtyards and backyards

As noted earlier, the conquest of the territories under Almohad rule by the kingdoms of Castile and Portugal in the 13th century brought about a change in the religious, political and social paradigm that crystallised in a veritable cultural revolution. The house, as a support for the activity of the closest social nucleus – the family – immediately reflected these changes. While the Almohad inner-wall fabric of the cities was maintained in its majority, at least in some cases, the size and configuration of the house changed radically with the new customs. Those new types of house were located both in the renewed city centres and in later urban expansion areas. In this context, the patio (courtyard) acquired a predominant position in the organisation of the house in Western Andalusia, both in the modest houses of day labourers and in the manor houses, although with very different roles. Depending on the role played by the courtyard, we can differentiate between courtyard houses and houses with a courtyard. In the former, the courtyard has a profoundly functional role, as it accommodates daily life activities in the open air as well as work associated with agriculture and domestic livestock farming. In the latter – heirs of the Roman Domus through the reinterpretation carried out in Italy during the Renaissance – the courtyard is the main element around which all the rooms and distributions are organised, positioning itself as an element of social representation.

The traditional popular house in the west of Andalusia is organised in sections parallel to the façade that alternate with interior free spaces according to the following sequence: façade body, patio, intermediate body and backyard (*corral*), all of them crossed by a system of independent passages composed of the hallway (*zaguán*) and the corridor of the intermediate body. This pathway protects the privacy of the living quarters and allows direct access to the backyard for tools and farm animals. The living quarters are located in the main bodies, whose under-roof spaces were used for storage.

The kitchens were located next to the patio or backyard, as well as the latrines, stables and spaces for raising small animals such as chickens, rabbits or even pigs. The same use of the backyard is common in many of the domestic buildings on the Portuguese side, although in these cases the patio is absent, as we have seen. In fact, similar but simpler typologies can also be found in the western part of the province of Seville and the province of Huelva, which dispense with the courtyard and the intermediate body. They are composed of a single front body and backyard, always accessed through a hallway.

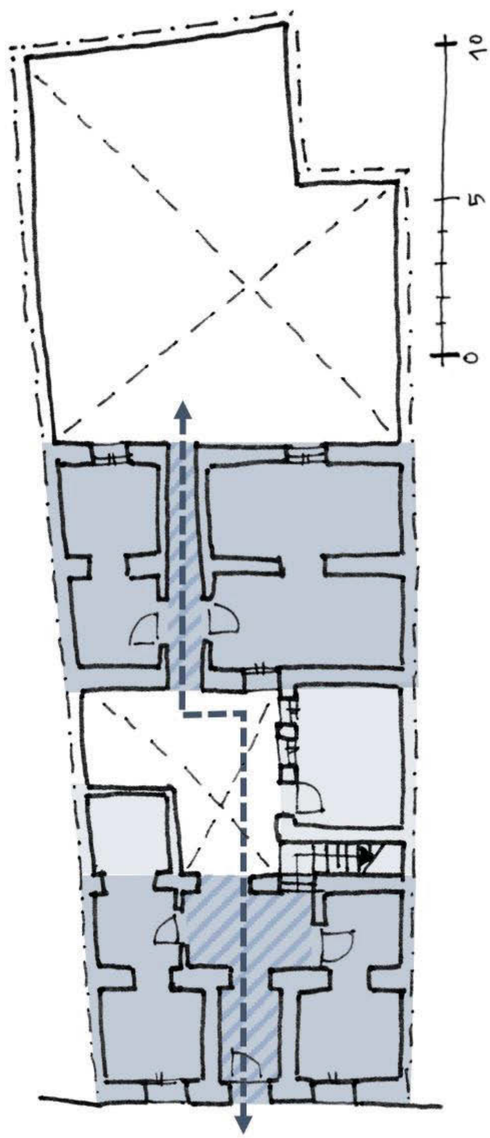

Fig. 6. Groudfloor plan. House in Utrera (Source: PEPCH Utrera 2018).

3. Conclusions

In the Islamic period, the south-western peninsular border region was a territory marked by the continuity and preponderance of the Almohad courtyard house, with characteristics identical to those of other Mediterranean geographies. The transition from the medieval Islamic period to the medieval Christian period resulted in a break with this model of housing organisation in a way that is still to be understood for many of its regions. In any case, some recent studies on vernacular architecture allow us to equate, in an integrated way, the transformation of the domestic architecture of these regions during the late medieval and modern periods.

The present paper sought to contribute to this line of research, still in an initial phase, by characterising three fundamental themes: the cell composition of adjoining rooms, the emergence of the corridor, and the presence of the patio and the backyard. It was possible to register some common aspects of a shared history that extends from the settlement process of the border region to domestic architecture.

In the urban context, the most modest house tends to be characterised by the composition, in a deep plot, of several cells (each delimited by structural walls and with a single slope roof). This solution was often the basis for forming larger two-storey houses with wide façades, in which the ground floor housed warehouses and commercial spaces while the dwelling occupied the upper floor.

On the other hand, in the one-storey buildings of agricultural owners, in an urban context, the backyard became important for livestock and storage of agricultural products and tools. As a result, the crossing through interior space to the backyard acquired a fundamental role in the organisation of the different domestic activities, often resulting in the formalisation of a corridor. From the 19th century onwards, there was a functional redefinition and generalisation of the corridor as the predominant space in the organisation of the house, associated with the increasingly widespread use of partitions walls.

In any case, the several studies in progress also confirm the border as a space of differentiation of the traditional house, both in its internal organisation and in the architecture image and its formal elements. This conclusion is less evident in the modest architecture of the regions closest to the borderline and more explicit in the urban centres' richer and larger dwellings, as well as in the rural settlements associated with large estates. One of the elements that confirm this dissimilarity is the importance that the patio, absent in Portuguese territory, acquires in the traditional house's architecture in different Andalusian sub-regions.

With the continuation of the research, we will seek to deepen the importance of the border as a differentiating line of domestic architecture, but considered in the more complex framework of the different sub-regions of Alentejo, Algarve and the western region of Andalusia. The understanding of this diversity should still be framed by the way in which history ended up configuring a set of common themes of architectural transformation evident throughout the study area.

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The Hameau de la Reine at Versailles and the reproduction of vernacular architecture

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
The proposed paper analyses the system of small buildings that compose the Hameau de la Reine in the Petit Trianon gardens in the park of the royal palace of Versailles. The complex of architectural artefacts, built at the end of the 18th century, emulates the features of vernacular architecture typical of the villages of Normandy. The main interest lies in the analysis of the masonry which reproduces the signs of wear caused by the salty coastal climate of northern France using the trompe-l'oeil technique. The studies conducted on the buildings of the Hameau de la Reine highlight the typical features of Norman vernacular architecture. The analysis process can be achieved through the methodologies of the restoration discipline, The availability of many iconographic and documentary sources testifies the will of the planner to emulate the vernacular landscape by reproducing the peculiarities of its architecture. Enlightenment thought derived from the physiocratic theories expressed by Quesnay and the Marquis de Mirabeau is the cornerstone of the design and realization of this section of Marie-Antoinette's Domaine. The contribution intends to underline, through the analysis of the method of imitation of vernacular architecture, the importance that this architectural typology assumes in the process of rediscovery and fruition of the territory. The analysis of the Hameau complex testifies how vernacular architecture, not yet codified according to this terminology, was already identified at the end of the 18th century as an example of high-quality value that found its effective collocation within the boundaries of the royal park of Versailles. The characteristics of this architecture allow it to find an effective place even inside the perimeter of the royal park of Versailles. It is possible to identify the prodromes of the modern architectural sensibility that recognizes and codifies the values of vernacular architecture within the site studied by this paper proposal.

Keywords: *garden; landscape; Versailles; vernacular architecture reproduction.*

1. Introduction

The *Petit Trianon* Park of Versailles has its origin in the middle 18th century by the will of king Louis XV. The area of the future park is identifiable in the cartography of 1766 made by Louis Charles Desnos in the north-eastern sector of the wider Royal Park between the gardens of the *Grand Trianon* and the *Saint-Antonie* gate. The area was an empty territory, characterized by clearings and woods. The main one of the woods is of rectangular shape and it is known as

Bois des Onze-Arpents. The founding act of the *Petit Trianon* Park can be identified in the 1749 assignment to the architect Ange-Jacques Gabriel of a *menagerie* for the *Grand Trianon* palace.

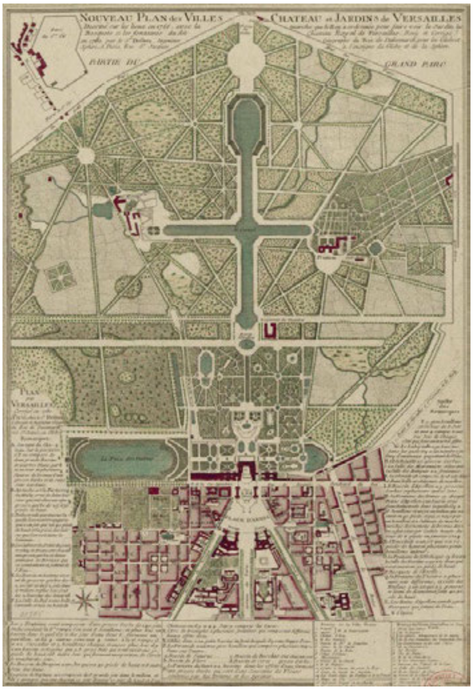

Fig. 1. Versailles Royal Park. *Nouveau Plan des villes, château et Jardins de Versailles dessiné sur les lieux en 1766* (Louis Charles Desnos, 1780).

The *menagerie* of Trianon must be less representative than its counterpart called Royal, which is situated at the end of the opposite branch of the cross-shaped *Grand Canal*. Even if the Royal one houses the most exotic and rare species of animals, to be shown off in occasion of institutional visits, the Trianon *menagerie* is designed to accommodate more ordinary species such as farmyard animals. The architect connected the two structures through a French-style garden with geometric *parterres* and fountains. Gabriel endows this space with two architectural elements. The first, well-known as *Pavillon Francaise,* is placed in the center of the garden. It is a small neoclassical pavilion composed of four orthogonal rooms that converge towards a central circular summer dining room. The second element is the *Pavillon Frais*, made entirely of wooden trellises and surrounded by two small fountains. Subsequent evolutions led its development towards the eastern edge. A section of the park, that was destined to safeguard valuable and exotic essences, was realized through the creation of flowerbeds, canals and greenhouses necessary for the planting and survival of these botanic species. The extension, realized by Bernard de Jussieu, configures a botanical garden equipped with a channel for aquatic plants and with a Dutch greenhouse which is also called *serre chaude*. Later, during the sixties of the 18th century the *menagerie* was almost completely dismantled for the realization of a new building in neoclassical style, but the French garden did not suffer the same destiny. Finally, years after the first interventions, the *Petit Trianon's* project was commissioned to the architect Gabriel, to be built in the old area previously used for the menagerie. The building is designed to host the Marquise of Pompadour, the sovereign's favorite. It is separated from the more imposing *Grand Trianon* by the French garden. The Seven Years' War caused a considerable delay in the execution of Gabriel's project, and so the construction of the *Petit Trianon* palace did not begin until 1762 (Hoog, 1992).

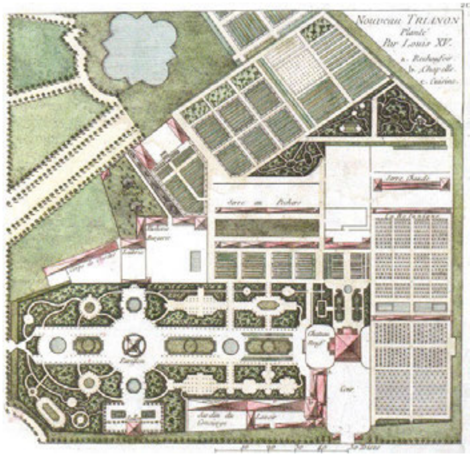

Fig. 2. Petit Trianon, Versailles Royal Park. *Nouveau Trianon planté par Louis XV* (Georges-Louis Le Rouge, 1774).

The final configuration of this section of the park is due to the reign of Louis XVI who, in

1774, gave to his wife Marie-Antoinette of Habsburg-Lorraine as wedding gift the of the *Petit Trianon* palace and the entire enclosed *Domaine*. Marie-Antoinette significantly modified the site by removing the greenhouses and exotic cultivations which were transferred to the Parisian *Jardin des Plantes*. According to the late 18th century taste for the emerging modern style, the queen commissioned the realization of an English garden initially to Antoine Richard and later to Richard Mique with the help of the Count of Caraman. The figure of Caraman is emblematic for the configuration of the spaces of the park (Lablaude, 2003). The Count personally directed the construction of his own garden of Roissy in the previous years. As part of Marie Antoinette's *entourage*, he transferred the knowledge acquired during that experience into the creation of the *Petit Trianon's* English garden. The works that led to the configuration of the English garden in the form that has been transferred to the present day began in 1777.

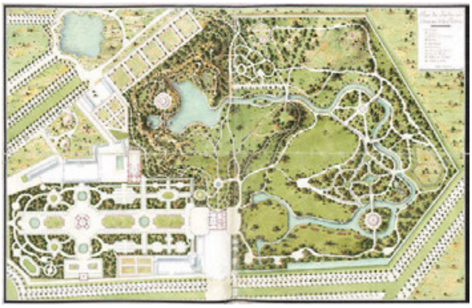

Fig. 3. Petit Trianon, Versailles Royal Park. *Plan du jardin et château de la Reine* (Richard Mique, 1779).

2. The Hameau de la Reine

The last section of the garden is the subject of the present study. It was created at the eastern end of the *Domaine* from 1783 onwards. This appendix was created with the purpose of widening the spectrum of scenarios offered by the garden complex: «there is still a missing *nuance* in the mixed palette of the various English, mountain, classical or Chinese genres. The queen obtained the annexation to her small property of the free land adjacent to the north, towards the *Bois des Onze Arpents*, in order to complete it with the contribution of the rustic taste. This style had been happily illustrated already in 1775 by the *Hameau* created in Chantilly for the Prince of Condé on the idea of the ornate farm». (Lablaude, 2010, p. 173).

Lablaude's affirmation clarifies how the rustic taste of the *jardin champetre* completes and enriches the glossary of scenes of the park.

Fig. 4. Petit Trianon, Versailles Royal Park. *Jardin pittoresque du Petit Trianon* (Louis-Pierre Baltard, 1784).

The project of this new expansion is assigned once again to Mique who avails himself of the Hubert Robert's pictorial work, who was able to capture the Norman landscapes towards which the project had to aspire. Duvernois affirms that it was the figure of «Hubert Robert, that once again provided the impulse for the start, inspired by the beauty and picturesqueness of nearby Normandy and his own paintings. From these sketches, Mique and his assistants produced a series of drawings, paintings, and detailed studies of the *Hameau* and its landscape. [...] Thanks to the talents of Richard Mique and Hubert Robert, the small rustic houses have a fascination and an elegance that make them models that have subsequently been reproduced many times over» (Duvernois, 2008, pp. 51-52). The village of the *Hameau de la Reine* is structured in a compound of eleven small houses arranged in a hemicycle around the artificial lake. Five buildings were for the queen and her guests; these are: the *Maison de la Reine*, the *Billard*, the *Boudoir*, the *Moulin* and the *Laiterie de propreté*. Four other buildings including the *Ferme*, the *Grange*, the *Colombier*, and the *Laiterie de préparation* were destined for those who would populate this small village and make it work as a self-sufficient village by cultivating the land and raising animals.

Fig. 5. *Un moulin à eau, un homme sur un pont, un chien au premier plan*. Red chalk (Hubert Robert, end of 18th century).

The *Réchauffoir*, that is located behind the *Maison de la Reine*, was dedicated to the preparation of meals which were served to the queen and her guests during their visits to the *Hameau*. The last building, the *Maison du Garde*, was used as accommodation for the guardian. Each house had its own vegetable garden and was bordered with low bushes and fences. Gustave Desjardins in his *Le Petit Trianon Histoire et Description* emphasizes how these plantings that surrounded the houses as well as contributing to increase the verisimilitude of the achievements had an actual productive vocation, stating that: «The gardens were real village yards, planted with vegetables: cabbages, cauliflowers, beans, etc.; strawberry bushes, raspberries and red currants and fruit trees: there were 50 walnut, 400 cherry, 200 plum, 400 pear and other 100, 100 peach, 200 apricot trees»[1] (Desjardins, 1885, p. 287).

Close to the *Laiterie de propreté* there is an annex called *Tour de Marlborough*. The tower can also be considered as a twelfth building that completes the *Hameau* complex. This building has an octagonal floor plan, develops in height, and takes the shape of a lighthouse. Also known as the *Tour de la Pêcherie*, the building was configured as a docking point for boat trips on the lake. The tower housed the equipment used for pike and carp fishing. The upper part was used both as an observatory and to communicate with the castle of Versailles using signals. Its name is inspired by the song composed in 1722 at the death of the Duke of Malborough[2] (Benoit, 2016).

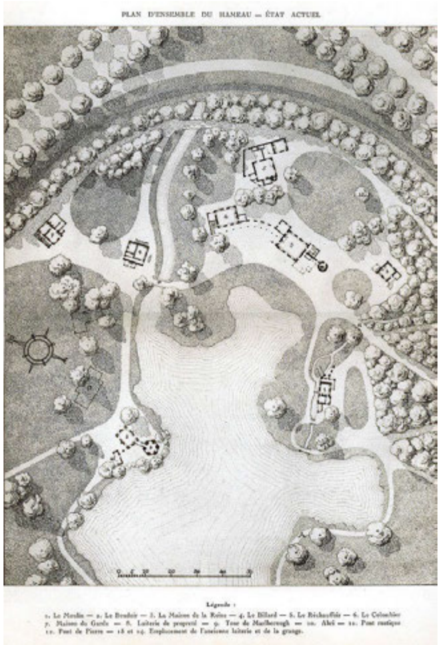

Fig. 6. Hameau de la Reine, Petit Trianon, Versailles Royal Park. *Plan d'ensemble du Hameau - état actuel*. (A. Bernard, 1928) (Source: Gromort, 1928 pp. 12-13).

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[1] Original edition of the text: «*Les parterres étaient de vrais jardins de village, plantés de légumes: choux de Milan, choux- fleurs, haricots, etc.; de fraisiers, de framboisiers, de groseilliers et d'arbres fruiti-ers: il y avait 50 noyers, 400 cerisiers, 200 pruiners, 400 poiriers de plein vent et 100 autres, 100 pêchers de plein vent, 200 abricotiers*». G. Desjardins, *Le Petit Trianon Histoire et Description,* 1885, p. 287.

[2] The song titled *Marlbrough s'en va-t-en guerre* has a popular origin and dates back to the beginning of the 18th century. It was sung in France to joke about the historical enemy constituted by the British people and personified by John Churchill, first duke of Marlborough, who was wounded during the battle of Malplaquet (1709) during the Spanish war of succession (1701-1715). The already 70-year-old song returned to popularity in the eighties of the 18th century.

3. Venacular emulation features

The artifacts that compose the complex of the *Hameau* are made according to the rustic or country style emulating the aesthetic typologies typical of the villages of the Normandy coast. The masonry masses are finished with plaster and then painted to represent with the *trompe-l'oeil* technique the specific characters of the architectures taken as example. The applied method simulates different types of finishing. A first example is the simple pictorial representation on the plaster of a light-colored stone wall with the reproduction of the courses of mortar interposed between the blocks. An evolution of this methodology is represented by the reproduction of the masonry textures typical of the *maison a colombage* also known as *pan de bois* of Norman tradition. The *Guide illustré des palais et jardins de Trianon* published by Bernard in 1887 reports that: «The exteriors of all these houses were finished with decorations that imitated old bricks, crumbling stone and worm-eaten wood»[3] (Bernard, 1887, p. 78).

Fig. 7. Hameau de la Reine, Petit Trianon, Versailles Royal Park. Maison de la Reine (Source: D. Crispino, 2021)

[3] Original edition of the text: *«L'extérieur de toutes ces maisons fut revêtu d'une décoration imitant la vieille brique, la pierre effritée et le bois vermoulu»* Louis Bernard, *Guide illustré des palais et jardins de Trianon: catalogue des objets d'art, histoire et de description dans l'ordre de visite des appartements du musée des voitures et du hameau.* 1887, p 78.

The reproduction of the characteristics linked to the vernacular architecture of the northern French coasts is not limited to the emulation of the building typologies, but it extends to the simulation of the peculiar degradation phenomena of the materials of the structures exposed to the salty and humid climate of the Atlantic shore. It is therefore possible to detect, from the analysis of the masonry apparatuses, the representation of the typical phenomena such as: detachment, erosion, gaps and lacks. Through the pictorial film it is also possible to see the drippings, the presence of fronts of rising, of patinas or biological colonizations.

«The side of the *Maison de la Reine* is a good example of *trompe-l'oeil* painting intended to accentuate the rustic and decrepit character of the buildings of the *Hameau*» (Duvernois, 2008, p. 174).

Fig. 8. Hameau de la Reine, Petit Trianon, Versailles Royal Park. Billard. (Source: D. Crispino, 2021)

The buildings of the *Hameau de la Reine* artificially reproduce the constructive typologies and degradation phenomena typical of the Norman vernacular architecture. The artificial reproduction of degradation phenomena complicates the identification of real ones affecting the architecture. To draw up an accurate study of the state of conservation of buildings, it is necessary to produce graphs that highlight and separate real deterioration phenomena from those made just to imitate the vernacular Norman architecture. It is necessary to consider that, in the case of the *Hameau de la Reine*, while constantly subjected over the years to a careful program of ordinary and extraordinary maintenance, the subject of the study concerns artifacts made during the eighties of the 18^{th} century and therefore susceptible in their agedness to degradation related to the structures that the external pictorial film hides to a less careful observation.

The 20^{th} century contained a series of interventions of restoration and rehabilitation of the buildings and gardens of the *Hameau de la Reine*. The first intervention, carried out in the 30's by Patrice Bonnet and financed by Rockefeller, involved all the gardens and buildings except the *Réchauffoir* and the *Ferme*. The objective of this first intervention was to restore the buildings and gardens to their 18^{th} century layout, described by Baltard's plan of 1784 (Fig.4), and to their ancient village appearance. The structures of the buildings were consolidated, the roofs rebuilt, and the gardens replanted, but nothing was done about the interior decoration. The second restoration campaign was conducted between 1957 and 1958 by Marc Saltet. Due to recurrent problems of humidity, some of the wooden beams were replaced by metal ones, and the internal ground of the houses was reinforced. «At the end of the 20^{th} century, various interventions concerned mainly the *Moulin* (1995), the *Ferme* (1996), the *Réchauffoir* (2000), and the staircase of the *Tour de Malborough* (2002), under the direction of Pierre-André Lablaude» (Garnier, 2018, p. 21).

Afterwards, in the early 2000s, several interventions were completed and aimed at restoring the rural landscape around the *Grand Lac* and the surroundings of the *Ferme*, recomposing the screen of trees along the eastern edge and partially restoring the network of internal paths of the *Hameau.*

The last restoration, completed between 2015 and 2018 by Professor Jacques Moulin, chief architect of historical monuments currently in charge of the park and gardens of Versailles, concerned the *Maison de la Reine* and the *Réchauffoir* (Moulin, 2019). The intervention focused on the restoration of the structure, facades and roofs of the two buildings. Regarding the gardens, the intervention has maintained unchanged the general layout reestablished in the 1930s by Patrice Bonnet, just restoring the altimetric level of the late 18^{th} century identified through an archaeological survey in 2013, to reduce the occurrence of degradation phenomena related to rising damp. Specific attention was given, as part of the restoration program to the reproduction of the peculiar aspects of the Norman typology through the execution of decorations on the restored plaster such as the reproduction of false stone blocks, false brick facings, false *pan de bois* walls. Similarly, an emulation of the typical degradations has been carried out through the realization of *bois pourri* decorations on all the external wooden works and the execution of patinas of aging and integration between old and new decorative elements (Garnier, 2018).

The final analyzed item as a distinctive mark of the emulation of the vernacular architecture of Normandy is the method used to produce the roofs. The roofs of the houses are made of straws or stubble defined in French as *roseau* or *chaume*. This type of construction technique requires constant care to guarantee good waterproofing. The rooms of higher value, provided with decorations or delicate vaulted systems, were equipped with a double layer of coverage. The first layer made of tiles to ensure safety and waterproofing. The second overlapping layer made of straw had only an aesthetic value and necessary to the consecution of uniformity with the context. A roof composed only of stubble, in fact, if not properly maintained, could have deformed or collapsed, putting at risk the integrity of the internal decorations (Heitzmann, 2005).

Fig. 9. Hameau de la Reine, Petit Trianon, Versailles Royal Park. Le Moulin (Source: D. Crispino, 2021).

4. Conclusions

The complex of architectures contained in the *Hameau de la Reine* testifies how already at the end of the century of the Enlightenment there existed in Europe a culture capable of appreciating the characteristics of vernacular architecture, even if not yet codified according to this terminology. In the case of this garden, it is opportune to notice that both the architecture and the vegetation, declined according to the productive and ornamental plantings, contribute to the reproduction of the original landscape. All the elements of the scenic system participate in the representation of the vernacular. The effectiveness of the reproduction is entrusted to the high degree of fidelity of the compositional elements and to the harmony that the single parts establish with the totality of the configured scenery.

Fig. 10. Hameau de la Reine, Petit Trianon, Versailles Royal Park. Aerial photo of the Hameau (Source: D. Crispino, 2021).

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Vernacular architecture of the Amalfi coast: a medieval *domus* in Villa Rufolo in Ravello (Italy)

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Topic: T1.1 Study and cataloging of vernacular architecture

Abstract
The oldest medieval domus in Ravello date back to the twelfth century, as an evolution of the original house with barrel vaults, a primitive stone construction with walls of dry masonry of limestone and almost always connected to an olive grove or a vineyard, widespread on the Campania coasts between the island of Capri, the coast of Sorrento and that of Amalfi. Vertical and horizontal aggregations of this module have constituted, over time, the evolution of the building typology, while retaining some of the pre-existing architectural elements and the peculiar construction characteristics, including the strong link of this architecture with the particular orography of the territory. The private building complexes are the result of this ongoing process, consisting of various rooms connected to each other and arranged on several levels, in which the members of a single family lived with their servants. The entire structure was surrounded by walls and defended by towers. The interiors consisted of rooms heated by fireplaces, kitchens, furnaces, Arab baths, cisterns, wells, cellars, warehouses, stables, rooms for winemaking, gardens and cultivated terraces. The paper analyzes the history and construction features of one of the few medieval domus still existing and which has not undergone substantial transformations, also because it was brought to light only in the last decade of the twentieth century, currently located in the boundaries of Villa Rufolo in Ravello. Its original conformation is hypothesized, thanks also to a description made of it in the archive documents. The paper also reports the work carried out on the case study in order to undertake a cataloguing of a heritage in continuous discovery.

Keywords: *Amalfi coast; medieval architecture; vaults; traditional techniques.*

1. Introduction

The Amalfi Coast is rich in architectural remains of inestimable value from the medieval period, date from between the time of the Duchy of Amalfi to the beginning of feudalism, that is, from the 9th to the 14th century[1]. These architectures possess a qualified environmental and landscape value that has always been appreciated by Italian and foreign travelers and writers and constitute the memory of the wise use of traditional construction techniques that have transformed a difficult orographic condition into a landscape peculiarity to be preserved and handed down. In particular, the houses with extradosed vaulted of the Amalfi coast, although they may appear to be a poor production, have substantial peculiarities connected to the geographical environment, history and production activities and some characteristics that make this type of construction not a simple spontaneous building, but a construction designed down to the smallest detail.

1 Cf. Fiengo G., Manco A. (2014). *Ruderi medievali della Costiera Amalfitana. Diffusione e caratterizzazione del paesaggio*, Amalfi, p. 7.

2. The medieval house in Ravello: typology and construction techniques

The medieval *domus* of Ravello is made up of several floors and covered by a characteristic element of these buildings, the extradosed vault, made with the "battuto di lapillo", put in place using a construction technique with which an exceptionally resistant and waterproof mortar was obtained. The slaked lime was combined with pumice to create a light but at the same time resistant mortar; the mixture was then left to rest for 24 hours and stirred four times; after these operations it was spread on the extrados of the vaults for a thickness of 10-15 centimeters and it was beaten for three days at the same time by several people, the whole operation was accompanied by folk songs that accompanied the rhythm of the work. Another characteristic element of these houses was the presence of an external staircase next to the house which allowed access to the various rooms and to the different levels. The *domus* also had several rooms, kitchens, cisterns and *balnea*. The building material used came largely from the surrounding area. The use of local limestone, combined with good quality mortar, has allowed these buildings to survive over time even in the presence of partial collapses[2]. For greater protection from the summer heat, in these particularly arid areas, the houses did not have windows or, where they exist, they are small while the water was collected through terracotta pipes inserted into the masonry and ending in a special cistern[3]. Today the ruins of the medieval houses of the Amalfi coast are not sufficiently protected also because there is no exhaustive cataloguing of them, moreover they are exposed to numerous dangers, deriving not only from abandonment and lack of maintenance but also, and above all, from the uncontrolled transformations. These have almost always changed the form of these architectures and led to the irreversible loss of their original characteristics.

3. Methodology

The paper presents the results of a methodological experience[4] that has updated the knowledge of the remains of an architectural complex located within the boundaries of Villa Rufolo in Ravello not yet sufficiently investigated and previously known under the name of *balnea*, that is, as remains of a thermal complex of the Villa. The research carried out revealed that the complex is an architectural palimpsest consisting of a wall system and of a first original nucleus identified in an ancient house with an extradosed barrel vault then enlarged with the addition of an upper floor and other surrounding rooms, whose consistency is described in a document dating back to the 12th century[5].

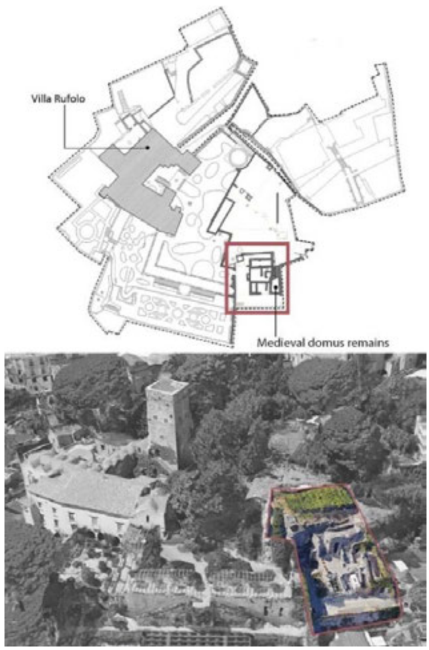

Fig. 1. The remains of the medieval domus in Villa Rufolo

2 Cf. Fiengo G., Abbate G. (2001). *Case a volta della costa di Amalfi: censimento del patrimonio edilizio storico di Lone, Pastena, Pogerola, Vettica Minore e Tovere*, Amalfi: Centro di cultura e storia amalfitana.

3 Cf. Niglio O. (2005). *Conservazione Conservazione e valorizzazione dell'Architettura Vernacolare Mediterranea: la "casa a botte" in Costa di Amalfi*, in TECNOLOGOS, IV, august 2005, pp. 9-11.

4 The paper enriches the results of a collaboration project started in 2019 between Villa Rufolo and the Department of Civil Engineering of the University of Salerno.

5 Document of 1148 in PAVAR, I, pp.60 ss, n. XLI.


Figs. 3-4 The excavation of the medieval domus in 1997 (Source: Archive of the Soprintendenza BeAP Salerno and Avellino)

The research methodology used a multidisciplinary approach by addressing an in-depth historical-archival examination, as well as an analysis of materials and typological-constructive characteristics, focusing on the consistency of the building and its stratifications. Significant advances have been achieved in the knowledge of this architectural complex by combining information from indirect sources (bibliographic, archival surveys, etc.) with direct reading of the architecture and with data from photogrammetric and laser scanning surveys.

3.1. A medieval house in Villa Rufolo in Ravello: discovery, history and transformations

The first excavation campaigns in the northestern sector of Villa Rufolo were carried out between 1988 and 1989, promoted by the European Center for Cultural Heritage. Until that time, the area, excluded from the tourist route, was used for cultivation. Only in 1996, a more systematic excavation campaign was undertaken and, in 1997, the first restoration and consolidation of discovered structures, coordinated by the Soprintendenza B.A.A.A.S. of Salerno[6]. The excavations brought to light a series of environments. The oldest and also the only one known until then, consists of a room with a rectangular plan covered by an extradosed barrel vault, subsequently raised by a further floor, today almost entirely collapsed, as it was possible to deduce from the stratigraphic analysis and from the survey. To the south of this room there is a cistern to which the water from the vault was also channeled. It has an inclination such as to allow rainwater to drain into a special channel that reaches the cistern. Very interesting are the small rooms east of the main body consisting of a *calidarium* and its hypocaust. The *calidarium* consists of a small square room covered with a cross vault. The ribs have a well-marked edge that was probably used to convey the con-

6 Cf. Peduto P., Richter D. (1999). *Una discarica ottocentesca nella villa medievale dei Rufolo*, in Richter D., Romito M. (edited by), *I profumi di Reid. Uno scavo archeologico e la vita di un inglese nella Ravello dell'Ottocento*, Ravello, pp. 17-18.

Fig. 5. The north-east sector of Villa Rufolo in a photo from the early twentieth century. Before the excavations, the area was occupied by cultivated terraces.

densation water of the vapors to a small channel that crossed the perimeter of the room. On the south wall there is a niche with a small tub that contained water, below which there is the hypocaust which was accessed from another room located at a lower level. Terracotta pipes arranged vertically in the corners of the *calidarium* allowed the steam to rise upwards. A staircase, which partly overlooked the *calidarium*, gave access to the complex from the vineyards; on the lower level, on the other hand, there are three other rooms, one is undoubtedly a cistern, another, smaller, consists of an access corridor that led to the upper rooms.

The consistency of these remains coincides with that described by a parchment from the bishop's archives of Amalfi and Ravello dating back to 1148. The document is the act of division between several heirs of two domus, one new and one old located in via Episcope. The remains of the analyzed complex seem to coincide with the old domus described by the document which, in fact, describes a "*caminata fabricata supra ispum valneum*"[7], that is a path over a *balneum*, just like in the house under study, where the staircase passes over the *calidarium*, and, moreover, that the boundaries of the property arrive directly "*at lentiam*" that is to a control point that could be identified with the small tower located at the edge of the complex.

The description of the house made by the document, together with its position, suggest that these remains correspond to an ancient *domus* of Ravello that already existed and was frequented at the beginning of the twelfth century. We do not yet know the subsequent history of its transformations at least until the nineteenth century, thanks to further information obtained from the Murattian land registry. In particular, the cadastral sheet relating to the properties of Francis Nevil Reid, already owner since 1851 of the ancient noble residence of the Rufolos, attests that the Scottish lord bought the remains of the medieval *domus* in 1859 from the Manzo Cosmo and Pantaleone, (who in turn they had bought it from the heirs of Giuseppe Confalone in 1821[8]) and transformed them into a terraced

7 Document of 1148 in PAVAR, I, pp.60 ss, n. XLI.

8 State Archive of Salerno, Murattian land registry, sheet 690 (about the property of Francis Nevil Reid), 479 (about the property of Manzo Cosmo e Pantaleone di Ravello), 122 (about the property of the heirs of Confalone).

Fig. 6. Cross section of the complex (Source: De Feo)

garden. Thanks to the reading and analysis of these documents it was possible not only to obtain information on the *domus* under investigation, but also to reconstruct a piece of the history of Villa Rufolo whose current borders, as it has been noted, are the result of successive additions carried out from Reid, a great project of unification of different properties aimed, most likely, at the rebirth of forgotten and abandoned places.

3.2. The digital survey and the material survey for study and cataloguing

Three-dimensional survey techniques play an important role in the documentation of cultural heritage. The elaborations produced, in fact, are a precious tool for facilitating historical interpretations, they constitute a geometric basis of reference for their cataloging and allow to investigate the complexity of the structures to be analyzed.
Different digital survey methods have been implemented for the survey of the remains of the medieval house under investigation. In particular, the data acquired from laser scanning were integrated with those from photogrammetry. The former was used to create a digital model of the architecture from which to obtain a scientifically verified survey. The latter made it possible to create high resolution orthophotos for the material survey of the complex. Thanks to these infographic outputs, the hypotheses proposed on the transformations of the complex have been confirmed. The oldest structure consists of the defensive tower with a quadrangular base probably dating back to the 11th century. The small tower, losing its defensive function in the following centuries, underwent transformations and was reused as a cistern. The existence of a large boundary wall between Villa Rufolo and the analyzed complex confirms the original separation between the two properties. In fact, the only passage was built only in the 70s of the twentieth century. The following construction phase, dating back to the early 12th

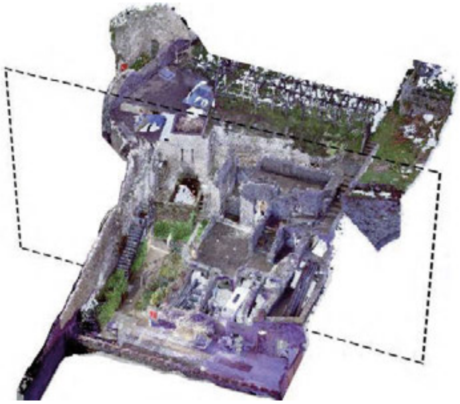

Fig. 7. Points cloud model of the complex analyzed (Source: Survey and elaboration of De Feo).

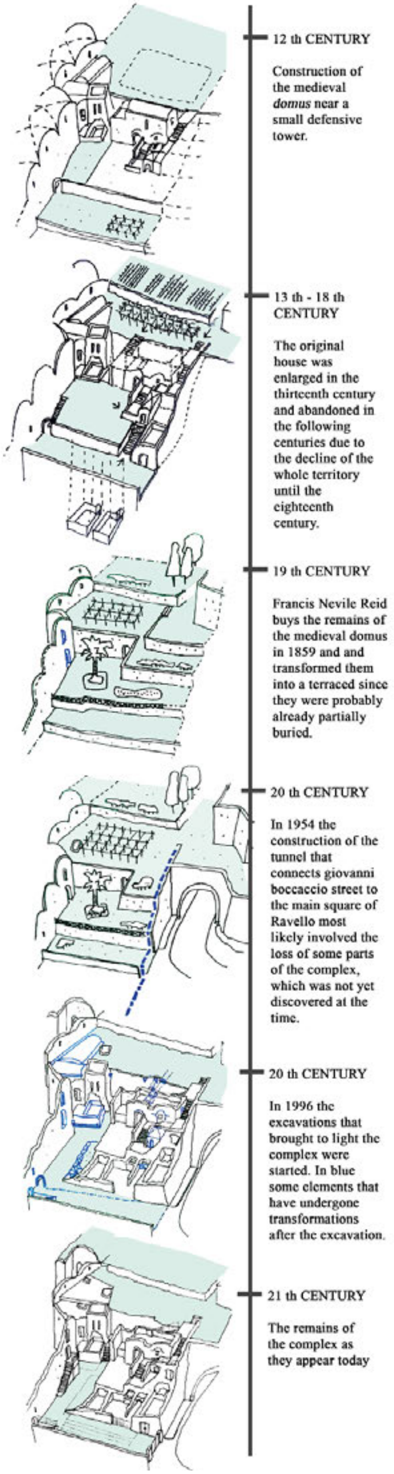

Fig. 8. Graphic scheme on the historical evolution of the complex (Source: Drawings by Fernandez)

century, coincides with the construction of the house with extradosed vault with its cistern. To overcome the cliff between the vineyard area and this environment, now occupied by a stone staircase built after 1996, a masonry bridge was probably built which no longer exists. Its remains are still partially visible and highlighted by the material survey carried out as well as from the archive photos of the archaeological excavation. Particularly interesting was the section on the *balneum* of the house which reveals the construction system of the small *calidarium* with hypocaust. A system that was commonly employed on the Amalfi coast and of Islamic derivation. These Arab baths are found not only in large noble palaces but also in smaller houses[9], as evidenced by the presence of a small Arab bath in our complex, with some constructive differences. In our case, in fact, the *calidarium* is not covered by a ribbed dome, as happens in great palace, but by a cross vault.

3. Conclusions

The research work has shown that the current borders of Villa Rufolo in Ravello are the result of successive additions made by Francis Nevile Reid in the nineteenth century. After the purchase of the ancient Rufolo residence in 1851, the Scottish lord annexed the area north-east of it in 1859, occupied by the remains of the medieval residence and, in 1868, Villa Episcopio. Furthermore, by crossing the information from indirect sources with the direct reading of the architecture and with digital restitution, it was possible to identify the remains of the medieval residence with the *domus veteris* described by a document of 1148.

This work intends to provide new information on the remains of an architectural complex on which little information was available and also intends to outline a methodological approach to

9 Caskey J. (2010). *I sollazzi di Villa Rufolo* in Camelia G., Cobalto G. (edited by), *Fieri iussit pro redemptione. Mecenatismo, devozione e multiculturalità nel Medioevo amalfitano*, Amalfi, pp. 247-250.

address future investigations on the theme of the ruins of medieval vaulted houses of the Amalfi coast. The data obtained from the documentary research, compared with the information that emerged from the material survey of the elevations and of graphic representations (plans, sections and views), have produced advances in the knowledge about the theme of the medieval domus. These architectures, considered as a whole, constitute an original expressive attribute of the local landscape which is particularly fragile and exposed to constant dangers. In this sense, a work of cataloging, knowledge and identification of the characterizing elements constitutes a first step for their protection and the conservation of resilient values.

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Architectural survey, realized with integrated methodology, of the complex of Walser houses in Alagna Valsesia, Italy

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract

The subject of this paper is the architectural survey, realized with integrated methodology, of three Walser houses, located in Ronco Superiore, within the Alagna Valsesia (Vercelli, Italy) municipality. The task of surveying the complex was assigned to us by the Superintendence of Archeology, Fine Arts and Landscape for the provinces of Biella, Novara, Verbano-Cusio-Ossola and Vercelli in cooperation with the Regional Secretariat of Piemonte. The aim of the work was that of providing graphic and metric references for the houses, which are a typical example of the rural architecture at the foot of Monte Rosa, to be made available for subsequent interventions of restoration and enhancement. The Superintendence took over the safekeeping of the site from the Public Property in 1998 and, since then, has promoted a process of recovery of the buildings, winning the Europa Nostra Award in 2014. Granting access to visitors has given a larger audience the possibility of knowing the history, the constructive peculiarities and the works of conservation carried out in this area. Specifically, the complex of Walser houses is the most ancient settlement in Alagna, built between the end of XVI century and the beginning of XVII century. Walser houses have a stone basement and wooden roof and walls. The latter are built with the Blockbau technique, i.e. a superimposition of trunks and beams, juxtaposed to shape walls; interlocking connections ensure the rigidity of the structure. First, we have acquired the morphometric characteristics of the buildings; then, we have elaborated them graphically, by employing a georeferenced, 3D laser scanner. Photogrammetric data have, instead, been acquired using digital cameras and drones.

Keywords: *Walser houses; point cloud survey; drone survey; Alagna Valsesia.*

1. Introduction

In the last decade, architectural surveys realized with integrated methodology (laserscanning and photogrammetric data) have been playing a major role, especially in restoration projects (Balletti et al., 2015; Remondino & Stylianidis, 2016; Valente et al., 2019; Patrucco et al., 2020; Zaragoza et al., 2021). In fact, this way of proceeding allows one to gather metric references about the existing buildings which are more accurate than the ones obtained with a traditional relief. The present paper is the result of an architectural survey of a complex of Walser houses situated in Alagna Valsesia, i.e. a peculiar example of vernacular architecture of the Italian mountain area. The aim of the work (assigned to us by the Superintendence of Archeology, Fine Arts and Landscape for the provinces of Biella, Novara, Verbano-Cusio-Ossola and Vercelli jointly with the Regional Secretariat of Piemonte) was that of creating graphic and metric references[1] of three Walser houses (Fig.

1 All images are published with the permission of the upper mentioned Superintendency and the express prohibition of further reproductions is communicated.

1). Besides, our work updates the existing relief of the latter ones, realized before the last restoration works, concluded around 2012. During this conservative intervention, construction elements were disassembled and reassembled; the aim was that of understanding which materials were used to restore the houses by adopting the techniques originally employed by the Valsesian artisans. The architectural conservation project won the 2014 *Europa Nostra Award*, within the *Conservation* category, as decided by a jury of experts from 30 countries worldwide, who selected it among the ones that benefited from the support of the European Union Culture Program[2].

Fig. 1. Aerial view of the three Walser Houses shot by drone (Source: Frosini).

As frequent relief campaigns are desirable for preserving the structural details of architectures considered fragile and highly perishable (Balletti et al., 2014; Hu et al., 2016) because of the substantial use of wood constituting the upper part of the buildings, like in this case[3] (Fantoni, 2008a, p. 27), the survey of the Walser houses carried out by us will ensure any future restoration project to be based on an up-to-date documentation of the buildings themselves.

2. The Walser architecture

The Walser architecture characterizes several areas of the Italian region of Piemonte. The name derives from that of the Walser population, who migrated to Italy from the Swiss Canton of Valais[4] (in German *Wallis*), located nearby the Monte Rosa mountain massif. The Walser population, first, settled in semi-nomadic conditions; subsequently, created stable settlements, while maintaining the original Germanic customs (Giordani, 1973). To survive the conditions of inaccessible, mountainous areas, the Walser population deeply changed the rural landscape, by transforming the woods into productive pastures, cultivating the land up to the highest slopes, raising cattle. Moreover, Walser people adopted a strongly-characterizing architecture for the construction of their houses,

2 *Europa Nostra* represents a rapidly growing citizens' movement for the safeguarding of Europe's cultural and natural heritage: see European Heritage - Europa Nostra Awards (2022, March 26).

3 The location in high altitude settlements of Walser houses also favored their degradation due to natural causes: some wooden houses were destroyed by the weight of the snow, by floods or avalanches, by fire. The reconstruction generally coincided with the abandonment of the wood and the new houses were rebuilt in masonry, as happened in Alagna at the end of the XIX century.

4 The name *Walser* is precisely a contraction of the name *Walliser* (Valaisan, inhabitant of Valais).

built with the aim of optimizing the available, environmental resources and further fostering the social cohesion: the life of an individual was not conceivable without a family and the family itself was integrated within the larger community of the village (Zanzi & Rizzi, 1988).

The "house" is, thus, the most significant expression of the Walser architecture, providing an answer to a specific (economic, social and climatic) need, i.e. gathering men, animals, stables, kitchens and granaries under one roof. From an urbanistic point of view, houses are often built very close to each other: the aim was that of leaving a covered passage (ensured by the sloping roofs) between the two, allowing people to circulate while remaining sheltered from rain and snow; moreover, the houses are usually built in a place exposed to the south, close to pastures and safe from avalanches and floods.

2.1. Three Walser houses in *Oubre Rong*

In the XIII century, the first Walser communities in Valsesia (an alpine valley that occupies the northern part of the province of Vercelli) settled in Alagna, Rima and Rimella. Among the many, existing Walser houses[5] in the hamlets of the municipality of Alagna Valsesia (Daverio, 1983; Mirici Cappa, 1997), those in Ronco Superiore (*Oubre Rong*, in the Walser dialect) are the oldest. The path to Ronco Superiore (part of the group of upstream hamlets, called *Unna Hin*) starts from Pedemonte and passes through the village of Ronco, where the Ecomuseum[6] of the Walser culture can be found. The village of Oubre Rong stands on a steeply sloping ground at an altitude of 1320 meters above sea level and is constituted by a complex of Walser houses that looks like a small, very compact group of buildings, with the western front looking towards the Mud valley and the northern one looking towards the Mud brook (Mesturino, 1960).

The monuments analyzed by us, whose safekeeping was taking over by the Superintendence from the Public Property in 1998, are the southernmost ones among those located into the area of Ronco Superiore. Coming from the valley, four Walser houses, built between the end of the XVI century and the beginning of the XVII century, are visible. The first two houses, almost perfectly-squared[7], are called House 1 (the southernmost) and House 2 (the northernmost); behind these, House 3 and House 4 constitute a parallelepipedic structure (whose base measures 6x12 square meters): in fact, the block of House 3 and House 4 consists of two separate units with common external spaces and fronts[8]. Our work focused on the northern portion of such a block (i.e. House 3), as the southern portion (i.e. House 4) cannot be accessed, being a private property (Fig. 2).

Fig. 2. Planimetric map with identification of Walser Houses surveyed (Drawing by Di Paola).

House 1 and House 2 represent the typical Walser house for a family unit, i.e. a single building organized on several floors (three for House 1

5 We refer to the censuses performed for the first time by the engineer Arialdo Daverio in the 1980s.

6 An *Ecomuseum* indicates not only a building but a territory characterized by traditional living environments, relevant naturalistic and historical-artistic heritage.

7 The first floor of House 1 measures 6x6 square meters.

8 The House 1 is engraved with the date *1594* on the lintel of the door located of the highest floor on the west front; House 2 and House 3 are considered to be a little later.

and four for House 2), a barn to preserve the fodder and a stable for the animals.

Each floor is surrounded by an external porch, accessible through a staircase built with stone and wood and located on the east side of the houses to take advantage of the smaller height difference caused by the slope of the ground. This external gallery (from 1.20 meters to 1.60 meters wide) is closed by a sort of horizontal railing, formed by rods inserted on vertical, wooden beams. On the ground floor, these vertical wooden beams rest on a stone plinth, which has the function of detaching the humidity of the ground (Daverio, 1983, p. 199). The horizontal poles allowed the farmers to arrange hay, barley and straw on them to dry the forage even on rainy days.

Lower floors were employed as food stores, as in House 2, or as stables, as in House 1. Here, stables were adjoining to the living room (the mangers with separation poles are still visible) to use the heat produced by the animals in the winter - so much, in fact, that between the stable and the living room there is no dividing wall but just a simple wooden partition. A passing stove was, then, placed on it, to allow the two rooms to be heated at the same time. An open fireplace (1,10 x 1,10 m) was also present in the living room, put directly on the floor of the room in a central position (Fantoni, 2008b, p. 79). The kitchen area was made of stone, like all the flooring at the ground floor, and built in the north wall. The upper floor housed the bedrooms, arranged above the stable to take advantage of the heat produced by animals; each room occupies half of the overall floor area (on average, a room measures 3x6 square meters and is 1.80 meters high) and has access to the exterior gallery. The upper floor also hosted several rooms that served as a warehouse, a granary and a barn (Fig. 3).

Unlike House 1 and House 2, House 3 is composed only by a barn (which measures 5.93x6.36 square meters and is 1.83 meters high) and a storage room (which measures 5.66x6.03 square meters and is 3.82 meters high).

Fig. 3. Transversal section drawing of House 1. At lower floor, stables and the living room divided by a wooden partition; at first floor bedrooms; at the upper flow warehouses reachable by an external wooden (Drawing by Verona).

From the structural point of view, the ground floor of the three Walser houses[9] considered by us is in masonry, made by small, worked stones and a bit of mortar. Masonry was used because it could contain fires and resist to winter storms; it is of considerable thickness, in some places up to 70 cm, to prevent heat dispersion and give the structure a solid base to support the wooden part[10]. All the floors above the stone basement are entirely made of wood, including the roof (but not the roof covering).

The external walls are enclosures[11], formed by four walls of half trunks (usually in spruce or medium-sized larch) joined at the corners with U-shaped incisions that allow the wooden elements to be interlocked. The walls are built with the *Blockbau technique*, i.e. a superimposition of trunks and beams, juxtaposed to shape walls:

9 Unlike the other two, House 2 has stone walls for both the ground floor and the basement, whose face is partially visible from the north front.

10 A particular interruption between the two materials is found in House 3, where the wooden part is divided into two level and the lower one is suspended from the basement with massive wooden pegs with tapered bases, to keep rodents away.

11 The length of the wood available influenced the dimensions of the structure. The beams hardly exceeded 5-6 m: therefore largest room in the house generally measures from 4.5 x 4.5 to 6 x 6 m.

the trunks were squared with large axes, sawn in half and planed on the inside to form a smooth wall while the dried moss was used to supplement the thermal insulation and to seal the joints (Fig. 4).

Fig. 4. Detail of the *Blockbau technique* at the House 2: half-log walls joined at the corners (Source: Di Paola).

The internal walls are erected with wooden planks as well, wedged into the floor and the ceiling via small beams with a central groove. The floor consists of wooden boards, whose thickness is about 3 cm, placed on a horizontal beam and fixed to it by means of wooden nails.

The roof is gabled with two pitches, composed of a wooden skeleton and a mantle of stone slabs, called *piode*. Initially, the mantle was also made of wood; however, the need for constant maintenance led it to be gradually replaced by heavy stone slabs (weighing about 6 q/m^2). In order for such a roof to be capable of carrying the weight of the stone and of the winter loads of snow, its structure is reinforced by two pediments interlocked in the *Blockbau*, linked by a mighty ridge beam. The rigidity of the structure is further increased by two beams, acting as chains, that cross the former one; two compact half-walls of interlocking trunks, wedged into the external walls, reinforce the structure between the ridge and the underlying chain beam. The two minor frames (perpendicular to each other) that carry the *piode* are placed on the main roof beams. The gutters themselves are made of wood, obtained from dug half-trunks of larch (Fig. 5).

Fig. 5. Detail of the structure of the roof built with three frames, carrying stone labs (Source: Di Paola).

2.2. The architectural survey

The survey of the three Walser houses and the surrounding land required tools capable of collecting as much data as possible to create multipurpose databases for future use (e.g. structural analyses, study of construction techniques, restoration and communication projects). It was executed by employing data for locating the houses according to their terrestrial coordinates (i.e. georeferencing them).

Our first aim was that of delivering a 3D model (colored point cloud), able to provide dimensional information on the houses and allowing one to virtually tour them through 360 pano pictures. Our second aim was that of extrapolating orthophotos (scale 1:50) and vectorized CAD drawings (including the ones of the technology systems of the three buildings). Accordingly, the tolerated measurement error had to be smaller than the graphism error at the chosen representation scale, i.e. less than 1 cm. In order to reach both aims, we used three different tools: a flight-time 3D laser scanner, a couple of photo-sensors (a quadricopter of 900 grams with a camera 1” CMOS on board; a SLR camera) (Kraus et al., 1998; Micieli, 2019) and a GPS GNSS RTK receiver (Cina, 2014; Leick et al., 2015).

The planning of the survey required a careful identification of both logistic and technical problems and an accurate organization of the work phases on field. After having identified the geomorphological characteristics of the site and the critical issues about the use of the technical equipment, we positioned the control points (Docci & Maestri, 2009).

From an operational point of view, we set up a first net, composed by two types of targets (rectangular B/W and circular 8 bit), for the facades; a second net, composed by PVC, rectangular (50x50 square centimeters), yellow-black colored, weatherproof targets, was positioned on the ground (*Ground Control Points*). The first net allowed us to link the point cloud from the photogrammetric survey (obtained from drone and SLR camera) with the point cloud from the laser scanner; the *Ground Control Points* allowed us to link the photogrammetric survey of roofs with the point cloud from laser scanner and the total point cloud with data from GPS (Barzaghi et al., 2018).

The laser scanner survey was obtained by means of 208 scans, each scan having a density of one point every 12 mm at 10 meters of distance. At every position, the laser scanner took a panoramic image, allowing for the creation of an RGB-colored point cloud and of a pano picture for virtual tours: 360 pano pictures gave us the possibility to measure what is captured by the scanner directly onto the panoramic image.The integration of the laser scanner survey with the photogrammetric survey [12] was necessary to complete the operations on the sides that were not accessible (i.e. the sides of the Walser houses overlooking the Mud brook and the roofs) and execute orthophotos of facades.

In order to carry out the photogrammetric survey, the GSD (*Ground Sample Distance*) was set to 0.5 cm/pixel; the maximum distances for the photographic shooting were about 14 meters for the drone and about 20 meters for the SLR camera (based on the characteristics of the instrumentation used and the required resolution). The number of photos to be taken has been calculated to guarantee a lateral overlap of at least 90% between contiguous frames and a vertical one of 80%. Due to the characteristics of the site, the photographic distance was smaller, but constant, for each side of the houses.

At completion, *Ground Control Points* were taken with the GPS receiver.

2.3. Methods of data processing

The individual scans obtained from laser scanners have been combined into a single reference system by using a dedicated software (Fig.6).

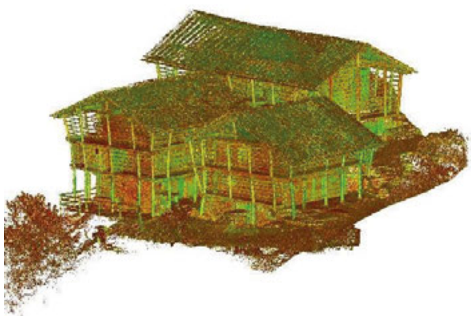

Fig. 6. Image of point cloud from laser scanner 3D (intensity view) created by 208 setups (Source: Vecchio).

The 3171 images of the photogrammetric survey were equalized and imported into the photogrammetric processing software with the Structure from Motion (SfM) approach; these have been placed in a unique workspace and

12 The *photogrammetric technique* is a methodology based on the acquisition of images of the same area from different points of view and partially overlapped: exploiting the principle of stereoscopy, starting from the data relating to the positioning and orientation of the camera at the time of shooting, from the type of lens used and the resolution of the images, the mathematical reconstruction of the perspective geometry allows to carry out an optical triangulation of the points identified by the pixels of the images and to reconstruct the three-dimensional geometry of the photographed areas.

integrated. We, then, exported two outputs: the point cloud and the orthophotos of the facades and roofs (Fig. 7).

Fig. 7. Image of point cloud from photogrammetric survey (RGB view) of House 3 (Source: Frosini).

The georeferencing of the data took place by inserting the coordinates of each *Ground Control Point*, acquired by using a GNSS receiver. The procedure used made it possible to scale the three-dimensional model allowing the point cloud from laser scanner to be merged with the point cloud from the photogrammetric survey, thus enhancing the accuracy of the relief by limiting the metric error.

Fig. 8. Ortophotos of House 2 's facades (west and north) overlapping CAD drawing (Source: Frosini).

The obtained point cloud was imported into a CAD environment where it was used, together with orthophotos, to draw plans, sections and elevations and create the required drawings (Fig. 8).

Finally, the panoramic images taken with the laser scanner were uploaded to an online server, in order to make them accessible to cultural heritage operators. The system allows one to navigate between photos as if you were on site, simulating a virtual tour in which users can use measurements and annotation tools to work on the state of play of the three Walser houses.

3. Conclusions

This project confirms the great potential of point clouds in the managing activities concerning the cultural heritage. Point clouds can be used for metrology and inspection and for a multitude of applications, such as visualization, animation, rendering and mass customization. Moreover, exporting data in different formats allows one to reach multiple stakeholders. Although an in-depth integration of multi-sourced information has not yet been achieved, the approach we have followed for this survey greatly facilitates data sharing. Machine learning methods represent the next step for improving the analysis of the cultural heritage and, in turn, enhancing the automation of the processes constituting the surveys to be taken.

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Modern attitudes towards vernacular architecture. Works by the Italians Luigi Angelini, Alberto Alpago Novello, Ottavio Cabiati, Alessandro Minali

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
Among the many architects practicing between the two world wars, some looked at the so-called vernacular architecture - then referred to as traditional or local, primitive, and spontaneous - as a model of genuine functionality. For some of them, its revival also stands for a solid and reliable solution for preserving the continuity between past and present, local communities and their traditions, society and its generations, a place, and its materials. Architectural historians have widely explored the theme, highlighting figures, subjects, and currents. Nevertheless, investigation of the role of history and historic culture is still far from exhausted, not only for Modernists but also among the Avantgardes and the International Style too. As a response to this conference's topics, some of the architects working in and around Milan the 20th century focused on the relationships between tradition and modernity. Here we look at some of their works to open a discussion on different scales: the landscape, the town, the building. We shall examine their proposals for a functionalist and modern design concept in traditional terms: the Mediterranean colonial house will illustrate the research by Alberto Alpago Novello and Ottavio Cabiati on local architecture; the modern pre-Alpine house proposed by the engineer Luigi Angelini for the Bergamo valleys and the building materials chosen by the architect Alessandro Minali show their respect for each place. The conclusions will – one hopes - lead to talking about typological and constructive building features, materials, and traditional techniques as a tool for preservation.

Keywords*: tradition; vernacular; material culture; type; modernism.*

1. Introduction: an interest in materials culture

In 1911 the Minister for Education, Ferdinando Martini (1841-1928) launched the Italian ethnographic and regional exhibition in Rome to celebrate the first fifty years of the Unity of Italy and entrusted Lamberto Loria (1855-1913) to manage it. A brilliant and clever ethnologist, Loria arranged the objects he had gathered in the remotest areas of the Earth, already in order in the Ethnographic Museum of Florence, but he also proposed the reconstruction of ethnographic groups and of some typical architectures, even minor, to represent the Italian regions.

To display and convey the regional features of Italian architecture in the collective memory was a far-sighted idea. Loria "feared that the progressive industrialization and the consequent urbanization could lead, in the space of a few years, to the disappearance of the agro-pastoral culture in many areas of the peninsula" (Ceci, 2006). He therefore turned to Italian culture: he collected, surveyed, rearranged, and exhibited documents (including oral and video-type expressions) to highlight and, hopefully, protect their variety and traits, looking at architecture not as folklore but as an ethnographic result (Loria, 1912a). Somewhere, interest in material culture and its protection was emerging.

Rearranging this exhibition of materials in the future National Museum of Italian Ethnography proved the existence of many counter-positions. The desire for a typological criterion, which would be useful for comparative studies of the objects, was opposed to the opportunity to preserve a regional distribution (Baldasseroni, 1912). Loria agreed with these positions but, at his time – before WW I - the idea of fostering the protection of local characteristics as an element with the unity of the country, caused ideological drifts (Loria, 1912b)[1]. His penetrating attention to the local peculiarities of architecture, of human beings' customs and industry, was misunderstood. Nationalism translated his purpose into the search for original and primitive characters. The idea of upholding a preeminent one as an expression of Italian culture, and to export it outside the country to justify colonization prevailed. The study of traditional practices relayed by micro-communities was flattened: it became the cult of origins, the myth of the peasant, the apotheosis of rurality, or it was lent to a form of colonization that was only apparently peaceful (Aquarone, 1977). As the exhibition catalogue demonstrates, this was not the purpose of Loria nor of the others (Puccini, 2005).

The catalogue was entrusted to Francesco Baldasseroni (1878-1923), a distinguished medievalist historian. He himself presented the contents of the exhibition to the readers of the well-known *Emporium*, a monthly review on art, literature, science, and related topics and linked the event to a core cultural purpose. In his opinion, not only would opening an Italian ethnographic museum have promoted these studies but it would have validated their usefulness for artistic development (Baldasseroni, 1911).

He invited the public to seek in products made by the members of local communities and to everyday objects resulting from centuries-old practices; to consider them as know-how handed down by tradition, expressions of lasting shapes and therefore of identity. This interest in popular custom, though strongly supported by esthetic evaluations, also captured the application of architectural styles in everyday objects, the recovery of specific elements (for example the rose window) in the Abruzzo region's traditional women's dresses, ornaments and sculptural reliefs, in glass or snuffboxes. He did not consider this an original or spontaneous result, but neither was it a question of trivial copies. He did not repute the common man a creator but considered him a bearer of forms and symbols, rules and habits, who makes and upholds tradition thanks to the economic constraints[2].

While in the figurative arts many turned to the peasant world and its feelings, as the paintings by Giovanni Segantini, but also pre-futurist portraits by Giacomo Balla show (Sabatino, 2010), the contemporary architects were taking a more critical attitude towards the past. It is well known how the progressives, moved by a desire for functional modernity, forced their uprooting from the past to renew forms, speed up building procedures and accelerate mobility in the cities. While enhancing artisan and local industries as a tool for economic development, Baldasseroni omitted an evaluation of regional architecture. He did not take advantage of the magazine's distribution to broadcast what he had expressed in the much rarer exhibition catalogue about "ethnographic buildings". Only the amazing 'trullo' was selected to represent Pugliese architecture and not the ordinary 'masseria' whose functional distribution was grasped to Loria by one of his collaborators (Castano, 2014).

1 In his words: "occorre studiare se non convenga avere leggi speciali per molte regioni italiane. E questo, lungi dall'essere dannoso allo spirito nazionale, sarà il cemento che unirà indissolubilmente le diverse regioni italiane", Loria 1912b, p. 79.

2 In his words: "Il popolo non crea ma conserva con accorgimento e tenacia: mantiene in vita e in vigore ciò che le classi più alte della società gettano via e facilmente dimenticano: soggette queste al mutevole andazzo della moda, al variare dei gusti, alle sempre nuove necessità del viver civile; e per le sue stesse condizioni economiche e per il suo tenore di vita, impedito di seguire e di accogliere ogni rapida trasformazione della civiltà materiale", Baldasseroni 1911, p. 309.

2. Research method: from the exhibition to its reviewers, their works and professional circles

Among those recounting the exhibition was the attentive Luigi Angelini (1884-1969). His first writing only referred to the architecture designed by Cesare Bazzani (the still existing *Palazzo delle Belle Arti*) and Marcello Piacentini (the provisional pavilions) (Angelini 1912). But a second, though perhaps excessive appreciation of the eclectic pastiche of the Lombardy and Emilia Romagna pavilions, did stop to mention the “faithful and admirable reconstructions of houses and typical groups of Italian dwellings of the past centuries”, inviting us to admire their simplicity, strength and lightness; that is, to recognize the beauty also in “peasant architecture” (Angelini, 1912, p. 35).

Here we will present the outcome of a further investigation on the exhibition contents and the attitude towards vernacular architecture. Some North-Italian architects practicing between the world wars will be introduced: Luigi Angelini, Ottavio Cabiati, Alberto Alpago Novello and Alessandro Minali. It will be argued that Loria’s concern has been carried further to propose an investigation of traditional architecture as a tool for preserving cultural identity and place.

3. Research result: being modern while learning from the past

Three keys are offered to reading their works: recovering the authenticity of peasant life, mixing cultures, and applying craftmen’s ability.

3.1. Rediscovering peasant life

A biased witness and witty chronicler at the time of the exhibition, Luigi Angelini was a civil engineer, architect, and urban planner, with fruitful activity. Born and living in northern Italy, in the province of Bergamo, he is perhaps a minor, not very influential personality, but his writings and works serve as a faithful mirror of the contemporary architectural debate and of the arguments between ‘passatists’ and modernists. In this fluid contradiction, he is among the designers sensitive about conceive ‘another’ modernity, founded on tradition, respecting local construction know-how and practices handed down over the generations. Since 1916, having studied and surveyed the minor architecture of the valleys around Bergamo but also of the small villages of central Italy, Angelini had drawn some conclusions on their characteristics (Angelini 1916; Angelini 1918)[3]. They are listed in the captions to his photographs and sketches and focus on spontaneity and undesigned shapes as opposed to straight and orthogonal lines, and the exclusive use of primary colours. He counteracted the Avanguardias and reclaimed an architecture that he called: ‘environmental’[4]. The distance between these writings and some subsequent ones measures the well-known difficulty of defining architecture of moderate modernity (D’Amia, 2013): based on respect for the past, rejection of disruptive contradictions, and openness to solutions of quiet harmony.

Between 1931 and 1932, returning to ‘rustic’ architecture, Angelini admits that the dialogue was interrupted by the prevalence of other currents (Angelini 1931a; Angelini 1931b e Angelini 1931c). He was now no longer limited to detecting picturesque aspects but proposed design criteria for architecture and landscapes. In *Caratteri e schemi dell’architettura rustica* bergamasca. *Per un’edilizia moderna ambientale* [Characters and schemes of Bergamo’s rustic architecture. For modern environmental building] published by the well-known *Rivista di Bergamo* between August and September 1932, directly citing Le Corbusier’s and John Ruskin’s theories, he stood his distance from standardized architecture, from “a common type of civil construction”, to promote, with no romantic

3 Regarding decay, he suggested carefully distinguishing the danger of cracked walls weighed down by prolonged fatigue or unexpected loads but tolerating the effects of simple picturesque erosions.

4 Like that of *Neoplasticism* which appeared in 1916, cfr. Polano 1979.

ambiguity, a poetic vision (Angelini, 1932a; Angelini, 1932b)[5]. He explains that between the two currents (one tending towards renewal based on tradition and the other contrary to it) he chooses the first, admitting looking at "Scandinavian, Polish and Magyar examples"[6]. Looking to Eastern Europe he is not explicit on his references; but we like to think of Kós Károly (1883-1977), the Hungarian architect who was translating local and spontaneous architecture - that is, vernacular - into modernity. At the same time, *Lares*, the oldest Italian anthropological magazines still existing, and probably Paolo Toschi himself, its new editor, praised the census of the 'inn signs' collected by the Bergamo engineer, attributing to him absolute authority in the field of 'rustic architecture' (P.T., 1932)[7].

Shortly thereafter, the same Italian ethnographers magazine published *Aspetti dell'architettura rustica nelle valli bergamasche* (Angelini 1932c): summarising what had already been described elsewhere, but more harshly, and recalling the features suggested in 1916, now arranged in six points. Like in an architectural 'manifesto', he suggests: I - grouping the masses of the building; II - parts of the buildings; III- overhanging and protruding roofs, IV- outdoor stairways; V- arcades and loggias; VI- long balconies[8]. The article was published without any illustrations. But the thousands of sketches he made of the pre-Alpine valleys are now being widely published: mostly perspectives of rustic buildings and environmental views more than architecture prototypes. The article is also a clear indictment against the demolitions and an invitation to be beware of the glamor of modernity. At that time, it sounded like a challenge to builders, owners, and institutions; later it would offer typological prefigured schemes, as many others did[9].

3.2. Mixing cultures

Alberto Alpago Novello (1889-1985) and Ottavio Cabiati (1889-1956) shared with Angelini a similar course of studies; trained by the same teachers (Gaetano Moretti, Ambrogio Annoni, Ludovico Pogliaghi, among others), they have the same background (Milan, now the Polytechnic, and the Brera School of Architecture). Their professional paths are different as was their participation in cultural debates: the younger architects favored the more international and distinctive sites. But there are some similarities: these relate to vernacular architecture and are captured in their design research which is similarly based on substantial studies of the context, far from prejudices towards the past, respectful of tradition, and aware of transformations. The first professional job Alpago Novello tackled was post-war reconstructions in the north-east areas of Italy, the place he came from. For the damaged buildings there was an obligation – including a moral one – of 're-construction': it should have shifted from imitation towards organic modernity- at least in the words of the distinguished Ambrogio Annoni (1852-1954).

One of his contemporary writings (Annoni, 1920) moved the issue towards the education of builders and recalled earlier thoughts (Giolli, 1918; Massara 1917; Melani 1917). Annoni, already a professor, rejected every kind of reconstruction: the historical, because it was false and fetishist, but also some new types, because

5 In his words: "un tipo comune di costruzione civile".

6 For instance, he stated that in 1925 the Paris exhibition minimized the impulses that had appeared in Milan in 1919 during the *First Lombard Regional Exhibition of Decorative Art* held at the *Umanitaria* (Calzini 1919) but also of the *Biennale of Decorative Art in Monza* held in 1923 and 1925.

7 It was written: "Engineer architect Luigi Angelini is one of the few well prepared scholars of rustic architecture and, more widely, of popular art". P.T. 1932, p. 104.

8 In his words: I raggruppamento delle masse dell'edificio; II uso delle costruzioni in sopralzo; III variazioni delle sporgenze di tetto; IV movimento delle scale estern; V formazione di porticati e logge; VI uso di lunghe balconate.

9 *Arte minore bergamasca. Vecchie case di paese* and *Arte minore bergamasca. La decorazione delle case* were published by *La Rivista di Bergamo*, a local but renowned magazine, between June and August 1937. *Arte minore bergamasca. Architetture di case: organismi, proporzioni, rapporti spaziali*, where types and standard models are clearer, would appear not before 1941.

they were standardized and serial. He was afraid of the practice "capace" but "rapace", that sounds like speedy but greedy, of construction companies. He promoted builders' organizations to preserve their know-how and the use of local materials. Blaming school systems and the professional world, he was hoping for the rebirth of local trade schools (such as that of the wood-artisans in Brianza). He therefore approved the collection of "peasant and regional art objects" as a means of protecting the products of slow experience, gathered throughout centuries and families. He recalled his masters Luigi Conconi (1852-1917) and Giuseppe Sommaruga (1867-1917), Alessandro Mazzucotelli (1865-1938) and Giovanni Buffa (1871-1954). He professed he was one of their pupils (like Mazzucotelli, Giovanni Beltrami, Enrico Monti and Gaetano Moretti) at the '*Società Umanitaria*' in Milan. While the works of Buffa and Castiglioni were sliding, he pointed out the designs by two young architects, Luigi Maria Caneva and Luigi Angelini: snapshots of damaged or endangered village houses (fig. 1).

Fig. 1. XVII century house in Montebelluna. Drawn by L. Angelini, dated, 28 January 1919. (Annoni 1920, p. 77)

Raffaello Giolli wrote first to defend "the harmony of the village house". The renowned critic explained that it was not a matter of "pedantic archeology" or "obstinate conservatism"; nor of ephemeral beauty, but of constructive wisdom: because "a rustic farmhouse is the result of a thousand trials and a thousand selections over the centuries" [10].

He himself had already observed how villages grew slowly over the centuries, how buildings had to be placed in relation to the ground, like trees, to survive. He pointed out that we build to satisfy real daily needs and not formal criteria, making use of local materials, and thus being spontaneously vernacular (Giolli, 1918).

Critics started looking at old building techniques as genuine solutions: a kind of modern architecture seeking the best solution without prejudice to those of the past. Annoni feared post-war reconstruction when entrusted to outsiders, to foreign entrepreneurs who would provide quick, cheap results, lowering the quality of the result. Therefore, he believed in solid initiatives: one promoted by the *Amici dell'Arte Cristiana* under the impulse of Celso Costantini to establish an institution dedicated to the reconstruction of churches in the war-damaged areas; the other by the *Touring Club Italia* under the impulse of Luigi Vittorio Bertarelli and Ercole Marelli for a competition on the types of rural architecture (Bertarelli 1918; Giolli 1919). They both picked up studies conceived before the defeat at Caporetto (November 1917), inspired by foreign experience (in France and Belgium and also in England, Canton Ticino and Germany); they collected documents "on typical constructions in war zones": a working group that in Italy found support from the most authoritative figures like Gustavo Giovannoni, Corrado Ricci, Luigi Rava, Giovanni Rocco e Antonio Massara (1878-1926), the President of the Museo del Paesaggio, and author of the cited paper. The interest for vernacular architecture, which is deeply rooted in the 19th century moderate and conservative culture in Italy and in the north-east, was running along different and

10 In his word: "una cascina rustica è il risultato di mille prove e di mille eliminazioni secolari".

contradictory roads. The clarifying writing by Massara moves the issue outside the war-damaged areas and shows the recurrent but uncertain desire to claim and protect Italian identity (Massara, 1917).

Alpago Novello's part in the reconstruction program for damaged churches was a circumstance perhaps favored by his relations (Zanella 2002, p. 31). Surely it was also an opportunity to study the local features and context and surveys before shaping the project, as he did in Agordo, near Belluno (fig. 2). Designing the new post office of this small town he arranged the central square which had been gutted when the old St. Peter church had been demolished, thus creating 'ambience'.

Fig. 2. The Post office in Agordo, Drawings of the Front and Side view. A. Alpago Novello, 1919 (Zanella 2002, p. 60)

This approach is recognized by the positive reactions to his work in the colonies where he acted both on the architectural and urban scale. In Tripoli and Bengasi, for the cathedral as for town plans, and I.N.C.I.S. residential buildings (the new district for civilian and military colonial officials) the design seems to grasp and manage social relationships, with a mix of architectural elements on different scales. When 'reading' and designing the city, he adhered to functionalism without forgetting social dynamics, by protecting identities and excluding segregation by ethnicity; thus, he firmly rejected the kind of oblique, controlled 'integration' proposed by others. Similarly, in the architectural device (a representative office or a dwelling) he explored local distribution solutions but without slipping, despite the appearance, into the ideal of a reconquest of Roman roots: the *forum*, the *domus*, etc. This resulted in some interesting hybridizations of constructive characters, like the *mashrabiyya* (مشربية): a traditional Islamic passive cooling tool to control environmental parameters (fig. 3).

This is why these works are interesting as the result of some 'other modernity' (Capresi 2012) and represent a post-colonial heritage rich in stimulating protection issues.

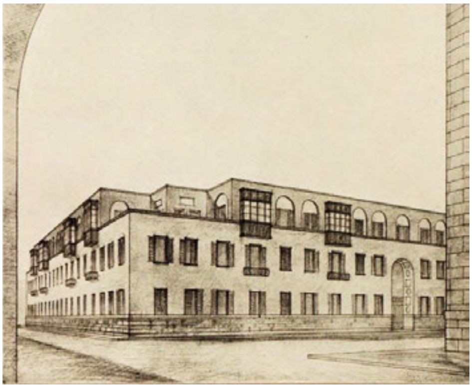

Fig. 3. Bengasi. Perspective view of the I.N.C.I.S. Quarter by A. Alpago Novello – G. Ferrazza, 1930-32. (Reggiori 1930-31, p. 1361).

Since 1911 Tripolitania and Cyrenaica had been dragged into an increasingly aggressive and imperialist colonization program, justified by the rediscovery of the Italian roots of coastal Africa. Archeological and architectural research was directed towards finding the imperial monuments buried by the sand (arches, theaters, etc.) and the mark of the Roman house in the Arab building. As far as possible unrelated to ideological and nationalistic contamination, Alpago Novello with Cabiati took the Libyan adventure as an opportunity to test new solutions, to look for modernity in tradition (Zagnoni, 1993). They investigated traditional distribution schemes and rediscovered the use of internal courtyards. They studied orientations and understood the use of the blind wall as an expedient for cooling the air. They analysed the effects of light and shaped windows and entrances regardless of symmetries according to sunlight and temperature. They observed the roofs and adopted the flat one as the most suitable for temperate and drier climates. Their design drawings, ink on paper or simply print copy, do not render this sensibility which appears in their perspective sketches, capturing the environmental values, and in their watercolours, transferring light-dark effects (Grisoni, 2020).

3.3. Applying craftsmanship

Alessandro Minali (1888-1960) had an unassuming shy personality but was very active and competent professionally. His work is mostly unpublished and under study. His partnership with Alpago Novello is well known and went back some years. In 1923 they proposed, without success, to arrange a central area of Milan released from railway infrastructures, ensuring modern traffic but retaining the travellers' palace of the nineteenth-century Central Station. But Minali's debut was with Cabiati: in 1916 they took part in some funeral architecture competitions that showed the historicist imprint of their training, a Camillo Boito legacy. Without refusing this historicist root, it can also be argued that by resorting to Christian architecture, they do recall local culture. The decision to propose that style (early Christian) for that function (the cult of the dead) depended on the setting - even urban - in which the structures had to be built (the north-west of Milan). Minali would never betray this approach. Thus he proves that a certain generation of architects tried, mostly in vain and amid ideological drifts, to rejuvenate the syntax of the building preserving tradition.

4. Conclusions: a doomed circle

"Architecture is, among arts, the one that has more references with geographic habitat", stated Regina (Gina) Algranati (1886-1963), a lively and witty Italian intellectual, in 1931[11]. She was following a study concerning the differences between urban and country architecture. But she also rediscussed folklore. She involved ethno-graphy and human geography in architectural theory and promoted local resources as opposed to international innovation. Shortly after this statement, she was asked, with Gino Chierici, to join the Naples section of the C.N.I.A.P. (*Comitato Nazionale Italiano per le Arti Popolari*), an organization devoted to promoting the "various genius of Italians" which also enrolled, as institutional representatives (museum or school managers or National Preservation Service Officers): Ugo Nebbia for Genoa, Giuseppe Gerola for Trento, Ferdinando Forlati for Trieste, Gino Fogolari for Venice, Ettore Ghislanzoni for Padua, and Angelini – already mentioned - for Bergamo (Starace & Bodrero, 1933). A circle of competent scholars and professionals was working on vernacular. Unfortunately, Algranati was ousted from public office by the racial laws (1938). The tragic historic events of the time limited the possibilities for architects to complete their research and architectural construction. The proposal for vernacular architecture as a form of mediation between modernity and tradition, between new architecture and the preservation of that existing, ultimately suffered too.

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11 So in her words: "L'architettura è, fra le arti, quella che ha maggiori rapporti con l'ambiente geografico".

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Wind and the villages in Rincón de Ademuz, Spain

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Topic: T1.1 Study and cataloguing of vernacular architecture

Abstract

This study focuses on a sustainable system which makes it possible for the villages in the region of Rincón de Ademuz to have stood within their natural environment for over two thousand years. For this analysis the study has focused specifically on the wind factor. The dry weather and the wind trajectory make it possible to create a comfortable living environment in the villages. This research analyzed the position of a building unit in order to offer a clear representation of the relationship between wind and these villages.

Keywords: *Sustainable system; Micro-climate; Comfortable environment;*

1. Introduction

The purpose of this article is to try and explain the conditions in which building complexes control wind, creating a comfortable environment in a given village. The villages studied, located on mountainous terrain in the region of Rincón de Ademuz, have not altered their original form because of limited land use, even after the civil war and the villages continues to be inhabited (Rodrigo, 1998). The difference between suburban new towns and vernacular villages is that new towns are based on regional policy, whereas vernacular villages have been built up by the inhabitants themselves over many years. Their trial and error and extensive feedback have shaped the village in its current form (Mileto, Vegas, 2006; 2007; 2008). Therefore the traditional village is not decided by a single top-down regional policy (Alexander, 1966). This study focuses on vernacular buildings, found in large numbers in villages. In turn, these vernacular buildings incorporate interconnected dwellings, designed to take wind into account.

2. The method of research

Initial fieldwork was carried out in the villages of Torrebaja, Casas Bajas and Castielfabib to give an accurate account of their present condition. The villages are composed of dwellings, different facilities and barns. Thus, the type of building and the position of public facilities such as the church, village hall, bar, and pharmacy were researched. In addition, water places (fountains, laundries, etc.), benches, and trees in public space were plotted. Supplementary interviews carried out with inhabitants who still remember past conditions in the villages provided valuable information on how the inhabitants use the central square at each time and in each season.

3. Composition of villages

The three villages studied, Torrebaja, Casas Bajas and Castielfabib, are built on different types of terrain, influencing how the buildings are built in each location. Basically, buildings built on flat land are composed as blocks, defined as "block units" in this study. Buildings are also built continuously along the street. Some give onto two different streets and are defined as "line units". This is particularly apparent in the case of Torrebaja, built on flat land. The streets are straight, forming block units and long line units. In contrast, where buildings are built on sloping land four or five buildings are connected to compose short line units, as in the case of Castielfabib. One of the main reasons for this difference is the way in which the inhabitants walk through the streets. It is easy to build straight streets on flat land. However, on sloping land steps or sinuous streets are needed to climb the slope. This is why the inhabitants built the way they built, incorporating short lines of buildings and sinuous streets. Another reason for these sinuous streets may have been the need for protection from enemies. Villages were built on the mountain for protection, despite the difficulties entailed.

Torrebaja is on flat land, Casas Bajas is halfway up a mountain and Castielfabib is on top of the mountain. If focusing on each village in detail the different locations should be considered. For example, dwellings in mountainous terrain are built on sloping land in Torrebaja. Some buildings built around the central square are on the flat land in Castielfabib. In these villages the buildings have different positions, as detailed below.

Fig. 1. Torrebaja

The eastern parts of the village are on flat land in Torrebaja. Some dwellings are built as block units while others are built as long line units along the straight wide streets. The streets to the east of the village are narrower than the others due to the difference in the level of the terrain, which makes it difficult to build a block. In the western part of the village there are two flights of steps. The sinuous streets and buildings in short lines are due to its proximity to the mountain.

Fig. 2. Casas Bajas

Part of Casas Bajas was built halfway up the mountain; the southern part is on flat land close to the river, whereas the northern part is built on the mountain slope. Therefore, Casas Bajas is characteristically a mix of flat and sloping land. There are no clear lines separating the two locations but there are some dividing features. The streets are straight on the flat land toward the mountain, where locations are changed. The buildings are connected to form long line units in the west part of the village. Some units give onto two streets with an inner courtyard, typical of buildings built on flat land. Here there are no differences in level and the village spreads further up the slopes.

Fig. 3. Castielfabib

Although Castielfabib is built on the mountain there are relatively few sets of steps. Unlike Casas Bajas, the central square of the village is surrounded by sinuous streets. The west part of Castielfabib is new, as can be seen from the presence of steps, which are considered a more modern way of configuring the village than sinuous streets. On the other side of the village there is flat land around the central square. The single block unit found in the east of village indicates that this is where the village began to grow. It is therefore essential to focus on the detail of each building location, as this provides information on the construction of buildings complexes in villages.

4. The zoning of the villages

Like trees, the non-dwellings also work as windbreaks. In the case of Torrebaja, the non-dwellings are located in the northern part of the village, protecting the village from the cold northern wind. It is particularly cold in the villages located on flat land, where the cold air stays on the flat terrain and reduces the temperature of the ground. Therefore, the inhabitants need to protect themselves and their village. In the past, inhabitants built a door on the street on the north side of the old part of the village. Although these doors have now been removed, they were mentioned repeatedly in interviews. Currently there is no need for a door on the street outside the town walls. However, in this case, a door is normally not a protection against cold wind, but a weak point, a possibility for the cold wind to enter the dwellings. And it is clearly divided the space between living quarters and the cultivation zone. For the same reason the non-dwellings create line units in the north part and on the mountainside in Casas Bajas. They are especially found on the northeast side, in the older area of the village, just as in Torrebaja. However, the case of Castielfabib is different as it grew around a castle found there in the past, alongside a castle wall. The village was designed for protection against the enemy. There are only a few non-dwellings in the village, some of them in the northern part. However, they do not appear in line units unlike in Torrebaja and Casas Bajas. Sheds for domestic animals can also be found in Torrebaja. In the western side of the village inhabitants keep cows and sheep. The wind changes direction and blows from the north or south, depending on the season so that the west side is not leeward, protecting the village from

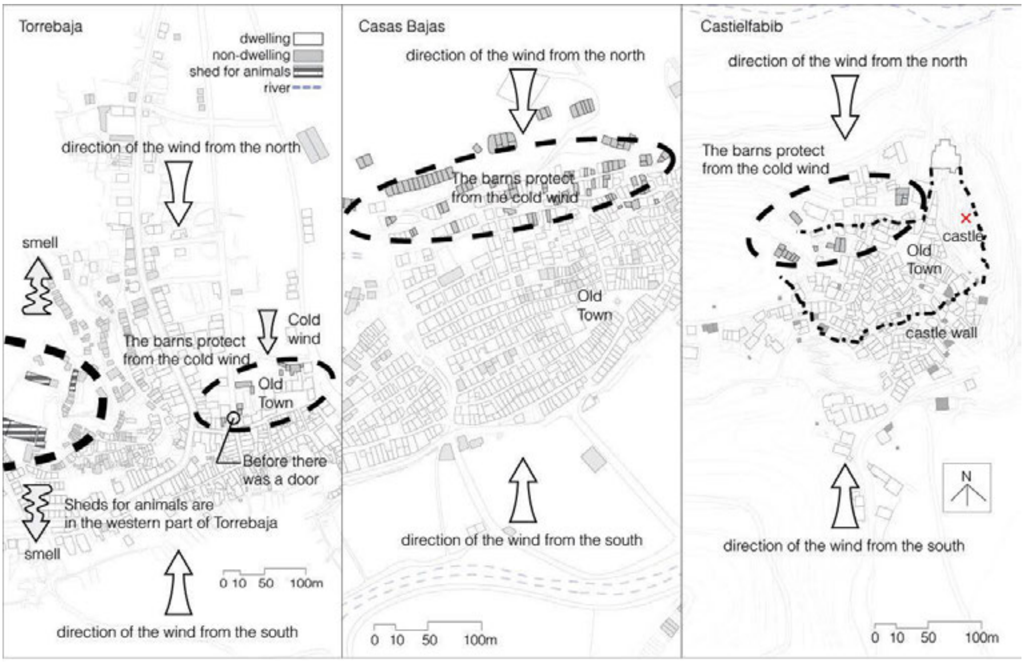

Fig. 4. The zoning of the villages

unpleasant odors. This is presumably the same logic applied in the village of Ademuz where sheds for domestic animals are distributed in the eastern side of the village, despite the difficulties of providing water on the mountainside. However, there are no sheds for domestic animals in the northern or southern parts of the village. The wind has a strong influence on where inhabitants establish buildings for domestic animals. Trees and non-dwellings protect the residential areas in all three villages. In addition, inhabitants take wind direction into account when building sheds for domestic animals in order to avoid unpleasant odors. This is why the composition of the villages and the residential areas can be explained by studying wind direction.

5. The direction of the building units and the wind-path in the village

Rincón de Ademuz is on mountainous terrain and many dwellings are built on slopes. As a rule, inhabitants build their dwellings parallel to the contours of the slope to avoid construction problems. If they built perpendicular to the contour lines, they would have to dig up more earth. This would require not only special technology, but would also increase construction costs. This is why the dwellings are always built along the contour lines, making the line units follow the slope. When dwellings are built on flat land, the inhabitants build them in streets forming long line units in the village. Some dwellings are built as block units. This is the most noticeable difference between the dwellings on flat land and on sloping ground. However, all the buildings are interconnected and form units, regardless of where they are located. This section focuses on how these units function and adapt to the environment, controlling the wind.

(1) The building unit façades coincide with the wind

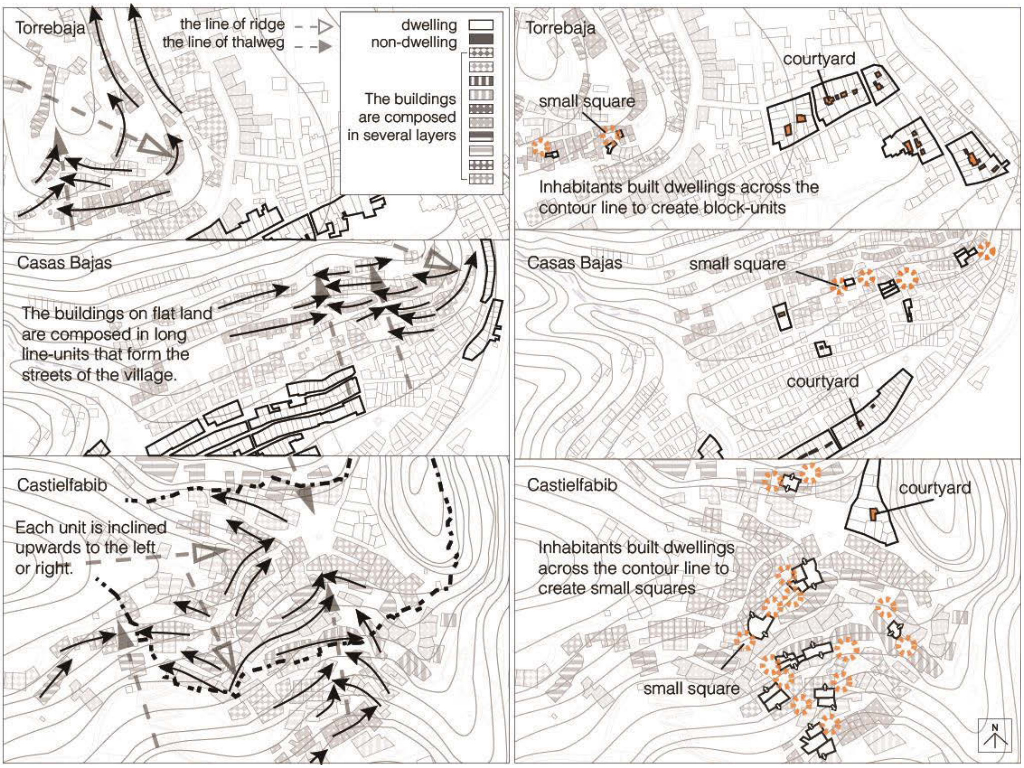

Fig. 5. The directions of the building units and the wind-path in the village

Normally, dwellings compose line units along the contour line in any location although the sizes of the units are different in each location. In general, the units on flat land are composed of more than 10 dwellings in contrast to the units on slopes, composed of less than 10 dwellings. All the villages in Rincón de Ademuz were built on the southern slope of the mountain so that the line units are always south-facing to accommodate the direction of the wind. This in turn allows the line units to "catch the wind" and let it pass through the streets.

In the case of flat land, dwellings are composed in long line units, with streets between them. These line units catch the wind from the south, leading it down the streets. In the particular case of Casas Bajas the line units are built in several layers on a gentle slope to the southwest. This new area is the result of population increase, as the priority was to build a large number of dwellings in a limited area using more modern construction methods.

In contrast, on the slope the composition of line units focuses on irregular forms which are not rectangular. Each unit slopes upwards to the left or right. Theoretically the line units must be connected straight because of construction techniques and, of course, the rectangular shape does make this simpler. However, every building on the slope is constructed in a trapezoidal shape to create curved line units. All these curves follow the contour line of the mountain because of the ridge line and the thalweg. Even in villages on flat land like Torrebaja and Casas Bajas, the ridge line and the thalweg are on the mountainside. In addition, inhabitants passing through the village follow the line of the thalweg, which usually guides them, winding up the mountain. Thus, it can be said that the villages are not only developed on the southern slope of the mountain, but that they also follow the ridge line and thalweg.

Figure 2 shows that depending on the line of the thalweg the line units change direction. As the wind blows through the thalweg it can be seen that inhabitants built the line units to direct the wind along the thalweg. Thus, the inhabitants not only use the thalweg to walk up the mountain, but they also directed the wind to blow through it. The windbreaks in front of the line units are concentrated toward the line of the thalweg. This is most obvious in the case of Castielfabib as there are no buildings that cross the line of the thalweg inside the castle walls.

Thus, the line units on flat land are long, directing the wind down the street. There are two directions of line units on the slope. Each unit slopes upwards to the left or right, creating a front to catch the wind and directing it to the thalweg to pass through the whole village.

(2) Building units built across the contour line to dodge the wind

One of the most important characteristics of the wind is the need for an outlet. In terms of hydrodynamics, for the wind to pass through well, the outlet should be larger than the inlet. However, villages are built outside and the inhabitants efficiently directed the wind through the village, creating outlets everywhere. As each location has its own characteristic way of forming these outlets the analysis focuses on the building units built across the direction of the contour line. In the villages where building units are built across the contour line to create small squares or courtyards, it can be said that dwellings "dodge the wind" creating an outlet for the wind.

In the case of the villages on flat land, inhabitants built the block units across the contour lines on a gentle slope. This is a common way to build dwellings on flat land. In fact, in Castielfabib, there is even a block unit on the flat land on the mountain slope. In general, there are two types of block units. One is the block unit which is almost square, as in

Torrebaja. Another is the block unit composed of several line units, found in Casas Bajas and Castielfabib. The common factor in both these two types is that they have an inner courtyard.

The courtyard functions as an outlet for the wind because of the chimney effect. This is the same system that uses the difference in atmospheric pressure to draw smoke up from a chimney.

In contrast, dwellings built on the slope across the contour line create a small square. Normally, dwellings on the slope are composed in line units along the contour line, as explained in the section "The building unit façades coincide with the wind". Therefore, to create a small square between two line units, inhabitants built some dwellings to connect them. This is why some dwellings are built across the contour line. Three dwellings in Torrebaja and five dwellings in Casas Bajas fit this description. In Castielfabib, there are eight cases of dwellings connected across the contour line to create several small squares inside the village. These small squares - like the courtyards - function as outlets for the wind. In addition, these small squares also allow sunlight into the dwelling complexes creating comfortable living environments. Furthermore, the sun increases the chimney effect by warming these small squares (Fig.6).

6. Conclusions

In conclusion, the building units have two directions. One of them is when the building units coincide with the wind to "catch" it and direct the wind to the streets and thalweg. The other is when dwellings are connected across the contour line to create courtyards and small squares in the villages. In this case, the units function as outlets to dodge the wind and lead the wind through all the dwellings.

In Rincón de Ademuz the wind blows in a south-north direction. The villages are built on the southern slope of the mountain, facing south, because dwellings need sunlight. The south is also a suitable direction to catch the wind and it is no coincidence that the dwellings face in this direction. This is one of the reasons why the villages have survived up to the present day.

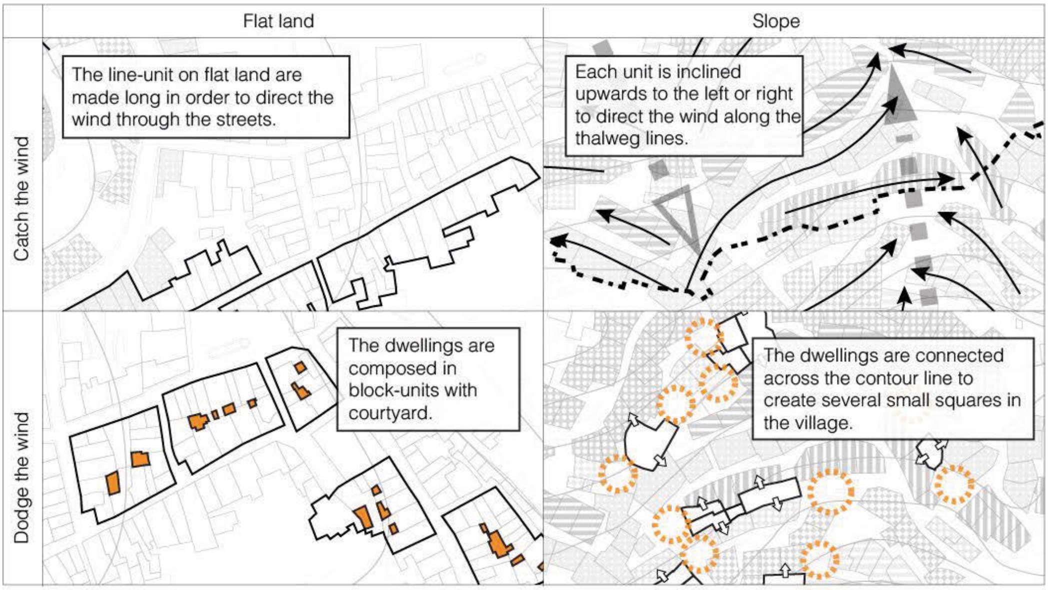

Fig. 6 The directions of the building units and the wind-path in the village

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Vernacular Features in Eclectic Architecture from the Tropics. An Analysis by means of Architectural Survey

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract
This study is focused on vernacular features from eclectic architecture from the Colombian tropics, particularly on the San Jeronimo de Monteria Cathedral, one of the most important architectural symbols from this Colombian city. During the 19th and early 20th centuries, architecture in Europe and America was characterized by a resumption of historical styles, generally called 'revivals', and the blend of these, 'eclecticism'. Montería was no stranger to this situation, also assisted by national and international migrations into the territory and the adaptation of local vernacular techniques. This cathedral is explored as an example where elements from vernacular tradition are recognized, which guaranteed the operation of foreign models, especially in the bioclimatic functioning of this tropical region.

Keywords: *history; culture; vernacular architecture; eclecticism; cathedral.*

1. Introduction

An architectural renovation process began in Colombia at the end of the 19th century, a movement that obeyed a general trend in Europe, used by Latin American countries after their independence as a way to break up with everything that had to do with the Spanish (Angulo, 2008).

Someone (Saldarriaga, 1997) points out that the newly constituted republican country would need to plant its presence in Colombian regions and cities, also change its traditional image and stand out with a dominant presence in the national landscape. New architecture should be responsible for proposing the desirable image. This is how two European models -Gothic and Classic- marked the emergence of the Colombian architectural image, influenced in turn, by vernacular architecture from religious monuments. Nonetheless, continuous disputes to develop public buildings with a classical style and temples with a Gothic style, generated a particular blend that then was adopted by many Colombian cities.

Throughout the Caribbean region, a considerable amount of these architectural blends can be seen, adapting them as syncretic models (Segre, 2003) with vernacular features, not only in political or religious entities but also in the entire urban image transformed during this period. The city of Montería is one of these cases that at the eartly 20th century would be transformed, evidenced with many of the mansions of prominent personalities influenced by the architecture brought from the city of Lorica. Later, the lower social class would use it, calling it popular republicanism.

The department of Cordoba was segregated from the department of Bolívar in 1951, a fact that had a direct influence on the region dynamics, including its architecture. Historical eclecticism became a general rule, slowly adapting the style to a new concept. A more modern and independent era, but with a particular way of building, since vernacular techniques were used to a great extent. These arises as a response to the elementary needs of the human being, solving basic problems, leaving aside aesthetics or modernization. It develops with man's own evolution, not representing eras or styles and therefore not requiring architects to conceive it (Tillería, 2010). Thus, diverse contrasts are found in the city, coexisting the indigenous tradition and imported architectures in a single space.

Fig 1. Monteria at the early 20th century. Vernacular architecture can be seen as an urbanism structural element. All buildings are generally read with the same language. (Source: Justo Tribiño, early 20th century)

An inspiration source was sought in the country, first in England and then in France. Materials, techniques, and architects that marked the Republican era architecture would also come along with French products. North American (Rudolfsky, 1964) influences would come later since the United States seized a considerable number of Caribbean islands and populated these territories with a tropical architecture based on the British Empire (Samudio Trallero, 2001).

This type of architecture is known as '*Antillana'*, the Creole interpretation of Victorian architecture, blended with local techniques, generating interesting eclectic results. This style reached the coastal plazas in Colombia such as in Cartagena de Indias, influencing nearby territories, characterized by use of plinths, doors, and planked walls, structural elements in wood, shutters, dividing screens and openwork in carpentry elements. All linked to a large selection of colors characterizing the coastal area (Fig. 1).

In this wise, vernacular architecture is presented as a crucial part in the constitution of the urban image, including temples. Great use of these elements can be seen in the city of Montería. Particular components are the large roofed terraces and porticoes to obtain shaded and cool places, as well as the dominant heights and sloping roofs from the houses for proper ventilation (Fig. 2, 3)

Fig. 2. Cordoban vernacular house, lattices in upper spans and roof expansion for free air circulation. (Source: Authors, 2021)

Fig. 3. Roof expansion over the wall, space for exit of hot air. (Source: Authors, 2021)

2. Methodology

An exhaustive exploration of the Montería cathedral was conducted both inside and outside. It was selected as a study specimen due to its particular architectural composition and importance at the sociocultural level. The analysis and subsequent three-dimensional development were carried out with all the mechanisms available for data collection, including general observation of volume, photographic tour and taking scans at different points to carry out the indirect survey (Leserri & Rossi, 2020).

The restored planimetry is presented in views with orthogonal projection, making it possible to reliably express this architectural space and understand its operation, creating in turn, the basic documentation to recognize the elements from the vernacular tradition (Parrinello & Picchio, 2017). This also approaches the original monument conception originally given by the author in his day. The architectural element did not present plans or documentary records at the beginning of the research, reason why it was restored for its conservation and valorization.

From the resulting images by the laser scanner, the scope of the general plans and details was defined, as well as a digitization methodology. We began with the identification of the Cathedral orientation and with the areas that are part of it, such as naves, choir, sacristies, clock tower, stairs, terrace, and dome. At the same time we analyzed materials, detailing what techniques were used and how tradition and modernity were blended, delving into the sociocultural determinants of the population in which it was established and the influences received in its space conception processe. All this was done during the architectural survey process by means of laser scanning technology. With the use of the Faro device, the monument was scanned inside and outside, generating a 3D model (Fig. 4). It was developed in several stages where metric data play a predominant role, so much so that the process of acquiring this metric information is carried out through 46 scans (Fig. 4), determining its three-dimensional model in a SCENE application vector environment. The recording process is done so that each scan can be linked to the others through waypoints (Catuogno et al., 2021).

After scanning the monument, a laser recording was made towards the interior in order to comply with a serial type record (Fiorillo et al., 2013).

The stages wered developed from the main nave to the sides and up to the choir level, ending with the roof where the clock tower is located, which has two levels.

Fig. 4. Three-dimensional model by laser scanning. (Source: elaboration by Gómez Mejía, 2020).

In order to establish a relationship through the reference points between the exterior and interior scans, the laser-scanner device was parked near openings such as windows, doors or openings for the collimation of the external points previously purchased.

After the digital process was carried out, the assembled three-dimensional model emerged with a contained error of less than 8 mm, and the extraction of orthogonal views necessary for the two-dimensional restitution was determined. (Ferreyra et al., 2021).

The orthogonal views determined by the laser serve to restore, as a tracing, the entire cathedral planimetry, contained in floors, sections, and facades, carefully observing each construction detail, thus delivering a product that serves to analyze its morphology and specific areas of difficult access (Fig. 5, 6).

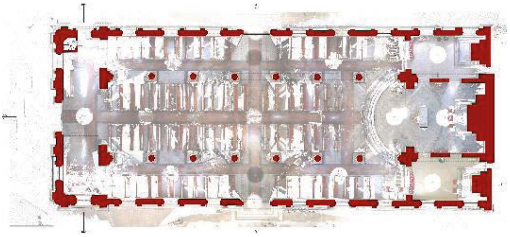

Fig. 5. Planimetry restituted with orthothography Source: elaboration by Gómez Mejía,2020)

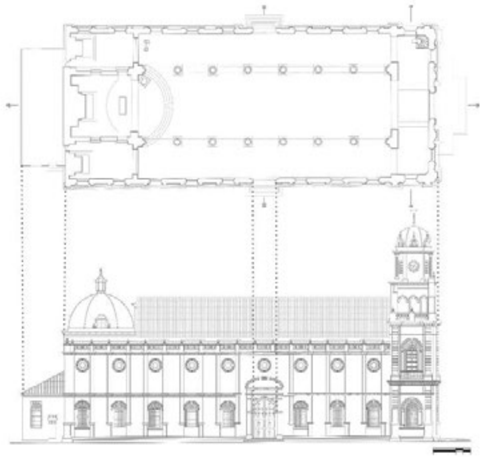

Fig. 6. 2D graphic restitution, architectural floor plan, and lateral façade. Source: elaboration by Sergio Gómez Mejía, 2020)

3. Vernacular lesson in religious buildings. The Monteria case.

Religious monuments in this specific area have evolved all along the years (Fig. 7), finding that the San Jerónimo de Buenavista village, initial name of Montería (Exbrayat, 1996) had its first hermitage in 1759. This was made up of bahareque and mud fibers, prominently palm-covered, an austere and functional construction for the evangelization of that time. It was destroyed at the end of the 18th century and then replaced. Tagged as a church, it occupied the space where the cathedral is today. This was a straw-roofed with board walls, completed in 1774 and consecutively demolished due to its great deterioration (Exbrayat, 1996).

Based on the chronicles from Jaime Exbrayat, the third and last church prior to the current one was inaugurated in 1872, and quickly demolished due to the great progress from the sector, it was not very aesthetic. The first stone of the cathedral was laid in 1903, which started the construction process. Work resumed in 1906, and in 1909 a new plan was received, drawn up by Luis Felipe Jaspe from Cartagena de Indias, who concluded the work at the beginning of 1916. The Cathedral was inaugurated in 1917.

Contributions received from the pre-Hispanic indigenous buildings have left as a legacy the use of different materials from the immediate environment such as raw wood, stones, and plant tissues along with palms to form the roofs, which are gabled or hipped depending on whether the building is squared or rectangular. That was the case of the 3 buildings prior to the current monument that, along with the Antillean influences, charaterized the society back then because of the way these ancestral techniques were used on the building, with materials endemic to the region and functional at the bioclimatic level, serving as reference in some aspects of the building that is found today, such as: notable use of wooden lattices at the high of windows, balustrades that give way to false balconies, gabled roofs with quite prominent angles, and use of wood at different points as a solution for structural load. All these aspects help to reveal the remarkable relationship of the structure with the environment, the awareness of generating a defined architectural space with a bioclimatic study that precedes it. This is also seen in the monument location since its shorter faces are arranged towards the sun, allowing it not to heat up inside.

Compared to the typology of traditional housing developed in Cordoba, a direct relationship can be made with the assessed element, finding the marked use of lattices (Fig. 2), roof separated from the walls, and the characteristic sloping roof slopes (Fig. 3).

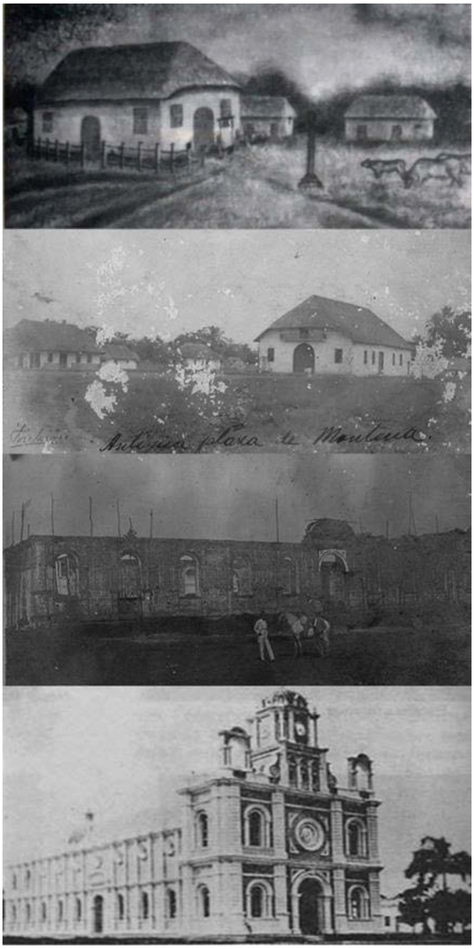

Fig. 7. Evolutionary process of religious monuments in Montería city. First structures of a very marked vernacular feature. Note the poorly marked or defined location; imported styles contributed to an urban harmonization. (Source: Justo Tribiño, early 20th century)

In this way the close relationship between popular architecture and high-level constructions can be seen.

4. Conclusions

Vernacular architecture is greatly important as a cultural structural element. Its essence has always existed and adapts to the needs.

This also applies when it merges with specific architectural styles that form eclecticisms and a punctual identity in turn. The Caribbean region highly influenced by Antillean techniques can establish a series of typolo-gies or common architectural elements, since they are the evidence of a certain social behavior, framed in a time of change.

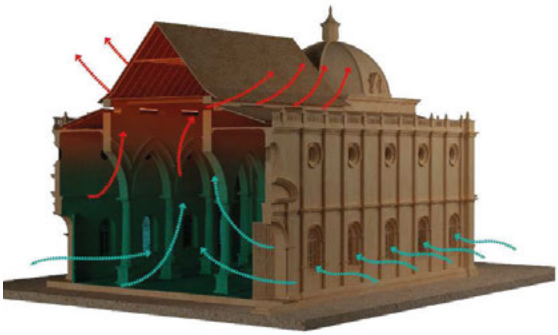

Fig. 8. Three-dimensional model, convection current inside the monument, rectangular openings in the upper part of the walls for hot air evacuation. Notice the slopes on the roof, a vestige of the Antillean Creole architecture for rapid evacuations of rain and heat. (Source: Authors, 2021)

Also, the urban dynamics of the early 20th century can be seen. The permanent exploration of new ways of building that would use the appropriate resources and materials found in the area is evident. As well as the strong references such as religious buildings used to inspire nearby constructions and later, the city image.

Fig. 9. Lacharme House, Monteria. Convection current ventilation, upper blinds for air renewal. Use of internal terraces to generate microclimates. (Source: Authors, 2021)

Although European models were definitively established in the daily image of all over Latin America and in the Caribbean region specifically where this case study is located, in constructive and bioclimatic terms, these traditional aspects of local architecture can always be easily observed (Fig. 8, Fig. 9). The significance of building spaces that interpret the tropical climate needs are implicit in the monument design. The exterior and interior proportionally dialogue as vernacular architecture does, interpreting from a European stylistic vision, the most important aspects of the local tradition.

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Configuring, building and inhabiting the house from a gender perspective

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract

The study of vernacular architecture allows to know a culture through its domestic constructions. It also permits learning from its values to apply them in new architecture. In order to achieve both objectives, it seems pertinent to gain an in-depth knowledge of the reality, something which involves questioning what this traditional habitat means for each member of the community. Gender, as a category of analysis, is applied in a research on the vernacular architecture of the Mossi culture and its transformation, as an initial approach to the study of the role which women have played in relation to this traditional habitat. This analysis was based on a literature review which was subsequently contrasted with data collected during two stays in the village of Baasneere (Burkina Faso) in 2018. The study, which considers the relationship of women with the configuration, construction and use of dwellings, shows two opposing aspects of the house: its essence as a setting for tradition-based power relations and a flexible nature capable of easily accommodating change. Finally, the research raises the possibility of investigating how this relationship with inhabiting and building the house varies with the modernisation of architecture.

Keywords: *Vernacular architecture; Burkina Faso; women; transformation.*

1. Introduction

Architecture is the art of separation, the creation of boundaries that structure space. However, a boundary is also a relationship between what ends and what begins. As the philosopher Françoise Collin (1994) explains, architecture can be the art of thresholds.

The most frequently mentioned dualities, when talking about limits in architecture, are inside-outside, interior-exterior, private-public, closed-open and individual-collective. A simple analysis would establish an association between these concepts, placing the most internal reality in opposition with the most external. However, following Collin's reflection and in keeping with the ideas of architects such as Van Eyck (1961) or Hertzberger (1991), the reality of spaces is much more complex.

This complexity mainly stems from a highly subjective component: the qualities of a place may vary according to individual perception. A neighbourhood square can be part of a house, the interior of an unwelcoming building can be the outdoors. Everything appears to depend on the degree of autonomy, security and comfort that a place is able to generate in a person. In addition, there is also the weight of experience: memories associated with a given place link to it in a positive or negative way. Arguably, all is related to the appropriation of space and to that feeling of *enracinement* which Simone Weil considered to be the greatest need of the soul.

When analysing architecture in relation to gender, it is usually noted that tradition relegated women to the domestic sphere, and that "interior", "privacy" or "inside" were the concepts most associated with them (Rosaldo, 1974).

Thus, architecture would have divided its domains between the two extremes, adding "feminine" and "masculine" to the opposing phenomena mentioned above. However, referencing Collin once more, a reflection beyond the simplification of these phenomena would suggest that interiors could not in fact be considered the domain of women unless they had a personal space within them. “Domestic” should not be confused with “private”. The room of one's own, demanded for all, was ultimately (and most importantly) a place to be oneself.

It should also be remembered that gender is not an absolute category and that individuals are influenced by multiple circumstances. Generalisation should therefore not be admissible. Gaining an understanding of a social reality is a complex task that requires consideration of different variables from all aspects of life. To that end, the first studies incorporating a gender perspective into vernacular architecture research appeared during the 1990s (Kwolek-Folland, 1995).

The study of vernacular architecture allows to understand a culture through its constructions. The materials and techniques used, the places generated and the types of buildings created have a reason for existence and are explained by the complex social and cultural relations established by a community in a specific environment. Habitat is, therefore, inevitably permeated by gender, among other relational systems, and the adoption of this issue as a category of analysis allows for a more detailed approximation to reality: Who inhabits these spaces? Why? Who builds them? What role does each member of the family play in configuring the dwelling and the village? How do these roles change with the modernisation of society?

Does traditional architecture offer an equitable distribution of space or does it perpetuate the subordination of a given part of the community? Have women had a place of their own in vernacular solutions?

This article is part of an ongoing research on vernacular architecture in Burkina Faso and its transformations, and focuses in particular on the traditional habitat of the Mossi culture. As in other contexts, the roles traditionally associated with women and men and their respective positions in the family have determined the configuration of households.Women, especially the carers of their relatives, seem to have governed the affairs of the compound. However, their relationship with the house has not been limited to inhabiting it. The roles traditionally assigned have also reserved a place for them in the process of construction and maintenance of the buildings.

This research aims to explore the inevitable relationship between architecture, and especially traditional heritage, and gender roles, aiming to explain this type of architecture from a female gaze. In the field of research, the approach employed when observing reality is a determining factor while the cultural framework itself occasionally influences what is studied. Without aiming to offer categorical answers to the questions posed, this article will attempt to bring to light the role of women in the configuration, construction and use of the vernacular habitat in Mossi culture.

2. Materials and methods

The aim is, therefore, to try to present traditional Mossi dwellings from the perspective of women, as part of a research project that began in 2018.

Specifically, the study is based on a literature review, complemented with data collected during two research stays in the village of Baasneere (Centre-North region, Burkina Faso) in the initial stages of the research.

Fig. 1. The village of Baasneere in 2018.

The existing literature on Mossi culture comes mainly from the fields of geography, anthropology and sociology. Geographical studies focused on land occupation systems, means of production and consumption and, in general, the establishment of communities in the territory (Kohler, 1971; Lahuec, 1980; Marchal, 1983, 1987; Imbs, 1987, etc.). Anthropology and sociology covered the history and the political and social organisation of the Mossi (Zahan, 1961; Tiendrebeogo, 1963; Skinner, 1964; Izard, 1970; Gruénais, 1984, etc.) as well as the economic and technological transformations that social groups experienced during the colonisation and subsequent independence of the country (Hammond, 1959, 1962). One particular study (Lallemand, 1977) focused on the analysis of the way of life of a family in a village located in the same region as Baasneere. The study examined the characteristics of the family economy and, more specifically, the social relations between family members, which provided valuable information on how the household was inhabited.

More recent research continued to study production systems and land use integrating gender and social norms to provide a first and, over time, more detailed insight into Mossi women's access to land (Kevane & Gray, 1999; Cavicchioli, 2018).

In the discipline of architecture, the first studies conducted on the country's habitat mentioning Mossi architecture, were reports commissioned by the UN or within the framework of the UNDP (Silva, 1970; Boetschi, 1978), as well as general compilations on the different cultural groups (Fiedermutz-Laun, 1986; Kéré, 1995). These studies, combined with the information compiled from research in the abovementioned disciplines, formed a working basis for the comparison of the information obtained during the visits.

The fieldwork consisted of participant observation in the daily life of the families in the village, the recording of graphic data on the traditionally configured dwellings, and informal conversations to identify the uses of the spaces.

3. Results

3.1. Configuring the house

As in other West African cultures, the traditional Mossi dwelling was an enclosure (*zaka*) formed by a series of individual buildings grouped around a courtyard. The buildings were situated on the perimeter, defined by the earthen walls or braided straw mats (*seko*) between them. Each of these buildings is assigned to an adult member of the family unit: a man, his wives and children along with his younger brothers and their families. Boys used to occupy their mother's house until the age of 10, when they could share a building with other children, and girls did so until the time of their marriage. However, in 1977 Lallemand reported some flexibility in childcare. Daughters and sisters left the family compound upon marriage to move into their husband's, although they maintained ties with their family and were allowed to separate and return home if they so wished. The transitory connection between the parental and the marital home, and the constant guardianship of a father, brother or husband, has been reflected in the writings of women authors as a non-belonging to any place (Emecheta, 1975; Ogundipe, 1994; Schipper, 1996).

Even so, in terms of architecture, the presence of women was decisive in the configuration of the dwelling, as the enclosure expanded as new marriages took place. Each woman in the compound inhabited one or more buildings and a courtyard facing the main central space. The house was thus flexible to the family growth.

These individual units were traditionally round constructions (*roguilga*) and, less frequently, rectangular-shaped rooms (*rogo*).

The predominance of circular houses meant that the Mossi enclosures also tended to be circular in plan (Kéré, 1995). However, this contrasted with data collected at the time of the research, since only 61 of the 300 cases in the sample were traditional round houses. The compounds, at that time, were mostly orthogonal in shape, including the courtyards.

According to local testimonies, the round typology was the typical construction while the rectangular one would have been reserved for heads of households in the past. This coincided with the findings of previous research which identified this new typology, with its terraced roof and larger size, as the one preferred by notables and military men (Dubourg, 1957). Men and women under these family heads would inhabit round traditional buildings. Hence, architecture marked difference and hierarchy.

This was not always the general rule, though. Drawings by Lallemand in the 1970s showed rectangular constructions, rare at that time, used in three cases which allowed the custom to be qualified:

- In the courtyard of the eldest wife of the family head, who, according to Lallemand, had more authority than her husband.
- In the courtyard of a young couple who had emigrated to Mali and then returned to the village.
- In the courtyard of a woman who often visited Ouagadougou (the capital) accompanying her husband who, instead, preferred to inhabit a traditional round hut.

This could be indicative of two situations. Firstly, the notable of a family could also be a woman, not just her husband. Secondly, regardless of the family hierarchy, in the 1970s housing innovations were introduced by those in contact with the foreign or urban world and, contrary of expectations, there was certain freedom to introduce these changes into the family compound.

In 2018, the most common typology in Baasneere, regardless of the gender of the inhabitants, was the rectangular building covered with corrugated sheets. Some older women, however, still preferred the typical round buildings. These seemed safer and cosier during the stormy season, compared to the rectangular houses covered with metal, which were more vulnerable to heavy rain and wind. Moreover, these typical constructions were linked to traditional remedies and customs and, according to the testimonies of elderly women, they still stored their fetishes or sacred objects in them. For this reason, in some traditionally configured compounds, the women's private courtyards consisted of a larger rectangular building and a typical round one, used on rainy days or to house their own belongings (Fig.2).

This could be a significant detail. Although the configuration of the dwelling as a group of individual units around a courtyard was maintained, there was no longer any sign of privilege reflected in the type of construction inhabited. Furthermore, in the women's maintenance of a traditional hut alongside the modern construction, it was possible to observe the preservation of a cultural heritage, somewhat divested of the burden of subordination that it may have had in the past.

Next to the access to the enclosure a structure of branches forming a shed was traditionally used by the elder and head of the family to control access, receive visitors and establishing the connection of the house with the rest of the village. The area beside the entrance (*samandé*) functioned as an extension of the courtyard and, when shared with other enclosures of the same family branch, it formed a semi-private anteroom.

This concatenated configuration of places with different degrees of privacy, from the village to the individual room, provided a great wealth of spaces, offering many opportunities for family members to interact with each other and with the rest of the community.

This spatial richness was maintained in most of the dwellings analysed in Baasneere, but had been lost in recent constructions, which favoured privacy. The new dwellings consisted of indoor rooms shared by the whole family and were located in the centre of a courtyard enclosed by walls.

Family granaries (*tudgou*) were located outside the house compound, closer to the fields, to protect them from possible fires. In individual courtyards, men and women could have small granaries to store crops from their private fields.

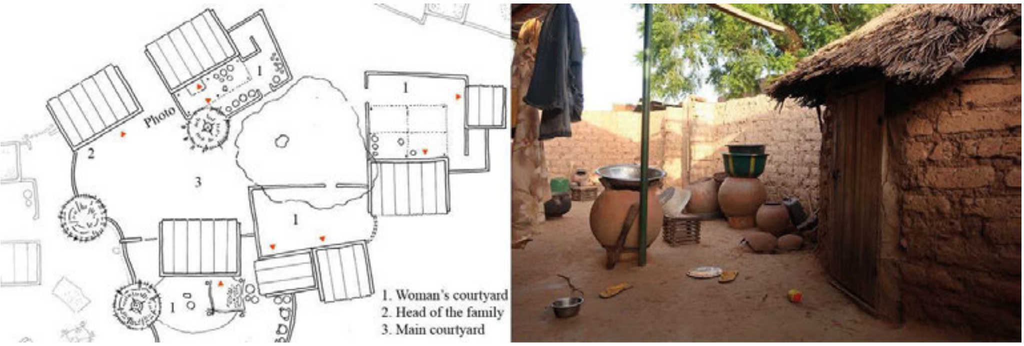

Fig. 2. Example of the combination of round and rectangular constructions in some women's courtyards.

3.2. Building the house

The whole family was involved in the traditional building process with well-defined roles. If necessary, the help of other relatives or friends was also requested, and in this case, the owner of the house provided food and drink, prepared by women, in return. The construction of new houses usually meant the family was growing, something seen as a sign of prosperity celebrated with joy. Building was both a social event and a collective activity based on mutual help.

Fetching water from wells was one of the daily chores assigned to women and girls in the household. Thus, at the time of construction, they were also responsible for providing any water needed to mould earth.

The process began with the tracing of a circle in the ground with a stake and a rope. Men extracted the necessary material from an excavation near the compound, while women and girls brought the water and boys trampled the moistened earth to make the mortar and carry the balls of *banco* with which the men built the wall. The conical roof, with a structure of wooden branches, braided straw mats and straw protection, was built on the ground, then raised over the wall and tied down. Once the construction was completed, women were in charge of finishing the surfaces, wall coatings and decorations and the interior and exterior floors with mud.

Banco balls were replaced, at some point, by the use of sun-dried mud bricks. In fact, previous research noted how this innovation had also begun in the rectangular dwellings of notables (Dubourg, 1957). In 2018, this adobe construction technique was the most widespread in the village, regardless of the type of construction (round or rectangular) or the status of the owner. Something similar must have occurred with the roofing technique. As reported in other regions (Hanke, 2004), the new metal sheet roofing solution would have been adopted first in the dwellings of the military elders. Like the use of adobe, stone or, later, cement blocks, this innovation was a sign of privilege. This reflects the prestige culturally attached to home improvements, which always seemed to be introduced first in the dwellings of elders, family heads or notables. In contrast, like the use of adobe, the use of corrugated sheets was widespread at the time of this research (Lidón de Miguel, 2019).

The repairs, like the construction, were carried out by individual members of the community as a family chore. According to custom and the annual cycle of the seasons, this work was carried out after the rains, in mid-October, when the work in the fields had finished and the still damp earth and the abundant vegetation provided the necessary building materials.

It should be noted that, in 2018, the most recent innovations, such as the use of reinforced concrete or glazed windows, were no longer determined by the traditional social status of the family members, but by the economic level of each individual and his or her greater or lesser accessibility to the new materials. In other words, the most innovative constructions in the village no longer implied the distinction of a family hierarchy either.

It is also worth highlighting that recent professionalised construction methods necessarily required specialisation and resulted in more limited involvement of families, particularly women, in the construction of buildings in the village. With the decline in the construction of round houses, the tradition associated with the creation of new dwellings, based on cooperation and mutual help, was disappearing.

3.3. Inhabiting the house

Household chores were traditionally organised and assigned by the first wife of the head of the family (*zaka naba*). These tasks included preparing meals and clothes, collecting wood from the fields, pounding millet and providing water for the household. In addition, women took part with men in the work of the communal lands and were also allowed to work their own personal fields. Equally, they could sell the products of their work on the market and thus obtain resources to be invested in the family or in the equipment of their personal living spaces. They governed the matters related to life within the compound, although there was also a hierarchy within the group of women in a household: between the first wife of the head of the family, the older wives and the young newcomers to the compound.

As Mangin explained in early texts on Mossi culture (1916), women were valued in families because, in a subsistence economy, new marriages meant a larger workforce and, thanks to the boys and girls possibly coming, multiple prospects for the future.

Later on, Lallemand (1977) reported on the great mobility of relationships between women and men: polygamous families that were reduced through Christian marriages or the reverse, new links and new ruptures, arrivals and departures of relatives to other regions or to the neighbouring Ivory Coast, etc. The family enclosure was continually adapted according to the need for new individual constructions or lack thereof, and this flexibility was still maintained in the traditional dwellings in Baasneere.

The main daily activities in the house took place outside, in the personal courtyards or in the main central space, under the shade of trees or small sheds. The outdoor spaces constituted the largest surface area and the most important part of the dwelling, while the interior spaces were used as shelters, mainly for resting or storage. This indoor space, associated with the individual adult, extended its influence to the immediate outdoor space, regardless of whether it was delimited as an individual courtyard. Thus, architecture was articulated in a series of scales of privacy (neighbourhood, grouping, enclosure, individual courtyard, personal buildings), linked to each other by transition places and associated with the different levels of kinship (neighbours, family branches, family unit, closest relatives).

Cooking and cleaning were done outside, on the floor of the courtyard or in mud structures. This tradition was maintained throughout the village, although some traditional dwellings also included constructions dedicated to cooking with adobe bricks arranged in latticework to allow ventilation.

Daily activities were still mainly performed outside and the functions of the interiors, with the exception of these new kitchens, had not changed. Only the recent constructions mentioned earlier, still in the minority, represented a change of function with more shared space indoors.

New professions, carried out by men and women, had been added to the work in the fields, and many young people temporarily left the village to study in the capital.

4. Discussion and conclusions

Examination of the role of women in the configuration of the traditional Mossi dwelling has shown how their presence was decisive in the expansion or reduction of the family compound. The house was the constructed reflection of an extremely hierarchical patrilineal family structure, but this hierarchy was, in fact, complex and changeable. It was established between men and women, between old and young, towards newly arrived relatives, etc. The family unit could be understood as a dynamic system of relationships of affection, but also of power and alliance, situated in a flexible and adaptable setting. The traditional compound was ready to welcome changes in families and, with them, also a gradual relaxation of social norms and greater autonomy of women within the group.

It could therefore be argued that vernacular architecture was the translation of a hierarchical social system which subordinated certain members of the family, especially women, to very specific roles. Nevertheless, it is also worth considering that this system was extremely complex and flexible, changing over time, and that this architecture, in short, shared this same complexity, flexibility and capacity to adapt to change.

This can be seen when considering the arrival of the rectangular typology, that seemed to be associated, as indicated above, with the notables of the families. However, in the 1970s Lallemand already noted changes with respect to this custom, showing a degree of freedom and independence in who prompted the innovations of the dwellings. This freedom of inhabiting and building could be observed in a more generalised manner in the dwellings visited in Baasneere in 2018. One particular example was the presence of new and traditional constructions in women's private courtyards. They had preserved the typical houses not because they were subordinated to occupy these constructions, but because they recognised advantages in them which they could combine with those in modern houses.

The great permeability of spaces should also be highlighted. Organised without clear boundaries, they allowed views of the public from the private and vice versa. The opposing pairs mentioned in the introduction were naturally linked, allowing protection and exposure, withdrawal without exclusion. In contrast, new constructions were increasingly multi-room dwellings, which meant a clear transformation in the way houses were inhabited. What was happening in these new dwellings with the degrees of privacy and with flexibility? What place did women occupy in modern dwellings in the village? In this respect, further research is required to determine whether or not the modernisation of architecture was leading to a domestication of the female part of the family, as was already reported in other changing contexts (Rogers, 1980; Larsson, 1988, 1989).

Finally, the loss of building traditions generally led to lower levels of involvement from the community, including women, in the creation of new buildings in the village.

The study of vernacular architecture responds to the existence of values which can be preserved by learning from them. Conservation refers, not to the object itself, but to the intangible heritage of constructive knowledge and beneficial relations with the natural and social environment which should be safeguarded. But who holds this knowledge? What relationships from vernaculars may be useful for the future? Perception of a place is highly subjective and depends to a large extent on the behaviours that occur in that space. Architecture could be seen, then, as a device ready or not to accommodate certain attitudes. The Mossi dwelling seemed to have reserved very specific and traditionally determined places for women. At the same time, it represented also an architecture of thresholds that offered multiple possibilities and was able to allow for variation. More detailed research will help ascertain whether this flexibility can be the basis for a relational architecture truly generating autonomy, security, comfort, sense of appropriation and, ultimately, *enracinement*, for all individuals.

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Rediscovering tradition through representation: the vaulted house of the Amalfi Coast

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
The Amalfi Coast represents one of the most fascinating examples of the Mediterranean landscape with a unique cultural and natural setting, resulting from its dramatic topography and the evolution of its community. The universal value of the coast, the evolutionary process of human adaptation to its production and exchange spaces, as well as its residential settlements, are very important to preserve. In this regard, the research is focused on the interpretation of these places, and in particular on the typical medieval houses, to find the main features through the representation of ancient and new designers. The observation through the drawing allows to rediscover the essential elements that distinguish and at the same time link the buildings with the Mediterranean tradition. The geographical and economic characteristics that particularized the Amalfi Coast in medieval times and the absence of terrestrial connections inevitably led to isolation towards the hinterland and an opening by sea. The owners of these artifacts were mainly merchants and, coming into contact with different cultures, brought to their territories a miscellany of traditions. Similarly, these houses are made of local stone and are characterized by their vaulted roof extrados that, depending on the type, lead back to a specific historical phase. The study and analysis of the drawings over time, therefore, aims to discover the main characteristic and rediscover the historical, aesthetic, and artistic value of the vernacular architecture of Campania. These buildings have always been a source of inspiration for great artists and architects who, following the Grand Tour along the coast, have characterized their works, and therefore represent an important heritage to be known, protected, and enhanced to safeguard the harmony and splendor of the Amalfi Coast.

Keywords: *Heritage; Tradition; Houses; Drawing.*

1. Introduction

The fascinating territory of Amalfi Coast has always been a source of inspiration for artists and intellectuals. From the middle of the 16th century, in particular, the *Grand Tour* began to spread in Europe and, starting from the 18th century, the myth of Southern Italy began to increase (Cardone, 2017). This phenomenon, therefore, encouraged educational journeys to the cities of Southern Italy; however, the harsh and wild nature of the Amalfian territory excluded the Coast from the usual itineraries, which was rediscovered only after the middle of the 18th century (Cardone, 2012). In this epoch, some romantic painters, interested in the representation of natural landscapes and picturesque images rather than urban scenarios and monuments, increasingly traveled to the Coast. The abrupt and irregular profile of its landscape and the picturesque image of its villages made it an ideal scenario for these artists (Amodio and Ghiringhelli, 2007), who appreciated the perfect integration between the morphology of the site and anthropic interventions. This integration was the result of a slow and gradual process of transformation (Caskey, 2004). In fact, over the centuries, the territorial conformation of the Coast was significantly modified to meet the different settlement needs, while preserving the naturalistic features. Thus, the steep slopes became necessary terraces for agricultural activities; in many cases, these were then accompanied by hydraulic systems and a dense network of roads that guaranteed accessibility (Fiengo & Abbate, 2001). The orographic characteristics of the place also influenced the coastal architecture; looking, in particular, at the living space of Amalfi's villages, it is possible to observe how during the medieval period particular and authentic architectural forms were developed, evidently influenced by Roman and Oriental cultures. What particularly distinguishes the coastal residential building, preserved intact until today, is that it is a widespread and popular architecture. Therefore, it represents a heritage to be preserved as a testimony of vernacular architecture in which stylistic features and typical signs are recurring; the architecture that, by the intrinsic beauty of its spontaneous and distinctive forms, has always fascinated travelers. The analysis of some representations of artists, architects, and writers who came to the place represents then a starting point to analyze the peculiarities of rustic and rural architecture of the coast, the "aesthetic value of its functionality" (Pagano and Guarniero, 1936; p. 6) that today, unfortunately, is partly lost or abandoned, overwhelmed by the need to replace the old with the new, apparently, more effective and prestigious.

2. The vaulted house and its origins

The Amalfi Coast, in the past, showed a perfect balance between anthropic space and natural space (Sgrosso, 1984): this harmony, in the last years, has been deteriorated due to the work of man, the over construction processes, the expansions – often illegal – of the existing volumes at the detriment of a collective historical, architectonic and cultural heritage. So that these "masterpieces" of popular art, as they have been defined many times, have been damaged, and even if they are punctual elements of the coast, their disappearance goes to ruin the beauty of this portion of the territory of Salerno.

An attempt at preservation, of particular interest, was the development of the urban plan elaborated in 1977 by Roberto Pane and Luigi Piccinato (but made executive only in 1987). It was an important intervention for the protection of civil and urban heritage of the Coast since it tried to deal with the process of over-building that was affecting this territory, with the aim, moreover, of safeguarding the "rustic buildings with vaulted roofs" representative of traditional building (Fig. 1). Preserving the rural houses of the Coast implies conserving the very essence of the territory: they are, in fact, in perfect harmony with the surrounding landscape and express the sense of spontaneous architecture. They are meant as the product of a constructive tradition that, even if not supported by rigorous project elaborations or by careful *ex-ante* studies, produces architectural forms that perfectly integrate with the surroundings. The predominant characteristic of the coastal houses is, as observed, the vaulted roof – barrel, cross, sail, *schifo* – vaults mostly extradosed. Their uniqueness, however, lies also in the spatial organization and construction features that give plasticity, making them a spectacular product of architecture, almost as "an object of clay out of the hands of a craftsman" (Pane, 1936; p. 6). The development and evolution of these buildings are to be found, as often happens, in the socio-economic activities as well as in the characteristics of the territory. Despite the presence of the sea, in fact, the people of Amalfi carried out both the mercantile and agricultural activities, practiced at different times of the year. This interest, and the consequent need to make the land productive and accessible, inevitably led to the redesign of the impervious coastal territory into a well-structured and organized landscape, in which the typical rural houses were built.

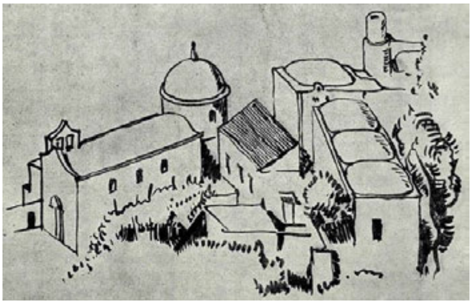

Fig. 1. Pane R., *Positano*. Tav 10 (Source: Pane, 1936).

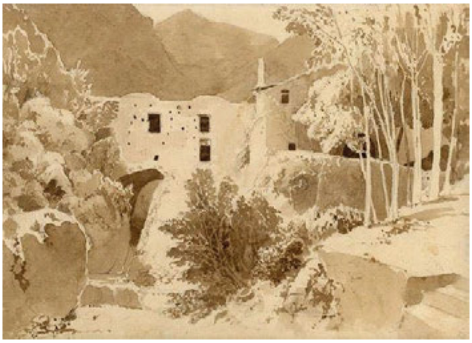

Fig. 2. Blechen k., *Gebäude, einen Bach überquerend*, May 1829. Sepia over graphite. Akademie der Künste (CC0 1.0).

Of questionable certainty, instead, is the Arabic influence on the constructive housing model: a hypothesis, this last one, that probably derives from the historical past and from the similarity with the Mediterranean houses of Islamic tradition, in which the extradosed vaulted roof in stone appears a typical element. However, as pointed out by Roberto Pane in his book *Architettura rurale campana*, the presence of ruins from the Roman period perfectly adapted and assembled in the farmers' houses, and at the same time the lack of wood as opposed to the abundance of stone material suitable for the construction of vaults (pozzolana, lapillus, volcanic scoriae), suggests the adoption of a building model consolidated locally since the Roman era (Pane, 1936).

3. Travellers to the "discovery" of the coastal territory

The interest in the coastal territory during the Enlightenment period is the consequence of an "extension" of the travel itineraries of foreign intellectuals (Mozzillo, 1982). The "discovery" of the Amalfi Coast with its intact, wild, unexplored landscape determined, started from the second half of the 18th century. The growing number of travelers arriving here were so enchanted by its beauty that they wanted to tell about it with drawings and descriptions (Messina, 2012). The Coast, therefore, became the privileged subject of several artists and writers who in those years stayed in this wonderful part of the province of Salerno (Richter, 1989). Over time, it is also possible to notice an evolution in the interest of travelers towards the environment. Initially, in fact, the attention is turned to the romantic aspect of the coast, impervious and difficult to reach, a mysterious and fascinating territory to be rediscovered and represented. The images produced by draftsmen and painters, therefore, rarely focus on the single architecture. What is captured and depicted instead is the great balance that exists between anthropic and natural space. With time, however, more and more attention is paid to vernacular architecture that, with its simplicity and at the same time austerity, enchants intellectuals and artists from all over the world, also influencing the ideals of various movements of avant-garde architecture.

3.1. The union between building and nature

On 16th May 1787, the Coast unexpectedly appears in Goethe's eyes (1749-1832) who collects his impressions in *Italian Journey* (Goethe, 1816), one of the first literary descriptions of this landscape: a territory rich in light and chromatic shades which generate sensations of harmony, and is able to arouse astonishment to whoever observes it. In those years, writings and representations about the Coast became increasingly widespread, so much so that they attracted famous romantic painters of the time here.

Among the most famous, Joseph Mallord William Turner (1775-1851), during his first trip to Italy in 1819, reproduced with a few but extraordinary pencil strokes the charm of the Amalfi Coast and the close connection between architecture and landscape. The contribution of the German landscape painter Karl Eduard Ferdinand Blechen (1798-1840), who traveled to Italy in 1829 and visited the Amalfi Coast, is also interesting. It was during his stay on the Coast that he produced several sepia drawings collected in the famous *Amalfi Skizzenbuch*. Often his views depict buildings with extradosed vaults and not wide landscape views. His drawings particularly underline the simplicity of the minimalist architecture of Amalfi, whose plasticity is dictated by the openings of the windows and of the organization of space: these always explain, with great effectiveness, the strong relationship between the work of man and nature itself (Fig. 2). The documentary contribution of Edward Lear (1812-1888), an English painter, poet, and traveler who, a few years later, made several drawings and watercolors of the Amalfi Coast (Camelia et al., 2017), some of which were dedicated to housing, is also precious. Like the other English travelers of the 19th century, Lear did not focus his attention only on the architectural element itself but generally included the entire surroundings. The result are *en plein air* representations that the artist makes after carefully identifying the "perfect" view to immortalize. In 1844, for example, he painted a view of the town of Cetara where the Torre Saracena, the dome of the church, and the roofs of the vaulted houses that once dotted the area are clearly visible. The village is surrounded by nature and is made up of simple cores that blend into perfectly with the surrounding landscape. A similar representation, from a top view, can be found in the sketch of Pogerola, also dated June 1844. In this preparatory drawing, on which there are also notes of various kinds, it is possible to notice a composition of extradosed vaults with different geometric configurations (barrel, *schifo*, pavilion, to mention the most evident ones) arranged in an almost linear way (Fig. 3). The space of the houses is generally developed on two levels and the composition of the plant is organized by the combination of several rooms distributed in line.

Fig. 3. Lear E., *Pogerola. 13 June 1844. (65),* 1844. Drawing, MS Typ 55.26 (296). Houghton Library, Harvard University (CC BY 4.0).

This layout is necessary to cope with the presence of steep and long terraces that are not very deep and characterized by strong changes in height. The nature of rural architecture, however, generally accentuated by the absence of a unitary project, makes it difficult to date the building precisely: indeed, in many cases, the various nuclei that make up the built space, all very simple, were assembled overtime to meet the needs that arose during the years.

3.2. Analysis and properties of the vaulted house

From the early years of the 20th century, the forms of rural architecture, especially in the Mediterranean, seemed to be of particular interest to intellectuals, fascinated by the simplicity and, at the same time, the refinement of the buildings. In particular, artists and architects not only found in these places a romantic setting, but also the inspiration for the development of new ideas. The vernacular architecture of the Amalfi Coast, together with that of the Island of Capri, thus became an opportunity for the development of new considerations by various avantgarde architects of the 19th and 20th centuries. A careful analysis of Amalfi's rural buildings is, for example, carried out by the neoclassical architect Karl Friedrich Schinkel (1781-1841) who, on the occasion of his journey to Italy in 1803, describes the unusual territory of the Coast and the existence of a great relationship between the buildings and the local environment, climate and culture (Fig. 4). The Prussian architect identifies in these architectures precise sources of design inspiration, focusing on the essentiality of the means used for their realization and on the authenticity of the forms, the building is the result not of careful design studies, but responses to human needs.

Fig. 4. Schinkel K. F., Stadt Amalfi am Golf von Salerno, 1810. Drawing, Inv.-Nr.: SM 1b.33. Kupferstichkabinett, Staatliche Museen zu Berlin (CC BY SA).

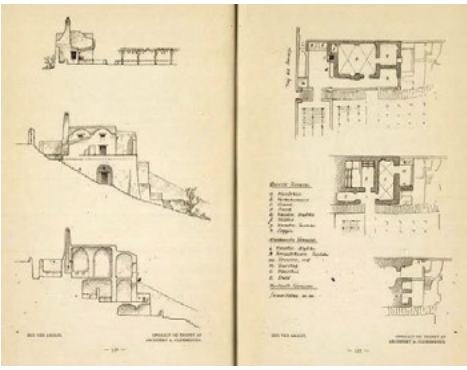

Fig. 5 . Clemmensen A. L., *Hus ved Amalfi*, 1905-1906. Arkitekten.

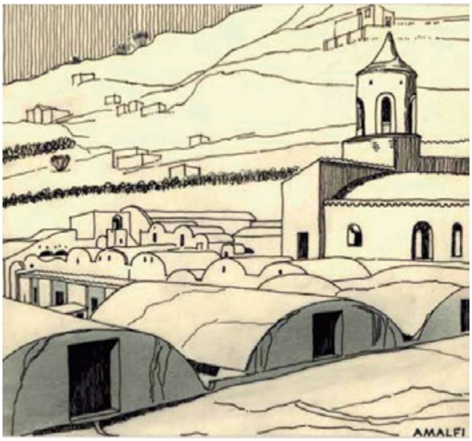

Fig. 6. Garcia Mercadal F., *Amalfi*, 1924. Black ink and pencil on vegetal paper. Private collection, Zaragoza (Source: Vallespín Mune-sia et al., 2019).

A further compliment comes from the Austrian Josef Hoffmann (1870-1956): he also found in the Coast signs and elements that would suggest his architecture and, in general, modern architecture. During the *Tour* of Italy, Hoffmann was struck by the simplicity of the rural houses, without pomp or particular style, but which nevertheless connote the Amalfi territory, making it unique (Sabatino, 2008). The influence of this harmonious laconism on the architect was demonstrated when, on his return from his trip to Campania, he proposed the Capri house as a design model in the prestigious magazine *Der Architekt* (Hoffmann, 1897). In 1906, a subsequent study was published by Andres Lauritz Clemmensen (1852-1928) in the magazine *Arkitekten* of the Federation of Danish Architects (Clemmensen, 1906). In this short article, the architect analyses a small medieval building located along the road to Conca (Belli, 2019). The structure is built against a rock face and the elevations, sections, and plans are reproduced in detail, accompanied by a descriptive legend of the rooms (Fig. 5). The building is on three levels, with barrel-vaulted and cross-vaulted spaces, and has large, scenic terraces on the outside. The spatial composition, certainly dictated by the orography of the site as well as the essentiality of the structure, gives a harmonious geometry in which functional parts, such as the eaves, are transformed into stylistic elements.

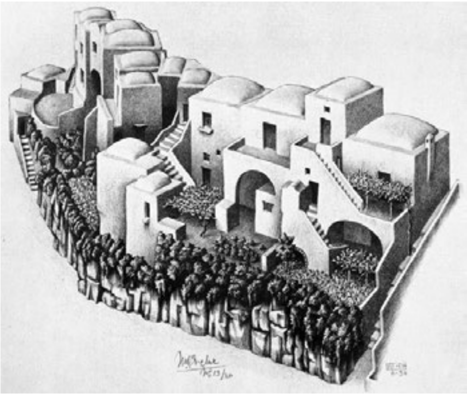

Fig. 7. Escher M. C., *Old Houses in Positano*, 1934.

Regarding the architectural configuration, the author hypothesizes that this is the evolution of a primitive core enlarged in a non-random manner, to respond to a series of needs and consider the coastal terrain. The building technique is also well-known, limestone masonry with lime mortar. Italian vernacular architecture also influenced many Spanish architects; among them, Fernando Garcia Mercadal (1896-1985) is noteworthy. In the early 20th century, he produced a series of drawings needed to study and analyze Mediterranean architecture. During his first year at the Spanish Academy in Rome, the architect from Zaragoza showed great interest in vernacular buildings, trying to grasp their foundations and suggestions for modernity. In a depiction of Amalfi (Fig. 6), for example, the prevailing element in the representation is a succession of simple buildings covered by extradosed barrel vaults. His drawings from this period show a great capacity for synthesis; the well-defined contours allow us to highlight parallelism with certain characteristics of the modern movement (Vallespín Munesia et al., 2019). These drawings are the result of an initial sketch made on site, a method which nevertheless manages to underline the essential and at the same time peculiar characteristics of these architectures, with their simple volumes which together generate a fascinating view.

The architectural charm of such modest buildings is also captured by Louis Kahn who, during his stay on the Coast, designed a fisherman's house in Conca dei Marini, the only one selected for the annual exhibition celebrated by the Academy of Fine Arts in 1929 (Montes Serrano, 2005). The architect's attention is focused on the contrast between simple volumes and the rocky ground, and the appropriate use of light and shadow allows the geometry of the house to be defined without the need for an outline. Essential, devoid of any form of decoration or redundant elements, the buildings of vernacular Mediterranean architecture express, in their simple archaic appearance, their adherence to necessity and the absence of any superfluous detail. They appear humble before the eyes of the artists, but at the same time, with flowing, elegant lines, perfectly integrated into their environment. They are almost as if they were "a living product of nature rather than of art [...]; they appear to have been built without the benefit of rigorous geometry, but with a sense of approximation that is perhaps the greatest factor in their picturesqueness" (Pane, 1936; p. 7).

3.3. Beyond Real

The representation of the Amalfi Coast and its vernacular Mediterranean buildings did not only influence Romantic painters, landscape painters, or modern architects, but also artists such as Maurits Cornelis Escher (1896-1972), who also found inspiration for his imaginary worlds in the architecture he admired during his journeys to Italy.

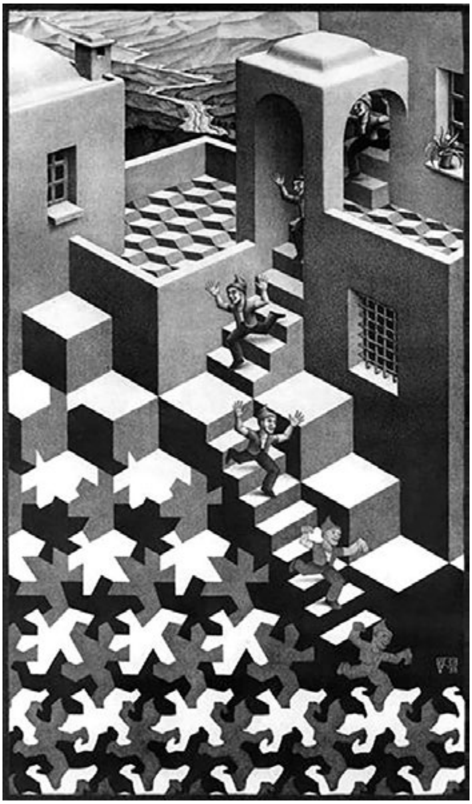

Fig. 8. Escher M. C., *Cycle, 1938*. Lithograph

There are several representations in which the reference to a typically Italian spatial setting is evident. In particular, Escher produced varius drawings and lithographs on the Amalfi Coast (Messina, 2014). This is the case of *Houses in Positano*, a lithograph produced around 1934 (Fig. 7). It depicts an agglomeration of traditional vaulted houses connected by external staircases - another typical sign of vernacular coastal architecture, which rarely has internal vertical connecting elements. Although these reproductions belong to the generally more realist period, they are the starting point for the better-known illusionary images and fantastic worlds that Escher presents in, for example, *Metamorphosis II* (1939-1940). The latter work, in a graphic process that could be defined as morphing, transforms the urban aggregate of the village of Atrani into a game of chess and the tower on the chessboard is a clear reference to the Norman artifact along the coast. The coastal suggestions also return in *Cycle* of 1938 (Fig.8): here, in fact, the buildings depicted reproduce, although in a stylized manner, the forms and geometries of the vaulted houses of Amalfi, whose terraces and staircases are also reproduced, which – as in Costa d'Amalfi – mix and evolve in an endless continuum (Van der Ham, 1986).

4. Conclusions

Camillo Jona, Giuseppe Pagano, Bruno Zevi, and Plinio Marconi are just some of the architects who over the years have focused on the relationship between utility, technology, form, and aesthetics, the origins of which can be found in residential buildings of the past. There are also countless internationally renowned artists and architects who have stayed on the Coast over time to admire, study and draw its vernacular architecture.

The journeys were taken to the South to observe the fascinating territory of the Amalfi Coast – with its vaulted houses set like diamonds in the surrounding landscape – and to rediscover the simplicity and essentiality of the architecture of its villages. These latter aspects, as John Ruskin points out in his writings, are distinctive features of Italian rural architecture capable of giving the building an *air noble* so that "while there is nothing about it unsuited to the humility of its inhabitant, there is a general dignity in its air, which harmonizes beautifully with the nobility of the neighboring edifices, or the glory of the surrounding scenery" (Ruskin, 1878, p. 40). An architecture that, however, too often goes unnoticed today, but which must be strongly protected, also through the knowledge that drawing, and representation help to spread.

Appendix

Author Contributions: B.M. performed and wrote “Introduction and conclusion”; C.F. performed and wrote “The vaulted house and its origins”; S.M. performed and wrote the “Travellers to the “discovery” of the coastal territory” and its subtitles.

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Traditional dwellings and techniques of the First Indigenous Peoples of South Africa in the Eastern Cape

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Topic: T1.1. Study and cataloging of vernacular architecture.

Abstract

Vernacular indigenous dwellings of the Khoikhoi Peoples (First Indigenous Peoples of South Africa) present in the Baviaans Kloof area in the Eastern Cape (South Africa) have been surveyed and are currently under study by the authors with the direct involvement of the community members. This research is of particular relevance because: it is conducted in a geographical area that is currently under-researched in respect to this particular theme; the dwellings are an exceptionally rare example of the use of Khoikhoi traditional techniques and materials; it was achieved with the direct engagement of the Indigenous community. The research collaboration applies a transdisciplinary approach and method – already in place with the NRF-CEP research by Dr Minguzzi – that employs a multi-layered methodology: practice-led research, community engagement/ community cultural development, influenced by narrative inquiry. In the age of globalization, it becomes necessary to study the origin and development of those buildings to understand their constructive process, the use of specific local materials as well as the consequences that the introduction of unsustainable colonial materials caused. This is an aspect that could be relevant for future reflection on how to preserve and promote the Indigenous cultural, social inclusion and sustainable built environment. The paper will define the state of the art and morphological, functional and technical analysis of contemporary Khoikhoi dwellings to identify the tangible and intangible cultural heritage and the influences of colonization on it.

Keywords: *Khoikhoi; South Africa; documenting Indigenous dwellings; participatory research.*

1. Introduction

Discussing the vernacular architecture of the First Indigenous Peoples of South Africa[1] – the Khoikhoi and San – is a complex topic, for many reasons, the main being related to the tremendous repression that these Peoples have suffered over the centuries since the arrival of the colonisers. Due to this repression, very little is left "visible"[2] of their tangible and intangible heritage.

1.1. Historical background

It is well-known, that the arrival and establishment of the settler colonials in South Africa[3] –

1 The First Indigenous Peoples of South Africa are the San (hunter-gatherer) and Khoikhoi (herders). Two groups which, in precolonial times had overlapping subsistence patterns and use of the territory, and which, from the colonist arrival until the present, have been fighting for the recognition of their identity and heritage. In this regard see: Besten M. "We are the original inhabitant of this land: Khoe-San identity in post-apartheid South Africa", in Adhaikari M. (2013), Burdened by Race: Coloured identities in southern Africa, UCT press, Cape Town.

2 Like many other Indigenous Peoples, oppressed by colonialism, the only way to preserve their culture has been to hide it, not share it with people external to the tribe or family, and in some cases, to "mix" it - using the métissage as strategy - with the one of the colonisers.

3 The arrival of colonisers in South Africa can be traced to the shipwreck of the Dutch ship Nieuwe Haarlem in 1497.

the Dutch East India Company[4] followed by the British empire[5] – led to an escalation of inequality and oppression, a slow and painful process in which the First Indigenous Peoples of South Africa lost their freedom to express the practices associated with their culture, their way of life and their religion. In other words, it led to a drastic interruption of their indissoluble ties with the land; with Mother Earth.

Before the enactment of the colonial policy of settlement, the lifestyle of the Indigenous Peoples was based on planned movements[6] in the territory, according to the seasons and the availability of natural resources such as water. Their holistic approach to nature was (and still is today) founded on the concept of "custodianship" of the resources that Mother Earth offers (Minguzzi, 2021).

The colonisation and dispossession of indigenous territory by the waves of settler colonisers, meant the delimitation of "private land", and the establishment of farms, through the use of fences and walls on which natural resources were located. Fundamental resources for the life of the Indigenous Peoples and their livestock were thus immediately restricted and controlled.

At the beginning of the 1800s the situation had already degenerated to a point where the Khoikhoi and San were not a free society but forced to prove they had some means of gaining their subsistence (Malherbe, 1978).

Indigenous oppression was exacerbated with the application of the racial laws of the Apartheid regime, in place from the 1948 until 1990. The Khoikhoi and San were mostly classified "coloured" together with the Malay, Javanese, Sumatran, Indian and Chinese people, and from this moment onwards, their distinct ethnic group ceased to exist[7].

1.2. Khoikhoi contemporary dwellings reflecting the pre-colonial indigenous knowledge

Through the above concise historical background (Cavanagh, 2013; De Jongh, 2012; Minguzzi, 2021) we can easily understand how difficult it was initially, and then impossible, for the First Nation of South Africa to be able to freely express their cultural heritage, of which architecture is a part.

There appears to be no examples recorded of pre-colonial First Indigenous dwellings handed down to the present[8]. In this paper the researchers examine examples of contemporary indigenous dwellings, where it seems very clear that Khoikhoi building knowledge, typology, materials and techniques have been handed down from generation to generation till the present. The examples analysed are located on communal land, in a remote and very isolated area, where the Indigenous people has been able to self-build their houses without the imposition of western-based systems.

2. Research Objective and Methodology

The objectives and methodology of this specific research are framed in the general research project entitled "Origin: and investigation on KhoiSan heritage sites" led by Dr Magda Minguzzi with a group of 10 indigenous leaders, staff and students of the Nelson Mandela University and supported by the National Research

4 The Cape was under Dutch rule from 1652 to 1795 and again from 1803 to 1806.

5 British sovereignty was recognised at the Congress of Vienna in 1815.

6 Theorists of international law have used the concept of Indigenous "nomadism" to imply "indifference" on the part of the natives regarding the occupation of their territory in order to justify property rights imposed by the European settlers. The movements of the Indigenous Peoples were geographically well-defined according to specific natural boundaries as rivers and mountain ranges.

7 The racial group classifications "Black, White, Coloured, Indian or Other" remain officially in place today. For example, when applying for a job or registering as a student at university, the applicant is obliged to fill in a form declaring to what racial group he or she "belongs".

8 Perishable materials have been used to build the indigenous houses which have contributed, over time, to the disappearance and easy deterioration of the buildings.

Foundation of South Africa. Which is a research project based on the documentation of the First Indigenous Peoples' pre-colonial tangible and intangible heritage in the Eastern Cape, using the community engagement/participation in each step of the investigation as modus operandi.

Here we are focusing on the dwellings as part of the heritage that need to be documented and deeply investigated.

The cases studied were identified during the site visits of Baviaanskloof by Gaob (Chief) Margaret Coetzee, Inqua tribe, Dr Magda Minguzzi and several community peoples.
In order to gather knowledge, especially of the change of techniques over time, we proceeded in two major directions. From one side we collected the archival testimonies of the early travellers to understand how, in pre-colonial times, the dwellings were described in terms of typology, techniques and materials used. From the other side we consulted and interviewed the indigenous community members of the area of study, together with the site surveys of the selected dwellings.

3. Analysis of Khoikhoi dwellings

3.1. Pre-colonial Khoikhoi settlements and dwellings

The descriptions of the pre-colonial dwellings left by Peter Kolbe (1675-1726)[9] are detailed, accompanied by technical drawings, and probably are among the earliest ones, and for those reasons we decided to use it as main point of reference for our investigation.

Kolbe wrote that the shape of the settlements, as well as the one of the huts, was circular, and he called them "kraals". The number of huts in a settlement was not less than twenty, and the inhabitants could vary in number and reach even five hundred people.

The huts were described as oval in shape, 12x3 meters, and built with a structure of sticks and covered by mats, that were fixed on the structure so the wind would not blow them away. If the mats were not enough, they used sticks to cover the structure The huts of wealthy people had a double covering: one made of mats positioned just above the sticks, and above the mats, a layer of animals skins.

Kolbe also describes the functional organization of the interior space of a hut which serves a single family, usually made up of 10 to 12 people. It is a centralized space around the fireplace, located inside a hole of 1 foot (approximately 30 cm) deep and serves to cook and as heating (Kolbe, 1731).

Schapera (1930) in his *The KhoiSan Peoples of South Africa* also writes about the tribal encampment and the huts of the Khoikhoi, referring also to the annotations of Kolbe, which were built at the beginning of the 18th century, long before his book was written. Shapera describes the huts as " (…) well adapted to the nomadic life of the people. They provide an airy shelter from the wind and the sun, are light in weight, simple in material and structure, and can be easily taken down, packed up, transported and rebuilt". He describes the skeleton of the huts as a frame made with light pieces in "supplied undressed wood" that are planted vertically in holes dug into the ground in a circle. "Their upper ends are then bent inward and tied together in the centre until the framework is compete." The main structure was made by the men. The next step is the addition of stalks of reeds bored through and sewn together with bark thread by the women. "The finished mats are then laid round and directly over the wooden framework. (…) The main entrance of the hut is usually opposed to the direction of the prevailing wind, and on the other side is left a smaller opening. (…) The floor in the interior is smeared over with a mixture of cowdung and

9 A German astronomer and mathematician that wrote the book that became probably the most well-known source of information on the Indigenous peoples settled around the area near Cape Town in the eighteenth century: "The Present State of the Good-Hope". Kolbe P.

blood, often renewed, and is covered with skins. In the centre a depression is made as a hearth for the fire, and round this are stretched the mats or skins on which the inmates sleep" (p. 230).

Futher in this paper we will compare the pre-colonial dwellings using in particular the observations and drawing by Kolbe – for the above mentioned reasons – with the ones surveyed by the research group.

3.2. Study sites

The houses analysed are located in two specific areas situated in the western part of Baviaanskloof[10], which is a narrow valley, sufficiently isolated, enclosed between two parallel bands of mountains. That part of the valley consists of a mix of large, privately owned farmland, conservation zones, and communal lands. The Indigenous Peoples occupy the communal lands where the studied dwellings are located, namely Zaaimanshoek and Sewefontein (Pérez, 2010).

Fig. 1. Point 1 and 2 are the sites where the communal lands and the dwellings surveyed are located.

Although there are farms that have been settled in this study area, the indigenous families have lived in the area from the pre-colonial period. Therefore their link with the place has not been drastically interrupted as for other communities located in other parts of the country that experienced severe forced removals. These conditions – isolation and permanent continuity – have created the perfect circumstances for which the houses that the natives have built today, present characteristics unmistakably linked to their origins, although colonial elements have been introduced.

Fig. 2. Aerial view of part of the settlement surveyed. (Source: Minguzzi, 2021)

Fig. 3 and 4. Examples of the dwellings surveyed in Baviaanskloof. (Source: Minguzzi, 2021)

3.3 Critical and descriptive analysis of the houses

Next, a descriptive critical analysis is presented that synthesizes the knowledge extracted from the case studies, from the following points of view: morphological, functional and material. It emphasizes the continuity with the pre-colonial huts described by Kolbe.

10 Dutch for "Valley of Baboons".

Morphological analysis

At the territorial level, changes are observed in the planning and organization of Khoikhoi settlements if compared with the pre-colonial time. The circular composition of the kraal defined by Kolbe is not in use anymore, although it is possible to notice some sort of organic and fluid arrangement of the dwellings. They are not organized around a central space as it used to be but follow sustainability criteria related to the wind directions and sun orientations or towards the access from the road. Although it is communal land, the notion of "private" use of the land has been introduced in the contemporary settlements, closely linked to the imposed western planning that divides the land into distinct properties and imprints a feeling of possession over the land that initially did not exist among the Indigenous peoples. In fact each house surveyed sits in a plot where the family has an area organized as vegetable garden, and space for animals (usually chickens).

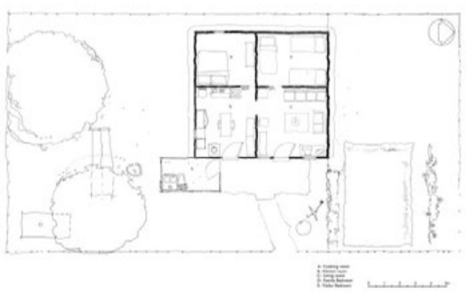

Fig. 5. Site plan of one dwelling. A. - cooking room, B - kitchen room, C - living room, D - family bedroom, E – visitors' room, F - toilet.

At the unit level, a fundamental transformation is observed in contemporary KhoiKhoi dwellings: the rectangular shapes have replaced the circular and oval pre-colonial shapes. Two causes explain this change: one, the influence of colonial dwellings and; two, the use of imported materials of straight geometry that are better adapted to orthogonal buildings. This is the case with metal sheets fitted to the roof structure.

The composition of the floor plan is centripetal and highlights the kitchen as a focal point. This fact establishes a relationship of continuity with the arrangement of the Khoikhoi huts.

In pre-colonial times the centre of the place, the fireplace, was the focal point, the space for eating and sleeping (holes) were organized around it. The same can be noted in the dwellings we surveyed where the living room, family bedroom and visitors' bedroom are disposed around the kitchen.

The cooking room with the fire stove is presented as an addition to the dwelling This is related to functional reasons and therefore manifests itself volumetrically. In the surveyed examples it is a volume almost separated from the main, but located on the main facade, with access from the same front step, transmitting its essential role in the whole. The presence of the cooking room characterizes the main facade of contemporary Khoikhoi homes, being an identifying and distinctive feature. Its origin could be traced back to the customs of the first Khoikhoi settlements. On the one hand, Kolbe describes that the ventilation and lighting of the huts were achieved only through the door and recognizes outside the cabin, near the access point, a fireplace made to scare away the beasts. On the other hand, other African communities studied in Togo (Hernández Navarro et al., 2020) and in Burkina Faso (Lidón de Miguel et al., 2020), used the outer space of the huts, near the gate, to prepare food and subsequent intake, reserving the fireplace inside the cabin in case of bad weather conditions. Therefore, although there is no evidence

Fig. 6. Reed wall and blue bush wall. (Source: Minguzzi, 2021)

in this regard, it is hypothesized that the current presence of the cooking room has a cultural significance, in that the current construction of the cooking room signifies the evolution from an open space to an indoor space.

Functional analysis

The basic needs programme is developed in the main construction and complemented with other auxiliary constructions. The main is inserted inside a polygonal plot, away from the fence. It presents its main facade in front of the principal road from where it is accessed. The auxiliary constructions are located near the fence and are intended for: toilet, henhouse, and store. The toilet cabin construction adopts western construction methods of concrete panelled wall and metal roof cover unlike the henhouse and the storage units which present traditional building practices with timber poles, mesh or netting and metal roof cover.

The main volume of the dwellings originates from 4 rooms. It is sometimes extended to 6 according to the number of family members, organized according to their public-private character. The kitchen and living room are always positioned at the front and the bedrooms (family and visitors) at the rear. The cooking room is attached in the northeast corner. This space has no direct connection with the other rooms, and its only access occurs through the front step. This disconnection is justified from a hygienist logic. It prevents the spread of smoke from coal combustion that is not adequately evacuated by its chimney. However, isolating the house from the warmer room (cooking room) is not a problem, as, on cold days, the living area is heated with a brazier with coal produced by the coal stove of the cooking room. This is how one of the community members explains it:

"We make food in the kitchen (referring to cooking room) which is also where the fire is made, and then we move towards the living area where we sit and have dinner. Sometimes we take the coal inside the house to the living area to keep the house warm"[11] (Minguzzi & Vosloo, 2021).

The kitchen is the heart of the house. It is the point of entry and distribution to the other rooms. In this room, the vistors are greeted and food is shared. This functional organization and the prominence that the kitchen assumes in today's dwellings is culturally related to the pre-colonial fireplace inside the hut and the organization of its space.

Other activities complement the functional programme developed inside the built volumes. These are carried out outside the house where the space is also conveniently arranged: terrace on the front step of the house to sit down to talk when the weather permits; washing and scrubbing place; clothes laying and drying area; vegetable garden, inside the plot a more densely fenced enclosure to prevent the intrusion of baboons or wild animals.

Materials analysis

The materials used to build the house are collected by the inabitants locally. They could be either natural resources or recycled from other abandoned constructions. This direct relationship with the environment leads to non-substantial material variations since no modifications of the construction techniques are observed. The constructive type is maintained, and variants have been found in respect of some materials used. As in the case of the reed wall or blue bush wall (Fig. 6).

The basic materials for the construction of the dwellings are bamboo poles for the main wall and roof structure (vertical), reed bundles for wall enclosures (vertical) and reed for supporting wall structures (horizontal). Traditionally layered reeds for roof enclosures (confirmed in interviews) and earth for coatings of walls and floors[12]. All of these materials are from the

11 Community member, interview with authors, 7 May 2021.

12 The mud is reinforced with manure.

nearby environment. It is noted that metal sheets have been added, which were imported since colonization, and currently replace the traditional roof made by the layering of reeds.

Other materials are used in smaller quantities. For example, lime and ash to improve the qualities of mortars; salt and manure to give toughness to soils, and; dye colour to tone whitewashed walls. Only the lime, salt and dye require external provisioning.

4. Conclusions

The Baviaanskloof area, Zaaimanshoek and Sewefontein settlements in particular, represent a unique case study of the culture of the First Indigenous Peoples of South Africa.

From the analyses and the comparison that have been made, we can affirm that the contemporary Khoikhoi settlements, despite showing influences from the colonial models, increasingly continue to preserve strong features of their origins.

This community has enjoyed the freedom to build, using spatial and functional organization as well as constructive techniques inherited from their ancestors. Therefore, the settlements studied constitute tangible documents that contain the cultural values of this social group and provide us with information about their way of life, their customs and their traditional holistic and sustainable approach to the environment. An approach that is of extreme importance because it can constitute a valuable, environmetally sustainable model to be proposed in other parts of the country.

"While materials do not necessarily determine the form and content of architecture, it is obvious that the form of any art is conditioned, to a greater or lesser degree, by the medium through which it is expressed" (Yavo, 2013).

At the scale of the dwelling, the pre-colonial construction with bamboo, reeds and earth is altered by the introduction of colonial materials such as sheet metal, or metal wire for the connections, causing mutations in the built forms. However, the link with the origins remains strong and in place as reflected in the built form.

The engagement and collaboration with the Indigenous members of communities was of extreme importance to the study presented here. A collaboration that gave us the opportunity to meet extraordinary community members and to learn and undestand from them the importance to live as part of nature.

Currently the research team works to obtain funds that can cover the continuation of the survey, in order to be able to collect more case studies, and to develop data already collected as video interviews.

Supplementary Material

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Rediscovered earth heritage becomes motor for local change
The Guérande Peninsula (France)

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
In the northwest of France, raw earth has been broadly used, especially in Brittany where cob dwellings have been built since the sixteenth century. Today, cob buildings represent 20 % of the built heritage on this territory (Bardel P., Maillard J-L. 2009). The cob technique is also found in the Vendée marshes, where squat dwellings ("bourrines"), dating back to the fourteenth century, bear witness to the use of local, natural resources (Patte E., Streiff F. 2006; Bonnet S., Alzeort D, Poullain P. 2021). Between these two well-documented earth-building territories lies the Guérande Peninsula where earthen heritage, until recently little-known and neglected, has become the object of study. As a result of several inventories undertaken by earth-building professionals, a part of this heritage has been recorded and mapped (Hilton A. 2016; Miranda Santos M. 2016; Humblot D., Josset F., Marquis B. 2018). Two main research methods have been used: a general audit of the specific areas of the peninsula where earth buildings exist; a targeted audit of certain villages and their buildings.
This latter entailed a comparison of historical maps with current cadastral maps, followed up by on-site verification. Following this inventory work, a sense of the nature and extent of local earthen heritage is beginning to emerge, feeding synergies with renewed local interest in earth construction. The Maison Neuve eco-district in Guérande presents a clear example of this: its objective is to reuse several thousand tonnes of its own site-excavated earth in earth-building projects over the next 5 years. The results of the inventory work helped this local project to understand the nature of the earth available and the different relevant earth-building techniques. The inventory work has also fed into local educational and awareness-raising activities to raise awareness of local earth-built heritage and disseminate best practice in the renovation of earthen walls.

Keywords: *Heritage; earth construction; cob.*

1. Introduction

Of all human activities, construction is one of the biggest consumers of global energy, depleting over 40% of all energy consumed in the economy (Dixit, 2019; Keefe, 2005; Ding, 2004). It also consumes 40% of the world's production of natural aggregates, 25% of the world's virgin forests and 16% of global water annually (Keefe, 2005; Ding, 2004; Dixit et al. 2010). The European Commission estimates that the sector is responsible for 50% of extracted raw materials in Europe (European Commission, 2011). It is also a major generator of waste (Dahlbo et al., 2015).

About 75% of building sector waste is made up of mineral soil, the raw material used in raw earth construction (Cabello Eras et al., 2013). Raw earth is a local resource with low embodied energy (Dixit, 2019) and possesses reversible characteristics (Hamard et al., 2016). For these reasons, raw earth stands out as a key building material in addressing the climate crisis.

In many higher income countries, the emergence of industrial materials in the early 20th century led to the abandoning of traditional materials and skills, including raw earth and associated expertise (Erica et al., 2008; Villain, 2020). However, over the past few decades, raw earth has attracted renewed interest, due to its low carbon footprint. This can be seen in the growing number of building projects and studies involving raw earth (Morel & Charef, 2009).

Traditionally, raw earth was used extensively in buildings in the northwest of France. In Brittany, cob dwellings have been built since the sixteenth century and represent 20 % of the built heritage on this territory (Bardel & Maillard, 2009). The cob technique is also found in the Vendée marshes, where squat dwellings known as bourrines, dating back to the fourteenth century, bear witness to the use of local, natural resources (Patte & Streiff 2006; Bonnet et al., 2021). Between these two well-documented earth-building territories lies the **Guérande Peninsula** where earthen heritage (see Fig.1), until recently little-known and neglected, has become the object of mapping and inventory studies.

Sustainable in itself, thanks to raw earth's excellent carbon footprint (Dixit, 2019; Hamard et al., 2016), the vernacular culture of cob building is also a beacon of inspiration for sustainability projects in current times. As individuals and institutions look more closely than ever for genuine solutions in the face of our global climate emergency, these rediscovered buildings are already providing inspiration and encouraging renewed interest in earth-building on a local level. As practical, vernacular expertise around earth-building has almost totally disappeared in the region, every cob building still standing is a vital witness and example from which a new generation of earth builders can learn.

Fig. 1. A cob outhouse at Kerhebé, dating from the mid-19th century (Source: Hilton, 2015).

Lessons gleaned from such buildings help assure best practice in earth renovation and construction projects. A number of local earth professionals and students have drawn significant understanding of the behaviour and qualities of local earth from studying the siting, conception and implementation of the existing cob buildings (Hilton 2016; Miranda Santos, 2016; Humblot et al., 2018). Recent inventory work, and the body of professional expertise developing from it, are already feeding into local initiatives. The new Maison Neuve eco-neighbourhood in Guérande is a good example (Ville de Guérande et Loire-Atlantique dévelop-pement, 2019). This flagship project aims to reuse several thousand tonnes of its own site-excavated earth in building projects in the eco-neighbourhood over the coming years. The findings of the inventory work in the Brière helped Guérande town council and the eco-neighbourhood's main developer, LAD SELA, to understand, firstly, that site-excavated mineral earth is not simply a waste product, but also a quality building material, and, secondly, that its reuse on-site is a neat, circular solution to the waste "problem" it presents. Also, drawing in part on knowledge of vernacular practices learned during the inventories, local earth-building professionals were able to advise this initiative on relevant building techniques, compatible with the qualities of the local, site-excavated earth (L'Echo de la Presqu'île, 2020).

The inventory work has also led Guérande's School of Art and Heritage and the Brière Natural Regional Park to develop new educational and awareness-raising activities around local earth-built heritage, plus, in the case of the Brière Park, to take several steps towards greater dissemination of best practice in earth building and renovation (Parc naturel régional de Brière, 2020).

The aim of this paper is to present the methods and findings of the recent inventories of cob buildings on the peninsula, undertaken by an interdisciplinary team of academics, researchers, university students, earth masons and a key regional partner, the Brière Natural Regional Park.

2. Investigation zones and methods

2.1. Investigated region

The region investigated in this work is the Guérande Peninsula, located in the west of France, close to Brittany (see Fig. 2). The area is known for its salt marshes, in the south-west of the peninsula, and, to the east, the Brière inland marshes. It is an attractive, touristic region and the peninsula is densely populated.

Covered with wetlands and famous for its many *chaumières* (thatched cottages), this territory also bears witness to significant use of earth in traditional construction. As well as many examples of wattle and daub[1] elements in both vernacular and noble buildings, the peninsula is home to an as yet unknown number of cob buildings.

1 Wattle & daub: plant structure with a fibered earth infill, which can be used to build walls or ceilings.

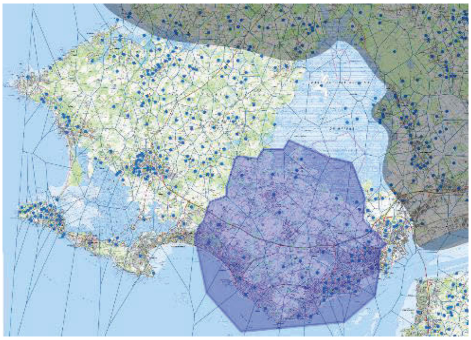


Fig. 2. Guérande Peninsula and Voronoi tessellation of the region based on the official names of locations (blue dots), with blue polygon showing the investigation zone.

2.2. Cob buildings

Various different techniques for building with raw earth exist, and generally developed in accordance with the qualities of the earth available in a given region. Cob, rammed earth, adobe, compressed earth blocks and wattle and daub (Houben & Guillaud, 2006) are all examples of earth-building techniques used in France. The cob technique is widespread in the north-west of France, especially in Brittany, Normandy and Pays-de-la-Loire (Bardel & Maillard, 2009; Patte & Streiff, 2006; Bonnet et al., 2021). As the Guérande Peninsula is located in this latter region, its cob buildings became the obvious focus for our research. The cob technique consists of stacking clods, or patties, made from a wet raw earth mixture with a fairly stiff consistency, in order to build a monolithic, load-bearing or free-standing wall. The earth is excavated on-site or nearby and may well be mixed with natural fibre additives such as straw, reed or hay. A cob wall is built in layers known as "lifts", as each layer of the fresh, wet material has to dry sufficiently before a further lift can be applied, in order to support the mechanical load of the upper layers. Cob building generally also comprises a stone foundation plinth, which protects the walls and floors from water damage from capillary rise and splashback from rain hitting the ground.

2.3. Investigation method

In order to locate the cob buildings on the Guérande Peninsula, we combined several sources of information and open source digital tools. The first step was to demarcate sub-zones for investigation. To do so, we imported the digital map of the region from Géoportail, a government website[2], into the geographic information system application QGIS. Each place (hamlet, village, district, etc) is already assigned a location and a name on the Geoportail map. These locations were used as nodes to perform a Delaunay triangulation, from which we obtained Voronoi cells (Fig. 3).

Delaunay triangulation is an optimised method to join the nearest nodes and create a triangular mesh. The Voronoi tessellation method allows us to create a tiled partition of the surface in which each vertex of a given polygonal Voronoi cell is equidistant to the vertices of the Delaunay triangle it belongs to. Each Voronoi cell on the map is an investigation sub-zone.

As this method is based on location names, and as the number of dots on location maps is greater in denser zones, it allows us to delimit the investigation zones according to building density. This is the reason why the investigation zones (Voronoi cells) are larger in the countryside than in the towns.

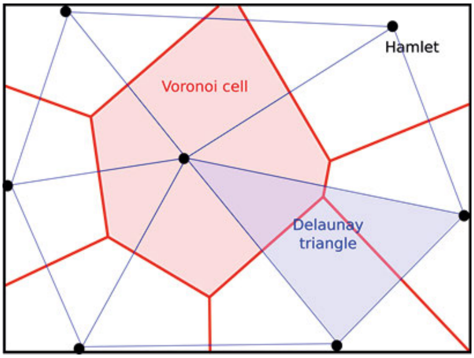


Fig.3. Delaunay triangulation and Voronoi diagram to define the investigation zones

2 www.geoportail.gouv.fr.

It should be noted that the area of study, to the north of the port town of St Nazaire, suffered large-scale destruction due to bombing during the Second World War. Surviving old buildings are scattered amongst the many post-war, modern buildings. In order to assess the importance of the cob heritage, which we assume to have been built before WWII, we therefore had to look at general maps dating from 1850 (IGN Institut). The next step was to import these maps from Geoportail into QGIS, and to superimpose the 1850 map and the modern map. This allowed us to identify matching constructions which were then circled and numbered (see Fig. 4). Then, using Google Maps and Google StreetView, we carried out virtual visits to the different locations identified, which allowed us to ascertain whether the constructions were old or recent. These visits enabled us, firstly, to eliminate certain locations where old buildings had been razed, and secondly, to note if matching buildings were old or recent. Once identified, matching old buildings were inspected closely via StreetView to try to detect the construction materials used (stone, cob or both). This preliminary screening stage was followed up by field visits to confirm whether the buildings identified as being potentially built of cob were indeed so.

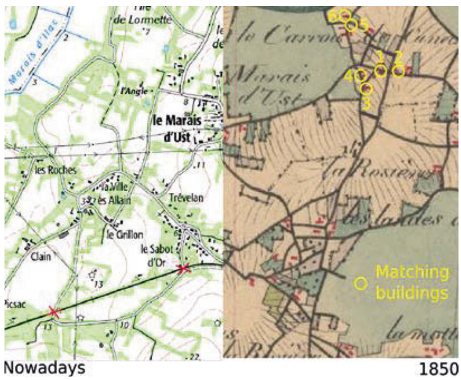


Fig. 4. Comparison of the maps and matching buildings – Focus on the “Carrois de Cuneix” hamlet.

Once a cob building was identified, we took photographs and noted certain data : type of building (dwelling, outbuilding, etc.) ; state of preservation (based on pre-established parameters) ; building dimensions ; height of the stone foundation plinth ; height of the cob lifts. These data were finally keyed into QGIS to complete the database.

Fig. 5. Examples of Google StreetView investigation to find cob buildings - the numbers correspond with the circled buildings on Fig. 4.

The results presented in this paper concern buildings located on the eastern part of the peninsula around the towns of Saint-Nazaire, Pornichet, Saint-André-des-Eaux, l'Immaculée and La Baule (blue zone on Fig. 2). Other buildings outside the investigation sub-zones were also found by talking with inhabitants during field visits, by Hilton's work [4], and during heritage events, local festivals and other awareness-raising activities.

2.4. Statistical analysis

For the numerical parameters measured on accessible buildings, we determined the normalised distribution fX(x), i.e. the percentage of buildings for which the value of a parameter X (wall height, lift height) is lower than a given value x.

$$f_X(x) = \mathbb{P}(X \leq x) \qquad \text{Eq. 1}$$

To do so, we discretized the interval of variation of the parameter and we counted the number of buildings fulfilling the condition described by Eq. 1. Then we divided this number by the total number of buildings. We then derived the 25%, 50% and 75% percentiles that give a statistical description of the value distribution inside their range of variation. We also calculated the average and standard deviation for each parameter.

3. Results and discussion

3.1. The cob buildings, in numbers

Using the method described, we identified, in the investigation area, 802 buildings which we suspected to be old and potentially built from cob. For the moment, we have visited only 50% of the buildings identified.

Among these, we have identified 46 cob buildings, representing 6% of the total number of buildings. However, many more of the buildings visited have been classified as "suspected cob" because it was not possible during the field visit to determine whether they were definitely made of earth or not. This is because certain buildings were located on inaccessible private properties, the owners of which were not present at the time of the visit or did not allow us to enter their property. Nevertheless, remote observation of these buildings led us to believe that they were potentially made of cob.

Category	Number	Percentage
Total	802	100%
Still to visit	400	50%
Cob buildings	46	6%
Suspects	149	19%
Other buildings	207	26%

Table 3.1. The cob buildings in the investigation area

The 26% remaining buildings are either old buildings made of stone or wood, or new modern buildings. So, up to half of the buildings visited are potentially made of cob, a finding which validates our searching method.

3.2. Cob building location

In order to better understand where the cob buildings are located, we used the automatic algorithm HeatMap implemented in QGIS. It creates a colour map corresponding to the number of entities in the investigation zone. The result is presented in Fig. 6. We can see that most of the buildings are located to the north-east of the zone (22 in Marais des Aurielles and Le Petit Marsac), on the edge of the Brière marshes.

A secondary group is located to the south-west (16 in Saint-Sébastien, Chaussepot and Le Guézy). Both these zones are poorly populated rural areas, which could go towards explaining the significant number of cob buildings remaining there. Pressure on real estate is lower in these areas compared to the towns of Saint-Nazaire, La Baule and Pornichet, where the increasing need for accomodation forces the municipalities to incentivise the construction of residential buildings, leading to the destruction of old ones. Even so, certain buildings are located in the old quarters of sea-side resort towns such as Pornichet.

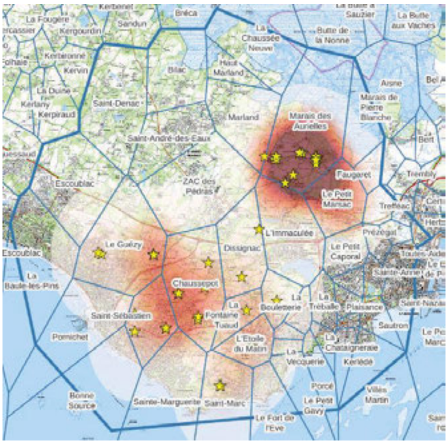


Fig. 6. Location of cob buildings in the investigation zone - the red zone represents the density of the cob buildings discovered.

3.3. State of preservation

We classified the 46 cob buildings identified according to one of four states of preservation (Fig. 7):

- *Destroyed*: present on old photographs collected from local inhabitants but not present on site
- *Ruin*: not usable, no roof, only the walls or part of the walls
- *Good*: usable as an outhouse, existing roof
- *Habitable*: the building is still used as a permanent dwelling

Fig. 7. Cob buildings in different states of preservation

The following table presents the results of the classification. We can observe that most of the cob buildings in the investigation region are still in a good state of preservation (63%) and two of them are occupied.

Category	Number	Percentage
Total	46	100%
Destroyed	3	7%
Ruin	14	30%
Good	27	59%
Habitable	2	4%

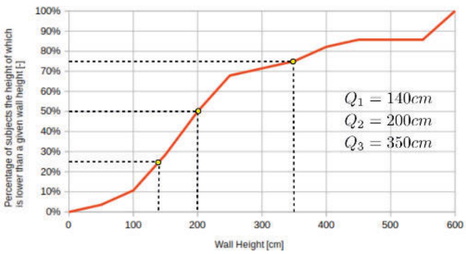
Table 3.3 State of preservation – Cob buildings

3.4. Statistical analysis

For each of the accessible buildings, we measured different characteristic lengths. Statistical analysis relative to the cob buildings' wall heights (for 28 buildings) and lift heights (for 20 buildings) is presented below. The distribution functions are given in Fig. 8 and the statistical parameters in the following table:

Parameter	Wall height [cm]	Lift height [cm]
Average	262	61
Standard deviation	160	10
Q1	140	50
Q2	200	56
Q3	350	62

Table 3.4. Statistical parameters of lengths



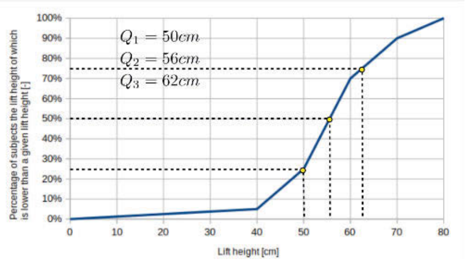


Fig. 8 : Statistical analysis of wall height and lift height for the different cob buildings

We can see that some of the buildings have walls as high as 600 cm. These are the habitable houses that are in a good state of preservation. However, some of the high values belong to ruins. The lower heights were all measured on ruins. 50% of the buildings have a wall height of between 140 and 350cm.

The lift height varies from 40 to 80 cm, with an average value of 61cm, which is in accordance with values available in literature (Hamard et al., 2016). 50% of the buildings present a lift height of between 50 and 62 cm. The lift height can generally be correlated to the properties of the fresh earth during construction and possibly also to wall thickness. This latter parameter is not presented in this study as only a few buildings were accessible for such measurement. It would nevertheless be interesting to correlate these different pieces of information to develop knowledge around the local technical specificities of cob construction.

4. Conclusions

In this article, we presented an original investigation technique based on a comparison of historical maps from 1845-1855 (IGN Institut) with current land registers to identify existing cob buildings and, thanks to digital tools and field investigation, to check whether the identified buildings are truly made of cob. The field investigation allowed us to confirm the validity of the technique and to gather complementary pieces of information relative to the buildings (type, state of preservation, wall height, lift height, etc). The analysis of the results using the software QGIS allowed us to show that the cob buildings are located in poorly populated rural areas where the real estate pressure is low compared to the neighbouring towns. The buildings identified are mainly in a good state of preservation and used as outhouses and in some cases dwellings. To date, we have also identified cob buildings in other parts of the peninsula, via different approaches. In future research we intend to apply the technique described in this article to analyse the other parts of the peninsula and verify whether the areas around the medieval city of Guérande comprise cob buildings.

The cob heritage on the Guerande Peninsula is still present but disappearing, and could vanish rapidly if people are not aware of the interest of this vernacular architecture. As a result of this research, the cartography of a centuries-old architectural culture is beginning to emerge. In recent decades, local institutions have carried out important work to protect the thatched cottages on the peninsula, as these vernacular buildings bear witness to local skills and ways of life. A similar approach could help to protect local cob heritage, and in doing so also highlight its many lessons for sustainable building practices today.

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Tradition and semantics: the case of Aeolian architecture

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
Vernacular architecture is identified as a structure based on specific local needs, on the presence of building materials present in the place and on the extemporaneousness of the architecture, built according to structural dogmas based on the local construction tradition. This is confirmed by the etymology of the word 'vernacular', from the Latin "vernaculus", meaning "indigenous, domestic", or from "verna", that is "native slave". In the present, vernacular architecture takes on new meanings, often used as an identifier for popular architecture - as also stated by Allen Noble in "Traditional Buildings: A global Survey of Structural Forms and Cultural Functions" of 2007 - or rather structures belonging to common people but «That can be built by skilled professionals, using local and traditional designs and materials», which is also supported by the Oxford English Dictionary. It is in this context that the vernacular Aeolian architecture fits, which significantly and identically characterize the entire territory of the Aeolian Islands, awarded the title of World Heritage Site by UNESCO. Aeolian architecture is inextricably linked to the history of the invasions of different peoples that have taken place in this area, such as the Greek-Roman, Islamic and finally Campania influences, due to their modifications both from an urbanistic and compositional point of view. But today how is it possible to encourage the dissemination and knowledge of these architectures which are so identifying for the Sicilian territory? Cataloging and semantics are configured as fundamental actions for the analysis and use of the architectural heritage, broken down into its deepest formal and compositional characteristics, identifiable in Aeolian architecture through the identification of semantics with a peculiar nomenclature. This article therefore investigates the aspects of semantics applied to traditional language and the compositional characteristics of Aeolian architecture, treated as an indissoluble link of knowledge and analysis of the building, through possible uses of digital applications.

Keywords: *Aeolian architecture; tradition; cataloging; semantics; digital dissemination.*

1. Introduction. Vernacular heritage as a synthesis between architecture and history

In order to deal correctly and thoroughly with vernacular architecture, specifically the Aeolian vernacular architecture, it is essential to understand the history and genesis of this type of architecture that defines places so much, tracing a sign in the mind of those who observe them. Vernacular architecture represents the origin of all architectures, structures without constructive dogmas as much as local traditions and materials more or less scattered throughout the surrounding area. In this sense, vernacular architecture is defined as the traditional architecture of a specific place, performed by local builders who do not have special construction studies and with local raw materials. These architectures are also defined as spontaneous architectures, as the

Latin origin of the word itself suggests, which refers to domestic and native elements, as it is extremely adapted to the needs of the place and not the result of reasoned planning. As stated by the architect and historian Bernard Rudofsky, it can be defined as a spontaneous architecture (*non-pedigreed architecture*), referring to the concept of traditional architecture from the tents of nomadic peoples, to Celtic tombs, etc. (Rudofsky, 1964). It is thanks to him that, in the course of the *Architecture without architects* exhibition set up at the Museum of Modern Art in New York, the term vernacular was born: «For lack of a generic label we will call it vernacular, anonymous, spontaneous, indigenous, rural, depending on of the cases».

Previously, the word 'traditional' was used as an adjective dedicated to these architectures, although the total distance of these structures should not be confused with the real 'traditional architecture'. This is because traditional architecture properly understood, while welcoming similarities with vernacular architecture, is also identified with 'polite' design elements: temples and palaces are an example of this. It is for this reason that vernacular architecture refers to aboriginal, indigenous, ancestral and rural structures, in contrast to the more intellectual, formal and academic traditional architecture. In fact, it should be remembered that Rudofsfky's definition has always been considered limiting and problematic as this type of architecture clearly deviates from the adjectives 'anonymous' and 'spontaneous', as they are influenced by the climate and intentionally designed. What makes a vernacular architecture impossible to replicate, and therefore from the necessary implementation of the safeguard, is undoubtedly the intent of the building, the spontaneity of the designer of the design act, in constant thought and rethinking. The architecture carefully designed by professional architects, albeit extremely learned about the characteristics of the place, of local and vernacular architecture, can never be equated with an impromptu construction. As Paul Oliver argues in his book *Encyclopedia of the Vernacular Architecture of the World* (1997), vernacular architecture "includes people's homes and all other buildings. In relation to their environmental context and available resources, they are usually built by the owner or the community, using traditional technologies. All forms of vernacular architecture are built to meet specific needs, adapting to the values, economies and ways of life of the cultures that produce them». These architectures therefore go hand in hand with respect to a specific place and period, as they respond to defined needs. It is in this context that the vernacular Aeolian architecture fits.

2. Aeolian architecture: history and landscape

Aeolian architecture represents a splendid example of architectural style developed in the geographical area of the Aeolian islands, also known as the Lipari islands, or rather an archipelago belonging to the Aeolian arch located in the southern Tyrrhenian Sea, north of the Sicilian coast. The Aeolian territory welcomes by its nature a landscape of high beauty, guarding in addition to a large number of naturalistic and cultural sites, two active volcanoes today, namely Stromboli and Vulcano. The Aeolian archipelago includes seven islands - Lipari, Salina, Vulcano, Stromboli, Filicudi, Alicudi, Panarea - and numerous other islets not far from each other and easily accessible by private boats or hydrofoils placed for public service (Fig. 1).

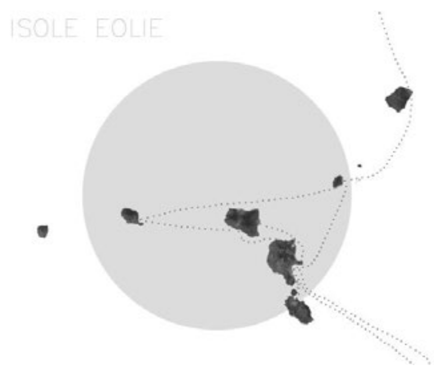

Fig. 1. Aeolian islands.

The Aeolian architectures fit into a landscape marked by terraces, in order to create flat footpaths, alternating with unspoiled, wild and steep nature. In these territories a shrub-like vegetation typical of the Mediterranean scrub flourishes and the cultures are for the exclusive use of vines and capers, making a small contribution to the Aeolian economy. In this sense, we also remember the prickly pear, which is the most characteristic plant essence of the landscapes and architectures of these territories. It is in this landscape and geographic context that the style and characteristics of Aeolian architecture develop (Sabatino & Lejeune, 2010). Over time, this has been affected by the numerous historical events that have taken place, defining and determining the culture, life and consequently also the architecture of this area. Today's architecture is characterized by an urban fabric defined by multiple building types: from the houses of the less affluent population to the villas or buildings of the wealthiest families, passing through the houses of artisans, workers, fishermen, etc. To intersperse the architecture for residential use there are structures that mark and characterize the territory such as, for example, small watchtowers and defense towers, churches, sheds used for processing and pumice[1], archaeological finds, etc. But it is rural architecture, that is, the one identified with the word 'Aeolian' that characterizes the main historical urban or agricultural fabric. It is this type of housing that this contribution addresses in order to dissect the semantics and possible methodologies to be put in place in order to ensure its usability, dissemination and knowledge according to digital systems.

1 The extraction of pumice stone in Lipari, one of the seven Aeolian islands, has always been a huge economic and then tourist source for the entire island and its surrounding islands. In fact, since the Neolithic, the extraction of this stone was practiced together with obsidian, generating an export of 100-200 tons per year. It represents one of the most widespread building materials of the Aeolian vernacular architectures of the past. Today the quarry is abandoned, serving as a backdrop to the expanse of the sea every year flooded by tourists in search of refreshment from the warm climate typical of Sicily.

3. Composition, semantics and cataloging

Vernacular architecture still represents a heritage to be protected and preserved as a historical memory of peoples and architecture. In this sense, Figini (1950) defines the value of vernacular architecture as «A lesson in morality and logic (simplicity, sincerity, modesty, humility, adherence to necessity, renunciation of the superfluous, adaptation to the human scale, adaptation to local conditions and environmental). A life lesson (extensive use of 'intermediate' elements between outdoor and indoor life, loggias, terraces, porches, pergolas, patios, enclosed gardens, etc.). A lesson in style/anti-decorativism, love for smooth surfaces and elementary sculptural solutions, the site and the 'frame' of buildings in the landscape».

As stated by Figini, therefore, this type of architecture by its nature welcomes a very precise semantic language, made up of specific structures and nomenclatures, but above all of well-defined living spaces: internal and external. In this type of structures, in fact, life outside the home is often very present, a consequence of small homes or homes inhabited by numerous family members[2]. Aeolian architecture, in the same way, originally consists of non-redundant spaces, although the size of the place together with the low percentage of the population made it possible to build much larger houses than other known vernacular architectures. Today, the Aeolian-style houses maintain their main characteristics, despite the urban and tourist development that has affected the islands in recent decades. The Aeolian architectural structure, which is a type of structure common to all the islands present, is characterized by a cubic type setting. The expansion of the architectural organism takes place through the multiplication of cubic modules according to the vertical or horizontal axis, while maintaining the other

2 In this sense, we recall the Apulian *trullo*, in which a large number of family members resided - in addition to animals such as hens or donkeys - in very narrow spaces. For this reason, every moment of daily life is carried out outside the home.

semantic characteristics explained below unaltered. The only substantial difference from the past is represented by the conspicuous presence of windows. In the past, in fact, this type of construction had to respond above all to the need to defend against external dangers, mainly attributable to piracy, and was therefore equipped with a single entrance door and two small circular windows with bars, today no longer present, accompanied instead by further holes of a larger size. Even the location of the houses in the most inaccessible areas was a consequence of the dangers coming from the sea, subsequently giving way to buildings closer and closer to the coastline. The Aeolian architectural elements today configure a type of dwelling well defined by semantic/compositional characteristics peculiar to the tradition and denominated in the typical local dialect: the Sicilian dialect. As mentioned, the Aeolian construction develops according to cubic compositional models, allowing the structure to be adapted to flat areas or rocky ridges. The cubic overlap in a vertical sense is generally made up of two cubic rooms not communicating internally - although there are fewer houses with vertical overlap communicating internally - but connected by means of a staircase placed on the outside surmounting a flying buttress. This type of overlap is typical of the period of pirate raids, as it is more suitable for construction on steep hills (Fig. 2).

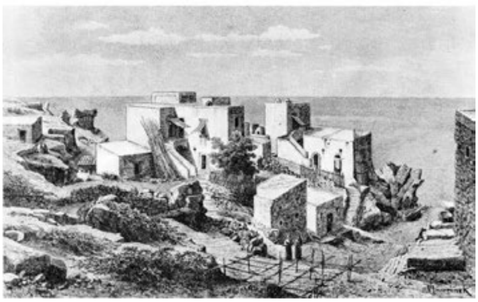

Fig. 2. Rural houses near the Piscità district, Stromboli (Source: Famularo, 1971).

With the passage of time, the cubic cells of horizontal development spread, more performing for flat areas, obtained through the juxtaposition of two or more non-communicating cell compartments and stretched out onto a large terrace. Having defined what is configured as the general compositional apparatus of the main structure, it is possible to precisely define the different sematic characteristics that make up the Aeolian house. The layout of the rooms is divided according to a horizontal axis from which the various rooms open in succession. The first room, that is the entrance, is a loggia or terrace (*bagghiu*) generally covered by a pergola[3] (*cannizzi*) on wooden beams, supported by cylindrical pillars of white plaster (*pulèra*). Along the terrace there is a stone step raised above the floor, often covered with polychrome majolica tiles, giving life to a seat (*bisola*) along the entire perimeter of the terrace (Fig. 3). The terrace was often accompanied by a rustic lava stone wash house (*pricu*) and a tub for washing clothes (*pila*) (Fig. 4) (Maffei, 2000).

Near the house, connected by the terrace, it is often possible to notice some small structures used for production purposes: the mill for grinding wheat and barley, the cellar, the stables (*pinnate*), the mills for pressing the olives (*palmento*) and of the semi-underground stables of straw and stone (*pagghiara*). It is the terrace that connects the house to a small vegetable garden connected to the *littiera*, that is a small space in which figs and grapes were placed to dry on the characteristic cannizzi, placed in the shelter in the evening in the open-air warehouses. Also in the external space is the *furnu*, that is the oven used for baking cakes and bread (Fig. 5) and the *furnieddu i squadari*, that is a hearth for sterilizing raisins (Lo Cascio, 2005). During the winter months it is the internal space that is the fulcrum of domestic life, carried out in a modest space in which the kitchen triumphs (Fig. 6), composed of masonry and polychrome

3 This cover serves to shade the terrace during the day and to protect the rooms from humidity in the evening.

majolica, traditional local materials, a pyramid-shaped hood surrounded from a wooden beam serving as a shelf. The layout of the rooms is extremely conditioned by the surrounding environmental factors.

The external environment, such as the terrace, is always facing the sea as this solution allows greater cooling of the environment due to the wind on summer nights. The spaces dedicated to the sleeping area, on the other hand, are often located towards the mountain side as they are able to intercept less solar radiation and, therefore, a more comfortable internal temperature. It is therefore about housing founded and thinking in order to live social life and the surrounding area as much as possible. In this sense, the composition of this type of housing reveals a different model of social life, more open to the neighborhood and the landscape, in a housing context that reflects the modest living conditions and dedicated to the essentials of existence.

In line with the modus operandi of vernacular construction, the materials used for these architectures are mainly: pumice stone for the external masonry; the blocks of massive lava stone for the foundations; pumice stone for the external walls; pozzolanic mortar and lime to make the roof waterproof; the tuff for the covering of the walking surface of the house and terraces.

It is only with the passage of time, and with the increase in tourist flows to the Aeolian islands, that these homes are enriched with new materials and decorations: decorative frames in local stone; precious finishes with lace or masonry pinnacles that embellish the roofs and walls; brightly colored or totally white plasters (figs.7-8).

Fig. 3. Representation of the *bagghiu* (blue), the *pulèra* (purple) and the *bisola* (fuchsia) in a house in Lipari, 'Marina Lunga' area.

Fig. 4. The wall surrounding the terrace (*bisola*) in a house in Lipari, 'Marina Lunga' area.

Fig. 5. The *furnu* in a house on the island of Stromboli.

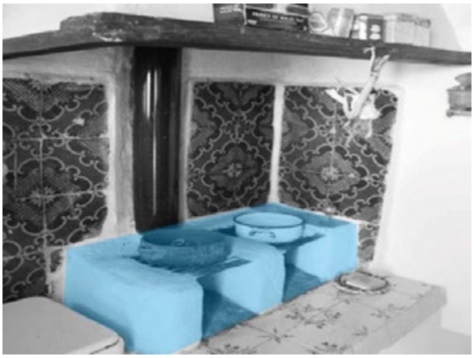

Fig. 6. The kitchen in a house on the island of Stromboli

Fig. 7. Alicudi Island (Source: web).

Fig. 8. Locking systems. Detail. Stromboli Island.

4. Cataloging: possible digital dissemination

As Paul Oliver (2003) states, «There is still no clearly defined and specialized discipline for the study of housing or the broader compass of vernacular architecture. If such a discipline were to emerge, it would probably be one that combines some of the elements of both architecture and anthropology with aspects of history and geography». It is now known how the learning of knowledge takes place through the transposition of the same on digital representations, to safeguard/enhance the places (Bortolotti et al., 2008). These immersive technologies enhance the conception of space, amplifying the real experience through virtual spaces capable of educating the visitor towards previously unexplored cultural concepts (Krueger, 1985).

In this context, the semantic cataloging of Aeolian architectures represents the premise through which to hypothesize possible applications in the cultural sphere capable of disseminating knowledge and the enormous historical and cultural potential of vernacular architectures. The semantic identification of these architectures allows the classification of the same by common characteristics and almost completely present in every architecture in pure Aeolian style. By creating digital applications that can be used from smartphones, it is now possible to re-read the artefact in both intellectual and virtual terms (Croce et al., 2020) through the creation of opensource applications which, through Beacon sensors[4], can being able to tell the user about semantics, history and culture. Getting ready in the immediate vicinity of the architecture, it is possible to view, through augmented reality, the same architecture painted in different colors, to identify and indicate the nomenclature of each compositional part, viewing the etymology (Fig. 9). Knowledge of the artefact is completed through the transmission on the same application of stories of the island, cultural

4 Associated with POI (Points Of Interest).

analyzes and small tourist suggestions, in order to make the visit increasingly aware and interactive.

Fig. 9. Augmented reality application. Semantic reading.

The use of this type of digital dissemination is the consequence of a reflection implemented in the context of the specific knowledge of the territory with respect to the language/dialect of the place. The linguistic identity of the places, in fact, is configured as a fundamental aspect for the social and architectural understanding of these places as it is strongly connected with everyday life and social space. In this sense, the Aeolian islands are a privileged summer destination for tourists from all over the world, but often unaware of the intrinsic cultural history belonging to the places they lived. A digital application would make a linguistic tradition more usable that would otherwise not be sufficiently disclosed in the tourism context, making users more integrated into social, cultural and architectural places.

5. Conclusions

Ultimately, the vernacular cultural heritage represents a bet with enormous potential to be exploited both for the growth of knowledge and for the enhancement of the territories, potential attractors of important tourist flows. The semantic identification represents one of the possible interpretations not only of the Aeolian vernacular heritage but also of the rest of the heritage characterized by semantics and recurring compositional characteristics. This latter reading, more classical and traditional, can be combined with all those enhancement systems capable of making the user an integral part in the discovery of architectural and cultural knowledge. In fact, it is now well known that digital dissemination represents the right compromise between the transmission of knowledge and the safeguarding of cultural heritage, in the case of the Aeolian heritage which is extremely tied to the tradition of the places and the island culture.

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The Italian case of *Leopoldine* in Tuscany: methods and issues for the cataloguing of rural building heritage

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract

*The Val di Chiana is characterised by a dense rural building heritage, which differs according to its mountain, hill and plain areas. Among the houses on the plains, there is an elegant model called '*Leopoldina*', which can be considered an exemplary case of vernacular architecture: indeed, such a farmhouse, built on the occasion of the land reclamation initiated during the Grand Duchy of Pietro Leopoldo of Lorraine (1765-1790), presents local materials and building techniques and, moreover, it was designed to meet the precise economic, agricultural and lifestyle needs of the peasant families of sharecroppers. Although the* Leopoldine *refer to a repetitive typological model, there are many singularities that can be found in the Val di Chiana area, both from the formal and constructive point of view. For this reason, it is indispensable to have a thorough knowledge of them, based on cataloguing. The Landscape Project entitled "*Leopoldine in Val di Chiana*" (Tuscany Region, 2021) proposes cataloguing the Leopoldine, while in the past, certain municipalities in the Val di Chiana had already carried out a survey of these abodes. However, from a critical analysis of the various files, certain critical points have since emerged. Thus, the present contribution introduces a new tab model of* Leopoldine*, taken from a PhD Research Project, based on both the richness of information and on an inter-dimensional reading between architecture and landscape: the purpose is to allow an exhaustive knowledge of the factories within the Lorraine area aimed at restoration and re-use projects compatible with the value of the houses, as well as with the development needs of the territory involved. For this reason, the tab has become a valid tool, even to be adopted in agricultural territories, through which it is possible to address, the challenge proposed by the Convention on the Value of Cultural Heritage for Society (Faro, 2005) of heritage conservation in a sustainable way, as an opportunity for the recognition and strengthening of social cohesion.*

Keywords: *rural heritage; agricultural landscape;* Leopoldine; *cataloguing.*

1. Surveying *Leopoldine*: a specific Vernacular Architecture

The Leopoldine are the farmhouses that identify the "*Paesaggio Storico della Bonifica Leopoldina in Valdichiana*"[1] (Fig. 1). They date back to the end of the 18th century, when, on the occasion of the rehabilitation of the swamped countryside, the Grand Duke of Tuscany, Pietro Leopoldo of Lorraine, also worked for the progress of the sharecropping community, which from that moment onwards could avail itself of houses that had been rationally designed to be safe, healthy

1 Since September 2020, this landscape has been included in the *Registro Nazionale dei Paesaggi Rurali delle Pratiche Agricole e delle Conoscenze Tradizionali* (*See https://www.lanazione.it/arezzo/cronaca/leopoldine-il-paesaggio-volano-per-la-vallata-1.5497337*).

and functional to the productivity of the farm[2]; it is known that, already in the first half of the 19th century, the land in the valley furrowed by the *Canale Maestro della Chiana* was managed by thirteen Gran Duchy Farms, each consisting of a villa-farmhouse and dozens of *Leopoldine*[3].

The latter, precisely because of the history linked to the physical transformations and socio-political events of this area of central Italy, clearly reflected in their construction features, are a phenomenon that has been widely studied over time from various perspectives. Since the end of the 19th century and throughout the following century, numerous studies examined both its historical and typological aspects, as well as its socio-anthropological aspects[4]. The first surveys were carried out to identify the different types of rural buildings. In fact, these studies, resulted in publications that are still a point of reference today for those who approach the study of rural architecture[5], particularly in Tuscany, have identified the *Leopoldine* 'model' on the plains. Although the research was not systematic, and, in fact, reported on a 'sample' basis, it had the merit of highlighting the main characteristics of each type: the *Leopoldine*, for example, distinguishes itself for being an isolated block on a quadrangular plan, with internal or external staircase, superimposed portico and loggia, pavilion roof and central dovecote tower; the material-constructive peculiarities and the variants, related to the different geographical areas and to the new uses of the farms during the 20th century and also to the advancement of building techniques, have, on the other hand, been little explored[6]. However, the value of such research also remains in guiding subsequent cataloguing. Indeed, on the basis of these publications and under the impetus of regional legislation, which in those years was trying to safeguard the agricultural heritage by appealing to sampling as an essential tool for protection itself[7], the municipalities of the Val di Chiana launched various survey campaigns.

On the basis of a PhD Research carried out in recent years[8], this essay analyses the cataloguing of the *Leopoldine* in the Cortona area as well as the contribution provided in this field by the Tuscan Landscape Project entitled "*Leopoldine in Val di Chiana*".

2. Comparing Classifications for an integrated methodology of Cataloguing *Leopoldine*

Among the *Leopoldine* in the Val di Chiana, those situated in Cortona, in the hamlets of Fratta-Santa Caterina, are definitely one of a kind; theire good state of conservation has made it possible to survey them and, in many cases, even re-use them[9].

2 Within the vast bibliography on Pietro Leopoldo's 'enlightened' government, see, in particular, Listri P.F. (2016), Wandruszka A. (1968).

3 Contributions made by Bigazzi A. (2008) and Orefice G. (1979-1980) on the history of the Gran Duchy farms are particularly significant. A more recent survey on physical consistency is, however, contained in Di Pietro G.F. (by) (2009).

4 The bibliography on Tuscan rural architecture is extremely vast. The first essential studies include: Biasutti R. (1935); Pagano G., Guarniero D. (1936); Tinti M. (1935); Biasutti R. (1938); Biffoli G., Ferrara G. (1966); Gori Montanelli L. (1964).

5 The examinations contained herein are worthy of note: Aa. V.v. (1988); Barzanti R., Biffoli G. (1984); Aa. V.v. (1983); on the other hand, the research carried out by Di Pietro is more recent (2009, 2006).

6 A first "appendix of constructional characters" is contained in the text by Aa. V.v. (1983), in which photographs for each building type show a series of construction solutions for "walls, openings, ceilings, chimneys and chimney pots, dovecotes".

7 Reference is made, in particular, to the 'lists' provided for by: "*Norme urbanistiche transitorie relative alle zone agricole*"; L.R. n.59/1980 "*Norme per gli intervenenti per il recupero del patrimonio edilizio esistente*"; L.R. n. 52/82 "*Norme per la formazione del sistema delle aree protette dei Parchi e delle riserve naturali in Toscana*".

8 The results of the research were incorporated into the dissertation entitled "*La Materia del Paesaggio. La Conservazione dell'Architettura Rurale delle Leopoldine in Val di Chiana*" (supervisor: Prof. Bianca Gioia Marino, 2021).

9 See Nocerino I., Marino B.G. 2019.

The survey relating to the *Leopoldine* in Cortona is listed in the *Piano Strutturale* (2000). More specifically, an initial “*Analisi del patrimonio edilizio rurale di valore*”, which includes five hundred and sixty-four buildings, contains ninety-five of "exceptional value": of these, seventy-two are located in the valley area and include no less than thirty-six Leopoldine. On the other hand, the “Repertorio Leopoldine” is an excerpt of the previous map, which shows only the thirty-six buildings "attributable to the *Leopoldine* ‘type’"(Fig. 2). All the rural buildings are subsequently collected in the “*Schedatura degli edifice di valore*”: the first tabs date back to 2003, followed by a renewal in 2008, the latter being part of the *Regolamento Urbanistico*.

By taking a look at the two tabs, it is possible to notice that they differ in both structure and content. The 2003 tab is structured as follows: the first part contains information on the toponymy and location of the farm, then cartographic extracts and references to previous plans and surveys; the second part concerns the main building, for which an assessment is requested of its state of conservation and typological-architectural value, followed by the inclusion of photographs and the indication of sources; finally, a final section regards valuable annexes, for which typological specifications and assessments of the state of conservation are required. As can be seen, the architectural specifications of the *Leopoldine* are lacking. On the other hand, the 2008 tab has four differently composed parts: although the first part includes exhaustive photographic documentation, it contains only the main identifying information, omitting certain data; the second part adds to the cartographic extracts of the 2003 tab also the orthophotos and the *Leopoldine* land register; the third part analyses the main building, requesting its morphological and typological characteristics, as well as a number of evaluation judgements, while only images of the annexe are requested; finally, the last section contains references to the Technical Intervention Regulations. From a critical examination of the two tabs: both appear to be lacking in the architectural aspects; for this reason they are insufficient for an exhaustive knowledge of the building; the 2003 tab appears to be better structured than the 2008 tab, although it lacks the building construction specifications, which the second one tries to recover, however still in a superficial manner. Furthermore, both appear to be lacking in the peculiarities of the landscape in which the leopoldina is located: instead, this type of architecture has a precise dialectic with its agricultural surroundings, as the Regional *Piano Paesaggistico* states in *Area 15 Piana di Arezzo and Val di Chiana*; therefore, the two spheres, architecture and landscape, must necessarily be analysed simultaneously.

The cataloguing proposed within the framework of the “*Leopoldine in Val di Chiana*” Landscape Project[10] (*PdP Leopoldine*) is different. In the spirit of safeguarding the historical identity of this specific landscape, the project aims to guide its transformation in a sustainable manner, including the *Leopoldine*; as well as providing indications for restorations, it also proposes a Type Tab. From the evaluation of the latter, several doubts arose as to the comprehensiveness of the required content. As far as the farm is concerned, although it appears to be well identified in terms of ownership, dimensional and cadastral data, as well as constraints, there are limited indications of location, cartographic extracts, references to previous censuses and technical regulations; contextual information is completely lacking. In the section relating to the *Leopoldine* - whose annexe has been neglected - there is an assessment of the state of the site, yet not the construction characteristics of the building, nor references to historiacal sources; the photographic equipment required is minimal.

10 This is the first Landscape Project to be implemented in Tuscany, approved by D.C.R. 25 febbraio 2020 n.13 (BURT 11.03.2021 n.11), provided for under Art.37 of the PIT-PPR "*Discliplina*".

The aforementioned Phd Research, which focused precisely on the conservation of the 'matter' of the landscape of the reclaimed land, was also an opportunity to experiment with a different method of understanding the rural building heritage. To this end, an emblematic case has been selected from among the *Leopoldine* in Cortona[11]: the farm has been analysed in terms of its contextual and historical-transformative aspects, while the architecture has been investigated in terms of its construction and conservation peculiarities and, on the whole, reflections have been made on the material-constructive aspects to be taken into account during restoration work. This type of approach to the farm has provided the tools for setting up a new Tab Model of the *Leopoldine*, referring, moreover, to the possibility of extending the minimum contents of the *PdP Leopoldine* [12]: the contents of the previous tabs have been studied in depth, filling in the gaps.

The proposed tab[13] (Fig. 3) consists of four parts, preceded by an introductory section. The latter contextualises the farm through: image, location, dimensional data, ownership and intended use, cadastral data, dated cartographic extracts (including at least the *Catasto Leopoldino, Carta Tecnica Regionale, Mappa Catastale*, an orthophoto). Following this section, the first part deals with the regulatory sources (town planning instruments, previous surveys, constraints, technical regulations for interventions) as well as those of a historical-archival nature; furthermore, reference is made to a desirable digital archive, which could contain the 'historical memory' of the farmhouses: a collection of photographs, films, texts and graphs concerning the farm as well as the families who lived there. The second part of the tab focuses on the context of the farm, identifying a landscape "unit" for analysis. After having framed the historical Gran Duchy farm as well as the landscape-territorial area (PIT-PPR Tuscany) to which the *Leopoldina* belongs, the physical references of the space that interacts aesthetically, historically and functionally with the farm was examined, recognising, by carrying out both a synchronic and diachronic analysis of mutations and permanences[14]: in this way, it has been possible to cut out a 'slice of the landscape' corresponding to a radius measured in metres from the main building[15]. An interpretative analysis of this unit is required: after describing the morphology of the built-up area and its relationship with the landscape, the characteristics and integrity index of the historical farm system are specified, following a cartographic and/or photographic comparison; the "matter" of the unit is then discussed, i.e. all the "natural", urban, architectural and other elements of which the landscape- space considered consists, including a description of the treatments of the farm margin, the crops and the plant species present in the unit. The third and fourth parts of the tab, structured in a similar way, deal in depth with valuable rural architecture, respectively the *Leopoldine* and subsequently the annexe: after indicating the type of building and the state of the site (dimensions, age, description of the building complex and internal distribution, state of conservation and level of historical integrity), the construction details of the vertical and horizontal load-bearing structures (masonry, floors, arches and vaults), of the openings (doors, gates, windows), of the connections, finishings and historical furnishings must be specified. These two sections are enriched by an extensive collection of dated photographs.

11 This is the "Paterno II" farm in Chianacce.

12 This possibility is mentioned in the *Relazione Generale* of the *PdP Leopoldine,* p. 25.

13 The completion of this tab has been simulated in the dissertation.

14 In order to see an approach to the rural landscape of this kind, see SCAZZOSI L., BRANDUINI P. (2014). See also: Mileto C., Vegas F., García-Soriano L., Cristini V. (ed. by) (2020); Schittich C. (ed. by) (2019); Mileto C., Vegas F., García-Soriano L., Cristini V. (ed. by) (2018).

15 In the case of Paterno II, for example, a landscape 'unit' has been proposed for analysis that stretches for approx. 400 m from the Leopoldine farmhouse itself, thus including the *Canale Maestro della Chiana* and a small portion of the Poggio Bello hill on the opposite side, beyond the carriageway.

Composed in this way, the tab represents a multi-dimensional analysis of both the *Leopoldina* as well as the surrounding landscape. This approach takes into account all phases of the life of the farm, from its origin to the present day, and it also identifies the transformations it has undergone. Emphasis is placed on the material and constructive value of the farmhouses, which is primarily responsible for their image and typological identification and must therefore be safeguarded; attention is also paid to the compositional elements of the landscape, so that their relationship with the factory can be identified and all the necessary elements for future planning of the revitalisation of this space as a whole are available, in harmony with the context.

3. Conclusions: the operational validity of Tabs for the restoration of *Leopoldine*

It is agreed that cataloguing is the primary fundamental tool required in order to understand a historical artefact. Not only, the completeness of the historical-constructive and aesthetic information on the building - which also includes its dialectic with the landscape - is indispensable for a compatible design of restoration work, which also includes its re-use, as also asserted by the *Charter on the Built Vernacular Heritage* (1999) and the *Icomos-Ifla Principles Concerning Rural Landscapes as Heritage* (2017), including cataloguing among the first lines of action for the transmission of this heritage. For this reason, it is clear that, although the model tabs presented are suitable for an initial approach to the building, they do not go into detail on the construction and landscape aspects, making it difficult to apply the technical standards drawn up by the regional legislation in a consistent manner. Instead, it is indispensable to carry out an inventory, such as the one proposed, to examine historical architecture in its current context, in order to compose an exhaustive framework of knowledge upon which to base future *Piani Operativi Comunali* and discerning programmes to enhance the value of the territory through its resources, in compatibility with the *'genius loci'*. Moreover, a multi-scalar study of the factory, such as the one suggested, lends itself to being an experimental model on which to apply, on the one hand, the technical prescriptions dictated by the regulations (in this case the *PdP Leopoldine*) and, on the other, a lexicon of materials for restoration that responds to the peculiarities of the landscape under examination.

It is clear, therefore, that the value of heritage records includes both the cognitive and operational aspects. On the other hand, if knowledge is an essential part of restoration, since it is the historical-critical foundation that ties in with the technique, allowing the latter to be confronted with the 'values' of which the monument is the bearer[16], it follows that the tab can be a very useful tool: a presentation of the architectural heritage in its twofold aesthetic and historical, physical and immaterial polarity, also including the data functional to the technical restoration operations.

Therefore, just as the importance of taking a census of rural architecture was understood at the end of the last century, so it is important today to ensure that these operations are carried out with scientific criteria, so that they are not a mere bureaucratic practice, but a valid cognitive tool, indispensable to public and private bodies that need to work on this heritage and - as far as possible - a guarantee of respect for the values of the heritage itself.

It is only by pursuing respect for cultural heritage that a sense of belonging and social inclusion can be cultivated, as well as co-responsibility by communities to look after their roots, on which to

16 Giovanni Carbonara has repeatedly stressed the importance of the knowledge phase of the asset; see "Per una definizione attuale del restauro", in Carbonara G., *Avvicinamento al Restauro. Theory, Storia, Monumenti* , Liguori, Naples 1997, pages 23-33, in particular pages 31-33.

base a sustainable future, preventing conflicts (Faro Convention, 2005).

Fig. 1. A Leopoldina in Cortona.

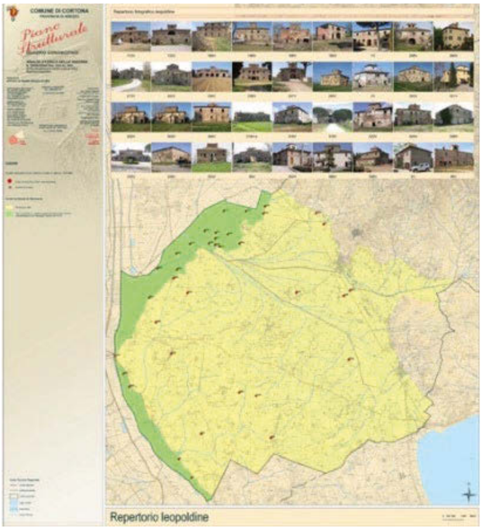

Fig. 2. Repertorio Leopoldine, Cortona 2003.

a

b

c


SCHEDA N.XXXX

EDIFICIO PRINCIPALE

1. DESCRIZIONE E VALUTAZIONE DELLO STATO DEI LUOGHI

2. STRUTTURA PORTANTE VERTICALE: Murature

3. STRUTTURE PORTANTI ORIZZONTALI/PSEUDO-ORIZZONTALI: Solai, Archi, Volte

e


SCHEDA N.XXXX

6. FINITURE

7. ALTRO

f

Fig. 3. Six pages (a-f) of The model of the *Leopoldine* Tab elaborated within the context of the PhD Research dissertation ("*La Materia del Paesaggio*. La Conservazione dell'Architettura *Rurale delle Leopoldine in Val di Chiana*", 2021).

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Highlighting the Heritage of Meseta Ibérica

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract
Meseta Ibérica is a region placed along the border between Spain and Portugal in the international Douro river area. This region has an exquisite rural landscape, of which the urban landscape is part. A detailed characterization of the existing buildings was also possible to perform. As stated above, six villages were selected as a reference to the urban heritage of this region in a rural context. These villages were Atenor, Rio de Onor and Bemposta, in the Portugal side, and Fariza, Riomanzanas and San Martín de Castañeda, in Spain side. Altogether, 767 buildings have been studied according to different parameters such as the type of building, the type of utilization, the stage of conservation, type of building materials, type of structure solution, the colour of the façade, among many more. This paper intends to share some of the obtained results from the heritage perspective. These results may give guidance for future urban rehabilitation management.

Keywords: *Heritage; Meseta Ibérica; Vernacular; Rural construction.*

1. Introduction

An international research work was done focused on studying the landscape of the Mestea Ibérica which is an important biosphere reserve, Fig. 1 (*Paisagem Iberica – Proyecto Paisaje Ibérico Poptec Interreg*, 2015). The primary relevance of this work was to characterize this inheritance to give guidance in terms of maintenance.

This paper intends to highlight some aspects of the urban areas on a village scale. In particular, it wants to show the important heritage in the rural areas of this territory. This purpose is related to the fact that a village is also part of the landscape, and its evolution may disparage it when it is not done correctly (Alcindor et al., 2021; López Sánchez et al., 2020).

A considerable amount of data was produced and treated. Surveying was done in some villages considered as reference. A detailed characterization of the existing buildings was also possible to perform. Simple statistical analysis was done concerning several technical building aspects, and also some of them were mapped by village.

Similar research works were done in similar contexts (Cardoso, 2013; Cepeda et al., 2010; Leserri et al., 2018; Padrão et al., 2020; *Surveys - Vernacular Architecture and Landscape Architecture Resource Guide - Library Guides at UC Berkeley*, 2022)

This paper is structured in six parts. Apart from this introduction, a brief description of Meseta Ibérica is done in the second part. The identification of the selected villages studied during this research work is made in the third part. In the fourth part, a brief description of the adopted surveying strategy and the presentation of the used application form are considered. Afterwards, in part five, some results are delivered. Finally, in the last part, some final remarks are made. It is concluded that Meseta Ibérica is rich in terms of heritage. These villages and their traditional buildings keep their identity. The buildings present specific building details which are worth preserving. The original built rural areas are in harmony with the landscape, and there in deep respect with nature. The simplicity, the volumetry, the shape and the adopted materials of the building solutions confirm this statement.

a) Low vegetation

b) Vineyards

Fig. 1. Some highlights of the Meseta Ibérica landscape

2. Meseta Ibérica

Meseta Ibérica is a vast region that includes both Spain and Portugal territory. Since June 2015, UNESCO has recognised it as a cross-border biosphere reserve that has five natural parks such as Montesinho, Lago de Sanabria y Alrededores, Douro Internacional, Arribes del Duero, and Vale do Tua. Its landscape, natural resources and culture are some of its unvalued richness.

3. The studied villages

As it was stated above, six villages were selected as a reference to the urban heritage of this region in a rural context. These villages were Atenor, Rio de Onor and Bemposta, in the Portugal side, and Fariza, Riomanzanas and San Martín de Castañeda, in Spain side. Each village's digital map was used as an operational element base of the surveying performed during this research work. Fig. 2 shows an image of the Fariza village, and Fig. 3 presents its digital map as an example.

4. Surveying form

In order to characterize the existing heritage of the territory, it was required to prepare a specific application form to systemize the surveying process. Several technical building technical aspects were considered for this purpose.

5. Some results

5.1. Some examples of heritage of Meseta Ibérica

All studied villages are rich in heritage. Buildings are likely to have two floors. The volumetric of the buildings is regular, and the architecture is plain. The ground floor is mainly used to keep cattle and agricultural products, and the first floor is for accommodation.

In general, they are vernacular. Stone (e.g. schist or granite) masonry walls are the main vertical structural elements. However, other vertical structural elements applied are tabique walls, adobe walls, timber and stone columns. Timber floors are the main horizontal structural elements. The structure of the roof is also likely to be built with wood. Exterior stairs tend to be made of stone. Balconies tend to be built by stone and timber. In roof covering, ceramic and schist tiles are the most traditional solutions. Fig. 4 exemplify this type of heritage.

Fig. 2. Fariza village

Fig. 3. Fariza digital map

a) Example 1

c) Example 3

b) Example 2

d) Example 4

Fig. 4. Heritage of Meseta Ibérica

5.2. Some examples of building details

Based on the above buildings solutions, the number of building details is pretty significant to be referred to in this paper. Therefore, only a few building details are presented in Fig. 5 to exemplify this matter concerning the heritage of Meseta Ibérica.

The detail of the connection of orthogonal exterior granite masonry walls (Fig. 5. a), the application of adobe units and earth with straw is also referred in Fig. 5.b. The existence of exterior tabique walls (Pinto et al., 2017) and its finishing in the end with a timber element is also considered in Fig. 5.c and, finally, the typical timber balcony built with zimbro (zuniperus communis) timber is also included in this part (Fig. 5.d).

a) Junction of orthogonal walls

b) Finishing of a tabique wall

c) Traditional balcony

d) Adobe and earth mortar

Fig. 5. Examples of traditional building details

5.3 Some examples of data delivered

Based on the surveying performed in all the identified villages, it was possible to produce several maps of different technical aspects concerning the heritage of the Meseta Ibérica. The level of conservation of the building, the number of floors, the type of building and the type of utilization were some of the topics considered in this mapping process. Fig. 6 exemplifies this result concerning the Fariza village as an example. This tool may also be used to guide the maintenance and planning of this heritage.

6. Main conclusions

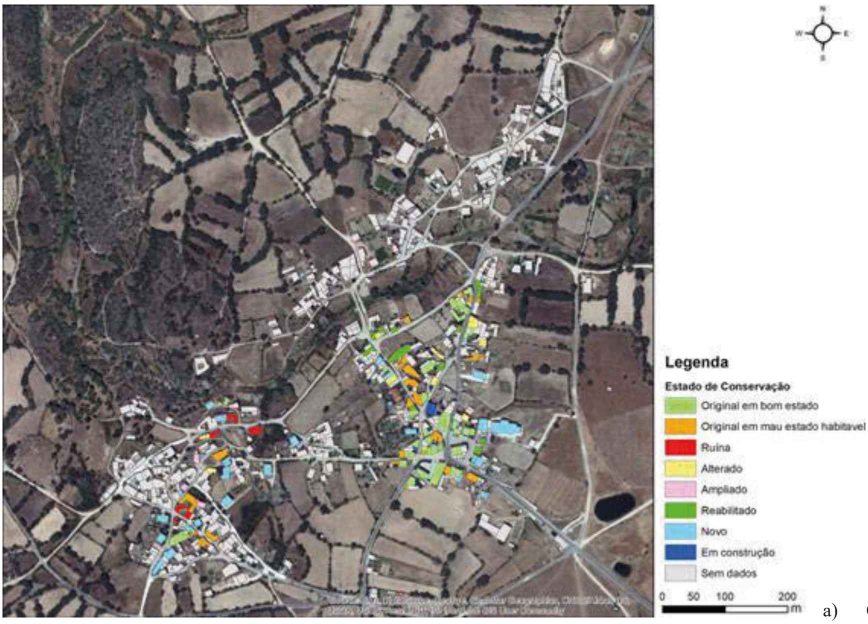
The Meseta Ibérica has an important heritage to preserve and value.

Six villages were studied as representative of the rural built areas of this reserve.

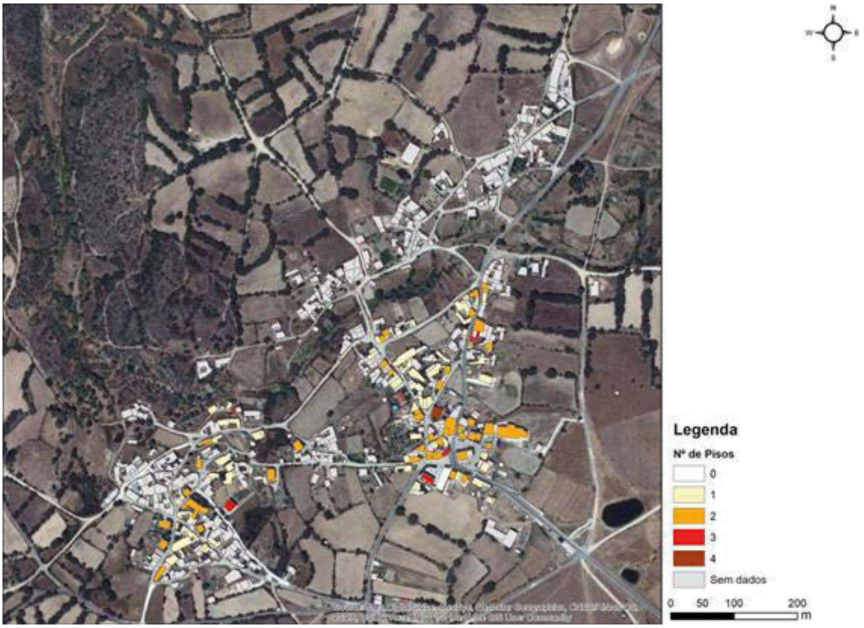
A rich heritage was found. Vernacular and traditional building techniques, local and natural building materials and local architecture trends were observed. Tabique and adobe are some of these building techniques which gave some surprise. The usage of the earth as a traditional building material was another interesting fact verified during the fieldwork.

A brief description of the most common types of buildings was done in this paper. The presentation of some traditional building details of this region was also done. In addition, examples of maps of several technical aspects were introduced. The obtained data may be helpful in terms of guiding future managing processes of this important heritage.

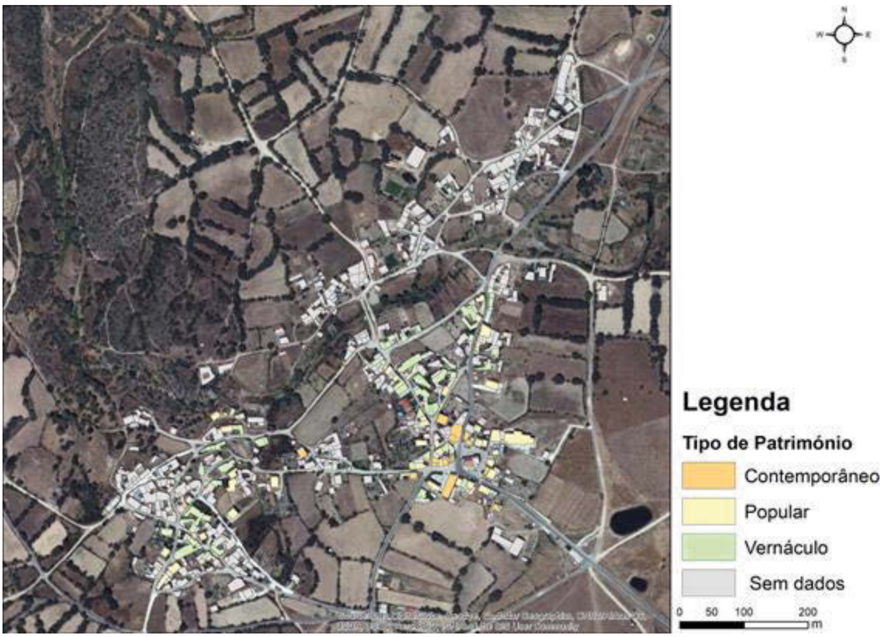
Fig. 6 exemplifies this result concerning Fariza village as an example.



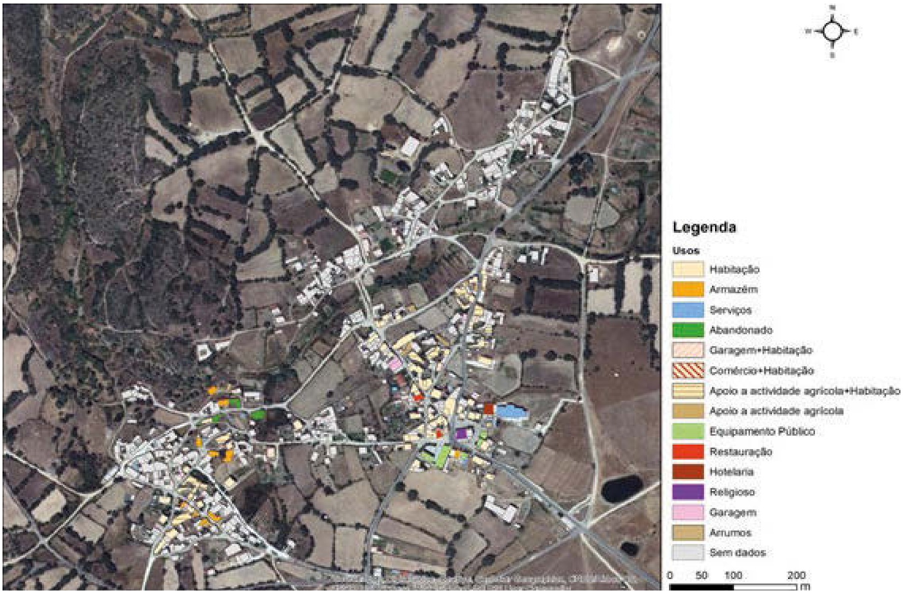
a) Conservation level



b) Number of floors



c) Type of building



d) Type of utilization

Fig. 6. Maps produced for Fariza village as an example

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A heritage to reveal and protect. Historical water-based paper mills and ironworks in Campania (Italy)

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract

Within the rich heritage of vernacular architectures, hydraulic power works still exists in various parts of the Campania region in the South of Italy: paper mills and ironworks show aspects that require further investigation. Built according to the orographic features of the landscape and in relation to water use and supply, these structures need to be deepened in terms of understanding with respect to their building techniques, production technologies and principal vulnerabilities. Despite its relevance, in fact, the lack of knowledge about this water-related heritage in its material consistency, and the associated risk of loss for misuse or abandonment, needs to be addressed. Accordingly, this paper presents the first outcomes of a study about the evolution of ironworks and paper mills' recurring assets, technologies and building techniques from the proto- to early industrial period; highlighting the historical adaptation skills to water and other local resources, as well as the vital connection of these historical factories to wider hydraulic systems in their territory. It is part of a broader applied research about water-related built heritage carried out at the University of Naples, in which educational activities and exchanges with local authorities have been combined. The paper offers new data on paper mills and ironworks construction history and their sustainable operation starting from the selection of relevant case studies in the regional context and through the crossing of direct field observations and indirect sources (e.g., bibliographical, iconographic, and archival), also to define a knowledge basis for future protection and preservation strategies.

Keywords: *proto-industrial archaeology, vernacular architecture, building techniques, cultural landscapes*

1. Introduction

Among the historical factories typologies working with hydraulic power, paper mills and ironworks represent an interesting yet under-analysed category in built heritage studies. Originally, the building techniques and technologies characterizing such vernacular architecture – together with their location, and their frequent systemic distribution and organization – have been shaped according to the environmental and topographic features of the landscape in relation to water use and supply. Because of its mountainous nature and the numerous valleys and deep ravines crossed by rivers, over the centuries the Campania region in the South of Italy showed a particular aptitude to host such proto-industrial productive systems whose main testimonies are represented by many watermills, tanneries, paper mills, copper, and ironworks, as well as by the structures built to convey and direct the waterways (e.g., aqueducts, drainage systems, canals, and towers). With respect to paper and iron production, this region represents a considerable observatory as it hosts one of the first and most valuable paper mills settlements on a national level (i.e., the Valley of

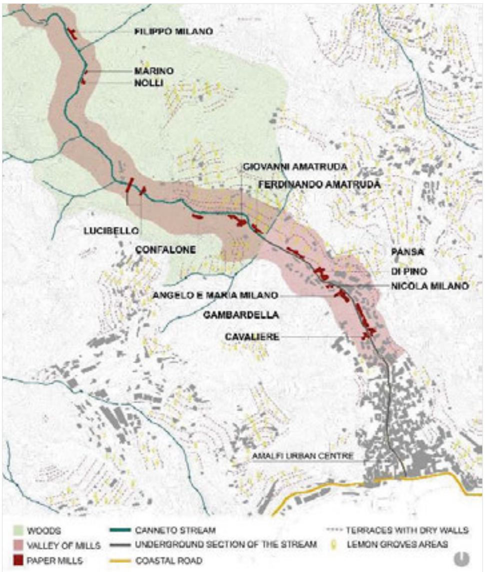

Fig. 1. Amalfi, Valley of Mills. Distribution of the paper mills along the Canneto stream.

Fig. 2. Amalfi, Valley of Mills. The Lucibello paper mill.

Mills in Amalfi), as well as several water-based ironworks (e.g., the Teano settlement), active between the Middle Ages and the second half of the 19th century.

During the last decades many publications have examined various aspects of this heritage, deepening the knowledge also through iconographic, archival, and cartographic tools (Assante, 1977; Assante, 1983; Gentile, 1978; Guida, 1983; Gargano, 1993; Gargano, 1998; Rubino, 2004; Rubino, 2006; Dentoni Litta, 2008). Among these studies, a research and teaching project carried out at the Department of Architecture of the University of Naples Federico II, in agreement with local institutions, wanted to investigate material and intangible components of this heritage by selecting several proto-industrial systems through the five Provinces of Campania. Combining the results of historical research with the field research, the knowledge process allowed us to construct a complex overview about this heritage.

Within this broader applied research framework and in addition to the essays on the Valley of Mills in Gragnano, already published as first results of the research work (Ceniccola, 2017; Russo, Pollone, Ceniccola & Romano, 2018), this essay intends to present some of the results acquired thanks to bibliographic, iconographic, and archival research and field investigations conducted through metric and material-construction surveys. These acquisitions firstly concern recurring assets, material consistencies, technical expediencies and building skills. Secondly, the main vulnerabilities of these vernacular architectures, also in relation to future conservative strategies.

2. Proto-industrial landscape in the Amalfi Coast

Due to the rugged orography and the mountainous nature of its territory, the Amalfi coast has never offered space for extensive cultivation, partially obtained only through the terracing system. For these reasons, over the centuries, alternative activities to agriculture have been launched that promote the affirmation of handcrafted manufacturing – to produce paper, wool, iron, and *pasta* – which, especially between the 16th and 17th centuries, earned these coastal centers fame. Regarding paper production, in 1836 there were still forty-six operational factories in the coastal space connecting Positano and Maiori – eighteen in Maiori, sixteen in Amalfi, seven in Minori, three in Atrani and two in Furore (Camera, 1836; Dal Piaz, 1983; Rubino, 2004; Rubino 2006).

The establishment of such activities in this context was favoured by the rich presence of springs and streams, used both for handicraft processing and semi-mechanized production, as well as by the proximity of landings for the supply of raw materials by sea (Dal Piaz, 1983; Guida, 1983; Gargano, 1998; Rubino, 2004; 2006). For their strong link with the surrounding landscape, these networks of factories – a first form of "productive" system if considered as a whole – represent the result of the research of solutions for the optimization and sustainable management of natural resources that have resulted in differentiated strategies for adapting to the orography of the sites and the flow of waterways. In the case of localities at the bottom of the valley – such as in Amalfi – simpler water supply systems were defined consisting of small dams and canals that partially diverted the course of the streams to feed the hydraulic mechanisms of the factories arranged in succession. Otherwise, in correspondence with particularly steep and uneven terrain or more irregular and weaker streams – as in the Furore fjord – the conveyance of water took place through a more complex hydraulic system consisting of a dense network of masonry structures such as canals, aqueducts, dams, sluices, and basins – also used as reserves during periods of drought. The water diverted from the main course and conveyed through these hydraulic infrastructures then directed into the factories through the piezometric towers – cylindrical in shape, enlarged at the base to better resist the pressure of the water (Perriello Zampelli, 1959; Guida, 1983).

Interesting examples of these "adaptations" of the landscape remain in Amalfi but also in other coastal contexts. In Positano, for example, there are traces of a complex system of factories arranged in series and fed by a network of canals supported by mighty buttressed walls, tanks, and sluices (Guida 1983). Furthermore, in the fjord of Furore there is an example of a factory in which a mill and a paper mill coexist, developing vertically the chain connection also present elsewhere (Rubino 2004; 2006).

2.1. The Valley of Mills in Amalfi: a system of vernacular architecture and nature

The Valley of Mills in Amalfi is the site which best represents the peculiarities of this proto-industrial landscape: here the natural components and those resulting from the changes made by man coexist in a fascinating balance. Starting from the 18th century, the Amalfi valley became the subject of travel literature and iconographic testimonies by Italian and European artists and *voyageurs* thanks to those choral values that remain still unchanged, despite the abandonment and the changes occurred over time. Values that are attributable to the coexistence in the same landscape of the paper mill system – often associated with mills – of the network of routes that connect them, of the hydraulic infrastructures and of the canals for irrigation of the surrounding fields deriving from them.

Extending outside the northern gate of the city (*Porta Hospitalis*), the narrow valley is softened along the slopes by terraces used for different crops and crossed by the Canneto stream (or, more anciently, Chiarito) which originates from the Lattari mountains in the territory of the nearby municipality of Scala. This watercourse is called *Chiarito di Sopra*, for the stretch in which it flows in the open to the Ferdinando Amatruda paper mill, and *Chiarito di Basso*, for the one that descends from this structure to the sea, conveyed below the road completed in 1939 (Rubino, 2006). Thirteen paper mills are preserved along the watercourse (Fig. 1), which receive state protection except for the Gambardella paper mill. They are for the most part privately owned and, over time, have been transformed into homes or abandoned, except for the Nicola Milano paper mill, hosting the *Museo della Carta*, and the Ferdinando Amatruda one, still used for the same productive activity.

As regards the construction and evolution of these factories, it is believed possible that some of them derived from the conversion of mills, or more probably, of fulling mills to produce wool, built in correspondence with the *Chiarito di Basso* between the 12th and 13th centuries, so much so that they originally acquired the name of "paper fulling mills". As a result of this transformation process, the new paper mills would have preserved the spatial organization of the pre-existing settlements, inheriting some of the "technologies" and machines already in use (Gentile, 1978; Rubino, 2006). Other structures built further upstream along the river were added to the factories of the first nucleus located close to the urban centre. There were eleven units, as shown in the *Catasto Onciario,* that dates to 1741-1742. The end of the 18th century into the early decades of the 19th saw the transition from an artisanal process to one semi-mechanized. This led to a further expansion of the production area towards the upper part of the valley, along the more rugged slopes, where the beating force of the water was greater. In this way a total of sixteen factories were reached, as noted in 1836 (Camera, 1836; Dal Piaz, 1983; Rubino, 2004; 2006).

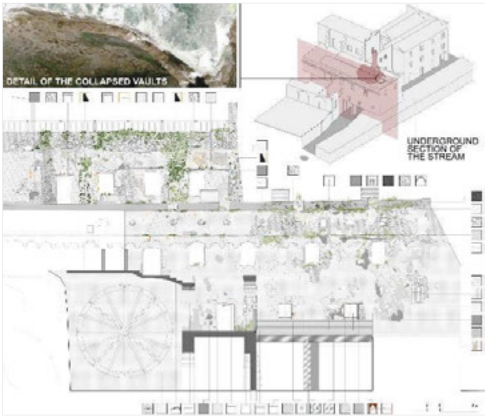

Fig. 3. Amalfi, Valley of Mills. Northern elevation and details of the Di Pino paper mill (Source: Malangone, Xiques Arteaga 2011).

Fig. 4. Amalfi, Valley of Mills. Processing machinery and rooms of the Di Pino paper mill (iron wheel*; fuso, pila, tino, torchio* or *strettoja,* and *spanditoio*).

In addition to the wise use of water resources, the sustainability of this proto-industrial system – as clearly emerges from the direct reading of materials and construction types – had to be sought in the ability both to adapt the architecture to the orography of the sites and to make the best use of the raw materials available in those places for the construction of the factories. Regarding the first point, field investigations have shown that the oldest paper mills have small volumes and irregular layouts, adapted to the conformation of the spaces. In fact, different architectural solutions can be found in relation to several factors and, firstly, to the orographic conditions of the sites – e.g., foundations dug into the rocky bank, structures partially leaning against the rocky walls. Secondly, with respect to the distance from the watercourse or the most favourable climatic conditions – e.g., different distribution and shape of the openings in the elevations. Furthermore, despite the manufacturing destination of these factories, an adherence to the vernacular construction tradition of rural buildings of the Amalfi coast has emerged (Pane, 1936; Fiengo & Abbate, 2001). Clearly referring to the small structures used as warehouses and service rooms (*monazeni*) still existing in the fjords of Furore and Crapolla (Vitagliano, 2014) and, in some ways, to the mills of Gragnano, very similar to the latter, some of the Amalfi factories – in particular, the Cavaliere and Nicola Milano paper mills – are characterized by the recurrence of small rooms and pseudo-rectangular layouts with vaulted roofs. In these cases, also due to the limited space for processing, the rooms for drying the paper sheets (*spanditoi*) were built near the main buildings in such positions as to exploit more favourable ventilation conditions.

Elsewhere, and especially in correspondence with the *Chiarito di Sopra*, the paper mills demonstrate greater autonomy from the traditional typologies of the coastal rural heritage, adhering to a more "functionalist" architectural model. Structurally more impressive than the others, these paper mills are characterized by a stronger synergy between form and function: the definition of more regular buildings is preferred, also placing them straddling the stream to optimize the exploitation of hydraulic power – as in the Lucibello factory (Fig. 2) –, and of such dimensions as to allow the installation of machinery suitable for chain production cycles (Guida 1983). Arranged on several levels, these structures are defined by masonry vaults and wooden slabs, as well as completed, on the top floor, by the *spanditoi* closed with double-pitched wooden roofs. Examples of this type are still recognizable in the Pansa, and Ferdinando Amatruda paper mills and, despite the ruderal state, in the Confalone, Lucibello, Marino, Nolli, and Milano ones.

Regarding the characterization of building materials found, there is a widespread use of those available on site such as first limestone – widely used for the construction of both ashlars and mortars or plasters – yellow tuff and, more rarely, grey tuff. The absence of plaster and the ruderal condition of these structures have facilitated the direct reading and stratigraphic interpretation of the constructive elements. We highlighted a recurrence of irregular masonries, in which building materials, primarily limestone, are used in ashlars and flakes bound with mortars made by lime and *pozzolana*. Rarer is the presence of masonry with consecutive construction sections (*a cantieri*) which are, however, found above all in the factories built further upstream.

The vaults, used both for intermediate floors and roofs, are structurally defined by limestone ashlars, sometimes mixed with elements in yellow tuff, or exclusively made up of blocks of the latter material. In addition, there are vaults consisting of concrete with limestone and tuff aggregates of various sizes (*volte 'a getto'*), as can be seen in the section of the collapsed vaults in the Di Pino paper mill (Fig. 3). The reading of extrados reports the presence of impermeable layers in "beaten lapillus", consisting of a mixture of *lapilli*, lime and *pozzolana* (Fravolini, Giannattasio & Rotolo, 2008; Ceniccola, 2014). Due to the availability of wood from the woods of the Amalfi Republic and the chestnut groves of Scala and Tramonti, the factories of this valley, more than in any other in this coast, have a notable occurrence of intermediate wooden slabs and double pitched roofs with wooden beams or trusses, mainly within the rooms intended for drying the paper sheets. Despite the transformations over time and the current state of abandonment of most of the Amalfi paper mills, the system of sluices, basins and supply canals that fed the factories connecting them in series is still recognizable. The identification of spatial articulation of such buildings and of their "technological" equipment – aspects carefully investigated by this study –, has testified a strong "functional" link to the paper processing phases (Fig. 4). In most cases the main phases of this artisanal work took place at the lower levels, more easily served by water canals or piezometric towers. Here, the wooden crates for the collection of the raw materials (i.e., cotton, linen, or hemp rags) are kept together with the stone tanks (*pile*) where the latter were deposited after the maceration phase (*marcitura*), to then be crushed and reduced to mush with the addition of water by means of wooden hammers nailed at the ends. Still found in most of the paper mills, the multiple hammers were operated by a transmission shaft (*fuso*) connected to the hydraulic wooden (or iron) wheel powered by the driving force of water. During the 17th century, in some of the factories this shredding system was flanked or replaced by the more efficient Dutch refining cylinder, made of wood, iron or stone. All variants are still preserved, for example, in the Lucibello paper mill. Another essential element of the manufacturing process consisted of a circular masonry tank (*tino*), in some cases covered with precious ceramic tiles, in which the mush was deposited and, mixed with glue, collected in a rectangular frame (*cassio*) that defined the final shape of the product. The sheets thus obtained, alternating with wool felts, were pressed inside a wooden press (*strettoja*) to let the water out, laid out to dry and, finally, smoothed (Gargano 1993; 1998).

3. Architectures for iron production. Metallurgic complexes in the regional context

Among the proto-industrial assets investigated, the research also focused attention on ironworks by analysing, even in these cases, the results of the skills relating to the exploitation of natural resources in constructive terms. As for paper mills, the proximity of waterways for generating the hydraulic energy to operate bellows and hammers, determined the choice of the sites for building; this was combined with the need of large forests, especially chestnut groves, for the (less sustainable) production of charcoal used to power the furnaces, for which, moreover, the action of air was also essential. In addition to these factors emerged another substantial condition linked to the possibility of extracting raw materials on site or in mineral deposits close to the factories which, however, were never conspicuous in the regional context, considering the massive imports from the Elba Island.

The metallurgical settlements had a certain diffusion in Campania already in the Angevin age, to reach a larger number in the following centuries, especially starting from the mid-16th century. This increase was partly attributed to the southward migration of entrepreneurs and skilled workers from Liguria, where the metallurgical proto-industry had been active since the 13th century – in fact, we speak of "Genoese" or "Catalan" ironworks that used the low heat (Rubino, 2009; Rauccio, 2010). At the beginning of the 19th century, the Campania production plants, whose management had passed several times from the public to private, were still in operation at the sites of Pianodardine, Atripalda, Serino, Giffoni, Acerno, Amalfi and Sant'Agata dei Goti (in the ancient provinces of Principato Citra and Ultra) and in Maddaloni and Teano (in that of Terra di Lavoro) (Barra, 2000; Rubino, 2004).

Among the oldest settlements considered there is the Amalfi ironworks, known as early as 1361 and active until 1815 (Assante, 1983; Gargano, 1993; Rubino, 2004; Rubino, 2006). Built in the most upstream part of the Valley of Mills where the Ceraso and Gorgone springs are grafted into the Canneto stream, what remains of the structure still testifies the ingenuity of the system built to generate the hydraulic energy.

Partly straddling the stream, the ironworks consisted of two buildings, of which the smaller featured the same system of the largest on a smaller scale. The latter was equipped with three hollow wooden pipes (*trombe idro-eoliche*) – made of masonry or iron in other contexts – into which the water deriving from the aqueduct was canalised.

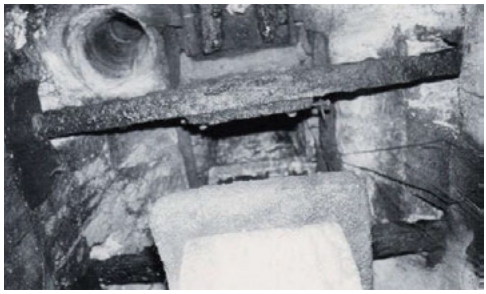

Fig. 5 and Fig. 6. Teano, the Salvi metallurgic complex along the Savone River: the ironworks (on the left) and the copper factory. Below: Salvi ironworks. The hydro-aeolian pipelines (Source: Rauccio, 2010).

This last, still partially preserved, was supported by a system of arches in pseudo-regular masonry made of limestone ashlars and flakes. The current of air generated by the fall of water inside the pipes – adjustable by means of a valve – fed the fire of the furnace for melting the mineral; the water subsequently flowed into a masonry basin (*bottazzo*) from which, through an inclined conduit, it operated by fall the wheel whose axis generated the movement of the hammer for beating the iron.

Iron manufacturing also flourished in Teano, currently the province of Caserta, from the beginning of the 14th century to the 16th and 17th century. A complex consisting of an ironworks and a copper factory in the *Gomite* locality is currently preserved here. Its construction (1830-1845) was due to Nicola and Bartolommeo Salvi, descendants of a family of metallurgic entrepreneurs coming from Liguria who settled in Campania during the second half of the 16th century and whose ancestors had also dealt with the Amalfi ironworks since the end of the 17th century (Salvi, 1991; Rubino, 2009; Rauccio, 2010). Further refining the techniques of adaptation to the features of that territory, the nineteenth-century builders were able to derive the greatest benefit from the available resources (e.g., the rich chestnut groves of Roccamonfina and the waters of the Savone River), defining structures perfectly suited to the morphology of the landscape and a complex hydraulic system capable of feeding both the factories. Derived from the main course of the river by means of a dam, the water was collected in a loading basin, and, through canals, it activated the wheels of the hammers; passing into a smaller tank it fed two mills to then split and fall partly into the river and partly into the hydro-aeolian pipelines (*trombe idro-eoliche*).

The two factories were built in such a way as to accommodate the contour lines as much as possible, which, in fact, defined their position (Fig. 5). The body of the ironworks – the best preserved of the two – develops parallel to the river, following its course also in correspondence with the waterfall, overcoming a difference in height of about 20 m through a system of rooms and stairs, partly excavated in the rock. As emerges from the analysis of the masonries, the construction techniques used here show a remarkable ability in working with grey tuff, a raw material certainly more available in the province of Terra di Lavoro. This material is used in well-squared blocks of considerable size bonded with thin lime-based mortar joints for the definition of extremely regular masonry. The same regularity characterizes arches and vaults, consisting of ashlars of the same material, as can be seen in the well-preserved barrel vault of the coal deposit. The other slabs, as well as the single or double pitched roofs with beams or trusses, are made of chestnut wood, also available on that site, which, when transformed into coal, was also used to power the furnaces.

The iron processing took place, therefore, by exploiting both hydraulic and wind energy in a very ingenious way: the flow of water – regulated by a sluice – through a vaulted canalization, also made of blocks of grey tuff, reached three wooden cogwheel that operated the hammers for beating the raw material and the slag. Therefore, the water was canalised partly towards the drainage mouths, from which it returned to the river, and partly towards the *wind chambers* which are large vertical ducts in grey tuff masonry extended for the entire height of the difference in level of the waterfall. Here the water flow gained speed due to the vertical fall and beating on the surface of slightly convex stones generated a vortex of air (Fig. 6). The latter, canalised into another pipeline, fed the melting furnace and the four heating fires of the ironworks before being conveyed to the copper factory.

4. Conclusions

What is presented here represents the first result of a research which has the main objective of building an in-depth knowledge of this proto-industrial heritage through the reading of its components at different scales. It should also help to define adequate conservation and enhancement strategies. In this perspective, the first assumption was to consider these architectures not in isolation but as elements of a landscape system in which natural resources, hydraulic infrastructures and buildings have the same importance and are a synthesis of relevant material and intangible values. Downstream of a phase of systematization of previous knowledge, the research was able to count on a meticulous field reconnaissance conducted through the dimensional and material-constructive survey, carried out mainly with traditional techniques. This has made three things possible. Firstly, to verify or reveal the material traces resulting from the adaptation of the landscape to better exploit natural resources. Secondly, to verify the consistency of the production facilities still preserved, with particular attention to the recognition of technical and technological solutions resulting from the application of practices related to local vernacular knowledge and the use of raw materials available on site. Finally, to assess the state of conservation and the main vulnerabilities that characterize these assets, also in relation to the risks accelerated by abandonment and the condition of ruin, as well as the possibility of better grading the conservation guidelines. This interpretative process is therefore an indispensable step also in relation to the opportunity to improve knowledge and promote the recognition of all the traces of which these vernacular production systems are composed, both at the scale of the landscape and at that of the individual technical-constructive choices. A knowledge acquisition, finally, that is useful to adequately weigh the conservative choices both with respect to the possible expansion of the physical and perceptive use of these places, and to the provision of conservation and protection actions that will need to be calibrated so as not to distort the delicate balance existing between the built and natural components of these cultural landscapes.

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Architecture and Proto Industry.
Watermills in the historic peri-urban landscape of Benevento (Italy)

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Topic 1: T1.1. Study and cataloging of vernacular architecture

Abstract
The landscape of Benevento is historically characterised by the presence of vernacular architectures which exploited the driving power of water for productive purposes. The abundance of watercourses and natural resources coupled with the large quantity of agricultural products enabled the development of a real proto-industrial centre, which was particularly active in southern Italy between the 18th and 19th centuries. Production activities linked to the manufacture of textiles and leather were flanked by a dense system of watermills. Situated in the proximity of the city walls and the town's main rivers, such watermills and their inherent complex network of canals have shaped the historic peri-urban landscape of Benevento over centuries. Thanks to the availability of numerous historical maps and archival drawings of mills, a link can be established between the past and what is currently visible in the area. The recognition of the physical traces of the mills and of the remains of the water adduction system deepens the knowledge of an unresolved strip of city territory that still retains a peri-urban character, being delimited on one side by the historic walls and on the other by the 20th century expansion of the city. In light of these considerations, this paper offers a new contribution to the study of the proto-industrial architectural heritage of Benevento, focusing on the interpretation of material traces of the past with the purpose that their recognition could strengthen the identity of this part of the city.

Keywords: *historical maps; canals; construction techniques; proto-industrial production techniques.*

1. Introduction

In the centuries preceding Italian unification, the city of Benevento was a small enclave of the Papal State, surrounded on all sides by the territories of the Kingdom of Naples, then of the Two Sicilies. Its peculiar position, detached from the pontifical territories and close to the Neapolitan ones, has put the city in a severe competition with the neighbouring areas, especially for the exploitation of natural resources (Del Prete, 2009a; Zazo, 1950).

Despite some attempts over the centuries by the kings of Naples to divert the water flow from the Serino spring, under their jurisdiction, to the capital of the Kingdom (Del Prete, 2009a), Benevento has always managed to use its waterways profitably and feed its few but flourishing proto-industries.

These industries, founded in the Middle Ages (Ivone, 1997), were located on the south-western side of the city and exploited the driving force of the water of the Sabato river – which together with the Calore river flows through the city – mainly for the production of flour but also of leather and textiles (Del Prete, 2009b).

These vernacular architectures, repaired and sometimes rebuilt countless times over the centuries due to the frequent flooding of the river, functioned thanks to the water provided by a complex system of artificial canals. They had the double task of providing motive power for the mills and water for the fertile gardens and orchards located nearby.

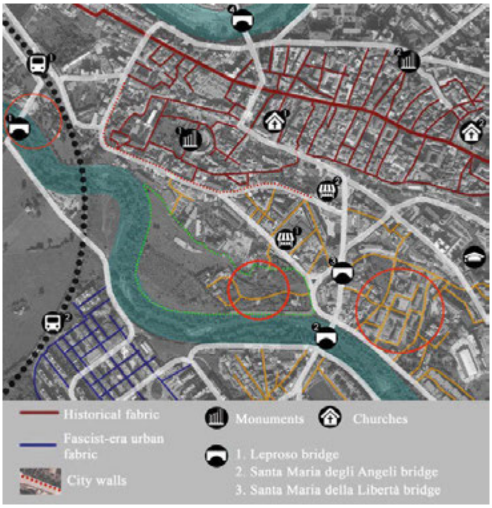

Fig. 1. Benevento, zenithal view of the city and the mills area, highlighted in red (Source: elab. by Cuntò, Intermoia, Longo, 2016).

At present, the canals are buried and their traces are only visible in a few limited sections, while not many material traces of the mills remain, abandoned to total decay. They are located in a peri-urban area characterised by a strong presence of greenery, and surrounded by residential areas and the Sabato river (Fig. 1).

The contribution focuses on these architectures, framing them in the historical and contemporary landscape. The methodology involves crossing rich data from cartography and archival documentation with the reading and interpretation of the material traces still visible on the territory.

2. Water-built heritage in the historic landascape of Benevento *Pontificia*

In the history of the city of Benevento, the water of the Sabato and Calore rivers has always been a vital and fundamental source of energy but also a cause of destruction and disputes. While the artificial canals made it possible to activate the mills and irrigate the gardens and trees, the frequent floods caused regular damage to the architecture and modification of the landscape. The current course of the Sabato river, in fact, in the area under investigation between the Roman *Leproso* bridge and the *Borgonero* district, does not correspond perfectly to the course shown in the historical maps of the 18th and 19th centuries.

Floods occurred on a regular basis. In the 18th century, the city was hit by at least three major events in 1707, 1753 and 1778. These conditions required constant maintenance and sparked actions such as planting trees (e.g. poplars) along the river banks, considered necessary for consolidation and improvement of flood resilience.

There were frequent requests from landowners to officially remeasure their arable land, often reduced in size or enlarged as a result of the flooding, as well as a consequence of the reconstruction work. Therefore, the changing nature of the area required a constant attention to its landscape and architectures.

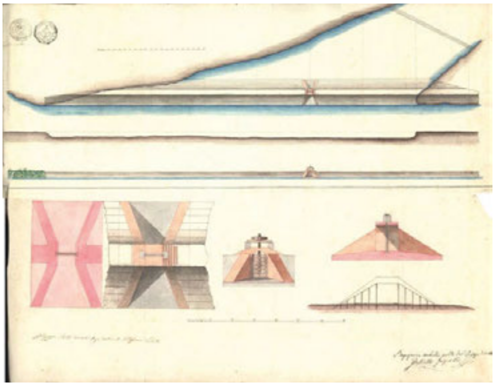

Fig. 2. Gian Battista Iazeolla, river Sabato dam project (ASBN, *Notai, Atti dei Notaio Bartolomeo Maziotta*, n. 16487, 1855)[1].

In addition, the area was marked by several legal disputes between the owners of the proto-industrial buildings, due to the unauthorised opening of new small irrigation canals from the main canal (*formale*), diverting the waters of the Sabato river from a sluice (*palata*) situated in a place about a mile east of the city, in the present-day *Borgonero* district (Ivone, 1997).

1 Images from State Archives (Rome and Benevento) are published by permission of the Ministry of Culture (MIC). Further reproductions of the drawings are not permitted.

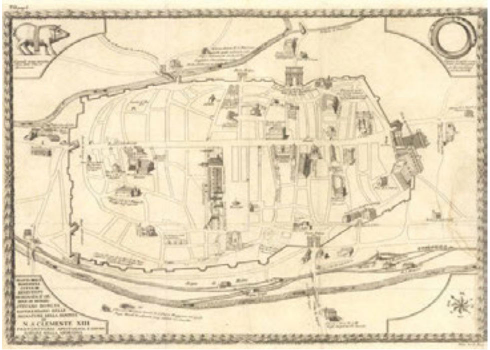

Fig. 3. S. Borgia, view of the city of Benevento. The lower part shows the Sabato river, the artificial canals and the mills, which are outside the city walls (Source: Borgia, 1764).

This sluice, which allowed to divert part of the Sabato river and to activate mills and irrigate gardens, already existed since the end of the Middle Ages (Ivone, 1997), and was rebuilt, even on other sites, several times over the centuries. In the middle of the 18th century, a new version of the sluice was built and financed by all mill owners, whose interest was guided by the benefits of such hydraulic work[2] (Ivone, 1997). In 1821, another major maintenance operation was carried out[3], while in 1853, a similar operation was necessary in response to another flooding event. In this case, the engineer Gian Battista Iazeolla, a well-known figure in the technical environment of Benevento at the time, intervened (Iazeolla, 1996) (Fig. 2). The latter presented a detailed plan of the dam – in the document he wrote "Map of the new dam built on the Sabato river" – without, however, specifying the location of the new structure[4].

The owners of the businesses, which were not only connected to the milling of grain, belonged to the local upper middle class or the clergy. The maintenance of the architectures and the complex hydraulic system connected to them (canals and sluice gates) required consistent, long-term investments, which small entrepreneurs and farmers could not afford.

In addition to the mills for flour production, which harnessed water as power source, the city had mills for paper production, fabric factories (*gualchiere*) for textiles and felt and dye factories (*tintiere*) for textile dyening. There was no lack of tanneries and proto-industries producing pasta (*maccheroni*) (Fig. 3). These activities were supported and encouraged both by Pope Orsini in the period following the earthquakes of 1688 and 1702 and by Governor Louis de Beer during the French Decade. In both cases the importance of these industries for the city economy and the employment of its inhabitants was recognized (Del Prete, 2008).

Fig. 4. L. Cottarini, map of the Sabato river, canals and mills, from the Morra sluice gate to the Leproso bridge, 1828 (Quesada 2008; ASRM, *Disegni e Piante*, coll. I cart. 7 foglio 27).

After the disastrous earthquakes of the 17th and 18th centuries, Pope Orsini (Pope from 1724 to 1730), already archbishop of Benevento since 1686, initiated numerous actions to support the reconstruction of the devastated city and boost the wool industry. This period saw the opening of a

2 Rome, State Archive (ASRM*), Camerale III*, b. 365/115, f. 30.

3 ASRM, *Tribunale della Segnatura, Jura diversa*, b. 217, f. 84, July 1820.

4 Benevento, State Archive (ASBN), *Notai, Atti del Notaio Bartolomeo Maziotta*, n. 16487, a. 1855.

large number of *calcare* (sites for lime production) and facilities for brick production. Together with limestone, bricks represented a common choice as construction materials for local buildings (Menzione, 2003; Taddeo, 2008).

Louis de Beer, governor of the town on behalf of Talleyrand, took the fate of the small town and its economy very seriously (Ingold, 1984; Ceniccola, 2014). During his government in the early 19th century, he promoted measures to consolidate the banks of the Sabato river and supported the hat and pasta industry. In order to increase and improve pasta production in Benevento, he invited workers from the town of Torre Annunziata, near Naples, in order to teach the local workers how to properly dry goods before selling them (Del Prete, 2009a).

3. Watermills: canals and architectures

At the beginning of the 19th century, local aristocracy and the Church owned eight mills close to the Sabato river. They were located outside the city walls beyond *Porta Rufina* in three areas: near the Roman *Leproso* bridge, in the *Acqualonga* district and on the land east of the *Santa Maria della Libera* bridge (Fig. 4).

The Morra family, an important noble branch with properties in Benevento and the Kingdom of Naples, owned three mills (*Santa Barbara* mill, *Nuovo* mill and *Sant'Eramo* mill) as well as a tannery[5]. The Marquises Pacca and Terragnoli were the owners of two mills located next to the *Leproso* bridge, and of the *Capibianchi* mill in *Acqualonga* district. The *Badia Sofiana* (Church of Santa Sofia, now a Unesco heritage site) owned the *Acqualonga* mill – one of the few structures still visible – while the *Mensa Arcivescovile* (archbishop) owned another structure on the same site (Fig. 5).

Thanks to a rich iconographic documentation, mainly consisting of maps of the area and few rare detailed architectural drawings, dating from the late 18th and early 19th centuries, it is possible to catalogue mills and other production activities and to know their location. These drawings also allow to reconstruct the course of the complex system of artificial canals that branched off from the main *formale* and fed the horizontal wheels of the mills.

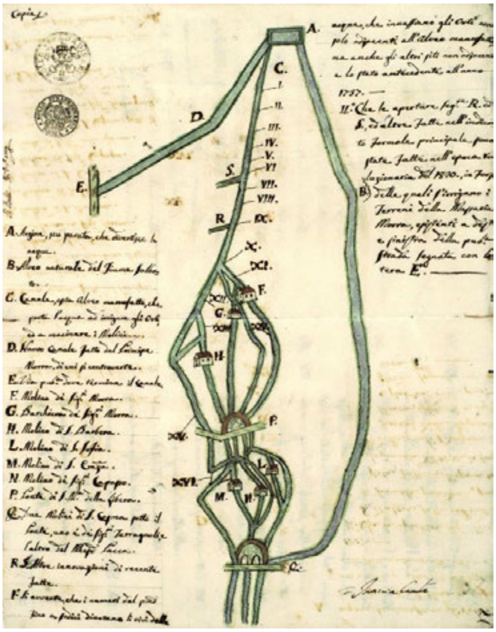

Fig. 5. P. de Juliis, plan of the canals with the innovations made by Prince Morra, July 1820 (Source: Quesada, 2008; ASRM, *Tribunale della Segnatura*, b. 4352, f. 84).

The maps were drawn up in order to re-measure the arable land after the frequent floods as well as during disputes between the owners of activities mainly related to the use of water and the opening of new unauthorised secondary canals. Significant in this respect are the drawings preserved in the notaries' files of the Benevento State Archive and in the documents of the State Archive in Rome (Cirillo & Musi 2008). These representations allow to locate not only the architectures, but also the canals, now buried, the vegetable gardens and the bridges, some of which are no longer used as such. This is the case of the three-arched *Santa Maria della Libera* bridge, which divided the possessions of Prince Morra from those of the *Badia Sofiana* and the *Mensa Arcivescovile*. Of this bridge, only

5 ASBN, *Notai, Atti del Notaio Benedetto Perrillo*, n. 10568/1, 1808.

a partially buried side remains visible today, integrated into the city's road system.

Canals and mills are also clearly visible in illustrations of the city (e.g. Borgia) (Borgia 1764) and in the plans of the Gregorian land register from the 1820s[6] (Fig. 6).

Fig. 6. Benevento, Gregorian land register, 1825. The map shows the three mills located in the *Acqualonga* district and the system of canals (Source: ASBN, *Catasto gregoriano, Benevento, Mappe*, sez XI, foglio V).

Information on the technological system implemented in the mills is scarce. Certainly, the mills of Benevento were not historically equipped with a vertical wheel but, like most of the architectures of this type located in Campania – e.g. the mills of the Gragnano Valley (Russo et al., 2018) – they had a horizontal wheel, placed at an underground level and which, once powered by the water flow, innescated the rotation of the millstones (Florio, 1871). The wheel system was therefore not visible externally and the structure, according to the plans available, had not piezometric towers (i.e. water storage devices).

The disputes between the owners together with the deeds of the notaries are also a source of information to deepen the understanding of the mills and their construction techniques. In the case of the mills in the vicinity of the old *Leproso* bridge – of which one remains today, converted into a theatre – the list of enlargement works dating from the mid-19th century is accompanied by a detailed plan and legend[7].

The mill, owned by Marquis Pacca, had, in addition to the spaces used for milling grain, rooms for sifting the grain (*cernotoj*), and square areas, located outside the building, used for drying cereals and threshing them (*aje*). The large two-storey structure had walls made of local limestone, known as *campese*, and bricks every two palms (approximately 52 cm). The vaults were made up of *zoccoletti*, that are bricks laid flat. The use of the term *zoccoletti* undoubtedly reflects the influence of the technical culture of Rome and the Papal State, where this word was commonly used to indicate the tiles with which these types of vaults were built (Cavalieri San Bertolo 1826-1827). In the Neapolitan area, instead, they were known as *pianelle*. The roofs, on the other hand, were built with chestnut wood, available locally, and with two pitches, as solution known as *alla Calabrese*.

3.1. The *Acqualonga* mill

The *Acqualonga* mill is a significant case in Benevento, being one of the few mills that did not experience total demolition or reconversion to other activities.

Probably founded in the Middle Ages (around 900 AD), it was owned by the Church, in particular by the *Badia Sofiana* (Borgia 1764). The structure visible today is the result of numerous reconstructions and transformations (Fig. 7). The 1707 flood, for example, destroyed three mills from the foundations, including the *Acqualonga* mill, which was partially or totally rebuilt in a differente way (Zazo 1950).

6 ASBN, *Catasto gregoriano, Benevento, Mappe*, sez. XI, foglio IV, 1825; sez XI, foglio V, 1825; sez. XII, foglio I, 1825.

7 ASBN, *Notai, Atti del Notaio Carmine Nardomeo*, n. 15606, 1851.

Fig. 7. Benevento, *Acqualonga* mill. View of the western façade.

The current planimetry and the system of buried but still partially visible canals (Fig. 8) do not correspond to the available topographical plans dated between the first and third decade of the 19th century.

Fig. 8. Benevento, *Acqualonga* mill. View of the buried canal and of the 20th century sluice gate.

In the topographic plan drawn up between 1826 and 1827 by the architect Giovanni Torre in connection with a court case between Goffredo Morra and the archbishop of Benevento[8], the *Acqualonga* mill shows an L-shaped outline and appears to be fed by a large canal running through the central body where the millstones were located.

Similar information can be deduced from the plan of the mill drawn up in 1814 in connection with a rental contract for the structure owned by the *Camera Ducale* during the French domination of the city[9]. The plan of the mill had to be redrawn, as the available one did not correspond to the state of the building and the land, probably due to the repairs carried out after the floods at the beginning of the century (Fig. 9).

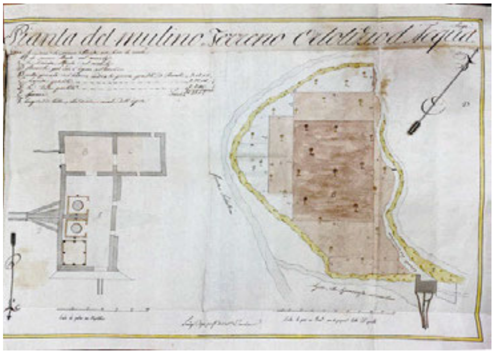

Fig. 9. L. Porzi, plan of the *Acqualonga* mill, vegetable gardens and surroundings lands, 1814 (Source: ASBN, *Notai, Atti del Notaio Filippo Zoppoli*, n. 14972, 1814).

The mill had two millstones of different sizes (9 and 6 ½ ounces, about 18 cm and 13 cm) and three rooms, two of which were used for sifting the grain and one, larger, for grinding. The entrance was located on the eastern side of the mill in front of a small bridge crossing the canal.

Today the mill is substantially different from these drawings and descriptions. The shape has changed from an L to a T and the original entrance can no longer be identified (Fig. 10). In addition to the two millstones listed in the 19th century document, a survey conducted in 1980s identified three addition millstones (i.e. five in total) connected to horizontal wheels and a further millstone situated on a raised wooden floor, now collapsed, with a vertical wheel, probably from the 20th century[10]. The vertical wheel is still visible today while the millestons are not easily detectable.

8 ASRM, *Tribunale della Rota, Jura diversae et cedulae privatae*, b. Z-634, 1827.

9 ASBN, *Notai, Atti del Notaio Filippo Zoppoli*, n. 14972, 1814.

10 Benevento, Archive of the City Planning Office, Benevento Municipality, *Survey of the Acqualonga mill*, unknown author, 1980s.

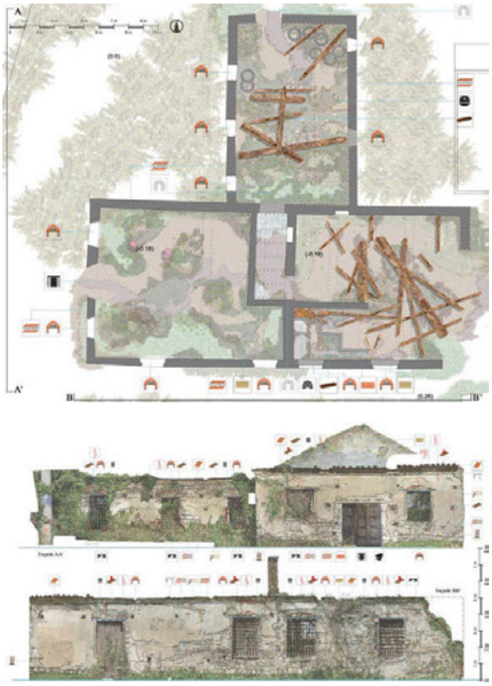

Fig. 10. Benevento, *Acqualonga* mill. Plan, western and southern façades (Source: drawing by Cuntò, Intermoia, Longo, Restoration Studio, Dept. of Architecture, University of Naples Federico II, prof. V. Russo, July 2016).

From a present perspective, the construction techniques used are similar both in the north-south section (18th century), and in the east-west side (Fig. 11). The masonry appears to be a mix, as in the case of the mills at *Leproso* bridge, of rough-hewn ashlars of local limestone and bricks. The roofs, inclined with two pitches, are made of wooden beams and brick tiles. The mill, used until the second half of the 20th century, has some internal partitions in squared tuff ashlars and a concrete flooring. Some wooden architraves have been replaced by steel profiles.

The comparison between the historical plans and the present situation allows to identify a canal and a sluice gate, which are now partially visible and not indicated in the 19th century drawings. They are located along the southern front of the building. The canal probably animated the vertical wheel, located in the more recently built east-west body (Fig. 12).

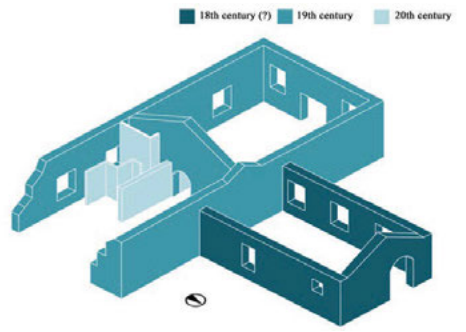

Fig. 11. Benevento, *Acqualonga* mill. Hypothesis of transformation (drawing by S. Cuntò, L. Intermoia, L. Longo, Restoration Studio, Dept. of Architecture, University of Naples Federico II, prof. V. Russo, July 2016).

Fig. 12. Benevento, *Acqualonga* mill. View of the vertical wheel (Source: Cuntò, Intermoia, Longo, 2016).

4. Conclusions: the mills in the current peri-urban context of the city

At present, the *Acqualonga* mill is in an advanced state of disrepair and is completely abandoned. However, its strategic location, between the ancient walls, the Sabato river and the fascist expansion of the city, makes it a potential place of attraction, both architecturally and in terms of landscape. Located in a large and isolated green area designated by the local urban plan (PUC) as zone F (activities of general interest), it was acquired by the Benevento municipality in 2000 and is part of a project known as the "Green Park and Sabato river Boulevard". Although the project on the building has not yet started, funds for its restoration have been allocated and should be spent in the near future.

This, together with the other planned interventions in the area, would make it possible to enhance a forgotten part of the city which underwent profound changes in the 20th century (Vergineo 1989; Bencardino 1991). In addition, the recognition of the historical value of the building and its context, would allow the city to regain possession of a part of its history unknown to most citizens. Unlike the area of the mills owned by the Morra family, which today appears densely built – and where only the *Mulino Nuovo* is still visible (former Rummo pasta factory, now a hotel) (Del Prete 2011) – the part of the city where the *Acqualong*a mill is located still retains a rural and peri-urban character as in its past centuries that deserves to be protected.

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An architectural catalogue for the study of traditional building features from their seismic behaviour in the 2016 Central Italy earthquake

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract
The preservation of vernacular architecture is grounded on the study of those building techniques adopted in the past, when know-how and craftmanship (the rule-of-thumb for a well-arranged building) governed the spontaneous construction. The advent of new industrial materials and the progressive impoverishment of constructive skills caused the loss of traditional architectural features in favour of a standardized construction. In the framework of the actual debate about the reconstruction of earthquake damaged historical centres, traditional building techniques and materials may play an effective role, as an alternative to a purely aesthetic appreciation, in the conservation of vernacular architecture. This contribution deals with the features of vernacular architecture in the area hit by the 2016 Central Italy earthquake, taking advantage of systematic observations of the built heritage in its context. The appearance of a building was subdivided in 'volume', 'surface' and 'components & materials', and, per each theme, those architectural features which played a role in the seismic performance of a building were collected. This led to the proposal of a catalogue which relates geometric and morphological features to structural ones, as a function of the local construction traditions and the architectural appearance of the townscape. Structural interventions applied over time were also recognized, categorizing them in 'spontaneous', 'standardized' and 'designed'. As in vernacular buildings architectural choices reflect on the structural behaviour, this catalogue and other similar ones are essential for actions (interventions or reconstruction) which are respectful of the built heritage and its values.

Keywords: *catalogue; 2016 Central Italy earthquake; seismic vulnerability; interventions.*

1. Introduction

In absence of archival documents which testify its genesis, the cataloguing of vernacular architecture from actual buildings is a viable option for its knowledge. In Italy, a systematic approach to the study of vernacular architecture dates to the 1970s. Among others, Caniggia and Maffei (1978) focused on the layout of a building in plan (position and number of rooms, position of the staircase) and in the façade (position of openings, number of floors): those recurring patterns among buildings were called 'types'. Later, building materials and construction techniques used in a specific place were collected in 'restoration manuals' (Bertoldi, 1989; Giovanetti et al., 2000; Ranellucci et al., 2004, 2009). These works aimed at both documenting and promoting traditional techniques, conformed to the state-of-the-art rules, as a reaction to standardized building practice that appeared in the 1970s, whose application had been widespread in the reconstruction or strengthening of buildings hit by the earthquakes in those years (1976, 1979, 1980) (Sbrogiò et al., 2022). Giuffrè (1993) and Carocci (1999), firstly analysed the capacity of vernacular architecture when seismic actions are involved. They proposed a relation between building features – resulting from the specific layout of a type, thr rules-of-thumb (i.e., *typical vulnerability*, (Doglioni, 2005), and the transformations that happened over time (i.e., *specific vulnerability*) – and seismic damage mechanisms, which were distinguished in first and second mode. A first mode failure (out-of-plane mechanisms) consists in the movement (translation or rotation) of a bearing wall of a building outwards its middle plane, whereas in a second mode failure (in-plane mechanisms), these movements are restrained to the middle plane of a wall.

The latest earthquakes in Italy (2009, 2012, 2016) stimulated anew studies on the architectural and construction features and the seismic response of buildings in villages and small towns, where the built heritage is mainly composed by vernacular architecture. For instance, Carocci (2012), Centauro et al. (2014), Taffarel et al. (2015), Brunori and Zampilli (2021) concluded, in spite of their different experiences, on the importance of a careful evaluation of traditional buildings techniques and architectural features, seeking for a viable reconstruction process, also with the support of compatible strengthening techniques. In addition, the documentation of the built environment can now rely on tools which allow precision and wide range at the same time, e.g., laser scanners and drones (Croce et al., 2019), and which relate information to geometry, in a holistic design approach (Savini et al., 2021).

The owners of vernacular buildings appreciate functionality and usability over material and technical authenticity (Strati, 2017). Furthermore, limited resources favour those interventions which are more effective in terms of costs and structural safety, if compared to more refined solutions, suitable to cultural heritage buildings (Pianigiani et al., 2020). Interventions on vernacular architecture can easily alter values linked to material culture, which may be sacrificed to aesthetic ones. However, a ban on interventions would condemn such buildings to abandonment, owing to poor usability and safety conditions, and, ultimately, to their loss (Giuffrida et al., 2020; Oteri, 2019).

The building activity in a territory selects those architectural and structural features which are the most adapted to environmental conditions (Giuffrè, 1993). Earthquake is a rare event and, therefore, specific provisions against it (the 'local seismic culture' cf. Ferrigni, 2015; Scibilia, 2017) belong to repairs rather than original construction, e.g., buttresses, tie rods and wall-base enlargements. The level of conformity of a building to both the supposed 'optimal' situation and a good overall state, as a function of maintenance and transformation, is a possible description of vulnerability and it results in specific damage patterns (Binda et al., 2007; Valluzzi, 2016).

In the study of vulnerability factors, two approaches are possible. A 'normative' one, which extracts from buildings individual critical situations matching to these compatible damage patterns (Binda et al., 2007; Doglioni, 2005). However, in those buildings where these factors can be recognized, it is hard to predict the actual damage. A 'descriptive' one (Giuffrè, 1993), in which vulnerability factors appear as features of building types, determining their structural behavior (i.e., damage mechanism). The association between vulnerability and damage patterns, as well as between building types and a certain town, is very specific and it may prevent a generalization.

Based on the idea that the features determined by the building 'dialect' of a certain area also define the (empirically determined) 'good' structural behavior of a building, it is possible to identify the best and worst situations and to use them for cataloguing purposes.

The paper proposes an intermediate approach, in which vernacular architectural features are collected in types, according to both their overall appearance and their influence on the structural behavior of a building. Structural transformation processes were also accounted for.

Therefore, these types can be generalized to a larger area than a single town or village, like a district or a territory which is rather homogeneous according to geographic and historic conditions. This is the case of the area hit by the 2016 Central Italy seismic sequence, which spanned between August 2016 and January 2017.

2. Methodological approach

Facing the damage patterns induced by the 2016 Central Italy earthquake (§3), the Authors wondered which factors concerning the *appearance* of the architectural layout of a historical centre (*townscape*), i.e., masses, lights and shadows, textures, influenced the structural response of its masonry buildings to seismic loads.

To that end, the proposal of a catalogue which collects the visible architectural hallmarks started from a literature review of those well-known factors which (typically) impair the seismic performance of the built heritage; they were also compared to real damage patterns (§4). For systematic purposes, the analysis of townscapes was split into three themes: i) *volume* and ii) *surface*, as determined by functional, social, and economic needs; iii) *components & materials,* as a function of the climate, building tradition, and availability in the surroundings of the building site. These elements of buildings are shaped by their inhabitants according to specific social, historic, economic, and geographical background. Architectural and non-structural details (e.g., lintels, chimneys, cornices, mouldings, etc.) were not considered, as a large-scale observation was carried out.

These choices aimed at reducing the influence of those details which distinguish each centre, despite the same geographical area, and at extending the validity of the final catalogue (§5) also to other vernacular centres.

The methodological approach is therefore independent from both the architectural layouts and the building materials. In addition, it could help in interpreting the damage of past earthquakes, provided that enough information on building features and damage was available, e.g., by the means of detailed survey campaigns and photographs.

3. Study area

The research focused on masonry buildings in 25 historic centres in Marche and Umbria regions in Central Italy, spread over the districts of Perugia, Macerata, Fermo and Ascoli Piceno, the most heavily hit by the earthquakes in 2016. These areas are characterized by a hilly landscape progressively changing into the harsher Apennine environment. In most cases, towns and villages were built in the Middle Ages as castles or fortresses in strategic positions, close to crossroads, important churches, bridges, or fords. As the circulation of people and goods was limited, building materials, such as stones and mortar, are those available in the surroundings of the settlement (Valluzzi et al., 2021). Those historical centers resulted from a spontaneous process of aggregation of masonry buildings, clustering around churches and castles or stretching along roads (Caniggia & Maffei, 1978).

4. Reconnaissance of architectural features with a structural role on built heritage

According to Giuffrè (1993) and Doglioni (2005), the vulnerability factors of vernacular masonry buildings can be categorized in the following items: i) position in town-blocks; ii) misarrangement in architectural layout; iii) poor structural details; iv) transformations which reduce the load-bearing capacity of walls; v) poor connections among walls and among walls and floors; vi) structural interventions with modern and incompatible materials such as reinforced concrete (r.c.). The maintenance state, which may influence the seismic performance of a building as well, was not considered in this work.

4.1 Volume

The position of a building within a block determines the mutual buttressing effect: corner and end units showed higher damage than internal ones as they lack of it (Fig. 1, left). The façades of clogging units, i.e., those built between already existing buildings, were often not properly connected to the adjacent ones. Misaligned cells in plan are exposed to corner overturning as well (Fig. 1, right). These situations, strictly connected to construction processes, favored the first mode mechanisms (overturning of walls and corners) (Fig. 2).

Fig. 1. Terrace in Castelsantangelo sul Nera: damage on head unit (left), overturning of façade in jutting unit (right)

Fig. 2. Overturning of façade in a clogging unit (Nocria)

As regard the elevation, some units stand higher than the eave line of the surrounding ones and, therefore, have free walls on one or both sides. As these latter were generally unrestrained by tie rods, they suffered of out-of-plane mechanisms, causing damage also to the roof of the adjacent units (Fig. 3). A unit higher on both sides than the neighboring ones was the most unfavourable situation.

4.2 Surface

Vulnerability is related to the geometric layout of a façade, which in turn is determined by the internal usage of a building. The structural behaviour of a façade may result from either a low conception of the architectural layout or modification processes which reduced the load-bearing capacity of the structural elements. Windows express the arrangement of rooms inside and delimit the loadbearing pier elements, which should stretch from the ground to the top level of a building. Overall, openings can be either regularly spaced or clustered; referring to horizontal distribution, the two key parameters are their mutual distance and the distance from the edges of a façade. Additionally, considering their vertical distribution, openings can be either aligned or shifted between storeys. Clustered windows determined a lumped distribution of stiffness and masses, which triggered out-of-plane mechanisms. Tightly spaced windows reflected in slender piers, which rapidly reached their peak strength (in-plane damage), whereas slender piers at corners easily overturned during the quakes. Shifted windows or shop windows and garage doors at the ground floor interrupt piers at an intermediate storey. In this case, the lack of a proper support caused the collapse of piers. Considering the interaction of adjacent units, openings can be staggered between the two buildings, because of different storey height. This caused pounding, i.e., cracks at the vertical joint between the two buildings, or in-plane damage (Fig. 5 left). Adjacent buildings with different floor stiffness (e.g., a timber floor and a r.c. one) or façades with a relevant difference in number and distribution of openings were exposed to similar situations.

Fig. 3. Overturning of standing walls (Castelsantangelo sul Nera)

In the study area these factors were often combined, resulting in severe damage patterns (Fig.

4). Conversely, provided that masonry quality is good, a well-arranged façade system, i.e., squat piers and an even distribution of openings ensured an overall behaviour with minor damage.

Fig. 4. Crumbling of masonry and shear damage owing to misaligned openings (Visso, courtesy of Eng. Falsetti)

4.3 Components and materials

Façades are made of undressed or roughly cut stones, randomly laid in poor mortar (lime and/or clay); their cross-section is divided in two or three leaves, without bonding stones. Overall, the poor masonry quality (Borri et al., 2020) eased both the crumbling of walls, owing to the lack of connections in the cross-section, and first-mode mechanisms, owing to poor interlocking between walls. Crumbling took place before any damage mechanism could activate, and it interested the outward layer of a wall, especially when r.c. roofs and tie beams were added to the building. Damage associated to crumbling is severe and often determines the loss of a building (Fig. 4).

Traditional horizontal structures are made of hardwood timber joists resting in sockets in walls. Loadbearing masonry vaults were sometimes observed at ground floors, but their usage was not widespread.

Starting from the 1970s, many buildings underwent interventions, as repairs and strengthening, with standardized methods and r.c. elements, according to the seismic codes passed after the earthquakes in the late 20th century (Sbrogiò et al., 2022; Sisti et al., 2022). Three categories of interventions were defined, as:

i) ‘Spontaneous’ interventions, i.e., devices which were applied in the past based on the local seismic culture, i.e., the empirical experience of contrasting the overturning of walls. These were buttresses at the foot of walls, buttressing arches between adjacent but separated buildings and metal tie rods. They contrasted first mode mechanisms and led to visible in-plane damage.

ii) ‘Standardized’ interventions, which were applied starting from the 1970s, in compliance with seismic codes and handbooks, prescribing rigid floors (Sbrogiò et al., 2022). Standardized r.c. elements replaced existing floor joists and roof beams, and r.c tie beams were added to connect the walls at floor and roof levels. These interventions, which added mass and stiffness to the horizontal structures, were not compulsorily associated with the strengthening of the bearing walls, which crumbled, resulting in severe damage (Fig. 5 right). The available strengthening solution for masonry walls was a cement plaster reinforced with a steel mesh.

Fig. 5. Left: pounding owing to staggered roofs (Pieve Torina); right: masonry crumbling and r.c. roof collapse (Campi Alto)

iii) ‘Designed’ interventions, i.e., the most suitable strengthening action for a specific building according to models and simulations. They target masonry through injections and fibre reinforced plasters, floors with a light stiffening, connections among parts (Senaldi et al., 2014), by the means of tie rods, steel bars, composite materials, in place of r.c. elements.

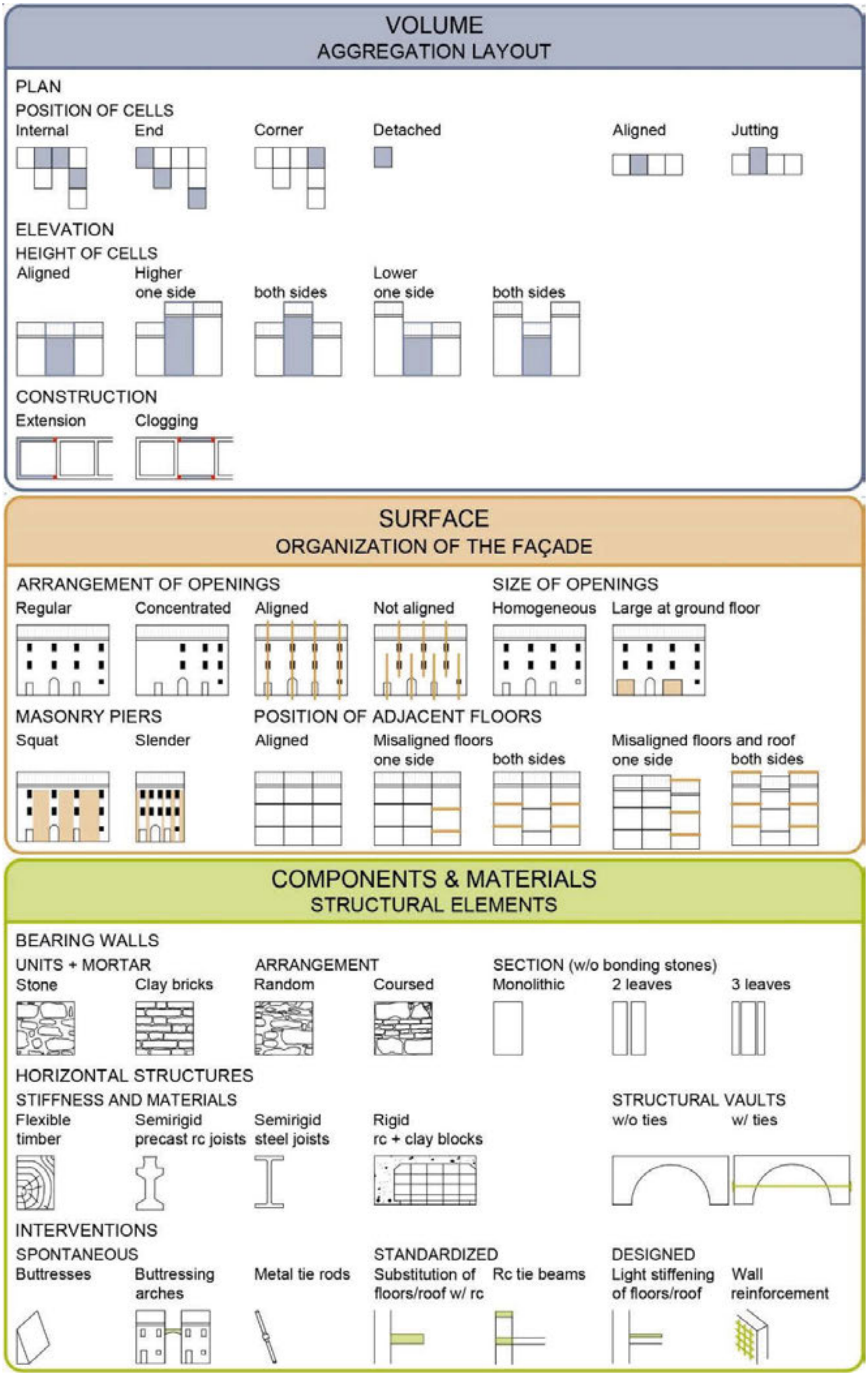

Fig. 6. Proposal of a catalogue of architectural hallmarks in a historical center

These interventions are more respectful of material and architectural features as they search for both material compatibility (weight, stiffness) and the collaboration with original parts. However, they are a viable option only in cultural heritage rather than vernacular buildings. Also in this case, an insufficient strengthening of the walls led to masonry crumbling, although localized if compared to that determined by standardized interventions.

5. Discussion

Fig. 6 shows the resulting catalogue for the ordinary masonry buildings in the study area, grouped as described in § 4.

The observations highlighted that damage patterns resulted from the interaction of multiple factors. The overall structural response of a building was mainly due to its components and materials, i.e., to the masonry quality. Secondly, it was governed by the surfaces, i.e., the layout of façades as a function of the distribution of stiffness and masses, which determined the damage distribution. Finally, the irregularity of the built volume determined localized damage with cracks at the interfaces between buildings and damages due to the fall of debris from adjacent units.

Proper interventions (type ii or iii) on masonry walls obtained minimum damage to buildings, even in the epicentral area (Sisti et al., 2022). However, the strengthening of walls determined a relevant alteration of the original features of a building.

6. Conclusions

The systematic observation of both the features of and the seismic damage to masonry buildings in the area of the Central Italy 2016 earthquake led to the proposal of a catalogue of vernacular architecture. A building was decomposed in *volume*, *surface*, and *components & materials*, i.e., those architectural features related to townscapes which also played an important role in the seismic behavior. Structural interventions on buildings were widespread in the study area and they were therefore included in the catalogue. The observations confirmed the role played by some well-known vulnerability factors (e.g., position of buildings in town blocks, dimension of the piers in a façade) or excluded some others (e.g., number of floors). Masonry quality and interventions were crucial in the determining the final behavior of a building. Poor masonry determined the local crumbling of walls, which was eased by the mass and stiffness of floors and roofs replaced with r.c. elements in intervened buildings.

Material impoverishment, economic downturns, depopulation, and seismic vulnerability put the values of vernacular architecture at risk. However, safety is a requirement for the conservation of vernacular architecture. Any design proposal must start from the improvement of masonry quality, which experience proved to be crucial for safety. Other interventions can rely on the inventory of traditional techniques and the composition of building materials as described by restoration manuals. A specific awareness on this theme by practitioners and supervisors is the only hope for both a viable reconstruction of that which has been damaged and future effective strengthening campaigns.

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Earthen vernacular architecture in flood-prone areas: characteristics and typologies in the Ebro basin

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract
Earthen architecture is one of Spain's longest-standing construction traditions, used from antiquity to the mid-twentieth century. Given its hygroscopic nature, earthen architecture is generally seen as barely resistant to water and as more associated with geographical areas with hot and dry climates. However, it is found in different places with different climate and geographical characteristics. In these surroundings, its survival over time has been ensured by a process of adaptation and modification producing architectural and constructive forms which reflect the identity of the geographical areas in question. One of the main risks to earthen architecture are floods, which have always represented a threat to this architectural heritage. The increased frequency and intensity of floods due to climate change have in turn gradually given rise to an increasing risk of disappearance for this architectural heritage. This paper aims to study the typologies and features of earthen vernacular architecture in flood-prone areas through the analysis of case studies in the Ebro basin. The study of earthen buildings in the area under study provides information on the most recurrent architectural features and vulnerabilities, as well as the inherent resistance which has enabled this earthen architectural heritage to survive. Moreover, a study of the pathologies and structural damage visible on buildings highlights those which are a direct consequence of the action of water and can potentially affect structural behaviour during a flood. Aiming to establish conservation strategies for earthen architectural heritage the data collected are analysed using a qualitative vulnerability assessment methodology, establishing the degree of influence of individual characteristics on the response of earthen structures to floods.

Keywords: *floods; vulnerability; conservation strategies; climate change.*

1. Introduction

Vernacular architecture or architecture "without architects", as termed by Rudofsky (1964), can be defined as a form of building connected closely to territory, the geographical space in which it is located. This connection is apparent in the architectural type and the construction techniques. Architectural heritage in the territory of the Iberian Peninsula, which is extremely varied, is the result not only of geographical conditions but also of social and historical ones. Thus, vernacular architecture has developed thanks to the combination of several factors: geographical, climatic, historical and social. These factors have influenced the definition of the architectural type and the development of the construction techniques. Earthen architecture is one of the most widespread constructive traditions of the Iberian Peninsula and Earthen construction techniques, used since ancient times, continued until the first half of the twentieth century (De Hoz Onrubia et al., 2003). Despite the progressive abandonment of this constructive tradition, the energy crisis and climate change issues have prompted a renewed interest in earthen architecture. This in turn has encouraged extensive study and research, as well as publications and manuals on the topic (Jaquin, 2012; Maldonado Ramos & Vela Cossío, 2002; Warren, 1993). In addition, many authors have focused on the study of earthen architecture in the Iberian Peninsula (Gómez-Patrocinio et al., 2020; López Martínez, 1999; Camilla Mileto et al., 2019; Vegas et al., 2011) and on its conservation (Keefe, 2005; C. Mileto & Vegas, 2017; Warren, 1999). At present, climate change has had a major impact on the risks associated with the loss of architectural heritage, with a significant increase in the scale and frequency of natural risks such as floods (Bracchi et al., 2020; Díez-Herrero et al., 2008; Eguibar et al., 2021; Huntington, 2006; Lastrada et al., 2020). As a result, the concepts of the vulnerability of architectural heritage and risk prevention and mitigation are of paramount importance (Canivell et al., 2020; Figueiredo et al., 2021; Ortiz et al., 2014). Flooding is one of the greatest threats to architectural heritage, causing irreversible damage and, in some cases, the collapse of structures (Drdácký, 2010; Herle et al., 2010; Mebarki et al., 2012). Although earthen architecture is generally considered more vulnerable to the consequences of flooding given its hygroscopic nature (Beckett et al., 2018, 2020; Gerard et al., 2015) various earthen buildings, both monumental and vernacular, have been found in areas exposed to flooding in the Iberian Peninsula (C. Mileto et al., 2021; Trizio et al., 2020, 2021). However, these traditional buildings are disappearing due to social and other external factors, such as the erosion and land consumption caused by flooding, even in areas which had previously been dry. This paper aims to analyse and catalogue vernacular earthen buildings located in flood-prone urban areas in order to identify their most recurrent formal and constructive characteristics. For this purpose, the Ebro valley has been selected as an appropriate case study area since it is a territory with extensive earthen architecture (Villacampa Crespo, 2018). Moreover, a component-based methodology is used to assess flood vulnerability in order to establish conservation strategies and guidelines for the protection of earthen vernacular architecture.

1.1. Territorial context

The study area of this paper is the basin of the river Ebro, where there are urban centres at high risk of flooding in the flood plain (ANEXO I Municipios y Núcleos de Población Situados En Zona A de Alto Riesgo, a Efectos de Emergencia Para Poblaciones, Incluidos En El Anexo XII (Tabla 12), Del Decreto 201/2019, de 8 de Octubre, Del Gobierno de Aragón., 2019). The Ebro is one of the rivers of the Mediterranean basin of the Iberian Peninsula (Fig. 1).

Fig. 1. Basins and flood-prone areas of the Iberian Peninsula. Legend: 1. Cantabrian Basin; 2. Mediterranean Basin; 3. Atlantic Basin (Source: Authors, 2021).

In its lower-middle course, the Ebro River causes serious prolonged floods exceeding 3000 m^3/s. These floods are due to long-lasting frontal precipitation or snow melting pre-eminently during the summer months (Camarasa Belmonte, 2002). The case studies selected for analysis are located in the town of Torres de Berellen (Fig. 2), 20 km from Zaragoza, the capital of the Autonomous Community of Aragón. The urbanised territory of the municipality covers an area of 53.8 km^2. During the periods of major river flooding the town is reached by water because of the bottleneck that the river causes as it reaches the urban area nearby. In addition, as it is impossible to expand the evacuation section the water flow velocity increases, triggering important erosion issues in the area (Gobierno de Aragón, 2005).

Fig. 2. Map of the territorial context of Torres de Berellen.

2. Methodology

The analysis carried out in this study is based on a methodology which catalogues earthen architecture and assesses flood vulnerability in flood-prone areas. The study is divided into three fundamental phases: data collection, analysis and evaluation. The data collection phase was preceded by a preliminary phase in which the most relevant areas were selected for study. This selection was made by superimposing the map of the distribution of earthen architecture in the Iberian Peninsula (SOS-Tierra Project, https://sostierra.blogs.upv.es/) onto that of the flood-prone areas obtained from the SNCZI (National System for Cartography of Flood-prone Areas) for Spain and the Portuguese Environmental Agency for Portugal. The strategic use of maps as tools for vulnerability assessment made it possible to establish the basis for preliminary study and flood vulnerability and risk assessment (Hervas & Bobrowsky, 2009; Wang, 2015). In addition, this superimposition of maps resulted in a map showing the flood exposure of architecture in the Iberian Peninsula (Fig. 3), a tool essential to the preliminary phase. Thanks to this map the most common earthen construction techniques within the areas most at risk from flooding were identified. As Figure 3 shows, there is a high concentration of adobe buildings in the Ebro basin.

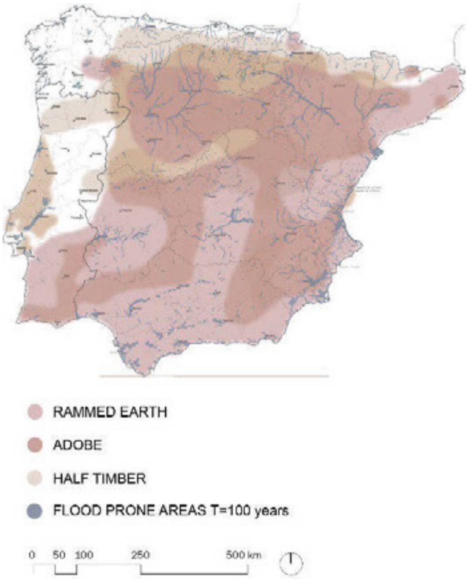

Fig. 3. Flood exposure map of earthen architecture in the Iberian Peninsula (Source: Authors, 2021).

As a result, the town of Torres de Berellen, with a high proportion of adobe buildings, was selected as a highly suitable case study. Subsequently, fieldwork was used to obtain information on the characteristics of the earthen buildings, which was then organised into synoptic data collection forms. These contain all the building characteristics that are essential to this analysis, divided into three categories: environmental, morphological and constructive. The characteristics identified in the data collection forms have been used as susceptibility parameters for assessing the flood vulnerability of earthen architecture. In order to simplify the analysis, the number of susceptibility, urban typology, number of floors, rendering and additional protection (Fig. 4).

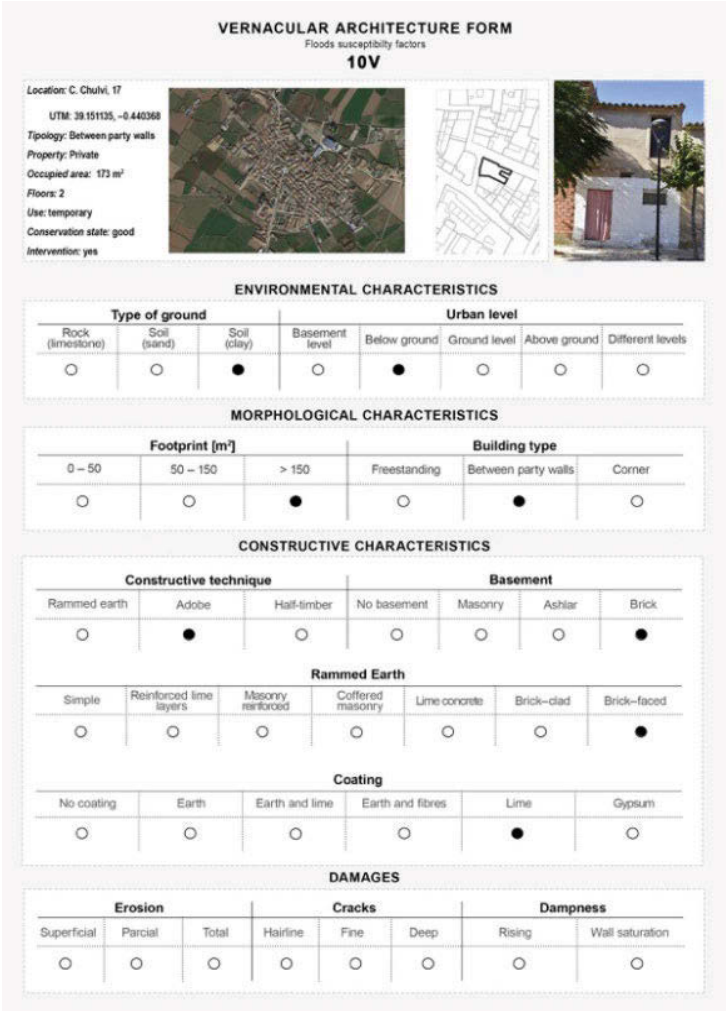

Fig. 4. Data collection form (Source: Authors, 2021).

Each characteristic was assigned a susceptibility value between 1 and 5, weighted by a reduction factor calculated using the Delphi method (Gordon, 1994; C. Mileto et al., 2021). In addition, the state of conservation of the buildings was taken into account in the vulnerability assessment, by including parameters which represent pathologies and structural damage affecting the buildings that could influence flood resistance.

3. Results

In the first phase of the work, the fieldwork, 38 earthen buildings in Torres de Berellen were identified. All case studies are built in adobe, a construction technique which continued in use until the first half of the twentieth century. An initial analysis of the buildings and the quality of the walls highlights some fundamental characteristics of their architectural type and construction techniques. The buildings are between 3 and 8 metres high, and have 1 to 3 floors. The ground floor is generally used as storage or a garage while the upper floors are used as dwellings. From a constructive and structural perspective, the building structures incorporate load-bearing walls 40 to 60 cm deep. The walls are made of adobe blocks measuring 17.5x7.5 cm on average with 2 cm mortar joints. The corners are reinforced with bricks in order to ensure greater structural stability. Moreover, the wall plinths are made of bricks or concrete blocks which have been added in some cases to fill gaps, while in other cases the entire plinth is built with concrete blocks. The height of the plinth varies from 60 cm to 110 cm. In many cases, the buildings are in an advanced state of decay. Different types of damage identified include cracks, rising damp and saturation of the walls (Fig. 5).

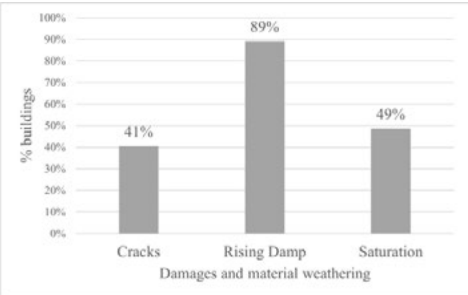

Fig. 5. Percentage of buildings with damages and material weathering.

Differential settlements and rotations caused by the long-term effects of flooding can lead to the formation of vertical cracks. Indeed, the presence of water in the foundation soil favours erosion and results in differential settlements. In addition, adobe masonry does not use transversal connections such as ties to prevent the independent rotation of the parts or cracks worsening. According to surveys on the state of conservation of buildings a high percentage of the case studies analysed shows rising damp. While the presence of moisture in the walls could trigger severe damage mechanisms this type of degradation is not usually included in flood damage analyses (Kelman & Spence, 2004). However, it was considered appropriate for this analysis as it is detrimental to the overall resistance of the walls. Siedel (2010) explained that floods occur in a short time with wide intervals between events. As a result, the saturation of materials, which modifies their characteristics and damages architectural components, takes place in a short period. The effects of excessive saturation may also include the loss of material, especially in the plinth, as found in some case studies (Fig. 6). This material degradation is mainly due to the characteristics of non-stabilised earth, which has a strong hygroscopic nature.

Fig. 6. Vernacular adobe building with visible erosion.

After carrying out the morphological and degradation surveys, the flood vulnerability of each case study was assessed. The vulnerability index values obtained ranged between 1.5 and 3 on a scale of 1 to 5. The vulnerability indexes of the buildings assessed are in a range of low and medium values, as shown in Fig. 7.

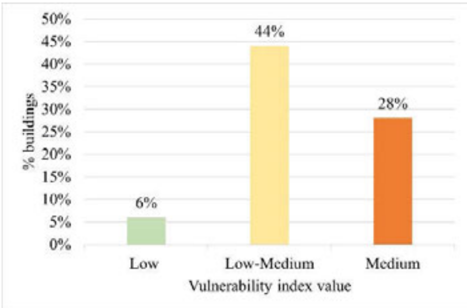

Fig. 7. Vulnerability index results. Legend: Low (<2); Low-Medium (<3); Medium (<4).

Analysis of the data obtained shows that despite the presence of various forms of degradation, buildings are not highly vulnerable to flooding. However, as the buildings are exposed to floods, appropriate strategies are necessary to mitigate the risk and the consequent effects. Therefore, the study of structural and non-structural measures is considered necessary (D'Ayala et al., 2020). The design of emergency plans is considered a key measure for preventing further damage and reducing risks. Such plans could reduce the impact of flooding and prevent possible damage to historic structures. It is essential to establish criteria and guidelines for restoration and structural reinforcement¸ in addition to non-structural measures. A correct design of conservation actions, such as the interventions for reducing rising damp and wall saturation, as well as structural actions to reduce displacements and differential settlements, can prolong the useful life of traditional buildings, preserving their mechanical characteristics and strength without damaging their historical and traditional features.

4. Conclusions

The cultural heritage of traditional earthen architecture is the result of knowledge and techniques with roots in the history of its setting. At present, this heritage is in danger of disappearing due to certain risk factors, jeopardising its survival. Floods are a threat to traditional earthen architecture. In the Iberian Peninsula, the Ebro basin is a flood-prone area where floods have threatened earthen buildings on several occasions. From the morphological and constructive study, it can be concluded that the traditional constructions of the Ebro basin analysed in this paper are mostly made of adobe. Furthermore, the vulnerability assessment led to some conclusions. Firstly, the degradation issues identified decrease the resistance of buildings making it necessary to carry out structural reinforcement actions in order to reduce vulnerability. In fact, if risk is seen as the combination of exposure, vulnerability and probability of the event occurring, only vulnerability depends on the characteristics of the object exposed to risk. Therefore, to conserve heritage it is necessary to intervene not only on the buildings to be protected but also on the surrounding territory through prevention and risk mitigation plans. Vernacular architecture is particularly important as it creates a sense of belonging to places. It comes "from the place" (Loos, 1910), without effort or disfigurement of the landscape, and from careful observation and knowledge of the use of the territory by its inhabitants. Preserving vernacular architecture means preserving this ability to design while maintaining a strong awareness of the landscape.

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ANEXO I Municipios y núcleos de población situados en Zona A de alto riesgo, a efectos de emergencia para poblaciones, incluidos en el Anexo XII (tabla 12), del Decreto 201/2019, de 8 de octubre ,del Gobierno de Aragón., (2019).

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New studies for the knowledge of the vernacular characters of the ancient water mills in central Sicily

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Topic: T1.1. Study and cataloging of vernacular architecture

Abstract

In the centre of Sicily, hidden in a rural landscape that has changed significantly in the last decades, remains the traces of an old economic and productive reality: that of traditional water mills. Even if, often in precarious conservation conditions, these vestiges show an unsuspected resilience. They embody tangible and intangible values worthy of being known, protected, valued, and shared. In this sense, the research that this paper introduces aims to identify and re-read the numerous structures still existing. The purpose is to find effective strategies to safeguard and promote this important vernacular heritage: a silent guardian of uses and customs, traditional methodologies, materials and building systems. All elements that show a wise use of native resources and are the result of functional choices aimed at optimizing production. The paper presents the first results of the study, namely the cataloguing activity carried out in the Gela River valley. The methodology followed relies on innovative systems for online inventory and sharing of the identified properties. The ultimate goal is to create a digital infrastructure capable of also improving the sustainable use of assets scattered throughout the territory.

Keywords: *water mills, restoration, cataloguing, vernacular architecture.*

1. Introduction

Central Sicily presents interesting features for the development of strategies related to the knowledge and conservation of vernacular goods in their significance of the essential elements of the cultural landscape. Here, the process of territorialisation, which over the centuries has caused continuous changes, in close connection with the variations in social, economic and productive conditions, has kept traces of agrarian (pre-industrial) societies. In particular, the research that this paper summarises focuses on the fluvial landscapes of the upper valley of the Gela River. This area extends from the coasts of Gela to the hinterland of Piazza Armerina, well known for the Villa del Casale, a UNESCO world heritage site since 1997. This area has historically been rich in water resources that have shaped its present configuration, as evidenced by the presence of numerous rural buildings and, in particular, several old water mills (Fig. 1). A long-term historical sedimentation testifies to the inseparable link between this territory, the community and the river that has unfortunately been increasingly lost over the past century (Nigrelli & Martelliano, 2018). The study is based on the consciousness that the rural landscape is a dynamic living system and a direct expression of the identity and belonging of local human communities (ICOMOS-IFLA, 2017). It is the result of agricultural production, consciously and continually impressed by humans on the natural world (Sereni, 1961).

The study aims at identifying and analysing the processes that transformed it into the current palimpsest, rich in outstanding examples of cultural assets, either tangible (paths, waterways, artefacts) or intangible (trade networks, practical knowledge, traditions, toponyms).

As mentioned earlier, a considerable part of this heritage consists of the remains of rural buildings formerly devoted to production, but which are no longer used. Evocative icons from a past time survive as isolated fragments left to themselves and besieged by nature that takes revenge on what man has built. They are ruins that have their own story and deserve to be understood and preserved.

Very often, these properties lack data about their location and status, physical, material, historical and artistic characteristics, hazard maps and other relevant resources. Information that must be systematically collected and shared to prefigure their safeguarding, monitoring and management as memory sites. Such information also aims to establish the necessary maintenance processes to provide a way to transmit these heritage places to future generations (Letellier, 2007).

The first step of the research on the water mills around Piazza Armerina was the analysis of the inventories already accomplished over the last thirty years by regional and local institutions. These lists were thus combined with the evidence provided by the maps of the Italian Military Geographical Institute (IGM), where some items not mentioned elsewhere were identified. The water mills were then catalogued using the A sheet provided by the Regional Centre for Catalogue and Documentation (CRicd), according to the standards and methodologies established by the Italian Central Institute for Cataloguing and Documentation (ICCD).

Sheet A has become the metadata of a database to understand these historical structures. They have been designed as part of a Web portal created to make the acquired information and materials as accessible as possible. In addition to pursuing the collection and sharing of essential data on these assets with a high identity value, this digital infrastructure has been intended as a tool capable of addressing different types of users. This has been possible through the elaboration and insertion of multimedia content that can communicate both with scholars and people not directly engaged in scientific research. Individuals potentially intrigued or drawn by this heritage are eager to obtain intuitive information and participate in a suggestive and 'subjective' way in the process of interpreting the landscape.

In this sense, the Web platform will also support initiatives aimed at enhancing the cultural itineraries of the territory. It would be managed and/or implemented by associations or institutions, allowing, on the one hand, getting in touch with many potential visitors and, on the other hand, transforming them into both active and responsible content providers and custodians.

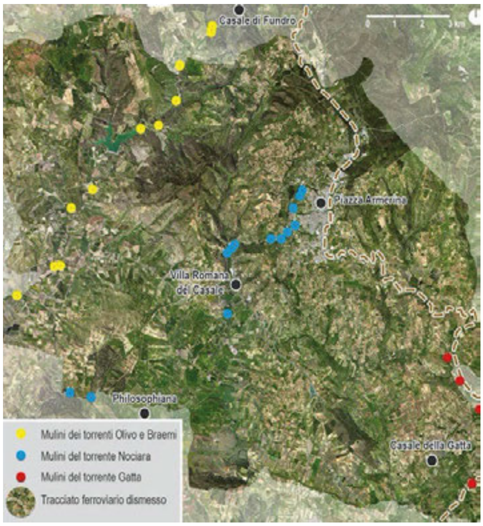

Fig. 1. The water mills around Piazza Armerina. They have been divided into three systems: Olivo and Braemi streams, Nociara stream (first section of the Gela river), Gatta stream.

As can be seen from the study of ICT platforms for cultural heritage, the real success of these systems lies in a continuous updating designed to keep pace with the sudden changes imposed by technological innovation and the network itself. It is not a finished job; instead, it is a continuous work in progress—both in terms of content and of the IT architecture itself—aimed at improving the efficiency of the institutions involved and the policies for the protection and conservation of our cultural heritage.

2. Methodological aspects of the cataloguing of windmills in Piazza Armerina

The identification of the ruins of the ancient mills in Piazza Armerina was an operation that required patient work. A rigorous methodological approach was followed to cope with the inhomogeneity and the inconsistency of the data found in the already available records.

As noted, this activity began with the consultation and comparison of existing cultural heritage inventories in this area. To this end, the lists compiled to catalogue isolated assets, within the framework of regional and provincial landscape plans (PTPR and PPTP), have been very useful. From the integration of these data, twelve water mills were identified: three of which are located along the Olivo stream (the Rodilosso, Olivo and, Olmo mills), four along the Braemi stream (the two Salemi mills, the Ugliara and Ugliarella mills), four in the Nociara stream (the Sant'Andrea, Cappuccini Vecchi, Berretta and, the Falcone mills) (Fig. 2) and one in the Gatta's stream (Gatta's mill). In the area of Enna, the cataloguing and filing of this heritage had already been carried out in 2003 by the local Superintendence for Cultural and Environmental Heritage, on the occasion of a documentary exhibition related to water myths, rituals, and festivals. The results from this activity were published in small catalogues. This census recorded another specimen: the Rasalgone water mill, located in the homonymous district, along Gatta Creek (Fig. 3). For three of the thirteen water mills identified, the Enna Superintendency also developed detailed fact sheets, which were unfortunately not updated later. The water mills listed on the 1:25000 scale maps of the Military Geographical Institute were added to this initial list. To obtain a picture of the whole area, eight maps from the 1940s to the 1960s were combined.

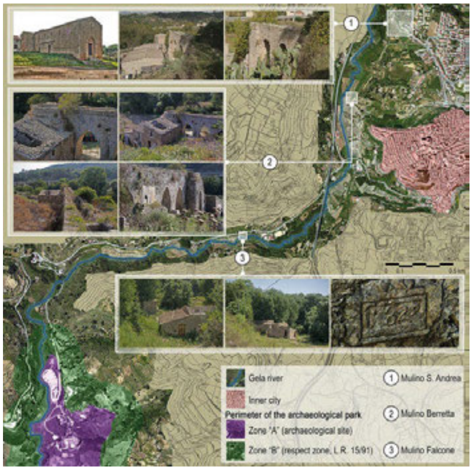

Fig. 2. The section of the Nociara stream that connects the town of Piazza Armerina with the archaeological site of the Villa Romana del Casale.

These maps of the territory showed five additional mills along Nociara Creek. The IGM map also distinguishes the water mills between 'mills' and 'old mills'. This information, compared with the date on which the map was drawn up, has made it possible to discover the plausible period of cessation of the activity of some of these structures (Fig. 4).

The water mill's census was completed with the on-site investigation. The inspections were carried out according to specific routes, identified along the watercourses. This allowed to locate other mills not mentioned before: one north to the Villa del Casale, about 50 metres from the water mill today incorporated by the La Ruota restaurant and another in the Rossignolo district, on the Nociara River, about one kilometre south of the famous archaeological site. Two other mills have also been identified in the neighbourhood of Alzacuda, at the border between the territories of Piazza Armerina and Mazzarino (Fig. 5).

Fig. 3. The Rasalgone water mill in its current situation.

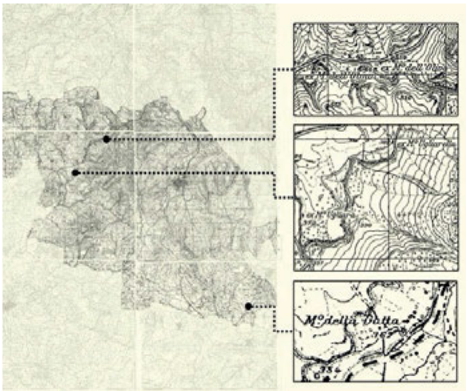

Fig. 4. Map resulting from the combination of the 1: 25000 IGM cartographies consulted. The administrative boundaries of the town of Piazza Armerina and the locations of some mills are highlighted.

In addition to the mills documented around Piazza Armerina, it was considered useful to include in the research also other similar artifacts which, although falling within the boundaries of neighbouring municipalities, constitute significant polarities from the point of view of the process of recovery and re-appropriation of the river landscapes taken under exam.

This group includes four water mills located near the border between Enna and Piazza Armerina, along the Furma stream: the Marletta one and three others attributable to the ancient Casale di Fundrò. Two other specimens are in the territory of Mirabella Imbaccari, intercepted by the river section that leads from the Rasalgone mill to that of the Gatta, respectively called Molino Grande and Molinello. Also, the Quattrova mill has been added to the list. Situated on the border between Piazza Armerina and Barrafranca is a unique example in the area because of the presence of a long twill, still preserved for approximately 800 meters.

3. Recommendations for the recovery of water mills in Piazza Armerina

The inventory carried out has allowed assessment of the conditions of the water mills around Piazza Armerina, mostly reduced to suggestive ruins attacked by vegetation and exposed to climate-related and human-induced hazards.

The archaeological site of Villa Romana del Casale represents the region's most important cultural polarisation and tourist attraction. However, the effective promotion of these scattered assets, which constitute a varied and extensive 'minor' heritage, can certainly fascinate a broad range of visitors. While going to the Sicilian hinterland to visit the UNESCO site, they would be encouraged to stay longer, attracted by itineraries aimed at discovering other vernacular aspects of the territory. The traveller, as in the past, is constantly seeking novelty and difference (Hanson, 2001).

Fig. 5. Some images of the mill located near the Gole di Ratto, on the border between the territories of Piazza Armerina and Mazzarino and of the one located in the Alzacuda district.

Specifically, in this case study, it was decided to improve as much as possible knowledge about the former mills to make this data available in the future: a scientific and ethical obligation to record for posterity (Stanley-Price, 2009). In this sense, metric and material surveys were carried out by overcoming a series of difficulties related to the accessibility of places thanks to a wide use of new technologies (i.e., drones, image-based 3D modelling, laser scanning, etc.). This activity also had the purpose of documenting absences, recognising gaps and weaknesses due to oblivion and destruction and allowing the residual elements of an integrity that no longer exists to be mapped. A set of signs and voids, still filled with material meanings, knowledge, ideas and symbols left by man and time that should be preserved and made recognisable. To survive, fragile balances need to be preserved 'by making the lived experience visible, establishing dialogues of an equal and assonant nature between instruments of intervention and permanence' (Ugolini, 2010, p. 13). In this sense, to allow authentic substance protection and to avoid distorted site interpretation, the destruction of the original evidence, the disruption of landscape values and the reconstruction of the ruins of the ancient watermills found in this area would be discouraged (as contemplated by international legislation and guidelines). Surveys undertaken have shown an adduction canal - a wall structure like an aqueduct more than 10 m high - which is the only surviving part in the process of 'natural selection' to which these artefacts were subject after their abandonment. For these components, only conservation activities will be allowed to maintain the minimum intervention principle. Keeping the form of a permanent ruin will require continuous monitoring to minimise the scope of necessary treatments. To counteract biological attack activities related to the eradication of plants, weeding and disinfection are foreseen.

To prevent the detachment of wall portions and water infiltrations inside the structure, compensating for the particularly disintegrated mortar joints providing new ones as backward as possible is planned, "as Alois Riegl already advised, to maintain the chiaroscuro effect, the perception of the work that the degradation has done" (Doglioni, 2008, p. 277). For the essential protection of the wall ridges, the use of cocciopesto is recommended to integrate and repair, where still present, the original coating layer of the canal that led the water to the mills. This operation must also contribute to making this large channel clearly legible. Approximately 70 cm wide and 90 cm deep, it extends along the entire top of the walls.

For ruins where there are critical problems that compromise the static aspects, it will be necessary to study the possible causes and then take measures to neutralise the effects. Among the causes of failure of these rough details are to be mentioned: the lack of the building that housed the millstones, located at the end of the adduction channel, which compromises the static behaviour, as there is no longer an element of contrast of the forces acting in an orthogonal direction to the canal wall structure; the collapse or ineffective clamping of reinforcing elements, such as the lateral buttresses; and the presence of portions of the wall subject to unforeseen efforts at the time of construction, such as the thrust of the soil accumulated over the years. Once the causes are identified, structural stability measures will be taken. In some cases, they could include the consolidation of the elements preserved (e.g., supplementing the walls, ceilings or roofs in a form based on research results or introducing additional, modern supporting structures). However, the activities aimed at restoring the static behaviour of the masonry should be effective, but visually not very invasive, so as not to compromise their general appearance as a ruin (Jurina, 2006). On the other hand, some water mills have retained an original clear morphology. Their conditions can allow their reuse for different purposes through alternate uses with respect to the original function, also aiming at the economic enhancement of the properties and the territory on which they stand. For example, it cannot be excluded that these old water mills could be reinserted into a productive circle, allowing them to host transformation activities—developed with traditional processing methods—of typical local products, thus safeguarding both the vernacular architecture and the food (Tomaselli & Ciravolo, 2003). In specific cases, small architectural additions would be possible. However, they should be both clearly different from the historic fabric and structure, and the transformations introduced should be ‘reversible’. Modern grafting (such as museum rooms or tourist service) will be designed to avoid altering the image of ruins in the landscape and dominating its authentic substance.

4. Digital infrastructure in support of the knowledge and improvement of vernacular architecture

The territory analysed by this research is the result of thousand-year-old stratifications. However, it now suffers from considerable fragility, both due to poor infrastructure and great vulnerability to environmental risks that can even cause permanent loss. The lack of clear perception of these internal areas and the objective difficulties linked to their accessibility make any proposal for enhancement (e.g., through the establishment of paths and itineraries) difficult to implement and maintain.

Some experiments carried out in the past in this direction, thanks to the use of EU funds, have unfortunately turned out to be unsustainable and have failed. Despite this, the relevance of their historical meanings makes it necessary to protect these ancient productive realities, understood as a real resource that represents collective values and cultural production. It is a question of establishing a genuine dialogue between institutions, foundations, landowners, public opinion and genius loci. The objective is to reestablish a direct relationship with the identity of the goods by reworking visual codes and developing graphic vocabularies that can be used to orient, animate and decipher this heritage. It is then necessary to study new hypotheses of valorisation to prevent the forgetting of all the knowledge, traditions, memories and values closely related to this cultural landscape. As shown by the analysis of many other case studies, the most recent dynamics of cultural heritage management today require a rethinking of the actions to be taken in the field, indicating new ways to follow that can fully exploit the potentialities offered by the ICTs. The collection of data and documents and the production of digital content conducted during archival and bibliographic research has led to the creation of a diversified database that can represent a tool for a holistic approach to knowledge and dissemination. In view of the re-evaluation of these specific community's identity resources, the undoubted effectiveness of sharing the collected data on the network emerges. However, it is crucial to both make a classification and diversify these data to optimise them for a platform that can be useful for different purposes: research, management and valorisation (Paolini et al. 2009). The idea of creating a shared data platform lies at the basis of the research path undertaken, which aims to create a sort of virtual infrastructure for knowledge, technical control, and enhancement. A structure that would allow multilevel access to information, from guided tours for the simple visitor to thematic insights for scholars. Finally, this instrument would ensure the interaction of users, now increasingly involved in the Web-sharing process, to insert new content in dedicated spaces.

To this end, a specific logic and semantic organisational structure has been designed for this platform. The results of the research have been catalogued in specific digital sheets where new fields (metadata) have been integrated to also contain types of data not covered yet, such as drawings in vector graphics formats, hyperlinks to multimedia contents (i.e., virtual tours and 3D models) and virtual reconstructions (Fig. 6). The content of the datasheets created for the water mills in the region of Piazza Armerina was organised using Microsoft Access. The goal was to provide a database that would be implementable on a Web platform and integrated with existing systems, allowing interoperability with both the platforms developed by the Italian Ministry of Culture (MiC) and the Open Data portals based on ArcGIS Hub technology, increasingly requested by the Web users, based on the free sharing of georeferenced databases. For the implementation of the data on the Web, it was necessary to convert the database to structured query language (SQL). It will allow the simultaneous presence of different types of digital data, including virtual 3D models that can be presented in formats currently not contemplated in the ICCD's cataloguing standards for architectural heritage, connected through specific uniform resource locator (URL) paths. It will also be easy to implement and support existing platforms. The latter feature is essential to prevent data redundancy in the desirable perspective of continuous system growth and integration with existing platforms, such as the General Information System for Cataloguing (SIGEC) created by the ICCD or the numerous GIS Web platforms, which for years have become an essential support system for spatial planning tools.

Conclusions

This work attempted to study and highlight the identity meanings contained in traces of an old economic and productive reality: that of the traditional watermills of central Sicily. The research, still ongoing and punctuated by numerous implementation difficulties, aims to develop the knowledge and awareness activities necessary to guide appropriate protection and valorisation actions. In this sense, it has put in place innovative methodologies for data collection, digital representation and sharing as part of operating procedures for the recovery, monitoring and enhancement of these precious cultural assets. The goal is to increase knowledge of the value and precarity of these properties scattered over a fragile territory. It will therefore make use of images and information that should be able to convey the same recognition and evaluation, quantitative and qualitative, of the many elements that contribute to defining their essence. An ambitious project that, in the context of the attention paid to the rural landscape by Italy's national resilience plan, should finally get the attention and support it deserves.

Fig. 6. Photogrammetric survey of the main adduction channel of the Olivo water mill and virtual reconstruction of the mechanism of a horizontal wheel mill.

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Identification and safeguarding of Central Sicily's forgotten vernacular heritage: elements of identity and memory

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Topic: T1.1 Study and cataloguing of vernacular architecture

Abstract
The coronavirus pandemic has created new challenges for rural areas already affected by chronic economic, social, and environmental problems such as depopulation, reduced service provision, ageing, the decline of agriculture income, inhibited accessibility. These problems are very serious in Central Sicily. Here, the absence of adequate infrastructure, the limited presence of organizations for the promotion and marketing of agricultural products, and the effects of climate change have strongly affected the rural landscape. Numerous small towns, farms and extraordinary underground structures are on the verge of extinction, threatened by the ravages of time, forgetfulness, and vandalism. Although often unknown, these eloquent examples of the vernacular heritage of the interior of the island are no longer an integral part of the life of the region. However, if properly identified, studied, protected, re-used, and reconnected to the territory, they could help to reinforce the local cultural identities, and bring positive changes in the socio-economic conditions of the concerned peoples. This paper aims at exploring all these aspects, focusing on the territory of Enna. It also intends to present a pilot project aimed at identifying the most important elements of local rural architecture to promote sustainable methods of preservation and restoration.

Keywords: *cultural and rural landscape; safeguarding; restoration; reuse; Sicily.*

1. Introduction

In recent decades, there has been a consolidation of the collective interest in the safeguarding of the landscape and, even more specifically, of those legal categories of cultural and rural landscapes, still today in a process of continuous affirmation and deepening (Petrillo 2014). This may be due to both the mass of rules and regulations that have been promulgated over time in the field and the multiple meanings given to these notions. Concepts that are progressively moving away from an aesthetic and/or aestheticizing vision and from a static, sectorial, and local reading of existing reality, to be transformed into complex images, in constant evolution as resulting from dynamic interactions.

In Italy, landscape safeguarding is a primary duty of the Republic, as stated by the Constitution written in 1947. However, it is in article 131 of the Code of the Cultural and Landscape Heritage - the Legislative Decree 42/2004 with its 2006 and 2008 amendments - (Leone 2009), that the term is clearly defined as “an integral part of the territory whose characteristics are derived from nature, the history of humanity or from their reciprocal inter-relationships”, in compliance with the European Landscape Convention (ELC).

The landscape is considered a distinctive feature of a clearly demarcated territory. Its protection first requires the recognition and protection of the specific aspects that characterise it and distinguish it from the others. The ELC has affirmed that landscape has strong cultural and economic value and, for the first time, highlighted the need for managing and planning it as a key element of individual and social well-being. Not limiting itself to expressing the need to safeguard areas that might be considered outstanding, it has also underlined the urgency to proceed with the recovery of everyday and degraded landscapes, and the peri-urban areas. He brought to the forefront the issue of the quality of their transformations. If this instrument undoubtedly represents a significant stage in a process aimed at the full awareness of the identity of the landscape, it is UNESCO that, many years earlier, introduced the category of ‘cultural landscape’ as a specific element to be saved (Jakob, 2009). Twenty years after its approval, the UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage (1972) has become the first international legal instrument to identify and protect cultural landscapes. Following the revision of the *Operational Guidelines for its implementation* in 1992, cultural landscapes may be added to the World Heritage List. According to the document, they represent the “combined works of nature and man” and are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic, and cultural forces. Since then, the need to establish specific measures for the protection and enhancement of that specific category of cultural landscapes represented by the so-called ‘rural landscapes’ has been affirmed (Carmignani, 2009). In Italy, one of the main institutional steps was provided by the National Observatory for Rural Landscape, Agricultural Practices and Traditional Knowledge established in 2012 by the Ministry of Food, Agricultural and Forest Policies, following the results of a research project called National Catalogue of historical rural landscapes aimed at identifying and studying the most important rural landscapes (Agnoletti et al. 2019). The art. 2 of the National Observatory’s founding decree gives a clear definition of the traditional rural landscape of historical interest, by identifying it in those parts of the territory classified as rural and/or [in] linear or punctual elements, which while continuing their evolutionary process, retain clear evidence of their origin and history. The rural landscape is so characterised by physical and material features: cultures, settlements, and historical and traditional artefacts. At the same time, it reflects the evolution over time of the relationship between the community and this area. It is evident how it results from the interrelation between the human and anthropic elements on the one hand and the environmental element on the other hand and how its cultural value derives from their combination. The landscape, in a physical sense, “is like the great architecture, consisting of natural and artificial elements. It has three dimensions, shapes and functions; it is the work of man and nature and in constant transformation” (Scazzosi, 2011). However, the landscape is fragile: an asset ‘at risk’ as exposed to processes of physiological alteration and degradation of its components, capable of obscuring or cancelling peculiar traits, differences, characteristics. It is, at the same time, a ‘changing’ or ‘unstable’ good due to anthropic action that very often compromise its natural equilibrium through aggressive transformation processes characterized by a high level of precariousness. A good subject, in the latest decades, to dramatic threats connected to economic and social processes (poverty, inequality, ageing, mass migration, etc.), and, more recently, to sanitary problems at the global level, which are causing extensive challenges towards rural areas and their communities.

2. The Sicilian agricultural landscape: current and future issues

Resulted from both innumerable cultural contamination and stratifications and the millennial encounter with the most important agrarian civilizations and with their heritage of plants, animals, techniques, customs and social relationships, the Sicilian landscape today can show only pieces of that long history that, instead, characterizes it. The failure of the agrarian reform combined with

Fig. 1. The rural landscape of Enna, Sicily.

the start of industrial polarization policies has caused considerable imbalances in the structures of rural areas since the 1960s. Technological innovation in agriculture, the abandonment of polyculture in favour of intensive and specialized monocultures, the agricultural machinery and the intensive use of pesticides and herbicides, have caused a profound alteration of the agricultural, historical landscape as well as the erosion when not the destruction of many of its original features. A transformation that seems to have dissolved "that aromatic intrigue in which Phoenixes, Dorians and Ionians found it, when they landed in Sicily" referred to Tomasi di Lampedusa, so extinguishing "that seed of cultural expression that was the protagonist, for centuries, of human movements on the territory" (Barillaro, 2008). A landscape now largely lost, which seems to have become a real concern for European, national and, obviously, regional policies in the now widespread awareness that its protection and enhancement represent an opportunity to be seized for not only economic reasons but also for the social and cultural improvement of the community. This is the context in which the province of Enna stands. An area that sees its peculiarity in its barycentric position in the island (the Romans called it the *Umbilicus Siciliae*). Nevertheless, the historical events of the last century affected the relationship between the physical substrate and its settlement model and converted its geographical centrality into an element of marginality. Lacking infrastructures, terrestrial connection networks and skilled labour, penalized by the scarce presence of structures organized for the enhancement and marketing of agricultural products and a victim of climate change, Enna's rural landscape, still suffers the consequences of a period of great unease in the sector that the development programs promoted by the EU have been trying for some time to fill through the implementation loans and recovery plans (Fig. 1).

The initiatives adopted for safeguarding and protecting natural and non-natural environments, albeit numerous, still struggle to show major results, certainly due to the complexity of the phenomena involved and/or, perhaps, because they were not yet sufficiently based on the necessary understanding of the culture of place, seen as spatial-temporal entities repositories of testimonies and relationships, from which every subsequent action should derive. Knowledge based on analyses of the signs impressed on the territory and their relations with their performers. That is, the result of a process of the signification of the landscape based on the analysis of its links with society since, according to the Charter of Cracovia 2000, "each community, through its collective memory and consciousness of its past, is responsible for the identification as well as the management of its heritage".

The architectural heritage that characterises the countryside of Enna, the backbone of this system, is still little known to the community today. Having now lost its original function, it is globally affected by problems of neglect, degradation, poor accessibility. However, these are elements with a strong identity that show the existence of a local constructive logic that allows them to be traced back to the building typologies to which they belong (Fig. 2). Places and architectures which, if recovered, could certainly be actively reintegrated into the life of the community, placing themselves as poles of development, based on local heritage, natural resources, creativity, and social inclusion as essential elements to regenerate rural areas and to rapidly support their transition towards sustainable future (De Luca et al., 2020).

3. The rural heritage of the area of Enna

Surrounded by a rocky setting formed to the north by the Madonie and by the last slopes of the Nebrodi and largely occupied by the Erei mountains, the territory of Enna (the only Sicilian landlocked) is characterized by an extremely varied natural heritage, rich in rivers, streams, lakes, and hills that slowly descend towards the vast plains of the Catania's area. This territory, which shares many characteristic features with the rest of the Sicilian hinterland, has very strong geographic and cultural dissimilarities with coastal Sicily, better known and, historically, more visited. The spontaneous vegetation, in the past very dense and heterogeneous, is today significantly impoverished due to the deforestation and the harvesting of tree crops already carried out by the feudal system since the 1600s, with serious damage to livestock breeding and the silvopastoral economy. The large estate, with its system of intensive land exploitation, has transformed the landscape, giving it the chromatic traits and the still pre-eminent characteristics of the extensive monoculture of wheat and a consequent uniformity that only changes with the seasons. Because of both its central position in the island and the geomorphological characteristics, Enna has played a strategic role in ancient times. Inhabited since the pre-Greek era, as evidenced by some stable settlements presumably dating back to a period between the 13th and 8th centuries BC, it was subject to a broad process of Hellenization starting from the 7th century. The shape of the rocks, with an abundant presence of limestone and sandstone subject to severe erosion by atmospheric agents, favoured the formation of underground housing structures, as evidenced by the number of necropolises found in the area with the typical *grotticella* tombs (VI-V century BC, fig. 2a). A territory, therefore, in which the settlement by agro-pastoral communities was favoured by the presence of caves, cavities, underground complexes along the mountain slopes and the torrential valleys that surround Enna and the close cities of Assoro, Gagliano, Leonforte, Nicosia, as well as Calascibetta and Sperlinga where rupestrian dwellings arranged on superimposed terraces are still visible. The whole rural landscape is marked - especially in the northern area of the province, but also on the Enna urban territory, albeit residually - by numerous rock structures, very often used without solution of continuity up to the present day, first in the natural state to then become stable abodes for shepherds and shelter for the flocks. Their dimensions are variable according to the consistency of the rock and their intended use: generally, small for shelters or very large when used as a sheepfold, closed on the outside by a fence of stones and weeds (Gambino & Ursino, 1973). Limited, compared to the other rural areas of the island, is the scattered settlement, that is, the spread of housing and the distribution of the population along with the land and cultivated fields. This characteristic is closely linked to the socio-economic structure of the *latifondi* (large estates), whose forms of settlement are fundamentally articulated in the system of farms, rural constructions widely present in the territory of Enna, and which at the same time gave rise to the poorest forms of rural architecture: the *pagghiaro* (the straw hat) and the single-celled houses.

The *pagghiaro* was once the home of the peasants who worked in the big fiefdoms. The simpler type made of plant material has now completely disappeared, while there are still a few examples of a second type built according to a system composed of reeds resting on dry stone walls, along the road that connects Enna to the nearby town of Leonforte (Fig. 2b). The masonry base usually does not climb more than half the total height of the haystack (2.50 m). The entrance, surmounted by a rudimentary wooden architrave, is closed by a single-leaf wooden door or by bunches of twigs. The more advanced form compared to the haystack is given in its simplest geometry by the *casedda*: a quadrangular construction with a single compartment, with a single rain pitch roof with tiles. Small stones bonded with mortar are the most used building materials. The inside, never plastered, sheltered a modest bed and heavier agricultural tools; leaning against a wall was the trough for the mule and the donkey. Beside this shelter-house, there were also permanent residences of rectangular plan divided into three sections: in the centre of the house, at its ends the stable and the warehouse.

The *masseria* (toponym of agricultural structure with functions of the fund management centre) is, on the other hand, the most eloquent expression of the feudal system, located mainly in the middle and lower hills. It constitutes the collection outpost of the agropastoral production of the large estates, entrusted by the baron (usually resident in large urban centres) to a tenant (*gabellotto*) in charge of managing on his behalf the most extensive and distant land and living, for this purpose, in the farm. This was established to prevent workers from still stay on the land and thus owning their flocks and tools, as was the case, precisely, in sharecropping and dispersed rural crops (Fig. 2c). They thus continued to reside in the villages perched on the hills, moving seasonally to offer work to the *massari*. Its layout is characterized by a massive quadrangle that revolves around a large central paved courtyard. The access to the courtyard, always unique and consisting of a two-leaf door surmounted by a round arch in which the owner's initials are engraved, seems to want to exclude any possible contact with the outside. Together with the bare surfaces, in which there are rare and small slits and grated windows, it highlights the defensive nature of the building. On it lies the mansion (inhabited only at certain times of the year, ie. at the time of harvest), accessible via an interior staircase. Inside the building, large surfaces were intended to host warehouses for storing products and stalls, multiple and differentiated according to their destination. Special care and finishing characterized the stables for horses, of which this type of farm always had an important endowment. A little less cared for were those of cattle, generally rectangular in plan, divided into two lanes, with a drain in the middle for waste. Next to the warehouses, there were the rooms used as storage for agricultural tools, the dormitory - where, on the straw beds, the adventitious manpower (*jurnatari*) that flowed to the farm during the harvest period was once housed -, and the *ribatteria* used for bread-making, the consumption of meals, characterized by a wood stove and an oven. In addition, the mill and the millstone were present, based on the company's production orientation. In the area of Enna, there are also forms of scattered settlement built by the State starting from the 1940s as part of the redevelopment program of the rural areas of the island and later by the Region. They were created to both combat the landowner type which was seen as the main cause of the backwardness of the island and spread the permanence of the peasant on the land with a consequent restructuring of the cultivation systems. Just as the issue of social housing for the urban worker, that of the agricultural worker began to be addressed, so extending "the concept of the city (as a human residence equipped for work, leisure, and rest) [...] to broader conglobation territories, even what we commonly call rural building" (Caracciolo, 1949).

The first series of farmhouses was built at the initiative of the fascist Entity of Colonization of Sicilian Latifundia (*Ente di Colonizzazione del Latifondo Siciliano*, ECLS) but these, too distant from each other and completely devoid of civil services, did not favour colonization and the stable settlement of farmers in rural areas. The legacy of the ECLS was collected, starting from the 1950s, by the newly established Regional Government through the Institute for the Agrarian Reform in Sicily (*Ente per la Riforma Agraria in Sicilia*, ERAS, renamed ESA in 1965), which expropriated more than 12,000 hectares assigned to nearly 3,000 farmers and built more than 500 rural houses. Furthermore, to meet the needs of the agricultural community, traditionally reluctant to isolation, two villages were built with the services necessary for collective life: Borgo Antonino Cascino, near

Enna, designed by the architect Giuseppe Marletta and Borgo Baccarato, not far from Aidone (Fig. 2d), by the engineer Francesco S. Siragusa. The first has benefited from a partial recovery program thanks to a specific measure of EU structural funds (Rural Development program - 2007/2013) and today hosts almost 50 persons; the second is, today, a ghost town, despite having been identified by ESA as one of the villages to be recovered to allocate it to the promotion of typical food products. Due to the small size of the assigned parcels (from three to six hectares) and the often-mediocre quality of the divested land, unsuitable for crop conversion, the budget for the operation was found to be in deficit; consequently, the numerous rural houses built by ERAS in the countryside, most of them lacking in light and with insufficient water availability, were soon abandoned. Among the various types of rural houses introduced in the area under consideration by the agrarian reform, the most frequent has a covered porch in which the entrance and the house consisting of two rooms and the kitchen-living room open, as well as the warehouse and access to the stable; on the back, are the pigsty and the chicken coop. Finally, numerous watermills (Fig. 2e), fountains, washhouses, drinking-troughs dot the territory widely, placing themselves as milestones of a widespread and extensive water network, but built with total respect of the man/environment relationships. Goods that are characterized by an architectural and stylistic refinement that testifies to the feeling of deep attachment to a natural element so important for traditional society.

4. Development policies and strategies for enhancing the rural heritage of Enna

Today, this immense heritage, often considered almost useless, is suffering the consequences of a widespread state of abandonment or under-use, while preserving its identity. Placed in a state of suspension and relegated to the role of a picturesque element of the landscape, it awaits new

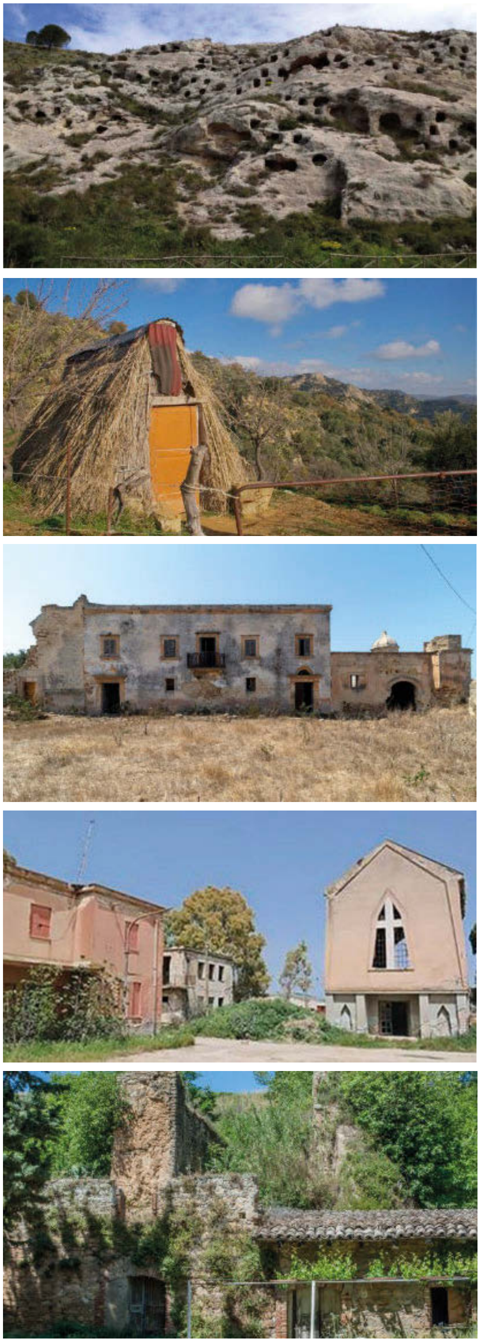

Fig. 2. Examples of vernacular heritage in the area of Enna: the Necropolis of Realmese with its *grotticella* tombs (a), a *pagghiaro* in Leonforte (b), a typical *masseria* today abandoned (c), the rural village of Borgo Baccarato in Aidone (d) and the Rasalgone watermill in Piazza Armerina (e).

functions while falling more and more into ruin, as exposed to degradation and decay phenomena. Yet, if subjected to appropriate actions of knowledge, recovery, and revitalization, it could prove to be a strategic development tool for a region with great patrimonial wealth (among the others the close Villa del Casale at Piazza Armerina, Unesco World Heritage Site since 1997, or the archaeological area of Morgantina). An area which still does not have sufficient tourist attractiveness and competitiveness, because of the low level of efficiency of transport infrastructures and accommodation structures.

Per the regulatory guidelines of the regional landscape plan, the Free Municipal Consortium of Enna (the body which, following changes in regional legislation in the years 2014-2015, replaced the Province of Enna) approved in 2018 the provincial-territorial plan which assumes the strategic and operational infrastructural contents, indicating and prescribing a series of mainly active interventions for the transformation of the territory, calibrated in a spirit of sustainability and environmental compatibility. As part of the plan, an inventory has been carried out on the vast cultural heritage of the area, which shows the wealth of its rural assets: a formidable articulation of landscapes, sites, vernacular architecture that are not fully exploited, but which could prove to be of great value in terms of development of organic agricultural policies, but also as accommodation facilities for the rural tourism.

Among the European Union initiatives to support rural development projects, the LEADER II (Links between actions for the development of the rural economy) program financed through the Local Action Group Rocca di Cerere, several activities aimed at the conservation and recovery of rural heritage: sites of high naturalistic and landscape value (ponds, crossroads, hedges, monumental trees, etc.) and other cultural elements of the traditional agricultural landscape (vernacular architecture, dry stone walls, terraces, drinking troughs and artefacts that bear witness to agricultural work and collective rural life).

As mentioned, if as part of the Rural Development program 2007/2013, the Sicily Region had drawn up a pilot project for the enhancement of the rural villages of the ESA called 'the road of the villages' unfortunately only little implemented, a harbinger of preparatory studies and research have been established and then implemented the knowledge of the construction techniques and morphotypological characteristics used (Cardaci & Versaci, 2017).

All these initiatives, certainly not listed in an exhaustive manner, represent important elements of an already highly advanced process of recognition of the rural landscape as a cultural asset also in terms of memory and collective identity of which it is a direct expression (Del Mastro, 2005), representing that "form that man, in the course and for his agricultural production activities, consciously and systematically imprints on the natural landscape" (Sereni, 1982). From this point of view, a fundamental role in the processes of conservation, improvement and development of the rural landscape is represented by the architectural patrimony that characterizes it. However, these actions lack worldwide coordination that should start from a thorough and detailed analysis of this heritage in its material, morphological and technological components, still not available.

In many situations, traditional rural architecture, generally characterized by its compact mass, has lost part of its recognisability, engulfed by larger farms, in which sheds and/or greenhouses prevail, or by impressive accommodation facilities that gradually erode the original building components. Only in-depth knowledge of rural architecture in its various declinations can lead to respectful restoration projects and, even in the combination of the new, to original interpretations deprived of mimesis or nostalgic approach. With this in mind, the research project initiated by the authors of this paper on the territory of Enna - starting from some of the most interesting subsystems, the mills of the Gela river valley and the rural villages built during the Fascist era - proposes the cataloguing and analyses of rural building morphotypes, the definition of the cultural matrix on which the local construction technique was based, the evaluation of the characteristics and potential of the artefacts and their availability thanks to the application of the semantic web technologies and building information model. These elements are necessary for the definition of useful design guidelines for restoration and recovery planning consistent with the original and sustainable constructive lexicon. The aim is to provide guidance for the valorisation of Enna's rural architecture and landscape. A tool to support citizens and local communities, aimed at providing greater awareness in the formulation of the projects that, following the pandemic, Italy's recovery and resilience plan has expressly foreseen in the field (PNRR).

5. Conclusions

The rural landscape of Enna's area, if properly studied and enhanced, can be a key element for both the recovery of local identity and the activation of a new global attractiveness, which have been claimed by many as the indispensable conditions for generative and non-deceptive development (Carta, 2015). In this sense, it seems crucial to return to an in-depth dialogue with nature, respectfully 'recycling' the existing, the abandoned and the underutilized, so fighting oblivion and building degradation through the retrieval of ancient construction skills.

The ongoing health crisis, the incessant environmental and climatic decay, the increasingly pressing economic challenges have highlighted the fragility of our life contexts, putting the territory and inland areas, no longer considered, at the centre of the debate. They are backwards, but resilient, less contaminated places where to start a new, more sustainable life. That of going back to the land, to the vernacular tradition, to the use of local resources, to the rediscovery of old techniques is an opportunity to seize not as in an old-fogey vision but as a cornerstone of our future.

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The particular ensemble of Mas d'en Segures: Functional and constructive analysis of a house and a barn in Tinença de Benifassà (Castellón, Spain)

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Topic: T1.1 Study and cataloging of vernacular architecture

Abstract

In the northern interior of the Castellón province Tinença de Benifassà is found, a rural and mountainous region in which territorial organization combines villages with plenty of scattered settlements. As the phenomenon of rural exodus goes on, more and more of these ensembles are abandoned, which implies a critical patrimonial and identity loss, both physical and immaterial. Vernacular architecture shares morphological and constructive characteristics with that present at other regions of Spain, such as Teruel or southern Catalonia. These parameters are strictly linked with immediate environment and field labour in rough terrain. The analysis deepens on the documentation of Mas d'en Segures as a case study of spread settlements in the region. It was made up of four houses, three barns associated with threshing floors, and some farmyards. Some morphological, functional, and constructive characteristics differentiate this settlement from others in its context, which marks its antiquity and relates it with defensive constructions.

Keywords: *Scattered settlements; rural architecture; defensive buildings; vernacular architecture.*

1. Introduction

This paper aims to analyse the network of farmhouses known as *mas* in Tinença de Benifassà as a case case study to esteem their contribution to the cultural landscape and historical value. It results from ongoing studies about the spread settlements in the region, especially those with historical relevance, notable traits, or defensive architecture. Tinença de Benifassà is a historic territory set on the most septentrional part of the Castellón province, not far from the borders of Aragon and Catalonia. This area has an antique relationship with Morella, an industrial and administrative pole on a regional scale, and a city with historical significance to the Valencian kingdom. Its abrupt geography and the hydrographic composition characterise a landscape and vegetation with certain mediterranean factors but, in general, more similar to those present in the Iberian System.

Seven small villages compose it, but quite a few scattered ensembles colonise all its territory, defining a complex structure with a significant weight of dispersed habitat. The elementary unit of the network outside the towns is known as *mas*. This concept has been defined in several ways, with its nuances, by scholars in geography, history, architecture or anthropology. It is a broad idea that includes not only the dwelling buildings but also agricultural constructions, woods, and arable and pasture lands that are managed and exploited by the community (Tarazona Marí, 2005, p. 163-165). It usually includes a house for one family, though it can also refer to a group of houses for three or four households.

Spread settlements are a common way of populating territory all around the world. However, geographic determinants such as orography, climate, soil, or even land ownership structure determine how vernacular architecture develops in each region. Here, arid farmland where grain is almost the only crop viable, dry and windy climate and rugged orography have made settlement to be relatively remote. Distance is generally directly connected to relief and the chance of taming the mountains with terraces to take advantage of every piece of land. Where territory is not so harsh, houses can be a 20-minute walk away, but this could be more than an hour where the terrain is rougher and the soil available to grow crops in is lacking. The above system is not exclusive to the region; it is present in the Valencian provinces' interior and vast areas of Catalonia and Aragón, with subtle differences related to each location's context if mountainous areas are compared. Construction's typologies on plains is not comparable to mountain *mas*. The former has been extensively investigated, especially in Catalonia's fertile regions based on the studies by J. Danés i Torràs (2010), but its conclusions are not broadly applicable to rugged areas.

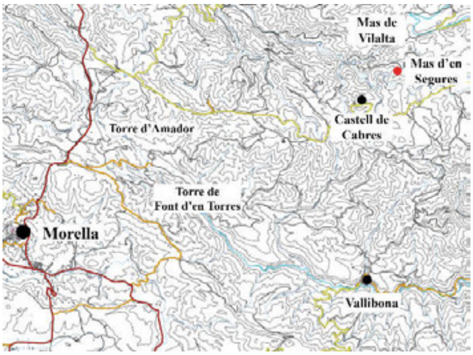

Fig. 1. Map of the settlements analysed.

Currently, Tinença de Benifassà is suffering the effects of depopulation, as well as other Spanish mountainous and inland regions. Its territory of 180 sq km had a census of 252 inhabitants in 2021, which means a population density of 1,4 people/sq km (INE, 2021), although the actual number is slightly lower. Some experts on Spanish regressive demographic phenomena consider this circumstance a 'demographic desert' (Burillo, 2019, p.85-86). The present situation is even worse in scattered settlements. Only a few remain inhabited or used at present, usually those easily accessible and as bovine farms or weekend houses - the vast majority were abandoned more than 40 years ago due to challenging life conditions and accessibility difficulties.

There are few remains of inhabitation in the area before the Christian conquest and are limited to minor and brief settlements, which date from before the Ist century BC. Tinença de Benifassà was divided into two *husun*[1] at an administrative and military level during the Muslim period (Pica, 2014, p.54). The remnants of one are located near the monastery - the other one on Castell de Cabres - but there are not many more remains from this time. In 1233, when the Crown of Aragón ruled the region, Jaume I ceded these lands to the Monastery of the Order of Poblet, which first colonised the area with Cistercian farms and had been the motor of the region for many centuries (Pica, 2014, p.60-69). Until the disentailment processes in the XIX century, the religious community exerted the lordship rights of all this territory, which caused many conflicts with Morella. Since 2006, the area is protected as a natural park to sustainably manage its natural resources due to landscape values that have been formed because of environmental and human interaction.

2. Methodology

Research methodology has been based on both site work and documental studies. Several visits to the area and its surroundings have been carried out, making it possible to conduct a photographic record, architectural survey and identification of materials and techniques. These processes allow the comparison of technical-constructive, functional or morphological results of the case study with other cases.

[1] *Husun* is the plural form of hisn, an Arab term that designates Andalusi castles with defensives and military functions and relevant influence on its immediate inhabited environment.

Previous studies carried out in nearby locations, such as Maestrazgo in Teruel or Els Ports in Catalonia had been reviewed, but also specialised bibliography about the history and scattered architecture on the enviros in Castellón province, such as Maestrat or Morella and its territory. In the future, this information will be completed with the archives that are not currently accessible, such as Benifassà convent. *Mas d'en Segures*, in Castell de Cabres, fullfils these investigation's goals as an ensemble located on the ancient route between two clustered population places and comprising four houses, a defensive building with particular characteristics and other secondary structures.

3. Mas d'en Segures

Mas d'en Segures is found in the northeast part of Castell de Cabres municipal district, 1180 m high, halfway in the path between the town and Coratxà, at around 50 minutes on foot. Its location offers a clear view of the village and its connection road with the rest of the region, and advantageous position in climatic terms. As it can be seen in other examples such as *Mas de Vilalta*, o *Torre d'Amador* in Morella, this type of ensemble is located in a place relatively protected from the wind by the terrain and with a good amount of solar radiation to avoid cold, not far from natural fountains or ravines.

Fig. 2. Mas d'en Segures, Castell de Cabres. Scale 1:750 (Source: Villasante Claramonte, 2020).

It comprises four households (*del Rei, del Racioner, del Bord i del Sord*), four ovens, and three barns, each with a threshing floor. The general composition of the *mas* is assembled by a 'central core', formed chiefly by the houses and some pens mainly for draught animals; a small group of stables and other auxiliary buildings southeast of the core; and finally, the barns on a satellite position. Aerial images show clearly how the constructions have been laid out. Moreover, the first bay from the north side shows the probable origin of the entire ensemble, conserving the alignment on both sides in all its length, from *Casa del Racioner* to *Casa del Rei*.

Houses were all jointly set along on a northeast-southwest axis, supported on the terrain slope and aligned northwest. This dense configuration helps to ensure the maximum amount of solar radiation possible, as well as limits thermal transmission losses reducing the portion of the façade exposed. In fact, two of four houses had a small frontage width, and *casa del Racioner* is the widest. On other examples considered, such as *Mas de la Carcellera* or *Torre Segura*, dwelling buildings also follow this habitual organisation in which they face south and stay together to reach the maximum comfort conditions available. The use of topography in the design of vernacular architecture is likewise crucial and widespread in mountainous areas not only for protection from the elements - mainly wind and cold- but also for functional reasons.

Fig. 3. Mas d'en Segures. Castell de Cabres (Source: Villasante Claramonte, 2020)

Fig. 4. Pallissa del Racioner. Window with stone benches (Source: Jara Calabuig, 2020)

In the case of threshing floors, the difference of level was used to ease the storage works in barns, and because of that, it is usual to see them associated with a slope. These constructions, made for storing grain, and some pens are the only ones that are free-standing. However, a general pattern can not be established, as in other examples analysed, buildings are more compact or even complete one or two groups, as it happens on *Mas de Vilalta*.

3.1. *Casa del Racioner* and *Pallisa del Racioner*

Casa del Racioner and *Pallissa del Racioner* are the best-preserved buildings of the mas, which belong to the same family. Their interest and efforts on preserving this constructions allow a more profound investigation. Each one has its specific traits due to the different uses of the buildings, but they also share some architectural attributes that make them valuable. The names of the houses always referred to the head of household who inhabits there, in this case, *el Racioner*. In canon law, this term was associated to people who had some prebends and roles in the community. People who lived and managed these buildings probably had functions related to store tithe or intermediation with the religious order.

The granary on the south, known as *Pallissa del Racioner*, stands out compared to the rest of the ensemble. It is dominant over the pathway to Coratxà due to its position and dimensions - its height point surpasses 10,5 m, while the plan measures 8x6 m. Granaries and pens are commonly built with lower-quality materials than dwelling buildings (García Lisón, 2000, p. 52-55), and as a matter of fact many of them in this region are wrecked or about to collapse. These measures are clearly superior to the usual barns in the area, morphologically close to the square and approximately 6x6 m and one storey high. Regardless, this building also had three separate accesses on distinct faces, which gave the possibility of using each floor for different purposes. At the time of the research, the whole building is used as a storehouse, while the architectural layout hints at the ancient coexistence of multiple uses - lower floor as a corral, first floor as a haystack and second floor, which has a loft, as habitable spaces.

Actually, the differential character of architectural elements was conspicuous for each storey: the last one was accessed through a semicircular arch facing northwest with prominent voussoirs, but what was even more distinguished is the southwest-facing window built with stone benches. This element was more typical of religious or noble buildings and definitely not common on a barn. Findings of oral testimonies of older people in the area did not show these benches as habitual in vernacular housing. These statements had been completed with studies of rural architecture carried out by *Els Ports* Natural Park (Benet Ramos, 2014, 2016), in the nearby Montsià region, which did not find this feature on nearly forty constructions analysed as they were reasonably more austere. Nevertheless, B. Martin's thesis on towers and fortified architecture in Maestrazgo, Teruel, demonstrated that there is not a rare trait (Martín, 2021, p. 64, 103, 180). Many of the buildings on that investigation and others in Teruel, specially those carried out by E.J. Ibáñez and J. F. Casabona Sebastián (1990, 1992), presented it on towers or defensive constructions, generally associated with elite families or nobles (Ibáñez, 1992, p.318). What made *Pallisa del Racioner* significant is its free-standing position with the rest of the buildings, the multiple functions its layout provides thanks to different entrances and the gable roof -most of the similar towers are built with a shed roof-.

The barn was built with masonry walls of about 55 cm wide, reinforced on its corners with stone blocks well engraved. Although the state of the builind at the time of the research allowed noticing the uncoated wall, there are enough remnants of lime coating on the exterior layer to consider it a general cladding, as well as some traces of gypsum plaster on the last storey interior walls. This last characteristic revealed the former use of these spaces, more as living ones than for storage. On the south front there were three buttresses disposed with unalike quality and dimensions, showing how different their building times were. The roof was assembled with Spanish roof tile on a wooden board, supported by a squared beam with dimensions 55x35 cm approximately. Rounded wood beams were more common, as trees in the area do not have large diameters, indicating this construction's importance.

Morphological and structural parameters were similar to those found in *Torre de Font d'en Torres* in Morella: gable roof, the position on a slope or the access through the semicircular arch facing southwest - although this example was not located in any ensemble and its layout is not so versatile. It is estimated to be original from the 15th century because of its gothic features, and some oral testimonies assure that a religious community existed on its origin (Gamundí, 1991, p. 158).

Fig. 5. *Torre de Font d'en Torres*, Morella (Source: Villasante Claramonte, 2022)

Fig. 6. *Torre d'Amador*, Morella (Source: Jara Calabuig, 2022)

Torre d'Amador (or *Torre Madó*) is an ensemble in Morella formed around a tower from the late 15th century or 16th. It resembled the type of tower in the area, or even on Teruel's Maestrazgo, although these usually had more defensive elements. This tower had been used historically as a storehouse for the tithe to guard it safely, but its look and construction techniques are rather more austere than the other two towers considered (Gamundí, 1991, p. 161). Despite that, its protective character is justified as there are remains of embrasures on its walls, now walled up.

There were other examples of defensive architecture in the area of Morella, usually associated with the leading ensemble in its *dena* - the subdivisions of the municipality - such as *Torre Segura* or *Torre Querol*. They were generally more similar morphologically to the type of *Torre d'Amador*, dating from the 15th or 16th centuries and having the function of tithe safe-keeping combined with others of the *mas* (Gamundí, 1991, p. 88).

Casa del Racioner is located on the southwest part of the central core of *Mas d'en Segures*, being the only house with a west-facing front that is very advantageous thermically speaking. It was one of the largest houses on the *mas*, as well as *Casa del Rei*, but with the best position and distinguishing architectural elements. In this building, a window with stone benches facing west on the most significant room of the first floor is also preserved, through which Castell de Cabres can be seen. Some authors point out that these benches on the window -known locally as *festejadors*- were more common in Catalan farmhouses between the 14th and 17th centuries (Pradas, 2021). Storage was the last usage of this room, but its favourable orientation and this window hint at a more considerable use. Right below this space was located the kitchen, where standed out the large fireplace that occupied virtually half of the room and could be dated, at the latest, on the 17th century following Miguel del Rey's parameters (del Rey, 2010, p.280). Behind this fireplace, the owner found a diminished arc blocked off, the same width as the own kitchen and with high-quality keystones. This element had no sense in the layout and indicates the distinct steps of the stratigraphy of the building. In this respect, distinguishable construction phases were also noticeable from the west front of the house, coinciding with the alignment of the first bay stated before, which would be the origin of the four houses.

Constructive and structural solutions were somewhat similar to those found on the granary related to the walls and roof, although it was striking that the round ridge beam on this building is considerably smaller than the one in the barn. Nevertheless, in this case, and as a common practice in the region, only the main front was coated with lime plaster while the rest maintain its masonry insight. It was precisely on this façade, on the main entrance, that a basket arch can be found, again with high-quality stones. There is only one arch more on the ensemble, a rounded one, on the front door of *Casa del Sord*.

4. Conclusions

Mas d'en Segures as a whole, as well as its constructions separately, is a singular example of rural architecture and spread ensemble in the area. Both buildings analysed share some traits in their structural and morphological attributes that make them particular, compared with others in the region.

Pallisa del Racioner - whose name may be changed to *Torre del Racioner* - stands out from the rest of the group because of its defensive character and distinct architectural components already defined, which state the quality of its construction. There are not as many protective elements as in the buildings studied in Teruel (Martín, 2021), presumably due to the social relevance of its inhabitants. In those investigations it is stated that generally, its owners were part of the local elites. In Tinença de Benifassà, even if proprietors probably had some prebends in what relates to tithe storage, buildings in Mas d'en Segures do not have such a representative character. An essential factor to consider is that, on the line of other ensembles in the area, defensive use of this building may be related to safe tithe custody, more presumably to prevent the success of banditry actions than for military reasons. Overlapping uses are another defining attribute of this building that presumably had living spaces on its top floor while agricultural and livestock uses were in the lower levels. Compared with other examples whose longevity is adequately documented, its origin could be established in the 14th or 15th century, although a deeper investigation is desirable, using dendrochronology or reaching historical documentation inaccessible for the moment.

Establishing a date of construction for the house is visibly more complex because of its organic growth and different strata. Authors have found difficulties in establishing specific types for mountainous farmhouses because of their variability (del Rey, 2010, p.339-341) justified by the necessary adaptation to their immediate environment. Nonetheless, there are some elements like the stone benches on the window - with similar appearance and materials to those of the granary- or the large fireplace that reveal the age of the construction, presumably coetaneous to the barn.

The ensemble described is only a tiny sample of the richness and history that rural architecture in this area has. The environmental benefits of the complex network of farmhouses, as well as their heritage importance, have to be considered, appreciated and catalogued to at least preserve its cultural value. Nowadays, the economic and social situation in rural contexts as this one do not favour the occupation of the territory in the way it was 50 or 100 years ago, and that is what is causing this patrimonial loss. The cultural landscape in Tinença de Benifassà, where environmental protection exists by law, can not be understood without the presence of scattered settlements that are disappearing. Protective legislative instruments of this type of building are not considered to directly and feasibly impact their preservation since the problem is more related to social and economic situations and lack of use. The institution ruling the natural park, however, could carry out cataloging studies as it has been done in

Els Ports Natual Park in Catalonia, contributing to landscape care that also includes its vernacular architecture. Thus, even if a significant proportion of these constructions are about to disappear or be reduced to ruins in the following years, a testimony of its historical, cultural, antiquity or sustainability values will remain.

Fig. 07. *Casa del Sord* (Source: Jara Calabuig, 2020).

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In the shadow of Vesuvius. Sustainable and bioclimatic lessons from a vernacular heritage

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Topic: T1.1. Study and cataloguing of vernacular architecture

Abstract

Downstream of the Somma-Vesuvius volcanic complex, the countryside records the flourishing of communities based on agricultural economies that have been facilitated, since the early modern history, by the fertility of the land, the mildness of the climate and the favourable location with respect to the natural routes of communication. The adaptation and dialogue between this territory and man led to the realization of the so-called "masserie", the articulated rural artefacts, mostly developed on a primitive compositional structure at court, in which residential and working functions seamlessly coexist. The paper discusses the sustainable and bioclimatic solutions for building and running evidence of this volcanic vernacular system, to inquire how the constructive knowledge, based on the awareness of the properties of local materials, has given solutions to various needs. Indeed, the peasants used the different characteristics of the various igneous rocks, exploited to their maximum performance capabilities, to realize rubble masonry, light vaults, outdoor flooring, and even fixed furniture. In the same functional and "green" resource use, the plan layout follows a distribution corresponding to the best use of the sun and its effects on environmental optimization, and the rainwater collection system connects multiple wells to the underground tank whose position, spatial conformation and materials are expertly engineered. The study finally deepens a case study (the masseria of the Duke of Salza) representing the application of local building tradition in terms of construction features and typological aspects, and the evidence of the history and vulnerabilities of the Vesuvian land. In addition, the specificities of the masseria sample allow mastering the functioning of the whole building organism and the quality of the finishes, which demonstrate how, in their formal simplicity, these vernacular "monuments" were soberly embellished and complexly designed.

Keywords: *Vesuvian masseria; ancient bioclimatic strategies; building tradition.*

1. Introduction

In ancient times, the current municipality of Somma Vesuviana formed the hilly and economic relevant (De Simone 2008, p.329) area of the wider territory, immediately north of Vesuvius, that divided Naples from Nola and approached the borders of Herculaneum and Pompeii. After a first land management from the superimposition of Nolan centuriation systems (Pardo 2001) the territory of Somma witnessed a general administrative and structural reorganization carried out by the central Roman government between the I century b.C. and the I century a.C. (Migliaro 1995, p.90), that involved the establishment of numerous rustic settlements, in the higher foothills (D'Avino, 1984, p.5) close to the sources of streams and free from swamping[1]. The fortified medieval centre of Somma grew away from the plain which, reduced to woodland after the fall of the Roman Empire, developed thanks to the Angioinian and Aragonese expansion of religious orders, and the subsequent investments of the large feudal families of the Kingdom.

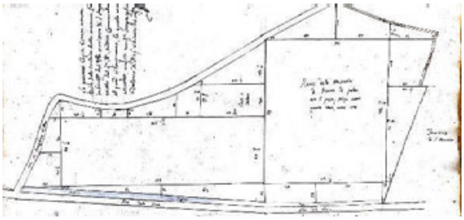

Fig. 1. Detail of a territory in Somma owned by the Chartusians of the Monastery of St. Martin in Naples (Source: S.A.N., *Corporazioni religiose soppresse*, vol 2329, f.16)

The latter, urged by the Viceroy Don Pedro of Toledo to leave Naples, moved to the fertile rural vesuvian land (Canino 1981, pp. 127-128). The discretization of the territory shaped the system of the so-called *masserie*, architectural complexes with residential and productive vocations, realized by expanding pre-existing structures or building new ones – in dialogue with the surrounding landscape of natural and artificial riverbeds, gardens, fields and sporadic road arteries (Cennamo, 2002, pp.101-102).

2. *Masserie* in the countryside of Somma

2.1. Mapping and typological analysis

As highlighted by overlapping eighteenth and nineteenth-century cartographies and a satellite image of Somma Vesuviana, more than twenty masserie still remain in the countryside, albeit abandoned or completely renovated, allowing the comparative reading for a typological analysis. These vernacular architectures were part of microsystems that included fertile farmland delimited by roads or stone ends, small artifacts and,

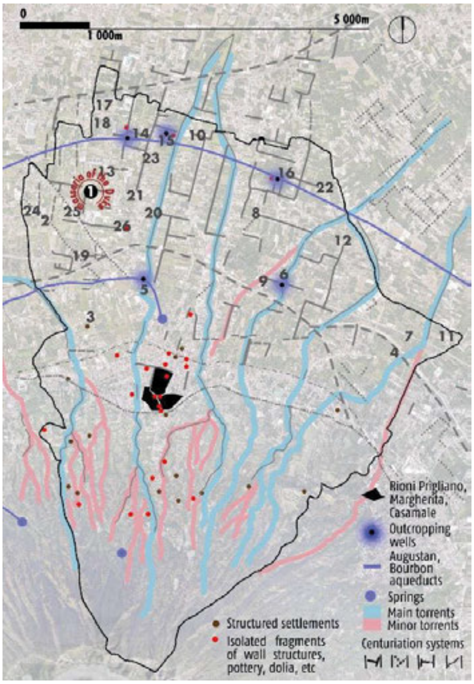

Fig. 2. Chart drawn by interpolating bibliographic sources (D'Avino 1984; Pardo 2001; Cirillo 2003), carthographies (Rizzi Zannoni 1793; Marchese 1799-1800; ROTN 1817-19; Amedei, Leonardi et al. 1876) orthophotos, and hydraulic risk map. The black line is the municipality of Somma. The masserie identified, from 1 to 26: Duke of Salza, Starza Vecchia, Starza Regina, Pigno, Resina, Santa Chiara, Serpente, Alaia, Ciciniello, Cuomero, Di Siervo, Madama Fileppa, Paglietta, Sant'Anna, San Domenico, Montesanto, San Giorgio, Prattico, Mele, Allocca, Guidi, Cammarelle, Castagnola, Panico, Villa rustica, Allocca (author's elaboration)

sometimes, dovecote towers (Guarniero & Pagano, 1936, p.77) or rural residences with the exclusive function of dwelling (*case palazziate*). Many *masserie* in Somma were developed with a courtyard layout featuring at least two large arched entrances for carriages. Full-height spaces or small rooms in succession expand around the centre, lacking space limitations or problems of soil irregularities, which instead affected the urban contexts and areas at higher altitudes. A farmyard, often detached from the perimeter of the main building[2], and a small walled orchard

1 In the *ager nolanum*, the discovery of wooden finds, sometimes worked and in a good state of conservation, testify the possible reclamation interventions by man (Castaldo, Vecchio, 2011).

2 To allow its use also to the settlers of the surrounding fields (Venuto, 1777, p. 280).

complete the plan of outdoor areas. The rooms, entrances, and stairways are structured by use destinations. It follows that the spaces hosting the owner are distinct from the one connected to the work in the fields, there are two different kind of cellars, one for aging and one for production of wine, the stables feature a bipartition between places destined to farmyard and those for draft animals. The distribution of the rooms respects precise criteria as well. The cellars are optimally ventilated and placed underground facing north to avoid the sunlight, a primary requirement for the conservation of wines. The apartments are often located on the opposite side, with large terraces above the coating in wrought lapillus. The stables, preferably positioned in the eastern wing, open towards the courtyard, while the chapel connects to the outside both in the main and internal facade. Finally, the attics used for the conservation of food, the storage of hardware, seeds and hay, crown the first floor and shelter the apartments below from winter cold and summer insolation (D'Avino 2006). Far from the water springs of the mountain, the roofs are also equipped with systems to convey rainwater into underground cisterns, even if in a few cases, the passage of the Augustan aqueduct ensured the water supply with outcropping wells[3].

2.2. The construction tradition: lessons from local master builders

The techniques, technologies and construction systems adopted in most of the architectural elements of the *masserie* in the countryside of Somma can be referred to simple structural typologies, made exclusively with local resources of igneous and wooden materials. The oldest masonry is made of *scheggioni,* shapeless volcanic stones coming from the crushing of the original block with thin and sharp ends that fit into voids. The application of this technique required that the stones, previously wet, were arranged with the widest base downwards and that every step of work finished with the laying of smaller and spheroidal stones, the *scardoni*, which better settle on the mortar bed. The same masonry is often used with dry techcnology for the borders of the threshing floors, surrounding walls and animal shelters, while additions or maintenance interventions made use of blocks of tuff imported from nearby Naples. The windows, proportionate to the levels of lighting, ventilation and environmental optimization required by the function of each room, generally mark the facades with rectangular geometries in correspondence with the above-ground floors, while smaller square openings light up the basement rooms. Furthermore, articulated shapes such as those referable to the lunette semicircular compartment located on the doors, or the oval ones to ventilate the chapels and the main halls, enliven the sober elevations enriched only by a few moldings. On the other hand, the interiors offer finer surfaces with frescoes depicting festoons or figures, a few stuccos and decorated papers. Vaults and wooden floors cover spaces sized on needs, and a boulder formed by white and black lapillus and mortar wrought overhangs and protects the horizontal structures, even in clay (*lastrico terraneo*). The light vaults, mostly with sail, simple barrel or with lunettes[4], are built of pumice, lime, and pozzolan cast on ephemeral mounds of soil or wooden scaffolding and overtopp cellars, stables, and the chapel. The other rooms, especially on the upper floors, are hedged by wooden structures made up of rough-hewn chestnut main

Fig. 3. Mansonry of scheggioni in the masseria of Starza Regina (Source: Author 2021).

3 For example those present in the *masserie* of Santa Chiara, Montesanto, San Domenico.

4 Even if there are other geometries.

Fig. 4. A section on the courtyard of the *masseria* of the Duke of Salza. The section intercepts the cistern, along the shorter side, the room on the groundfloor where there was the *scalandrone*, a stable with the upper terrace, the meeting hall in the apartment of the administrator and the attic. On the background, there's the loggia facing the courtyard (Source: Author, 2018).

beams and rough transvers beams, decorated with "wrapped" (*incartate*) on the intrados or hidden by false cealing in wooden frame and paper finishes (Aveta 1987, pp.164-170). Peculiar pitched structures configure the coverage trusses, usually designed with simple arrangement as two struts joined at the bottom of the chord and at the top of the king post. Webs are sometimes added to reduce the free deflection span of the struts. Purlins, beams, and battens complete the structural part of these roofing systems. The backed clay tiles are finally installed. The most common type of covering is made up of trapezoidal tiles, (*embrici*), on the top of which curved ones are superimposed forming gaps in the foreheads, sealed with punctual applications of rough mortar (*palombelle*).

3. The *masseria* of the Duke of Salza

In a side street of the road that connects Pomigliano to Somma, the *masseria* of the Duke of Salza stands in the center of a driveway, acting as a traffic divider between the two directions of travel. Despite the poor state of conservation, this example of Vesuvian rural architecture is an excellent case study thanks to the archive sources and the not excessive contemporary manipulations.

The *masseria* was built on commission from Strambone family[5] as an extension of a previous architectural artifact purchased in the first half of the seventeenth century[6], perhaps consisting of the northern part of the *greco* cellar[7], the eastern body and the cistern. After the death of the Duke of Salza in 1749, the Pio Monte della Misericordia, a secular charity organization, inherited the *masseria* with the explicit condition imposed by the testator not to sell, exchange, nor rent it[8]. This clause entailed the continuous maintenance of the building led by an administrator of the Pio Monte, with the collaboration of farmers for the management of agricultural and production activities[9]. The backdrop changed with a Bourbon decree that enabled the sale of the *masseria*, besides the apartment on the first floor, so that the property passed to the business partners

5 Noble family of Naples belonged to the Sedile di Porto (De Lellis 1663, p. 307).

6 State Archive of Naples (S.A.N.), *Notaries of XVII century, Nicola Maione,* vol.4, ff.34-35; Historical Archive of Pio Monte della Misericordia, *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.16.

7 *Greco* is the ancient white wine products in the *masseria* (Historical Archive of Pio Monte della Misericordia, *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.17).

8 Historical Archive of Pio Monte della Misericordia, *Eredità*, Cat.B, Rub.b, n.LV, fasc.1, ff.4-5.

9 The collaboration was regulated by a guide (Venuto 1777).

Forquet, Giusso and Olivieri[10]. Vintage photos[11] prove that *masseria* has operated at least until the 1970s, even if there are no documents about interventions or further changes of ownership after the first sale.

opposite point along the perimeter of the fence. Inside this *hortus conclusus*, fruit trees grew for the subsistence of the administrators[16], while in the surrounding fields the landscape was characterized by vines cultivated in *arbusta*[17], that is "married" to live brackets according to Etruscan customs (Buono & Vallariello, 2002, pp. 55-56). Thirteen octagonal pillars with stucco enclose a third garden, the backyard[18], forming a filter between the fields and the facade. Few openings interrupt the linearity of the front and, in the case of the chapel and the cellar, provide direct entry to the inside of the *masseria*. A ramp paved with large basaltic boulders leads to the basement, facilitating transport by carriage, and leans on a pavement partly in *lastrico terraneo*[19] and partly in bare earth – to improve the coolness necessary for the conservation of wines. The first room along the route is that of production, the so-called *cellaio,* whose floor was lowered in 1761 for its enlargement along the western wing of the building, with the goal of increasing the production of

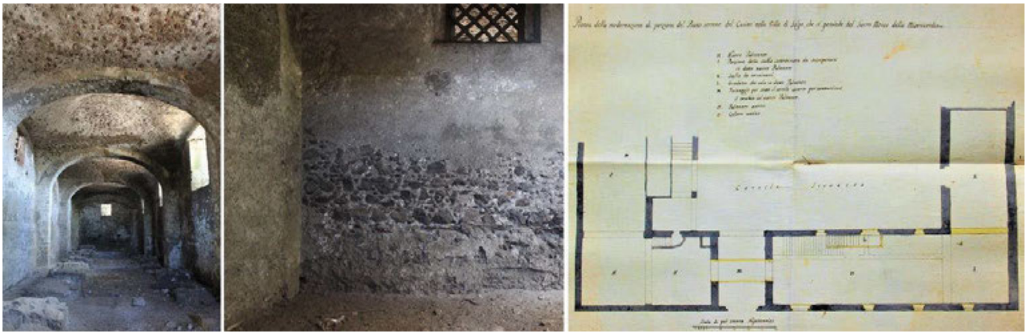

Fig. 5. Spaces in the *masseria* of the Duke of Salza, for aging and production of wine. The first photo represents the late eighteenth-century cellar, whose left wall is in adherence with the *cellaio*. The second photo shows the right front of the *cellaio,* where the traces of the old *lastrico terraneo*, demolished in 1761, are evident (Author, 2018). The last image reproduce the eighteenth-century project of the enlargement of the *cellaio* (Source: H.A.P.M.M., Fondo Patrimonio, Cat.B, Rub.e, n.XIV, fasc.32).

The case study qualifies as a pre-industrial wine factory and consists of a square-shaped building developed on three levels, with an open courtyard in the center overlooked by the external *distesa*[12] staircase (Cennamo, 2006, p.188), the rooms on the ground floor, and the windows and terraces of the apartment above. Two portals in igneous stone with monolithic jambs, facing respectively east and west[13] in asymmetrical position with respect to the center, lead to barrel-vaulted hallways[14] that guarantee access to the courtyard from a pubblic road, closed with gates in 1765[15] and perhaps part of the Nolan centuriation. Likewise, the walled garden adjacent to the building had double arched accesses, located perpendicular to the north-east corner of the main front of the *masseria,* and in the diametrically

10 Historical Archive of Pio Monte della Misericordia, *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.33.

11 From the photographic archive of R. D'Avino.

12 *Distesa* staircase consists in a slab with steps, based on the perimetral walls, whose section is an arc.

13 Comparing the description in the deed of sale and the eighteenth-century reference to the backyard on the western front, it is clear that the entrance has changed with the inversion of access (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.8,33).

14 Under the eastern one once the little portal has the Strambone coat of arms carved on a jamb (D'avino 1991, p.6).

15 H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.8.

16 In 1821 are attested figs, mulberries, licks, pears, plums, laurels, oaks, walnuts, sour cherries, citrus fruits, vines, poplars, a mulberry (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.33).

17 In addition to the type of cultivation, poplars, licks, mulberries, chestnuts and pines are indicated in the inventory of plantations as essences married to the vines ((H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.33).

18 Called *retrano* courtyard (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.8).

19 Realized in 1761 (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.5).

lacryma Christi[20]. Adjacent and also facing north there is the cellar built in 1768[21] to ensure new storage spaces benefitting the first floor of a terrace. This rectangular space is coeval with the reinforcement of the *cellaio* structure[22]. Therefore, its project incorporates some solutions adopted in the intervention of the *cellaio*. Light vaults (in pumice, lapilli, and lime) are built to cover large spaces. Arched structures are added to reduce the excessive planimetric length and prevent injuries from construction mistakes. Moreover, a construction site was set up in 1771 in order to defend this late eighteenth-century cellar from damage caused by rainwater and soil moisture. This refurbishment envisaged the laying of volcanic gutter ends to reduce the leaching of waters from the terrace onto the above-ground masonry, and the flooring of a strip in the fenced garden[23] protecting the underground portion of the cellar. The latter solution is also adopted for the road to the courtyard, which had previously a ditch next to it, used first to extract material and then as an opened dump[24]. As memorials of its productive vocation inside the *masseria*, low scaffolding for locating barrels, wine basins, a well to ventilate the cistern and collect the water, the millstone called *palmento*, remain in situ, while only written sources mention the *cercola*, the winepress obtained from a huge oak trunk[25]. From the winemaking spaces, a modern staircase leads to a covered loggia with two cross vaults which enters the coutyard. Here is one of the three wells that maybe conveyed the waters of the roofs and terraces towards the central cistern, an underground and rectangular barrel-vaulted room with hydraulic plaster coating[26]. A fourth *lava* stone well, in the center of the courtyard, communicates directly with the cistern and, when the *masseria* was in operation, supplied water to the animals housed in the stables on the ground floor[27]. All the other rooms not used for breeding and winemaking serve, except for the chapel, as residences: those next to the main entrance are furnished with a fireplace in the corner and hosted the farmers; the apartment on the first floor accommodated the administrator. A typical wooden staircase, the *scalandrone*, constitutes the internal access to the meeting hall, while, the outdoor and main entrance to the upper foor, featuring grey lava stone steps, starts from the loggia in the courtyard. The suite consists of rooms with a rich stratigraphy of frescoes and with wooden roofs, often hidden by additional wooden structures covered in the past by canvases or papers. The most interesting settings on the second level are the meeting hall, divided by two round arches resting on a square pillar in tuff covered by stucco, and a loggia enclosed by rectangular pillars with rounded edges that embellishes the entrance to the terrace. A "gooseneck" staircase leads to the attic where farmers stored rural instruments. Here, trusses interspersed with tuff arches distribute the weight of the roof. Another room features a staircase to reach the

Fig. 6. The courtyard of the *masseria* of the Duke of Salza (Source: Author, 2018).

20 It was the red wine producted in *masseria* (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.17).

21 H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.17.

22 Through the construction of arches aimed at avoiding the inflection of the roofs and setting the vaulted covers to replace the flat floor (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.17).

23 With *lava* stone blocks supported by an hypogeous wall (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.22).

24 Intervention in 1819 (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.30).

25 H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.30.

26 That also runs through the ducts of the entire system.

27 A room with nine fidingtrough and a stable for two horses.

Fig. 7. The rich layered indoor (top image) and outdoor (lower immage) surfaces, in the *masseria* of the Duke of Salza, with superimposition of frescoes (Source: Author, 2018).

choir of the small chapel in the south-east corner of the *masseria*. The *topos* of rural churches is here declined with the solution of a parallelepiped, closed by a segmental barrel vault with lunettes, and furnished with a stucco altar[28] which was surmounted by a painting. A few neoclassical moldings, at the entrance to the chapel, in correspondence with the openings, and on the surfaces of the dovecote tower, typify the sober facades. However, as with the interiors, the underlying colors resurfaced or preserved by protruding elements highligh the overlap of multiple layers of paint[29]. Gaps in the rough and thick plaster of fronts, as in the whole building, revealed the masonry of *scheggioni* representing the main structure of *masseria*, and tuff blocks or pieces of old *lastrici* reused[30], employed for additions or restorations.

4. Conclusions

The volcanic vernacular system of *masserie*, although in ruins and deprived of most cultivated estates, defends the identity of the countryside downstream of the mountainous duo Somma-Vesuvius, which is left in a state of neglect acting as a buffer zone between the centres on the slopes and the *ager nolanum* in the hinterland.

Urbanization and industrial progress have certainly caused the obsolescence of these architectural complexes, but the aggravating circumstance of their abandonment is a consequence of private property ownership and the lack of state constraints. The owners, either for economic reasons or ignorance of the techniques to be applied, often distort these artifacts with improper interventions or leave them forgotten, pending their complete collapse. This contravenes the main rule respected in *masserie* of conservation through continuous checks and repairs. The maintenance and reuse activities have in fact always been central to the management of the *masserie*. The presence of arches, metal tie rods, vaulted structures, reveal attention to structural and seismic themes, while the local rebuilding ("*scuci-cuci*") in reused blocks, pavements made or restored with lapilli quarried *in situ*, the carving of waste beams for the suspended ceilings, the masonry in pieces of dismantled *lastrico* and the care in choosing the correct exposure for each room, prove the economic and environmental sustainability at the basis of the Vesuvian vernacular culture. Therefore, a primary need consists in the definition of a program with common conservation goals that considers the single building as a node in a network, that guides private owners in their restoration choices, and perhaps even to establish partnership contracts with the public. Another important theme stressed here is the question of traditional outdoor spaces of rural Somma, a natural landscape often overlooked in studies about *masserie*, but fundamental to these pre-industrial factories. Paleobotanical research,

28 Inauguraed in 1767 with the visit of the vicar general of Nola, Francesco Broccoli (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.15).

29 As at the entrance to the administrator's apartment where a shelter, at least until the 1990s (D'Avino 1991), protected the underlying surface or in correspondence with the chapel, where the window molding protected what appears to be a square perhaps filled with a sacred image.

30 In the late eighteenth-century cellar a front is completely made with pieces of lastrico (H.A.P.M.M., *Fondo Patrimonio*, Cat.B, Rub.e, n.XIV, fasc.5)

experiences of re-proposing ancient vines or *viridarium* with the aim of conserving biodiversity, and rediscovering traditions of Vesuvian culture are widespread in the archaeological field with projects carried out in nearby Pompeii (Ciacci et al., 2012) and Boscoreale (Coralini, 2009). However, there is still no example of such projects in the countryside of Somma. Nevertheless, a strong feeling of belonging in popular festivals and in the establishment of associations between farmers promote the rediscovery of the cultural roots of the site[31]. In the context of environmental and cultural requalifications, the conservation and enhancement of the vernacular systems in Somma Vesuviana could certainly be a precious mean to appreciate the territory and to know its evolution. Moreover, the study of these topics is fundamental to investigate the available resources and the technologies to use them, to acquire the skills necessary to repair and reuse the historical building, and to develop economic and energy sustainability for the care of our heritage and homes.

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31 The Festival of the *Lucerne*, added in 2019 in the inventory of Campanian intangible culture; the traditional walk on the mountain in the Easter period, *'A perteca 'e Somma*; the enhancement of typical vegetables or fruits, such as *torzelle*, *crisommole*, tomatoes of the *piennolo*.

VERNACULAR ARCHITECTURE: MATTER, CULTURE AND SUSTAINABILITY

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The rural founding villages of the Italian Agrarian Reform in Basilicata (1950-1970): urban planning and 'modern' vernacular architecture to the test of contemporaneity. The case of Borgo Taccone (MT)

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Topic: T1.2. Urban studies of vernacular architecture

Abstract

The contribution aims at providing an overview on urban planning and on 'modern' vernacular architecture of the rural founding villages built during the Agrarian Reform (1950-1970) in Italy, in the inland areas of Basilicata Region. In particular there are settlements not yet sufficiently known, in which the important of inventorying the considerable built heritage must be the objective of a necessary, urgent safeguarding.
With the 'Agrarian Reform' (Law 841/1950), the Italian government carried out a redistribution to settlers of the lands of uncultivated or abandoned large estates. The purpose was to increase productivity in the reformed areas, as long as a better profitability of labor and an adequate 'social equity'. As a consequence, new villages were created that had to fulfil the task of reorganizing rural centers of socio-economic concentrations, able to reconstitute environments similar to the agglomerations from which the laborers, once employed in the latifundiums, came. Among the numerous centers built in Basilicata, Borgo Taccone is representative of this system of agrarian colonization of the Lucanian territory. The settlement, in which the modern construction techniques were broadly experimented, is the service center for farmers living in farmhouses in the surrounding funds and for this reason it was equipped with core services such as the church, the school, the post office, the clinic, cinema/theater, etc. After an initial period of demographic expansion, in the seventies the 'Borgo' began to depopulate and is now in a state of abandonment and decay. Despite this, this settlement, surrounded by agricultural land in a well-preserved landscape, still retains a strong formal character in both its urban and architectural layout. The contribution traces the physical, social and cultural transformation line that led this rich asset to the contemporary world, outlining a possible future cultural theoretical debate on its safeguard and sustainable enhancement.

Keywords: *Rural founding villages; cataloguing; conservation; sustainability.*

1. Introduction

The backdrop for the reflections and results of the research presented here concerns the future of the fragile architectures of the 'Modern' era in the rural villages and associated areas that were infrastructured by the settlement process of the Agrarian Reform in Italy (1950-1970).

There is a great deal of attention from both the national and international community on the 'Modern' heritage, which is not always easy to recognise as a monument/document, often consisting of buildings, collective spaces, and entire settlements commonly in use (or disuse) which can only be conserved and managed through appropriate instruments and policies geared towards their protection. The history of the rural founding villages and newly-settled areas of the 1950s-1970s in Basilicata is a valuable starting point for a rereading of the failure to develop certain parts of the Italian South, as well as of the modifications and transformations that took place over time. Revisiting this issue serves to promote a potential revival of these places, which are falling victim to depopulation, in our present era. The research actions include a reconstruction of the narratives, the history of these fragile areas, which still cast their shadows on the present day, and a careful look at a vast and homogeneous heritage in need of protection, consciously improving the conservation of the high-quality historical building stock, as well as directing any interventions towards a compatible, sustainable future reuse.

2. The rural villages of the Agrarian Reform in Basilicata

After the end of World War II, the construction of new rural founding villages in Italy was an opportunity for experimentation with Modernism from the perspective of urban planning and architecture. Although belated, the Modern Movement in the south of the country produced some of its most significant achievements during this period of reconstruction. Between 1950 and 1970, thanks to funding from the Marshall Plan (1947) and the consequent Agrarian Reform, the Italian government was able to make a huge political, economic and social commitment to redistribute the land of unproductive, uncultivated or abandoned latifundia - vast landed estates - to the tenant farmers (see the ‘Regulations for the Expropriation, Reclamation, Transformation and Allocation of Land to Farmers’, no. 841 of 21 October 1950).

The implementation of a new wave of settlement had some specific objectives, namely a certain ‘social equity’ for smallholders and farmhands, an attempt to achieve greater productivity in the reformed areas by improving the utilisation of farmland, and improved profitability of labour (King, 1973; Marciani,1966; Nigrelli & Bonini 2017). The redistribution of agricultural land involved a reorganisation of the territories, with the foundation of new rural villages with an urban structure and high-quality architecture, their homogeneous and functional designs modelled on traditional architecture, but reinterpreted according to the language of Modernism.

It should be borne in mind that architecturally speaking, in the south of Italy, and especially in Basilicata, the Modern Movement developed considerably later than it did elsewhere. Despite this, thanks to the work of a pool of well-known architects of the time operating in Basilicata in the aftermath of World War II - such notable figures as Ludovico Quaroni, Luigi Piccinato, Carlo Aymonino, Marcello Fabbri, Giancarlo De Carlo, Mario Fiorentino, Ettore Stella, Luigi Agati, Federico Gorio, Pier Maria Lugli, Michele Valori and Plinio Marconi - in the years of post-war reconstruction, this region would become an exemplary model of a renewed Italian society, paving the way for experiments in architecture and urban planning in these areas, with the construction of rural villages, scattered settlements, and social housing districts. This was an important time in history, seeing the undertaking of a complex physical and social transformation of the area based on the design of new models for settlements and housing, new building materials and techniques that innovated whilst keeping the past alive, bringing together modernity and local traditions. As such, the experiments of Modernism were not limited to urban areas alone, but also extended to the rural sphere with the design of architecture spread throughout the region (Dimichino, 2013). These new constructions were made possible by the contributions of technicians from the Land Reclamation and Agrarian Reform projects, as well as numerous well-established planners who developed new forms of settlement, in parallel with an overhaul of the infrastructure in the area required to increase productivity, with major civil engineering works undertaken to resolve issues with hydrogeological, irrigation and road systems.

The activities of the organisations responsible for implementing the Agrarian Reform, then, primarily concerned the expropriation of latifundia and the allocation of farms, followed by the execution of large-scale land reclamation and irrigation works, as well as the establishment of a transport infrastructure network and, as a final stage, the construction of villages and farmhouses. As such, as a result of the Agrarian Reform in Basilicata, numerous rural settlements sprang up in the provinces of Matera and Potenza. Some of the most significant ones in the Matera area include: Borgo Taccone and S. Maria d'Irsi in Irsina, Macchia in Ferrandina, Calle in Tricarico, La Martella in Matera, Caprarico in Tursi, Scanzano in Scanzano Jonico, Serramarina and Metaponto in Bernalda, Pianelle in Montescaglioso, Gannano in Stigliano and Policoro in the town of the same name. The Potenza area, meanwhile, saw the establishment of: Masi and Piano del Conte in Avigliano, San Cataldo and Sant'Antonio Casalini in Bella, Gaudiano in Lavello, Boreano in Venosa and Leonessa in Melfi (Abate & Argento, 2015; Filadelfia, 2004; Percoco, 2010).

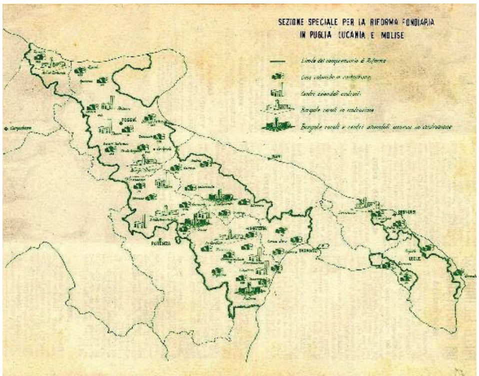

Fig. 1. Map showing the distribution of the rural villages of the Agrarian Reform in Puglia, Basilicata and Molise (Historical Archives ALSIA Basilicata)

The settlements built in these agricultural areas largely followed one of three models:
- scattered: with isolated houses built on the specific agricultural holding assigned to each individual family, who would rely on neighbouring settlements for essential services; alternatively, dedicated service centres were sometimes built to serve the farmhouses;
- centralised: rural residential villages equipped with some essential public services, as well as commercial and small-scale craft businesses;
- semi-centralised: mixed settlements combining elements of both of the above models.

The first model was initially the one preferred by the Reform Agency because it was better suited to a more streamlined organisation of the farms and the management of work and production, but it was far removed from the traditions of the local settlements, making communal life difficult. The second and third models, which garnered approval from urban planners and architects alike, allowed them to permanently populate the uninhabited areas of the latifundia by constructing new residential villages intended to become the driving forces behind a productive rural community. These new settlements therefore had to incorporate the buildings necessary for the civil and social organisation of their populations: they included a church with a rectory, public buildings (police station, post office, the offices of the municipal delegation, doctor's surgery with the doctor's house), educational buildings (nursery and primary school, along with accommodation for the teachers), buildings for recreational and leisure activities (theatre, social club, restaurant), shops for essential items, houses for craftsmen and rural houses for farmers (terraced, in groups or detached, with livestock farms attached to the homes) who owned farms within a 3km radius of the village (Canali, 2015: Carbonara, 1954; Conte, 2008; Prinzi,1956; Pontrandolfi, 1999; Tordeillas, 2013).

With regard to the architecture of the villages of the Agrarian Reform, standard architectural designs were generally used, with the buildings often modified by the local workers at the execution phase to adjust the design concept to suit their construction knowledge, using a combination of new materials and those available in the regional area. However, this common design practice, adopted at the national level, also went hand in hand with the creations of contemporary professionals, including many prominent figures, who were experimenting with new architectural languages. On this, Nallo Mazzocchi (1955) provides an overview of the design approach and architectural language that architects and engineers were to adopt when designing rural villages: they had to create 'non-standardised' works, but at the same time avoid any costly or misplaced monumentalism, providing each village with suitable formal characteristics whilst maintaining respect for the environment and local character. The architects were free to interpret the local language and adapt it to suit the new, modern functions of the buildings.

Under the Agrarian Reform in Basilicata, more than 75,000 hectares of land were expropriated, with a total of 11,557 farms distributed to the tenant farmers. These farms - fragments of land spanning no more than between three or four and seven hectares at most, allocated to fairly sizeable families - very soon proved to be too small to be economically justifiable (De Leo, 2008). The allocation of farmhouses and plots of land, the construction of rural founding villages to establish service centres for the tenant farmers, land reclamation and new infrastructure (irrigation, railways and roads) did not provide the desired results. The Reform was not considered an economic 'triumph'. Indeed, in some respects it actually proved to be a failure (Bonini, 2012; Villari, 1979). The isolation of the farms, the failure to construct infrastructure and irrigation works, and the mediocre quality of the land in many of the expropriated territories very soon led to the allocated farms being abandoned, with the consequent wave of emigration: in the 1960^{s} and 1970^{s}, people left Basilicata. This was an exodus that the Agrarian Reform - which unfortunately did little to change their living conditions - was unable to stop, ultimately leaving the region's farmhouses, rural villages and territories depopulated and destined to fade into obscurity.

3. The case study of Borgo Taccone

The research project, launched in 2020 and still underway, initially focused on efforts of familiarisation with Borgo Taccone, in the Town of Irsina (MT), consisting of a settlement complex which saw experimentation with Modernist construction techniques. The village was built in the 1950^{s} based on a design by Plinio Marconi (1893-1974), an engineer and architect (Di Biagi et al.,1992; Intini et al., 2021).

Borgo Taccone is, with good reason, representative of the system of agrarian colonisation: a village proportionate to its population, including the people from the surrounding countryside, who lived in farmhouses outside the village. The site was established as a rural settlement and service centre for the farmers living in the farmhouses on the surrounding estates, and as such it is equipped with a selection of 'basic services': a church with a parish centre, a primary school with a house for the teachers, a nursery, a sports ground, a post office, a police station, a doctor's surgery with public toilets, a cinema/theatre, houses for craftsmen and workers, a settlement centre consisting of silos, a weighing platform, the caretaker's home, workshops and warehouses, offices with their respective houses, sheds to shelter farming equipment, a complex of residential lots which was the site of rural houses and, finally, not far away, the Appulo Lucana railway station (Bari-Potenza line).

Fig. 2. View of the centre of Borgo Taccone (Source: Bortolotto)

The buildings in Borgo Taccone, all gathered around the central square, are small yet of remarkable architectural quality, expressed in simple but not uninspiring forms, and even feature prestigious finishes such as majolica tiles for the church and coloured terracotta at the entrance to the cinema. Their white surfaces, pure forms and skilful manipulations of light and harmonious proportions make for a stark contrast with the obvious deterioration: crumbling plaster, reinforced concrete now with no concrete cover, unusable doors and windows, a handful of incongruous conversions, and now-obsolete technical facilities. In Borgo Taccone, the functional demands of the 'colonising rurality' (but also those of the propaganda of the Reform) are combined with aesthetic concerns; the local skills and customs adapt to suit the techniques, materials and finishes of Modernism; in short, a heritage that exists in continuity with tradition. According to Mauro Sàito, they combine "realism and vision, pragmatism and experimentation, an ability to engage with tradition, but also a strong drive towards the future of the 20th century in southern Italy" (Pagliuca & Sàito, 2019, p. 12). Indeed, as early as the start of the 20th century, during the interwar period (including under the autarchic regime) and the reconstruction phase, the practice of 'making architecture' was enriched with innovative materials and modern forms which, through the individual imagination of each designer, reinterpreted - in the area under consideration here - the facies of rurality and Mediterranean landscapes.

Thanks to historical research, it was possible to see in images the ways in which these urban planning and architectural projects were implemented, as well as how the village was lived in and subsequently abandoned. Indeed, after an initial period of demographic expansion, in the 1970s the village and its farmhouses began to suffer the phenomenon of depopulation, and only a handful of families still live there currently. Borgo Taccone, despite its current state of neglect and deterioration, still retains a strong formal character in terms of both its urban and its architectural layout and is surrounded by farmland and arable land in a well-preserved cultural, rural and environmental landscape.

Borgo Taccone can be considered a truly typical example due to its modern vernacular architecture, its functional urban layout, and its relationship with the surrounding context thanks to the infrastructure brought by settlement. Its deterioration and abandonment highlight the critical issues and challenges affecting the other villages built in Basilicata during the same historical period in much the same way. These rural villages - a heritage that is still entirely ripe for 'rediscovery, conservation and restoration' - are now abandoned or undergoing depopulation.

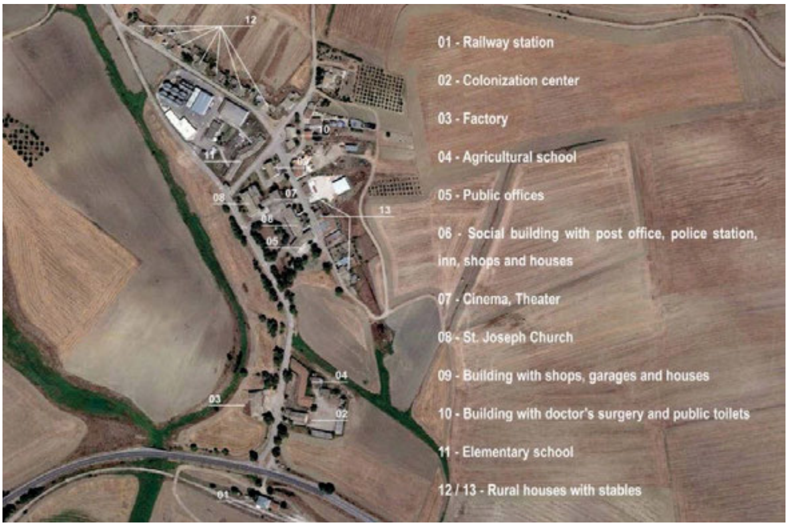

Fig. 3. Plan of Borgo Taccone with identification of the functions of the buildings (Source: elaboration of the authors on a satellite map)

The critical issue of the depopulation of these villages can, however, paradoxically be seen as a unique characteristic; indeed, throughout the entire period since their abandonment, these founding settlements have not suffered any particular detractive variables, nor have they presented any latent conflicts of interest with regard to the property market. It is worth noting that the entire building stock (aside from a handful of private properties) currently belongs to a single public body: the Agenzia Lucana di Sviluppo e di Innovazione in Agricoltura (ALSIA).

4. Modern urban planning and architecture of the rural villages: the research for Borgo Taccone

One of the goals of the research was to shed light on the importance of protecting, conserving and promoting the vast and still insufficiently recognised 20th-century architectural heritage of the rural founding villages, as well as their urban and architectural design, largely by implementing knowledge and safeguarding thereof. This objective is in line with the course of action initiated by the Ministero per i Beni e le Attività Culturali e per il Turismo (MiBACT), specifically the Direzione Generale Creatività Contemporanea (DGCC), which has undertaken a census of this heritage. Unfortunately, it has become clear that there are only four files available pertaining to the area covered by the research project, one on Borgo La Martella in Matera and three on Borgo Taccone. Given the sheer extent of this vast heritage, a broader survey was undertaken - in an effort to produce an exhaustive census - of the building materials used, the design drawings found, and the main problems of deterioration affecting them; this proved essential as a means of gaining familiarity with them and preserving their historical memory. As such, when studying Borgo Taccone, it was interesting not only to allow the 'material data' speak for itself (traditional materials used in an innovative way, new techniques used to assemble prefabricated reinforced concrete elements), but also to strive to outline the virtuous dialogue that developed between the knowledge of local workers and the new technologies introduced. To this end, it proved useful to consult the State Archives in Bari, which held not only the plans, sections and elevations for the buildings in Borgo Taccone, but also the bills of quantities, with the entries relating to the operations involved in their construction; as such, for the building works in question, it was possible to retrace the building site, estimated costs, and the construction of the structural, masonry and finishing works.

Moreover, in addition to the analysis of historical sources (including bibliographical, documentary, cartographic and iconographic sources), the short space of time separating us from the period of the Modern Movement also made it possible to draw upon unpublished oral information from the direct memory of people - still living - who worked on the buildings themselves or simply lived in the village, thus providing a new perspective from which to interpret the 'text' of the work being explored. Along with this oral testimony, for the rural villages established as a result of the Agrarian Reform, it was also possible to view propaganda relating to the law in the form of photos and videos, largely provided by the Istituto Luce Cinecittà. Ad hoc guidelines are being prepared that take into account the material and architectural characteristics of these rural villages, with the aim of providing a solid basis to guide any design choices as well as best practices for proper conservation works in order to ensure that they remain intact. Furthermore, this research may complement the work of Docomomo International, the "International Committee for Documentation and Conservation of Buildings, Sites and Neighbourhoods of the Modern Movement", which began establishing national/regional chapters in 2002. The local point of reference is Docomomo Italy, Basilicata-Puglia chapter, which in 2019 published a catalogue, that breaks into thematic sections, with 100 examples of modern architecture widely acknowledged to be of high quality, linking the originality of the works found in the two regions to the national cultural debate. It is these established 'itineraries' (with Borgo Taccone also included amongst the works mentioned) that we intend to pair with the 'route' of this specific research into the rural founding villages - which are not yet sufficiently well-known - in which the urgency of cataloguing the sizeable modern heritage that has arrived to the present day will provide fundamental support for the highly necessary and now incredibly pressing requests for protection.

5. Conclusions

The study of the villages of the Agrarian Reform in Basilicata, complete with the associated census and cataloguing of the architecture, has led to an improved knowledge of the vernacular architecture in Modernist forms, specifically the languages, materials and construction materials used. This has proved useful not only as a means of increasing awareness about its intrinsic value, but also in order to be able to initiate and promote requests for protection and orient the possible choices to be made in future conservation efforts. It is worth bearing in mind that arguing the reasons for the restoration of this architecture is no mean feat: there are countless apparently irremediable defects, limited experience of construction sites, and the value of these buildings is appreciated by but a few experts in the field. As such, the central challenge of this undertaking lies in comparing the Modern-era buildings of historical and documentary interest with the concrete problems of selection, legal protection, conservation, functional reclamation with compatible reuses and any possible necessary/admissible adjustments, all in light of the current regulations.

The housing stock built in Basilicata based on the architectural culture of the Modern Movement, both in its most iconic representations and in the more common ones of the wider heritage, is to be recognised as a 'work of contemporary architecture' according to the Italian Legislative Decree of 22 January 2004, no. 42, 'Code of Cultural and Landscape Heritage', that states: "the work of a creator who is no longer living and produced more than seventy years ago, are subject to protective measures". This means that the numerous rural and social housing projects that make up the majority of the Modernist heritage in Basilicata built since the 1950s - and more specifically the rural villages of the Reform - can be, or shortly will be, the subject of obligations and protection plans. This action will inevitably have to be followed by the restoration of these villages, which are largely in a state of serious decline or total abandonment. The lack of maintenance has consequently led to the steady deterioration of the material, which has in many cases resulted in a partial loss of the distinctive features of the architecture, with the risk of also destroying the cultural matrix with which the villages were originally designed. It is also important to consider that these architectures will also inevitably have to undergo transformations to make them suitable for the new needs of the contemporary world. With this in mind, any proper conservation work must urgently and unavoidably go hand in hand with repurposing projects that take into account these new requirements, but without compromising the core identity of this heritage. It is only on this basis that it will be possible for the community to reappropriate these places, reinhabiting them and experiencing them once again as inhabitants of the 21st century, though always with a strong awareness of the particular historical value of their context. It is precisely this intrinsic characteristic of the rural founding villages that must be preserved, promoting and respecting their value as a unique and irreproducible heritage. Bearing in mind that this heritage exists against a social, cultural and economic backdrop that is constantly evolving, it is crucial to not only protect and conserve it in and of itself, but also to establish management strategies capable of ensuring the possibility of sustainable development, always with an enduring respect for the continuity between past and future. It is therefore necessary to develop, in tandem with measures for the protection and conservation of the villages of the Agrarian Reform, policies aimed at promoting and increasing their value which also involve the culture and tourism industries. From this perspective, the interaction of economic development between the agricultural and tourism sectors may well play an important role: agriculture is a significant traditional business, whilst cultural and food and wine tourism is an additional line of business which opens up the possibility of complementary relations between the two. In conjunction with the rural economy (agricultural and livestock farms, as well as small-scale processing companies) and hospitality, so-called ‘slow’ cultural tourism could prove to be a winning partner in promoting the narratives of these places from the Agrarian Reform of the 1950s, helping to defend the identity and authenticity of the ‘genius loci’, to redefine their role as the focal point of a territorial system that connects and enhances all its resources, to trigger a virtuous and productive cycle for local businesses, and to increase the overall quality of life in the area, with a view to sustainable development in the long term.

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Vernacular architecture and written sources: the case study of the Tronto Valley

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Topic: T1.2. Urban studies of vernacular architecture

Abstract

Medieval archaeology has developed very effective instruments for investigating the smaller rural settlements and local production and construction techniques, on which the documentary sources are scarcely fluent. However, documents assure precise hints or general references to which archaeologists do not give up. In the same way, the most abundant, although indirect institutional sources, and the technical literature, from the Modern Age to the nineteenth century, are very useful to understand this kind of construction, with local materials and according to local models and practices – widespread in rural Europe until the early twentieth century. The historic villages of the upper Tronto Valley, near Ascoli Piceno, can offer a good example in a territory devastated by the 2016 earthquake in which material sources have been heavily depleted. The documents - although discontinuous - often explain constructive choices. The nineteenth-century literature describes the territory in a transformation phase, still based on the scarce local resources, and returns the mentality and the expectations of the contemporaries. Literature and documents contribute to consolidating the role of the built heritage as a historical source, highlighting both the cultural depth and the nature of housing resources that characterize the individual buildings and villages.

Keywords: *Modern Age, building techniques, Archaeology and material documents, Tronto valley*

1. Introduction

"Vernacular" are generally defined buildings realized with local materials, by relatively simple practices diffused within the corresponding geographical context, without referring to advanced cultural models or techniques. However, at least in Europe, building practices or even building typologies can be difficultly referred to clear geographic delimitations. Riegl's – and then, Dvorak's – considerations are still valid (Riegl, 1894, pp. 41-50; Dvorak, 1907, pp. XX-XXI). Folk art and local traditions were different reflections of a universal, common will of artistic expression (Vasold, 2004), both in the past or in more recent times, yet it does not make them less interesting, or forbids defining the identity and quality of single contexts. Riegl's *Kunstwollen* also included technical aspects. In this sense, he opposed the nationalistic "regionalism" of his time: in this perspective, the vernacular heritage was the root of national consciousness, and the best foundation on which a new architecture. should be build. Nevertheless, the "regionalism" also had anti-historicist and anti-eclectic components, which could be seen as rationalistic and progressive in some respects.[1] Several ambiguities can be solved by admitting that vernacular architecture

[1] The bibliography of the last thirty years is rich, even though the topic has a particular temporal and geographical ambiguity. The synthesis coordinated by François Loyer (Loyer 2001) is still useful, Storm (Storm 2010) treats a much more general picture. For these concepts, see also Riegl (Vasold 2004).

has its own history; it receives external influences and changes over time, and these transformations often happens at relatively slow paces, in ways that untrained eyes can hardly recognize. It must be considered that practices and models have significantly different durations, which characterize the definition of vernacular architecture itself, as its periods do not always coincide with the sequences of architectural history. Sometimes, the scene is even more complex due to the presence of real building fossils, such as the Venetian "casoni" (Tieto, 1979; Agostinelli, 2018) or the "loges" in Anjou Touraine (Epaud, 2014; Epaud, 2009). Perhaps they perpetuate millenary models, of which in the archaeological digs the postholes represent the only labile traces. Conversely, in 20th-century Italian culture, and in the legislation that still derives from it, the only discontinuity in local building traditions is seemingly represented by the industrial expansion at the end of the 19th century. In this view, "vernacular" architecture ends up coinciding with the so-called "typical local constructions", a category that is – not accidentally – fiscally favoured by the cadastral estimations of the '30s. This system of ideas overshadows the stratification and inhomogeneity of this heritage, whose constructions – or, at least, additions and reconstructions – are often relatively recent, dating back to the 19th or early 20th century. Hence, this attitude might hide the frailness of this heritage, which must be remedied for the sake of its protection.

2. A case study: Vernacular Buildings of upper Tronto valley (Ascoli Piceno, Italy)

The building fabric of villages and houses in the upper valley of the river Tronto, in central Italy, represents a good example to discuss these observations. During the late Medieval and Modern Age the valley was part of the Pontifical State, on the border with the Kingdom of Naples, and its history is described by the huge documentation produced by the papal administration. Except for churches and some fortifications, there are only a few fragments of the earlier periods, in particular with respect to the small centers on high hills and mountains. The area is characterized by frequent earthquakes: in 2016, historical dwellings in Arquata have been severely damaged or destroyed. Hence, repairs were performed frequently, and these continuous adaptions produced an intrinsic frailness, which led to the occurrence of partial collapses and consequent reconstructions in undisturbed years as well. To a certain extent, data detected from buildings correspond to historical records: this allows performing an absolute dating of transformations and acquiring information on local building techniques from indirect sources. The literature offers a useful frame. Filippo Re (Bonini & Pazzagli, 2016) realized a renowned inquiry on agriculture during the Napoleonic Age, carried out through questionaries sent to experts from each Department, and then published in "Annali dell'Agricoltura del Regno d'Italia" (1809 – 1814). After the national Unification (1861), an even more renowned report was realized, that is the Jacini agricultural inquiry[2], named after the President of the Parliamentarian Commission that coordinated it from 1877 to 1881. Both documents provide a very detailed description of this territory and realize a relatively wide coverage of rural dwellings. As Alberto Caracciolo (Caracciolo, 1958; Caracciolo, 1973, p. 90) comments, both are "*an essential historical source*" rather than "*a historical work…with easily acceptable, critically achieved results*". However, the two inquiries represent valuable support for the interpretation of the building heritage, as they contribute to – and oblige to – reconstruct the cultural and social context. The Canon Orazio Valeriani (1769-1841), professor of botany and agriculture at the Lyceum of Fermo (Mazzanti Bonvini, 1967), highlighted the radical difference between the

[2] The T. II and the T.II of volume XI of Atti (Atti 1881-86) concern the Marche region. The Marquis Francesco Nobili Vitelleschi was formally the rapporteur of the V disctict (Rome Grosseto, Umbria with Rieti, Marche). The research on these areas was coordinated by Ghino Valenti (Caracciolo 1968, 88-89), who partially published the first revised part (Valenti 1888). Giovanni Derio's thesis, "Le abitazioni rurali nell'Italia postunitaria. I dati dell'inchiestra Jacini" (Cagliari University) has tourned into a website: http://web.gioder.altervista.org/jacini/index.php?option.

rural buildings in the lower valley of Tronto,[3] made of bricks laid with earth, and those in the upper valley, made of stone laid with *"good lime"* mortar (Valeriani, 1812, pp. 132-134). The Canon recalls several literary references, and the principle of *"bienséance"* is almost literally drawn from Laugier; moreover, as a remedy to the defects of a building *"without an architect*", replaced by the farmer or by the owner, he suggests: "*May the architectural design spread in owners: and may they be bestowed by the idea of beauty, comfort and solidity*". In other words, he encouraged the diffusion of an acquired habit in aristocratic education that has produced a huge number of amateur architects among noblemen, especially in northern Italy. In the Papal State, we can cite as example Camillo Morigia from Ravenna and his designs of farmhouses (Pirazzoli & Fabbri 1976, p. 173). On the international scene, literates agreed that landowners should take care of design and construction of their farmhouses. Duhamel de Monceau showed his own interventions on his farmhouse in the second edition (1779) of the *"Elements d'agriculture".* This is echoed by a vast literature that has acquired a significant publishing fortune since the half of the 18th century, to the first decades of the 19th century and has recently been rediscovered (E.g., Garric, 2014). Even though Valeriani probably did not obtain these publications in Fermo – where he could not find Petrarch's *De remediis utriusque fortunae* either (Valeriani, 1813, p. 179) – he could read their mentions in Filippo Re's bibliographies (Re, 1808-09). The great agronomist, while appreciating Morozzi's work (Morozzi, 1770; Re, 1808-09, T. III, p. 174), criticized earth constructions when reviewing *"an extract from Mr. Cointeraux's work*" (Del Rosso, 1793); yet he took a more cautious attitude – as often, with living authors – by reporting it under the name of the translator Giuseppe Del Rosso in the following volume (Re, 1808-09, T. II, p. 160 and T. III, p. 322). Cointeraux's work as well aimed to verify a vernacular practice and transform it on the account of new scientific knowledge. Hence, Valeriani adopted the illuminist approach toward practical knowledge from the past. Indeed, only the universal filter of Reason, which inspires the formation of owners and technicians, can select the local practices that will perpetuate within a different division of skills and work. Outlining a history of Picenian agriculture, Valeriani initially referred to greek and latin authors, as renowned authorities. Then, along his narration, he moved to a critical analysis of more recent literature. Following Muratori's example, medieval documents such as municipal statutes represent a testimony of actual life, in opposition with literary mediation making room for the new historical science. Hence, Valeriani noted that "*…roughly, barely two hundredths of the buildings of the Department were realized in past ages, two fifths were constructed during the 14th and 15th centuries and at the beginning of the 16th, the same or more in the 18th century, and the rest in the 17th, which was the least productive…"* (Valeriani, 1813, p. 162). These observations, written 200 years ago, reflect the current situation of the heritage of upper valley built prior to the nineteenth century.

3. Exchanges of local skills and resources

Valeriani was always a keen observer, and wondered to what extent cultural gaps lead to the backwardness of the building sector: "*... what has to do an uncultured worker, who is sometimes farmer? Yet many of them have been in Rome, but this is not enough…*" (Valeriani, 1811, p. 133).

The cause of backwardness is not isolation: the *Congregazione del Buon Governo* controlled municipal budgets and supervised public works, realized and maintained by the communities, and this produces intense correspondences, direct contacts and led many individuals among the local élites to travel to the Capital[4]. The

[3] "…Non vi è ornato alcuno; non vi è: né vi deve essere.Vi deve però essere convenienza; non vi è: vi deve essere bellezza comodità, solidità, niente per lo più…", Valeriani (1812) p.133.

[4] On activity of the Congregazione Tabacchi 2007 and index of its Archive in Lodolini 1956.

central administration fined them if their accommodation, economically sustained by the community[5], lasted too long; however, this did not prevent the formation of strong bonds.

Fig. 2, Rural house alonge the Tronto river, Trisungo, Arquata del Tronto, AP (Source: Grimoldi, 2018)

These were also generated by the shepherds' seasonal migrations to the Roman Countryside[6], and by the dynamic flows in the upper valley of the Tronto river, which moved along a route that connected the eastern coast to Rome, passing by Norcia and Spoleto, and are proved by Roman notaries' deeds. In Arquata del Tronto, which is the most internal town, a kind of capillary cultural mediation occurred thanks to many figures: the judge, Lieutenant of the Governor - Prelate of Norcia or "Prefetto della Montagna", the doctor, the schoolteacher, notaries who serve as chancellors for the community and, though to a lesser extent and by official duty, regular and secular clerics. Mobility also affects workers: a significant amount of workforce came from the Prealps after the 1703 earthquake, which severely damaged, in addition to Abruzzo, also the Apennines between Umbria and Marche. In Arquata, "Milanese master-masons" often served as community experts or public works contractors[7]. The origin of one of these families, Andreoni, is not even mentioned since the end of the 18th century[8]. Hence, material conditions appear to be the key factor behind constructive choices. There were no roadways, even Salaria is a network of trails. Stone, limestone and sand quarries, even forests where wood for construction is cut down, had to be close to the building site. In 1794-1797 sand transportation cost was the 5% of the cost of raw building, or a sixth of the cost of workforce[9]. Recent studies on mortars (Roselli, 2019) from four different locations confirm the difficulties in supplying good building materials. The lime sands were too fines and are one of the causes behind masonry disintegration. Anything available is used in constructions, even earth sometimes. Conversely, roof tiles, floor tiles and roof slates were widely used since the early Modern Age. In the Fortress, which was built during the 14th and 15th centuries and abandoned in 1655, the brickwork had progressively been taken from it and reused by inhabitants. The resistance of large load-bearing walls improves as the dimension of openings decreases. Valeriani confirms that "*on the mountains, windows are small, and there are few external doors*", and more in detail he highlights that "*at least is lacking one room equiped by good doors or windows*". Openings are small because they cannot be sufficiently protected by simple wooden shutters, while influential people's houses sometimes have glazed frames. Only one of this kind was documented, presumably dating back to the second half of the18th century, yet with several later additions (Zampilli & Brunori, 2020). Moreover, "two small windows and one big win-

5 ASR, C.BG, II Serie, B 263, February 4, 1657; the Governor of Norcia Radolovici to the Congregazione.

6 Valeriani, 1812, 73, and ASAP, Amministrazione provinciale, Ufficio Tecnico, B. 9-22. Many documents prior to 1860 report women and children doing heavy work due to the absence of men, who are in the Roman countryside with their livestock.

7 ASR, CBG., II serie B.270; July 10, 1794; Stefano Scolari "milanese" established the estimate for the "pan venale" oven; September 19, 1795; the assessment of another "milanese" builder, Giacomo Scolari, about the works carried on.

8 ASR, C. B. G, II Serie, B.265, February 6, 1766; Angelo Andreoni, "Milanese" mastermason, writes expertise for the construction of a boundary wall of the public road near Borgo d'Arquata; B.268, August 3, 1781, Giovanni Andreoni "de suburbio Arquate" estimated a municipalitie's house.

9 Stefano Scolari, the same expertise of footnote 7.

dow" [10] with small glass sheets secured by lead-cames were realized in the Priory Palace in 1783, then in 1801 a woodworker received the payment for "renovating the window of the school by adding glass panes", in addition to placing 16 and 28 more sheets in other windows[11]. A similar glazed window appears in Ascoli, in the Governor's Palace, still in 1831, while glass panels exceeding the width of 40 cm had already been used[12] in Lombardy more than 50 years before. In 1817, the corps of *Carabinieri Pontifici*, recently established, resides in the province of Ascoli, in rented houses whose openings lack glazed frames. Even in city barracks "*most window frames are missing*" [13] . Glass is the first, consistent exception to the logic of self-production in the building site. The selection of raw materials and the complex equipment of furnaces require a high concentration, but however local manufacturers could allow a better distribution of goods for everyday use. In 1802, Pio VII had granted property rights for the construction of a glass plant in Ascoli Piceno (Barberi (ed.) 1846, T. XI, pp. 278-281) it could be the same plant noted as "*being subjected to a continuous development every year*" in 1865 (Annuario, 1865, p. 7). Galli, outlining a general picture of economy in the Papal State, among the 11 glass plants that produce windowpanes in the provinces, listed on the Adriatic side the plants in Ferrara, Rimini and Pesaro (Galli 1840, 245-246, 276-277). Another one opened in Ravenna in 1843 (Annali di Statistica, 1843 p. 7); the Marietti family from Milan operated in Murano since 1826 and sold a huge quantity of windowpanes at Senigallia fair. Their industrial-scale manufacturing process was powered by a steam machine introduced in 1853, as reported in Maestri's industrial statistics (Maestri, 1860, p. 231). These fragmented pieces of information confirm that the Picenian area experiences an increased production and a consequent fall in prices, just as it happened in more developed territories.

4. From early modern to Age to the nineteenth century: construction between permanence and change

This improvement in window protection allows widening and adjusting wall openings, by placing external frames from square sandstone blocks into the voids, or by reintegrating the edges, when performing a simple squaring. The stratigraphic traces of both operations are hardly visible in an ashlar masonry wall, with extensive grout lines filled with mortar, and often covered by an additional layer of plaster that follows the irregularities of stones. Since the half of the 16th century, this system has also replaced in churches and fortifications an accurate masonry walls with exposed stones and squared ashlars, which was on turn preceded by – or alternative to – small squared blocks. These characteristics can be found in a limited number of houses that have resisted over time, where frames of doors and windows follow simplified Renaissance vernacular models. Archaeological tools have a fundamental role; however, when using the simplest ones, such as chronotypology, which outlines time sequences in broad terms based on formal data, it is necessary to consider Tiziano Mannoni's "warnings", regarding both masonry walls and constructive elements[14]. Stone frames, in particular, show elementary, often repeated, profiles, and the execution techniques are fundamental to attribute to different ages buildings elements apparently similar. Despite the notable number of documents, they can hardly be univocally referred to buildings with a level of detail that allows an absolute dating of construction elements.

[10] ASR, C.B.G., II Serie, B.268, July 16, 1782; The *Vicario Foraneo* G.P.B. Amodio to the *Prefetto della Montagna* D. Campanari.

[11] ASR, C.B.G., II Serie, B.270, "Ordine dei pagamenti" of 1801, copy, July 10th, 1802.

[12] ASAP Delegazione Apostolica di Ascoli, 1831, B.27 tesoreria; August 31, 1831, Zacchei e Fazzini carry out an estimate, attached to the report of F. Prisciani for the *Delegato Apostolico.*

[13] ASAP Delegazione Apostolica di Ascoli, Istruzione pubblica militare 1817, B.13, Ascoli, no date, The commander of *Carabinieri Pontifici* of Ascoli sends a report on the conditions of five barracks in which his soldiers must live.

[14] The topic is explained in a very accurate repertoire of essays that provide further examples in Boato (2021).

In the countryside of the 19th century, construction techniques were rarely updated, nor did their quality increase over time. Instead, increases in housing demand and – relative – poverty resulted in shoddier works. Wood was no longer squared, masonry arches were always – in this area as well – substituted by wooden lintels; as some documents suggest, similar solutions in older contexts are presumably reconstructions. Even though Salaria was already carriageable a few years after 1860, new materials did not appear before the use of trucks, which made their transportation sustainable. In 1909, a well-documented house – as it was involved in a dispute with an adjacent one – was in stone masonry with wooden floors[15]. A vaulted basement, which serves as a foundation in the older buildings, is in this case missing. The documents produced by the Corps of *Ingegneri Pontifici* and then by the Public Works Office[16]provide accurate details on the costs and times of execution and on – strictly local – materials. However, it contains little information on techniques used for repairs, where no visible inhomogeneity can be detected, and for new constructions, mainly bridges and road works, inspired by scholastic models. Stones are placed according to a roughly polygonal shape (*opus poligonale)* when used in retaining walls, and according to a square shape, with raw surfaces, in small bridges and gutters. Instead, wood constructions, often documented by drawings, presumably had minor innovations. Hence, identifying 19th-century traces in the existing building stock is not an easy task. The cartographies from Pio VII's cadaster (1816), completed during Gregorio XVI's papacy (1835), and updated in the Kingdom of Italy (1881) – are not very helpful, as new buildings are rare, and often isolated, elevations or reconstructions are much more numerous. After incorporations or, more rarely, subdivisions, the resulting parcels represents the distribution of land property, rather than existing buildings. Fiscal documents do not focus on the buildings, as they do not represent a source of income outside main urban centers, but rather a burden. Conversely, in the framework of the agricultural inquiry, 2964 houses have been registered in the district of Arquata (Atti, 1884), which includes all the three towns in the upper valley – Arquata, Montegallo and Acquasanta –and out of these, 45 churches and 79 scattered houses, while 2.215 have been registered according to the number of the cadastral units in 1853 (Statistica, 1857, p. 179). At that time, population growth was equal to 30% of the inhabitants of the whole province over the last 30 years (ibidem, XXII). Over the following 30 years, the building stock would grow almost by one third, while population growth would be lower: 12.519 inhabitants (1853) increased to 14.216 (1881). The further increase to 18.709 inhabitants in 1911 leads to the registration of a certain number of buildings in the cadastral maps, before population decline reduce inhabitants to little more than one tenth, over one century. But the survey criteria and reliability are different (Bonelli, 1967, pp. 1-14); uncertainties on data processing can only be solved by an accurate analysis on the preliminary documents, and by a comparison with the existing buildings and the "*information handed out by the municipalities*" (Atti, 1883, T. II, p. 361) in the Jacini inquiry.

Fig. 3. Arquata del Tronto, Borgo, increasing in building construction (Source: AS.Roma, Catasto 1820-1881)

15 ASAP, Prefettura, Culto, b. 12.

16 ASAP, Amministrazione provinciale, Ufficio tecnico 1810-1910, BB.9-158.

Aside from numbers, these descriptions of the lathe nineteenth century echo Valeriani's more analytical ones, but the lack of a historical perspective, which is typical of Positivist agronomy and statistics, reduces them to mere, slightly impressionistic recordings of the state of fact[17]. The terrible building and hygienic conditions of rural houses on the mountain was related to the prevalence of small rural owners, who lack the necessary resources. Conversely, in the plains and in the lower valley, big owners have allocated significant investments to improve houses and farms. Rather than a description, this is a judgment that values a certain kind of "winning" agriculture and the corresponding social balances, while other scenarios appear to be backward and destined to abandonment.

5. Conclusions

Archival series we have exploited, and others, as the municipal statutes, albeit indirect, are abounding in details on other building elements, from vaults to wooden structures.

Fig. 4, House in Trisungo, Arquata del Tronto, AP (Source: Grimoldi, 2018)

However, some aspects of the method are already clear. If we want to go further the description of the current state of the built heritage, to explain its genesis, we need to go back to the sources, and reconstruct with the available tools, very precise or more general, the world of the production and use. Geographers and ethnologists (Brigidi & Poeta, 1953, pp. 114-132), and agricultural historians (e.g., Paci, 1981; Anselmi Volpe, 1987), have studied the rural houses in their relationship with agriculture and its evolution over time, with significant results. However, archaeology integrates this aspect into a more general productive dimension, which also includes construction. If archaeology defined itself as a historical story through material sources, nevertheless, the comparison with the available documentary sources is continuous. By their twofold research, Medieval archaeologists have reconstructed, at different scales, the transformations of the territory and in particular the dynamics of the settlements. For the following centuries, the quantity and nature of information transmitted by literature, documents and constructions made the task more complex. The much greater amount of data is more difficult to reorder and reconnect, and the very detailed information on some cases makes even the gaps seem too large. However, only by insisting on attempts, perhaps not always lucky, to interpret the built heritage also through the most numerous written testimonies, by avoiding to be confined in the technique or figure, and trying to understand the construction in a broader horizon of knowledge, we can better define the research fields, refine the tools and improve the results.

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[17] Description of rural houses in Atti 1883, T.II, 588-589, "*ve ne sono delle buone, rispondenti così alle prescrizioni dell'igiene, come alle necessità della famiglia, ma alla loro volta se ne incontrano delle pessime. Sono in maggior numero queste nella zona summontana e in genere nella provincia di Pesaro e in quella di Ascoli…si veggono case fabbricate di pietrame, e così mal costruite che la prima impressione che si prova in entrarvi è quella che da un momento all'altro il tetto debba cascarvi sul capo, il pavimento sfondarvisi sotto i piedi. Anguste, con finestre che molto più esatto è qualificare per buchi, e che nell'estate impediscono l'aereazione e nell'inverno vi espongono a tutte le intemperie*".

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Urban vernacular architecture in the Middle Ages in Galicia, Spain

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Topic: T1.2. Urban studies of vernacular architecture

Abstract

The emergence of the first urban settlements during the High Middle Ages in Galicia allowed the appearance of a typology of half-timbered houses with very heterogeneous characteristics according to the different Galician regions. Its general characteristics were a ground floor made of rammed earth, granite or schist stone and an upper floor made with a wooden framework system used as structural closures with different fillings (clay, straw, stone, brick or decking). The urban fabric of these settlements has been analyzed, studying the survival of the medieval lots. A small number of half-timbered houses of medieval origin have been found. The extension of this typology throughout the Galician geography allowed us to rethink part of the existing imaginary about vernacular construction in Galicia and contextualize the medieval Galician urban phenomenon within the European context.

Keywords: *Half timbers; Galicia; urban architecture; Middle Age.*

1. Introduction

This research aims to highlight the importance of Galician urban medieval housing through the study of a number of housing units, heirs of medieval types, which appaeared during the High Middle Ages and are still preserved with different levels of transformation at the present time.

Main Galician vernacular architecture monographs (De Llano, 1996; Bas, 2002; Caamaño, 2006) focused their attention on the rural constructions that were gradually consolidated during the 18th and 19th centuries which had stone as their main building material. They hardly showed examples of urban constructions or half-timbered constructions as pioneers of Galician material culture had previously done (Lorenzo Fernández, 1962; Otero Pedrayo, 1927, López Cuevillas, 1973).

Urban vernacular areas have been rarely studied in Galicia, with only a small number of historical studies examining popular urban constructions. Some articles which described medieval urban housing features in general leaving out their typological evolution or their diferent types were referenced in the bibliography (Soraluce Blond, 1998; López Carreira, 1999). Similarly, there is hardly any bibliography about Galician half-timbered constructions, only a few studies in the province of Ourense could be found (Lorenzo Fernández, 1962; Rodríguez, Romero, 2000).

1.1. Resources used

This research is based on an exhaustive cadastral revision and field work in main medieval Galician settlements with field visits to private ancient properties when allowed by their owners. In addition, a selection of urban local historical works were consulted.

Interviews with civil servants from City Council Rehabilitation Offices and technical and local experts as well as the use of Google Maps when and where possible, were fundamental to locate medieval urban housing.

1.2. Limitations of the research

The scarcity of Iberian half-timbered medieval construction studies and the lack of half-timbered medieval housings has required a careful search in historic urban settings in order to find examples of well-preserved and distinct typological elements. A large part of this heritage was destroyed in the last two decades without being documented by technical services that carried out the works. Due to the scarcity of investigations about medieval urban Galician architecture, it was necessary to search references from elsewhere in the north of the Peninsula.

2. Galician popular urban medieval housing

Urban life reemerged in Galicia between the 9th and the 13th century. The new boroughs of the main cities of the Roman, Suevian and Visigoth periods were consolidating, (Lugo, Ourense and Tuy), with the addition of the episcopal cities of Compostela and Mondoñedo (López Alsina, 1976) and the new foundations of Allariz, Ribadavia, Monterrei and Verín in inland areas and a series of villas on small port establishments (Ribadeo, Viveiro, Ortigueira, Ferrol, Betanzos, A Coruña, Noia, Padrón, Pontevedra, Baiona, A Guarda and Salvaterra) (Solano Fernández-Sordo, 2010). In just two centuries the Galician territory would create a series of nodes to control the territory to which the small enclaves linked to pilgrimages (Palas de Rey, Portomarín, Leboreiro, Arzúa, Melide, Sarria, Triacastela and Fonsagrada) and seaports (Portonovo, Rianxo, Cambados, Vigo, Cangas de Morrazo, Muxía, Laxe, Cedeira, Neda, Pontedeume, Muros, Caldas de Reis, Redondela and Foz) must be added.

2.1. The new half-timbered houses

The new city foundations in western Europe implemented new housing typologies that can be found, with 2dentifie variations, throughout the north of the Iberian Peninsula including Galicia (Flores López, 1973; López Carreira, 1999).

Building plots were small, between 30 and 35m^2 with spans for 4 to 5 metres long (López, Alsina, 1976; Álvarez Pérez, 2021). They had a backyard garden called *eixido* and a well (López Carreira, 1999).

Two main types were appearing in Galicia:

- A modest type with a ground floor of stone called *chá* house
- A half-timbered house type called *asobrallada*, with stone foundations, a ground floor of stone or rammed earth, depending on the availability of the material, and one floor called *sobrado* where the wooden structure overhang the street or was supported by pillars forming a porch. Originally, half-timbers did not have fillings but, due to the continuing fires that were occurring in these cities, they began to incorporate different fillings (brick, stone or earth).

2.2. Medieval settlements analysed

This research analysed 41 settlements of medieval origin. More specifically, the study included bibliographic searches, planimetric analyses of cadastral maps and field work in different settlements in various counties.

- In Rías Altas 2denti: A Coruña, Betanzos, Pontedeume, Ferrol, Neda and Cedeira.
- In the Cantabrian coast: Ortigueira, Viveiro, Foz, Ribadeo and Mondoñedo.
- In Rías Baixas 2denti: Muros, Noia, Padrón, Caldas de Reis, Pontevedra,

Redondela, Baiona, A Guarda, Tui y Salvaterra.

- In the southern interior area of Ourense province: A Cañiza, Melón, Ribadavia, Ourense, Allariz and Verín – Monterrei.
- Along the Pilgrim's Way to Compostela: Santiago de Compostela, Arzúa, Melide, Leboreiro, Palas de Reis, A Fonsagrada, Sarria, Samos, Triacastela. Portomarín and Chantada.
- Along the Sil River route: Monforte de Lemos, A Rúa and O Barco de Valdeorras.

Many small medieval coastal towns of medieval origin (Portonovo, Rianxo, Cambados, Muxía, Cangas do Morrazo and Laxe) were discarded because of their peripheral location, their small medieval fabric size or an insufficient documentation.

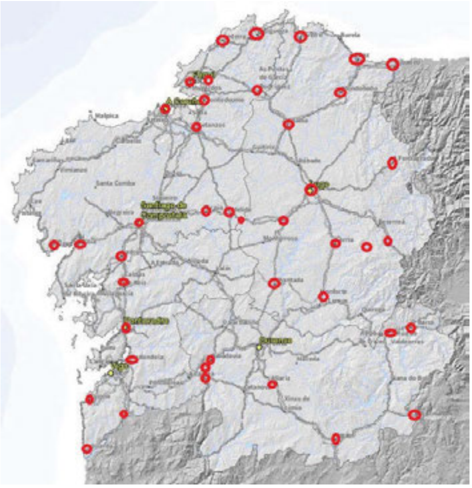

Fig. 1. Scheme of 41 medieval settlements analyzed, (Source: AFP).

2.3. Methodology

Firtly, local historical studies about different villas and cities were collected as in the case of Pontevedra (Armas Castro, 1992; Ávarez Pérez, 2021), Tui (Vila-Botanes, 2001 and 2009; Gonzalez Soutelo, 2007), A Coruña (Velo Pensado, 1992), A Guarda and Baiona, (Sánchez Carrera, 1997), Pontedeume (Couceiro Freijomil, 1971) Neda (Vázquez Rey, 1994; Yáñez, 2008), Ferrol (Vázquez López, 2001), Betanzos (Fernández de Rota & Monter e Irimia Fernández, 2000), Cedeira (López Díaz, 2007), Mondoñedo (Mayán Fernández, 1994; Vigo Trasancos, 1999), Ribadeo (López Alsina, 1976), Santiago de Compostela (Tellechea Idígoras, 1965; Vigo Trasancos, 1995; Rosende Valdés, 2005; Costa Buján, 2015), Viveiro (Cal Pardo, 1985; Durán Villa, 1986; Novo Guisán, 1997; García Oro & Romaní Martínez, 1989; Novo Guisán & Martínez Arias, 2012), Ourense (López Carreira, 1986; Gallego Domínguez, 2001); Monforte de Lemos (López Carreira, 2009), Verín (Taboada Chivite, 1949).

Additionally, the various urban medieval fabrics were analysed locating foundational city areas, studying the continuity of medieval urban lots and identifying potential medieval houses.

In this second study, two settlements were discarded because of the medieval fabric fragmentation (Palas de Reis) or destruction (Portomarín).

Furthermore, most attention was focused on nearby urban áreas, close to the main medieval streets, which have not undergone significant changes in its urban configuration. Interviews with local agents were also fundamental to locate medieval urban housing.

3. Localized case studies

Several medieval types were located in the distinc areas studied:

Fig. 2. Half-timbered houses in Betanzos (2018), (Source: AFP).

- In the Rías Altas region, in the towns of Betanzos and Neda different preserved houses were located as well in Pontedeume. In A Coruña, no constructions were found, but bibliographical references showed the city was erected with half-timbered houses until the 16th century (Velo Pensado, 1992). At the end of this century, new legislations to build with stone or half-timbers with earth were introduced because of the proliferation of fires, the increase of wooden prices and the lack of wood.

Fig. 3. Group of half-timbered houses in Neda (2021), (Source: AFP).

Fig. 4. Group of half-timbered houses in Neda (2021), (Source: AFP).

- In the Cantabrian coast, many examples were founded in Ribadeo and Viveiro, where half-timbers were filled with stone. The 4dentified consulted provides examples in these settlements (López Alsina, 1976) as well as already studied in Mondoñedo (Fernández Palicio, 2020).

Fig. 5. Detail of the half-timbered wall with stone in Viveiro (2021), (Source: AFP).

Fig. 6. Group of half-timbered houses in Viveiro (2021), (Source: AFP).

- In the Rías Baixas region, medieval types were collected in Muros and many references in Pontevedra (Armas Castro, 1992; Álvarez Pérez, 2021). Currently, it is possible to locate various constructions heirs of medieval types but erected with stone.

Fig. 7. Group of half-timbered houses in Pontevedra (2018), (Source: AFP).

Fig. 8. Half-timbered house in Muros (2018), (Source: AFP).

- In Ourense province, a lot of cases were already located in the city of Ourense (Gallego Domínguez, 2001; Fernández Palicio, 2018). Moreover, important groups of half-imbered houses were 5dentified in Ribadavia and Melón, and many types in Allariz and A Cañiza.

Fig. 9. Group of half-timbered houses in Ribadavia (2019), (Source: AFP).

Fig. 10. Medieval type house in A Cañiza (2022), (Source: AFP).

Fig. 11. Group of half-timbered houses in Melón (2022), (Source: AFP).

- Along the Pilgrim's Way to Compostela, medieval types were found in Chantada and Arzúa, in addition to Santiago de Compostela which was already studied. (Fernández Palicio, 2020).

Fig. 12. Group of half-timbered houses in Árzúa (2021), (Source: AFP).

Fig. 13. Medieval type house in Chantada (2013), (Source: Googlemaps).

Fig. 14. Group of half-timbered houses in Chantad (2013), (Source: Googlemaps).

- Finally, along the Sil river route many medieval houses were recognized in Monforte de Lemos, A Rúa and O Barco de Valdeorras.

Fig. 15. Group of half-timbered houses in O Barco de Valdeorras (2022), (Source: AFP).

Fig. 16. Medieval type house in A Rúa (2013), (Source: Googlemaps).

Fig. 17. Group of half-timbered houses in Monforte de Lemos (2010), (Source: AFP).

4. Implications for vernacular heritage imaginary

The previous and important studies carried out on the vernacular constructions in Galicia created a necessary collective imaginary about vernacular architecture. However, typological and material constructive variations over time and Galician vernacular architecture evolution received less attention. This fact favoured a perception of linearity and continuity which has partially distorted the enormous wealth of the diverse adaptive processes which have taken place in Galicia with greater or lesser success.

Thus, the wooden cities stage (Soraluce Blond, 1998) is unknown by the population and construction professionals. Vernacular heritage popular perception is frequently understood as a continuous process between the Neolithic stone housing and the modern age stone dwelling.

The current regulation about built heritage reflects this imaginary and feeds it back. Regulations define cultural heritage items and materials to preserve. Medieval half-timbered buildings are not included. Thereby, in addition to preserve built heritage, current regulations purge it, decreasing its variety and richness.

5. Conclusions

Galician vernacular half-timbered constructions are not localisms or particular cases. The extent of its territorial coverage across the whole of Galicia and its survival over more than five centuries in the majority of Galician urban settlements reflects a construction system with significant impact of which there are hardly any remaining examples.

The knowledge of this forgotten stage allows for expanding the imaginary and the field of vision about Galician vernacular heritage. Therefore, vernacular heritage is understood as an adaptive process and not as forms associated with certains materials.

This unprejudiced approach allows for facing the future of vernacular construction as an adaptative and non linear process. This is a lesson to be applied in new sustainable contructions which wish to become heirs of vernacular heritage.

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Binibeca Vell. Interpreting tradition

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Topic: T1.2. Urban studies of vernacular architecture

Abstract
Following the visual and volumetric bases extracted from the traditional Mediterranean architecture, Francisco Juan Barba Corsini (1916-2008) and Antoni Sintes Mercadal (1921-1981) designed Binibeca Vell (1964-1972) a respectful complex with the environment and the constructive traditions. The integration in the site, the built forms, the materials used and the urban structure reflect the organization of a traditional village. The research aims to analyze the architectural features, the reinterpretation of vernacular elements and the local traditional construction crafts involved in the complex and the details, symbolism and aesthetics. Binibeca consists of 165 townhouses, shopping center, hotel, social club, church and a small marina, all arranged in the form of a fishing village. The urban structure, the different typologies and the construction process is considered an alternative to the block of apartments of tourist promotion, reinterpreting a model of traditional settlement. The initial proposal was to recreate a traditional fishing village that would inspire the work of intellectuals, painters and writers. Barba Corsini stated that he had felt closer to the way a fisherman builds than to an architect: "I have met Alvar Aalto on several occasions and I came to understand the superiority of the beauty of a wall made by a fisherman or a farmer compared to that of a specialist technician" (Barba Corsini, 2005). With the reinterpretation of an architecture of the past, Binibeca Vell recovers the autochthonous values of the Mediterranean coast. The resonance between topography and architecture, the harmony with the constructive traditions, the plasticity of organic integration and the picturesqueness of the access route characterize Binibeca, which incorporates the adjective "Vell" to the toponym to distinguish itself from new constructions.

Keywords: *Barba Corsini; Antoni Sintes Mercadal; vernacular; Menorca.*

1. Introduction

In the sixties, when tourism was beginning to emerge on the island of Menorca, a group of promoters from Maó, Arcadi Orfila, Rafel Sintes, Francisco Caules and Vicente Amer, approached the Binibèquer Vell marina area and were amazed at the beautiful place in front of to the islets of Binisafúller. In 1963 they founded the company Ordenación Binibeca Vell and proposed the construction of single-family houses in the Menorcan style to attract the attention of artists and intellectuals. The architect Pedro Luis Mercadal developed the plan for the general urbanization of Binibèquer Vell.

On the south coast of Sant Lluís, a small urbanization of Alcalfar had been built, whith the first tourist hotel on the island. In Punta Prima another summer resort was also beginning to be built. Josep Pla writes in the *Guide to Mallorca, Menorca and Ibiza* (Pla, 1950) that "Cala de Alcalfar is at the moment the largest tourist creation on the island of Menorca and deserves special attention – an indication of what will become the southern coast of Menorca in the tourist future. That farmhouse created, so to speak, by spontaneous generation, constitutes today an urban complex in full growth, beautiful and pleasant (Pla, 1950). In Alcalfar, the collaboration between the Catalan architect Francisco Javier Barba Corsini and the Menorcan surveyor Antoni Sintes Mercadal began, who a few years earlier had collaborated in his Barcelona office. In 1961, they built a set of bungalows with modern lines in Alcalfar and in 1962 they built "Sa Tanca" with vernacular echoes, a leisure club in San Lluís. In S'Algar they develop the urbanization subdivision project and propose the idea of building a fishing village that will be rejected by the promoters.

As one of the promoters points out, Francisco Caules Sintes in *Es Diari* (08/02/2011): "in 1970, when seeing his idea rejected in S'Algar, he convinced us to make a kind of fishing village in the cove formerly called Bini Bini on the maps and is known as "es Caló d'en Fust". The promoters of Binibèquer Vell will accept the idea of Antoni Sintes Mercadal to build a fishing village and will have the architect Francisco J. Barba Corsini. The complex, which takes the form of a fishing village, is made up of 165 semi-detached houses, a shopping centre, a hotel, a social club, a church and a small marina. This project is proposed as an alternative to the routine tourist apartment block and adopts the popular Mediterranean architecture of the Balearic Islands as a reference to build a traditional complex in the urban structure, typologies and construction process. Barba Corsini and Antoni Sintes Mercadal, combine the vernacular patterns of traditional construction and the autochthonous values of the peoples of the Mediterranean coast to build this complex in dialogue with the territory.

1.1. Context

The Binibeca Vell project aims to enhance the landscape enclave of Caló d'en Fust. Binibeca Vell is located in the south of the island of Menorca, in Caló d'en Fust, belonging to the municipality of Sant Lluís. The complex is located on the Canutells farm and the land, of little agricultural value, is characterized by a gentle slope to the edge of the cove. A natural cave was used as a recreation space for the families of the village.

The project arises from the analysis of traditional settlements and the vindication of the wisdom of vernacular constructions. From these they extract the principles that indicate in the project documentation "the non-destruction of the landscape; the harmonic unity with the site; the adequacy and use of geographical features; define the character of the landscape rather than level or deform" (Ruiz Millet, 2002: 210).

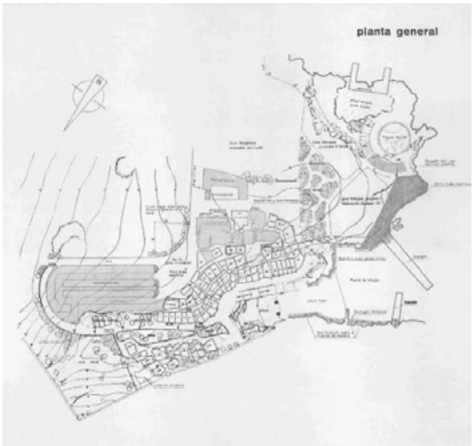

Fig. 1. Binibeca Vell Masterplan, (Source: Barba & Sintes, 1972, pp. 4-8).

This reinterpretation of a fishing village is developed around a roadstead that generates a natural port. In continuity with the traditional coastal settlements of the island, the implementation of the complex is adapted to the topography and the pre-existing conditions of the site. For Barba Corsini and Antoni Sintes, "This is an essay in which an attempt is made to get a concentrated group of apartments to adopt the form of a town, with all its peculiar characteristics (...)" (Barba & Sintes, 1972, pp. 4-8). The bottom of the roadstead, Caló d'en Fust, is used as a beach and next to it, preserving the natural character of the place and with limited interventions on the rocks, a jetty with a ramp for boats is built. The existing stream is preserved as a green area that structures the urbanization and the two bridges give continuity to the streets of the complex, which is located on a higher level. The layout starts from the understanding of the site and its topography. The layout is not imposed abstractly on the territory. The organization of the streets responds to the topographic variation of the terrain and its layout is parallel to the topographic curves. This adaptation to the topography allows to adjust the scale of the building. As they write, this is the "only adequate way to do it, because any other system based on large earthworks would make the final result enormously more expensive, apart from the fact that the natural character that was wanted to be given to the whole from the beginning would have been very easily lost" (Barba & Sintes, 1972, pp. 4-8). The difference in height of each of the roads establishes the staggering of the complex on the steep slope of the site and ensures that the apartments get privileged views over each other.

The two protective breakwaters of the Caló d'en Fust port designed in the project will not be built. The construction of a small slipway for boats and a natural pool flanked by a pavilion was also proposed in the rocky formation that juts out into the sea.

2. Urban structure

The general volumetry evokes a fishing village and was studied, after developing the schemes in plan using a clay model. The landscape and the topography modeled the organization of the complex. As they point out: "the architecture of the complex has been the result of adaptation to the irregularities of the terrain and the needs of the occupants of the apartments" (Barba & Sintes, 1972, pp. 4-8). The two rows of houses follow the alignment of the layout of the pedestrian street that structures the complex. Transversely passages are arranged that modulate the scale of the building and structure the urbanization. The car park is located on the perimeter of the urbanization and thus minimizes its influence on the complex. The layout of the streets is not subject to vehicle traffic and thus does not affect either the scale of the whole or the ground floors of the houses.

Fig. 2. Binibeca Vell urban structure, (Source: Barba & Sintes, 1972, pp. 4-8).

In the upper part of the complex, evoking the structure of a fishing village, the square is established, where the church and common services are located —supermarket, shops and restaurants— and a residence-hotel building. The church is an open space that acts as a chapel that, like a porch, connects the square with the adjacent streets. The lookout tower of the bell tower stands out over the roofs and constitutes a visual landmark of the complex.

2.1. Typologies

After drafting the urban project for the complex, the first two houses were built. Subsequently, on the ground, Antoni Sintes Mercadal drew each of the houses taking into account the topography and the needs of the residents. Each house is a different project that adjusts to the particularities of the site and the relationship in the complex. Thus, the houses are unique, both in their layout and program.

The house is built on behalf of the residents and is developed on two levels. On the ground floor there is, in addition to the access and a study, a free space for the shelter of a boat, which will be progressively transformed with the extension of the house itself or in an independent apartment. The first floor houses the reduced program of the kitchen, dining room-living room with one or two bedrooms, bathroom and terrace.

The modern spatial organization of open spaces is enriched by the variation of levels in the interior that segregates the rooms. Intermediate spaces, terraces and porches underline the relationship between inside and outside and expand the domestic space to the outside. The masonry furniture and popular decorations intensify the traditional atmosphere (Barba Corsini, 1969, pp. 43-45).

As in traditional construction, the complex is developed in successive phases. First of all the stone bridge over the stream and the beach and the jetty with the ramp were built. The narrow streets were urbanized and the plots put up for sale were delimited with the plan of the house to be built. The first house was Casa Candi and the last ones to be built were towards the end of 1970. The main square, the church, the promenade were built in the first phase. Later and until completing the entire town, it grew towards the area located on the other side of the stream. In 1965, the Residencia Bini Vell functions as a hostel and by 1966 many houses had been completed. In the press, the construction of this authentic Menorcan town stands out "in the face of so much vulgar and characterless architecture that is being built, the realization of this original holiday town is worthy of admiration and praise, which has a Mediterranean flavor and Menorcan atmosphere that everybody who visit admires. In 1967, the publicity for the complex in *La Vanguardia Española* emphasized the traditional nature of the complex: “Binibeca Vell fishermen's shelter. Get a fisherman's lodge.” To encourage neighborhood coexistence in the complex, the promotional campaign was aimed at national buyers, most of them Catalans, and shortly after going on sale, the promotion had been sold out. Binibèquer Vell constitutes a new tourist attraction and will be the image of numerous postcards until it becomes one of the main identifying symbols of the island of Menorca.

Fig. 3. Binibeca Vell advertisement published at La Vanguardia Española, 7/11/1967.

3. Construction and tradition

Barba Corsini and Antoni Sintes Mercadal draw their most objective lesson from the vernacular heritage: “the environment of the town has been taken care of with real attention, with a general white and continuous plastic, but edged, according to the character of the island” (Barba & Sintes, 1972, pp. 4-8). In Binibèquer Vell they adopt the character of the vernacular, in the identity of the forms and in the wisdom of traditional construction. The construction is "simple and economical, thanks to the use of the country's natural materials" (Barba & Sintes, 1972, pp. 4-8) and is materialized with load-bearing brick walls with plaster "finishing it with a broom", arches as support for large openings, sloping whitewashed Arabic tile roofs, ceramic tile pavements, dark varnished pine wood carpentry and vitrified ceramic in kitchens and bathrooms. In the construction of the houses they use traditional techniques that contribute to the material unity of the complex and to harmony with the island territory. Variations of the same elements contribute to the diversity of the whole. As Barba Corsini and Antoni Sintes Mercadal point out, “its forms are the result of the different layout of the land, and its plasticity is the result of a very direct work on the work, since, given its variety, a very close control was essential for the realization of even the smallest details" (Barba & Sintes, 1972, pp. 4-8). During the execution of the work, the quantity surveyor, Antoni Sintes Mercadal, lived in the complex and meticulously supervised the construction of the complex.

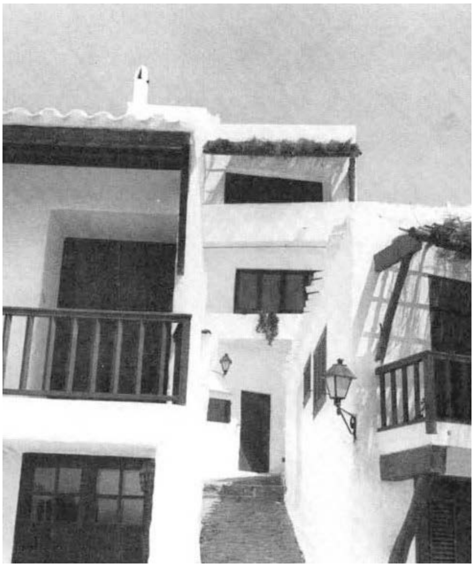

Fig. 4. Binibeca Vell and the vernacular construction, (Source: Barba & Sintes, 1972, pp. 4-8).

His direct work on the site and the team of local masons from Ferreries, with extensive experience in the island's traditional construction techniques, contributed to giving the complex a more human dimension. In Binibèquer Vell, Barba Corsini and Antoni Sintes Mercadal approach the formal reasons of the vernacular to access its objective and impersonal lesson.

They extract from tradition the local materials, the scale and fragmentation of the domestic, the symbolic character nature of the facilities and the civic dimension of the urban structure that gives identity to the complex, generating the construction of a traditional and characteristic environment that fosters the community and the interaction of the inhabitants. The town in dialogue with the territory, is organized around a community of owners that promotes a sense of belonging to the community and watches over the community and contributes to the preservation and care of the whole.

4. Interpretation and reception

Binibèquer Vell finds in vernacular construction the means to interpret and adapt architecture to the environment. Inspired by traditional Menorcan constructions and combining local materials with popular construction wisdom, they build this complex rooted in Mediterranean culture and which had a notable impact on the media since its construction (Cisquella, 1974, pp. 9-11). In *La Vanguardia Española* of August 28, 1970, they echo the visit of the Minister of Information and Tourism in Menorca, Alfredo Sánchez Bella: "In the Binibeca urbanization, the curious fishing village, with its original as unequal constructions and their narrow and winding pathways, to the point of feeling the desire to reward it and point it out as a model". In the *La Vanguardia Española* on September 10, it was stated that the minister found the pattern of "the adaptation of constructions to the landscape, of the exaltation of the autochthonous." The Binibèquer Vell urbanization was very successful as a holiday village and received the award for tourist merit in 1972.

Binibèquer Vell became a tourist symbol in the local and international media and served as a reference for other projects. In *The New York Times* of July 12, 1970, Patrick Raleigh makes a complete review of Binibeca pointing out the keys to the reinterpretation of the Mediterranean material tradition and of a primitive habitat in harmony with the environment: "like a pile of sugar cubes, the village of Binibeca huddles above a cove sheltering a mini-sand beach on the rocky south coast of this, the most northerly of the Balearic Islands. Tile roofs top ping a folk-art jumble of irregular houses leaning against each other and boats, nets and lobster pots scattered in front of massive boathouse doors recall old fishing villages on small harbors all around the Mediterranean. On close inspection, though, Binibeca's dazzling, even whiteness and unweathered wood reveal that this was never a Greek or Roman colony, nor even place from which Menorcan fishermen set sail. Only four years ago, in fact, there was not a single building at this cove. Although on the backs of postcards its called a pueblo pescador (fishermen's village), Binibeca is really a singular example of *urbanización*, a pre-planned town for an undeveloped site, designed either for warm-weather residency or as a hotel facility for tourists. Hundreds of these developments are going up all along Spain's 2,050 miles of island and mainland coast, some tastefully worked into their settings, but too many done with an eye to maximum exploitation and quick return."

On the international impact of the project and also for the criticism that had received Barba Corsini states: "*The New York Times* dedicated two entire pages to the town I made in Menorca. […] It is an intervention that has been highly criticized, but people have great affection for it, they respect it a lot, and every year everything is painted white" (Barba Corsini, 2006, p. 61). In 2007, he stated: "the town we built, Binibeca, was an invention of the sixties. But it looks like a real place, because it delves into the popular. At the time it did not have good reviews because it was not modern. They called me a folklorist. And I wasn't looking for folklore" (Zabalbeascoa, 2007).

5. Conclusion

Binibèquer Vell adopts as a fundamental reference the traditional Mediterranean construction and the vindication of popular culture. The rhythmic aggregations of the houses, with the additive logic of domestic volumes and the planimetric fragmentation of the typologies, is expressed with the roughness of the walls and the craftsmanship that materializes and represents the domain of tradition. The Mediterranean poetics of this lyrical white utopia is the testimony of a vernacular yearning that vindicates, with the fragmentation of what has been built, the specificity and sense of place.

The complex is also a social construction that supports the coexistence of the community and the sense of belonging and has determined a recent interest of the neighbors to obtain the declaration of a degree of patrimonial protection of the complex. The formal beauty of the traditional center makes it the biggest tourist attraction on the south coast of Sant Lluís and one of the best-known and most photographed images of Menorca. The Binibèquer Vell project provided Menorca with an alternative model to high-density tourist buildings, little rooted in the territory and traditional construction culture. Barba Corsini stated that "the island of Menorca was saved by towns like Binibeca, where houses were made that respected the volume of what was built and the building traditions of the island. Ibiza, on the other hand, is destroyed". Barba Corsini affirmed that he had felt closer to a fisherman's way of building than to that of an architect: "I was with Alvar Aalto on several occasions and came to understand the superiority of the beauty of a wall made by a fisherman or a farmer compared to that of a specialist technician" (Barba Corsini, 2005, p. 134). The fisherman or the farmer build objective and impersonal works. Antoni Sintes Mercadal, without an architect's education, and Barba Corsini resort to the ancestral wisdom of vernacular construction, in short, to the tradition of architecture. Adolf Loos summed it up in his writing published in the *Architektur* magazine in 1910: "How is it that every architect, whether good or bad, spoils the landscape of the lake? The peasant does not. Neither does the engineer, with his train tracks along the shore or with his boats that trace deep furrows on the clear surface of the lake. They create differently." The concern of Barba Corsini and Antoni Sintes Mercadal not to destroy the landscape leads them to recover in Binibèquer Vell the formal values that remain in traditional architecture.

In dialogue with the territory, the Binibèquer Vell tourist complex recovers the autochthonous values of the villages of the Mediterranean coast. The town of Binibèquer Vell evokes traditional Minorcan architecture, in the so-called *Casolan houses* such as Torret, but also alludes to other Mediterranean island territories (Vidal Bendito, 1978, p. 227). Being as natural as it is artificial, as archaic as it is contemporary, the town of Binibèquer Vell continues to be one of the main identifying symbols of the island of Menorca.

Acknowledgment

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Mapping Spatial Social Aspects of Urban Recovery in contested cities: A Case of The Historic Commercial Center of The Ancient City of Aleppo

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Topic: T1.2. Urban studies of vernacular architecture

Abstract
Cultural heritage can initiate pride in one's own identity. Therefore, in wars, the destruction of cultural heritage is weaponized as a tool aspired at disabling communities and demoralizing them. At the same time, reconstruction is a sensitive matter, and the process of post-conflict reconstruction has the potential either to advance social recovery or to hamper it. Consequently, the inclusion of all the affected communities is crucial. The old city of Aleppo is a classic case as rehabilitation projects in the historic commercial center have started to emerge. Those projects focus on the physical destruction of the city, neglecting the social damage, and failing to engage and reflect on the locals' needs and ambition on how to rebuild their heritage. Due to this neglect, this paper is seeking to bring the social dimension of the rehabilitation process to the discussion and promote a people-centered approach in the decision-making of the post-conflict rehabilitation process in the ancient city of Aleppo. This paper is seeking to create a framework so reconstruction decisions will be based on people's aspirations and vision. A collection of research methods was used to examine the above-mentioned points. These methods included: onsite field observation to collect data, (specifically, the Souk area) conducting interviews with shop owners, local people who live in Aleppo and from the diaspora (in summer 2020 and winter 2021), and setting an online questionnaire survey (June and July 2021). Findings were outlined in a base conceptual map for the post-conflict rehabilitation.

Keywords: *people-centered approaches; heritage; survey; Aleppo.*

1. Introduction

Managing urban recovery requires decision-makers to understand and deal with layers of complexity, their interactions, and their integrating processes. Therefore, doing so in a historic urban landscape adds another layer of complexity. How to balance competing forces and urgent demands in a context of highly complicated and uncertain post-conflict situations?

The required actions to accomplish urban recovery in World Heritage cities damaged by conflicts go beyond authenticity and integrity; they are complex processes that also address socio-economic issues and the needs of local communities (Farnaz et al., n.d.). In the post-conflict recovery of historical places, the idea of looking at cultural heritage as a static vision that must be "rebuilt" and not negotiated with local actors, could add to the challenges of contested cities. Thus, the paper's approach is built on the 2011 UNESCO Recommendation on the Historic Urban Landscape (HUL)(UNESCO, 2019) and the research's investigation is focused on the social dimension in the reconstruction process of historical cities. The case study is the historical commercial center of Aleppo, as its rehabilitation projects have started. However, those projects are neglecting the social dimension in recovery, and people are turning away from coming back to the Souks (Fig. 1).

Fig. 1. Souk Al Sakkatia recently rehabilitated in the ancient commercial center and only one shop is open that appears in the photo, (Source: © S. Ibrahim, 2021).

Due to this gab, the paper is seeking to bring the communities' ideas to the decision-making processes by taking the Souks as a case study and investigating the spatial transformation of the commercial center and the visions of post-traumatic societies. The paper is seeking to focus on the possibilities of rebuilding the central commercial historic area with a vision that takes into account points of view, experiences and the interests of the social actors who live in that space.

1.1 Historical background: Aleppo at the crossroads of trade routes

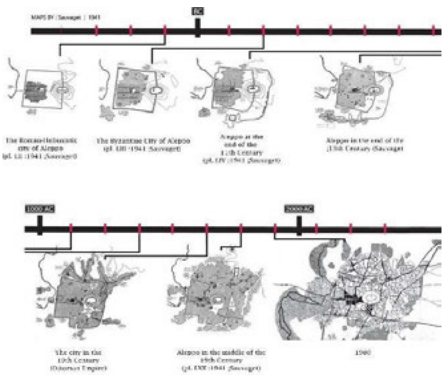

Fig. 2. Development of Aleppo from Hellenistic Period based on Sauvaget maps, 1941.

The ancient city of Aleppo was prosperous since the third millennium BC, and it remained in an important position, urbanization, and population throughout the centuries (Fig. 2). The city played a distinguished role in the history of the region. The old city of Aleppo is a world heritage and one of the oldest continuously inhabited cities in the world. It was the economic-industrial center of Syria and once the crossroads of many trade routes between countries. This importance was due to two main reasons:

First, its strategic location made it play a distinguished role in the history of the region. It was a commercial city, and the design of its street markets dates to the Hellenistic period. The main hub of the old souks was an important commercial focal point that attracted the city's residents and rural residents. Secondly, due to the economically and socially influential upper class from wholesalers, merchants, merchants dealing with international trade, stakeholders, and bank owners, those who knew how to take advantage of the properties of Aleppo's site, just as they knew how to take advantage of the favorable conditions in the global economy. Those who turned Aleppo into a cultural commercial hub (Gaube & Eugen, 1984).

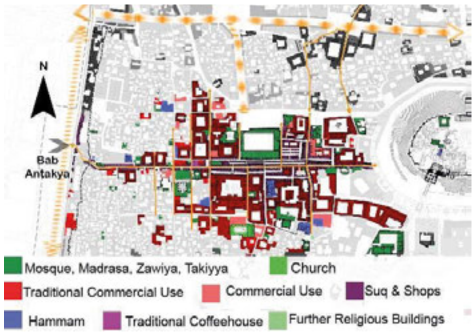

Fig. 3. The historic commercial center buildings' functions, Souk Al Medina, based on the Plan of Aleppo Archive in Exile, 2021.

However, during the war, those merchants left the city, and Aleppo was militarized, destroyed, and then abandoned, for five years (Apr 2012 – Dec 2016) (UN-Habitat & SwissAgency for Development SDC, 2014) (Fig. 4). Even after 2016 when the hostilities had subsided in the old city, the city stayed abandoned. The paper investigated the priorities of interventions in local communities' minds and the changes in the demographic structure of the city during and after the conflict.

Fig. 4. Aleppo city. Part D is the abandoned ancient city of Aleppo (Source: UN-Habitat, Swiss Agency for Development SDC).

2. Methodology

The methodological approach of this paper involves a three-step process: First is defining the social and economic challenges in the historic center through a reading of the situation before the war (previous onsite observation and analyses of the situation). Second, systematic reading of the rehabilitation projects happening, the transformation dynamics and the social mesh, the reading is based on the author's experience and work (as restoration architect in Aleppo). In addition, onsite observation methods were done and semi-structured interviews with Aleppies from professionals, merchants, and locals residing in Aleppo. Third, conducting **an online questionnaire with 107 participants** who lived in Aleppo before the war. The paper focuses on the survey results and introduce the methodology as it is a part of wider research about the social dimension in Aleppo's recovery.

2.1 The Survey

The survey aims to understand the experience and the reasons for leaving the Souks and seeks to measure the local communities' attachment to the Souks and understand their most familiar paths (axes) that lead to the Souks. This survey also aims to understand pre-conflict problems associated with the Souks and the needs and life requirements as well as the contemporary investment possibilities of the Souks. The survey focuses on the assessment of the ancient Souks' accessibility and the local community's attachment to them. It was divided into three main sections: Memory (past) – Present (challenges and possibilities) – and Future (hope, heritage, and Sense of Belonging). The assessment of the survey aimed to understand the pre-conflict problems associated with the Souks and to create a mental map-ping of the main pedestrian paths while taking into consideration the importance of reviving familiarity with the historical place. The criteria for prioritizing the historical building rehabilitation were specified through assessment.

2.2 Description of the questionnaire survey

The questionnaire was designed to collect data on respondents' profiles (gender, age, academic level, and place of residence). Respondents' experience and information about the Souks and heritage of the ancient city of Aleppo. They were asked questions that indicated general information about the visitors or traders of the Souks: Questions about pre-conflict period, and post-conflict period. The online questionnaire conducted in 2021 indicated people who lived in Aleppo before the war, their knowledge, practices reflections, and experiences about the Souks. The respondents confirmed they lived in Aleppo before the war. The survey was shared through Facebook and WhatsApp groups, people from Aleppo were addressed and tagged in the comments, and was completed by 106 respondents. Questionnaire instructions indicated the survey's content and purpose and estimated completion time. A consent question was included in the online questionnaire, to be selected by the respondent. The questionnaire was available from 23/05 to 16/08/2021 and 18/08 to 22/08/2021. Gender Distribution: 27% Female, 73% Male. Age distribution: Almost 48 % of the respondents are in the age range of 26 -35 years old, 18% in the range of 18-25, 15% in the range of 46-60, and 4 over 61 years old, who lived through the war in Aleppo. Place of residence now: 42% are still living in Aleppo, 55% outside Syria and 3% live in Syria but outside Aleppo. The survey and the semi-structured interviews covered the complex social layer of Aleppo's Society as follows:

Occupation	N
Merchant in the Aleppo Souks and a Shop owner in Aleppo Souks	4
Merchant in the Aleppo Souks and a Shop owner in Aleppo Souks and from Local community as I work in other sectors of the Aleppo economy	1
Merchant in Aleppo Souks	7
A shop owner in Aleppo Souks and a merchant in the Aleppo Souks and I work in the Souk	1
A Shop owner in Aleppo Souks;	1
Worker in Aleppo Souks	2
Worker in Aleppo Souks and work in other sectors of the Aleppo economy	1
A shop owner in Aleppo Souks and I work at the University of Aleppo	1
Merchant in the Aleppo Souks, Shop owner in Aleppo Souks, and I work in an NGO	1
Merchant in the Aleppo Souks, work at a government administration Aleppo Governorate / the city council of Aleppo;	1
A shop owner in Aleppo Souks I work at the University of Aleppo	1
A textile trader in the old city	1
Children clothes	1
I have my own business in the food industry	1
University of Aleppo	21
Master / Doctoral Student	3
University Student	5
Architecture Student University of Aleppo	1
Architect and I study for my master's in architecture in Germany	1
Local Community Associations and A student at the Archeology Faculty	1
Translator	1
Government administration: Directorate General of Antiquities and Museums;	8
Government administration: Directorate General of Antiquities and Museums, I work at the University of Aleppo and Directorate of the ancient city of Aleppo	1
Government administration: Directorate General of Antiquities and Museums;	8
Government administration: Directorate General of Antiquities and Museums, I work at the University of Aleppo and Directorate of the antient city of Aleppo;	1
Government administration: Employee at Aleppo Governorate or the city council	4
Local community: I work in other sectors of the Aleppo economy;	8
Local Community Associations, University of Aleppo, and I work in other sectors of the Aleppo economy;	1
NGOs	7
Engineer	1
Friday preacher in an archaeological mosque, I work at the University of Aleppo and from the Local community: I work in other sectors of the Aleppo economy	1
A photographer of old neighborhoods and interested in coloring old photos and archives	1
Railway employee	1
Islamic Endowments	1
Teacher	2
Architect	4
Students	2
Doctor	1
I do not work because I am still continuing my studies	1
blank	1
NGOs	7
Tailor	1
Teacher	2
Local Community Associations	1

Table 1. Respondents' profiles.

3. Findings

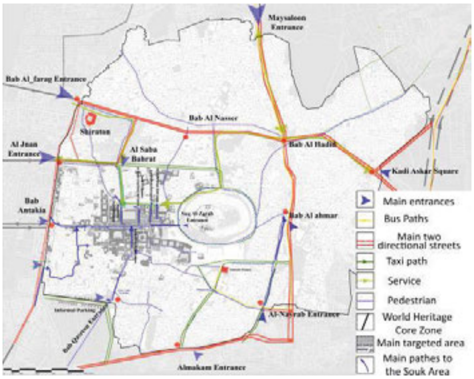

Fig. 5. Aleppo Historical commercial center as indicated by the respondents to the questionnaire.

3.1 The historic commercial center before the war

3.1.1 Challenges in Social Attitudes in The Historical Souks

The people's usage of historical buildings was investigated. Some problems were resulting from gaps between the conservation strategies and the socio-economic realities of the historic center. The consequences of these strategies can be seen in the changes that the merchants implemented to the historical structures of the old Souks (Fig. 6).

Khans were used as residential spaces by adding cement structures in the courtyards, some Souks were abandoned or used as parking areas for the service cars like in Khan Khayer Baik. Even the administrative uses made the khan not accessible to the public, like the usage of Khans as a consulate or governmental buildings, this added another reason to the lack of heritage value knowledge that Aleppo's community suffered.

Fig. 6. (right) is the residential structure in one of the Khans, (left) is the usage of the courtyard as parking (Source: Aleppo University's workshop).

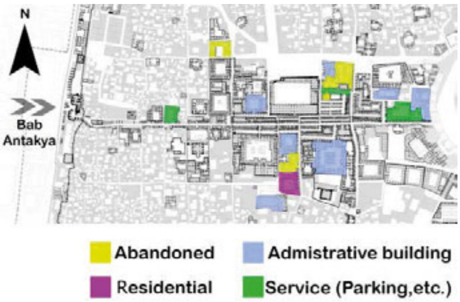

Fig. 7. The "controversial use" of Historical Souks and Khans before the war, (Source: © S. Ibrahim, 2022).

3.1.2 Important Souks Before the War

When asked about the most frequently visited Souks or Khans before the conflict, the respondents answered that the Textile Souks in general were the most frequently visited before the war. This goes to the importance of the textile trade in Aleppo as one of the interviewees said: "the Souk is like a stock market (Bursah) so we do not have all of our commodities in it, however, all the big deals happen there". Also, Spices Souk or Souk Al Attarrin (Fig. 9) was mentioned 28 times by respondents, one of the interviewees talked about her memories of going to buy spices and smelling the spices in the Souk, "Memories of me shopping in Souk Al-Atarin Can't be erased, I can smell Aleppo with this memory", 15 % of the respondents said they did not frequently visit the old city of Aleppo, however, 75 % of them answered that there is a strong connection between the rehabilitation of the urban heritage (in our case the Souks) and the sense of belonging to the city.

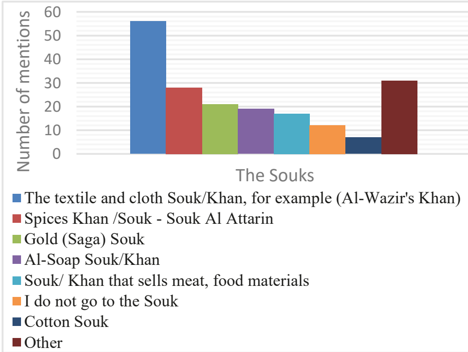

Fig. 8. The Souks or Khans visited most frequently before the conflict.

Fig. 9. Main Rubble area of Souk Al Attarin (Source: © S. Ibrahim, 2022).

3.2. During the war

3.2.1. Social and Physical Damage

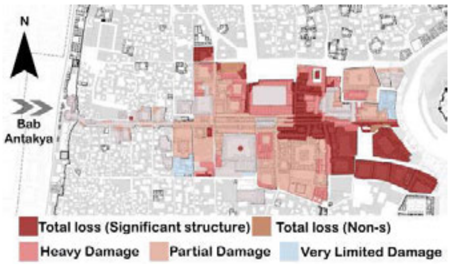

Fig. 10. Damage plan in 2016, (Source: © S. Ibrahim, 2021).

The main rubble area (Souk Al Attarin) that is shown in figure 9 and 10 was the range of weapons that were fired from the citadel according to the interviews/survey. The destruction was caused by the crossfire and explosions that occurred during the war, such as the Carlton bombing, which destroyed the entire building. During the war, the damage was not limited to the physical structure, the social fabric was severely damaged too. The tenants and owners of the shops were displaced outside the old city and the central commercial center became paralyzed since 2012 (UN-Habitat & SwissAgency for Development SDC, 2014).

3. 3. After war situation

3.3.1 Updated damage plan and rehabilitation projects

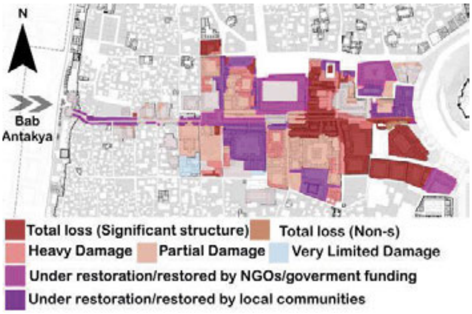

Fig. 11. Rehabilitation projects and damage plan, (Source: © S. Ibrahim, 2021).

Rehabilitation projects funded by NGOs and governmental agencies (Fig. 11) are more focused on the less damaged buildings (Souk Al Saqqatia), centralization of the site and religious symbols of the city (Umayyad Mosque).

3.3.2 Trends in Demography: Social, economic and demographic changes after the war

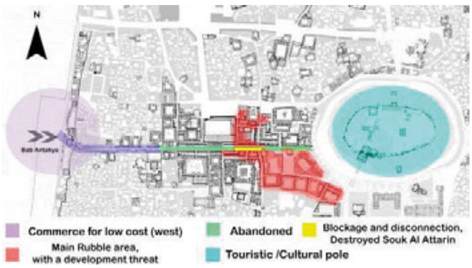

Fig. 12. Spatial social analysis, the map shows the central commercial historic area (Source: © S. Ibrahim, 2021).

Commercial activities "emigrated" during and after the war outside of the Old City. For example, according to our interviewees, the textile commerce emigrated to "Al-Jabiria" area, and Al Bodaaji shops which present the traditional perfume commerce emigrated to "Al-Furkkan" in new Aleppo. The damage to the social-economic fabric is a key factor in the abandonment of the city.

The Souk currently has two poles that began to show after the war: commerce for low cost (west) Fig. 13, and culture (east) Fig. 14. The straight Street or Souk Al Madina (Al Madina as the residents say it) meets up with the large perpendicular throughway, starts at Bab Antakya one of the main entrances to the old souk, and ends at Souk Al Zarab. Preserved and free of severe damage in the last years, the western entrance of the souk is currently active with low-cost commerce. However, as one moves along the Straight Street, the condition of the buildings and pathways deteriorates.

Fig. 13. west of the Souk (Source: © S. Ibrahim, 2022).

Fig. 14. The citadel in the east area cultural events (Source: © Al Arab UK, 2021).

Fig. 15. Abandoned East (Source: © S. Ibrahim, 2022).

Much of the middle and eastern parts of the souk are highly damaged, destroyed, and filled with rubble. At its eastern end, lies the ancient citadel, which suffered only minimal damage, and in recent history has begun to, once again, host cultural events such as concerts. Therefore, the old souk of Aleppo lies between two poles which have begun in recent months and years to grow. While much of the rubble has been cleared to the side of the pathways and into old buildings for future rebuilding, one area of the pathway was reported as a major obstacle which lies to the east of the central path through the Souk . Inhabitants find it dangerous and dark and tend to avoid it Therefore, a blockage between the west and east exists, the blockage of rubble Souk Al Attarin (the spices Souk) and abandoned Souk Al Al Zarab (Fig. 15, 16).

Fig. 16. Main Rubble area with a development threat, the rubble of Souk Al Attarin (Source: © S. Ibrahim, 2021).

4. Discussion

4.1 Spatial-social indicators

Several variables were investigated through the survey and interviews as follows:

- Al Medina Souk deterioration
- Previous use of the site.
- Sites' current use, activities, and rehabilitation projects.
- Accessibility and mobility.
- Trends in demographics.

Guiding Principles for Rehabilitation of Aleppo Souk based on the analysis to reflect on the local context is suggested by the research. First, the periods of rehabilitation can be divided into three phases (Bianca et al., 2018) as follows:

Short Term: 1-5 years: a focus on buildings that are lightly damaged and activities around commerce, education, socialization, and culture.
Medium Term: 5-20 years: a focus on moderately to seriously damaged sites, with the construction of more complex forms of working and commercial enterprises, an expanded repair of networked infrastructural systems (roads, water, electricity), and most access between all roads accomplished.
Long Term: 20-50 years: a focus on highly damaged or destroyed buildings, especially ancient and prestige architecture, which take immense financial and human resources to repair.

Connection of cultural and commercial activities, Since the Souk is located at the heart of the old city of Aleppo. Bridging the western side of the souk, currently a center for low-cost commerce, and the eastern side of the souk, where the citadel hosts large and elaborate cultural gatherings, can bring culture and commerce together. The souk could become again of social and financial exchange. In addition to the rehabilitation of the main many commercial shops that lie between these two poles. In addition, finding ways to invite people through the blockage of Souk Al Attarin in short-term interventions will be a key in rehabilitating the Souk. Punctuated Urban Rehabilitation through the Khans and addressing the current situation in the Souk. A key factor is to bring people back into the city, but also to provide the sort of activities that keep people in a city: jobs, education, and entertainment. One of the most important aspects will be to bring people together in sociality and create public spaces. Starting points for these kinds of interactions include taking part in artistic and cultural events, and places to eat and make small purchases.

4.2 Results

Findings were outlined in a conceptual base map for the post-conflict rehabilitation (Fig. 17). The revival of Aleppo Souk in short-term interventions, by focusing on the catalytic Souk mentioned in the survey (Souk Al Attarin) the disconnection area between the eastern part of the Main Path and the western which is creating division in the city between people with high income and people with modest income or even poor.

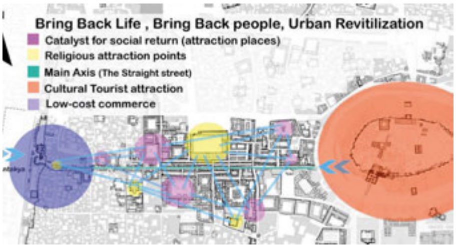

Fig. 17. Concept proposal (Source: S. Ibrahim, 2021).

5. Conclusions

The Migration of commerce and the dynamics of commercial decentralization are key factors in the urban recovery of the historic commercial center of Aleppo. Thus, further research should be done about the new commercial centers that emerged on the city's edges after the war as a reaction to the paralyzes of the old city.

The research showed that rehabilitation projects neglect the people's priorities that were shown through the survey and the spatial analysis. The neglect was reflected in the abandonment of the rehabilitated areas. However, the paper shows that drawing together the two energies/poles, economies, and demographics into the center of the souk so that the heart of the souk once again becomes a place of culture and commerce is an important factor in the recovery of the commercial center and an approach to avoid gentrification.

By observing the current dynamics conditioned by the past and present and changing societal and economic needs, the research focused on the possibilities of rebuilding the central commercial historic area with a vision that is more humane and more responsive to the contemporary needs of local communities after the conflict. Policymakers and regenerators could use this research to propose a tailored local context-based framework for the post-conflict regeneration of contested cities. The research offers an important example of methods used to understand indicators to accomplish people-centered approaches in the recovery process. Mapping spatial social aspects of urban recovery methodology were explained. Also, preparing for reconstruction decisions is based on understanding people's aspirations and societal vision through the survey. The survey is a tool to activate community participation in the decision-making of urban rehabilitation and it would be further investigated in the next publications to show the social and physical inspection of the building, supported by questionnaires and interviews with residents.

Acknowledgments

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Contributions of the vernacular heritage in the current city. Case study: Santo Domingo Neighborhood, Tuxtla Gutiérrez, Chiapas, Mexico

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Topic: T1.2. Urban studies of vernacular architecture

Abstract

The situation of marginality and vulnerability in the historic center of the capital of Chiapas is latent despite its location in the area of the greatest supply of services and urban facilities of the city. Specifically in Santo Domingo neighborhood in Tuxtla Gutiérrez, Chiapas, one of the oldest neighborhoods in the city, there has been a gradual loss of inhabitants since the 90s causing the decline of vernacular heritage and local identity. The commitment to sustainable development in cities worldwide sets as goals various actions that promote a look at the vernacular heritage and its relationship with the environment. However, the model of expansive growth of the city in an uncontrolled manner, moving away from the central city, also moves away from the Sustainable Development Goals. This article is part of a broader investigation in which the development of a methodology is proposed that establishes a specific cataloging system of the earthen architectural heritage of Santo Domingo neighborhood to provide guidelines for its preservation, strengthening and, in turn, of the historic city center, as a basis for redirecting the current city towards sustainable development. Through the analysis and characterization of the buildings built with raw earth and their inhabitants, it deepens in the analysis of the vernacular heritage, in its construction and consolidation of the urban environment, as well as its way of contributing to economic, social, and environmental links. However, the future of the vernacular heritage in urban areas, in this case, Santo Domingo neighborhood, depends not only on the patrimonial valuation in society but also on its economic revaluation by public and private institutions.

Keywords: *earthen architecture, sustainable development, integrated communities, historic urban areas.*

1. Introduction

Santo Domingo neighborhood, located in District I Center of Tuxtla Gutiérrez city, capital of the State of Chiapas, is one of the four oldest neighborhoods in the city that is part of the historic center without being decreed as such by the institutions.

As well as other historic urban areas of the city, Santo Domingo includes a set of buildings with precise characteristics, very different from the rest of the city and the new urban growth, *"conditioned by a physical structure from the past, recognizable as representative of the evolution of a town."* (International Council on

Monuments and Sites, 1977). As part of a previous investigation, an analysis of the neighborhood buildings has been carried out, of which 50 buildings constructed using traditional construction systems have been cataloged, specifically with raw earth contemplated as vernacular heritage (Parra Zebadúa & Genís Vinyals, 2017).

However, the loss and abandonment of this heritage since its identification in 1999 to date puts at risk this type of buildings, specially, because of the lack of protection by the administration or by financial institutions, which is the case nationwide in general (Guerrero Baca, 2008).

TYPE OF HERITAGE	1999	2015	2022
Monumental	1	1	1
Relevant	1	1	1
Traditional	96	61	48
Total	98	63	50
Heritage lost since 1999		35%	48%

Table 1. Count of heritage buildings in Santo Domingo neighboorhood (Source: Parra Zebadúa & Genís Vinyals, 2017)

Also, since the 1990s there has been a gradual depopulation of the historic center, especially Santo Domingo neighborhood.

According to the 2020 population census, the city has 578,830 inhabitants and a total of 199,918 homes, 20% of which are uninhabited; in the polygon called the Historic Center by the Partial Program of the Historic Center of Tuxtla Gutiérrez of 1999 it has 23,169 inhabitants and 9,033 homes, 24% of which are uninhabited, a figure higher than the local average.

However, in Santo Domingo neighborhood there are 481 inhabitants and 246 homes, 36% of which are uninhabited, a higher percentage of uninhabited homes than in the rest of the historic center and the city.

Concept	Tuxtla Gutiérrez	Historical Center	Santo Domingo Neighborhood
Extension	10 015 ha	299 ha	11 ha
Inhabitants	578 830	18 255	481
No. Households	199 918	8 876	246
No. Inhabited Housing	159 617	6 787	157
Percentage of Uninhabited Houses	20%	24%	36%
Inhabitants per Housing	3,62	3,4	2,95

Table 2. Population and housing data (INEGI, 2020)

The age of the resident population in the historic center and especially in Santo Domingo neighborhood increases compared to the rest of the town. 12% of the population is aged 60 years and over in the city, compared to 17% in the neighborhood, in contrast to the decrease in the population aged 0–14 years of 25% in the city and 17% in the neighborhood. The percentage of adults aged 30 to 59 years remains at 35% and there is a slight increase in the ages between 15 to 29 years of 28% in the city to 31% in the neighborhood.

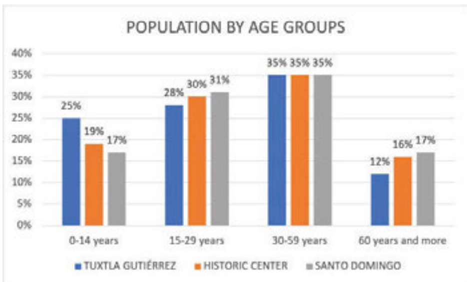

Table 3. Comparative graph of population by age groups in the city, the historic center, and Santo Domingo neighborhood (INEGI, 2020).

In terms of local efforts aligned with sustainable development goals, the Urban Development Plan of Tuxtla Gutiérrez 2015–2040 estimates an average annual growth rate of 2.3% in the city, for which a minimum population density of 80 persons per hectare is set as a goal to increase the current density of 66 persons per hectare and thereby reduce the territory to be occupied. Furthermore, in Mexico's 2030 Agenda, specifically in Goal 11 on sustainable cities and communities, only the proportion of the urban population living in precarious housing has been taken into account as an indicator, in which Chiapas ranks 2nd in the country with 26.44% and within the State of Chiapas, Tuxtla Gutiérrez with 27.63%. (Gobierno de México; INEGI, 2021). This indicates a pressing need for decent housing for the local population and an opportunity for housing developers. These data indicate that the return to the historic center is essential for sustainable development, but the way it should be done is different from the rest of the city as it is a historic urban area in which one of the pillars of sustainable development must be taken into account, which is culture, interconnected to economic growth, social inclusion and environmental balance, (United Cities and Local Governments, 2010), as the climate emergency also threatens cultural heritage, affecting ways of life that maintain a strong link with nature or the urban environment. This also demonstrates the interdependence between the health system and the cultural system in the current COVID pandemic (Martinell Sempere, 2021). Therefore, the analysis of the vernacular heritage of Santo Domingo neighborhood includes not only the buildings as independent entities but also the link between them and their physical and cultural environment that represent the identity of the people in Tuxtla Gutiérrez. In addition to the previous analysis of the immediate urban context, which shows that the existing traditional buildings are mostly related to their neighborhood center (Parra-Zebadúa & Genís-Vinyals, 2019), which represents the point of origin of the neighborhood and the meeting place for the resident population, demonstrating that "for centuries they preserved an urban network with great harmony thanks to the balance of their civil and religious adobe buildings..." (Guerrero Baca, 2008). Related in their immediate urban context directly to the neighborhood dynamics around public space. However, the gradual changes in the urban fabric and the disposition of the new buildings give certain spatial and functional consequences of marginality and vulnerability despite its location in the area of the greatest supply of services and urban facilities of the city that reveal a lack of analysis in the dynamics of compatible land uses in Santo Domingo neighborhood (Zenteno Hernández, 2022). Therefore, the need for a review of the quality of life in the historic center, specifically in Santo Domingo neighborhood, has become evident. For this purpose, surveys were carried among the resident population of the neighborhood, specifically among those who inhabit the houses identified as vestiges of the existing vernacular heritage, in order to find out their position regarding their neighborhood and their housing. As well as a more in-depht analysis of the architectural typologies of the neighborhood in relation to its immediate urban environment.

2. Methodology

The survey was designed specifically for those who live in the neighborhood's vernacular heritage in order to emphasise the importance of the user, their perception of the value of both their home and the neighborhood they live in, in the aim of answering some of the hypothetical questions posed as to why these homes have been abandoned and, on the contrary, why those who still live in them remain, and what factors influence the value of this heritage in its inhabitants. The surveys were carried out with the support of the Academic Body of Urban Development and the Academic Body of Heritage, Territory, and Sustainability of the Faculty of Architecture of the Autonomous University of Chiapas. In addition, both physical and psychological variables were considered for the measurement of adaptation and quality of life of inhabitants of social housing in Mexico (Mercado Doménech, Ortega Andeane, Luna Lara, & Estrada Rodríguez, 1995). Due to the small resident population and the distrust of the inhabitants, only 12 surveys were carried out, which were more like interviews, so it was possible to deepen into their needs and concerns regarding their housing, as well as to know the feelings about their housing and the neighborhood they live in. On the other hand, based on the typological analysis of the vernacular buildings and their relationship with the urban environment, it has been observed the features that still exist in the urban fabric that contribute to neighborhood dynamics.

3. Results

The people who live in the vernacular heritage of Santo Domingo neighborhood are mostly older people, especially women over 60 years of age, engaged in commercial activities that they carry out in their own homes, among which the following were identified: hairdressing, shoe repair, locksmithing, elaboration of handmade soaps, sale of homemade food or groceries, renting of commercial premises as part of their homes, renting rooms, art gallery, activities that are characteristic and help promote neighborhood community life (Gómez Crespo, 2013). In terms of their urban environment, they mainly appreciate its central location and proximity to the various urban facilities where they carry out their daily activities, such as public markets, the Marimba Park, churches, administrative buildings, museums, as well as the proximity to their relatives. Among the negative aspects regarding their housing, they highlighted the lack of continuous drinking water service, since in some cases they do not have a water storage tank to supply water on days when they do not have service. In addition to the lack of construction technicians with the necessary knowledge to maintain their homes. In a few cases, the owners themselves are in charge of the maintenance, and in others they simply decide to replace traditional construction materials with industrialised ones that are the ones that the technicians do know how to handle, as is the case of the curved tile roofs with metal sheet (Fig. 1), solid wood beam systems with steel, in the case of the traditional baseboards of limestone slabs or brick with ceramic tiles or traditional lime plaster with cement mortar.

Fig. 1. Replacement of curved clay tile roof with galvanized sheets. (Parra Zebadúa., 2021)

As for the negative aspects of their environment, they complain of having difficulty walking due to the bad physical state of the sidewalks (Fig. 2), inadequate pedestrian crossings, and the lack of road safety education by drivers of vehicles who do not give the right of way to pedestrians, especially in the case of elderly people. They also deplore the abandonment of the neighborhood and the presence of transgender women sex workers, a non-regulated activity due to the fact that they are transgender, which is mainly concentrated in the streets of Santo Domingo neighborhood, with the consequences that this entails, such as acts of violence against workers and feeling of insecurity on the part of the inhabitants (Gutiérrez Gamboa, Evangelista García, & Anne Winton, 2018).

Fig. 2. Sidewalk of the neighborhood in deplorable condition. (Source: Parra Zebadúa, 2021)

The dwellings in the best state of conservation are those that have been inherited and inhabited by the same heirs since they were born, they ensure their continuous maintenance, they know the materials used in its construction, they consider it to be of good quality and they value the climatic and interior comfort, as well as its living space and configuration. In contrast to unoccupied dwellings, which are in a deteriorated state and many of them are for sale. Unfortunately, throughout the research, the outcome of many of the abandoned buildings or those for sale can be observed, which are completely demolished, leaving an empty site and giving it the use of a public parking lot (Fig. 3) while another new building is being planned or while it is being sold, since these buildings built with raw earth cannot be sold through bank loans, giving value only to the plot.

Fig. 3. A public parking lot where previously there was a vernacular building. (Source: Parra Zebadúa, 2021)

Traditional buildings in the neighborhood are one level, with the façades aligned with the street and backyard. Maintaining he configuration of aligned façades has remained in the neighborhood to the present day, with the exception of newer built dwellings that are separated from the street by means of a front garden. However, in other parts of the historic center, the recessing of facades for private car parking is observed, a change that can seriously affect neighborhood dynamics by allowing vehicles to intrude into pedestrian space, especially for commercial use.

4. Conclusions

Buildings constructed with raw earth are especially undervalued by banks and government entities, making it difficult for them to survive after they pass to the hands of their descendants who wish to sell them, either in whole or in parts. Unless one of them is willing and able to keep it as their main home, which creates closer ties with the property. The people who inhabit the dwellings which are part of the vernacular heritage of Santo Domingo neighborhood recognise the heritage values of the buildings; however, the problems they face are related to the deficiencies of the urban environment that influence their daily lives, which directly detracts from their quality of life. On the other hand, the lack of technicians with the appropriate knowledge for the maintenance of their homes has repercussions on the safeguarding of the vernacular heritage, since in practice, despite the existence of specialised professionals, most people go directly to construction technicians who are not familiar with traditional construction techniques due to the loss of ancestral knowledge through the generations. The alignment of street facades gives rise to the neighborhood activities, provides pedestrians with greater safety and ease of access to the various services and products offered, mostly by the inhabitants of the neighborhood themselves, thus stimulating the local economy. The fact of aligning the facades to the street should be one of the urban policies that should be maintained in the neighborhood, since by recessing them for the benefit of vehicular parking directly affects and alters the dynamics of neighborhood uses, as well as promoting motorised mobility, instead of encouraging and protecting pedestrians. The repercussions of safeguarding the vernacular heritage in the current city are closely related to the Sustainable Development Goals, through culture, traditional construction systems with ecological values, community relations around neighborhood activities, as well as the non-motorised mobility that the urban fabric itself generates.

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The town of Collodi: the vernacular heritage

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Topic: T1.2. Urban studies of vernacular architecture

Abstract
The town of Collodi consists mainly of two parts, the ancient village perched on the hill and a settlement in the valley. The ancient castle, of which we have accurate information only after the twelfth century, still retains many of the characteristics of a medieval village. The planimetric development of this small settlement is highly interesting: both the main roads and the building aggregates follow the lines of the maximum slope of the hill, giving the entire skyline a cascading pattern. In the past two centuries, the castle of Collodi has not seen significant expansions beyond the perimeter of its ancient walls. Only the external roads have been adapted to the traffic of cars while movement inside the walls has remained exclusively pedestrian. For this reason, the structure still retains, for the most part, the vernacular features of the small settlements of northern Tuscany. These characteristics can be traced back using both the construction techniques and the typological elements. Through a careful study and an in-depth analysis of the buildings that characterize its typical elements, the vernacular architecture of the town can be both safeguarded and valorised. This paper means to illustrate the first results of the study on the entire vernacular heritage of Collodi, both the materials used and the architecture, which resulted in the identification of the unchanged parts of the buildings and the distinctive features that have been preserved, as well as the definition of the necessary guidelines for their restoration.

Keywords: *Castle of Collodi, small settlements, medieval village, valorisation.*

1. Introduction

In order to correctly recover and valorise the cultural heritage, it is important that the guidelines for their protection and safeguarding, as expressed by the scientific community, both national and international, be underlined for each specific case study.
With regards to vernacular architecture, the Charter on the Built Vernacular Heritage which was adopted by ICOMOS in 1999 must be made binding. This can be made possible via an attentive analysis of the characteristics of the specific structure, both as singular units and as a whole.
A study of the forms and structures that characterize the vernacular architecture of Collodi have never before been carried out.
The present analysis has collected data and information directly *in situ.* It is the result of an in-depth study of the constructions and the materials used to build them, a careful analysis of the archival and bibliographic sources, and finally a critical evaluation and comparison of both.
Thus, deciding on a course of action for the town of Collodi has meant carefully retrieving all the historical-critical materials and the archival sources required for the reconstruction of the architectural events of the complex. Next, the morphometric evaluation was attained with the support of the Department of Architecture of the

Fig. 1. Collodi, Pistoia, view of the town of Collodi, (Source: Francesco Pisani, 2020)

University of Florence[1], and realized using the combined action of the photometric and direct survey of the principal geometries, which was preceded by an urban topographic overview. Finally, the metrical geometric datum, the architectural critical descriptive datum (with an indication of the materials, the masonry compositions), and the level of deterioration was acquired by carefully comparing the print sources and a direct survey of the artefacts. The data was collected by the research team in a series of graphs with plans and elevations which were complete with legends for the identification of the materials and the state of the degradation using international glossaries.

2. Historical evolution

The town of Collodi is, today, a composite centre, composed mainly of two parts, the ancient hamlet perched on the ridge of the Battifolle mountain range (Fig. 1), and the settlement in the valley. The latter, built in more recent times, developed along the Pescia Minore torrent, also known as the Pescia di Collodi. Along with the houses, factories and, since the end of the 1950s, the *Parco di Pinocchio,* are also located here.

While numerous different studies, which include the production of an extensive reference bibliography, have been carried out on the Villa and the historical Giardino Garzoni – among the first texts to mention the Villa and Giardino Garzoni, we must remember the book by Sbarra (1652), to

[1] The Fondazione Nazionale Carlo Collodi, with the intent of carrying out a series of actions aimed to valorize Collodi, has stipulated a convention with the Department of Architecture of the University of Florence for studies on: Villa Garzoni, the historical Giardino Garzoni, and the town of Collodi. The scientific director of the project is Professor Susanna Caccia Gherardini.

which other 18th century travel guides would be added, like, for example the one by Ansaldi (1772), which would be followed by 19th century studies on the territory, for example, the Repetti dictionary (1833) or the Tigri dictionary (1853), and a series of other, more exhaustive texts in the second half of the 20th century (Fagiolo, 1995; Cazzato et al. 1992; Cazzato et al. 1997; Bechini, 2001; Giusti, 2001; Valentini, 2004; Martelli, 2002; Giusti, 2015a; Giusti 2015b) – research and publications on the town of Collodi are rather limited. Collodi, which is situated on the western border of Valdinievole, mid-way between Florence and Pisa, is an ancient settlement, but, as already noted, documentation on the town is limited. According to tradition, the name derives from a distant *Forum Clodii*, which can be found on the *Tabula Peutingeriana*. This hypothesis is supported by the fact that there are numerous toponomies of sure Roman origin in the area, and that the ancient Cassia or Clodia road, which linked Florence and Lucca, ran near there.

The construction of the town of Collodi in walled lands was also said to date back to the Goths, and some thought the settlement had continued to maintain a strategic and military importance under the Lombards (Andreini Galli, Gurrieri 1975). More recent studies (Pescagli Monti, 1990) explain how a small, ancient settlement, called Debbia, was once found at the foot of the hill on which Collodi now stands.

While the first attestations of the *castrum* of Collodi date back to the end of the 12th century, information relative to the church of San Bartolomeo dates back to the beginning of the following century. From the 14th century onward, the small fortified settlement, situated at the border between the lands of Lucca and those of Florence, became, given its dominant position, an important military centre and was often involved in diverse armed battles fought by both factions (Pedreschi, 1993).

From the second half of the 15th century, factories for the production of paper were constructed along the Pescia di Collodi torrent; this would favour the development of a second nucleus of dwellings at the foot of the hill. The walled town, on the other hand, would only undergo major changes starting at the beginning of the 17th century thanks to the Garzoni family, who had received the patent of nobility from Carlo IV in the 14th century, and possessed almost the entire valley. It was Romano di Alessandro Garzoni who initiated the construction of Palazzo di Villa (Fagiolo1995; Giusti 2001; Giusti 2015b) on the south side of the town, constructing the building on the pre-existing structure at the front of the walled town, towards the valley, where the Garzoni family already had their noble residence.[2]

The state of the structure, until the 1630s, is also well documented in the *veduta* of Collodi (Fig. 2),[3] which is conserved in the archive in Lucca. Along with the Palazzo in construction, in the *veduta* there is a very clear image of the walled town with its characteristic construction on the slopes of the hills (Pedreschi, 1993).

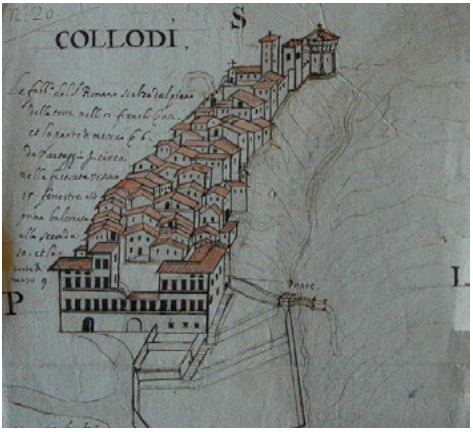

Fig. 2. Drawing with the representation of Collodi in 1633, (Source: ASL, Cons. Gen., Scritt. Segr. n. 673, p. 1584)

In the 17th century, along with Palazzo di Villa, Romano di Alessandro Garzoni began the construction of the Giardino (Cazzato et al. 1992;

[2] Cfr. Martilogio dei Beni dello Spettabile Romano Garzoni, 1550, ASL, Fondo Garzoni, filza n. 27, c. 1, in (Martelli S. 2002)

[3] Cfr. ASL, Cons. Gen., Scritt. Segr. n. 673, p. 1584. in (Pedreschi 1993).

Cazzato et al. 1997; Bechini, 2001); but it was only in the 18th century that the Palazzo and the Giardino took on their present-day appearance, with the definition of the southern facade of the Palazzo.
Still in the 18th century, Filippo Juvarra designed the *palazzina dell'orologio*, which would be constructed on the northern side of the courtyard by Ottaviano Diodati, to whom the current plan of the Giardino must also be attributed. (Valentini, 2004; Giusti, 2016).

3. The urban layout

In addition to the 17th century *veduta*, which offers a view of the underlying plains, the most ancient iconographic documentation existing today of the town of Collodi is the cadastral map of 1836, in which the entire town is at scale 1:1000 (Fig. 3). This document facilitates the comparison with existing maps and, consequently, the study of the transformations that have taken place in the settlement.
The urban layout of the town of Collodi (Fig. 4) runs along an axis that goes north to south, following the lines of maximum slope of the ridges, the *costone*, on which it rises and which, still today, encloses it within its medieval perimeter.
The remains of the fort are still present at the highest point; they occupy the northern side of the settlement. The ruins of an angular, cylindrical tower, easily recognizable in the 17th century *veduta*, are still conserved there, as is a tower with a square base inside the structure.
Another angular tower with a square base has, through the centuries, become the bell-tower of the ancient church of San Bartolomeo, which was constructed just below the military structure. It is important to note that a cluster of houses has risen in the centre of the ancient fort.
A vast parvis rises in front of the church. It, too, is overlooked by SS. Sacramento oratory. Today, this open space offers a view of the valley below. The only road on this side of the town descends steeply from the parvis towards the valley below, running along the walls of the western perimeter of the *castrum*. Maintaining the volume of the rectory on its left, the road bends sharply towards the centre of the cluster of buildings and then turns outwards again, past the steep incline of what is a proper hairpin bend. At the end of this road, in a tract that coasts the remains of the western walls, an entrance gives access to the town. It is framed by a door in moulded and embossed ashlar—illustrated in a document dated 1633 (Fig. 5).
Moving downwards, the road divides in two: the first tract of road continues along the western border of the town and delimits, together with the second tract, a cluster of houses at the centre of the settlement; the second tract goes on to delimit another cluster that stretches along the eastern perimeter of the castle. Continuing on, the two roads become one again and, for a brief tract, coast the remains of the western wall, leaving the constructed nucleus to the east. It then bends towards the centre of the settlement, surrounded by buildings on both sides, and ends its course at a large square: this is located halfway into the settlement, on the side that faces the valley, and its planimetry is fairly quadrangular with the main axis running east to west.
The square, piazza Della Fontana, as the name implies, houses a public fountain and wash-basin. From this square two parallel roads descend steeply through the rest of the town to the valley below, delimiting two continuous districts that run along the outer limits of the *castrum* and a *spina*, a block of houses, at the centre of the residential area that is subdivided into four blocks by a succession of roads that run perpendicular to the main two.
At the end of the second crossroad, on the eastern side, another entrance leads to the *castrum* of Collodi: it, too, is framed in stone with moulded elements. The two main roads of the town end their course inside the courtyard of Palazzo Garzoni, just after crossing Piazza San Martino.
In the 1940s, a road was opened here for access to the town by car. Until that date, the only entrance on the southern side was through the gates of Palazzo Garzoni and across the courtyard.

Fig. 3. Detail of the 1836 cadastral map, (Source: SASPe, Vecchio Catasto Terreni, Pescia, sezione L, foglio 3)

4. The road network inside and outside the walls

From an analysis of the historical cadastral maps, it is obvious that—in addition to the southern road that leads to Palazzo Garzoni— various other roads reached as far as the castrum. In fact, two lead to the already-mentioned historical entrances: one is on the eastern side in the lower part of the town, and another is west, on the upper part of the town.

It is also interesting to note that by widening and lengthening a road that already existed, and which stretched almost to the town walls, the entrance at Piazza San Martino was created in the 20th century. Using this same method of lengthening and adapting the road for vehicular traffic, another entrance to the fort was created where a "breach" was opened to allow access to the town in that area.

The changes made to meet the needs of road traffic, saw, along with the upgrading of ancient passageways for motor vehicles, the creation of parking areas near the gates, making Collodi easier to access.

Movement within the town has remained solely pedestrian, because the planimetric conformation, but above all the elevation difference, prohibits the use of cars.

In a few particularly steep parts of the town, the lanes become graded ramps or even flights of steps. The pavement in stones is one of the town's most precious elements and characterizes the urban setting of Collodi. It has remained almost unvaried both in the general configuration and in the materials. In fact, some of the stones still bear the incisions made for playing games like *triplice cinta*, a sort of tic-tac-toe. Thus, the pavement, too, has become the object of an attentive geometric and photogrammetric study.

Fig. 4. Collodi, Pistoia, orthophoto of the town of Collodi © AGEA, 2013, Geoscopio, (Source: http://www502.regione.toscana.it/geoscopio/fototeca.html). CC-BY-SA.

5. Building morphology

Again, a comparison of the archival documents and the artefacts underlines the fact that, in addition to being enclosed within the perimeter of the medieval walls, the town of Collodi has not undergone significant modifications in its planimetric configuration.

Along with maintaining the original alignment of the street fronts, some of the medieval "individual units" are still visible, those in which there is a smaller street front development with respect to the length of the house within the district. It is, thus, comprehensible how, in some cases, these "individual units" have been incorporated, in time, to create larger buildings.

Some housing units actually maintain, in their entirety, the original, private spaces in front of them: this makes for pleasant urban settings, created with green spaces, which give a particular character to the town.

By comparing the town today to the 17th century *veduta*, it is apparent that the skyline of the Castello di Collodi has maintained its typical cascading pattern: in fact, the buildings, standing one next to the other, in line with the orographic layout of the land, create a series of *gradonate*, terraces, covered in layered brickwork. These give the hamlet a distinctive air.

The majority of changes and alterations to the buildings are evident in the outer front of the town, the one facing east. These include, for example, the introduction of protrusions and overhangs for the addition of bathrooms and balconies. These alterations—both for the fact that their structural features are unrelated to those of historical buildings, and for the fact that they use technologies and materials that are anything but compatible—are elements that diminish the quality of both the individual buildings and the environmental context (Fig. 7).

Using a direct and photogrammetric survey of the street fronts of Collodi, it was possible to carry out further analyses of the elevation of the morphology of the buildings and the materials used to construct them.

Studies show that the majority of the buildings in the town are made up of three above-ground floors and that they are gabled with ledges that usually hold the eaves-trough. The distribution of the openings is very regular with alignments along the vertical axes, while horizontally the alignment is irregular from unit to unit, especially when the steep land has made it necessary to regulate the height of the adjacent building.

When the plaster is lacking, the curtain walls are made of mixed masonry—with stone ashlars placed haphazardly, and elements in brick—with carefully placed square stone blocks at the wall joints, for example, the corners. Brick was, for the most part, used in the construction of door and window frames—even though in some buildings, the use of stone is evident—or in the case of restorations and repairs to parts of the wall (Fig. 6).

Almost all the openings are rectangular; windows or doors with arches are rare, and where present, the arched frame is in brick. Plaster has been used on the buildings that have undergone restorations and maintenance work in recent times.

Fig. 5. Collodi, Pistoia, remains of the western walls, entrance to the town, (Source: Pisani, 2020)

6. Degradation of the materials and the urban layout

After having identified the materials of which the facade is made, an analysis was carried out on the main phenomena of degradation. The degradation of the materials is, for the most part, due to their exposure to atmospheric elements combined with an insufficient and, in some cases, a total lack of maintenance. The parameters of the facades, which are, for the most part, devoid of plaster, present more of less accentuated incidents of erosion, pulverization, and disintegration, which interest, in particular, the mortar joints. Over time this may also lead to the instability of the walls. In some cases, there is evident sagging/buckling or even damp patches due to the inefficient draining systems of rain water, on which biological colonization has developed.

Fig. 6. Collodi, Pistoia, glimpse of a street of the town, (Source: Pisani, 2020)

Along with exposure to atmospheric elements and neglect, the other causes of ruin can be attributed to the actions of man, for example, the introduction of incompatible architectural elements like balconies with slabs in concrete, iron railings, or small plastic awnings. There has also been a usage of construction materials and technologies that are incompatible with traditional construction methods, for example, the application of cement mortar-based plaster, or the repointing of the joints in the wall face—also carried out using cement mortar (Fig. 7).

It is, finally, important to underline the fact that the installation of necessary utilities was not carried out in an organic and adequate manner, lessening the overall wealth of the urban environment.

7. Conclusion

In conclusion, given the expansion of the housing units in the valley and the particular orthography surrounding it, the Castello di Collodi continues to present the characteristics of a walled medieval town, characteristics that must be preserved and valorised. The many critical issues encountered in the town are attributed to the underutilization of the existing architectural heritage as well as a lack of a full understanding of the typical features, both distributive and constructive, of these vernacular architectures.

These initial studies and graphs (plans, prospectuses, identification of the materials, construction techniques, and the levels of degradation) clearly underline the particular vernacular wealth of Collodi. As of today, the study has been conducted on the external parts of the buildings. In order to outline the actions needed to correctly protect and safeguard the town, further studies must be carried out. These must include morphological surveys of the interiors, to be carried out both in the laboratory and *in situ*, on the materials used and the construction techniques applied.

A detailed record of the data collected will, therefore, be needed to carry out the most appropriate restoration interventions on the structures within the town.

Fig. 7. Collodi, Pistoia, eastern front of the town, (Source: Pisani, 2020)

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Between landscape and fortified architecture: traces and memory of rural civilization in the territory of Pesche in Molise

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Topic: T1.2. Urban studies of vernacular architecture

Abstract

The small village of Pesche in Molise extends along the slopes of Monte San Marco, in a perfect symbiosis between architecture and nature. Pesche's origins date back already between the 5th and 6th centuries, when the steep natural slope was chosen as a place for the construction of a safe village, consisting of many small houses side by side and built using local limestone. Its position, guarding the Isernia valley, characterized at the top by the ruins of the castle-enclosure, supports the idea that Pesche may have played a dominant role in the passage along the ancient Pescasseroli-Candela sheep track. The castle-enclosure itself is evidence of the traditional medieval building site, but also of a rural civilization which until the beginning of the 20th century probably continued to live in these places, used as houses, stables and barns. This contribution focuses on the architectural and material characteristics of the buildings in the territory of Pesche, which, despite the current state of decay and neglect, are evidence of the use of local materials and the use of construction techniques that have characterized the traditional Molise building site.

Keywords: *fortified architecture, landscape, Pesche, Molise*

1. Introduction

«This is Molise, beautiful and peaceful» (Brandi, 2019, p. 345). With these words Cesare Brandi describes the small Italian region, too often relegated to a marginal role, but whose rich architectural and landscape heritage clearly testifies to the complex historical vicissitudes that have conditioned its present. In this region, characterized by a continuous alternation of mountainous and hilly areas, fortified architecture has a dominant role, almost guarding the surrounding area. And this is the case of Pesche, a small village in Isernia's province, where the town appears perfectly integrated with the natural rock on which it rests, dominated by the ruins of *Castrum Pesclarum*. The absence of systematic studies and research on the historic sites of Molise, but also the state of decay in which many buildings are found, make the approach to these sites very complex. The present research, conducted through an integration of historical documentary sources and direct knowledge of the object, aims to make known how Pesche still retains all the characteristics of a typical small town in the inner areas of Molise, born for defensive purposes, and then adapted to the needs of a rural civilization, always in a close link between architecture and landscape[1].

[1] This research is part of the Specialization thesis in Architectural and Landscape Heritage achieved in October 2021 at the Department of Architecture of the University of Naples Federico II.

2. Historical outline of Pesche's fortified settlement

2.1. The phenomenon of fortification in the Molise area

Perched on rocky slopes, emerging between natural green expanses or placed to guard a small historic center, the towers, castles and entire fortified centres represent the different types of fortified architecture that can be encountered while crossing the Molise region (Perogalli, 1975; Di Rocco, 2009; Perrella Cavaliere et al., 2011). In most cases these works arise on preexistences of Longobard or Norman origin, but sometimes also Samnite, which have undergone transformations and remodeling due to direct interventions of anthropic nature or natural disasters, such as the frequent earthquakes that have always devastated Molise. The origin of these structures is surely linked to the need to take refuge in safe places protected from Saracen invasions, but also to the desire to repopulate and manage deserted and uncultivated lands. This practice of fortification, indeed, was also the basis of the organizational dynamics of influential religious groups (Wickham, 1985).

2.2 Brief historical notes on *Pesclum*'s origins and transformations

Fig. 1. Aerial photo of Pesche's village, (Source: Facchini, 2020).

The characteristic position of Pesche, which differentiates it from most of the neighbouring villages built on the top and not along the rocky slopes (Fig. 1), gave rise to its toponym, because *Pesclum* or *Pesculum*, later Pesco d'Isernia, derives from *pesclum*, that is "stone" (Galanti, 1781, p. 81; Masciotta, 1984, p. 283). Probably a small community already resided in the flat area of the site, known as *balneum* because roman baths were attested (Tommasini, 1999, pp. 23-24; Greco, 2007, p. 187). The establishment of a first settlement along the slopes of today's Monte San Marco or Monte San Bernardo goes back to the 5th-6th century, when, following the barbarian invasions, the population residing downstream moved towards the naturally protected area, that is towards the rocky mountain called *Pesclatura*. It was only in the following centuries, and then especially during the Norman kingdom, that Pesche took on the appearance of a small fortified village, dominated by the so-called *Castrum Pesclarum*. The history of Pesche is intertwined with that of two important Benedictine complexes, that of San Vincenzo al Volturno first and that of Montecassino then. Although there are no explicit references in the *Chronicon Vulturnense* written by the monk Giovanni - which collects information on the foundation and historical events of San Vincenzo al Volturno's monastery up to the dawn of the 12th century - it is possible to trace donations of goods present in the territory of Pesche which were given to the above-mentioned monastery between the 9th and 10th centuries (Oldoni, 2010, pp. 171, 216, 362). Its fortune, however, is linked above all to the centuries of Cassinese relevance that extend from 1092 - the year of the donation of the Church of Santa Croce and of the *castellum Valneum* by Rodolfo di Molisio to the above-mentioned Abbey[2] - up to 1702, when Pesche was sold to the Diocese of Isernia[3] (Greco, 2007; Greco, 2011). During these centuries, Pesche - to which, as the historical iconography testifies, other toponyms

[2] Archive of Montecassino's Abbey, Aula III, capsula XI, n. 35; cfr. Aula III, capsula XI, n. 42.

[3] Ivi, Aula III, capsula III, n. 65.

are attributed such as *Pesculu a Sernia*, *Pesculu apud Isernia*, *Pescora*, *Le pescora*, etc. (Fig. 2, 3) - is entrusted as a fief to important noble families, such as the Ceva Grimaldi, who were the last owners until the subversion of feudalism in 1806, becoming an autonomous municipality only at the beginning of the 19th century (Tommasini, 1999, p. 170).

Fig. 2. Speculum & Exemplar Christicolarum. Vita Beatissimi Patris Benedicti Monacho[rum] Patriarch[a]e Sanctissimi, 1586 (by Pistilli, 2016).

Fig. 3. G. A. Magini, detail of the map *Contado di Molise et Principato Ultra*, 1620.

3. The medieval village

3.1. Architectural features of the historic centre

For those who arrive in Pesche from the Molise capital of Isernia, what is most striking is the singular panorama consisting of a «waterfall of houses» (*Guida d'Italia del Touring Club Italia*, 1926, p. 342), placed side by side and following the rocky slope, so much so that, according to tradition, King Ferdinand II of Bourbon, during a trip to Molise, compared Pesche to a bookshop (Amorosa, 1924, p. 99; Trombetta, 1984, p. 253 and p. 293 note 90). The constant use of limestone left exposed helps to fortify the fusion between the historic building and the rock on which the buildings rest. The village of Pesche, of which it is still possible today to perceive a very compact urban fabric, is crossed by a main longitudinal axis in an east-west direction (now via Arciprete Biondi), from which a series of secondary paths branch out which, through ramps or gradients, lead directly to the *castrum*. Although the historic center is still partially inhabited, it is possible to come across characteristic abandoned buildings in a state of ruin. Among them, a block of several buildings located near Piazza Roveto has a particular value, characterized by a three-arched loggia and a mullioned window at the top with frames in white limestone (Fig. 4).

Fig. 4. Buildings of Pesche's historic centre (2021).

In the same Piazza Roveto there is the ancient gate to the fortified city which still retains traces of the crowning with battlements. Another characteristic of the historic center is the presence of portals in worked white stone that unite many of the small houses and on which it is possible to glimpse symbols or initials of names attributable to the owner families.

3.2. Pesche and the historical road system: the Pescasseroli-Candela sheep track

The Molise territory is also known for being crossed by the so-called sheep track, the long green paths intended for transhumance, which descended from the Abruzzo mountains towards the flat areas located in the current Apulia. Especially, Molise is crossed by the five most important sheep tracks of southern Italy, including the Pescasseroli-Candela Regio sheep track - perceptible today only in some pieces - which connects Pescasseroli, in Abruzzo, with Candela, in Apulia, after having also crossed Molise and Campania (Petriccione, 1999).

Fig. 5. Pesche's castle-enclosure (ortomosaic obtained with the software *Agisoft Metashape*).

These "grassy streets" are still today a fundamental testimony of the memory of rural and country life that characterized this inland area of Italy. There are various cities that have developed along the Pescasseroli-Candela sheep track, such as *Bovianum*, *Saepinum*, *Aeserniam*, but, above all, there are various types of structures built along the route to ease the journey of both animals and farmers, such as the *tabernae*, the *mansiones*, the *caupona*, and others. The bibliography and cartography published on the Pescasseroli-Candela does not explicitly include Pesche among the halts of the journey, but its proximity to Isernia and its strategic position, clearly visible from what was once the path of the sheep track and today partially retraced by the SS 17, it is possible to hypothesize that it had a non-marginal role. A series of spontaneous architectures that can be found within the Oriented Nature Reserve that extends behind the castle-enclosure contribute to corroborating this thesis, such as the two fountains, Iodata and Maiuri (or Majuri) fountains, which are assimilable to drinking troughs used to quench the thirst of animals. Even more characteristic is the presence of dry-stone hut structures, called *toloj* or usually "*pagliari*", made by shepherds in the internal mountain areas and along secondary paths, for resting and sheltering from bad weather, but also for milk's processing (Carnevale, 2008). The existence of these structures, therefore, also found in other neighbouring Molise sites, testifies to the presence of a peasant civilization also in the Pesche area, perhaps reachable through a detour from the main sheep track.

4. *Castrum Pesclarum*: knowledge and conservation of the castle-enclosure

4.1. Architectural features

Fig. 6. Southern elevation (elab. by author).

The structure of Pesche's *castrum* presents a plan similar to a trapezium, but, very likely, the original structure had to be more extensive than the one preserved today, if we consider the position of the ancient gate of access still preserved in Piazza Roveto. The characteristic conformation of the so-called castle-enclosure represents almost an *unicum* in the Molise contest (Fig. 5), if we exclude a few examples such as that of Roccamandolfi and Roccapipirozzi, also in the province of Isernia, while it is a widespread typology especially in the Abruzzo territory (Perogalli, 1975; Trombetta, 1984). As has happened in many other sites, some environments of the fortress have been incorporated into other constructions built or subsequently adapted and their recognition is now almost impossible. Along the outer perimeter of the castle-enclosure it is still possible to observe two ancient access gates to the site: a door on the southern side, directly from the historic center of Pesche (Fig. 6); another on the western one, which connects the site with via Fontanavecchia. Along the eastern curtain, on the other hand, there is a postern, from which the external path branches off which leads directly to the highest point of the fortress, identified with a tower that must have probably been a *donjon*. The *donjon*, or more commonly the keep, occupies the north-western corner of the enclosure and it is preceded by two semi-circular towers lying on the rocky slope, and, in particular, the one on the west side still retains the crowning with the battlements (Fig. 7). A photo of the early 20th century and kept in the Alinari Archive allows us to reconstruct the portion of the keep that collapsed in recent decades (Fig. 8). Once you have passed the entrance located to the south, you can go along *via Torre*, which is also the only more easily accessible route of the entire *castrum*, unlike the internal system of stairs and ramps which served to overcome the difference in height. All the rooms, many of which over time have been used as barns and stables, as already attested by the land registry of the late 19th century buildings[4], are in a state of abandonment and neglect. Most of them are inaccessible due to the total or partial absence of floor slabs or roofing, leaving us only to imagine how they could be organized. Even inside the *castrum*, the small houses are side by side, thus helping to strengthen the defense of the site. Despite the abandonment, traces of domestic and rural life are preserved in some houses: in two of them it is still possible to observe ancient fireplaces with small furnaces side by side, typical of the less poor residences of the Molise area (Fig. 9, 10). The hearth, indeed, called *fucagn'*, represented the heart of the house and was usually located in the kitchen, where in addition to heating the room, it was also used for cooking (Guerrizio, Libertucci, 2008). Continuing eastwards and past the small access passage, it is possible to continue towards the path that leads to the highest part of the site and which flanks the perimeter of the Oriental Nature Reserve.

Fig. 7. External view of the keep (2021).

Fig. 8. A. Trombetta, *View of the castle of Pesche in the surroundings of Isernia*, 1900-1910, (Source: Archive Alinari, Collection Trombetta, Florence).

[4] State Archives of Isernia, Catasto dei fabbricati, registro delle partite, Pesche voll. 1-8.

4.2. Materials and construction techniques

Molise architecture is strongly influenced by the geographical characteristics of the territory, dominated by the mountain ranges of Matese and Mainarde, with a terrain that has typical characteristics of the central-southern Apennines. The nature of the territory is reflected both in the use of local materials, also due to the poverty of the regional economy, and in the typological and structural choices adopted, which also derive from the common earthquakes that hit the area (Varagnoli, 2006; Varagnoli, 2016).

Fig. 9, 10. Typical fireplaces in environments of the *castrum* (2021).

These characteristics have determined the prevalent use of local limestone in the traditional Molise building site, and therefore also in the territory of Pesche, used since the Middle Ages both in fortresses and castles and in civil and religious buildings. It is possible to find a prevailing use of blocks in mountain areas, while the recourse to pebbles near rivers. However, the use of travertine is limited, found mainly in the province of Campobasso in the Boiano area, and even more so is the use of tuff. The Molise architecture, however, is also affected by the influence of the workers from neighbouring regions, for example from Abruzzo, Campania and Apulia, mainly along the coast.

Fig. 11, 12. Details of *castrum*'s masonry (2021).

Furthermore, there are also influences of the workers employed in the San Vincenzo al Volturno site and its appurtenances, who introduce the knowledge developed in the Benedictine sites that revolved around Montecassino. The masonry devices that can be found in the architecture of the *Castrum Pesclarum* consist largely of facing with rough blocks of local limestone and with different dimensions, bound with mortar and placed irregularly, without horizontal alignments (Fig. 11, 12). In the cantonal it is possible to find the use of larger and squared blocks. There are few traces of brick walls, certainly dating back to a subsequent phase and probably to a consolidation intervention. In some environments it is still possible to observe the type of floor used, consisting of a main frame with wooden beams with an almost quadrangular section and a secondary frame with wooden strips with a circular section to form a canopy. There are also particular small niches obtained in the wall thickness, with a semi-circular shape and made with splinters and scraps of stone and brick. At last, it is interesting to observe how some curtain walls of the enclosure and the towers are characterized by the presence of small holes: quadrangular, with a section of about ten or twenty centimetres, intended for the pontoon holes, and circular holes, in diameter of about ten centimetres, intended to host connection and reinforcement beams between the curtain walls of the masonry. These holes, visible above all in the central tower on the northern side (Fig. 13), suggest the use of the *opus gallicum* technique, very common in medieval construction sites, especially in fortified works of the Norman period, such as in the the case of the castle-enclosure of Roccamandolfi (Marino, Dinelli, Nenci, 1996; Marino, 2008). The *opus gallicum*, so called because it was described by Caesar in *De bello gallico*, provided for the use of wooden beams as chains between two curtains of the masonry and was a technique used both for consolidation and for reinforcements already under construction, especially useful for seismic risk areas, as Pesche has always been. Furthermore, this tower still retains small typical loopholes of medieval defensive structures.

5. Conclusions

In its many centuries of history, starting from the first agglomeration built on Monte *Pesclatura* up to the partial abandonment of the last century, Pesche, and especially the fortified city developed inside the enclosure, has been evidence of the traditional building site of the region, based on the use of simple and easily available materials on site and using construction techniques suitable for the nature of the area.

Fig. 13. Central tower with circular holes (2021).

The presence of excessive vegetation and the continuous collapses of the structures certainly represent an obstacle to the overall knowledge of the site and its accessibility, but the characteristics and authenticity of what remains of the historical environments can still be preserved by a careful conservation and enhancement project. This state of decay and neglect, which unfortunately unites many other minor centres, both on a regional and national scale (Russo, Pollone, Romano, 2020; Varagnoli, Serafini, Verazzo, 2020), today compromises the use of the many fortified structures that characterize Molise and in particular of those located in the inner areas, in those territories considered too often fragile, but which should be considered «strategic places for the care of the territory» (Oteri, 2019 , p. 169). Therefore, the same feeling of nostalgia that pervades us as we pass through these places that must become the engine to rethink their future (Teti, 2017), understanding the real resource that these territories can represent for the national heritage.

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Light Touch on the land – continued conversations about architectural change, informality and sustainability

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Topic: T1.2. Urban studies of vernacular architecture

Abstract
Including 'informally constructed' buildings in the cornucopia of 'vernacular' has its opponents. They are not visually compelling, strongly represent the 'other', and their unpopularity derives from worldviews that prioritise 'architecture' as modernity rather than, perhaps, 'buildings' as humanity. However, it is argued that informal settlements are not only the kernel of new cities (using modern ma-terials), but are inevitable and sanitized by health legislation, with slum 'clearing' having different potentials, to 'slum building'. Considering informal settlements in Pietermaritzburg, South Africa in the early 1920s, and subsequent slum clearances due to post-War health legislation, tracking their continued negative, (and ambivalent connotations at the end of apartheid), and most extensive manifestations in current times, this paper considers informal settlements as recyclers of matter, distinct representations of cultural change (from the rural to the urban) and vectors of opportunity (driven by early health legislations). For the global north, which assumes culturally static societies, advocates for carbon-neutral construction, and renew-able construction materials and recycling, there is possibly much we can learn from informal settle-ments, addressing complex and diverse world views, recycling, political organization and spatial plan-ning. Also, viewed from the lofty perspective of the global north, such vernaculars are viewed derisively, are the focus of multiple, globally-crafted sustainable development goals, and are considered as 'prob-lems' rather than, 'solutions'. Thus, migratory trajectories, social and cultural change, and the contin-ued use of existing and found materials is real for many millions of people globally. These constantly negotiated territories provide compelling ground for re-assessment, reflection and repositioning, inter-pretation of the vernacular.

Keywords: *modern vernaculars, informality, slum, negative vernaculars*

1. Introduction

Contemporary lenses of informality and, particularly, informal dwellings, suggest that such structures disrupt the *status quo* of what we consider 'civilized' (a loaded word), and rather evoke disquiet, reinforcing the process of 'othering'. However, this paper argues, they are fundamentally important in the growth of new settlements in the developing world. Their aesthetic unpalatability is perhaps due to the use of unsophisticated materials, rather than their actual form and representation. Indeed, Paul Oliver reflected that the line between vernacular and informal is slim (Oliver, 2016); these tenets are truer today, more than ever. This paper considers informality in its broadest, historical sense, comprehending the challenges of contemporary South Africa through the lens of the reasonably immediate past. It considers white settlers in Port Natal (now Durban) and their first, rudimentary buildings, before presenting examples in Pietermaritzburg to contextualise informality as inevitable. It posits that our attitude needs to include informal dwellings as vernacular, and not as inconvenient step-children of the more resolved aesthetic, commonly discussed.

2. Placing informality in the vernacular

John FC Turner reflected in 1968 that, 'There is nothing new about urban slums and marginal squatter settlements; both have a history as long as urban poverty, but together with the unprecedented growth of cities in the modernizing world, they have grown enormously during the past twenty years. Indeed, slum-dwellers and squatters far outnumber the better housed in virtually all developing countries, and squatter settlements are currently growing at twice the rate of cities as a whole' (Turner, 1968: 120). Turner inverted the narrative, considering slum settlements as energetic and progressive, rather than couched in negative 'informality'. He considered the Peruvian examples of the *barriada* and *corralon*, both superficially considered as 'slum', suggesting that, '…both types of settlement are clandestine and superficially similar, they have different origins and functions as well as different destinies'. Tracking trajectories of development in the *corralon* he suggested that, 'the owner - or I don't think this title fitstenant - found it more profitable to sell - or to rent- tiny plots to immigrants or to families evicted from city-centre slums'. Citing cases in which stable populations emerge, families convert matting houses into earthen buildings but do little more due to insecurity of tenure (Turner, 1968, p. 120), Turner refers to slum removal as being inevitable due to expansions of cities and the need for additional land for development (Turner, 1965, p. 154). Such slum removal, whilst seemingly deliberate and ethnically-focused in colonial societies, and certainly racially-focused in South Africa, has its roots in greater discourse. Sue Parnell conextualises removals from urban slums in South Africa to trends in Europe at the same time: Citing Schiffers (1976), she notes that, 'The revival of conscience which motivated slum clearance at the time may be attributed in part to an imported awareness from Europe where the movement to rid cities of slums had gained new vigour' (Parnell, 1989, p. 265). Certainly, slum removal in Pietermaritzburg in the 1920s responded to imported post-World War I, notions.

Anthropologist William Mangin firmly couched the liminal experience of informal settlement dwellers within the genre of peasantry studies, popular at the end of the 1960s (Mangin, 1970). This was revived by McGee, who recognised the fluid nature of slum settlers and the inability to categorise them in their 'settlements', but the necessity to view rural urban migrants with a much greater lens. He upsets the static notions of settlement and the fixed understanding of rural/sacred urban secular labelling, although to a large degree, there is much to merit these categories in considering contemporary black middle-class homes in South Africa today, and their relationship with the rural (McGee, 1973). Indeed, these discussions in the early 1970s informed the the 1976 UNCHS Habitat conference in Vancouver.

Placing informality firmly within the vernacular has thus been long in the making (Rapopport, 1988). It was proactively revived by Paul Oliver in *Built to meet needs* (Oliver, 2006, pp. 384-393) in which he considers Turner's *corralones* in addition to other examples in Lima, the *pueblos jovenes* or 'young town'. For western scholars the need to categorise and assess, mitigated to some extent, the fluidity of these structures. It is now vital to move discussion to KwaZulu-Natal.

3. Informality in Pietermaritzburg

Accounts of early white settlers in Natal Colony reveal a total reliance on vernacular materials and to some degree, forms, until a more settled status allowed for the independent and piecemeal manufacture of materials to build homes which fulfilled the aspirations of their homelands of England and other European countries. Whilst the construction of these 'home-made' buildings relied to some degree on community support, many of the original homesteaders made their own bricks, tiles and other construction materials, with eventually, materials such as corrugated sheeting and cast and wrought iron, sourced from foundries in the north of England. Accounts, such as that by Eliza Fielden (Fielden, 1973), describe original homes as being constructed with help from local Zulu people, often strongly resembling the traditional Zulu beehive (*iqhugwane).* Importantly, the growth of these small settlements, particularly that at Port Natal (now Durban), meant the gradual promulgation of building by-laws which controlled the materials used. What we now term 'rough' or rude buildings were necessarily strongly couched in the vernacular, and as such form the baseline for discussion.

The next section introduces Pietermaritzburg. It describes 'informality' as being redolent not only amongst Africans, but as primary shelter for many white and Asian people, the latter arriving in the late 19th century, either as indentured labour on sugar plantations, or as 'Passenger Indians'; people of higher caste who became traders. This paper considers the vernacular through the lens of informality, as spontaneous, shelter-driven homes which reflect temporal changes in period and material. It suggests that pre-industrial vernacular utilised materials of natural origin, and holds that including industrial, 'found' materials such as corrugated iron and steel windows, comprises the vernacular as much as those sourced directly from the environment.

3.1. Colonial and settler Pietermaritzburg

Pietermaritzburg, the capital of the contemporary province of KwaZulu-Natal is a small city situated some 80 kilometres from Durban. It is situated on a number of small *spruits*, or creeks, but is dominated by the Msunduzi River which flows through the city. As a temperate zone, and central to good grazing, the Boers, people of Dutch origin, moved into the area in the late 1830s. They joined African people, now considered as Zulu, who were also cattle keepers and resident in this savanna or *thornveld.* Their first buildings were settler vernacular, often a two-roomed building housing both family and livestock. Roofs were often high *wolwe-end* (Dutch hip) or double-pitched and thatched with straw, endemic to the area. They used local shale for walls, and often polished their floors with cow dung, in the same manner as the local Zulu. British settlers also used local materials: George Mason describes making his own bricks on the *erf* that he owned in Pietermaritzburg in the 1850s, trampling the mud at night, when nobody would see him. He noted in his journal, '…we thought it as well not to afford them the opportunity of seeing two Cambridge men knee-deep in mud treading brick clay' (Mason, 1855 [1968], p. 167), reinforcing the vernacular as primary, facilitating settlement and shelter, but also made of locally- sourced and hand-made materials. Many living in Pietermaritzburg in the mid-1850s would have built similar homes, and most likely not in such a formally, constructed manner. Corrugated sheeting, a stalwart of 'informality' in South Africa, was readily available in Natal Colony around the late 1850s (Radford, 1997, p. 36). It was invaluable for building quick, robust shelter for settlers, who ordered buildings in kit form from traders such as HV Marsh, in Pietermaritzburg. With relatives across all former British colonies, wood-and-iron buildings promoted rapid settlement, and normalized the use of corrugated iron sheeting. For the inner city, this became gradually 'problematic': Radford describes building regulations from 1895 which prohibited wood-and-iron housing in the city, thus gradually formalizing material through law (Radford, 1997, p. 35). Settler towns were formal, laid in grids in the Dutch format, with buildings of locally-sourced material – mud brick, stone, timber (often Yellowwood – *Podacarpus falcatus*), lime mortars and plasters, and catalogue flourishes imported from England such as cast-iron columns, balustrades and lightposts. Accounts often describe first homes as rudimentary, of locally-sourced, organic material, with 'formal' (socially acceptable) homes constructed as a result of financial and social stability, reiterating Turner's (1968) comment of improvement through stability.

The end of the 19th century was a politically and economically complex time for Natal Colony. By 1910, it was compelled to enter the Union of South Africa, an agglomeration of four colonies which spatially comprise the contemporary nation. The Union supported the British in World War I, and lost about 500 000 people to the Spanish Flu. The indelible connection to Britain together with the Spanish Flu, drove housing policy: Sue Parnell connects post-War formal housing policy in the Union, specifically that for Africans, to the latter, blaming excessive deaths on, 'Abject living conditions, particularly among African communities' (Parnell, 1989, p. 263). Diversionary politics, war and the pandemic meant that little building occurred between 1900 and 1920. Further, the South African War (1899-1902) had swelled the population, as many British soldiers remained (Parnell, 1989, p. 262). The dearth of housing, and the tradition of 'self-building' still prevalent in South Africa today, continued, coinciding with large numbers of Indian settlers completing their indenture, and needing also, a place to live. Cities thus became surrounded by informal dwellings, which at the time were referred to as 'shantys' and 'slums'. Considering the rollout of public housing Parnell notes that, 'Historically, the racial character of the slums of South Africa has been blurred. People of all hues sought inexpensive shelter near to work or near to possibilities of work' (Parnell,1989, p. 262). The slums around Pietermaritzburg were no different.

3.2. Post-World War 1

In the early 1920s, further post-war immigration to the city presented problems: It was not only people moving in, but also moving out. Trevor Wills describes the gradual move of Indian people out of the prescribed zones of the inner city, to take advantage of open land just beyond the city limits on riverbanks on which they could practice market gardening. Wills mentions the Dorpspruit (forming a northern boundary to the original city layout), as well as an opportunistic settlement along the banks of the Msunduzi River, in the alluvial areas of Pentrich and Camps Drift (Wills in Laband & Thompson, 1988:39). Issues with these settlements arise frequently in the Borough Medical Officer's *Reports* together with descriptions of density and texture. Drawing strongly on Turner's experience of the *corralones* and expansion of settlement through leasing land to new settlers, the 1926 *Report* records that, 'Thirty dwellings in New Scotland were examined, and they were…occupied by 430 tenants, of whom 240 were Indians and 190 Natives. In six dwellings on Hathorn's Hill there were 86 tenants, of whom 35 were Indians and 51 Natives. In six dwellings on Forsyth's property there were 78 tenants, 16 of whom were Indians and 62 Natives.…The provision of housing for Natives must therefore be antecedent to any attempt to improve the housing of the Indians living on the outskirts of town' (Pietermaritzburg Corporation, 1926, p. 68). Pentrich consisted of around 166 acres, and its ideal situation between the river and the city made it perfect for market gardening. However, it was also below flood level. The land was owned by the city itself, as well as the brothers Forsyth, and the estate of Bodasingh, who all leased the property on a monthly basis to Indian and African people who built their own dwellings, described reluctantly by the Corporation as "shacks". The description is clear: 'They are constructed of old iron, wood, petrol tins or mud. They have earthen floors and no windows. They are cold in winter and hot in summer and freely admit the rain and the wind. In some of these dwellings a single family only, Indian or native, is accommodated, but to many additional rooms have been added for the accommodation of lodgers. These additional rooms are of the same type of construction as the original shack. The number of persons living in one of these shacks, enlarged to take lodgers, is in some cases twenty or thirty. The lodgers are in most cases native families' (Pietermaritzburg Corporation, 1931, pp. 71-78). Apart from pit latrines, sanitation, was non-existent, as was refuse removal. Potable water was inadequate, although the river provided water for washing and the roads leading through Pentrich were unsuitable in wet weather. The report records 183 dwellings, housing 1717 residents in total, with an average of 9.4 inhabitants per dwelling. Medical Officer Dr. Woods evaluated five of these buildings as being 'good', 45 as being 'fair' and 133 'unfit for habitation'. Hathorn's Hill to the north-east of the city was leased by one Tajoodeen; it reflected the situation in Pentrich, but with different topography. Unlike the alluvial plain of Pentrich, Hathorn's Hill is steep, hosting 83 dwelling owend by both Africans and Indians, with a total of 1022 inhabitants averaging at 12.3 people per dwelling. The Borough Medical Officer assessed, '…practically 100%' of the dwellings were unfit for habitation (Pietermaritzbueg Corporation, 1927, pp. 71-78). The materiality of these urban slums of the 1920s is significant; '…old iron, wood, petrol tins or mud. They have earthen floors and no windows' (Pietermaritzburg Corporation, 1927, pp. 71-78). As naturally-derived materials which erode and rot, old iron, petrol tins and wood are local, scavenged or 'found'. Earthen floors are typical of indigenous structures, perpetuating traditional technology, and windows are considered inappropriate in the traditional Zulu *iqhugwane*; the liminal position of these buildings between tradition and modernity is reinforced; even today windows are considered unwise as they let potential thieves see in.

3.3 Slums and disease

The adverse situations described above led to an impetus to provide social housing. Slum clearance responded to a swathe of legislations in the Union, starting with a direct response to the British *Ministry of Health Act* (1919), in the Public Health Department promulgation of *Act no 36 of 1919 (To make provision for the public health).*

By the 1930s, slum clearance was a firm agenda of the Union Government. Whilst Parnell connects this to race-based policies (with which slum clearance in South Africa is strongly nuanced) and being able to support what is generally known as the 'poor white problem', she notes firmly that, '…in the early 1930s the problem was made worse by world depression and national drought' (Parnell, 1989). In Natal province particularly, a number of malaria outbreaks between the early 1920s and the 1930s exacerbated the issue. Standing water, lack of sanitation and marginal living conditions resulted in a notable malaria season in 1930 which had repeated outbreaks: The Public Health Officer for Pietermaritzburg recorded efforts mitigating standing water, building emergency drainage and anti-larval campaigns (Pietermaritzburg Corporation, 1933). Malarial events impacted more on wetter coastal areas, and timber and sugar barons whose labour lived in self-built homes known colloquially as *schoomplaats*, were compelled to reconsider housing labour, leading to formally-constructed labour compounds from the late 1930s (Whelan, 2016).

Significantly, this paper is largely situated in a period of Southern African politics which deals with racially-motivated settlement. Discussions in Natal Colony as to the need for a Native Village, given the informal situation in which many Africans were living on the peripheries of the city of Pietermaritzburg, had been underway for many decades. Wills describes Africans squatting on the Townlands of Pietermaritzburg, and then the following year, official motions passed by Council to build a Native Village to formalize the situation, and effectively remove people who were squatting on townlands, to the periphery of the city (Wills, 1988:40). Subsequent years produced plans: a village of 200 half-acre plots for lease or sale to Africans, with sites proposed for a Church and a School did not find favour with white public (Wills, 1988:40). The eventual construction of the Native Village, now known as Sobantu was promoted by the Medical Officer for Health who, '…firmly believed that the slum conditions that had developed in peripheral shanty settlements could not otherwise be eradicated' (Wills, 1988, p. 40).

3.4 Slums and the apartheid city

The development of the 'apartheid city' was reinforced by the *Group Areas Act* of 1950, which sought to separate people dependent on race. It intended to remove 'unnecessary points of contact' between people of different races, and create zones within and beyond the city for white, Indian, Coloured (mixed race) and African residents. Indeed, in 1988, as Wills notes, whites had an 'adequate to oversupply' of housing, Indians and Coloured an 'extreme undersupply, and for Africans, an 'extreme undersupply of "formal" housing' (Wills, 1988, pp. 41-42) suggesting that, at the time of late apartheid, informality continued despite the efforts of the government to control it. Wills records that (for 1988), '…demand for housing...in Pietermaritzburg is reflected in the proliferation of backyard shacks and informal extensions to houses in Sobantu [the Native Village] and Imbali. These *amalawu* or *imijondolo,* as they are known, house family members, or lodgers taken in to supplement incomes. In some cases they represent the first stage of an upgrading of the basic house by the occupants, and may be superseded by more elaborate structures later, when the family income permits' (Wills, 1988:43). Reflecting the descriptions of the Chief Medical Officer in the 1931 Corporation *Report*, Wills describes similar incremental development in Indian and Coloured (mixed race) residential areas in 1981, noting 163 examples of which 115 were in the Coloured area (Wills, 1988, p. 43).

Indeed, The Pietermaritzburg Corporation Minute Books record the formal slum removals. In 1933, the minute books note that '…the commencement of the cleaning up of the Camp Drift area, and the moving of the Natives from the shacks which they occupied there…the bulk of the Natives have been moved, and a large number of buildings have been demolished (Pietermaritzburg Corporation, 1934, p. 18). Significantly, the records of the Sewage Engineer, note that the city at that time was under pressure to include other slum areas beyond the immediate boundaries of the city, 'which in a very short time will develop into additional slum areas' (Pietermaritzburg Corporation, 1933, p. 49). The 1933 report refers to a number of areas in closer proximity to the city. Stevens, the Manager of the Corporation Native Affairs Department, records that, 'Most of the Natives residing in the shacks in Camp Drift area have been removed as, also have Natives occupying premises in Chatterton Road and Boom Street which have been condemned by the Medical Officer of Health' (Pietermaritzburg Corporation, 1933, p. 86). Significantly, given that Boom Street is in the centre of the formally laid out city, and Chatterton Road is an arterial route directly out of the city, the nature of the buildings destroyed, whether formal buildings which were merely ramshackle and dilapidated, or structures which were self-constructed by the dwellers, is not known. One such informal settlement reported in the 1930s is that known as the Fitzsimmons settlement which was located on the fringe of the city, also along the Dorpspruit river. This settlement, it is argued, is indelible: it was located in what is today Fitzsimmons Road, which runs parallel to the N3 national highway between Durban and Johannesburg. Manifest today, and in close proximity, it is known as Jika Joe, after a notorious minibus-taxi boss from the early 2000s.

4. Informal settlers as recyclers

Jika Joe flexes and wanes through crisis and event; whether flooding due to its location on the stream, but also fires which are common events in settlements with illegal electricity connections and continued reliance on candles and parrafin stoves: ' "We are all scared of fire,"…, "but we are terrified of electrocution. My God, the *izinyoka-nyoka*." …Residents say 11 people, including three children, were electrocuted…by the improvised electrical connections known as *izinyoka-nyoka*, low-hanging wires that snake through the shacks….(Arde, 2022). John Robinson describes Jika Joe's materiality and quality of life; '…its bulk is made of mud, scraps of wood and cardboard, the roofs…are sheet metal, bits of hardboard and tarpaulin sales (sic) blown off passing trucks on a nearby highway' (Robinson, 2020). Greg Arde reinforces this, noting, 'About 4 000 people now live in homes of wood, plastic and corrugated iron, crammed between the economic artery that is the N3 and the Dorpspruit River, which often floods' (Arde, 2022).

Important to include in the discussion of materiality is the addition of plastic to the building components: given that much plastic technology was developed around and during World War II, earlier settlements in the city, such as that at Pentrich, also used this general material toolkit, most of which readily decayed, given its organic nature. The more recent use of plastic removes informal dwellings from a robust, 'authentically' constructed building using locally available materials fulfilling the tenets of definitions of vernacular, and introduces new, pliable materials which are unsightly, not necessarily decomposable, and relegated to the realms of 'rubbish'. This is a significant element of the conversation as it brings non-organic materials into the mix. Whilst it is accepted that traditional slum settlements consist of found materials, Robinson's relating of reuse of tarpaulins blown off trucks, handy for waterproofing in a wet summer, speaks to a general sustainable principle of recycle, reuse and redistribution. It breaks some of the momentum of consumption, and whilst not ideal, elements of accommodation, differ little from the informal and formal dwellings of early white settlers, and Indian and African landlords in the past.

5. Informality representing cultural change

Rural urban movement is recorded as an ímpetus for the growth of informal settlements, both historically and in contemporary times. Significantly, and particularly for groups such as the Zulu, these represent liminal moments which may extend for years. William Mangin's lens is useful to contextualise the situation of informal dwellers in South Africa. I have argued previously that informants indicate that informal settlements are inappropriate for ancestors as they are too noisy (Whelan, 2016, p. 127). This statement perpetuates a distinct separation of the rural and sacred, and the urban and secular; these homes demonstrate interstitial moments between. Informal settlments allow for an entry into capitalist societies and as Nnamdhi Elleh argues, modernity (Elleh, 2011); as such lifeways and traditional priorities are suspended with threads of the past, such as stabilised earth floors and minimal fenestration, bleeding through.

6. Informality as a vector of opportunity

Informality as access to opportunity is extensively described by Oliver and Hayward (1990), but each settlement, as the authors point out, has their own regional 'flavour'. Robinson describes the social texture of Jika Joe: 'Squeezed in between these dwellings are walkways and taverns where the people of Jika Joe walk and drink together and roundabout the children play…there is no centralised system ordering life as in the surrounding city. Rather, Jika Joe just has many slum lords who rent out their small rooms to whoever needs a place to live that is close to their place of work in the nearby central business district of the city' (Robinson, 2020). Kweyama is one such example, as Arde records that, 'Kweyama has lived in Jika Joe since she was 23. She says the settlement provides cheap shelter for people flocking to town for work and school' (Arde, 2022). Kweyama's reason for settlement illustrates the primary opportunity. However, opportunity for access to extra income and housing runs deeper. Many informal dwellers have been allocated government issued housing in the former township areas, which they rent out, choosing to remain in their informal dwelling. As residents of informal dwellings, they are prioritised for allocation for formal housing, and many wait for this opportunity to arise. Recently, what was once the Tatham Community Ground (constructed for non-white residents during the 1950s) has been subsumed by state-provided housing which Arde notes: 'The squalor of Jika Joe is juxtaposed by the big new state-housing project next door…14 four-storey blocks painted in pastel colours sit behind a fence – the site has been boarded up for months, despite 404 of the planned 760 apartments being ready for occupation. The state has committed to having the flats filled by May, but officials are wrestling with who will occupy the buildings that have cost the government R164 million so far' (Arde, 2022).

7. Reassessment, reflection and repositioning

Judith Ojo-Aromukudu focuses on these practicalities, of seeing the informal as a critical element of the contemporary built environment but particularly focusing on attitude. She describes in detail the lack of light, suggesting that, 'The interior lighting was of poor quality, with natural light streaming in through joints and openings between the walls and the roof in absence of the windows' (Ojo-Aromokudu, 2019:14). Ojo-Aromokudu suggests that this gloom is common in indigenous dwellings, particularly that, 'The sudden change in perceptive ability due to poor lighting disorientated any stranger on entering the dwelling thus giving the occupants the opportunity to welcome or refuse such a visit' (Ojo-Aromokudu, 2019:14). This descriptive image supports not only a visceral need to verify the intent of visitors, but supports that, in traditional societies, dark interiors provide an appropriate gloom in which to venerate ancestors. Firmly repositioning 'informal' in the vernacular, of the past, of material change and into contemporary times, begins to remove 'othering': considering vernacular as an inevitable continuum, process of active change and city building, is now more than ever, vital, if we are to address any of the UN Sustainability Development Goals. Oliver and Hayward noted that buildings in 'unauthorised expansions of the urban areas' around the world have, '…a number of elements in common, but many are special to each one' (Oliver and Hayward, 1990:147-147). This vernacular element is critical in assessing regionality, identity and built environment not as a global mass, but as inevitable vernacular responses to social, political and economic challenge.

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VERNACULAR ARCHITECTURE: MATTER, CULTURE AND SUSTAINABILITY

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The stone as constant presence: vernacular structure of the cultural heritage of Porcuna (Andalusia, Spain)

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
Human settlements, throughout history, have been characterised by the proximity of places of natural wealth, in order to perpetrate life and to strength their own anthropological and material culture. This is the case of Porcuna, a village in the province of Jaén (Andalusia, Spain), with more than sixty centuries of interrupted human presence. The main natural resource of the area is a deposit of sandstone used for three million years. The above-mentioned stone has been the constructive material in this territory for all the ages, marking not only its material culture but also its own social anthropology. Considering the durability of this material, it is possible to appreciate that its use has remained unvaried in spite of continuous changings concerning techniques or demands. The presentation deals with several cultural heritage buildings in Porcuna, carried out with the same local sandstone, from the Roman amphitheatre (I century b.C.) to the so-called Casa de la Piedra (XX century). Starting from this analysis, it is possible to observe that the same material has been used, over the years, in different cultural heritage buildings that have been affected by the same stone deteriorations. Basically, a single material has produced a vernacular culture conformed to different moments in the history of the village, allowing to preserve some relevant cultural heritage architectures.

Keywords: *stone, cultural heritage, Porcuna, stone deteriorations.*

1. Porcuna, stone and water

Porcuna is a municipality located in the province of Jaén (Andalusia, Spain). In spite of the fact that it is suffering a process of depopulation exacerbated in the inland villages, in ancient times it was one of the most important villages in the south of the Iberian Peninsula. Its location on a promontory and the geological structure of the subsoil have been the conditioning factors that have configured Porcuna as an urban nucleus with more than sixty centuries of uninterrupted presence in the same place.

Although being surrounded by an extensive and fertile countryside, that guaranteed a future in terms of agricultural production (especially wheat and oil), it was even more important to be located on a sandstones soil of exceptional characteristics, as well as the existence of water levels between these strata. The above-mentioned characteristics allowed this village, with previous settlements of the copper and bronze age, to develop a settlement that has lasted until the present. The stone, therefore, has been the *fil rouge* of this millenary culture, representing the feature that has allowed Porcuna to have its archaeological and architectural heritage (Chapa et al., 2009).

The stone has been generating its own construction systems, organization strategies and even characteristic typologies. These features highlight how the derived heritage, over the years, has been the result of a concrete way of applying this material with specific limitations.

Fig. 1. Subsoil section of Porcuna, in which it is possible to observe the different stone strata alternated by soft betas. (Source: Belmondo, Millán, 2022).

Nowadays, the quarries are still open and the stone is still worked. In some of the cases reported, each historical era has been carrying out a concrete way of building, both technically and aesthetically.

At present, though it is still a natural resource of the territory, the incursion of new materials on the construction industry has blurred the vernacular image of Porcuna. However, the Porcuna sandstone still has a relevant presence in the main representative monuments and buildings. In the context of heritage enhancement, the current government team aims to recover the stone of Porcuna as the key element of the municipality. The promotional campaign "Porcuna, a paradise in stone" aims to underline that this material can generate a rich heritage and could represent a bet for the future.

This research wants to analyse the historical use of stone as building material as well as the different developed constructive typologies. For this purpose, a deductive methodology, based on the patrimonial vestiges that still remain, has been carried out, showing how, finally, the construction processes have been conditioned by this local material. Consequently, the research has been structured in order to establish the common factors that have remained unchanged throughout history, from Roman ruins to the medieval and contemporary architectures.

2. Characterization of the Porcuna stone

Porcuna sandstone is a sedimentary rock widely used as a construction material (Cultrone et al., 2012) that, like all stone materials, can present alteration problems because of its formation in strata of different thickness and hardness. They vary depending on the composition, texture and environmental conditions (Charola, 2004). These rocks, due to their optimal characteristics as a construction material, have been widely used in the Andalusian architectural heritage and in particular in the area of the Jiennense countryside (Urosevic et al., 2011). The main problems of alteration of these rocks consist in the formation of surface deposits (salts and black crusts) as well as biological colonization. Though deteriorations typologies have been specifically studied and some technical solutions have been found for their treatment, the primary problem of the soft strata sandblasting still remain.

Fig. 2. Detail of the quarry with the alternance of soft and hard layers. (Source: Belmondo, Millán, 2022).

The deterioration provoked by salts is one of the major degradation mechanisms affecting historic buildings (Rodríguez-Navarro and Doehne, 1999), especially when salts are highly soluble in water and are transported into the porosities of the rock. From the geological point of view, the *Piedra Dorada* (commonly called in geological contexts) is a fine-medium grained bioclastic calcareous sandstone, which belongs to the deposits of an age between the Upper Tortoconian and the Messinian of the Guadalquivir Basin (Postorogenic Neogenic Basins of the Betic Mountain Ranges; Roldán, 2011). On a macroscopic scale it is very hard to distinguish the different varieties. The colour varies from yellowish-orange to greenish-grey. It occurs in very continuous strata ranging between 10-20 cm thickness with interspersed centimetric loamy strata (Gisbert et al., 2017).

In the Porcuna area, the deposits are dated back to the Messinian age, and the stratification is composed by an initial interval of about 20 m thickness of a sandy, massive, partially cemented part, with abundant content in bioclasts, followed by a part of about 14 m composed by an alternation of cemented bioclastic sandstones between which centimetric levels of grey-bluish loams are interspersed. This initial interval is followed by a part of about 6 m of rhythmic alternation of sandstones, blue-grey marls, grey-blue and white marls (Cárdenas et al., 2008).

This characterization of the Porcuna sandstone has been the cause of all the morphologies and constructive developments of the village. By alternating hard and soft strata, the constructive limitations have been overcome applying new techniques. It is worth to emphasize that, although everything is limited by the thickness of the hard strata, there have been constructions carried out with ashlars of large stone thicknesses. Because of such circumstance, these buildings have been damaged by relevant deteriorations no more solvable. It is also worth noting that, thanks to the geomorphological limitations described, Porcuna has an architecture and a stone constructive technique which are very specific and exclusive of this municipality.

3. The extraction of the Porcuna stone as the genesis of a vernacular process

The process of extraction of the stone is determined by the banks or deposits of stone from which the extraction is proceeding. As described above, there is an alternation of layers of different hardnesses. This is what defines the process by which the stone is obtained from the quarries of Porcuna. Though previously there were more places of extraction, due to the decrease of demand, today only three fronts of extraction remain.

The process by which the stone is extracted is still the traditional one dated back to centuries ago, by levers in the first place and then by mechanical processes when the stone block has been extracted. The first moment is the selection of the terrace on which the stone will be removed. Once selected and after delimiting the size, various steel wedges are nailed to the head of the piece and are gradually introduced into the soul of the stone. These wedges are usually located on the soft board, so that quickly, once they are beaten, they break the hard-stone reef and the stone slab comes out. This system allows to extract large pieces but with minimum thicknesses as mentioned before. This extraction process generates numerous small pieces or wedges of stones that are used to settle the large slabs in the construction.

4. Stone construction systems

Considering all the limitations that the Porcuna stone has due to its geological formation, throughout history it has been used, overcoming those limits and generating different forms or constructive systems. These systems have configured not only a way of building, but also a way of occupying the territory and a peculiar aspect for the future generations.

4.1. *A hueso* constructions and *emparejos*

The architecture made of this stone does not allow, in most cases, the use of mortars. It only allows the use of mortars or lime consolidants. Due to the properties of sandstone, if cement is used, it would cause relevant pathologies. When the cement enters the stone (considering that it is a very porous stone), it breaks its structure reducing its bearing capacity. Lime, on the other

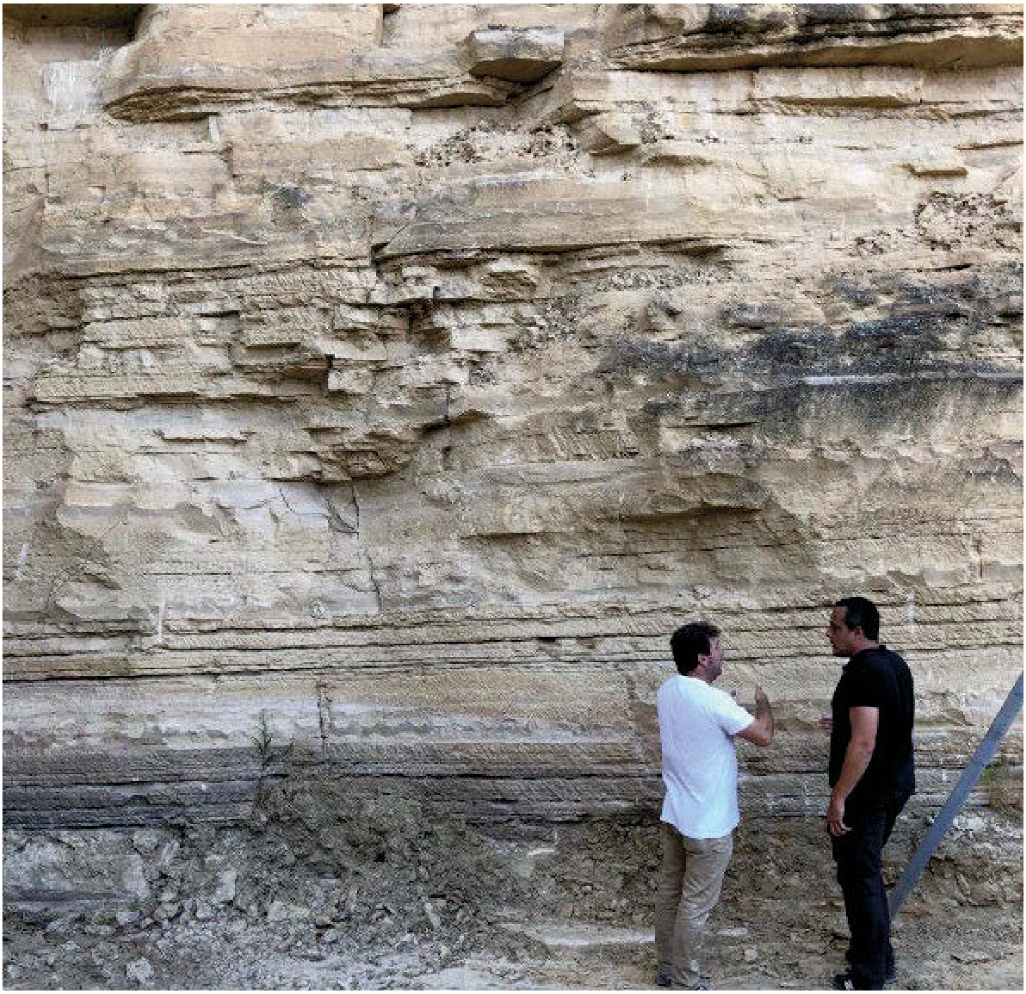

Fig. 3. Image of one of the historical quarries operating until recently. (Source: Belmondo, Millán, 2022).

hand, would be a natural hardener. However, the recommended and most used system in Porcuna, is the so-called *emparejados* system, that is, a system by which stone is used without mortars and is minted with small slabs of the same stone. This is the system known as *a hueso*.

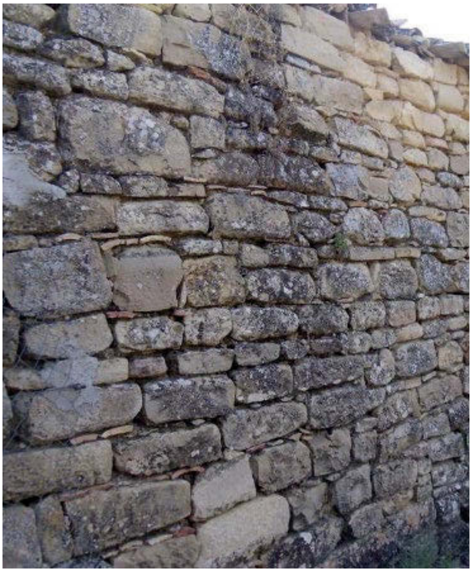

Fig. 4. Detail of a wall in Porcuna without mortar (*a hueso* construction). (Source: Belmondo, Millán, 2022).

4.2. Partition walls of *losetas*

Due to the internal structure of each of these hard-stone strata, it is easy to extract pieces of large flat dimensions, with large slabs. These, throughout history, have been used as separations of rooms, as partitions of solid stone, arranged in the so-called position *de canto* ("sailor" courses), known in the municipality as partitions *de losetas*. Although the boundaries were not usually regular, master stonemasons used wooden wedge systems to adjust them. After this, with a minimum amount of plaster, they managed to adjust them in a stable and safe way.

Fig. 5. Detail of a partition wall of *losetas* (blocks on "sailor" courses). (Source: Belmondo, Millán, 2022).

4.3. Load-bearing walls

Considering the small dimensions of thickness of each stone strata, the load-bearing walls used to be made of small volumes of stone but of great thickness. These load-bearing walls, although to the outside they showed an orderly configuration, the interior (known as the "soul" of the wall) was configured by small fragments and a minimum mortar that gave consistency to the wall.

All the residential constructions of the village have been built using this system. Once the structural enclosure of the house was delimited, all the interior separations would be carried out by means of the already described system of partitions with *losetas*.

Fig. 6. Test about the internal composition of the façade of the Royal Butchers (16th century) in Porcuna, during the restoration process. It is possible to observe that the façade is charachterized by an orderly configuration, instead the "soul" of the wall is composed of filling material without any consistency. (Source: Millán, 2014).

Fig. 7. Detail of the process of extracting the stone from a load-bearing wall to analyse its internal composition. It is possible to observe that the wall is without mortar but just a mud poor in lime. (Source: Millán, 2014).

4.4. Unique elements

The Porcuna stone generates, fundamentally, two types of stones. A very hard and waterproof stone, called *viva* and a softer one called *arena*. The first one has been used for the development of all the unique and specific elements in the monumental constructions. Thanks to this double type of stone, a large part of the unique heritage elements remains intact. Likewise, this double nature of the stone allows to establish two directions in the construction: the massive elements, whose objective is to support the structure, and the more stereotomic elements, which require a better definition in the design.

4.5. Claddings

The structure of the stone allows to develop large flat pieces. These have been used to cover large facades. With this system, vernacular typologies of facades have been built, limited by the thickness of the stone. It is interesting to analyse how today they are still built in the same way as they were centuries ago. Being stone cladding, its layout and design have been preserved perfectly throughout history. For this type of surface typologies, various finishes have been configured, with different ways of working the stone.

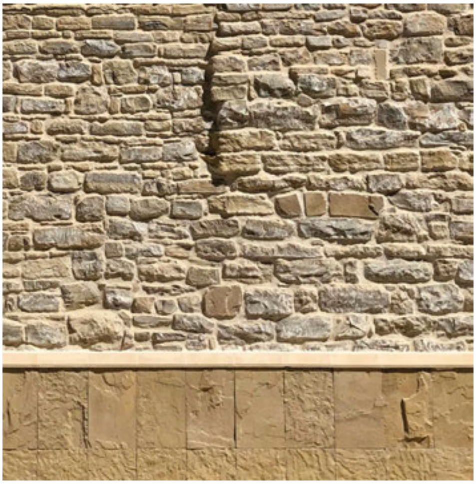

Fig. 8. Detail of a stone cladding in the lower part of the façade. (Source: Belmondo, Millán, 2022).

4.6. Constructions with *zamarrones*

The union of hard and soft strata is colloquially called *zamarrón*. This constructive element has a double nature so the rigid part remains unchanged over time while the soft part deteriorates rapidly. It is unique to see how, these stone blocks, when cut, have bearing capacity in all their dimensions, and it is over time when they lose it. This is the reason why many constructions in origin were developed with these blocks cut into large dimensions and have not stood the test of time. It is worth mentioning the example of the Parish of Ntra. Sra. de la Asunción, completed in 1885, according to the project of the architect Justino Flores. This construction was carried out with *zamarrones*, and today this building shows relevant deteriorations due to the soft stone used in it.

4.7. Floorings

The Porcuna stone has generated numerous possibilities for the construction of other elements, such as pavements. Throughout history, there has been the use of large pieces for pavements in slabs as well as pavements in small pieces. All these have been executed with the stone called *viva*, since the so-called *arena* could not be suitable for this use.

In various archaeological campaigns, it has been possible to verify how the floorings have remained unchanged and the same technique is still used.

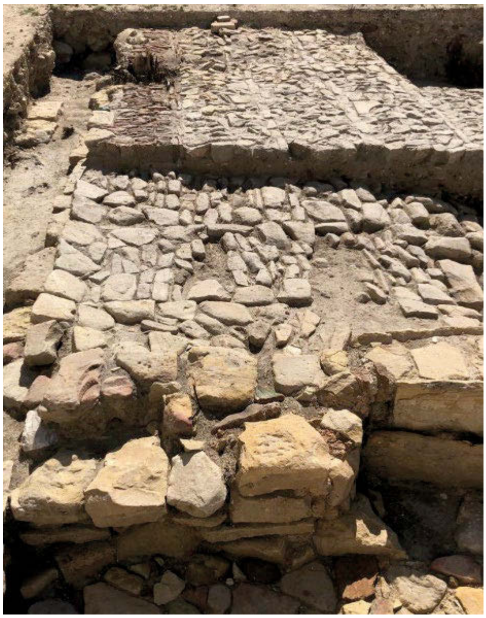

Fig. 9. Detail of the archaeological excavation in Porcuna in which the same types of pavements can be observed at different times. (Source: Millán, 2020).

5. Conclusions

The stone is what defines Porcuna and its territory from an architectural point of view. Today, it is possible to walk through each street of Porcuna, observing its monuments, and notice different ways of working this material as well as its way of adapting to the changeable requirements.

The paper has explained some of the constructive systems applied starting from the knowledge of the characteristics of this stone. This material has allowed to developed a way of understanding the territory as well as a way of inhabiting. The vernacular architecture that has emerged from the Calcarenite sandstone of Porcuna is a clear example of how, with a deep knowledge of the material, it is possible to transform something that could be limiting into an opportunity, taking it to highest levels of perfection.

The stone of Porcuna, due to its easy extraction system and physical properties, has always represented a concrete development for this municipality. Thanks to this today you can enjoy a rich archaeological and architectural heritage. Although these positive consequences, it is necessary to consider also the negative ones, represented by a series of pathologies still unresolved.

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From Natural to Artificial: Vernacular housing in the Spanish Caribbean

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Topic: T1.3. Artisans and crafts of traditional construction

Abstract
The Spanish American War of 1898 and the colonization of the Spanish Caribbean (Cuba, Puerto Rico, and the Dominican Republic) by the Government of the United States (U.S.), brought about changes to local vernacular housing. The Spanish colonizers substituted indigenous traditional means and methods of construction and replaced them with continental techniques and new materials. The U.S. occupation produced yet another transformation through the extensive use of portland cement which became the protagonist for their new domestic architecture. Even though cement had been introduced into the region two decades prior, to build industrial structures and through the importation of pre-manufactured new materials made with cement, it was slowly accepted for residential buildings, being promoted as fireproof, verminproof, and with the strength to resist hurricanes and earthquakes. Erection methods were faster, the dwellings were lighter, and built with the use of repetitive methods facilitated by reusable molds. Catalogs produced in each of these territories with the new prefabricated cement architectural elements would maintain the essence of the vernacular translated into cement and reinforced concrete. These architectural evolutions are traced with the use of historic archival materials: cartography, architectural layouts, photography, and extant contemporary representations.

Keywords: *vernacular housing, construction molds, portland cement, Spanish Caribbean.*

1. Introduction

The islands of Cuba, Hispaniola (geopolitically Haiti to the west, the Dominican Republic to the east) and Puerto Rico, constitute a major part of the group known as the Greater Antilles and linguistically and culturally constitute the Spanish Caribbean: Iberian colonies for 400 years.

During the five millennia prior to the Spanish colonial era, there was insular exchange by indigenous groups of trade amongst the Antilles. The area was partially populated from the South American continent, bringing with them cultural settlement traditions inhabited by groups organized at the level of chiefdoms. Their houses surrounded a common open communal plaza. For at least 1,000 years before the arrival of the Europeans, they successfully used their environs where the raw material for their structures was found and readily available year-round in a tropical climate with few changes. The indigenous dwellings, called *bohíos*, provided solar and water shelter as climatological protection (Fig. 1). Their construction, was described by Friar Bartolomé de las Casas, as chronicler of the Indies:

> …some houses very well made, made of straw (top of royal palms) and wood, and these had a plaza with a walkway to the sea, very clean and straight, made like a street and the walls are of intercrossed cane or weave…and near the sea was a high lookout tower, where ten or twelve people fit, made in the same general manner... (de las Casas, 1965).

The roofing for their dwellings were *yaguas* or palm fronds which are the base of the branch of the Royal Palm (*Roystonea Borinquena*) endemic to the islands of the Caribbean, for its water repellent properties and great size:1.5 mts. in length by 0.60 mts. in width. Chroniclers described the construction of *bohíos* as durable:

> The houses were constructed over beams or tree trunks, that were fixed into the ground, a distance of two to three paces from one another in oval form, cuadrilateral or oblong, according to the site disposition…All the construction of these was secured, instead of with nails, with wild reeds (*bejucos*) which are flexible and of great duration. (Abbad y Lasierra, ed. 1971).

Fig. 1. Pre-columbian bohíos (Source: Benzoni, 2017).

2. Transformation of this Vernacular housing

The evolution of vernacular housing in the Spanish Caribbean from pre-Columbian times to the early 20th century, and particularly, the natural and artificial materials used in their construction, summarizes the influences of those who built it, exhibits its adaptation to locally available natural and/or artificial building materials, and demonstrates site-specific climate protection. Oftentimes small in scale and common-looking to the inexperienced viewer, these dwellings incorporated changes slowly, and became repetitive in design.

Adapted from the *bohíos* described for the Amerindian tribes of these island-territories, the first Spanish settlements were primarily composed of wooden structures covered by *yaguas*, and/or ceramic curved tiles or *tejas* (Fig. 2).

Fig. 2. *Velorio* painting by Francisco Oller, Museo Universidad de Puerto Rico (1893).

The natural building materials were easily available in the abundant forests that surrounded their villages, but nails and clay tiles were imported from Spain. Even though The Spanish Crown insisted that the settlers to the New World build structures “in stone”, meaning permanent in character, they did not follow these mandates except for public buildings and upper-class individuals. (Pantel et.al., 1986)

The construction was principally done by indigenous slave labor, and in subsequent periods it was supplanted by black slaves. The evolution of *bohíos* also resulted in dwellings for the black population of slaves with a volume of just one space also utilizing *yaguas* to cover roofs and walls (Fig. 3). Without a doubt, the housing of early Spanish settlements in these islands was influenced by those who built it and must have resembled the indigenous and black *bohíos*. Permanent settlements were established where there were good sources of building materials nearby: “...there is in it much stone for buildings...that there is much limestone for the making of lime (and with regards to the site)...very good and firm soil to construct on, many stones, lime, and wood.” (Coll y Toste, 1916)

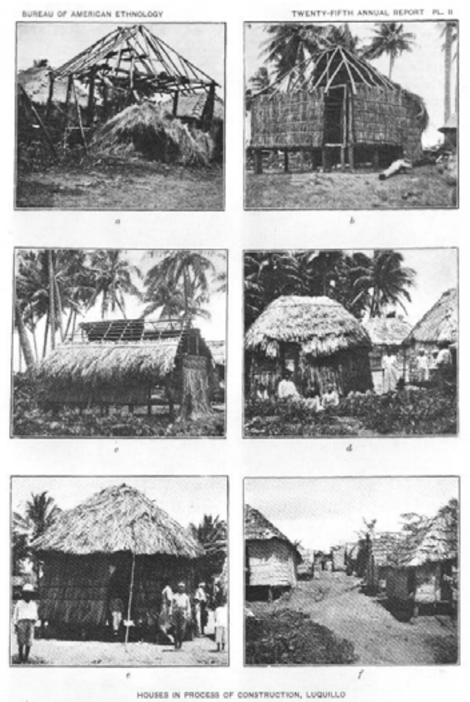

Fig. 3. Bohíos for rural coastal communities (Source: Fewkes, 1907).

These wood dwellings persevered despite two Royal Decrees in 1514 and 1538, that required that "citizens" with indigenous slaves, should build in stone, which signified durability. (Pantel et.al., 1986). Historic documents relate, without discrimination, that permanent structures meant those built in *mampostería* (rubble-masonry), *tapiería* (mud-wall), *cantería* (ashlar masonry) and *cal y canto* (stone masonry). The raw building material for these early houses (wood, palms, lime, mud, limestone, sand; or produced from natural sources: brick and sugar cane bagasse - useful for their hydraulic qualities when mixed with slaked lime) were available in these tropical island-territories.

In general, these same materials, with varying construction specifications, were utilized throughout subsequent centuries for institutional and larger scale buildings as well, and up until the late 19th century with the advent of artificial or plastic stone (names given to portland cement).

Apart from this new "colonial" housing, many of the settlers opted for inhabiting the *bohíos* that had been abandoned by the indigenous and black people. The framework of these structures was utilized as a base and renovated to serve the necessities of the new residents. Oftentimes, windows, interior partitions and even wood flooring were added. (del Cueto de Pantel, 1990).

As clearly illustrated in a 1766 map of Old San Juan in Puerto Rico (Fig. 4), most houses bordered the street layout of the towns, and the area behind the houses was used as a *corralón* (common yard). In these open spaces crop cultivation took place, domestic animals were raised, clothes were washed, and rainwater collection was also carried out of common wells or cisterns for the surrounding houses.

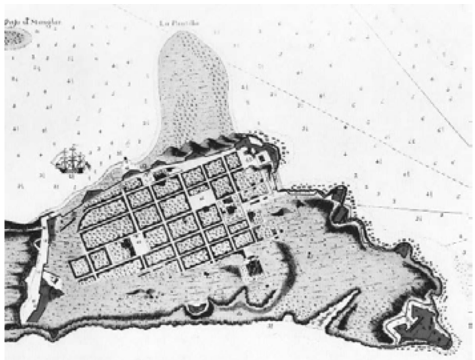

Fig. 4. Map of San Juan, Puerto Rico, National Archives Puerto Rico. (Source: de la Rueda, 1766).

Written historic texts by chroniclers of the 18th century, like Andre Pierre Ledrú, described the houses and social classes of the inhabitants in Puerto Rico:

> The city offers three different types of houses: the ones for rich people are generally spacious, with large doors and windows to give the place air renovation, constructed of stones, adorned with a large balcony and covered with a flat roof and that is paved with brick: these species of flat roofs, have the advantage of collecting the rain waters that are conducted to very large cisterns

> for domestic purposes, serving at the same time as a terrace for leisure use during all times of the year...The neighbors that only enjoy medium fortune, the merchants and the craftsmen live in small rubble-masonry houses, roofed with brick and only one story high…The last social class is housed in huts constructed of cane and palm bark and covered with palm fronds. These huts form the exterior boroughs of the cities. (del Cueto de Pantel, 1990)

In the mid 19th century, the islands reached their apex in material and cultural progress due to a significant rise in sugarcane production. The *bohíos* or houses of non-permanent construction were replaced and eliminated for the most part, due to the implementation of local ordinances and regulations. (Pantel et.al., 1986). The required town housing was to be constructed in rubble and/or stone masonry to avoid the spread of fires and become more resistant to natural disasters (Fig. 5). It is then when the roofs became flat *azoteas* and prevailed due to their utility as rain water collectors which was stored in underground cisterns. Their construction was a framework of hardwood beams, crossed by narrow wood slats and two to three alternate layers of thin roofing brick, that was then protected by a hydraulic, water-resistant *argamasa* layer.

Fig. 5. Rubble-masonry houses. (Source: a. Mignucci Giannoni, 1981, b. Photo by author 1982).

When the citizens reached economic stability, the common yard or *corralones* started to disappear. Dwellings became independent of their surrounding community since each housed its own interior patio (Fig. 6). The rooms opened and ventilated through this interior open space, where daily chores such as water collection and clothes washing took place. The houses became individual entities. As recurring elements, there was always the entrance vestibule or *zaguán*, and the interior patio, with size or distribution being of no importance. Façade decoration was simple and consisted of balconies facing the street, cornices, as well as protruding rectangular or half-arched ornamental borders for window and doors as solar protection.

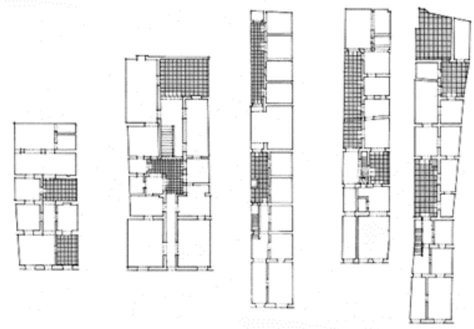

Fig. 6. Interior patio of different rubble-masonry houses in San Juan, Puerto Rico. (Source: Mignucci Giannoni, 1981).

3. Construction Technologies and materials evolve from natural to artificial

From the 16th to 19th centuries, commercial exchange continued between the Caribbean's Spanish colonies and Spain, until the Spanish-American War of 1898, which turned Puerto Rico and Cuba into U.S. territories. There were also two failed U.S. incursions into the Dominican Republic between 1910 to 1930. At the dawn of the 20th century, cultural and commercial interchange between the Spanish Caribbean increased with immigrant businessmen from the U.S. and Catalonia which imported not only the newer artificial or man-made cement building materials, but also brought the arrival of artisans and master builders knowledgeable with their production and use.

In general, most references of the same four centuries point out that there were two types of vernacular houses: those made of wood, and those built of more resistant techniques such as rubble-masonry, ashlar masonry, stone masonry, mud wall or wattle and daub. (del Cueto de Pantel, 1990). Both indigenous, colonial, and transitional housing types were built with natural materials whenever possible, even though wood was considered temporary, and those erected with hard raw materials, were considered permanent. In some coastal sites, there existed a predominance of red clay, and wood from the nearby mangroves, which were resistant to water, their natural environment. Inland settlements contained limestone, sand, clay, and excellent hardwood. In addition to the variations of these types, the construction continued to depend on the technical knowledge of the labor force, whether indigenous, black and/or European.

Two great events characterized the urban development of the capital cities of the three islands at the end of the 19th century. The first was the 'liberation' of the growing cities, marked by demolishing their surrounding defensive walls which prevented their physical expansion. The other was the Spanish-American War which eliminated Spanish sovereignty and regulations from their last colonies in the New World.

The drastic socio-cultural and economic modifications that resulted from this war, and the accelerated changes produced at the turn of the century, created considerable variations to vernacular housing. The 20th century brought with it the influence and traditions of continental North America as these became territories of the United States.

4. Artificial materials and building technologies in the 20th century

The beginning of the 20th century in the Spanish Caribbean was a moment when everything and anything seemed possible. The recovery of the region after long periods of war and economic depression had set the stage for an era that would embrace new trends with non-restrained passion. That passion, a natural and innate characteristic of the region's inhabitants, would result in "eclectic-modernist" architectural expressions that were like the islands themselves: exuberant, colorful, audacious, and exciting.

Between approximately 1880 and 1910, the importation of cements from the Old World to the Spanish Caribbean, started to substitute the traditional lime and hydraulic mortars. With cement also came prefabricated materials (Fig.7). The "modernizing" furor was then augmented by successful structural achievements from the United States. Professionals in the construction industry that immigrated to these three islands during the colonization periods, whether Spanish or from the U.S., established themselves as part of the temporary foreign governments and industry leaders. They also brought their technical knowledge to the new lands that they conquered, or settled.

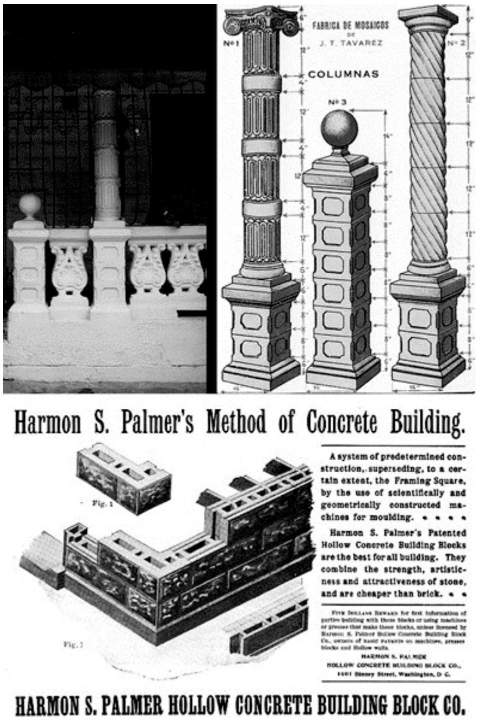

Fig. 7. Cast-stone architectural elements and cement block ads. (Tavárez and Palmer product catalogs 1921 and 1908).

Portland cement substituted the vernacular colonial housing of the region built with natural materials. This early 20th century molded vernacular dwelling, "…a product of industrialization applied to architecture…with an infinite series of combinable elements, such as columns, balconies, ornament, as well as roofs and walls made with molds and portland cement…" (Chateloin-Santiesteban, 2007) quickly filled new neighborhoods, usually located in the outskirts of the capital cities. The new cataloged cement architectural kit of prefabricated parts would help the original designs evolve, while maintaining interior layouts, and the front balcony as a recurring and important element for cultural communication.

During the Spanish colonization, as well as the subsequent American occupations of these island-territories, the influx of innovative and oftentimes unknown building processes that these foreigners brought with them would be tested on the new lands. That implied an educated effort at understanding their different and often unknown physical conditions. These included their geography and geological events - earthquakes, hurricanes, tsunamis; a climate - constantly hot and humid; flora, fauna, fungi, and wood-eating insects; all contributing factors that influenced building design (del Cueto, 2016). Foreign interventions included importing not only technological know-how regarding the design and erection of structures, but also building materials, tools, and equipment from their countries of origin. The presence of North American Companies, producing some of the basic building materials they needed in the new regions themselves, also helped to develop working relationships, and facilitated construction means and methods.

After the war, during a period of increased economic wealth and growth, the construction projects of these island-countries would benefit from the fast-setting properties of portland cement. Despite the local establishment of cement factories in the new territories, cement continued to be imported from the U.S. up to the 1920s. Portland cement, which was already known and used in the region, became an integral part of the formula for the novel structural designs and technologies brought by the North Americans.

The innate characteristic of cement setting especially well in an extreme wet and humid climate as well as in hot weather, made it the perfect material for innovative products in these tropical regions. Structural components, building facades, as well as interiors were immensely impacted by architectural elements made possible through the moldable characteristics of the portland cement mix, which provided infinite possibilities, allowing all shapes, forms, and even color in the mix (Fig. 8).

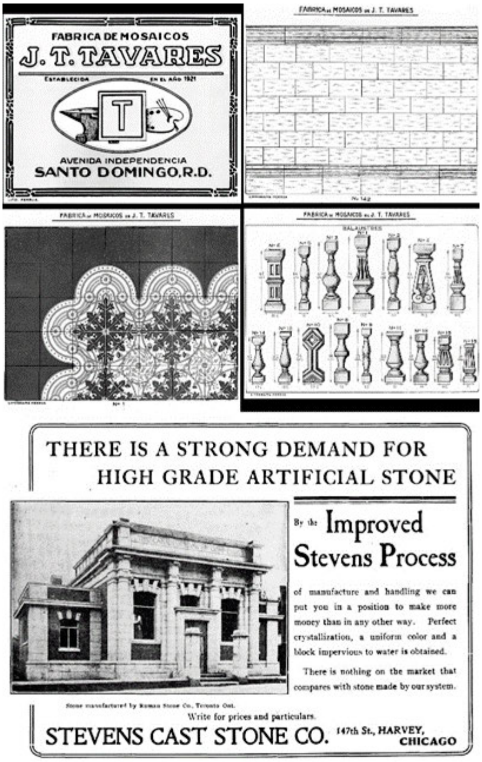

Fig. 8. Molded cement architectural elements produced by the Tavárez and Stevens companies. (1921 and 1906).

Prefabricated and rapidly produced building components, manufactured in these molds by less experienced hands (versus those of experienced stonecutters), facilitated installation and price-competitiveness. (Zardoya-Loureda, 2001).

During the first decade of the 20th century, there were two main accepted processes used to manufacture any type of molded artificial stones, that which included blocks as well as ornate cast stone (hollow architectural elements made with a cement mix): the dry-tamped method and the wet process. The wet method, mostly used for cast stone ornamentation, required finer aggregates and even color to provide a better likeness to the finished appearance of carved natural stone (Stevens, 1906). Both techniques were provided by American manufacturers who had established profitable businesses and applied one or both methods to fabricate these building components.

In the facades where these units were used, it was extremely difficult to discern whether in fact these were natural or man-made architectural elements. Being able to fully fill the cast stone units with concrete, also added structural rigidity to the building envelope. Original construction documents for the concrete houses built during this period specified: "...All facade walls, moldings, cornices and decorations of all floor levels shall be artificial stone made of cement, manufactured by the "Stevens" process..." (Archivo Nacional de Cuba, 1919). Cuba, having a factory to manufacture these building materials, facilitated and accelerated the building process, not only locally, but for their nearby island neighbors, the Dominican Republic and Puerto Rico.

Molded architecture with prefabricated components, converted "artificial stone" manufacture into a profitable business throughout the region. Innovative decorative schemes could be multiplied using molds which facilitated mobile architecture elements, "...the mold was a proper element of industrialization applied to an infinite series of architecture, repeatable and combinable, an architecture to be consumed and assimilated by the social masses that marked the 20th century..." (Chateloin-Santiesteban, 2007). One could consult a catalog and rapidly select the preferred combination of ornaments and building components for your design (Fig. 9).

Fig. 9. Ornate façade in Remedios, Cuba using molded cast-stone decoration. (Photo by author 2018).

A considerable number of Spanish businessmen, especially Catalonians, had established construction companies or building materials suppliers and were responsible for introducing new techniques and services to the building industry (Fig. 10). During the first three decades of the 20th century, in the main cities of the Spanish Caribbean the so-called decorative details' factories for housing were "…workshops which not only produced ornamental pieces but construction elements such as roofs, concrete blocks…and hydraulic mosaics" (Baroni, 2003).

Fig. 10. Installation of Catalonian-inspired hydraulic cement mosaics or tiles. (Source: del Cueto, 2016).

The American companies had resorted to building cement or reinforced concrete floors, walls and oftentimes roofs as well, whenever they could, despite the use of premade, manufactured and ready-made materials.

Molded and multi-faced cement block was also used for wall construction. "Reinforced concrete work meets there with popular approval, as it lends itself so much to the local desire for-strength, solidarity and permanence in architectural construction." (Butler, 1915).

More importantly, the local masons, having worked in mud-wall and rubble-masonry dwellings, were proficient in the use of formwork and molds for any type of construction. This is evidenced in:

> The numerous American corporations that are busy developing the natural resources of the islands are favorable to concrete as a building material, and much of the heavy construction that has been carried on in the past three years has involved the use of immense quantities of Portland cement. (Concrete, 1909).

5. Conclusion

Basically, the transformation of vernacular housing in the Spanish Caribbean evolved from its indigenous and European roots into a general-western tradition or prototype with the introduction of artificial building materials such as cement. The DNA of millenary vernacular housing could not, however, disassociate itself from its environmental and geographical realities. Needing no protection from temperate climate changes (i.e., cold, and freezing winters), thick walls, small windows, and heavy load-bearing roofs were unnecessary. The Islands lack of dangerous animals also made the need for solid walls even less vital. Therefore, vernacular dwellings in the Spanish Caribbean evolved and transformed in their basic building materials, but never really changed their main purpose in the tropics: protection from the sun and rain. As such, though the materials and building techniques transformed through time, their function, as a fundamental part of vernacular dwellings, as well as protection from nature's elements, and daily living, has remained constant.

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Designing with water for climate change adaptation and cultural heritage preservation

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
Climate change is a global challenge and one of its major impacts is on flooding, which has become more unpredictable and destructive in both the UK and Thailand since the beginning of the 21st century. Designing with water (DWW) and natural-based solutions are emerging as some of the most important approaches for dealing with climate change and adaptation for a resilient future. Flooding is a natural phenomenon and in the UK, and Thailand, as in many other parts of the world, local communities over millennia have learnt to live and co-exist with seasonal inundation, and their tangible and intangible heritage and lifeways celebrate their relationship with water. However, in part to the increase in the frequency and severity of floods but also exacerbated by rapid urbanization and floodplain encroachment, has resulted in many nationally and internationally important heritage sites in Thailand being at increasing risk because of longer inundation periods during the rainy season. In addition, climate change has made flooding in Thailand more unpredictable and widespread. Fragmented planning and management in the cultural sector, particularly the lack of integration between regulatory organisations responsible for flood protection, is also a major problem. The study investigates several successful DWW case studies from the built environment that highlights good practice and international expertise that will help scholars and practitioners designing in flood pone regions to develop their knowledge and strategies. These cases present integrative whole system approaches, which put DWW and more natural-based solutions at the heart of their design strategies for climate adaptation front and centre of cultural heritage management and preservation. The paper presents a series of recommendations to turn flood threat into an opportunity to improve water resources and community resilience at regional and community.

Keywords: *Designing with Water; Climate Change Adaptation; Sukhothai; Cultural Heritage*

1. Introduction

This study argues that designing with water (DWW) has created a resilient approach to living with water for a more sustainable future. Serious flooding impacts on cultural heritage assets have increased public awareness of Thais and relevant organisations to work more on flood resilient design; especially in heritage contexts which has insufficient information in Thailand. Previous studies suggest that urban conservation of heritage projects is a multi-faceted process of change and development rather than romanticism or drastic redevelopment (Elnokaly, and Elseragy, 2012; Elnokaly and Elseragy, 2013).

Sukhothai which is the first kingdom and capital city of Siam experienced both flooding and drought. Even if Sukhothai ancient town was planned and designed with an effective irrigation system. The heritage buildings/sites were surrounded by a waterscape making the site become unique and outstanding, however, more prone to flooding. The city's economy has been influenced by the highest level of tourism since Sukhothai historic town and associated historic towns (Sukhothai, Si Satchanalai, and Kamphaeng Petch) have been registered as UNESCO World Heritage Sites since 1991 (UNESCO, 2021). Similar to other heritage cities around the world, these mixed interweaved heritage forms part of the city's eminent significance of its historic value, which tend to represent and symbolise a diverse set of ideals of the city's identity, including its history, culture and mixed ideologies on one hand, and its local economic viability on the other (Elnokaly & Elseragy, 2007; Elseragy et al, 2007). Resource value and responsibility towards the others have been identified as key parameters for revitalization and conservation of heritage sites (Lichfield, 1988) as it saves more resources than demolishing and constructing new sustainable buildings (Elnokaly & Elseragy, 2013; Elnokaly & Wong, 2015).

For nearly a half-century the land use of Sukhothai has been replaced by corridors of roads and a great number of tourism-based services. The ancient city plan has been encroached by networks of roads and lost its traditional wisdom of hydro-scape design (UNESCO, 2021). Impacts from rampant urbanisation together with climate change are major driving factors resulting in unpleasant flooding in the city of Sukhothai. Therefore, this study aims to explore how to apply design with water in Sukhothai heritage sites to cope with climate change for a more sustainable future.

The paper is structured into five main parts. In the first part, the historical overview of the site of Sukhothai is provided, starting with its importance as a nation and world heritages followed by its unique hydro-scape design. The second part is the research methodology followed by observations from fieldwork in the third part. The fourth is good practice in designing with water which is discussed for further applications. A conclusion and recommendations are presented in the last part.

2. Sukhothai Heritage Sites

Sukhothai is located in the Lower Northern Region of Thailand which is about 427 km (Britannica, 2009). from Bangkok. The name of the city refers to the dawn of happiness. Sukhothai was the first capital of the Thai Empire (found by King Ramkhamaeng) for 140 years (1238-1438) (Britannica, 2009) and it is rich in both tangible and intangible cultural heritage; as Sukhothai has been the UNESCO World Heritage in 1991 and the UNESCO Creative Cities Network for Crafts and Folk Art since 2019 (UNESCO Creative Cities Network, 2019). The geography of Sukhothai can be divided into two parts; the centre of the city is mainly laid by the Yom River basin while the north and the south are shaped by mountainous and plateau areas. The city reflects the glory throughout its almost 1000 years of existence (UNESCO, 2021). The current city was located by the Yom River which is about 12 km far from the historic town (Wiener, 2018).

Fig. 1.Sukhothai Historic Town and its water reservoirs (Illustrated by Witiya Pittungnapoo, 2021).

The ancient Sukhothai was well planned with water management and the heritage monuments were designed with hydroscape making Sukhothai an outstanding value historic city. In 1991, Sukhothai and Associated Historic Towns were designated as the UNESCO World Heritage Historical Park, resulting in a great many visitors coming from around the world each year. Sukhothai has earned global attention from cultural heritage tourism, which had an enormous economic benefit on the city, the country and its local people.

3. Research Methodology

This part of the study presents the preliminary investigations and hence, the methodology was based on both secondary data collection and observations from fieldwork in Sukhothai heritage sites. Designing with water approaches was reviewed with a preliminary observation made in both dry and rainy seasons in 2021 and 2022. Documentary analysis was made to investigate how Sukhothai's ancient town planning and interventions were designed to manage flood risk. The second part is fieldwork to explore how heritage sites are affected by flooding along with locals' wisdom in designing with water which can be seen in vernacular houses. A qualitative discussion with semi-structured interviews was employed to explore how relevant organisations and key stakeholders can respond to the impact of flooding and climate change on the Sukhothai heritage site. However, these remain to be the initial explorations for this research work and further investigations remain to be undertaken including cross-case investigations with successful global examples from the built environment.

4. Observations from Fieldworks

The observations were conducted on two aspects of designing with water (DWW). The former is in heritage sites and the latter is in vernacular houses to explore how existing approaches do respond to climate change.

4.1. DWW in Sukhothai Heritage Sites

The Sukhothai historic town has a distinctive hydraulic and irrigation system which consists of extensive water reservoirs, networks of canals and roads which were considered an advanced-technology in the last 700 years ago. The ancient lands were occupied by paddy fields, betel nut trees, coconut, and various fruit orchards. Importantly, a large reservoir named *Sareed Phong* was built on the western mountain outside of the ancient town to maintain the flow of water throughout the canal networks connected by public ceramic pipes to the ancient city for year-round consumption (Fig 2 & 3).

Fig. 2. *Sareed Phong Earth Dam* (Source: Pittungna-poo, 2020).

Fig. 3. Water Pipes displayed in Ramkhamhaeng National Museum (Source: Pittungnapoo, 2022).

4.1.1 Sukhothai's DWW Wisdom

Sukhothai heritage park and its associated towns have reflected how ancient cities were designed with water management by gravitational canals and reservoirs connected among the three associated towns (Sukhothai-Srisatchanalai-Kamphengphet) as revealed by the remote sensing system technique (Tiva Suppajanya, 2004). Sukhothai heritage park was planned with a hydroscape design which can be seen in and around the heritage buildings in the ancient city walls. These waterscapes made Sukhothai an outstanding cultural landscape. The ancient temples, pagodas and monuments were built based on Khemer's influence (Shinawatra, 2021) along with waterscape and ponds (Baray/ *Traphang* called in Sukhothai Heritage Park) functioned as water reservoirs to manage water for living during the rainy and dry seasons. There are a great number of *Traphang* surrounding the heritage buildings in and around Sukhothai ancient town. More specially, *Traphangs* (Fig. 4) are also used for carrying *Loi Krathong Festival* – held annually in

November during the rainy season – in which Thais pay respect to the Goddess of Water. However, with severe drought due to increasing climate change, a shortage of water in these reservoirs has become more obvious which can be seen during *Loi Krathong* Festival. Therefore, extra water supply has to be filled into *Traphangs* during this traditional festival over the last few years (Sukhothai City Planning Department, 2021).

Fig. 4. Wat Traphang Thong was designed as a water reservoir (Source: Pittungnapoo, 2020)

Fig. 5. Chedi Yod Hak (Source: Pittungnapoo, 2021)

4.1.2 Innundated Heritage Sites

Increasing impacts from rampant urbanisation together with climate change not only have made Sukhothai an ancient town faced with flooding but also resulted in severe flooding in a new city (which is located in a lower area of the historic city). From observations made by Pittungnapoo in September 2021 (during flooding), there are certain heritage monuments located by roads that are inundated after rain due to a lack of a proper drainage system. Chedi Yod Hak was selected for observation. It is a derelict temple located outside Sukhothai Historic Town. The Chedi Yod Hak was built outside the ancient city wall in the East (about 1.5 km from the broken wall gate) which is a reason why there are limited sources of reference and documentation about this temple. This small temple plan was arranged on the East-West sides along Jarodwitee road. The chamber was built on a rectangular foundation (about 6 m. x 12 m.) with a base of a Buddha Image on the earthen ground. It was composed of six-room spans of laterite columns to support the wooden structure of the tiled roof. The main Chedi was built from bricks in cubic forms (about 5 m. x 5 m.) in the West of the chamber (Fig. 5). Additionally, there is a tiny chedi beside the North of the main chedi. Even if the temple was built in connection with hydroscope design; however, due to unfriendly urbanization, road encroachment, an increase in built-up areas together with climate change have made these heritage buildings affected by waterflood. The loss of a proper drainage system has made this heritage monument is in high risk of long-stay inundation during the rainy season. Therefore, it is timely for this project to investigate climate vulnerability; particularly in terms of impact from flooding (building structure, materials, foundation, and surrounding landscape) in order to develop a conservation plan for achieving a resilient future.

4.1.3 Locals' Wisdom of Living with Water

Learning how to live with water is a unique way of living which can be seen in many water-based settlements in Thailand. DWW is not a new idea for Thais who have learned to live with flooding and climate change for ages (Pittungnapoo, 2016; Tajai, S. and Pittungnapoo. W (2021). One evident adaptation can be seen in vernacular houses built on stilts to allow flood water flow during the rainy season (Fig. 6a). Traditionally, stilt houses are commonly seen by the river, canal and near other water-courses. Interestingly, many stilt houses were also built by the corridor of roads (Fig. 6b); as this area has become intruded by urban flooding due to a lack of a proper drainage system. Data from observation affirms that DWW has already existed in Sukhothai's wisdom since its ancient history which can be seen in its heritage sites.

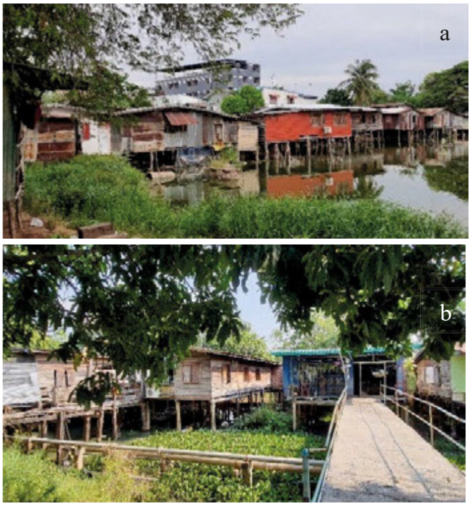

Fig. 6 (a). Stilt houses by the canal (*Klong Pho)* in the city of Sukhothai (Source: Pittungnapoo, 2022) (b) Stilt houses by the city road of Sukhothai (Route No.12) (Source: Pittungnapoo, 2022)

Moreover, vernacular houses have reflected how DWW was applied to Thais' ways of living. Stilt houses (Fig. 6 (a&b) are good practices in climate adaptation which can be commonly seen in either traditional settlements or urban areas.

5. Designing with Water and its Concern

Design with Water has become a global concern as experienced by many countries in order to cope with flood risk, water supply, and water cycle and its system for achieving a sustainable future. There are various aspects which should be taken into account for DWW beginning with the upstream and downstream areas: water resources, catchment management, rivers and waterways, coasts including ecosystem services; and built-up areas: demand management, green infrastructure, buildings and public realm, urban retrofit, asset management, and smart infrastructure (ARUP, 2022). Undoubtedly, integrated collaboration across organisations is imperative for DWW to manage the above areas in cohesive approaches. Unfortunately, there has not been enough attention paid to cultural heritage buildings. Recently, the literature study of Allan, Richards, and Fatoric (2021) pointed out four aspects of barriers and challenges to research on cultural heritage and climate change which are; 1) Technical issues in terms of methodological barriers, lack of understanding of climate impacts and its complication, and conservation challenges; 2) Knowledge and practice issue: lack of collaboration and loss of traditional practice; 3) Institutional issues: regulatory and policy challenges, and academic credibility of disciplines; and 4) Economic and financial constraints. They reviewed that even the study combined cultural heritage with climate change: however, this collaboration was limited within the same geopolitical region. Therefore, global knowledge exchange should be transferred across different regions for achieving interdisciplinary approaches (Allan, Richards. and Fatoric. 2021).

Therefore, it is timely for this project to work closer by integrating DWW for climate change adaptation into the heritage sector transferring knowledge across Thailand and the UK.

6. Conclusions

This paper argues that designing with water is the future for adaptive design in flood-prone regions. The case study analysis presented in this study argues that Thais have learned to live with flooding from generation to generation through imperative wisdom and resilient approaches. However, increasing impacts from climate change have made indigenous knowledge no longer able to cope with flooding; therefore, a combination between local wisdom and affordable technology should be developed to preserve Sukhothai heritage sites and to deal with flooding and climate change adaptation in a more resilient way. Learning from Sukhothai's historic town reminds Thai people to concern more about their own design with water approaches. It maintains that a comprehensive understanding between heritage, climate change, and scientific development is crucial for reaching resilience and sustainability as agreed by Allan, Richards and Fatoric, 2021). More specifically, DWW and its further applications should be implemented by a collaboration between public, private and community sectors.

Therefore, it is important to encourage all to be engaged from the initial stages of the research. The paper highlights the importance of DWW not only in heritage sites; but also in local implementations which should be widely promoted at the policy level. Importantly, DWW is a resilient approach for climate adaptation which should be simultaneously integrated into professional practise in related fields across design and planning disciplines (e.g. architecture, town planning, landscape and urban design) and cultural heritage management to preserve cultural heritage in broader perspectives. The findings and recommendations that emerged from this study are useful to introduce designing with water and climate change adaptation into design disciplines and cultural heritage management.

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La Vera´s vernacular architecture. Structural design and climate protection in timber frame wall houses using constructive systems and local materials.

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Topic: T1.3. Studies of traditional techniques and materials.

Abstract
La Vera is a region in the west of Extremadura in Spain, on the southern slope of the Sierra de Gredos. Its architecture was designed for a rural way of life about to disappear. Three municipalities declared Historic and Artistic Sites were studied to define and explain their design and construction systems. A wooden frame structure is typical in the region, which uses sun-dried bricks in the infills and leaves the wooden structure visible from the outside. Its composite materials, clay and wood, subject to water and sun damage, are made resistant to weather via an extremely intelligent, skilled combination of wood, clay, pigments, lime mortars and paint. Verata´s wood frame structure is explained in detail, with every element named and how it works. Unique to these structures is the use of different elements as counterweights, which is considered a safety measure. Foundations built on granite and clay transfer moisture up the walls which results in the way in which paint and mortars are found. They have a clay or lime base, combined with pigments. The mixtures and application techniques have been documented from oral transmission. The selection of the base material of paint and mortars depends on their ventilation capacity and which waterproof or disinfection properties are required. Pigments are used as additives to increase these properties while obtaining the colour required. Nowadays, facilities to allow ventilation and sunlight are needed. This makes us question how all the applied knowledge developed over centuries can be preserved. This symbiosis of technique, design, structural knowledge, and close material use is the essence of Verata´s architecture.

Keywords: *timber frame wall; wood structure rehabilitation; climate protection; lime and clay paintings.*

1. Introduction

The region of La Vera is formed by nineteen municipalities situated south of the Sierra de Gredos in western Extremadura. There is a clear typology of building in these villages that is a consequence of geographic conditions, material availability and local knowledge. Verata architecture is also representative of a way of living that is disappearing and causes the demolition of some of its buildings.

This complex and varied typology, usually on three floors, is associated with the rural way of living described in "*Arquitectura popular de La Vera*" (Chanes & Vicente, 1975). The ground floor might have a portico (Fig.1) before stepping into the hallway. This hall leads to the stairs and to a lower level (40 to 100cms below) with the wine cellar, the henhouse or the stable. Wooden stairs take us to the first floor with small bedrooms and the *vasar* (room where fine china is exhibited).

Fig. 1. Porticos. Valverde de La Vera (Source: Elena Franco, 2020)

The third floor has the kitchen and small rooms. The kitchen has a fireplace on a stone slab and an outside long balcony called *solana* where fruits are dried. The roof structure can be seen above. The smoke from the fire is not conducted and fills the whole room, to smoke certain products such as peppers. Grains are also kept on this floor, ham and sausages are processed and wet clothes dried.

Drying products, smoking, and keeping animals in the same place where people live was possible because the house was permanently ventilated. An air current was necessary to dry and let the smoke out, but also helped the house to dry its walls. It is difficult to imagine how it felt to live in those houses in the traditional way. Life has changed and people demand dry, sunny conditioned houses to stay inside for long periods of time.

A group of experts was formed in 2021 to analyse the construction systems and discuss how to restore these buildings with new facilities and uses. Construction faces countless problems that define the processes which solve them (Nuere, Franco & Fernandez, 2019). On this idea, investigation was done to fully understand the techniques used, why they were chosen, and consider using them in future rehabilitation so that the essence of this architecture is not lost. A natural evolution of Verata architecture is possible and necessary to allow it to survive.

1.1. Objectives

The objective of this paper is to describe the main characteristics of the buildings studied, in order to understand the basic definition of La Vera´s vernacular architecture. The most frequent problems found in these houses will be exposed. An outline of further investigation required to match regulations and rehabilitation will be given.

Sixty-eight houses were studied in three municipalities declared Historic and Artistic Sites: 17 in Garganta la Olla, 30 in Villanueva de La Vera and 21 in Valverde de La Vera. The main architectural constructive and structural systems are described from these studies.

2. Foundations and masonry

The three villages studied are located on hill slopes; therefore, streets are perpendicular to the slopes and houses have walls with foundations on different levels. These villages have their foundations on granite soils, although Garganta la Olla has also clay soils. The ground floor has masonry walls to protect the wooden structure from water. Granite ashlars strengthen the corners, as well as jambs and lintels. Masonry is disposed (Fig.3) with bigger stones on the lower part, alternating with medium and small stones, with a dry-stone wall technique.

There are two main problems in rehabilitation processes affecting the foundations. The first problem affects building walls, which are wet because they are half buried by the slope. Damp is not seen in masonry walls if they have the henhouse or stable inside and the house is well ventilated, but when this semi buried ground floor is rehabilitated, capillary damp patches on walls appear as the natural ventilation system. Ventilated air cavities on the floor and the use of permeable mortars would help to drive the moisture out. Further investigation on formulae of mortars and capillary damp measurement in foundations and walls is needed considering the new methodologies already stated. (Gil & Lasheras, 2017).

Sometimes the lower level of the house extends across to the entire ground floor. The second most frequent problem occurs when the building´s wall on the upper street is left with no foundations, causing cracks.

3. Half-timbered structures

3.1. Wood structure

The vertical structure is formed by facades and an inner structure. The facades, from the first floor upwards, are built with timber framed structures. The wooden elements (Fig.2) have been described by various authors (del Río, 1991; Nuere, 2000). Wooden frames in La Vera are usually infilled with sun-dried bricks, although some differently dated bricks are also found.

Fig. 2. Facade in Garganta la Olla (Elena Franco, 2021)

Astorqui and del Rio explain that the loads are transmitted mainly through the infills in the case of a wall filled with plaster rubble (Astorqui & del Rio, 2014). Nuere and Cabeza consider that wood structures are always isostatic, and the balance of the whole wooden structure must be preserved when restoring these buildings (Nuere & Cabeza, 2021). In La Vera buildings have been conceived as carefully balanced wood structures. Sun dried bricks are not rigid enough to stop deformations. The structural design is sometimes organized with a main structure with main posts and beams and a secondary structure in order to stabilize the infills.

Fig.3. Facade. Villanueva de La Vera (Source: Elena Franco, 2020)

A house in Villanueva de La Vera is analysed (Fig.3). On the first-floor façade there are main posts with a wider section, and thinner wall posts. The inner beams lay on the wall plate on the ground floor wall and so do the main posts, while the upper beams lay on those main posts transmitting the load. The *riostras* and *virotillos* and secondary posts are used to avoid deformations caused by horizontal movements and to help during the constructive process of the frame.

The inner structure follows a slightly different pattern. On the ground floor, masonry at the base of frames is sometimes found on the inner walls, but it is also common to see high posts that reach the ground floor on a stone base that protects the wood from damp. These posts will hold a big inner beam on which the upper structure will lay.

The floors, both inside and outside, are made of a wooden structure. Joists are laid on the main beams and finished in two different ways. One way is to use wood planking with underneath laths to help dust from falling on the floor beneath. The other way is to put the planking on a good layer of sand, to level the tile floor held by a clay mortar. The sand layer not only levels the surface, but also helps the tiles from breaking in a house with a very isostatic structure that will frequently move. Many Verata houses are designed with an increasing surface area on each floor, as the house grows up. The main beams will come out of the façade supporting the next floor and façade wall. (Fig.4)

Fig.4. House structure in Garganta la Olla. (Source: Bujalance, 2019)

The construction system is very efficient. The cantilever supports weight at the ends helping main beams decrease its flexion. The upper floors protect the wood and sun-dried bricks from the rain and sun. Living surfaces are increased and create shade that will cool the streets during the hot summers. These structures were built with large chestnut trunks and other high-quality woods.

3.2. Porticos, balconies and corridors

In La Vera, the façade, and therefore, the main structure, comes in and out of the vertical giving way to different solutions depending on how the house is distributed.

Porticos with the function of an outside *zaguán* are sometimes used as an outside living room. When this happens, the upper floors rest on wood posts or stone columns. (Fig.1)

Balconies can be associated with one or several windows that are sometimes inside the *zaguán*. Balconies also form the upper corridor called *solana* connected to the kitchen floor. They are constructed with different designs and complexity levels.

Sometimes they are supported by the main horizontal structure while other times they have their own beams inserted into the main structure. (Fig.3, Fig.4). If balconies or corridors are designed to support weight, they might have a complex structure (Fig.5) using decorated carpentry solutions.

Fig. 5. Balcony in Valverde de La Vera (Source: Franco, 2020)

No double-layer façade buildings like the one described for the Posada del Peine, in Madrid were seen in this research. (González-Redondo, 2019).

3.3. Roofs

Roofs follow the same structural design as the rest of the structure. Wall plates on top of façades are the first and last beams. Several parallel beams and a ridge beam support the rafters on which the roof lays. This type of roof structure can work without tie beams because they are light, and the main beams are supported by posts organized in short distances, around two or three metres. The planking lays on the rafters, and the roof tiles are laid on top, sometimes with a clay mortar in between. When covering the kitchen, the planks are separated, and the tiles are laid on top with no mortar so that the smoke of the kitchen can slowly come out (Fig.7). Some roofs have been structured so that the beams are separated the width of a curved roof tile that is directly laid on them with no planking or mortar in between. (Fig.6)

Fig. 6. Roof in Valverde de La Vera (Source: Franco, 2020)

Fig. 7. Roof in Garganta la Olla (Source: Franco, 2020)

The smoking of pepper was done in the kitchens, on a wooden floor set on the base of the roof level, called *doblao* (Fig.8). The fire was below, on a back hearth, and skills in handling fire was required to get smoke or flame when needed. The smoke would go up to the *doblao* and finally come out between the roof tiles.

Fig. 8. Kitchen and doblao (Source: Bujalance, 2017)

3.4. Balance

The structural understanding that is behind Verata architecture shows us how the building was understood as a balanced whole. The weight of materials is very often used as a counterbalance. This is the case of cantilevers in upper floors which, in the secondary direction, will use a structure balanced by the house floor (Fig.2, Fig.4). It is interesting to see how the *riostras* are used to prevent horizontal movements in the structure. They were also used to stabilize the structure during its construction as well as to direct weight in a particular direction. This can be seen in the façade in Garganta la Olla (fig 9), where one post and two *codales,* receive the corresponding façade, floor and roof weight. The granite stone used as the post base has been carved to drain water away from the wood.

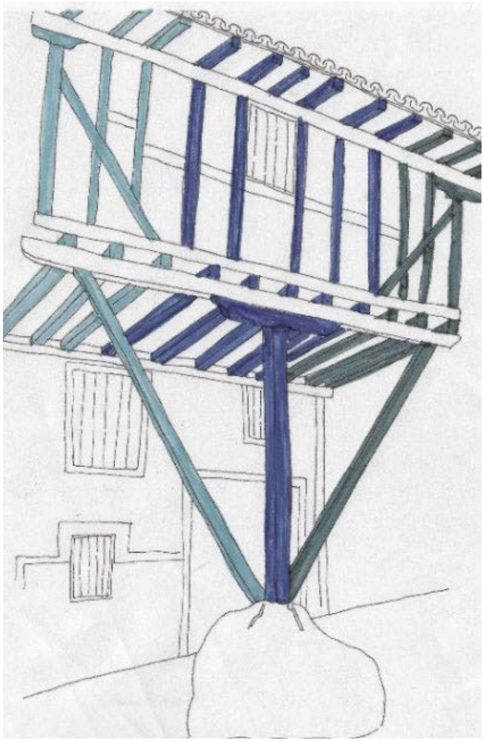

Fig. 9. Facade. Garganta la Olla (Source: Franco, 2021)

This balancing way of thinking is behind Verata construction and should be considered carefully when restoring because demolishing walls, floors, or even inner walls, might destabilize the whole building. These houses, when restored, will also need careful structural analysis, considering the new use they will have. It is compulsory to have an architectural project when rehabilitating and, in La Vera, it is recommended not to do any demolishing without a technical survey. It is common to see solutions where inner walls are used as a counterbalance for big balconies (Fig.10).

Fig. 10. Plankings. Valverde de La Vera (Source: Franco, 2020)

3.5. Wood and infills protection

There is plenty of wood on the outside of Verata architecture that is exposed to sun and water, as is the sun-dried brick infill of the walls. Popular strategies are used to protect them both. The most unique one is its design. Houses follow horizontal growth as they rise to the upper levels. This protects the facades below, but there are other systems helping to protect facades. Weather boarding is very common in La Vera. Wood planking is not used in main facades, and it is always placed on the upper levels. The planks are disposed by pouring water on the lower plank, and they are nailed to the posts. The wood is preserved because it is ventilated. It also protects the sun-dried brick wall (Fig.10).

It is very common to see decorated corbels, but it is an extended detail in La Vera to stripe the wood beam facing the street. This does not prevent the beam from moistening but helps it to dry more quickly. Different carved striped designs are finished in oblique, leading water to a drip. (Fig.11, Fig.12)

Fig 11 Corbel decorations. Valverde de La Vera (Source: Franco, 2020)

Fig. 12. Corbel decorations. Garganta la Olla (Source: Franco, 2020)

Beam faces are also protected with fretted boards which will be replaced when they get damaged. (Fig.1) Fretted boards have turned out to be a decoration motive typical in La Vera. They are also used as balcony posts. (Fig.11) Roofs always come out from the façade line by a distance allowed by the outcoming structure or by corbels. Roof tiles will stick out several centimetres more. Party walls sometimes also have their roof standing out of the vertical, when the house´s roof is higher than the neighbour´s.

In Garganta la Olla, we have seen some slightly burned wood house structures that are covered with oil. It is quite common to see roofs blackened from smoke throughout La Vera, so a sort of Shou sugi ban protective treatment could have been locally used.

4. Mortars and paintings

There are various mortars and paintings for each use. The main traditional mortar used to be made from a compacted clay and straw mixture that was laid on sun dried bricks. A variation of this mortar was used when it was applied on ground-level outer walls. This variation which includes cow excrements, in order to provide waterproofing properties. Lime was not used very much in La Vera as the soil did not contain it. It was brought from lime zones, and the application techniques were not as developed as they were in other places. Whitewashing was used. This technique is described in “Guía Práctica de la cal y el Estuco”, (Martín Sisi, García & Azcónegui, 1998). Local recipes have been found where hydrate lime was used immediately after hydration. This is not a correct procedure for a long-lasting finish, but it was enough for disinfection. The straw and clay mortars were painted. Paint was applied with a paintbrush called *brocha extremeña*, which was similar to Portuguese brushes. It was a good quality round brush, with a wooden handle and strong, vegetable hair, perfect to press the paint in a process called *repretar* (Gárate, 1993) necessary for the lime´s properties to be achieved.

The upper house levels, which were more difficult to reach, were usually painted with a fine clay and water-based paint. Garganta la Olla has a beautiful ochre coloured clay. This upper paint was applied with the *escobillo* once a year, to protect the walls (Fig.13).

Fig. 13. Jesus mother´s escobillo (Source: Bujalance, 2017)

Other mixtures were used to get new colours for a specific purpose. The fireplace walls were painted in black (Fig.8). Black paint was made with charcoal, *negro de humo,* mixed with clay or sometimes charcoal mixed with lime. This last mixture turns into a black or grey coloured finish that was also used in outside wall bases. This black paint could easily hide splashes, but also, the lime and charcoal mixture would help transpiration, letting the inner wall dry. This finish also needed maintenance and was regularly applied.

Unfortunately, this is one of the paints that is almost lost, having been substituted with all kinds of materials on the bases. There is another paint used in La Vera composed of brown lime, an impure lime with clay and hydraulic properties. This paint is only occasionally seen in ground floor inner walls.

Women used to paint the inner walls with the *escobillos*. They relate how they used it first to take off the spider webs on every corner, as well as in the joint between walls and wood. Then they painted these areas with colour. These paints can still be seen nowadays, sometimes just clay paint, with no maintenance, still stuck to the wood (Fig.14).

Fig. 14. Ochre painting (Source: Bujalance, 2017)

Plaster is not usually seen, but some estuco is found on modern applications.

The techniques shown conform the traditional decoration in symbiosis with construction knowledge, the use of nearby materials and the slow introduction of lime. Coloured paints; white, ochre, black and red; were applied on clean surfaces ending in wide curves following the structure, the base or the stairs.

One of the most common errors found in the studied restorations, is the use of waterproof materials to avoid capillary damp on the walls. Ancient walls have always had their foundations in the ground, and capillary damp is and will be inside the wall. Ventilation has always been the strategy to let this humidity out, avoiding damp patches or, at least, improving them. The use of waterproof materials such as cement or tiles in the outer bases won´t allow damp out, leading it directly to the inner rooms, with the opposite effect to the one desired.

Outside mortars did not cover the wood structure. They were used just on the infills. Using rope around wood to stick the mortar on, is probably a late and uncommon practice which is hardly seen, and full of cracks. There is plenty of paint protecting wood on doors, windows and structures, probably made with flour, linseed oil and ochres, greens and blues, with excellent adherence to wood, that would need further investigation.

5. Conclusions

The image of the three studied historical and artistic sites of La Vera is related to urbanism and geography, but also to a traditional way of living attending to rural needs. Houses were built with materials found nearby, such as wood and clay, although lime was also used.

The use of these buildings has changed, and a natural evolution of vernacular architecture needs to be found to maintain the essence and knowledge of these villages. This paper is the result of an investigation of construction techniques as a basis for this process.

The structural conception of Verata´s wood framed structures is leading weight to the wood structure. This was understood by builders who designed balanced structures using counterbalance weights and triangles to stabilize horizontal efforts or relieve below structures. This complex understanding has to be technically considered before rehabilitations or partial demolitions, to avoid loss or damage.

The design of houses is the clue to understanding how wood, clay mortars and sun-dried bricks could resist atmospheric damage. Houses increase in surface area as they get higher is the main strategy to protect facades. However, other strategies were used for this purpose: painting to protect infills and wood, ventilated wood planking or light burning were used. Every technique was developed based on the detail, increasing ventilation surfaces with corbel striped decorations and water drips, water drains or by the use of sacrifice fretted boards.

Painting and mortar techniques were developed on sun-dried bricks, wood and stone supports. Different mixtures of clay and lime with different pigments and substances were achieved obtaining different characteristics. There was an intention to improve hydraulic or waterproof qualities. Construction, a traditional use of architecture, design, structural conception, protection strategies and decoration, are the main elements of knowledge and image to be preserved in these villages. This is the essence of Verata´s architecture.

This knowledge acquired and the questions raised that require further investigation are the basis from which to define correct rehabilitation projects in order to maintain this essence that goes beyond an image.

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Traditional buildings for tobacco processing in Val Tiberina (Tuscany-Italy)

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
This paper focuses on the analysis of buildings used for tobacco processing, built in the first half of the 20th century in Tuscany (province of Arezzo), by studying construction techniques, materials, and preservation issues. Since the 16th century, in Tuscany, the sites involved in the cultivation of tobacco are both the upper Val Tiberina and Val di Chiana (in particular Arezzo and Siena areas). At first, tobacco was used either for medical purposes or as snuff and pipe powder. It soon became the most renowned cultivation throughout the Tiberina Valley, due to the excellent quality of the tobacco produced. The first significant crops date back to the early 17th century. The drying process took place in specific buildings named "tabaccaie", where tobacco leaves were placed over an oak wood fire to dry. This process was adopted until the 1970s. Subsequently, a profound crisis in the agricultural sector determined the falling into disuse and abandonment of numerous "tabaccaie". In some cases, these buildings have been reused as luxury hotels for tourism purposes, but many of them have been demolished or are in a state of ruin. They represent the testimony of agro-industrial vernacular architectures nowadays at great risk. Indeed, most of the recovery interventions have often completely obliterated the original structure to make the former "tabaccaie" able to satisfy housing and comfort requirements. The study aims to deepen the knowledge of these buildings to preserve cultural identities and transfer inherited values.

Keywords: *Tobacco processing, construction techniques, building material, preservation issues.*

1. Introduction

Tuscany and in particular the areas of Val di Chiana and Valtiberina (Fig. 1) are leaders in the Italian production of tobacco, which also extends to Campania, Veneto and Umbria. The cultivation of tobacco started in Valtiberina in 1574 when Cardinal Nicolò Tornabuoni, ambassador of the Grand Duke of Tuscany in Paris, sent some seeds of this plant, coming from America, to his nephew Alfonso Tornabuoni, Bishop of Sansepolcro. At first, the plant was used for medical purposes and as a snuff and pipe powder (Paoli, 2018). It soon became the most renowned crop throughout the Valtiberina, characterized by the excellent quality of the tobacco produced. The first significant crops date back to the early 17th century. Sansepolcro was granted the cultivation of 1,000,000 tobacco plants. Later, in 1868, the same concession was also extended to the neighbouring municipalities of Anghiari and Monterchi. Since 1910 the Tuscan Valtiberina has invested in the sector and has made the cultivation of Kentucky tobacco the main crop, becoming the basis of the area's economy as well as a real driving force for the local community's culture.

Fig. 1. The Valtiberina, in Central Italy, between Tuscany and Umbria (Source: rom Google Earth, modified).

A century after its introduction, the Kentucky tobacco of this area is known all over the world and is counted among the "Top grades" as regards its fine quality. It is used to produce the external part of the "Tuscan cigar" and in particular of the “Toscano Extravecchio", the only non-food product that "Slow food" has chosen as a praesidium and which is annually paired with excellent wines at the salon of taste (Santini, 1996).

The production of this cigar involves drying the tobacco leaves over a direct fire of oak wood. Specific dryers, still visible today in the area, were built by the landowners. They had been in use until the 1970s when a series of structural factors in the agricultural sector led to a profound crisis partially recovered through mechanization of the different production phases. The effects of this crisis were highlighted by the decommissioning and abandonment of the numerous tobacco processing buildings (called *tabaccaie*) in the area. In some cases, these buildings have been used for tourism purposes with the construction of luxury hotels or farmhouses. However, many of them have remained in a state of ruin or have been demolished and rebuilt adopting modern computerized processing systems for the production of tobacco. The interest, then, derives from different issues: on the one hand, the fact that these buildings bear witness to part of the social history of the area, and in particular to working conditions, to the more or less denied rights of a substantial part of the population, mainly female, up to the 1960s/1970s on the other hand, these buildings are examples of agro-industrial vernacular architecture, evidence of now obsolete construction techniques and industrial processes. They risk disappearing because of reuse interventions which often completely obliterate the original structure to satisfy current housing and comfort requirements. This research aims to deepen the knowledge of this type of buildings related to tobacco processing dating back to the first half of the 20th century, located in the surroundings of Anghiari, by analyzing their construction techniques and materials to preserve their cultural identity while designing reuse interventions. For this purpose, a survey was conducted in the territory of Anghiari. It was thus possible to identify 30 dryers representative of traditional construction techniques. Nearly twenty dryers are still in use, while others have been converted into residential dwellings or are in a state of abandonment. The historic working dryers have been analysed to assess:

- the presence of possible decay phenomena of the stone materials;
- the cohesion of bedding mortars and renders;
- the presence of fractures due to use (heat/humidity) or structural problems (stability of foundations, seismic events);
- the integrity of roofs;
- the functionality of downpipes and gutters. [MC, MM, FF, SR]

2. Productive process

The main type of tobacco produced in Tuscany (Tiberina valley) is Kentucky tobacco, derived by hybridisations of the North American flue-cured type with some local varieties. The favour-able environmental conditions of the Tiberina valley (both climatic and soil consistency) and the strict curing and drying process adopted, makes Kentucky tobacco a very typical tobacco, particularly suitable for the production of Tuscan cigars. The production process starts in February-March with the sowing of the very small seeds in the seedbed, followed by transplanting of the 10-15 cm tall plants (in May-June), the harvesting and drying of the leaves (in August-first half of

October), and finally the sorting of the dried leaves before sending them to the machining centres (in November-January). All steps of the production process require adequate procedures and attention to obtain good quality tobacco, but the harvesting and drying phases are the most crucial to obtain leaves with suitable characteristics (substantial and elastic tissue, dark brown colour, good combustibility) (Fig. 2).

Fig. 2. Image of a Kentucky tobacco leaf after drying (about 90 cm in length), suitable as cigar wrapper.

Before flowering, the tobacco plants are tipped leaving 12-20 leaves and eliminating the floral bud and upper leaves. After 40-50 days from the tipping and periodic elimination of the axillary shoots, the upper leaves are increased and ripening begins. Depending on the type of Kentucky tobacco hybrid, ripening occurs from the bottom to the top or from the top to the bottom of the plant, and a change in the colour of the leaves (from dark green to lighter green with yellow-greenish spots) is observed. The harvesting proceeds (from the bottom to the top, or vice versa) with the detachment of 2-4 ripe leaves at a time from the stem every 15-20 days. The leaves are then tied to each other through the stem, placed on a pole, and stored at room temperature and humidity. When the leaves turn yellow (typically after 4-6 days), they are transferred to the dryers for the drying and browning process. During this step, the temperature and humidity of the room are regulated by fires, typically one in the middle of the room and one or more in the corners, depending on the needs. The fires are mainly obtained with dry oak, which produces smoke without flame. The temperature is kept at around 30 °C for one day, then raised to around 35-40 °C until the leaves turn brown (typically 4-5 days). During this phase, excess moisture in the leaves is eliminated by opening the small windows located in the upper part of the structure. Finally, the temperature is further increased (45-50 °C) to reduce the moisture content in the leaves and activate the bulk fermentation, which gives a particular scent and bouquet to the tobacco (Fig. 3).

After extinguishing the fire and lowering the temperature, the tobacco leaves are transferred to the storage barns until the sorting step. [MC]

Fig. 3. Tobacco leaves after sorting and prepared for sending to the machining centres. The colour of the ribbon indicates the quality: red (best quality) for Tuscan cigar wrapper, blue for Tuscan cigar filler; yellow (poorer quality) for filler of some kinds of cigarettes.

3. Tobacco dryers in the Anghiari territory: types and construction techniques

In the Anghiari area, tobacco dryers are characterized by the presence of a curing room and shelter spaces for the storage of leaves and tools. The curing room consists of a high empty volume with a hanging system made of wooden beams and poles. During the drying phase, tobacco leaves are hung on the poles to be cured by the fire. (Fig. 4).

Fig. 4. Interior of the treatment room in which there are leaves in the drying phase (credits Manuela Mattone).

The treatment room (a real oven) has an almost square plan with load-bearing walls made of stones or mixed stones and bricks with corners made of dressed stone ashlars or bricks (Fig. 5). In the more recent buildings the walls are made of tuff blocks, sometimes interrupted by a brick course (Fig. 6). The two-pitched roof is characterized by the presence of a structure consisting of a double wooden framework on which a layer of brick slabs and brick tiles are located.

The spaces used for the storage of leaves and tools have a load-bearing structure made up of brick pillars on which the trusses supporting the double row of beams of the roof and the tile covering rest. Where present, the curtain walls are in brick (Fig. 7).

The oven has a small number of openings: a small door to limit the temperature range, a window on the façade opposite the entrance, and small holes in the top of the side elevations to ensure the necessary ventilation. The openings are generally finished with bricks or elements of natural or artificial stone. [MM]

Fig. 5. Detail of the masonry at the corner of a drying room (Source: Mattone).

Fig. 6. More recent drying rooms in Anghiari (Source: Mattone).

Fig. 7. Ancient drying room in Anghiari (AR) (Source: Manuela Mattone).

4. Dryer building materials

As previously mentioned, the walls of the oldest dryers are in mixed type masonry, made of river pebbles and bricks laid with abundant mortar and rendered. The river pebbles reflect the geology of the surrounding area, being characterized by the presence of arenaceous lithotypes (Cervarola sandstones), marly limestones, and ophiolites (belonging to the External Ligurids Units) (Fig. 8).

Fig. 8. Particular of masonry made of river pebbles and bricks laid with abundant mortar (Source: Fratini).

The corners show dressed sandstone ashlars alternating with bricks (Fig. 5). Stones are not affected by decay. Therefore the research focused in particular on the study of bedding and rendering mortars (which can most influence the durability of the masonry) and bricks of the mixed masonry (Fig. 9, Fig. 10 and Fig. 11).

Fig.9. Analysed rendering (Source: Fratini).

Fig. 10. Analysed bedding mortar (Source: Fratini).

Fig. 11. Analysed ancient brick (Source: Fratini).

These materials have been studied with the following methodologies:

- the mineralogical composition has been determined through X-ray diffraction (X'Pert PRO diffractometer by PANalytical equipped with X'Celerator detector and HighScore software for acquisition and interpretation of data according to the following operative conditions: Cu $K\alpha 1$= 1,545Å radiation, 40 KV, 30 mA, 2Θ = 3-70°);

-a petrographical study has been performed on thin sections with optical microscopy under transmitted light (ZEISS Axioscope A1) for evaluating the microstructural parameters (Pecchioni et al., 2014).

The bedding mortars show good cohesion and have been made with a binder/aggregate ratio of about 1/3. The aggregate is well selected with a grain size of less than 1 mm. The granules have a sub-angular to sub-rounded shape and are composed of quartz, fragments of micritic limestones, and serpentinites. The binder is a slightly hydraulic air-hardening lime as evidenced by the presence of small dark inclusions referable to calcium silicates. There are also numerous lumps. This indicates the lime was produced with a traditional technique, slaking the quick lime to obtain the lime putty. Concerning the raw materials, the aggregate comes from the sediments of the nearby Tiber river while the binder was produced by burning slightly marly limestone as shown by the texture of the lumps, referable to underburnt lime fragments (Fig. 12).

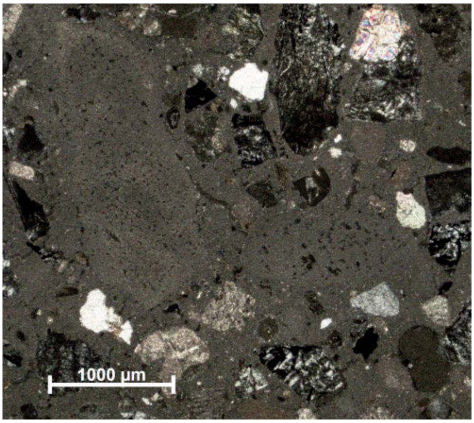

Fig.12. Bedding mortar: lumps referred to the burning of a slightly marly limestone (image at the optical microscope in thin section, polarised light) (Source: Fratini).

The renders are in a bad state of conservation due to the low cohesion of the mortar and the lack of adhesion to the substrate. This can be explained by the too high amount of aggregate (binder/aggregate ratio of about 1/4) (Fig. 13). The aggregate has not been selected and has a coarse grain size. The granules have a subrounded shape and are composed of serpentinites, fragments of micritic limestones, and quartz. The binder is similar to that of the bedding mortars. Numerous lumps are also present. The raw materials used to make these mortars are similar to those of bedding mortars.

In summary, the bedding mortars seem to have been made with greater care, compared to the mortars of the renders. One possible explanation is a greater interest in the quality of the structure rather than the aesthetic features of the building.

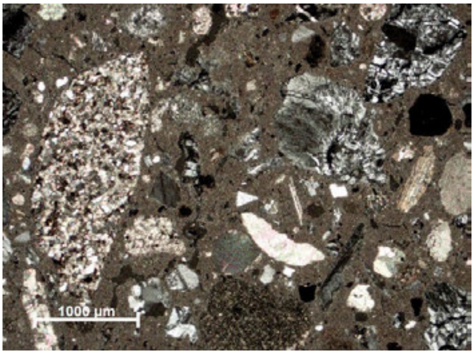

Fig. 13. Rendering mortar: the low binder/aggregate ratio is evident (image at the optical microscope in thin section, polarised light) (Source: Fratini).

The ancient bricks were made with the traditional method of wet pressing and show no signs of decay. The study under the optical microscope in thin section shows a birifrengent groundmass and an abundant framework made of quartz, feldspars, micritic calcite with a grain size of about 400µm- 1mm (Fig. 14). The birifrengent appearance of the groundmass indicates a firing temperature lower than 750 °C, therefore not capable of completely destroying the lattice of clayey minerals and carbonatic grains. [FF, SR]

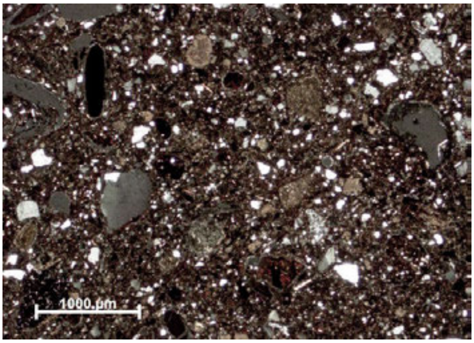

Fig. 14. Brick with an evident birifrengent groundmass and an abundant framework (image at the optical microscope in thin section, polarised light) (Source: Fratini).

5. Preservation issues

Since the 1970s, as a result of the crisis in the tobacco sector, many *tabaccaie* have been closed down. Some have been demolished, many have undergone interventions that have often altered their original layout, while others, deprived of any maintenance work, are in a state of total abandonment. These buildings are interesting examples of industrial architecture that characterise the rural landscape of some of the Tuscan provinces, bearing witness to the history, production activities and culture of these territories.

In recent years, actions have been taken to promote the knowledge and appreciation of this heritage. In particular, in 1998, the first work of cataloguing the *tabaccaie* in the municipality of San Miniato (province of Pisa) was carried out with the dual purpose of encouraging the acquisition of more widespread awareness of the existence of this heritage and the recognition of its cultural value through the census and cataloguing of the still existing constructions (Cavazza & Cavazza, 1998). More recently, in 2001, as part of the project promoted by the Province of Pisa entitled "The Memory Industry" (Torti, 2005), an attempt was made to promote both knowledge of the tobacco processing buildings (by disseminating drawings, photographs, archival and bibliographical material on the *tabaccaie* in the Province of Pisa) and their use by developing a specific cultural itinerary aimed at enabling tourists to approach this heritage and deepen their knowledge of these places, their history and the transformations they have undergone.

Unfortunately, some of these buildings have been irretrievably lost and with them part of the history of the agricultural activities, while others are at risk because they have been totally abandoned or are destined to undergo highly invasive renovation work. Safeguarding this heritage requires in-depth knowledge of it in terms of construction, structure and materials, and the development of proposals for its preservation by promoting its compatible reuse (Bartali, 2014). Permanence must be ensured not through simple musealisation and immobilism, but the identification of new uses, adapting the buildings to the changed performance and functional requirements, without altering their identity features. Since not everything can be simply maintained or transformed into a museum, cultural space, or exhibition hall, to guarantee a future for this heritage it must be re-introduced into an economic circuit that uses it and lives it, guaranteeing its maintenance. As Franco Milella points out, "the processes of enhancing the value of minor assets can and must take on the value of contemporary use" (Milella, 2015), the only means by which they can be used. This is the only way to guarantee their permanence over time.

To preserve the material as well as aesthetic features of these buildings, the analyses undertaken provide useful indications on the conservation work to be carried out. In particular, it was possible to verify that the bedding mortars have been made with care and have good cohesion, while the mortars of the renders are of worse quality and have often fallen off, leaving the masonry exposed. Therefore, for the bedding mortars only punctual interventions with mortars based on natural hydraulic lime, compatible with the original ones, should be adopted. As far as plasters are concerned, given their precarious state of conservation and poor quality, it is not advisable to preserve them, but it is recommended to remove detaching plasters and replace them with new ones based on natural hydraulic lime so as to protect masonry from external agents. [MC, MM, FF, SR]

6. Conclusions

The dryers (*tabaccaie)* of the Valtiberina are an interesting testimony to the history of the production activities that characterised and still characterise this area. The analyses conducted so far highlight not only their historical and cultural value but also the close link established with the surrounding territory. Built using local materials, they characterise the landscape. Having recognised their cultural value, their safeguarding requires projects respectful of their building technology and capable of ensuring their continuity of use. The needed and inevitable transformations must be designed with care to maximise the permanence of materials and identity features of this legacy, because “preserving the evidence of our past means picking up the broken threads, mending the broken wefts, weaving new ones, using all this for the future” (Ermentini, 2007).

[MC, MM, FF, SR]

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The parish church of San Michele Arcangelo in Metelliano: the path of knowledge of a vernacular architecture

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
The parish church of San Michele a Metelliano, located in Tuscany near the city of Arezzo, is a unique case of vernacular architecture. The building is the result of a synthesis of traditional local architecture and a strong Byzantine influence. It became a national monument in 1907.

Keywords: *traditional architecture; restoration; conservation; heritage; traditional techniques.*

1. Introduction

Research on parish churches in Tuscany has been ongoing for over a century.[1] The numerous studies that have been conducted are justified by the important role these places of worship have played throughout the ages. For centuries, parish churches have not only collected the material and immaterial records of their surroundings, but they themselves are, for the traditional building techniques and local materials employed, important testaments. Although the construction of holy places rose in the first centuries of the second millennium, many of today's parish churches are the result of stratifications that date back to early Christian and, in some cases, Roman times.[2] It is a well-known fact that in Tuscany, more than in any other region, the 9th century saw a radical renewal in the construction of places of worship, which was driven by the strong increase in productivity. In Arezzo, the situation was no different; in fact, numerous places of worship were built, both minor, located mainly in rural areas, and major, for example, the so-called *Duomo Vecchio di Arezzo*.[3]

This building, erected on the Pionta hill, was demolished by Cosimo I in 1561 for military purposes (De Angelis d'Ossat, 1978). The only information available today is comprised of episodic notes from recognised sources (Pasqui, 1899).

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[1] For further information on the subject, see the various studies conducted, including the following cfr.: Bracco M. (1971) *Architettura e scultura romanica in Casentino*, Firenze; Canestrelle A. (1904). *L'Architettura medievale a Siena e nell'antico territorio*, Siena; Moretti I., Stopani R. (1968). *Chiese Romaniche in Valdelsa*, Firenze; Salmi M. (1912). *Chiese romaniche in Casentino e in Valdarno superiore,* in "L'Arte"; (1927). *L'architettura romanica in Toscana*, Milano-Roma; (1972). *Chiese romaniche in Val di Pesa*, Firenze; (1985). *Chiese romaniche della campagna toscana*, Milano; Salvini R., Von Borsig A. (1973). *Toskana. Unbekannte romanische Kirchen*, Monaco; (1974). *Architettura romanica religiosa nel contado fiorentino*, Firenze; (1981). *Romanico Senese*, Firenze;

[2] Angelo Tafi in *Le antiche pievi. Madri vegliarde del popolo aretino* explains the mixture of peoples and events that led to the formation of the pievi in the ancient context of Arezzo by using a time scale.

[3] For a more detailed discussion of the subject, see Guglielmo De Angelis d'Ossat in *Atti e Memorie della Accademia Petrarca di Arezzo* N.S. XXXVII, p. XXVI, (citated in De Angelis d'Ossat G. (1978). Il "Duomo Vecchio" di Arezzo, *Palladio*, p.38)

Fig. 1 Territorial outline of the parish church of San Michele a Metelliano.

For the renovation of the episcopal complex in Arezzo, initiated by Bishop Elimperto (986-1010), Maginardo, the architect who would subsequently be known as Maginardo Aretino, was commissioned to build the *Duomo*, known today as the *Duomo Vecchio*, outside the walls of Arezzo. In that same period, Maginardo was also commissioned to build the parish church of San Michele a Metelliano, the object of this study. In order to understand the combination of different elements that the parish church of Metelliano presents today, it was important to study this architect from Arezzo; and it was particularly relevant to know that Maginardo travelled to the Basilica of San Vitale in Ravenna at the beginning of the 11^{th} century. The reasons for his stay there are made clear in a number of documents, in particular one dated 1026,[4]. which states that the work was commissioned by Bishop Adalbert. The bishop, who was previously the Archbishop of Ravenna, intended to have a new basilica, modelled on the one in Ravenna, built just outside the city of Arezzo. Some texts suggest the existence of study drawings made by Maginardo during his journey, but they offer no more definite information. It is, however, important to note that the Basilica of St Vitale influenced the architect not only in the construction of the *Duomo Vecchio di Arezzo* but also in his later works.

Fig. 2. In Morelli E. (2007). *Strade e paesaggi della Toscana, il passaggio della strada, la strada come passaggio*, Alinea Editrice, Firenze, p. 59.

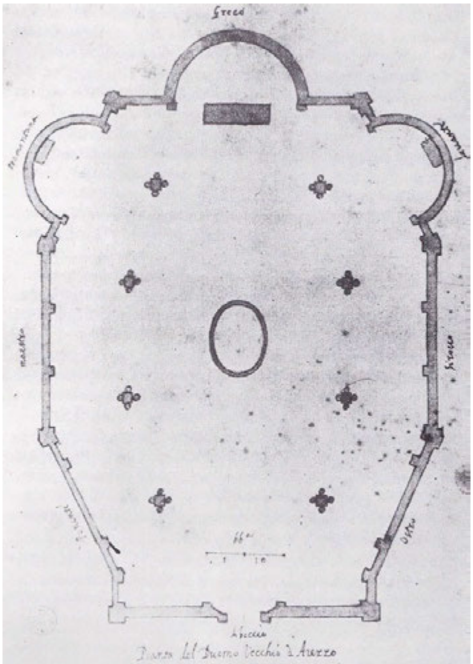

Fig. 3. Giorgio Vasari il giovane, Pianta del Duomo Vecchio (Uffizi, A4788)

[4] As reported in the document of 1026 (Arch.Capit, N.86) «eo quod ipse architectus Ravennam ivit, et exemplar ecclesiae S. Vitalis inde adduxit, atque solers fundamina in aula b.Donati, instar Ecclesiae sancti Vitalis primus iniecit» mentioned in De Angelis d'Ossat G. (1978). *Il "Duomo Vecchio" di Arezzo*

2. History of the Parish Church of St Michael in Metelliano

The parish church of San Michele in Metelliano is a summary of Maginardi's Ravenna experience within the framework of minor architecture in the Cortona countryside. The structure is, today, the result of multiple stratifications, which were determined by the needs of the community throughout the ages. The most evident intervention is, today, the one carried out by Maginardo at the beginning of the 11th century. At that time, a radical demolition was carried out, and it was later followed by the reconstruction that gave the building its present appearance. Some studies trace the origins of the structure back to Roman times, and it is hypothesised that an ancient temple, dedicated to the god Bacchus, once rose there. Traces of this previous structure can be found both on the tombstone of a Roman child, which was found during a 20th century excavation and is now preserved in the museum of the Accademia Etrusca di Cortona, and in the etymology of the word *Metelliano*, which derives from the name of an ancient Roman family, the *Gens Metellia* (Tüskés, 2006). One of the earliest references to the building is found in a document dated 1014, in which Henry II confirms that the abbey of Santa Maria in Farneta holds, among other properties, a church dedicated to S. Angelo (Minutoli, Repole, 2018). In 13th century registrations and tithes, the structure is listed as "S. Angelo del Succhio," bishopric of the parish of Cortona. The original construction of the church dates back to the 7th century and can most likely be attributed to the Lombards (Tüskés, 2006). The discovery of early-medieval elements in the building confirms this hypothesis. At the beginning of the new Millennium, Maginardo realized the present *structure. The building has undergone major* transformations over the centuries: in 1439 AD, the bell tower, located at the centre of the façade, was replaced with the present-day bell gable; and in 1674, plaster was added to the façade. During the restorations which began in 1905, and which are documented in the Cortona periodical "L'Etruria" (Pompilj, 1906), important interventions were carried out by Prof. Giuseppe Castellucci. [5] The plaster was stripped from the building entirely, uncovering, once again, the stone façade that lay underneath. This intervention not only allowed for a better understanding of the structure for purposes of stabilization (Minutoli, Repole, 2018), but it also gave the building its present-day appearance. Without the plaster, the façade is probably as it once was: simple and austere, and more similar to Lombard structures than Tuscan ones. In 1907 it was made a national monument.

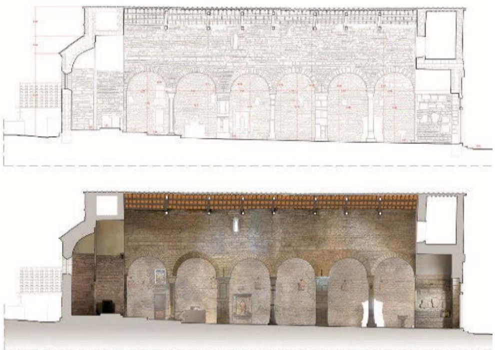

Fig. 4. Two-dimensional survey.

3. Method of analysis

The discovery phase combined an analysis of historical records with a direct analysis of the structure: the former provided a starting point for the understanding of the building and the discovery of known and unknown documentary sources that made it possible to answer the temporal questions that a direct analysis alone

[5] Giuseppe Castellucci Architect is a well-known figure on the Tuscan scene between the 19th and 20th centuries for the large number of restorations he carried out. For further information see: C. Cresti-L. Zangheri (1978). *Architetti e ingegneri nella Toscana dell'Ottocento*, Uniedit, Firenze, pp. 53–54; Sanguineti C. (2007). *Scheda su Giuseppe Castellucci, in Guida agli archivi di architetti e ingegneri del Novecento in Toscana, a cura di E. Insabato, C. Ghelli*, Edifir, Firenze, pp. 113–119.

could not; and the latter, carried out on the materials, involved the use of some of the most modern surveying methods, such as laser scanning and photogrammetry. Together, the two analyses made it possible to study the condition of the structure and elaborate thematic tables for its comprehension and conservation. The realization of the architectural survey, obtained through the two-dimensional restitution of the 3D point cloud, was the base on which further analyses were carried out. Having accurate geometrical-dimensional data makes it possible to elaborate an equally accurate restoration project. In the case of San Michele a Metelliano, in the design phase of the survey, attention was paid to the quality of the data to be acquired, so that it suited the level of detail that needed to be obtained (Pancani, 2017). The subsequent analyses involved, on the one hand, the outline of the state of conservation of the building − through a precise mapping of the materials used and of the relative deterioration and alterations – and on the other hand, an analysis of the static architecture of the church through the identification of both its structural elements and instabilities. Together with the instrumental analyses − and in order to understand the constructive and formal elements that are typical of the architecture of Cortona − comparative analyses of similar buildings were carried out. This made it possible to highlight the discordant aspects and elements in the structures that were analysed.

4. Analysis of the structure

San Michele a Metelliano presents a basilica plan with three naves at the end of which stand three semi-circular apses, and which has no transept. The ceiling alternates barrel vaults, near the apses and the entrance, and wooden trusses. The nave is twice as wide as the side aisles, and it has a slightly raised chancel. The three naves are separated by two massive rectangular pillars alternated by three narrow polygonal columns. From a stratigraphic point of view, the wall face is made of small sandstone blocks arranged in horizontal and parallel. The Lombard Romanesque façade preserves, above the door, a suspended prothyrum between two single-light windows. The apsidal area is richer: it is made of three apses which are divided by pilasters made from materials that are in part from Roman remains. From the above description, it is clear that some of the constructive and formal elements of the structure are typical of pre-Romanesque (H. E. Kubach, 1978), Tuscan architecture, for example, the basilica plan and the spatial distribution. Other elements, however, are typical of Byzantine architecture. Inside the parish church of San Michele in Metelliano, the alternated pillars and columns are an architectural element taken directly from the basilica of San Vitale in Ravenna. This architectural element is, as Kubach also affirmed, hardly ever the case in Tuscan churches, but it is very common in buildings found in Northern Europe. In the parish church of San Michele, the capitals themselves, which in Tuscan architecture are fashioned in various ways, have a square base and trapezoidal sides, like those on the monolithic columns in the presbytery of the church in Ravenna, which, however, include a pulvino that is absent in the church in Arezzo. The monolithic columns, on the other hand, are octagonal, like in other Tuscan parish churches but absent in S. Vitale. A comparison with what was once the *Duomo Vecchio*, would be of great interest, but, unfortunately, only exterior views and a plan made by Giorgio Vasari can still be found in his book "*Libro delle Piante*" (De Angelis d'Ossat, 1978). The constructive and formal elements that see the parish church of San Michele in Metelliano listed among other important Tuscan vernacular architectures are found in the decorative elements outside the apses. All three apses are divided by pilasters made of terracotta and stone. The lateral ones are also crowned in twin arches. The same construction technique is also present in the parish church of Santa Maria di Confine, in Tuoro sul Trasimeno, where the twin arches are the only peculiar element. In the case of the parish church in Metelliano, however, the pilasters are also worthy of note for their display of heterogeneous ashlars. This peculiar characteristic is the result of the reuse of remains from the pre-existing Roman temple of Bacchus. What is more, the reuse of material is not limited to the apses: the whole building presents elements re-claimed from Roman structures, mainly travertine (also reworked, like in the façade), and various bricks from the imperial age bearing diagonal incisions (Fatucchi, 1977).

Fig 5. Interior view of the church. (Source: Ghelfi, 2021)

Fig 6. External view of the church. (Source: Ghelfi, 2021)

5. Conclusions

The interdisciplinary approach, carried out by applying a rigorous scientific process, has made a deeper understanding of the architectural peculiarities of the parish church of San Michele a Metelliano possible.

The conservation of this structure becomes inevitable in a measure that is both critical and conscious and must be observed.

The building, unlike a great number of parishes found in Tuscany, stands apart from the rest for characteristics that are difficult to find elsewhere. The blending of essential elements of Byzantine architecture, first and foremost, the alternated pillars and columns, and the constructive elements of the local tradition makes the building an important example of vernacular architecture.

Fig 7. Lunette of one of the side doors of the parish church. (Source: Ghelfi, 2021)

The ties to the territory are present in its every element, from the materials to the stonework, from the decorative elements to the construction. The reuse of building materials has been an integral part of this structure. From when it was first constructed in the 7th century A.D. until more recent interventions, local materials, new or recovered, were used. From the palimpsest that has arisen, it is possible to gain information about the changes that have taken place. Some examples can be found in the walls of the church, where it is possible to identify materials from pre-existing Roman buildings: travertine, used for significant elements, or bricks dating back to the imperial age.

Even the monolithic columns are a synthesis of the alternated pillars and columns found in the architecture of Ravenna and the octagonal ones found in other local churches, for example, the Badia di Petroia, the church of San Pietro in Acqui, the church of San Martino di Pombia (Pardi, 2000). The parish church of San Michele a Metelliano became a national monument in 1907, and today it represents an important testament to be preserved and protected.

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Indoor air quality for sustainability, occupational health and classroom environments through the application of earth plaster

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Topic: 1.3 Studies of traditional techniques and materials.

Abstract
Clearly, the construction sector makes a large scale contribution to environmental degradation and urgently needs to change its principles to focus on environmentally sustainable construction. Earth, as a building material, has a potential cradle to cradle life cycle, thus, achieving a circular economy. This material also displays numerous advantages, namely: economic and ecological and as well as the ease of reuse and recyclability. The earth material also registers a high capacity to absorb and release water vapor, which helps to balance the relative humidity and the internal temperature, promoting not only the comfort of occupants but also the quality of the air in buildings. The materials applied in construction hold great influence over the indoor air quality (IAQ). IAQ ranks as such a crucial issue that it appears in the seventeen 2030 Agenda SDGs. As about 90% of our time is spent inside buildings, whether for leisure or work, it is essential to live in spaces with adequate and healthy interior environments. According to the World Health Organization, good air quality represents a basic requirement for life and is a determining factor for the health and well-being of occupants of indoor spaces. In schools, and due to the complex and diversified activities developed there, in addition to adverse health effects, indoor air quality may also have a direct impact on student concentration and performance. Understanding and studying materials, specifically earth mortars, with the ability to capture pollutants and reduce their concentration while helping to regulate the temperature and relative humidity conditions, and student comfort, is thus extremely important. Hence, with the objective of improving the development of construction strategies, this article details and highlights the beginning of the RESpira project.

Keywords: *earth mortar; indoor air quality; occupational health; environment.*

1. Introduction

The concept of indoor air quality is both quite complex and all-encompassing as it depends on numerous factors, including: temperature, relative humidity, air velocity, concentration of microorganisms and chemical pollutants, suspended air particles, among others (Abreu, 2010). Frequently, indoor air quality problems stem from combinations of the effects of the various pollutants present in those spaces and sometimes present in low concentrations and hence not only due to high concentrations of a single pollutant, which renders the study of indoor air quality (IAQ) even more complex (APA, 2010). The need to eradicate or minimize exposure to indoor pollutants is, for this reason, one of the priorities defined by the World Health Organization (WHO) for protecting public health in developed countries (WHO, 2016).

The WHO estimates that indoor air pollution is responsible for 3.8 million deaths every year (WHO, 2020).

The Environmental Protection Agency (EPA) even suggests that poor indoor air quality can reduce the ability of occupants to perform mental tasks that require concentration, calculation or memorization. According to the EPA, a study carried out in European schools revealed a significant reduction in student concentration following increases in carbon dioxide levels inside the classrooms. Similar results were also obtained among students exposed to high levels of volatile organic compounds (Environmental Protection Agency, 2003) and fine particulate matter, namely PM_{10} and $PM_{2.5}$ (Pulimeno et al., 2020). Even though indoor air quality in schools represents a problem impacting on around 64 million students in Europe alone, it still remains a neglected subject even while gaining greater importance due to the recent COVID-19 pandemic. Ensuring good air quality in schools is, for the reasons presented, a current need that should be high on the list of priorities for buildings managers.

Good indoor air quality can be ensured through the elimination or reduction of indoor pollutant concentrations either through source control (selecting low-emission furniture, materials and equipment) or by upgrading the ventilation (diluting pollutant concentrations). This last set of measures, while quite efficient, nevertheless implies higher energy consumption with a consequent increase in costs and negative environmental impacts (Wargocki, 2007), making it essential to search for more economically and environmentally sustainable solutions.

The UNESCO Chair on Health Education and Sustainable Development and the Italian Society of Environmental Medicine (SI-MA) recently presented a series of recommendations designed to improve IAQ in schools that includes, among other measures, the growing of plants as specific natural filters capable of absorbing some indoor contaminants (Pulimeno et al., 2020).

Earth, as a building material, also represents a material able to help improve indoor air quality. As a construction material, this provides a potential cradle to cradle life cycle in keeping with the circular economy. This material also returns numerous advantages, specifically: economic, ecological, ease of reuse and 100% recyclability. Earth as a material also contains a high capacity to absorb and release water vapour, which assists in balancing the relative humidity and internal temperature, promoting comfort among the building's occupants and overall indoor air quality (Santos et al. al., 2020a,b).

The materials applied in construction have a great influence on air quality. The materials chosen should either improve or at least not negatively affect IAQ. Given we spend about 90% of our time inside buildings (Leech et al., 2002), whether for leisure or work, it is essential we spend this time in spaces with appropriate interior environments.

Based on the assumptions presented, the main objectives of the RESspira project, as presented in this article, focus on monitoring the concentrations of chemical and microbiological pollutants in classrooms, through the application of different types of coatings, namely earth and cementitious mortars. Monitoring the actual concentrations of these pollutants is clearly essential to producing specific protection measures for building occupants. This project will therefore take an important step in trying to answer the following questions: Is it possible to mitigate the levels of pollutants inside classrooms by applying different types of coatings? What kind of passive strategies might be adopted to mitigate the high concentrations of chemical and microbiological pollutants in classrooms?

2. School buildings *vs* indoor air quality *vs* earth mortars

School buildings have particularities that distinguish them from other types of buildings and that significantly influence their indoor air quality, such as (US EPA, 2021):

- concentration of occupants: in schools, occupants are closer, with a greater concentration of occupation by area;
- investment in maintenance: funds available for preventive maintenance are generally low, with investment in new systems and equipment still lower;
- various sources of indoor pollutants: due both to the diversity of activities taking place and the wide variety of sources of pollutants, such as: laboratory products and equipment, workshop equipment, leisure and sports spaces;
- large amounts of heating and ventilation equipment and often with complex systems.
- variety of spaces: in addition to classrooms and offices, schools generally contain other types of spaces, with different maintenance and intervention requirements, including: laboratories, amphitheatres, cafeterias, gyms and diversified green spaces.
- adapted and temporary facilities: spaces are often adapted for other purposes or are facilities installed for temporary occupations.

According to the EPA, ineffective action when facing indoor air quality problems in schools can also indirectly lead to: increased absenteeism; reduced levels of comfort and performance among students and teachers; jeopardise the functioning and efficiency of systems and equipment; increase the probability of the departure and/or transfer of students and teachers; and produce negative publicity for the establishment impacting on the community's trust.

In Portugal, the monitoring of indoor air quality, pursuant to Decree-Law no. 79/2006 of 4 April, became mandatory for certain types of buildings, including school buildings, with the establishing of maximum values for the concentration of certain pollutants that the respective law states were selected according to guidance values issued by the World Health Organization (WHO) and national and international standards handed down by the International Organization for Standardization (ISO) and the Committee Européen de Normalization (CEN).

Currently, and in accordance with this development in the prevailing legal framework, the provisions on indoor air quality are regulated by specific legislation that determines the need to monitor the following physical-chemical pollutants and microbiological parameters: particulate matter (fraction PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC), carbon monoxide (CO), formaldehyde (CH_2O), carbon dioxide (CO_2), radon, bacteria and fungi.

2.1. Indoor air quality *vs* health effects

Poor indoor air quality has direct effects on the health of occupants with the appearance of a set of symptoms potentially directly associated with the time spent inside buildings and described in the literature as Sick Building Syndrome (SBS) or Building-Related Illnesses (BRIs). SBS differs from the BRIs as there is no ethology knowledge on the symptoms described in the case of SBS and it is therefore not possible to associate the symptoms described by occupants with their particular exposure inside the building. However, in the case of the BRIs the causes of the pathologies developed are perfectly known (Jones, 1999).

Although apparently minor, Jones (1999) maintains the symptoms associated with SBS may have significant impacts on the economy and public health as they contribute to increased absenteeism and reduced employee productivity. Furthermore, in the case of schools, students and teachers register decreased levels of concentration and performance.

The likelihood an individual will become ill or develop symptoms due to exposure to certain indoor pollutants depends on a variety of factors, such as individual susceptibility, the concentration levels of the pollutant, their physical and mental health state at the time of exposure, and the duration and frequency of exposure. Each pollutant, depending on its characteristics and the concentrations present in indoor air, can have noxious impacts on occupant health.

Jacobson et al. (2019) analyze the direct risks CO_2 poses to human health with acute or even chronic exposure potentially causing psychological and physical effects; ranging from depressive behaviors, drowsiness to bone demineralization and physiological stress. High levels of CO_2 can be found in densely populated indoor environments such as sports halls, hospital waiting rooms as well as classrooms. An acceptable CO_2 value is normally 400 ppm for indoor environments even though this value may potentially reach between 600 and 800 ppm with and this increase primarily due to human respiration (Hays et al., 1995). These values can easily rise to 1000 ppm or more (Wu et al., 2021), resulting in symptoms such as loss of concentration, states of drowsiness, headaches, among others. Thus, we may clearly perceive the importance of reducing CO_2 levels in interior spaces to drive increases in the IAQ for building occupants. As mentioned, and due to the complex and diversified activities carried out, in addition to the adverse effects on health, indoor air quality in schools may also directly impact on the concentration and performance of their occupants.

2.2. Earth Mortars

Current consumption of the earth's resources has led to levels of development in Western society that are now deemed unsustainable. Perceived environmental disturbances clearly indicate that, unless urgent measures are taken, humans will encounter considerable difficulties in adapting to their global habitat. The construction sector alone contributes on a large scale to environmental degradation. In 2018, the building and construction sector accounted for 39% of carbon dioxide (CO_2) emissions from processes and energy, and 36% from end-use energy; of these, 11% resulted from products such as cement, steel and glass, and from the manufacture of building materials (IEA and UNEP, 2019). Cement manufacturing is known to be a very CO_2 intensive process and responsible for about 60% of total emissions worldwide (GCCA, 2020). By weight, cement is the second most consumed substance in the world, trailing behind only water. One building material with very different properties to cement is earth as a construction material. Earth as a construction material (Fig. 1) displays numerous advantages, in particular: economic, as local material, without the need for transport or calcination, easy to extract and transform, and with low processing costs. Earth is simultaneously ecological, hence, with low energy consumption associated with its manufacture and, in many cases, its transport (since the material is obtained from construction work site), thus reducing the carbon footprint and the corresponding CO_2 emissions due to low embodied energy. The ease of reuse and recyclability represents another major environmental advantage in allowing for 100% reuse (Gomes et al., 2018). This material also returns thermal comfort as another contribution due to its low thermal conductivity, which stems from high levels of thermal inertia due to significant wall thickness. Last but not least, this contributes to interior comfort in keeping with clay's ability to regulate the relative humidity of the interior environment as a hygroscopic material - that is, fostering the regulation of the relative humidity in such environments and thereby promoting occupant comfort in buildings and indoor air quality (Santos et al., 2020a,b).

Fig. 1. Naturarte, rural tourism built with the earth technique, located in São Luís, Portugal.

3. RESpira Project

The RESpira project (Regulation of Indoor Air Quality Through the Use of Eco-Efficient Mortars) will focus on monitoring the concentrations of chemical and microbiological pollutants in classrooms, through the application of different types of coatings, namely earth and cementitious mortars. To achieve the project's objectives, earth (two different earth types will be used) and cement mortars will first be applied in classrooms

(Fig. 2). For the results to be as comparable as possible, the mortars will be applied in rooms with the same type of usage, number of occupants, temperature and relative humidity.

After applying the coatings, surveys will be carried out among students who attend the pilot classrooms to monitor and quantify the benefits, the feelings of comfort and their ability to concentrate due to the application of the different coatings (sustainable vs. common coatings). It is preferable to carry out these surveys in the winter, spring and summer seasons.

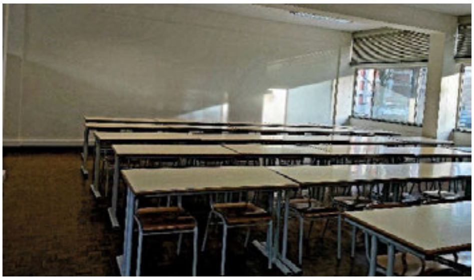

Fig. 2. Classroom to be plastered with earth mortars.

This research will contribute directly to ascertain whether or not improvements in indoor air quality are confirmed following the application of earth coatings in comparison with the current types. It is important to refer here that earth plasters are presented as eco-efficient and healthy in keeping with several of the UN Sustainable Development Goals (SDGs). Furthermore, this study emerges as unprecedented given the conditions are real (as opposed to simulations).

In the same three seasons (winter, spring and summer), air and surface samples will be collected for microbiological research (fungi and bacteria) using selective culture media and with the mortars also subject to microbiological analysis (Viegas et al. 2019). Simultaneously, evaluations of the chemical and physical parameters (T, HR, CO, CO_2, PMx) will be carried out by direct reading equipment (Fig. 3). In addition, electrostatic precipitators will be placed for one month in the pilot and "common" rooms, which will subsequently be analyzed chemically and microbiologically (Viegas et al. 2021).

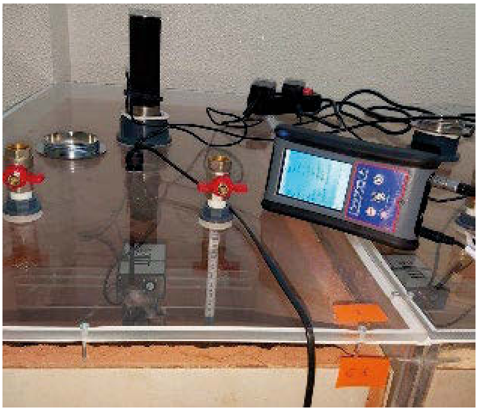

Fig. 3. Equipment for measuring pollutants.

4. Conclusions

There is currently sufficient scientific evidence relating complaints and environmental discomfort felt by the occupants of buildings to the construction materials applied inside these buildings. Hygienic and human-toxicological aspects are now beginning to be studied in built environments in order to guarantee not only the existence of pleasant and comfortable environments but also, and especially, healthy indoor surroundings.

Indoor air quality is very important both for the comfort and the health of building inhabitants as poor indoor air quality can have a high impact on health, low comfort levels and poor cognitive performance among the building's occupants. We would here stress how the levels of pollution inside buildings are often higher than those verified on the exterior. Understanding the determinants of health constitutes a fundamental issue for society, whether in classrooms or in other environments with high population densities, in order to nurture better health conditions. Another important factor is prevention as good IAQ boosts the health of the occupants inhabiting such buildings, not only improving health throughout life but also cutting the cost burden on national health services due to the reduction in Sick Building Syndrome related problems. The RESpira project thus aims to help answer some of the questions presented in order to achieve improvements in the indoor air quality of schools.

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The importance of water in traditional gypsum works

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Topic: T1.3. Vernacular architecture: matter, culture and sustainability. Studies of traditional techniques and materials.

Abstract
Until the second half of the 20th century, the traditional architecture of the Iberian Peninsula was directly linked to the resources available in its immediate surroundings, naturally diversification the built heritage throughout the territory. In its gypsiferous areas, we find a great versatility of construction systems in which the main binder used is traditional gypsum, although this material has been forgotten in the 20th and the 21st century architecture, meanwhile industrial gypsum currently plays a secondary role in the construction sector. Gypsum, like any traditional binder, is a material that is particularly sensitive to the amount of water with which it is mixed, which will be strongly linked to the technique of application, among other technological parameters. Thus, the final performance of the product is, among other things, a consequence of this water/gypsum ratio, as Francisco Arredondo states in some of his works. In them, the behaviour of an industrial gypsum is analysed as a function of the mixing water, relating it in turn to other parameters such as compressive strength, water absorption and bulk density. The aim of this work is to study the influence of the mixing water on the physical and mechanical properties of different traditional plasters, taking into account previous studies, the diversity of traditional uses of gypsum and current application techniques.

Keywords: *Traditional gypsum, hydration of plaster, dosage, mechanical properties.*

1. Introduction

The eastern half of the Iberian Peninsula is rich in gypsum outcrops, to which must be added the regions of Asturias, Valladolid, Palencia, Cádiz, Málaga, Seville and Córdoba. Adding these regions to the eastern, they represent a 58.5% of the total area of the Iberian Peninsula (Gárate Rojas, 1999; La Spina & Grau, 2020a; Bel-Anzué & Elert, 2021). It is therefore not surprising that in "gypsiferous Spain", a large part of the built heritage has been developed through the use of this traditional conglomerate.

It was not until the appearance of Portland cement in the second half of the 20th century that traditional binders such as gypsum, lime or natural cement were relegated to second place, both in terms of the diversity of their uses and their lack of inclusion in the new industrialised construction systems (Sanz Arauz, 2009; Mayo-Corrochano et al., 2022).

In the past, traditional gypsum construction was characterised by its versatility, as the performance of the material, its easy handling and adaptability allowed it to form part of multiple construction systems such as flooring, pavements, interior dividing walls, load-bearing walls, stairs, the manufacture of prefabricated elements with a structural function, decorations, interior and exterior cladding, etc. (Marín Sánchez, 2014; La Spina & Grau, 2020b; Bel-Anzué & Elert, 2021; González-Sánchez et al., 2022a).

Traditional gypsum has different mechanical properties to the industrial gypsum that we know today, which is basically characterised by its high degree of purity, its low resistance and surface hardness, and its high degree of hygroscopicity. On the other hand, in traditional gypsum these same properties are highly variable, which allowed it to be used in many construction systems. The characteristics of this traditional binder are the heterogeneity of the raw material, which is accompanied by associated minerals depending on the place of extraction, what we know as "impurities"; the variability in the percentage of purity of the stone used; the heterogeneous firing at high temperature; the crushing of the fired material; the hardness acquired after laying; the strength; and the durability of the heritage (González-Sánchez et al., 2020; Mayo-Corrochano et al., 2022).

Gypsum, like any binder, is particularly sensitive to the amount of water used during the mixing process. Although the proportion of water that gypsum needs to fully hydrate is relatively low, quantified at around 20% of the weight of anhydrous gypsum (Novo, 1966; Arredondo & Verdú, 1991; Villanueva Domínguez & García Santos, 2001), it is practically impossible to have workability of the gypsum paste with this dosage. For this reason, higher dosages are normally used to guarantee the workability of the material, varying significantly its physical and mechanical properties (Fig. 1).

Consequently, the amount of water used will be strongly linked to the construction technique and to the characteristics of the material used, so it can be stated that the final performance of the product is, to a large extent, a consequence of this water/gypsum ratio (Arredondo, 1963; Arredondo & Verdú, 1991).

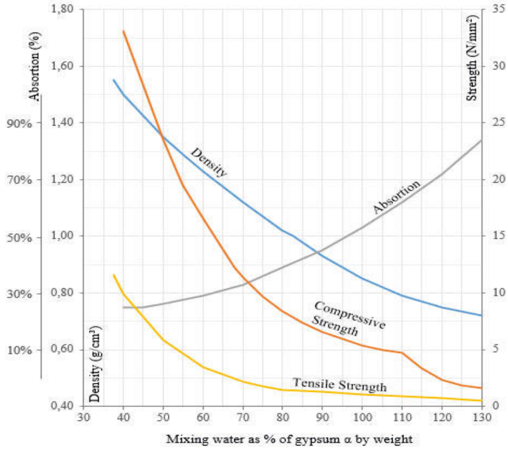


Fig. 1. Properties of gypsum according to test carried out at the *Instituto Eduardo Torroja de la Construcción y del Cemento* (Source: Arredondo, 1963)

2. Objectives

Since the end of the 19th century, there have been authors who have related the influence of the mixing water to the physical and mechanical properties of industrial gypsum, but differs when the study material is a traditional gypsum. One of the most cited authors in relation to this type of studies is Francisco Arredondo, who, in his many publications, clearly relates the influence of the water/gypsum dosage of α-hemihydrate gypsum, which are not the main product used in the construction sector, to the compressive and tensile strength, liquid water absorption and apparent density.

The aim of this work is to study the influence of the mixing water on the physical and mechanical properties of 3 different types of traditional gypsum, which are currently marketed or are in the process of being studied for their future commercialisation, similar to the studies carried out by Francisco Arredondo on industrial α-hemihydrate gypsum. This is a fundamental step towards the further study of this type of material, so unknown and with such different features to current industrial gypsum, which can be assimilated to those produced in the past, and to be able to recover traditional construction systems with current application techniques.

3. Materials and methodology

3.1. Materials

Three different types of traditional commercial gypsum were used for this study: *Argiofloor* (Argio/DécoSystem); *Plâtre* (Plâtres Vieujot); and *Yeso Artesano de Teruel* (Millánplasol) (González-Sánchez et al., 2022b).

3.2. Gypsum chemical characterization

The mineralogical characterisation of the different gypsum was carried out by means of thermogravimetric analysis (TGA), with the STA449 F5 JUPITER equipment of the NETZSCH brand. The interpretation of the results obtained was carried out with the NETZSCH-PROTEUS-80 reference software.

3.3. Paste consistency

Before making the samples, the mixing time and procedure were defined. In this case, the time was 1 minute, and the mixing was carried out mechanically with a mortar mixer model E93 of the MATEST brand, with a working speed in rotation of 140 ± 5 rpm and in planetary movement of 62 ± 5 rpm, according to the UNE-EN 196-1:2018 standard. The working range of the different gypsum pastes was also determined, which means, the range of water/gypsum ratio values in which suitable rheology are achieved for a specific application technique. This was done through the study of its consistency, which measures the diameter of the paste run-off, by the shaking table method, according to the UNE-EN 13279-2:2014 standard.

3.4. Manufacture of samples

A total of 11 pieces of dimensions 290 x 25 x 25 mm were made. The pieces were grouped into 3 units for the study of *Argiofloor* gypsum, 4 units for the study of *Plâtre* gypsum, and the remaining 4 units for the study of *Yeso Artesano de Teruel* Gypsum (Fig. 2). The manufacture of the samples was carried out according to the methodology of the UNE-EN 13279-2:20014 standard. The samples were demoulded 24 h after manufacture and were kept under laboratory temperature and humidity conditions until stable weight. The stability in weight of the samples was determined between 21 and 26 days after manufacture, depending on the amount of mixing water and the type of gypsum, so it was decided to take 28 days as the reference time in all cases. Subsequently, the 11 initial pieces were subdivided into 7 samples, by dry sawing of approximately 40 x 25 x 25 mm, obtaining a total of 77 samples for their subsequent physical and mechanical characterisation.

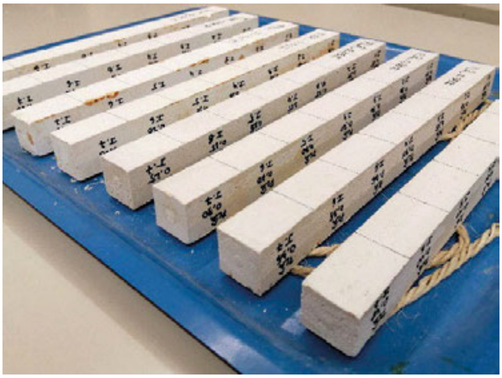


Fig. 2. Pieces of dimensions 290 x 25 x 25 mm

3.5. Characterisation of hardened gypsum

The characterisation of the three types of hardened gypsum pastes was carried out by determining the bulk density and the percentage of porosity of the samples, according to standard UNE-EN 1015-10: 1999 but using ethanol as the liquid; the maximum compressive strength by means of the *Mecánica Científica* brand 42 0440-ESP multi-test press with a load capacity of 50 kN, according to UNE-EN 196-1:2005 and UNE-EN 13279-2:2014; and the total percentage of water absorption by capillarity, according to UNE-EN 15801:2009.

4. Results

4.1. Gypsum characterization

In the comparative graph of the commercial gypsum studied, three significant weight loss intervals can be distinguished (Fig. 3). The first interval is between 100ºC and 300ºC, associated with the loss of water by dehydration of the gypsum. The second interval is between 300ºC and 700ºC, associated with the loss of water by decomposition of the clays. The last interval is between 700ºC and 950ºC, associated with the loss of CO2 by decomposition of the carbonates.

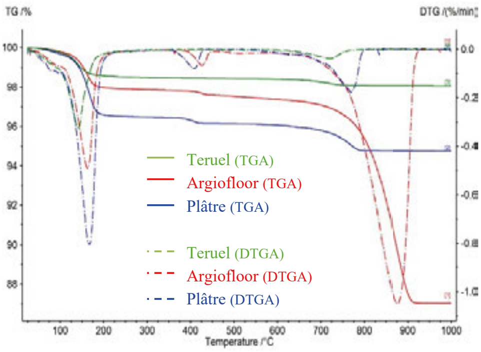


Fig. 3. Thermogravimetric analysis comparative for diverse types of gypsum

		ARG	PLÂ	TER
% Weight loss	100-300ºC	-1,93%	-3,20%	-1,27%
	300-700ºC	-0,77%	-0,68%	-0,23%
	700-950ºC	-10,05%	-1,05%	-0,20%
	Residual mass	87,03%	94,74%	98,06%

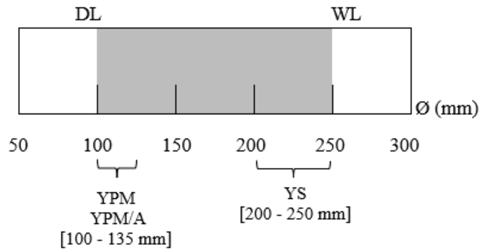
ARG = *Argiofloor* gypsum; PLÂ = *Plâtre* gypsum; TER = *Yeso Artesano de Teruel* gypsum.

Table 1. Percentage of weight loss and residual mass for diverse types of gypsum

The percentage of weight loss for each of the intervals studied and the residual mass for each type of gypsum are detailed below (Table 1). As can be seen, the *Argiofloor* gypsum is the one with the highest weight loss compared to the rest, mainly due to the decomposition of the carbonates it contains. *Plâtre* gypsum is the one with the highest purity of those analysed, and *Yeso Artesano de Teruel* gypsum has a practically negligible content of clays and a low carbonate content.

4.2. Consistency study

The theoretical working range of a gypsum paste depends on its future application, so the working limits were defined based on the consistency study of different commercial gypsum pastes already formulated (Fig. 4).



DL = dry limit; WL = wet limit; YPM = mechanically sprayed gypsum; YPM/A = lightened mechanical sprayed gypsum; YS = gypsum for traditional continuous pavements.

Fig. 4. Diagram of the theorical working rang of gypsum pastes

In order to select the least amount of water to use in this work, defined as "dry limit" DL, it was considered to study the consistency of industrial gypsum for mechanical projection on vertical walls, as is the case of *Proyal* y *Proyal XXI* gypsum (Saint-Gobain Placo Ibérica, 2021a; Saint-Gobain Placo Ibérica, 2021b).

In order to select the highest amount of water to be used in this work, defined as the "wet limit" WL, it was considered to study a traditional commercial gypsum recommended for application as a continuous gypsum pavement, such as NOHUKI decorative gypsum coverings (Millán Plasol, 2021).

Based on the working range, the relationship between the water/gypsum dosage by weight and its consistency was studied for our traditional plasters (Fig. 5).

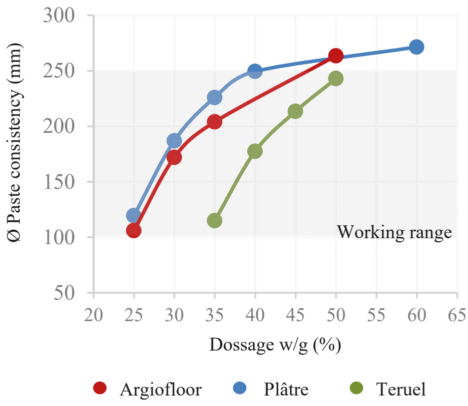


Fig. 5. Different water/gypsum dosage ratios vs the run-off diameter of the gypsum paste obtained by the consistency test

As can be seen, the resulting study area is small and lies between the 25% and 50% dosages. The water/gypsum ratio finally used for the preparation of the test samples is given in Table 2.

	TRADITIONAL GYPSUM		
W/G	**ARG**	**PLÂ**	**TER**
0.50	-	-	x
0.45	-	-	x
0.40	-	x	x
0.35	x	x	x
0.30	x	x	-
0.25	x	x	-

W/G = dosage water/gypsum; ARG = *Argiofloor* gypsum; PLÂ = *Plâtre* gypsum; TER = *Yeso Artesano de Teruel* gypsum.

Table 2. Matrix composition of the samples prepared

4.3. Bulk density and porosity

The graph in Fig. 6, compares the bulk density values obtained for the three traditional gypsum types with the reference density values (Arredondo, 1963). As can be seen, the bulk density values of all traditional gypsum are similar to those of the reference gypsum and they all draw a very similar downward sloping curve. The bulk density for *Argiofloor* and *Plâtre* gypsum is very similar, between 1.60 and 1.70 g/cm^3, and higher than the values obtained for *Yeso Artesano de Teruel* gypsum, between 1.30 and 1.51 g/ g/cm^3.

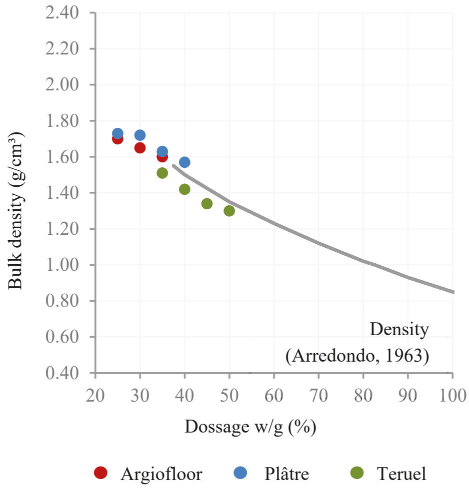


Fig. 6. Different water/gypsum dosage ratios vs bulk density

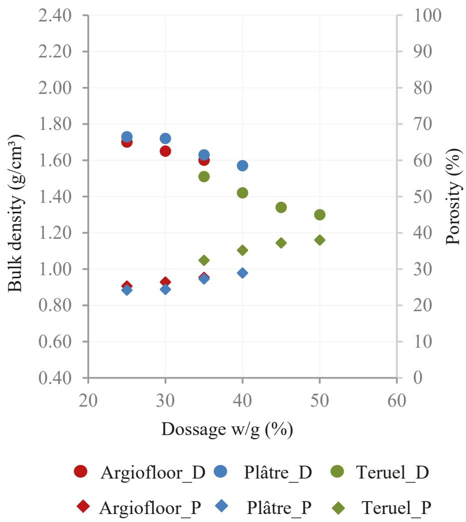


Fig. 7. Different water/gypsum dosage ratios vs bulk density (D) and porosity (P)

As can be seen in the graph in Fig. 7, there is a clear increase in porosity as the percentage of water increases with respect to that of gypsum, and an inversely proportional relationship between the values of density and porosity. As with the apparent density, the *Argiofloor* and *Plâtre* gypsum have a porosity very similar to and lower than that of the Teruel Gypsum, between 25% and 29%.

4.4. Compressive Strength

The graph in Fig. 8, compares the compressive strength values of the three types of traditional plasters with the reference values. (Arredondo, 1963).

As can be seen, the reference compressive strength values are much higher than those obtained for traditional gypsum. However, the inclination of the straight line drawn by the values for traditional gypsum is slightly less steep, especially in the case of *Argiofloor* gypsum.

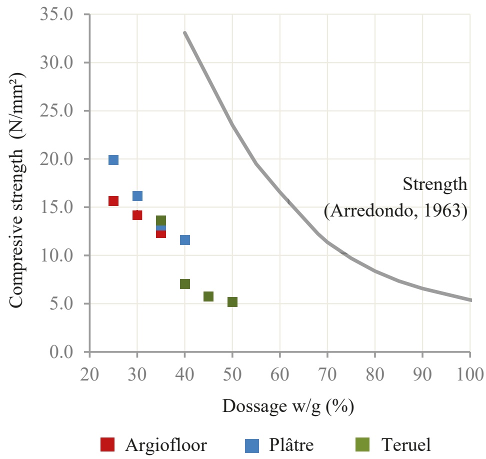


Fig. 8. Different water/gypsum dosage ratios vs compressive strength

In relation to the values obtained, with *Plâtre* gypsum we obtained the highest compressive strength values, between 11.64 ± 0.97 and 19.89 ± 0.71 N/mm^2, followed by *Argiofloor* gypsum, between 12.33 ± 1.49 and 15.67 ± 0.83 N/mm^2. The values obtained for the Yeso Artesano de Teruel gypsum are lower, between 5.17 ± 0.27 and 13.65 ± 1.01 N/mm^2, but it should be borne in mind that the water/gypsum dosage is higher to guarantee its workability.

4.5. Water absorption

The graph in Fig. 9, compares the water absorption values of the three types of traditional plasters with the reference values (Arredondo, 1963).

As can be seen, the absorption values obtained for the three types of traditional gypsum studied are close to the reference values and follow a similar upward trend. In this case, *Argiofloor* and *Plâtre* gypsum have a very similar behaviour in terms of water absorption, with values between 10% and 17%. On the other hand, for the *Yeso Artesano de Teruel* Gypsum, the values obtained are the highest, between 24% and 32%.

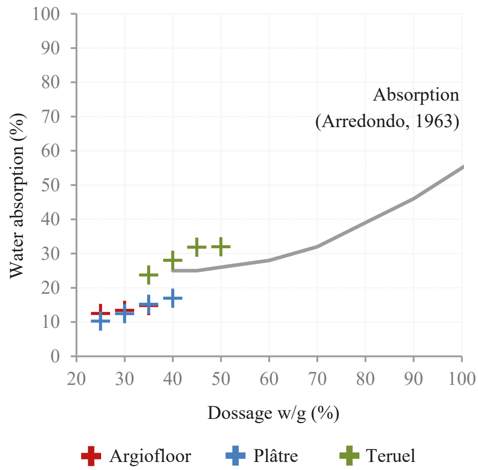


Fig. 9. Different water/gypsum dosage ratios vs water absorption

5. Conclusions

The purpose of this study was to find out the most relevant values of the physical and mechanical behaviour of three different types of traditional plasters, following the example of the studies carried out at the *Instituto Eduardo Torroja de la Construcción y el Cemento* by Francisco Arredondo (Arredondo, 1963; Arredondo, 1991).

Firstly, the relationship between the values obtained for traditional gypsum and the parameters studied was confirmed: as bulk density values increase, values of compressive strength raise too, but porosity and water absorption values are reduced. It is not possible to compare the results obtained in this study with those analysed by Francisco Arredondo, as there are big differences between traditional gypsum and α-gypsum, from their manufacturing process to their final use. However, it can be stated that the behaviour of all of them in relation with their water/plaster ratio describes a similar trend in all the parameters studied, so that traditional plasters also have a special sensitivity to the dosage of water used, and their study is one of the most important parameters to take into account during the installation of the material.

Secondly, *Argiofloor* and *Plâtre* gypsum, although they have a different mineralogical composition, have very similar physical and mechanical behaviour, except for the compressive strength values where *Plâtre* gypsum reaches 20 N/mm2 at a water/gypsum dosage of 25%. It would be necessary to analyse more parameters to determine whether this tendency is repeated in the case of Plâtre gypsum.

Thirdly, comparing all data gathered during the study, in the 35% water/plaster dosage is where the greatest affinity can be found between the three pastes, although there are clear differences between the consistency of the *Yeso Artesano de Teruel* gypsum and the other two: with a bulk density between 1.51 and 1.63 g/cm^3; a compressive strength between 12.33 and 13.65 N/mm^2; a porosity between 27.3% and 32.4%; and an absorption between 14.9% and 23.7%. For this dosage, and according to the values obtained in the consistency study, the *Argiofloor* and *Plâtre* plasters would be suitable for installation as continuous plaster flooring, but the *Yeso Artesano de Teruel* gypsum would have a more appropriate consistency to be projected on a surface.

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State of conservation of half-timbered walls in Burgos (Spain): Quantitative analysis of material and structural degradation

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
The systematic data collection and quantitative analysis of 225 half-timbered walls found in the province of Burgos made it possible to reach conclusions on the frequency and scope of 27 phenomena of material degradation and 11 types of structural lesions. Almost the entirety of the sample analysed presents some degree of material degradation, mostly slight atmospheric lesions such as surface atmospheric erosion and chromatic alteration and dehydration of the timber. A greater vulnerability to structural lesions, particularly structural deformation, has been observed in this type of wall. The results presented in this text form the basis for understanding the conservation and restoration needs of half-timbered walls, given the indispensability of knowledge of the most common degradation systems.

Keywords: *Traditional architecture, vernacular techniques, weathering, damage.*

1. Introduction

Half-timbering is a technique combining a timber structure with other materials and used for enclosures, rendering and insulation. Although these walls have not been as closely studied as rammed earth or adobe, they are part of Spanish traditional architecture and display a wide range of variants and typologies (Hueto Escobar et al., 2021).

Until the late twentieth century the degradation of this type of architecture was limited by the constant maintenance by its occupants, who had the necessary knowledge and local materials (IPCE, 2014). However, this conservation is currently at risk due to social issues such as rural exodus, depopulation, lack of valorization, the disappearance of traditional trades, the loss of associated knowledge and the predominance of industrial materials and techniques (Mileto et al., 2020).

In this context, in order to propose the necessary conservation and maintenance actions information is required on the state of conservation and the vulnerability of traditional techniques to the most common degradation mechanisms. It should be noted that the alterations and lesions visible at the time of study displayed some complex degradation mechanisms, which may have started long before, evolving to become more serious lesions unless action is taken to counter the principal causes (Vegas & Mileto, 2011). Half-timbered walls are found throughout the province of Burgos (García Grinda, 1988), with different infills and geometries of different complexity. The 225 samples conserved and analysed in this text were found in 45 different localities in mountainous areas with an altitude above 500 m a.s.l and less than 100 inhabitants. These are residential and agricultural buildings with 2 or 3 storeys on average, built in blocks either between party walls or on a corner.

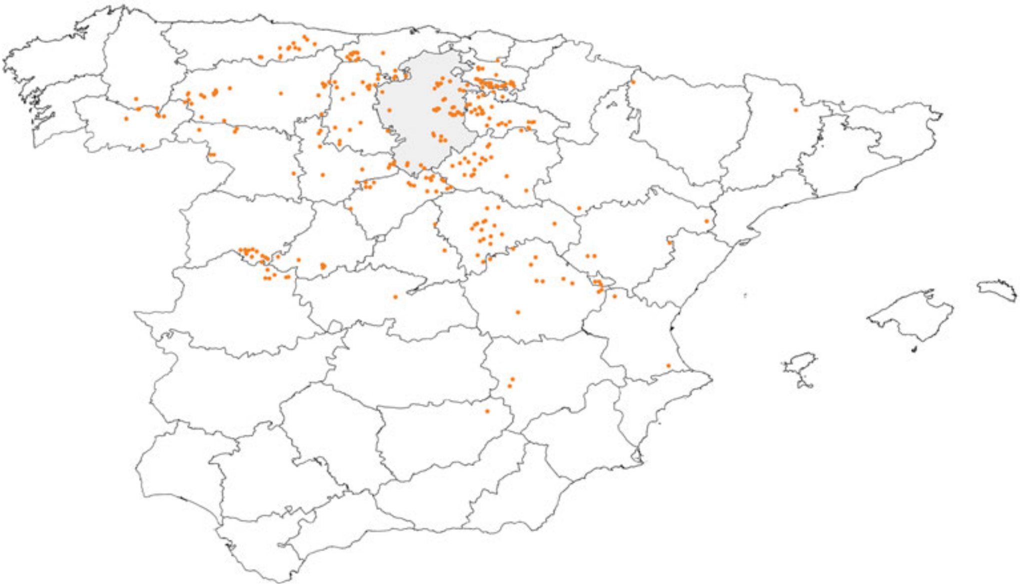

Fig. 1. Location of the cases studies that constitute the entire sample, indicating the territory of Burgos analysed in this document (Source: Hueto-Escobar, 2022).

2. Objectives and methodology

This publication is part of wider-ranging research studying the different variants of half-timbered walls in Spanish traditional architecture (Hueto Escobar et al., 2021), as well as the state of conservation and transformation dynamics affecting them. For this, a database was generated, compiling 1098 half-timbered walls found all over Spain (Fig. 1), and documented with 9170 photographs. The information was recorded in study fiches organized into three major blocks: general building information, specific data on the half-timbered wall; and finally, the state of conservation and transformation of the half-timbered wall. These were used for a scientific analysis of the information in order to obtain valid statistics (Hueto Escobar et al., 2019).

The specific objective of this text is to analyse the state of conservation of the 225 half-timbered walls documented in the province of Burgos (Fig. 1). This study aims to analyse the influence and extent of the degradation processes in a representative territory with a considerable variety of half-timbered walls, in order to propose the most suitable future maintenance and conservation actions. Based on the data collected in the final block of the fiches, a qualitative analysis was carried out on 38 types of material and structural degradations. These were identified beforehand through a review of the bibliography and a visual analysis of all the cases documented.

The main characteristic of these walls is the combination of a timber structure with other materials. Accordingly, their material degradation combines mechanisms linked to timber and to the given type of infill (Fig. 2). Furthermore, their structural behaviour, which is extremely complex, is conditioned by different factors such as the differences in rigidity and resistance of the materials, geometric position, bracing, the contribution of infill and traditional joints (Casanovas et al., 2007). Mechanisms characteristic of the timber and different infills and mechanisms relating to the structural interaction of both materials were identified.

Fig. 2. Building in Villanueva de Tobera (Burgos), showing material lesions (damp stains, erosion, loss of volumetry, rot, replacement of infill, elimination of structural elements) and structural lesions (excessive buckling of timber, lack of bonding and fissuring of the infill) (Source: Hueto-Escobar, 2022).

3. Material degradation

During the course of this research, 96% of the cases studied in the province of Burgos presented some sort of material degradation. A detailed analysis was carried out on 27 phenomena classified according to the agent causing them (Fig. 3). The degradation caused by atmospheric elements has a greater incidence.

The pathologies most frequently detected were the atmospheric erosion of infill (68.9%) and the chromatic alteration and dehydration of timber (79.6%). Among the lesions due to biological and anthropic agents it is particularly worth noting the presence of mould and lichens (44.9%), unsuitable anthropic interventions for the installation of foreign elements (42.2%) and repairs with incompatible materials (60.4%).

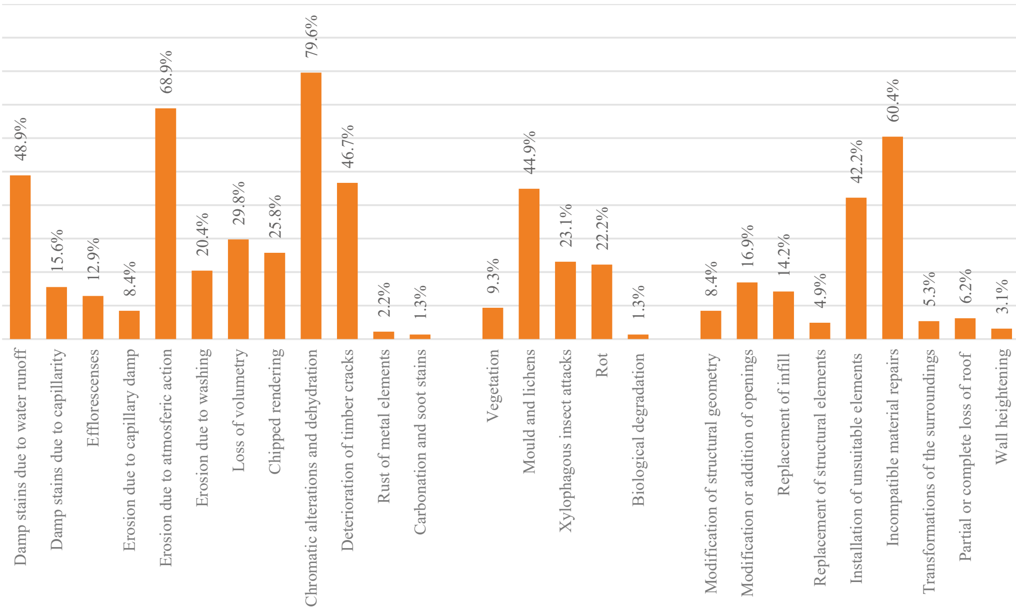

Fig. 3. Incidence of the different material degradation processes identified (Source: Hueto-Escobar, 2022).

3.1. Caused by atmospheric agents

This term refers to the influence of external factors such as water, wind, solar radiation and temperature. The hygroscopicity of the timber and infill leads to the absorption of exterior water through capillarity, infiltration or condensation. The increased humidity firstly causes chromatic stains and alterations which can lead to softening, erosion and loss of stability in the earthen infills or promotes rot and the attack of xylophagous insects on the timber (Lasheras Merino, 2009).

Damp stains were identified in 56.9% of cases studied, specifically due to water runoff in 48.9% of cases and capillarity in 15.6%. This last figure is in direct relation to the use of half-timbered walls on upper floors or on plinths with more resistant materials. Furthermore, the presence of damp can favour the migration of salts found in the soil or in the mix used for infill (Guillaud et al., 2008). These salts crystallize to form surface efflorescence or internal crypto-efflorescence which lead to increased volume and the material breaking up (Broto, 2006). Although this phenomenon was only detected in 12.9% of cases analysed, the use of cement products which incorporate soluble salts into their mix for intervention favour their formation (Mileto & Vegas, 2014). In this research, the number of intervention cases using cement and affected by efflorescence increases to 17.7%.

Erosion due to the abrasive action of rainwater and particles carried by wind was identified in 68.9% of case studies. In contrast, the erosion caused by capillary damp was detected in only 8.4% of cases and the erosion caused by water runoffs in 20.4%. The reduced influence of erosion by capillary damp is also linked to the presence of plinths and lower walls. The evolution of the erosion processes along with the possible mechanisms caused by people, animals or vegetation can lead to a loss of volume, endangering the structural stability of the infill. This degree of incidence was detected in 29.8% of cases studied, with a higher incidence in walls with brick infill where joints display weak points.

In addition, the combined action of damp, efflorescence and erosion and the difference in rigidity of materials used to make up this type of wall encourages fissuring and chipping in rendering. This type of lesion appears in 71.1% of rendered walls, with a greater occurrence in walls with brick infill.

Exposure to solar radiation causes the lignin of the timber to dehydrate and degrade, taking on a greyish hue. Although in principle this does not entail any serious risks it is the most common type of material degradation, detected in 79.6% of case studies. Equally, exposure to the elements can lead to a deterioration of cracks in the timber, as detected in 46.7% of cases studied. Although in principle these only entail structural risk in the case of radial cracks (Desch & Dinwoodie, 1996), they are a point where issues related to damp, rot and xylophagous insects can occur and worsen (McCaig & Ridout, 2012).

In addition to the timber and infill, the walls studied may include metal elements used as structural reinforcement for the joints or inappropriately used as fixtures for installation. Although only found in 2.2% of cases studied, these elements tend to be inserted into the timber and undergo a potentially damaging increase in volume when they rust. However, the limited occurrence of this lesion may be due to the fact that 71% of the cables installed are located in the upper half of the wall, with eaves partially protecting them from rainwater.

3.2. Caused by biological agents

When the correct hygrothermal conditions occur, earth infill is the ideal stratum for seeds carried by the wind to germinate and for the proliferation of different microorganisms including fungi, mould, and lichens (Mileto & Vegas, 2017). Vegetation was detected in 9.3% of case studies, compared to 44.9% with mould and lichens. The latter have been detected more frequently in monolithic infills, where the smooth surface formed is an ideal breeding ground. In principle they do not present a serious risk and mould and chromogenous fungi for example only cause changes in colour (Ridout, 2000). However, they slightly favour the accumulation of damp and infill breaking up (Feilden, 2003). In contrast, the roots of larger vegetation can grow progressively through the infill, generating internal stress which causes disaggregation, breaking up, losses and even stability problems (Reinprecht, 2016). Furthermore, the development of rot and attacks from xylophagous insects are increased when geometry, exposure or poor ventilation favour the accumulation of damp. Attacks from xylophagous insects were detected in 23.1% of case studies. Rot was detected in 22.2% of cases, mainly located in the exposed ends of the timber. As the identification of these processes is conditioned by external visual analysis the number of cases affected could be much higher. Biological degradation due to other animals, birds and insects, was only detected in 1.3% of cases and was mainly manifested by bird excrement and insect nests in adobes and joints.

3.3. Caused by anthropic agents

This group covers the lesions resulting from human action, either direct actions such as transformations, installation of elements and incompatible repairs, or indirect actions derived from lack of maintenance. Among the direct actions which entail the transformation of the walls in the strictest sense, the most common action is the modification or addition of openings, found in 16.9% of cases. Although the constructive configuration of the half-timbered walls allows the easy addition of openings, the current needs for hygrothermal and lighting comfort have given rise to modification. This may simply take the form of eliminating infills but can occasionally entail the total or partial elimination of timber elements, introducing discontinuities which affect structural behaviour. These modifications are also related to the installation of additional elements such as blinds, wrought iron bars and industrial balconies. Modifications with less aesthetic impact, consisting in the interior insulation of the wall and installation of more efficient window frames on the inner face, have also been identified. Whether due to functional needs, addition of openings or material degradation, the modification of structural geometry was identified in 8.4% of cases. This type of action covers the alteration of the original position of timber elements, as well as their elimination or replacement with other types of walls. However, in 4.9% of cases the replacement of these elements with other concrete or linear metal pieces was detected. Although this does not imply a transformation of the geometry it results in a modification of resistance and structural behaviour. In addition to the interventions on the timber structure, the replacement of infill was identified in 14.2% of cases. This may have been the result of a loss of volumetry due to the discontinuity and adherence inherent to the technique or it may have been linked to interventions to update the appearance and hygrothermal comfort needs. The replacements are generally non-rendered industrial brick which lead to an increased load and differences in rigidity, but rendered cases were also identified with problems of efflorescence caused by the cement mortar used in the joints.

However, by far the most common direct actions are the installation of unsuitable elements and repairs with incompatible materials, detected in 42.4% and 60.4% of cases respectively. Although in principle these actions are not as serious as those previously described, they are executed without considering material, structural or aesthetic compatibility and are dictated by the resources and needs of the occupants. The foreign elements installed are mostly electric cables which display the rust problems mentioned previously, as well as industrial downpipes and gutters where damp concentrates when these break due to lack of maintenance. The interventions with unsuitable materials tend to be patches, reintegration and renewal of joints using cement mortar. This in turn hinders the breathability of the wall, favouring the accumulation of damp, chipping and efflorescence.

Additionally, certain transformations external to the wall which could affect the state of conservation were identified. The main transformations of the surroundings, detected in 5.3% of the sample, are asphalting and the raising of the ground level, which causes damp to accumulate in the walls in contact with the soil or the demolition of neighbouring buildings which strip the wall of protection and favour the development of both material and structural lesions. Other external transformations detected were the wall heightening, found in 3.1% of cases and generally executed with industrial techniques and materials such as brick or concrete blocks. These favour the development of structural lesions as they increase the loads and at times lead to the modification of structural geometry.

Finally, the lack of maintenance as an indirect action mostly leads to a loss of protective elements such as rendering, eaves and roofs. The partial or complete loss of roof was identified in 6.2% of cases studied, also displaying damp problems due to water runoff and erosion due to runoff in half of cases.

4. Structural degradation

Structural degradation phenomena have been detected in 61.8% of cases studied. A total of 11 types of structural lesions, classified according to the mechanisms which generate them, has been analysed in detail (Fig. 4).

The lesions caused by excessive deformation are more common than those generated by excessive stress, mainly fissuring and lack of bonding (51.1%) in the first case and breakage of timber elements (13.8%) in the second.

4.1. Caused by excessive stress

This group covers the failure caused by structural elements with very concentrated stresses or stresses exceeding their working capacity, situations worsened at times by material in poor condition. The most common failure is the occasional breakage of timber elements, observed in 13.8% of cases. These occur mainly in the upper walers where roof load is combined with the effects of rot, favoured by water runoff and the poor condition of the eaves.

Compression of the timber was only detected in 0.4% of cases studied, specifically in an isolated case where the blind floor had suffered compression at the meeting point with the footing. In contrast, compression of the infill was detected in 6.7% of cases, mostly linked to an excessive overload which caused the buckling of an upper waler and in turn the compression of the inferior infill. This excessive buckling can also promote fissures in the upper infill, as observed in 3.1% of cases. When the waler supporting the infill is deformed it tends to descend and separate forming a discharging arch. This process tends to occur in porch walls or on the area of the openings, where there is no infill to limit deformation.

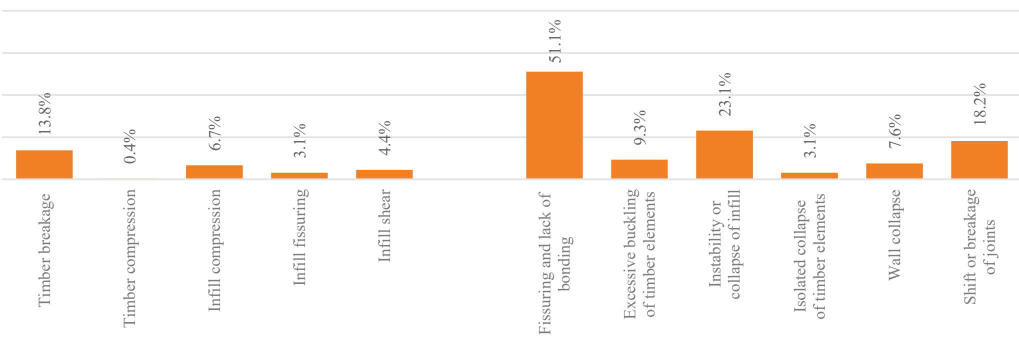

Fig. 4. Incidence of the different structural degradation processes identified (Source: Hueto-Escobar, 2022).

In addition, the concentration of loads in a specific point can increase the shear of the infill, especially when there are no elements for distribution or when the walers display deformations, entailing irregular transmission of the load. These lesions were detected in 4.4% of cases, characterized by the appearance of vertical cracks which run downwards from the supports of the joists and which in the case of brick infill run along the weaker joints (Casanovas et al., 2007).

4.2. Caused by excessive deformation

This section includes the lesions which result in movement in the elements, even modifying the load distribution scheme and influencing the appearance of lesions described previously. Half-timbered walls are structures which are highly susceptible to this type of movement due to a lack of bonding and the lack of rigidity of the joints. Fissuring and lack of bonding between elements are the most common lesions, found in 51.1% of cases studied. This is due to the constructive logic of half-timbered walls, which combines materials of different rigidity and resistance. Traditional treatises recommended different methods to counter this problem: roughening the timber, adding esparto rope or nails and incorporating slits or formwork (Arias y Scala, 1893). As a result of the discontinuity between the framework and the infill in the case of horizontal stress or material lesions endangering the stability of the infill, there can be some isolated cases of infill collapsing. This type of lesion was detected in 23.1% of cases, compared to 3.1% of cases affected by the isolated collapse of timber elements and 7.6% of cases where the entire wall collapses.

Although the main structural function of infill is to brace the wall, it also plays a part in the wall's overall resistance capacity (Santa Cruz-Astorqui & Del Río, 2014). In addition, when the timber suffers considerable material degradation which hinders its resistance, the infill is progressively subjected to stress, delaying the collapse of the wall (Gil Crespo, 2013). Therefore, 9.3% of the cases in which excessive buckling was detected mostly correspond to cases with no infill, either porches, galleries or openings. In cases where there is infill, the buckling has been limited by the infill, but other lesions such as shear and compression of the infill have occurred.

Finally, both structural deformations and the material degradation processes described previously can cause a shift or breakage of traditional joints. This type of degradation was detected in 18.2% of cases, although it occasionally affects isolated nodes.

5. Conclusions

Any intervention must be based on comprehensive knowledge of a building, including its history, techniques and pathologies. Therefore, in general, knowledge of the frequency with which half-timbered walls develop certain degradation mechanisms and their scope is of use in establishing future conservation and intervention guidelines. Throughout Burgos the most common material degradation mechanisms are the deterioration of the cracks and the chromatic alteration and dehydration of the timber, as well as damp stains and erosion of the infill. It is also worth noting biological degradations such as mould and lichen and degradations due to unsuitable anthropic actions. However, this type of material degradation could be reduced if the valorization of this technique were used to promote continued maintenance actions and more respectful interventions. A greater influence of deformation mechanisms, mostly the lack of connection and unstable infill, was observed in structural lesions. This may be due to the fact that although in half-timbered walls the elements are the right size, their degradation has caused movements which could endanger structural stability in the future.

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Adobe Constructions – Colonial Chilean House

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
This article presents part of the doctoral research carried out on raw earth constructions in the central zone of Chile between the 16th and 19th centuries, especifically in the so-called Chilean Colonial House, or Casa Patronal. The origin of this building typology is attributed to construction models and systems from Spain, such as the case of the Andalusian House, which was inserted in the construction culture of Chile since the foundation of the first cities of the country. Thus, the cities were continously evolving, firstly characterized by a large number of constructions of defense, but later after, diverse types of constructions were introduced, such as houses, churches and enclosure walls. Currently, more than fifty of these houses are preserved, which have resisted the historical seismic action recorded since the 16th Century, and whose last major event occurred on February 27, 2010, magnitude of 8.8 Mw, which revealed the precariousness and abandonment of the country's built heritage, especially of these types constructions. The methodology used for the study includes four stages. Firstly, the research and bibliographic review; secondly, field researches and collection of records in various Houses in the central zone of Chile; thirdly, the Systemic Method was applied in order to develop a diagnosis of the current situation of the case studies. This stage includes the application of the Chilean regulation for Constructions of Raw Earth NCh3332 of the year 2013. Finally, the fourth stage is focused on the analysis and discussion of the results, including conclusions regarding this matter. This document includes the progress of the study carried out up to the third stage of the doctoral research, which is the first part of the "Initial cycle of knowledge of buildings." This study aimes to provide and expand the range of tools for the diagnosis of the current situation of buildings, based on the analyses performed in three cases studies.

Keywords: *raw earth; heritage; earth architecture; adobe masonry.*

1. Introduction

Construction with raw earth in Chile dates back to periods long before the arrival of the Spaniards to the country. Evidences of construction in the so-called "Great North" has been found, which includes the current regions of Arica and Parinacota, Tarapacá, and Antofagasta, by the 1000 BC – 500 AD (Jorquera Silva, 2020), regions where mud or raw earth was worked manually.

By the 100 AD, settlements in the north of Chile are identified, such as the Ramaditas and the Guata-con-do (Urbina A. et al., 2012). This constructive culture based on raw earth is extended and consolidated throughout the north and center of the country, up to the current Region of Ñuble, adapting its structures to vegetation and climate diversity, very variable throughout Chile.

During the first half of the 16th Century, the arrival and first settlements of the Spanish in Chile took place, whom doubted to set permanently due to the lack of gold, the most desired metal by that time. During the Conquest of America (Lacoste et al., 2014), conquerors decided to built precarious constructions characterized by straw and mud huts, following the typology given by the structures of the indigenous people who already inhabited the place. The city of Santiago (Santiago del Nuevo Extremo) was founded in February 12th, 1541, in the Central Valley of the country, aside of the Mapocho River. By Septembre of the same year, the city suffered its first devastation, which was caused by the uprising of the indigenous people who destroyed the city's main buildings (Lacoste et al., 2014). A struggle for survival and a permanent war began that accompanied the Spanish conquerors in their efforts to conquer this territory. As an answer, they built the first forts with adobe bricks and thick walls.

The factors that explain the success of this construction system based on adobe bricks were: (i) the abundance and availability of the raw earth, (ii) the knowledge of techniques linked with it, (iii) and the strength performed by the structures in comparison to other methods such as straw or mud, delivering then a higher level of protection and security.

From the consolidation of settlements and a way of life based on the rural economy of this new country, the Hacienda was arised, an economic and familiar system formed by a Main House, "Casa Patronal," which was surrounded by service spaces and the so-called "Tenant Houses" (Benavides C., 1981).

A significant group of colonial or patron houses, nearly a hundred, were conserved until the 1980s, whose record is presented in the book "Patron Houses: rural architectural ensembles v.2" (Benavides Courtois et al., 1981).

Four years later, on March 3, 1985, an earthquake of 7.5 Ms in the country's central zone destroyed a large part of the heritage built in adobe preserved until that date.

Finally, the last great seismic event in the country occurred on February 27, 2010. An earthquake of Magnitude 8.8 Mw, acording to the information registered by the National Seismological Center of Chile (www.csn.uchile.cl), severely affected the central-southe area of the country and caused serious damage to a great number of the constructions with historical value (Consejo de Monumentos Nacionales & Corporación Patrimonio Cultural de Chile, 2010), particularly the adobe masonry constructions.

After the damages that occurred in the adobe constructions during this last earthquake, the need to evaluate and structurally analyze its state of architectural-structural conservation were arised with the view to take appropriate repair and reinforcement actions for this type of construction. In this sense, the Government of Chile has implemented action mechanisms through public investment to develop restoration projects for a series of heritage buildings. Aditionally, the development of regulations at the national level provides evaluation mechanisms and structural analysis for this type of construction.

From the implementation of this regulatory framework given by the NCh3332 of 2013 and the severe damages observed in adobe constructions, this doctoral research was arised. The Systemic Method is applied to deliver a diagnosis of the current situation. The method is based on the knowledge of the building, its environment, and history, which allow characterization and subsequent valorization to achieve the architectural-structural diagnosis of existing buildings.

2. Methodology

The methodology consists in four stages. Firstly, research and review of national bibliographic references about adobe's history and its use as constructive material for housing. Review and research of international literature in regards of adobe as main construction's material for historic houses.

The second stage consists in the compilation of constructive information about existing mansions, which are currently preserved and worked in the professional practice for some years.

The third stage with the collected information and data from the first two stages, the first part of the systemic method of existing constructions will be applied for making a diagnosis of current conditions, focusing on the status of houses' structural condition. Structural analysis using the Chilean standard NCh3332, modeling and structural analysis using computer programs will be used as tools. Finally, the fourth stage consists in doing a comparison between the structural results' analysis versus the existing condition at the time of the inspection of the houses studied, allowing the existence of areas with greater or lesser vulnerability to seismic action, among other aspects of the construction system, to be contrasted.

3. Development

This section presents the typological model under investigation and the evaluation methodology applied to three case studies, which correspond to houses in the central zone of Chile.

3.1 Chilean Colonial House

3.1.1 Origin

The house model was imported from the Iberian Peninsula by the Spanish con-querors, particularly from the region of Andalusia, whose house model with a patio "Casa Andaluza o Hispana" (Irarrázabal, 2012), comes from the Roman House and the Greek House. Although the model of the patio house, corral house, and Sevillian house originally had more than one level, the model was adapted to the construction of one level with thick walls of adobe bricks and roofs of logs of wood. Initially, the roofs were built with tied timbers covered with straw, but later by the mid-eighteenth Century this model evolved into trusses covered with clay tiles (Yantorno & Pasmiño, n.d.).

The seismicity of the country guides the evolution of the model. During the first 100 years of the Captaincy of Chile, the consequences of large earth-quakes were suffered. The following table shows those that stand out (Centro Sismológico Nacional & Universidad de Chile, 2022).

Fecha	Ciudad	Magnitud
17/03/1575	Santiago	7,3Ms
13/05/1647	Curicó	8,5Ms
15/03/1657	Concep.	8,0Ms
12/07/1687	Los Andes	7,3Ms
08/07/1730	Valparaíso	8,7Ms

Table 1. Registro grandes sismos siglos XVI a inicios siglo XVIII (Record of large earthquakes from the 16th century to the beginning of the 18th century.) Source: http://www.csn.uchile.cl/sismologia/grandes-terremotos-en-chile/

The earthquake that impulsed one of the most significant changes in the way of building in adobe was the so-called "Great Earthquake" or "Earthquake of May" on May 13, 1647 (Amunátegui, 1882), which almost destroyed Santiago, with the exception of two buildings: the Church and the Convent of San Francisco, which are preserved to the present day. This fact drives new constructions to the increasing the width of walls and decreasing their height.

3.1.2 Characteristics and evolution

The first models were given by rectangular floors with three patios and the main entrance hall.

Three significant periods of evolution of the Chilean Colonial House are distinguished. The first, from the mid-16th to the 18th century, where the widths of the walls were increased, and wooden reinforcement pieces, called chains, were included, particularly where the walls meet and areas with span openings. These strategies were consequence of the earthquakes that had destroyed the first constructions and which led to continuously improve these structures during reconstruction processes of the cities.

In the second period, from the end of the 18th Century to the beginning of the 19th Century, the interior corridors were included in the model as well as a second level in the whole volume of the main façade, which in the previous period only had a mezzanine to high-light the entrance, and in some rare cases covered the entire façade.

Finally, the third period covered until the second half of the 19th Century. In this period is where the most critical changes to the model of the house were took place. Among the main alterations are the changing of use of the first patio, which passes to the particular use of families and not for public service. Aditionally, the corridors were built on all four sides of the inner courtyards and, in some cases, the patios were roofed with skylights. Similarly, the second floor was extended in a U-shape along with the first patio (Secchi & Salas, 1952).

3.1.3 Main construction elements

Walls

The adobe masonry walls were built with bricks arranged with rope or head; the approximate dimension of this bricks is 60 cm long, 30 cm wide, and 7 to 10 cm high. However, walls of 100 to 120 cm wide have been found. Clay mortar and two layers of clay coating, a thick inner layer with a high level of vegetable fibers, and a thin outer layer. The walls are connected perpendicularly with the lock of their bricks and with ladders or wooden chains, which are distributed to thirds of the height in the meeting of the walls, crowning the upper level of the floor. In some cases, these reinforcing elements may be found throughout the wall and not only in these meeting elements.

Fig. 1. Casona Quilapilún adobe wall. (Source: Contreras & Jofré, 2016)

Foundations

The system is given by continuous foundations under the adobe walls, built in stone with mud mortar as a joining element. In other cases the foundation were built only with rocks stacked orderly, with pieces of certain homogeneity and size.

The minimum burial depth registered is 1 metre. On the upper level, it is possible to find a few rows of rectangular-shaped stones or fired clay bricks (minimum three rows), which give a horizontal level to the base of the adobe wall and isolate it from humidity at the ground level.

The cover

The roof is made up of trusses built by a pair of wood logs with a brace at the base or halfway up, as it is illustrated in figure 2. The trusses are distributed at a maximum distance of one meter. Above the trusses are installed wooden boards, which is the surface to directly receive the clay tiles.

Fig. 2. Example of roof trusses on adobe walls. (Source: Contreras & Jofré, 2016)

Corridors and patios

The existence of corridors is a variable characteristic within the complex since they generally are located in the interior perimeter of the house, around the patios. These corridors are developed as a continuation of the main roof, extending with ieces of wood that connect to the walls of the inner ring of the adobe walls.

Fig. 3. Example of corridors. (Source: Contreras & Jofré, 2016).

As for the patios, the model may vary. However, the most common to find is with three patios. The main uses are: (i) the first patio for private use, for owners or patrons of the house; (ii) the second patio for service, such as kitchen and other domestic uses of daily life, and (iii) the third patio, which was used for receiving cars or guests, generally aimed to the movement of floats and with services purposes (Benavides Courtois & Universidad de Chile. Departamento de Historia de la Arquitectura, 1981).

3.2 Systemic method applied to the "diagnosis of current situation"

The method is based on the knowledge of the building, its environment, and history, which allow characterization and subsequent valorization to achieve the architectural-structural diagnosis of existing buildings (González Moreno-Navarro et al., 2018).

A more precise definition of the meaning of "system" is that it can be defined or understood from the description of its composition (C), environment (E), structure (S), and mechanism (M). In this case, the tool used by the method is "Value," as they point out in their book "The Systemic Method of Interven-tion in Existing Buildings" (González Moreno-Navarro et al., 2018). In this respect, the value allows us to understand what moves a promoter to build, modify and/or rehabilitate in a building. Therefore, it helps to understand the motivation and causes of a restoration or rehabilitation process.

From this, the first part of the method will be applied, which corresponds to the Initial Knowledge Cycle of the Building and includes the following research processes for the case studies:

3.2.1 First approximation

It is defined as the first approach to the building, initial visits, and identification of spaces and the site itself.

3.2.2 Characterization

Compilation of antecedents of the construction and history of the property: history, place, promoter, function and use, classification of the building and its parts.

3.2.3 Initial valuation

- Quantifiable values: evaluation of the current architectural values, current use of the building, application of the Chilean standard for constructions of raw earth NCh3332.Of2013. Location. Ecological and economical aspects.
- Documentary values and subjective values.

Application NCh3332 Raw Earth Constructions

The NCh3332 standard, "Structures - Intervention of heritage constructions of raw earth - Structural project requirements," came into force in 2013, being the first regulation at the national level in the field of heritage constructions (NCh3332 - Estructuras -Intervención de Construcciones Patrimoniales de Tierra Cruda - Requisitos Del Proyecto Estructural, 2013).

Structural analysis

This regulatory framework provides the guidelines for evaluating the current state and the design of the intervention project, considering structural and patrimonial criteria.

The patrimonial criteria include the com-patibility of materials, reversibility, and case-by-case evaluation. The structural criteria are based on maintaining or restoring the resistant capacity. Aditionally, it is also considered the structural performance of the structure in previous earthquakes in order to avoid collapse elements and to develop minimal intervention proposals, compatible and reversible with the original materials.

In this respect, the standar points out actions of critical importance to carry out an adequate intervention, such as:

- Critical survey of the existing construction.
- Diagnosis of the current state of conservation.
- Structural analysis in the current condition, which considers structural modeling, design, and geometric verifications. Aditionally, in the case of calculating the basal shear stress, it considers three main factors: the previous performance of the structure (k1), the building occupancy (k2) and floor type (k3). Finally, for the seismic demand coefficient, C gives us a value for this type of material, particularly C=0.1.

In conjunction with the evaluation and knowledge of the building, this structural analysis allows to obtain a diagnosis of the current state of conservation focused on the structural and architectural perform of each the cases study.

The cases of study are:

- Casona Quilapilún
- Casa de los Diez
- Casa Piñera

Fig. 4. Casona Quilapilún, tower inside view. (Source: Contreras & Jofré, 2016)

Fig. 5. Casa de los Diez main façade. (Source: Jofré, 2019)

Fig. 6. Casa Piñera main façade. (Source: Sáez 2013)

4. Results and Conclusions

4.1 Results

Although the investigation is still ongoing, the evaluation carried out preliminarily with the NCh3332 standard indicates that the adobe masonry walls, which are preserved to date, can resist the requesting shear forces and mainly comply with the geometric re-quirements of the regulations.

The results of the structural and normative analysis carried out in the mansions located in the Central region of Chile indicate that there is a relationship between the results obtained with the geometric verification proposed by the standard, which considers the dimension and location of openings, the slenderness of walls, dis-tance between bracing walls, among oth-er considerations, and the most vulnerable sectors that show more significant deterioration in spans and walls.

The vulnerability of elements or areas where regulatory requirements are not met, is confirmed by registering areas with current damage or those that has been repaired and newly damaged due to the last major earthquake.

Despite of the apparent level of deterioration, the studies carried out tells us why these constructions have been preserved up to date, even when have been through major seismic events throughout more than 100 years. Thus, its resistance is given by its solid construction and its original design, which typological model of building was constinously evolving, undergoing improvements over time. Among these improvements can be mentioned the increase in the thickness and height of the walls, the rectangular geometry of enclosures, and patios, and the reinforcements of wood in meeting elementes, as well as the size of the intersection of partitions.

The resistance values of the adobe proposed by the regulatory framework for the resistant capacity of the adobe to compression and shear, although conservative, are presented in the field of structural safety of the evaluated constructions.

On the other hand, a significant difference is observed between those cases studies that have historically carried out adequate maintenance, with an active and permanent operation. Although these cases may present punctual damages, they are preserved in an excellent structural condition due to the conservation actions carried out permanently. In constrast, there are others constructions that have been left in a state of abandonment from the moment they were declared uninhabitable due to damages caused by previous seismic events, in many cases, after inadequate or inexistent protection strategies.

4.2 Future lines of research

- It is proposed to carry out mechanical tests on bricks and adobe walls from different country areas. Since Chile is a country of more than 4000 km in length and the inhabited areas are mainly distributed in the first 3000 km, we can find adobe constructions with a diversity of climates, which go from the desert in the north to a richer biodiversity in the central valley areas. This situation produces different types and qualities of adobe. In this sense, at least three zones of mechanical characterization of adobe has to be proposed: large north zone, small north zone, and central zone.

- Full-scale compression test campaigns for walls, which will provide actual ca-pacities for existing constructions, and background for the future of new build-ings in this material.

- Design a maintenance and conservation plan for projects to rehabilitate adobe buildings, which focuses on eliminating the risks and factors that cause damage in adobe constructions.

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Favignana bio-calcarenite: technological culture, knowledge and recovery

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Topic: T1.3. Studies of traditional techniques and materials.

Abstract

Favignana Island, the biggest one among Egadi islands, is well known for its deposits of calcarenite, which has been extracted and used since ancient times. The landscape of the Island is shaped by the widespread presence of quarries that mark the seaside as well. Furthermore, the constant presence of dry-stone walls, made of calcarenite, and of the characteristic architecture of buildings, represents a hallmark for the rest of Egadi islands as well, making it clear how important the presence of this material has been for the architectural and technological culture of these places. Calcarenite itself, exported by this island, is still a constituent material of many buildings in the western part of Sicily, in particular the prestigious buildings of the Baroque period. The presence of calcarenite, while notably all other construction materials, including timber, are absent, has meant that all the construction elements, indoor and outdoor, as well as all settlement types, have been affected by the almost exclusive use of calcarenite, the quarrying methods and the craftsmen's skills that inevitably derived from this context. Today, masonries, vaults, floors, roofs and all other elements show specific solutions that strongly characterize the buildings and the urban and rural landscape of the island. However, despite the constructive relevance of any elements or entire buildings, the touristic exploitation of the Egadi archipelago has brought to the replacement of buildings, or elements, as well as to a wrong and weak activity of building recovery. The reinterpretation of claddings and exposed masonry, and the replacement of original floors with concrete floors are just some of the many inappropriate interventions. In terms of typologies and morphological models, the study that we present has also dealt with the development of more adequate and relevant intervention techniques and repairs.

Keywords: *calcarenite; historic landscape; building recovery; technological culture.*

1. Introduction

The paper presents the results of the analysis of the culture of calcarenite, and of its use in traditional constructions within a specific context. The calcarenite in the island of Favignana, in the Egadi archipelago (a specific type of stone that belongs to the wider category of Sicilian calcarenites) has characterized the construction on the island and in western Sicily, where it has been exported for its great construction qualities. The quarries in Favignana – now dismissed – have determined symbiotic relationships both with the territory and the building fabric. The choice of stone constructions has followed practical and economic needs: the ease in the acquisition of the materials on the site and the consequently null transport cost; the scarcity of other resources, such as timber, and the great qualities of stone, such as the high unit weight, hardness, fire resistance and weather resistance, contribute to the high suitability of this material for durable and robust constructions.

Calcarenite is a sedimentary stone, constituted by calcareous particles whose size is comparable to sand (0,06-2 mm); it is used both for structural elements and for decorative purposes. The presence of fossils within in can lead to classify it as a “shelly breccia” or an “arenaceous limestone”. In Sicily, calcarenite in general represents a sort of "genius loci", a strongly recognizable part of the cultural heritage, handed down across centuries. It was used by the ancient Greeks to build the constructions in the Valley of Temples in Agrigento, and the Temple of Selinunte. It was initially found in Palermo during the Arabian period, in the well and the galleries (in Arabic, Qanat) excavated in the underground for water supply. This stone is the main construction elements of several Sicilian historical centers; in Eastern Sicily, it has characterized the well-known baroque architecture, from structural elements to complex decorations. In Favignana, calcarenite has been widely used in all urban and rural constructions; in the city and in the province of Trapani, it has been employed as well for the realization of masonry wall facings, true vaults, false vaults called "realine" and decorative systems in churches and other buildings constructed from the 15th to the 18th century. As of today, the extraction of calcarenite in Favignana is not allowed anymore due to reasons of environmental safeguard. Very little is still being extracted in the territory of Marsala, but the characteristics and properties of the material are deeply different.

Fig. 1. Calcarenite shell-shaped vault in Favignana, Basilica Maria SS Annunziata, Trapani (Source: Mamì, 2018).

In Favignana, calcarenite has generated a relevant production system, with a strong landscape value and a characteristic building fabric that includes spontaneous or vernacular buildings.

The context of the island, characterized by difficult connections with the nearby territories and a consequent need to use local resources, shows various modalities of use of this material in its architecture. The island is marked by the presence of quarries, where extraction activities reached their peak during the 19th century: as a consequence, buildings and stone have become adjacent to each other, and it is almost impossible to distinguish the borders between the two. The threshold of the house is the same as that of the quarry: the former results from the addiction of matter and the latter derives from its subtraction, produced by quarrying activities.

Fig. 2. Mixed quarry with a surface pit and tunnels, Favignana, Trapani (Source: Mamì, 2018)

Over time, the interaction between natural and built environment has become deeply interrelated and has characterized the whole spatial distribution of the houses realized above and inside the quarries. The urban center is formed on the quarries, and the relationships between the building fabric and the quarries are so complex that individuating building typologies or identifying single building units is an impossible task.

Fig. 3. Mixed quarry in the urban center (Source: Mamì, 2018)

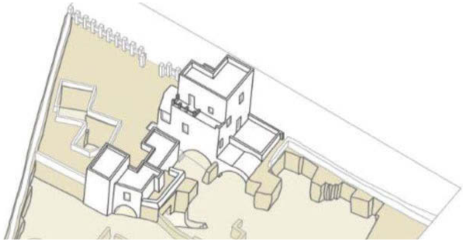

Fig. 4. Model of a house on a quarry (Source: La Rocca, 1995).

The operations within the extraction process derive from the knowledge handed down by the local workforce over centuries: iron plates were placed in natural cracks, then a wooden wedge was inserted between them, and hit with a club, pushed down to the depths. Next, the wedge was wetted, so its volume increased until it broke the stones and undermined the ashlar. The construction phase as well is the result of a secular sedimentation of knowledge and of a culture of craftmanship. The traces of this culture mainly lie in the fencing walls of houses, but also in other diversified forms, ranging from partitions between farms, to buildings themselves, from tanks to kitchens and chimneys. The unicity of calcarenite architectures inspired us to analyze the main construction elements realized by the workforce with traditional techniques. The primary material of these elements is, indeed, calcarenite, exploited at its best and employed to form various typological elements. Then, the study focused on interventions aimed to the recovery of construction elements according to the principle of minimum intervention, in an attempt to reconstruct their original configuration, both from a formal and technological standpoint.

2. The analysis of construction elements from the local tradition in Favignana

Calcarenite has been widely used in several construction elements of traditional architecture. Few different typologies have been found, as the single typologies are frequently repeated.

2.1. Dry walls in calcarenite stones

The territory of the island of Favignana features walls built to mark the delimitation of farms, and often constructed from stones cleared from the fields. The different typologies that have been detected and analyzed, were realized in different periods, and mainly in dry stone. This is caused by a functional need: dry stone, other than being less costly, increased air and water permeability. The construction phase consisted in placing single stones in order to create a bonded system that avoided sliding phenomena toward the exterior of the wall; then, the voids between the larger elements were filled with small stones. After defining the slope, a line, a spirit level and a plumb line were used and a wooden scaffolding was realized. After placing the stones, they were settled with hammer blows in order to form a compact and resistant system. In the final phase, the wall was completed by placing heavy stones on its top.

Fig. 5. Wooden scaffolding and line for the construction of a dry stone wall (Source: Progetto Medstone, 2002)

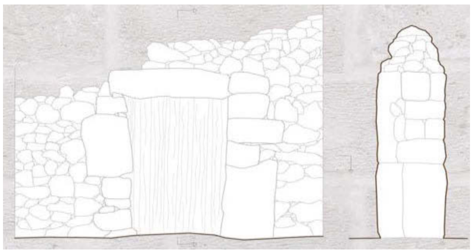

Fig. 6. Dry stone wall with boulders and shapeless stones (Source: Caleca, 2018)

Older walls usually have a truncated pyramidal section and were realized with shapeless stones. Smaller stones were used to fill the wall, while larger stones, usually employed for jambs and epistyles, had a large bearing surface and a high quality of the finish of exposed parts.

Other walls were constructed with surplus material from the quarries, and realized with rough-hewn or squared, parallelepiped- or cube-shaped ashlars, mixed with irregular stones.

Also for this reason, stones were settled in a very irregular pattern: in some cases horizontal lines were created by using stone shards, and the wall was compacted by adding a layer of raw mortar on the top of the element.

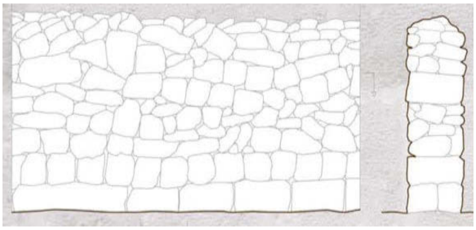

Fig. 7. Dry stone wall with selected shapeless stones and ashlars (Source: Caleca, 2018)

Other walls were realized directly on the quarry, by applying an intermediate layer of mortar and coarse aggregates between the wall and the plane of the quarry.

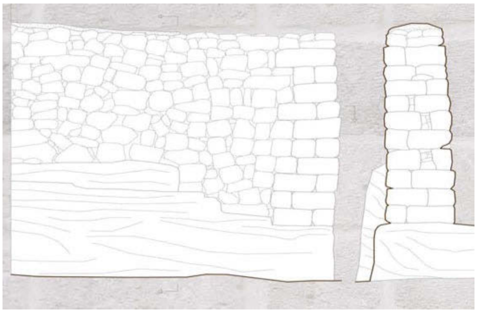

Fig. 8. Dry stone wall with selected shapeless stones and ashlars, realized on the quarry (Source: E. Caleca, 2018)

2.2. Masonry walls and calcarenite arch

In most cases, load-bearing walls have calcarenite ashlars toothed at the corners, up to 60 cm wide. They can be realized by *opus isodomum*, alternate *opus isodomum*, *opus pseudoisodomum* or *opus incertum*. Some masonry walls have particular characteristics: entrance portals, widely diffuse both in the urban center and in rural areas, are often defined by single, double or round arches; flat arches and frames appear on top of the windows, cornices are placed on the roof and the balconies are supported by cantilevers with various decorations and geometries; everything is made in local stone.

Masonry walls within the urban center are constituted by large-size ashlars, bonded with lime mortar. Stones are laid with staggered, smoothed joints. According to the standard practice, it was necessary to fulfill some conditions: the size of the stones had to be sufficient to provide the load-bearing function; binding stones (bondstones) had to run from one face of the wall to another (interior and exterior); a good proportion between the elements in the header and those on the facing was required; cornerstones, jambs and epistyle had to be perfectly integrated with the wall. Openings are marked by flat arches, while the entrance is marked by a double arch – an internal and an external one; in both cases, wedge-shaped ashlars were used in order to guarantee the adherence of adjacent stones.

Fig. 9. Masonry wall with arch systems (Source: Caleca, 2018)

Flat arches were realized from a timber slab, with a crossbeam in the center; wedge-shaped ashlars had to be laid on the plane of the slab, so that the ideal extension of the side faces of the ashlars converged in the same point of the beam. Balconies are supported by calcarenite cantilevers. These are realized from ashlars hinged into the wall, protruding in order to support the slabs of the balconies. Each cantilever was constructed with a squared ashlar whose protruding part was decorated, while the part placed within the wall remained rough.

2.3.Timber floor and calcarenite 'timpagnoli'

Intermediate floors were quite lightweight horizontal structures with a flat orientation. The main characteristic was the use of calcarenite instead of timber. The bedding layer of the pavement was made of 'tercisato', a material constituted by aggregates in crushed calcarenite from demolitions or waste by-products from the craftmanship of ashlars and irregular stones. This element has the function of reducing the transmission of vibrations.

Wood beams were arranged along the lower dimension of the compartment, and positioned either on recesses in the wall, or on holes specifically realized in it.

Beams were attached to the wall with alternated ends, in order to achieve a homogeneous mechanical resistance on the whole element. The most diffuse typology of floor was represented by a simple frame of beams with a diameter of 16 cm approx. and a span of 35 cm at least, which allowed positioning calcarenite blocks (or 'timpagnoli') with dimensions of 50 x 25 x 5 cm.

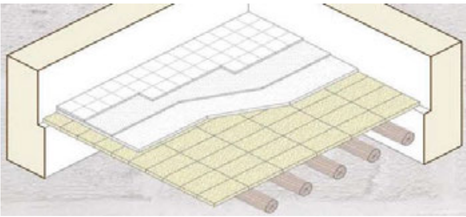

Fig. 10. Timber floor with timpagnoli (Source: Caleca, 2018)

Fig. 11. Timber floor with timpagnoli (Source: Mamì, 2018)

Calcarenite 'timpagnoli' were a particularly versatile material, as they were widely used in roof slabs as well, both in rural houses and in buildings with a high historical and monumental value. Calcarenite blocks were preferred to timber platforms and cane roofs ('incannucciato'), thanks to their improved load response excellent insulation qualities and, above all, high availability. A lime mortar layer was applied on the calcarenite blocks, in order to place roof tiles and their underlying supports.

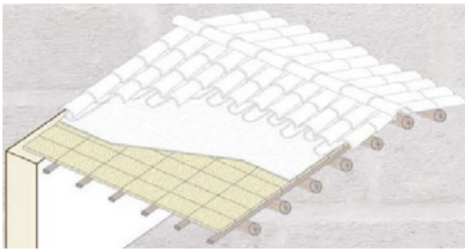

Fig. 12. Timber roof with timpagnoli (Source: Caleca, 2018)

2.4. True vaults in calcarenite

Vaults were a recurring element on the island, and calcarenite was the main component of this system, employed in several solutions. All vaults were in cut stone, that is in ashlars shaped according to the traditional rules of construction. Various typologies have been found. One of them is the barrel vault, whose exposed intrados shows the frame of longitudinal courses. The round arch was realized with square-shaped calcarenite ashlars, except for the keystone. The system was completed with a light spandrel in small stones, which contributed to smoothen the walking surface. Finally, a layer of bedding mortar was applied, followed by the pavement, usually in marble grit or cement paste.

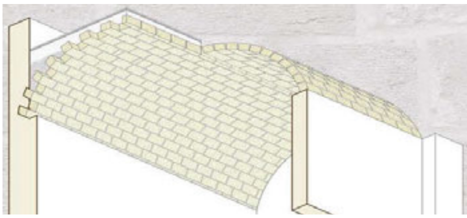

Fig. 13. Barrel vault (Source: Caleca, 2018)

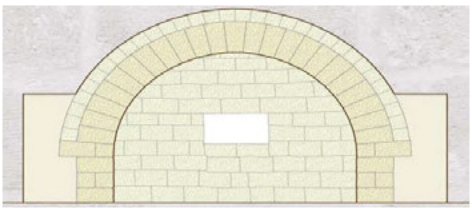

Fig. 14. Barrel vault with rounded arches (Source:. Caleca, 2018)

Fig. 15. 'Realina' tiled vault spring (Source: Mamì, 2018)

Another typology is represented by the barrel vault with lunettes (almost a false rib vault) with a rectangular plan. In case of two consecutive vaults, the central arch was constituted by twin stones. The blocks of the barrel vault were placed above the arches, while the blocks for the lunettes were placed transversally. The toothing at the corner was performed with a particular care: that point is subjected to strong stresses, and the convergency of the courses had to create solid ribs, in order to ensure the structural solidity of the system.

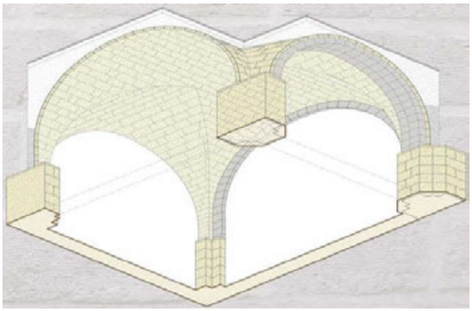

Fig. 16. Barrel vault with lunettes (Source: Caleca, 2018)

The tiled vault, called 'realina' in the Trapani area, is constituted by a double layer: a vaulted, and a flat one. It was mainly used on the roof, where it allowed producing a hollow space which mitigated temperatures in hot-humid climates. The intrados was realized with regular calcarenite blocks, positioned horizontally and bonded with lime mortar; the extrados was constituted by blocks with higher dimensions, placed along their width and supported by additional cornerstone blocks placed vertically. A screed in lime and calcarenite shards was applied on them, then the pavement – generally in cement paste – was placed above.

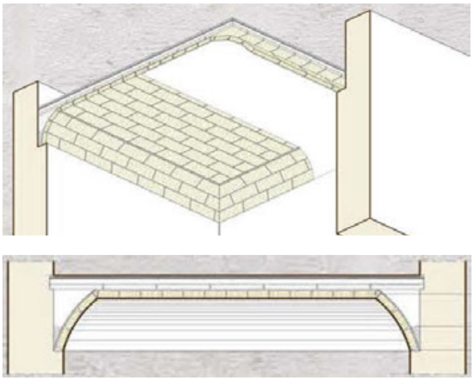

Fig. 17. 'Realina' tiled vault with a double envelope (Source: Caleca, 2018)

Fig. 18. Timpagnoli of the 'realina' tiled vault (Source: Mamì, 2018)

Fig. 19. Layers of the 'realina' tiled vault extrados (Source: Mamì, 2018)

2.5 Calcarenite kitchens and chimneys

Calcarenite was also used for elements without a structural function, such as kitchens and chimneys. All the detected typologies of chimneys have a fairly simple construction technique: calcarenite blocks are placed orthogonally to each other until the desired height is reached; they are positioned so as to obtain a square or rectangular section until the top. An additional chimney stack has been noticed in houses, which allowed expelling smokes in combination with the chimney of the kitchen. This drafting system also favored the inflow of fresh air into the environment, contributing to passive cooling.

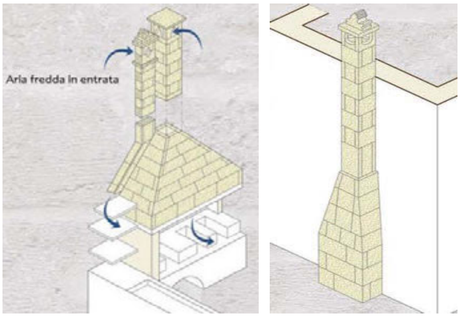

Fig. 20. Traditional fireplace with hoof and drafting system; chimney typology (Source: Caleca, 2018)

3. The recovery of the construction elements of the local tradition

These construction elements are deeply interesting from a technological standpoint, even more considering the local insular environment and their nature of spontaneous buildings and deserve attention in terms of conservation and recovery. However, despite a renewed awareness toward these themes, still today many of these elements are either dismissed, or consolidated and/or repaired with utterly inappropriate techniques. We have studied some intervention hypotheses, in compliance with their physical and formal conservation, with the principle of minimum intervention and reversibility.

3.1. Proposed intervention on timber floors with calcarenite ‘timpagnoli’

In the detected typologies of floors, the main frame is often subjected to warping, breakage and rotting phenomena. One of the proposed interventions is the insertion of one of more laminated timber beams (crossbeams) under – and perpendicular to – the existing beams that show bending or instability. The slot for the allocation of the end of the new beams is realized on the wall after the shoring of the existing beams. After placing the crossbeam, it is jointed with the existing frame with a large brass screw that reaches the screed, in order to obtain an overall collaborating system. Finally, the hole on the wall is coated with finished works and the shoring is removed. This intervention allows reducing the free length of the existing beams by acting on the point with the maximum bending, that is the midpoint.

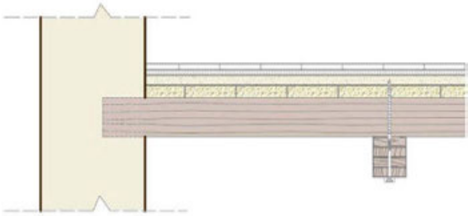

Fig. 21. Insertion of crossbeams in a timber floor with calcarenite timpagnoli (Source: Caleca, 2018)

Another proposal is to apply a layer of hemp-line substrate to the areas where the tercisato is particularly eroded. This layer, constituted by natural hydraulic lime mortar and mineralized shives, is a natural material with a high mechanical resistance and a good thermo-acoustic insulation. Moreover, areas where tercisato is in a good state could be reinforced by nailing a hemp fiber mesh, and then placing a lime mortar screed on it.

3.2. Proposed intervention on real calcarenite vaults

Vaulted systems can be subjected to various instability mechanisms which cannot always be predicted: asymmetric loads are troublesome, as they can increase lateral forces and cause a lowering in the keystone; if the piers do not provide a sufficient resistance, collapse scenarios can occur. The insertion of steel tie-rods is a quite diffuse intervention, and is performed at the height of the haunches, as these points are highly subjected to lateral forces. The threaded bars inserted in the walls can be in inox steel, or alternatively in brass and coated by a PVC protective membrane.

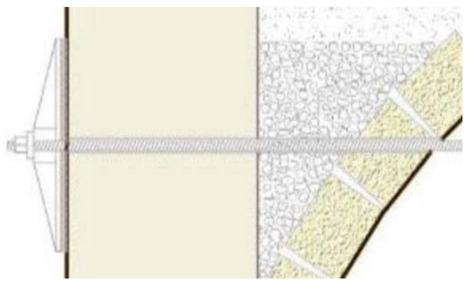

Fig. 22. Steel tie-rod in a barrel vault (Source: Caleca, 2018)

The anchoring plate of the bar – made of steel too – is separated from the external side of the wall by a neoprene pad.

3.3. Proposed intervention on timber roofs with calcarenite 'timpagnoli'

The most common instability phenomena can be related to an erroneous load distribution, or to rotting phenomena on the beams, or beam bending due to an insufficient section area. In cases where timber roofs are not subjected to strong decay phenomena, but beam bending is visible, a hardwood beam can be placed alongside the existing one. This beam serves as a prosthesis, and does not alter the balance of the system. When opportune, the intervention can be completed with the improvement of thermal and acoustic insulation, by realizing a false ceiling in wood wool panels.

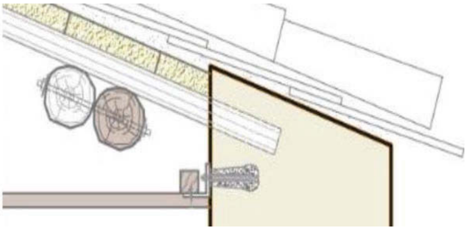

Fig. 23. Integration of a timber roof with timpagnoli with a supporting beam and a false ceiling (Source: Caleca, 2018)

4. Conclusions

The uniqueness of the landscape of Favignana is evident, as it is characterized by ancient and modern quarries, by the peculiar building fabric, born from the quarries and integrated with them; by the distinctive characteristic of the construction, generated by a heterogeneous use of calcarenite. The typological and technological analysis has highlighted a significant construction wisdom. The valorization of this heritage and of this landscape, together with the recovery of the material elements, requires complex valorization projects and a careful conservation. This is even more important as this tradition is ancient and no longer practiced in our times, following the dismission of the quarries on the island since the '60s. The characteristic of calcarenite – above all, its durability – show the importance of its reuse; moreover, it has proven to be a versatile and workable material, and its reuse has an ecological value. The analysis of existing buildings shows that ancient construction techniques could produce a solid and durable architecture, which fit the hot-summer Mediterranean climate thanks to the high thermal inertia of the massive stone system. In other words, buildings realized with natural materials and technologies are perfectly integrated in the landscape, making them a valid choice for contemporary recovery interventions as well. These solutions could support the respect and the valorization of technological and structural features of existing buildings in recovery interventions, through an attentive use of ad hoc techniques such as those described in this paper.

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Examination of earthen construction in archaeological sites of the Iberian Peninsula for risk analysis

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
Earthen constructions are one of the most widespread and fragile elements of the architectural heritage of the Iberian Peninsula. This situation is worsened when they lack the necessary protection and are found in vulnerable enclaves such as archaeological sites. Their geographical, cultural and constructive particularities expose them to different risks – natural, social and anthropic – which threaten their conservation and interpretation for future generations. This study aims to examine this type of heritage complex in constructive terms, focusing on constructions of a domestic and productive nature and paying special attention to those from prehistoric, protohistoric and Roman periods. Attention is also paid to later similar remains conserved. Quantitative and qualitative analysis methodologies are applied to a series of case studies found throughout the Iberian Peninsula in order to record the information on fiches examining general and specific aspects of the different techniques observed. Given the broad timeline and geography covered, as well as other identification and conservation factors, the data collected reflect a predominance of adobe over other earthen techniques which are also described, including daub, cob and rammed earth, with fewer examples identified throughout. This heritage is therefore classified to record the original states compiled from the different archives, reports and publications. Subsequently, a specific database is generated for the analysis of risks (exposure and sensitivity) and criteria, strategies or results (capacity for adaptation), gleaning as much information as possible from these characteristics.

Keywords: *heritage; archaeology; techniques; typologies; adobe; rammed earth.*

1. Introduction

Earthen construction is understood as any elements built using earth as a main component, whether for structural purposes or other domestic and production functions related to ways of life and needs. Despite lacking major resistance or bending properties in its raw state, earth has been a prime common resource from the earliest of times, due to its abundance and availability. Constructive tradition progressively perfected its execution, substantially improving mechanical and physical properties following experimental and physical criteria which provided a better response to the risks threatening the conservation and maintenance of earthen architecture.

The climate and geology of the Iberian Peninsula made it an ideal location for the widespread proliferation of this type of construction throughout prehistory and protohistory. In conjunction with the influences derived from historic events such as the Orientalizing period (Belarte, 2011), the Roman era and the Middle Ages, this brought about the proliferation of different historic types and techniques.

This information is now presented through the remains in archaeological sites, often found incomplete due to the speed at which they are being lost as these are complexes extremely vulnerable to exposure and abandonment (Pastor, 2017).

These techniques have been studied and generally defined by different authors in recent publications such as M. Pastor (2017) as well as in the late 20th century, by A. Sanchez, (1999). However, interest in earthen constructions in the field of archaeology had begun a few years earlier through studies like that by C.A de Chazelles and P. Pouet (1997), when attention was drawn to the fragility and neglect of earth as a material compared to others such as stone, generally recognized as more durable and resistant. It is this interpretation of earth as a non-renewable finite resource, exposed to different forms of deterioration, which has led to growing interest and documentation and interpretation processes since the late 19th century (Matero, 2013).

2. Objectives and methodology

In order to analyse risks and vulnerabilities within this theoretical framework, research is undertaken as part of the project "*RISK-Terra. La arquitectura de tierra en la Península Ibérica: estudio de los riesgos naturales, sociales y antrópicos y estrategias de gestión e incremento de la resiliencia*" ["*RISK-Terra. Earthen architecture in the Iberian Peninsula: study of natural, social and anthropic risks and strategies to improve resilience*"]. This aims to offer a picture of the variability of earthen constructive techniques and materials used in domestic and productive architecture within the Iberian Peninsula mainly during the prehistoric, protohistoric and Roman periods. In addition, some cases are conserved from later periods, when techniques such as rammed earth were disseminated and standardized. Knowledge of this original condition helps identify the percentage and scope of material loss of this heritage over time, while selecting the most interesting cases after cross-referencing the data relating to natural, social and anthropic risks for later consideration.

To do this a documentary database of case studies was established, each entry containing the general data (name, municipality, province, UTM ETRS89 coordinates, typology, chronology, current use, location plan, and general photograph) and constructive data (zone, constructive technique, stabilizers, as well as other techniques, and dimension data) which allow them to be classified.

Case study locations were identified from different sources, such as the excavation of sites with earthen techniques found in the archives of the IPCE [Cultural Heritage Institute of Spain] and other national publications, such as Excavaciones Arqueológicas en España: EAE and the Noticiario Arqueológico Hispánico; as well as publications and entries at regional level (i.e.. SIP of Diputación de Valencia, the Anuario Arqueológico de Andalucía, or the Mapes del Patrimoni Cultural Local de la Diputació de Barcelona); research projects (*SOSTierra: La restauración y rehabilitación de arquitectura tradicional de tierra en la Península Ibérica. Líneas guía y herramientas para una intervención sostenible*); and a range of reports from different excavations (Table 1).

IPCE	36	17%
Publications and reports	159	73%
National/regional documentation	23	11%
Total	218	

Table 1. Main sources for the identification of cases (Source: S. Manzano Fernández, 2022).

Efforts have been made to keep errors in classification to a minimum based on the problems of excessive simplification of categories (Chazelles & Poupet, 1985) discussed and analysed in the Iberian Peninsula (Pastor, 2017) (Sánchez, 1999), ensuring whenever possible to provide graphic and chronological documentation of the descriptive denominations of rammed earth, confused with cob or daub in pre-Roman periods.

In order to present dimensional statistical data care was taken to respect chronological periods and their variability using Kernel Smoothing - Density Estimation with a bandwidth of 0.8.

3. Data and case studies

The current database, with 218 cases of very different types, was compiled from a review of the bibliography. Most of the sites recorded (76%) are in isolated locations, more affected by natural risks. A further two types of locations can be identified at urban level: firstly, those in an unbuilt urbanized plot (9% of cases) and secondly, those within the urban layout (14% of cases) which are usually museumized or reburied following construction (Table 2).

Isolated	167	76%
In urban layout	31	14%
Isolated plot in city	20	9%
Total	218	

Table. 2. Location of case studies in current database (Source: S. Manzano Fernández, 2022).

Furthermore, the chronology for each of these earthen sites can be identified, offering relevant information on the constructive techniques and elements found. The standardization of materials and more resistant techniques leads to increased percentages of domestic and productive cases from the Late Bronze Age / Early Iron Age, with a total of 38% compared to the 64% found from the Iberian period and the 46% from the Roman period.

Currently, the percentage of representative cases from the Medieval periods, including higher proportions of techniques like rammed earth, which due to its particular proliferation, is identified in 9% of cases (Table 3).

Neolithic / Eneolithic	8	6%
Bronze Age	10	8%
Late Bronze Age / Early Iron Age	49	38%
Iberian	81	63%
Roman	59	46%
Medieval	11	9%
Total	218	

Table 3. Case study dating in the current database (Source: S. Manzano Fernández, 2022).

To some extent the geographical dispersion shows the absence of cases in areas with greater rainfall indices, as it is the drier areas where timber is scarcer which benefit from earthen architecture techniques. Location coordinate UTM ETRS89 H30 was entered into GIS systems to cross-reference different data for subsequent analysis (Fig. 1).

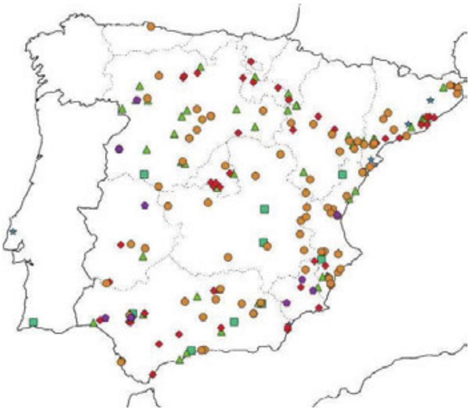

Fig. 1. Geographical location patterns of the case studies of the current database and chronological dating. Key: ★ = Neolithic; ■ = Copper Age / Bronze Age; ▲ = Late Bronze Age / Early Iron Age; ● = Iberian; ◆ = Roman; ⬟ = Medieval (Source: S. Manzano Fernández, 2022).

4. Constructive use

One of the data items recorded for the different case studies is the area in which these earthen constructions are used, as they are commonly found in structural elements as well as a wide range of solutions linked to the necessities of different ways of life. This is especially noticeable in periods such as the Iberian, when the use of earth as a main constructive material became standardized (Sánchez, 1999) giving rise to a wide range of typologies and pieces.

Wall elevation	135	62%
Flooring	104	48%
Elements for production	64	29%
Domestic elements	62	28%
Rendering	43	20%

Table 4. Presence of earth per element in the case studies in the current database (Source: S. Manzano Fernández, 2022).

Overall, the most frequently recorded element in case studies reviewed found in 62% of cases in different configurations, is wall elevations, with or without plinths. These are usually configured as a main element in domestic and productive architecture, but also as wall infill alongside other techniques in monumental architecture, although this is not covered in this study.

The next most recorded element, with 48% of cases, is flooring and related solutions, given the frequent use of earth for levelling and for the different finishes of rammed earth, beaten earth or adobe.

In the domestic space, non-structural elements introducing a wide range of pieces can also be found. 28% of cases incorporate earthen elements like benches, usually built into walls in the same material and length, and also found rendered or as modular solutions. In hearths, usually executed in clay or adobe, they are combined with other stone elements, defining a combustion perimeter (Abad & Sala, 1993) which can be found level, raised or sunken and eventually hardening, as seen in El Amarejo, in Cerro Redondo, and in Cortes de Navarra, both in stretcher and shiner bond. Other elements include mounds, outer rings of earth or adobe beside the small pebbles, occasionally covered in a pyramid shape, and other individual pieces such as the visible lintels in Las Casas del Turuñuelo, wells like those in La Indiana, shelves for ceramic goods in Cabezo Redondo, canals, chimneys, and oil presses.

Elements for production were also studied and found in 29% of total cases in a wide range of configurations. In terms of geometry, there are entries for kilns with different combustion chambers: circular, pseudo-circular, or oval, more or less elongated, with side or back supports, with central walls dividing the space into two or with a central pillar. In most of these earth is used to build the side walls, which are at times excavated from the earth in the ground and rendered in adobe. The grill, also in adobe and perforated for ventilation, was built on this structure and was usually made up of long pieces of mud and straw, flat on one side and convex on the other. These kilns were usually closed off using a false dome built with adobe courses (Luzón, 1973).

20% of cases incorporate rendering, regularly applied to protect all sorts of structures, from wall elevations to combustion chambers, which hardened when they were first fired. Different types of rendering identified, usually 2-7 cm thick, include mud and straw with a kaolin base, yellow and grey stucco, as well as paintings and decoration.

5. Analysis and characterization of the main constructive techniques

Although earthen construction has been documented both in mixed (Chazelles, 1997) and independent form, there are no examples of mixed earth constructions unaffected by collapse found in the Iberian Peninsula. These date from the earliest periods and are difficult to distinguish given their constructive similarity with roofing solutions used regularly in pre-Roman architecture (Sánchez, 1999).

This technique, daub (or *torchis* in French), is a mix of water and earth that cannot be separated from a timber substructure, which it covers, and serves as an internal load-bearing reinforcement (unlike conventional rendering) when increasing wall height or building roofs. Collapses of this sort have been identified in Neolithic sites such as Bòbila Madurell (Plasencia, 2016); in Late Bronze Age sites including Caramoro I (Jover, Pastor, Basso, et al., 2019) and Cerro de la Encina (Aranda & Molina, 2005); and in Iberian sites such as Tossal Montañés (Moret, 2001), to judge from the plant imprints observed on the surface. Traces of original daub are found in only 2.5% of cases reviewed.

Therefore, three main constructive techniques have essentially been identified in the case studies: cob, adobe and rammed earth.

5.1 Cob

Alongside the daub detailed above, cob (or *bauge* in French) is one of the oldest earthen techniques documented, the result of processes requiring minimal modification of the material, which can be prepared and handled on site. Considered the dominant technique of the 3rd and 2nd millenia along with daub, cob remained widespread until the Late Bronze Age (Chazelles, 1995). This technique, extensively described and documented, consists in the application of an earth and water mix, usually stabilized naturally by adding plant fibres such as straw, or anthropically using lime which dries to provide sufficient joint resistance to build load-bearing wall elevations from the base or plinth. This technique can be applied to all non-structural and homogeneous elements built without modulating, including beaten earth flooring; rendering; or other domestic constructions such as hearths, ovens, shelves and benches, built with similar characteristics and processes.

8% of the cases recorded in the current database appear to have been built with cob, although this technique is difficult to detect, often only identified by the finger imprints left during the production process. Examples of this can be found in the prehistoric cabin in Alcalar; in domestic walls with no plinth in the Rábita Califal of the Dunas de Guardamar (Azuar, Rouillard, Gailledrat, et al., 1998); in the mud shelves of Cabezo Redondo; or in wall elevations of Caramoro I, mentioned earlier, with clearly visible stacked damp earth balls (Jover, Pastor, Basso, et al., 2019). Some dubious registers are also observed, like the structures of Phase III of Cerro de la Encina (Arribas, Pareja, Molina, Areaga, & Molina, 1974) or those identified as adobe but whose ambiguous description and chronology suggest they could also be cob, like some structures in La Ereta de Castellar, Orpesa La Vella and Morro de Mezquitilla. Flooring with beaten and rammed earth is recorded in 47% of cases.

The dimensions of these elements vary widely with some cases of elevations 25-45 cm thick identified, while several domestic structures 10-15 cm thick are found. As is to be expected, all these examples conserved have been reduced to a few centimetres.

5.2 Adobe

Adobe, of complex origins, definitively appeared around the Late Bronze Age and Early Iron Age (13th to 5th centuries BC approximately) and became a major technique predominantly used throughout protohistory (Sánchez, 1999). All types of elements and structures became particularly standardized in Iberian settings. Unlike its predecessors, adobe (or *brique crue* in French) is usually a modular technique used to produce air-dried mud bricks in variable sizes produced with or without moulds.

This is the most frequently identified technique, with 189 case studies in the current database, 87% of the total recorded, including notable cases such as La Mata, Cancho Roano, Bílbilis, Libisosa, Casa del Acueducto de Tiermes and La Fonteta. Although as with cob it often used stabilizers such as straw, manure or lime to improve its properties, only 7% of cases have shown clear examples of these additions. Other additions observed in 4% of cases include the use of lime hydroxide, rough stones, ceramic, gravel, sand or absence of additives. Despite this, and according to the bibliography consulted, the majority of cases (88%) present no descriptive information in this regard.

In terms of the bond in elevations, flooring and equipment the placements are not usually in a set order, with many cases of stretcher bond, header bond, or several others in stretcher and header bond, generally depending on whether the walls were load-bearing, party or partitions, as well as others with no apparent logical order. Occasionally in the construction of walls a shiner bond was executed, placing the long side. This may be the case of La Celadilla de Ademuz, with some thicknesses of 15-17 cm but with practically unrecognizable pieces.

Analysis for usual measurements for executing adobe is complex as these vary widely based on numerous conditioning factors such as mould size, base thickness, manual execution or the transfer of constructive culture for each period and place (Sánchez, 1999). In spite of this, the data obtained for the different case studies have been grouped according to the three main periods of development of the technique (Late Bronze and Early Iron Ages, Iberian (5th c. – 2nd c. BC, approx.), and Roman (3rd c. BC – 5th c. AD, approx..) in the Iberian Peninsula, namely the following measurement ranges:

- Late Bronze Age / Early Iron Age: length 36-44 cm (44%); width 16-22 cm (38%); height 8-11 cm (60%).

- Iberian: length 36-44 cm (29%) and 28-36 cm (25%); width 28-34 cm (28%), 16-22 cm (23%) and 22-28 cm (21%); height 8-11 cm (61%).

- Roman: length 36-44 cm (29%) and 28-36 cm (25%); width 28-34 (50%); height 8-11 (76%).

From this it can be deduced that the dimensions of the older pieces tend to be around 40x20x9/10 cm, while in the Iberian and Roman periods the sizes are quite similar, 40x20/30x8/10 and 40x30x7/10 cm, respectively. Some relations could be established with research that have already been carried out in the Iberian Peninsula, in which the most widespread module in Western Europe was 40x30x10 cm, while the lengths of 50 cm would be more related to the Punic cubit (Asensio, 1995). Other dimensions such as 15x10x8 and 30x20x10 cm would be dated to older modules according to these studies.

There is a separate category for the special pieces mentioned earlier, like those supporting the grill in elements for production, which could measure up to 108x32x15 (Luzón, 1973) depending on the distance to the central pillar.

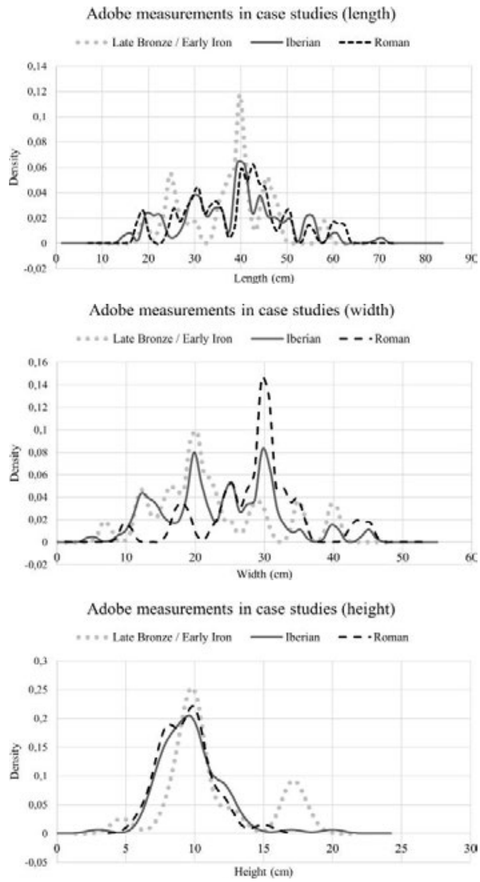

Fig 2. Most repeated dimensions according to Kernel density estimation of registered adobe (Source: S. Manzano Fernández, 2022).

Fig. 3. Earth hearth in the Iberian settlement of Coll del Moro (Source: S. Manzano Fernández, 2022).

Fig. 4. Earth craft structures in the Iberian citadel of Calafell (Source: S. Manzano Fernández, 2022).

5.3 Rammed earth

This technique (or *pisé* in French), as widely described and analysed as adobe, was consolidated in the Roman period although it pre-dated it (Sánchez, 1999). In the Iberian Peninsula the earliest recorded case is the domus in Ampurias (Chazelles, 1990). An earth rammer is used to tamp the earth in relatively thin layers, thanks to a mobile wooden formwork braced with transversal wooden pieces (putlogs). In this case these are stabilized through rammed earth instead of plant additives, although numerous typologies from later periods are found complemented with lime, stone and brick.

Given the extensive chronology analysed, the representation of case studies (10%) is discrete, including examples such as La Fonteta (Rouillard, Gailledrat, & Sala, 2007) and the Rábita Califal of Guardamar del Segura (Azuar, Rouillard, Gailledrat, et al., 1998), the dwellings of the castle of Niebla, and Libisosa. However, this percentage could vary if including the 4% of cases recorded prior to the example of Ampurias mentioned above, which gives rise to doubts regarding the excessive simplification described by Chazelles and Poupet, and mentioned earlier.

The measurements of this domestic architecture also vary considerably. The Roman rammed earth wall in Ampurias is 50 cm wide (Chazelles, 1990), a measurement close to the 47.5 cm observed in the Islamic Alquería of Bofilla. In contrast, the elevations of Medina Siyasa are 80 cm wide at the base of the wall (Navarro & Jiménez, 2011), close to the 85 cm of the Patio de San Laureano (Arenas, Carrasco, Conlin, et al, 2003). In the Comunidad Valenciana, the usual thickness found in rammed earth walls was between 40 and 90 cm (Font & Hidalgo, 1990) with a mould height of one metre, ranges observed in other cases of the Iberian Peninsula.

Cob		18	8%
	Signs of daub	5	
Adobe		189	87%
Stabilizers recorded	Plant	13	
	Others	4	
	Without stabilizers	3	
	Not specified	168	
Rammed earth		22	10%
	Rammed earth (possibly simplified category)	(9)	(6%)
Flooding (Rammed earth or beaten earth)		103	47%
Other techniques			
	Masonry	169	78%
	Ceramic brick	37	17%
	Flat stone or stone slabs	11	5%
	Pebbles or small pebbles	14	6%

Table 5. Distribution of constructive techniques observed in case studies from the current database (Source: S. Manzano Fernández, 2022).

5.4 Other techniques

Despite the presence of cases in which earthen elements spring directly from the flooring, which also tends to be earth (Azuar, Rouillard, Gailledrat, et al., 1998), due to its susceptibility to damp from capillarity it is usually combined with more durable techniques, particularly at the base or plinth. Of the cases reviewed, 85% are combined with stone masonry, detected in 78% of these cases. In addition, fewer instances are observed of earlier configurations with pebbles and small pebbles, as well as flat stone and slabs, present in 6% and 5% of cases, respectively. Coexistence with other techniques such as ceramic brick, whose use became widespread from the start of the 1st century BC (Pastor, 2017), is observed especially in later sites, accounting for 17% of the current cases documented. This is especially used for plinths, as in the case of El Molinete.

6. Conclusions

The dispersed pattern of cases confirms the geological and climatic suitability for the development of historic earthen constructions in the Iberian Peninsula, with the exception of areas affected by particularly heavy rainfall. Despite its complex origins, the material has evolved in step with the references consulted. The architectural data cover a wide range of structures and elements adapted to the different needs and provide extensive detailed information relating to the Iberian Peninsula.

In technical terms, the wide variability of applications is a response to numerous internal and external factors. Cob has mostly been lost, except in flooring. In the periods studied more in depth adobe is the main solution, with multiple applications and a wide range of sizes, albeit with frequent lengths and heights, around 40 and 8-10 cm respectively, or with widths of 20-30 cm which gradually increased towards the Roman period. The use of rammed earth became more prominent at this stage, with frequent cases measuring between 50-80 cm. Thanks to the in-depth study of the most vulnerable cases basic documentation can be established for use in risk analysis.

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Traditional mortars with chucum in Yucatan, Mexico, as biocultural heritage

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
The proposed presentation aims to characterize as biocultural heritage, the traditional construction technique of Mayan origin used to elaborate mortars with chucum (Harvadia Albi-cans) in Yucatán, Mexico. The aim is trying to keep alive the complex catalog of beliefs and traditions, the knowledge and productive practices specified in the materialization of the construction system whose origin is millenary. The study carries out the so-called "k-c-p complex (kosmos, corpus, and praxis)" which is used in ethnoecology in order to analyze documented information obtained in interviews with native teachers belonging to Mayan communities and construction surveys applied to current generations. The purpose is to increase its value to promote its safeguarding and its application in sustainable construction, conservation, and restoration of heritage buildings. Procedures are documented for the elaboration of the plant extract that would prevent the indiscriminate use of chucum in the industry. And finally, the importance of preserving learning scenarios to promote the transmission of traditional knowledge within indigenous people, for its future safeguarding is detailed.

Keywords: *constructive knowledge; mortars; chucum; biocultural heritage.*

1. Introduction

In the world, there are regions with great biological and cultural wealth. Many theorists call biocultural diversity the interconnection of these two spheres through the practices, traditions, and beliefs of indigenous peoples and traditional peasants. Lately, different organizations have highlighted the recognition, appraisal, and safeguarding of cultural manifestations and traditional knowledge of indigenous communities, and prioritize their participation in the conservation of their natural and cultural heritage.

Among the cultures that conform Mesoamerica region, Mayas stand out for developing a close relationship with its natural environment under sophisticated practices. An example of these activities and cultural practices is constructive knowledge.

Fig. 1. Vernacular architecture of Yucatán "Mayan house" (Source: Guerrero, 2021)

The notion in the Mayan language of this constructive knowledge is *U miatsil K'aax le naj* which refers to knowing how to "tie up" a Mayan house because this is the origin of all the construction techniques used in this area (Sánchez, 2014). Mayan traditional constructive culture has been generated and transmitted through practice and language (Sánchez et al., 2021, p. 39). In constructive practice, there are cultural and cosmogonic connotations appreciable in their folkloric denomination, which are still present in memory and buildings. Palpable evidence of the cultural burden is found in Mayan murals, where there were used mortars made by a mixture of calcium hydroxide, sand, and sometimes an additive of vegetable extract.

Fig. 2. Mayapan's Mayan murals (Source: Martínez, 2021)

One of the most used extracts is the *chucum* (*Harvadia Albicans*). *Chucum* is a legume plant with a small leaf, which has thick "V" spines at its base (González et. al, 2019)

Fig. 3. Chucum tree *(Harvadia Albicans)* (Source: Martínez, 2021)

There are records of the use of chucum extract in documents since the sixteenth century, noteworthy that the primary sources in these times were the master builders who resided in the communities surrounding archaeological sites. These documents were a watershed for the development of multiple investigations oriented to the technique of Mayan mortars. As a result of the Spanish conquest, there was a mixture of knowledge applying local materials and techniques for the construction of new buildings. Such was the case of the application of mortars with chucum extract in haciendas, urban dwellings, and other buildings generated from the sixteenth century in irrigation channels and water tanks as wells and cisterns. With the fall of the haciendas' agroindustrial production, the use and application of mortar were partially forgotten. It only remained in the memory of the inhabitants, whose knowledge was transmitted from past generations. The rescue of the technique is given thanks to archaeologists and restorers who, together with the preserved knowledge of the communities, have managed to determine some of the components used in the mortars. In the last decades, mortars with chucum are mainly produced in a semi-industrialized way, resulting in the creation of a "Chukum base" that is a product composed mainly of fine powder and white cement. This product is widely distributed throughout Mexico and begins to make its way internationally.

Víctor Toledo *et al*. developed an ethnoecology method described as the K-C-P complex, which consists of the set of beliefs or *kosmos* (k), the repertoire of knowledge or *corpus* (c), and the productive activities or *praxis* (p) (Toledo et al., 2018, pp. 3, 4), through the address of biocultural heritage and the understanding of the interaction of man-nature, practices, knowledge, and culture of traditional groups, indigenous, local peoples and peasants. The aim of this study was to characterize as biocultural heritage by the K-C-P method the mortars with chucum (Harvadia Albicans) in Yucatán, Mexico.

2. Methodology and tools

For the research presented in this paper the ethnographic tool of Participant Observation (OP) was taken as a basis (Vasilachis, 2006) in order to identify changes and permanence in the use of lime traditional mortars. As a first approach, face-to-face and digital surveys were carried out with people related to construction (masons, architects, engineers, merchants). Through the exploratory study based on the "snowball" technique (Polsky, 1969, in Taylor & Bogdan, 1994) a total of 169 responses were obtained.

A later field study was conducted in Nunkiní, Dzitbalché and Hechelchakán in the state of Campeche, and Tipikal, Halachó, Motul and Espita in the state of Yucatán. The inclusion criteria for interviewed people used were: belonging to communities in the Yucatan Peninsula, which are recognized for their work in their locality, having inherited the knowledge of their father or teacher, and accessing the interview through an informed consent format. The interviews were conducted in an open or semi-directed manner so that the interviewee did not limit his information. At the same time, the "in-depth interview" process was developed (Taylor & Bogdan 1994). In this way, data were collected that make up the three aspects of the k-c-p complex described in ethnoecology.

3. Results

3.1. Kosmos (beliefs and traditions)

The system of beliefs and traditions rooted in construction techniques in the use of chucum in traditional mortars is mainly linked to the management of plant species. For the form of transmission of knowledge and scenarios, the classification that separates the "vertical form" (VT) of knowledge transmission, that is, from grandfather, father to child, and by "horizontal transmission" (HT), which means that those involved are not related, was considered (Miss-Domínguez et al., 2017). Based on the information collected in the surveys, of the 80 people who have knowledge of the technique of making mortars with chucum,14% had a VT and in the other 86% the HT. This fact denotes that the main scenario of transmission and learning of the technique is at building work. On the other hand, the transmission of knowledge of what chucum is is also presented. It was obtained that 16% of the 169 respondents knew the chucum on VT. It should be noted that along with the answer they always mention the learning space, in this case, the "mountain" or the crop field. The other 84% obtained it by HT and the learning space that predominated was building work. In the case of knowledge of how to make the chucum extract; of the eight interviewees, six had a VT. Only two of them were learned by a HT. The reasons that lead to the interest in learning reflect the importance for the interviewees of the cultural heritage of their ancestors, their beliefs around their application, and their relationship with their traditional practices. Two were found mainly causes, the first is the motivation for the perpetuation of the family legacy and the second is merely economic. The whole process of making the mortar carries a cultural burden only because of the folkloric denomination of the tree, the rocks, and the preparation of the lime, among other aspects.

The majority of respondents (75%) and interviewees are unaware of the existence of other types of chucum. However, a few (11% of respondents) reported two; one red called *chucumchak* or *chakchucum,* and one white, which they call *sakchucum.* These varieties of *chucum* are also reported in the Yucatan Encyclopedia of 1977. Like trees, rocks and soils receive a folkloric denomination depending on their morphology, their uses, or their relationship with ritual aspects. For example, Shreiner (2003) explained that the folkloric name of the lime-making process refers to birth. In the case of lime making, several articles have been published and research has been carried out that has shown the persistence of certain types of rituals. Among them, the placement of vessels, some prayers of thanksgiving, and the placement of crosses arranged in a specific way stand out. It is also mentioned the orientation of the lime kiln and some beliefs such as avoiding the presence of women during calcination (Magaloni, 1996, 1998; Schreiner, 2003; Russell & Dahlin, 2007). All the interviewees agreed that they were not familiar with the association of their practice with any type of ritual process in the technique of making mortars or the elaboration of lime.

3.2. Corpus (knowledge and awareness)

The practices involve a grouping of knowledge that occurs under the maintenance of learning scenarios. As seen in the previous section, this information is transmitted generationally. In the case of the technique of mortars with chucum, it was necessary to divide the knowledge into the three main components, the extract or additive, the cementant and the sand. The results of the survey regarding the general question of 'what is the chucum?' were very varied, but two groups were assembled. Of the 169 surveys, 111 people relate to chucum as part of nature (tree, bush, tree resin, among others). The other group belongs to those who consider it a product (mortar, finish, material).

3.2.1. Vegetable additive (chucum)

All the people interviewed and 66% of the respondents, confirmed knowing about the chucum tree and distinguishing it between the different species that make up its natural environment. In addition to recognizing it, they attribute different uses, in construction, as firewood and in the tannery. The qualities of these additives are provided by tannins which are water-soluble substances that are present in the bark, leaves, roots and fruits of plants and trees of different species. The astringent property of tannins causes the skins to stabilize and in this way their putrefaction is prevented (Jáidar, 2006; Larqué-Saavedra, 2016).

The chucum is a tree up to 20m high with short spines and bipinnate leaves; it has a 10-12 mm sheath and a flat, thin fruit 10 cm long. In general, the population that is most in contact with the natural environment recognizes the tree by its thorns and by its thin leaves. Another feature they mentioned is that it contains bitterness, this was checked by testing the torn bark. The feeling of bitterness is due to the astringent substances characteristic of tannins.

Fig. 4. Chucum tree's thorns and leaves (Source: Martínez)

The *chucum* tree is distributed throughout the Yucatan Peninsula (Flores 2001, Duno 2014) and in large quantities. Duno (2014) in his research, concludes that the species is outside any category of threat with an abundant population throughout the peninsula and a low risk of extinction. The response of the interviewees shows that there is a high availability of the species. The result of the surveys (40% mention that it is very easy to find the tree) confirms raised by Duno (2014). This indicates that people do not have to travel long distances to find it. It was found that none of the interviewees is limited to cutting it at any time of the year; however, three of them mentioned that, if cut in the dry season, even though it is a little more difficult to extract, the bark contains more astringent substance. On the contrary, in the rainy season, it is easier to obtain the bark, but they mentioned that rain dilutes the astringent substance in the trunk. After deep research in the literature, no bibliographical information was found about the concentration that the extract may have in a certain season of the year.

3.2.2. Cementant

Within the research appeared two types of cementants mainly. One is lime and caters to the traditional technique and the other is white cement, used by current generations of builders.

The use of lime has declined as the main cementitious material in construction. This is demonstrated by the results obtained from the questionnaires, from people who say they know the process, only 20% affirm the use of lime in traditional mortars with chucum.

Regarding the knowledge of the elaboration of baking lime or traditional lime, the interviewees reiterated that it is an activity that is no longer practiced and they attribute it to "the ancients", referring to the people belonging to the Mayan community who have already passed away.

The main information regarding the cementants is that of the recognition of the rocks or geology. One of the interviewees mentioned two types of rocks, the one that is used for the elaboration of lime called *sak eel b'aach.* This stone has a similar origin to a type of sandy soil that is very abundant in the Yucatan peninsula that is known regionally by the name of *sascab*. In the same sense, another of the interviewees indicated that the stone used is "sascabosa" (like-sascab).

Among the characteristics mentioned by the interviewees to identify the *sak eel b'aach*, are weight, sound and resistance. These rocks must be light, this is one of the first features to identify. With the help of a hammer or machete (cutting tool), they determine the hardness or strength of the rock. They make cuts or fissures to the rock to check its resistance and generate a sound to know its hardness.

3.2.3. Sand

Sand, as well as lime, has been replaced by other more available materials. Of the 80 people who know the process of making the mortar, only 13% use *sascab* in the mixture.

The main knowledge related to the aggregate component is to know how to identify soils. The name of the soil depends on its morphological characteristic. In this case, the *sascab, sajkab' or sajka'* means white earth, white rock. Some characterize it depending on its particle size or mechanical behavior as sandy or silty soil with a low presence of clay (Pacheco & Alonzo, 2003; González & Vega, 2002). For his part, Littmann (1958) mentions that this material is mainly made up of calcite and is the product of weathering and erosion of the limestone material.

The Mayan master builders have been able to identify the types of *sascab* to assign it a certain use. For example, one of the interviewees commented that the *sascab* he gets from his cave contains a substance he calls *k'aab* [1] or *k'at* [2] and that it has a sticky, yellow consistency. He commented that when he made his mortars, the amount of lime he used was minimal.

3.3. Praxis (traditional practices)

Productive practices are the materialization of knowledge and beliefs. In this case, the practices related to the elaboration of the extract, the lime and the mixture are explored.

3.3.1. Preparation of the extract (times, quality controls)

Interviewees look for logs with larger diameters. When it is dry season, it is necessary to hit the trunk to be able to extract the bark since it does not contain water that favors the process. In the rainy season, it is not necessary, only a small cut is made with a machete (cutting tool) and removed in the direction parallel to the branch.

Interviewees who are related to the practice of crop, the harvest of the bark is done by pruning and the whole tree is not used. This ensures that it can regenerate and continue to grow. Jáidar (2006) mentions that it is necessary to be careful with the way to detach it so as not to affect the species and then let it rest for at least two years for its recovery.

The bark is arranged depending on the type of extraction. For "sancocho"[3] it is necessary to cut into strips 20 to 50 cm long. On the contrary, for maceration at room temperature very small pieces are available.

[1] It means broth, liquid or juice (Bastarrachea & Canto, 2007, p. 110)

[2] It means mud, clay or mud. Very fine soil that has the property of acquiring a sticky consistency when wet (Bastarrachea & Canto, 2007, p. 110)

[3] Sancocho is the term mostly used for the process of hot maceration of the bark in water.

Fig. 5. Two ways to cut the bark (Source: Martínez, 2021)

The two main forms of extraction found are that of maceration at room temperature linked mainly to bibliographic sources on restoration issues (Morris 1931; Littmann, 1960; Magaloni, 1996; Jáidar, 2006; García and Jáidar, 2013; Santini, 2005; Lorenzo, 2019). and heat maceration, "sancocho" or boiled is more related to contemporary constructors the case of extraction through maceration, the bark is placed directly in the water after turning it into small fibers. The sancocho consists of placing the strips of bark in a metal container and heating.

Fig. 6. Extraction techniques: maceration at room temperature and sancocho respectively (Source: Martínez, 2021)

In studies conducted by various sources (Morris 1931; Littmann, 1960; Magaloni, 1996; Jáidar, 2006; García and Jáidar, 2013; Santini, 2005; Lorenzo, 2019), the extraction method used consisted of letting stand in water for no more than two days, that is, a maceration. There is a wide variation in the times of obtaining the extract. The type of extraction does not influence the times considered. On the part of the surveys, no answers were presented on the maceration times at room temperature, but as with the interviewees, the times in the sancocho varied greatly. The times were grouped into less than five hours, between five and 24 hours, and those that take more than 24 hours. The most frequent time was 5 to 24 hours with 38%. The main indicator to demonstrate that the extraction is being done correctly is the color, as mentioned by one of the interviewees. The extract at the end of the process should have shades between purple and black. Contrary to this information, García and Jáidar (2013) warns that the "color intensity of these solutions is not a reliable parameter to measure the degree of saturation" (García & Jáidar, 2013, p. 120).

3.3.2. Preparation of lime

Lime processing is a chemical transformation of limestone rock. Researchers from several areas have hypothesized how the Mayan culture made traditional lime. American archaeologist Earl H. Morris recounts a technique known as "rotting". He mentions that lime was made using kilns, where the limestone rock was burned and then left outdoors to receive moisture from rain or dew (Morris, 1931). Two of the interviewees recounted the process they have used and coincided with what was described by archaeologist Earl H. Morris. Both mention that it is "rotten". One of the interviewees described the construction of the lime kiln as a square shape, very similar to type four mentioned by Thoma Schreiner (2001). Another interviewee described the lime tree as a round shape, as shown by Morris (1931). Mayan lime kilns, square or round have the main characteristic of using green firewood or logs with a high humidity level. This makes it have great thermal insulation and in this way, the calcination is slower and more controlled.

3.3.3. Preparation of the mixture

How the mortar is prepared varies within the literature on how they assume it was prepared in pre-Hispanic times, among restorers and how it is currently used in contemporary constructions. Most sources based on restoration and archeology refer to what was described by Morris (1931). Who mentioned that the mix consisted of 3 parts sascab to 1 part lime. After that, several studies were carried out varying the moments in which the vegetable additive was added (Magaloni, 1996; Jáidar, 2006; García and Jáidar, 2013;

Santini, 2005; Lorenzo, 2019). The components in the traditional mortars have been replaced. In the information obtained by the interviewees, the use of white cement has spread throughout the builders taking it as the original mixture. All interviewees agree that the amount of extract depends on the final finish desired by the customer and the manageability of the mixture to be applied. They look for a texture that they describe as “like cake mix”. About the surveys, it was obtained that of the people who know how to apply mortar, 25% have used products already industrialized or that sell preparations. However, as stated in previous paragraphs, they prefer the technique they know as “traditional”. The main properties found through interviews and surveys were aesthetic, economical, durability, protection, fungicides and impermeability. In the survey it was asked what qualities the extract provided to the mortar, the most frequent response was for aesthetic issues derived from the color and smooth texture.

One of the results obtained by Jáidar (2006) in his study was that chucum increased the physicochemical properties of the mixtures with which he experimented. The bulk density was improved and its permeability to water vapor, porosity and absorption by capillarity decreased. On the part of Magaloni (1996), the properties she found were that it helps to avoid cracking of the mortar at the time of drying since they retain moisture (hygroscopic) and delay and improve the setting, giving it waterproof or water-resistant properties. (Magaloni, 1996, p. 53). As mentioned in the introduction the use of mortar has been modified over time changing the purpose for which it is applied. Initially, the use of chucum extract was required to provide strength and manageability properties to mortars. Also as mentioned in the properties described by the restorers and archaeologists were used for the protection of buildings against extreme agents due to the climate of the region. With colonization, the purpose of the use of these mortars did not change and was used in pools and drinkers of cattle, as well as in exterior coatings. Finally, mortars are currently used for restoration, but mainly for finishes in swimming pools but their use has already covered any surface that requires a coating either interior or exterior, and is or is not in contact with moisture or water.

4. Conclusions

Based on the results, the intersection of the three aspects of the productive practices of the indigenous peoples is appreciated. It was demonstrated through the analysis of the variables and their evaluation from the k-c-p complex, that traditional mortars with *chucum* have sufficient aspects that make it possible to consider them as a biocultural heritage. It emphasizes the great role played by restorers and archaeologists in the documentary conservation of the process of making mortars but that without the presence of memory and the conservation of learning scenarios by the original peoples they would not have been able to achieve the task. Therefore, addressing issues of cultural heritage is necessary from a holistic perspective and with the active presence of indigenous peoples, through the dialogue of knowledge. Despite the gradual abandonment of the technique, it would be important to consider its reappropriation by the Mayan community, since it could provide a solution to problems of habitability within their homes that, unlike the solutions implemented by the government, will adapt in a better way and ancient wisdom would be rescued. It is possible to consider that the wisdom of indigenous peoples that has a sense of conservation and respect for nature rooted can provide solutions to prevent practices from dragging these environmental problems. It is necessary to dialogue knowledge between teachers from Mayan communities and industry, and in this way share knowledge related to sustainable management methods of the species, such as harvest seasons and extraction techniques. This process may broaden the interest in rethinking the study carried out by the Center for Scientific Research of Yucatan to define if it is a species that does not run the risk of extinction considering the market and the current demand for the extract. It is hoped that the present study will contribute to the enhancement of traditional forms of linkage between societies and their environment, as a measure to mitigate ecological damage that is becoming increasingly critical, as well as socio-cultural damage resulting from the loss of cultural diversity.

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Dry Stone Wall Relics as a Part of Cultural Landscapes: A Case Study from the Foot of Mt. Hira Region in Japan

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
Shishigaki (wild boar defense walls), as a part of cultural landscapes in Japan, currently faces serious deterioration. The research aims to identify the characteristics of Shishigaki walls in eight villages located at the foot of Mt. Hira and propose conservation strategies. Interpretation of historical documents and cadastral maps, interviews, and measurement surveys were conducted. As a result, about 4,3 km of Shishigaki relics are confirmed, of a total length up to12,7 km built in the 18th to 19th century. Shishigaki walls were built by local households collaboratively with different drystone masonry techniques. Based on the field surveys, it was found that although up to 91% of Shishigaki walls located within the village territories were demolished, only half of Shishigaki walls in the forest were deconstructed. Loss of functionality as protection fences with the change of land use is considered as the main reason for the demolition of Shishigaki walls. It is suggested that Shishigaki relics in the forest could be integrated into existing hiking routes and promoted through collaborative map-making with local residents. The authors contest that heritage interpretation rooted in local historical studies and conservation with community involvement could be adopted in the promotion of cultural landscapes worldwide.

Keywords: *Shishigaki; dry stone walls; cultural landscape; conservation.*

1. Introduction

1.1. Stone Use and Cultural Landscapes

Stone culture in the West is well known, but in Japan, stones have been used in various forms as well, such as castle architecture and gardens. They have formed the local culture, and become a part of the cultural landscape.

Cultural landscapes, an interface between nature and culture, are derived from a social-ecological process that has co-evolved throughout history (Sarmiento-Mateos et al., 2019). The social-ecological resilience of cultural landscapes depends largely on the transmission of traditional ecological knowledge (Berkes et al., 2011). Therefore, the conservation of cultural landscapes must be considered in terms of both natural and cultural aspects (Gavin et al., 2015).

In total, seven categories are identified under cultural landscapes in Japan: rice paddy landscape, farmland landscape, grassland landscape, forest landscape, seacoast landscape, river landscape, and landscape associated with settlements (Agency for Cultural Affairs, Japan, 2003).

However, rapid deterioration of cultural landscapes has been observed under threat from agricultural intensification, rural depopulation, urban sprawl, and overexploitation (Nakamura, 2016; Schmitz et al., 2021). Instead of the traditional approach, which is largely based on the strict protection of natural areas, conservation of cultural landscapes requires emphasis on human history, cultural and social values, admitting the importance of local people in determining the feasibility of conservation efforts (Phillips, 2002).

1.2 Shishigaki Stone Wall

Shishigaki are stone walls that were built to protect farmland against wild boar and ensured agricultural productivity. In Japanese, "Shishi" means "wild boar" and "gaki" means "walls". The origin of Shishigaki dates back to the Edo period (1603-1868), when the invasion of wild animals increased after the expansion of farmland. While Shishigaki used to be found across the Japanese countryside, they are gradually abandoned in modern society (Takahashi, 2010).

Thanks to the partial amendment of the Law for the Protection of Cultural Properties, which entered into effect in 2005, Shishigaki walls have been recognized as a part of cultural landscapes under farmland landscape as mentioned above, yet only applicable in a small number of regions (Agency for Cultural Affairs, Japan, 2003).

Though Takahashi (2010) offered a comprehensive introduction of Shishigaki walls in general, there is an absence of systematic study of Shishigaki walls in relation to their specific regional context.

1.3 Research Objective

In this research, a study of Shishigaki walls in eight villages located at the foot of Mt. Hira of the Otsu-city, Shiga Prefecture, was conducted. By studying the original Shishigaki records and current relics' distribution (length, morphology, location) and physical features (material, structure), the characteristics of Shishigaki walls in this study area were identified. In addition, by clarifying the current conditions of relics and causes of damages, the research aims to introduce feasible conservation strategies. The significance of the research is to provide a pilot study showing how the values of Shishigaki relics could be recognized in contemporary society.

1.4 Methodology

Historical documents (e.g. cadastral maps) and existing research were first studied to understand the construction time and rough distribution of Shishigaki in each village. Then field surveys were conducted from July 2018 to March 2021, to precisely confirm the locations and conditions of the Shishigaki relics on-site. Locations were tracked using GPS, and the structural details were recorded through measurement surveys. In addition, interviews with local seniors and a local stonemason were conducted to understand the local knowledge, drystone masonry techniques, and causes of damage to Shishigaki walls.

2. Outline of Study Area

This study area is located at the foot of Mt. Hira, with a land area of 71,73 km^2, spanning approximately 7,3 km from east to west and 15,9 km from north to south. In contrast to the short east-west span, a steep elevation difference could be observed up to 1.100m, owing to the particular geographical location between the Hira Mountain Range on the west side and Lake Biwa on the east. In total, there are eight districts (former villages) from south to north: Moriyama, Kido, Arakawa, Daimotsu, Minamihira, Kitahira, Minamikomatsu, and Kitakomatsu.

In the past, the stone industry flourished throughout these villages. Chert stones could be harvested in Moriyama Village and southern Kido Village, while the other villages were rich in granite stones (Fig. 1). Chert stones are relatively soft and their natural forms were appreciated by

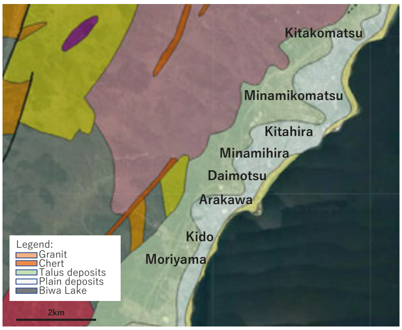
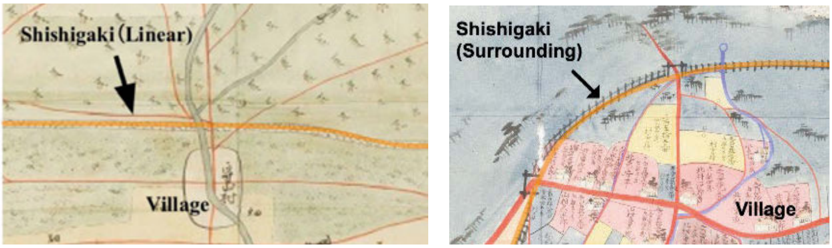


Fig. 1 Geological map of the study area



Moriyama Village Daimotsu Village

Fig. 2 Two Types of Shishigaki Morphologies in the Cadastral Maps (Otsu City Museum of History, 2017)

Fig. 3 Shishigaki relics in Kitakomatsu (left) and in Arakawa (right)

gardeners from Kyoto, with little processing required. Granite stones, on the other hand, were processed carefully for various stone structures including stone foundations, stone dikes, stone front gates of shrines, stone lanterns, and so on.

Locally, several studies have been conducted on the distribution of Shishigaki but only in limited villages in Shiga Town. Inoue (1985) analyzed the distributions of Shishigaki with cadastral maps from a geographical point of view, targeting four villages in Shiga Town. Matsuda (1997, 2000) studied Shishigaki with an analysis of village landscapes in the early Meiji era from a historical and geographic point of view. Furthermore, the Shishigaki walls in Arakawa Village were widely recognized among researchers because of their multifaceted roles as fences against both wild animals and mudflow, where maintenance is still conducted by residents (Takahashi, 2010). However, thus far, no comprehensive studies involving all eight villages in Shiga Town have been conducted and most of the Shishigaki relics have been abandoned and left unknown at risk of extinction.

3. Characteristics of Shishigaki Relics

3.1 Distribution

As a result of field surveys regarding the records of cadastral maps (Fig. 2), distributions of Shishigaki walls throughout the eight villages in the foot of Mt. Hira were identified. Shishigaki relics in two villages; Kitakomatsu and Awakara, are shown as examples in Fig. 3. Besides, details of Shishigaki relics of the study area are shown in Fig. 4 and Table 1.

(1) Lengths

As shown in Table 1, the total length of the Shishigaki walls was estimated about 12,7 km, and around 4,3 km of relics were remained. The original length of the Shishigaki in each village varied, from 633 m in Moriyama Village to 2,3 km in Kitakomatsu Village. The length of Shishigaki relics varied as well. Specifically, around 60% of Shishigaki relics (approximately 1,4 km) were remained in Kitakomatsu Village, while only 12% of Shishigaki (about 76 m) remained in Moriyama Village.

(2) Morphologies

Two types of Shishigaki morphologies were categorized by Takahashi (2010) — a "linear type," indicating a straightforward fence built in the forest to cut down the accessibility of animals to villages without referring to village boundary, and a "surrounding type," which followed the demarcation lines of villages and marked the border between forests and villages (Fig. 4).

While the Shishigaki walls in Moriyama, Minamikomatsu, and Kitakomatsu Villages belonged to the typical "linear type" and formed straightforward stone fences in the forests, the other stone walls followed the village borders. It is noteworthy that although most villages had individual stone walls isolated from each other, the Shishigaki walls in Daimotsu, Minamihira, and Kitahira Villages were connected and formed a long and continuous stone fence throughout the three villages.

(3) Locations

Based on the cadastral maps, this study identified that the Shishigaki stone walls had been constructed mainly along forestry borders, and often stretched to the shore of Lake Biwa or farmland areas in deep forests. As a result, the overall elevation of the historical Shishigaki traces ranged from about 100 m near the shore of Lake Biwa to around 230 m in the forest of the Hira Mountains. Still, the elevation interval of Shishigaki relics varied in each village. In particular, our measurement surveys showed that Shishigaki relics that remained in Kido and Kitakomatsu Villages have experienced steep elevation differences over 50 m, from 180 m to 230 m, and from 120 m to 194 m, respectively, whereas the relics in Moriyama Village remained at nearly the same elevation, around 142 m.

3.2 Physical Features

(1) Materials

Locally quarried stones were used for the construction of Shishigaki walls. Therefore, granite stones were utilized in all villages except Moriyama, where only chert stones were available, although they were not ideal as construction material according to locals. Interestingly, both types of stones were adopted in Kido Village, as it is located in an area of transition from chert stones in the south and granite stones in the north (Fig. 1).

The general stone sizes measured approximately from 15 cm to 50 cm in height, while stones at 80 cm or 1m were partially utilized in some villages. In addition, stones were found in either naturally rounded or square shapes after processing.

(2) Structures

The height of Shishigaki varied from 0,4 m to 1,9 m in general, but the average height of those in good condition was about 1,0 m to 1,5 m. In addition, many of the stone walls were constructed in a trapezoidal shape with the bottom section (about 1,0m to 2,0m) wider than the top section (about 0,8m to 1,5m). All Shishigaki walls were identified as dry-stone walls without the use of soil to prevent the growth of vegetation and reduce weathering.

Specifically, three forms of stone masonry were observed: uncoursed rubble masonry "Tani-zumi" with stones piled up at a specific angle, coursed rubble masonry "Nuno-zumi" with stones horizontally aligned with an equal height of each layer, and random rubble masonry "Ran-zumi" (Fig. 5). Thus, "Tani-zumi" can create a more stable structure than "Nuno-zumi" due to the interactive pressure of stones on each other. "Ran-zumi", on the other hand, requires least skills, and stones of different shapes are piled irregularly. As a result, "Ran-zumi" and "Nuno-zumi" masonry were the common techniques used in the villages, whereas "Tani-zumi" masonry was only utilized in Arakawa and Minamihira Villages (Table 1). The mixed stone techniques were the result of the varying skills of local households, who were obliged to participate in the collaborative construction of Shishigaki. In addition, stone pillars with a height from 1,0 m to 1,4 m, were utilized in Kitahira and Minamikomatsu Villages.

Among the villages, Shishigaki in Arakawa Village was constructed also using stone debris after it was damaged by a severe mudflow in 1945. The stone walls were then strengthened and utilized as countermeasures against further flood and mudflow attacks. Therefore, the Shishigaki relics in Arakawa village is well maintained compared to other villages and also locally well known.

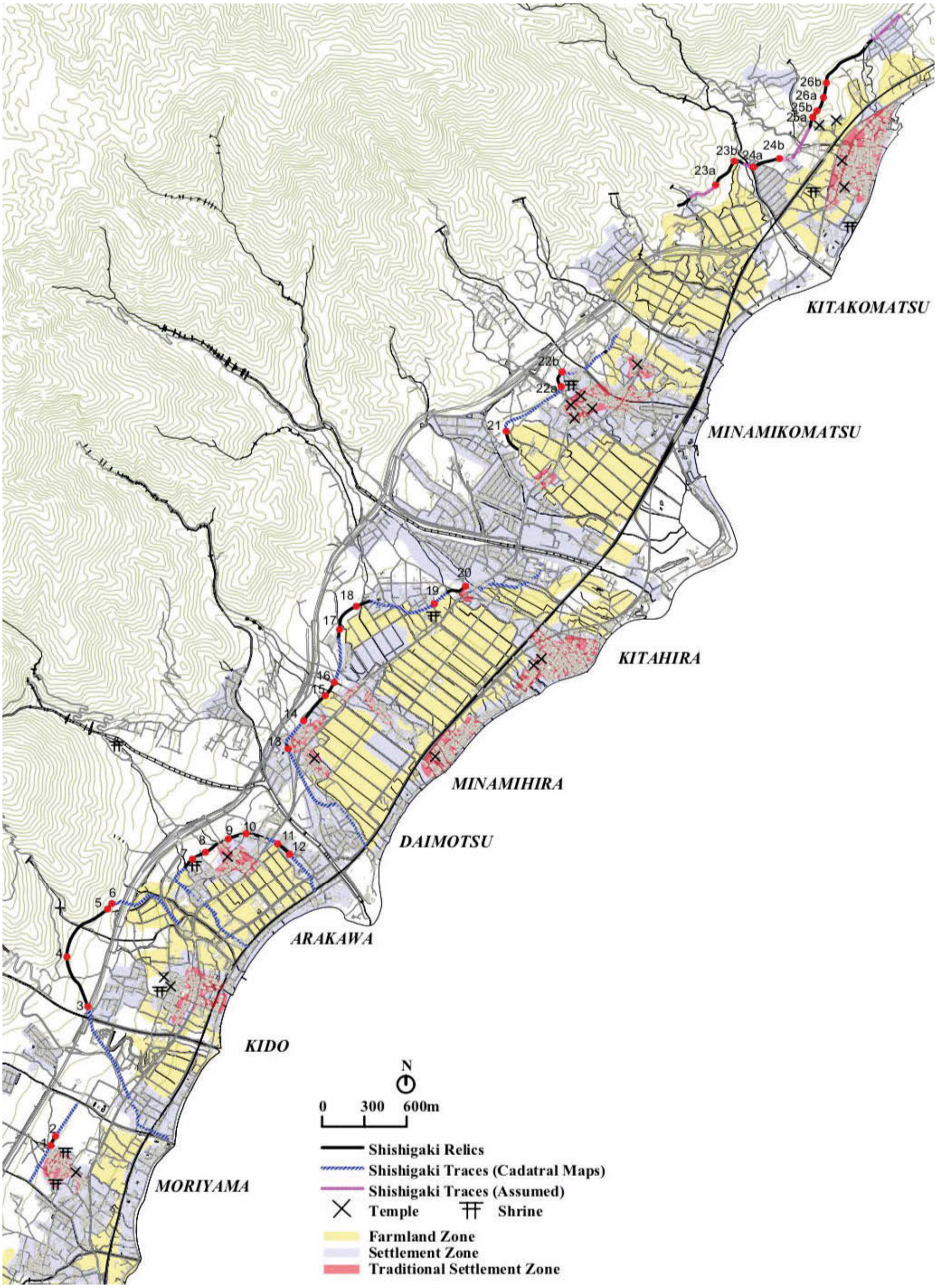


Fig. 4 Distributions of Shishigaki in Each Village

4. Current Conditions and Causes of Damages

The expansion of farmland and residential areas has led to the demolition of Shishigaki walls with newly defined borders between forests and villages. As a result, some Shishigaki traces originally along the farmland are now found within the newly formed village areas, with a percentage up to 43,4%, and most of them are demolished (90,6%) (Fig. 6). In constrast, Shishigaki walls left in the forest survive with a higher percentage up to 53,4%, correspongding to a total length around 3829 m. Thus, loss of functionality as protection fences with the change of land use is considered as the main reason for the demolition of Shishigaki walls.

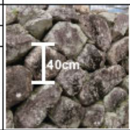
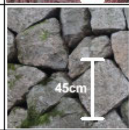
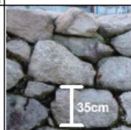
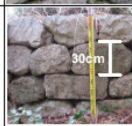
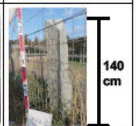
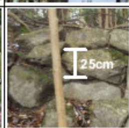
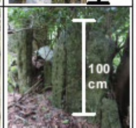
No.	Village	Length Current/ Total(m)	Elevation (m)	Height (m)	Width (Top) (m)	Width (Bot.) (m)	Conditions	Uncoursed Rubble Masonry/Tani-zumi	Coursed Rubble Masonry/Nuno-zumi	Random Rubble Masonry/Ran-zumi	Stone Pillars
1	Moriya-ma	76,0/ 633,4 (12,0%)	142,4	0,4	1,2	2,0	4. Barely Remained	-	-	-	-
2			142.8	0,5	1,2	2,0					
3	Kido	915,7/ 2708,8 (33,8%)	190,5	-	1,8	-	4. Barely Remained	-			-
4			230,5	1,1	1,1	0,6					
5			185,0	-	1,6	0,6-1,0	3. Partially Damaged				
6			182,0	1,1	0,7	-					
7	Arakawa	785,9/ 2042,6 (38,5%)	127,3	1,2-1,7	0,9-1,6		1		-		-
8			127,7	0,6	2,0	2,4	3				
9			121,5	1,9	1,2-2,0	1,7-2,0	1. Well Maintained				
10			116,9	1,2-1,3	2,3	2,3					
11			106,9	1,4	1,1	1,1					
12			99,0	1,0	0,6	0,6					
13	Daimo -tsu	221,6/ 1372,2 (16,1%)	124,3	1,2	0,5	1,3	2. Well Remained	-			-
14			124,6	1,5-2,0	-	-	3. Partially Damaged				
15	Minami -hira	536,9/ 1341,1 (40,0%)	121,8	1,4-1,5	0,7	0,7	3				-
16			124,3	0,8	0,9	0,9	2				
17			128,6	1,3	0,8	1,5	3. Partially Damaged				
18			122,2	0,5	1,2	1,2					
19	Kitahira	138,0/ 958,5 (14,4%)	113,6	-	-	-	4. Barely Remained	-			
20			114,3	1,0	0,9	1,0	2. Well Remained				
21	Minami-komatsu	305,0/ 1330,1 (22,9%)	111,6	-	-	-	4. Barely Remained	-			
22a			116,1	1,4-1,7	0,8	1,2	3. Partially Damaged				
22b			125,8								
23a	Kita-komatsu	1367,8/ 2291,8 (59,7%)	194	0,9-1,6	0,7-1,1	1,0-1,2	2	-	-		-
23b			155								
24a			130,5	0,5-1,4	0,7-0,9	0,7-0,9	3				
24b			120,9								
25a			128,3	1,0	-	-	2. Well Remained				
25b			163,3								
26a			157,4	1,6-1,8	1,4	-					
26b			157,1								

Table 1. Current Conditions of Shishigaki Walls in Each Village

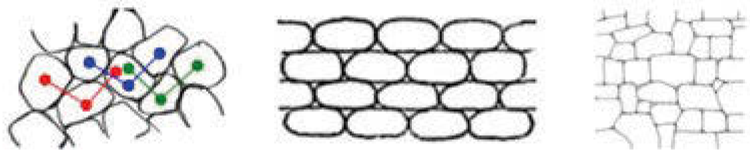


Fig. 5 Three Forms of Stone Masonry: (from left to right) Tani-zumi, Nuno-zumi, and Ran-zumi

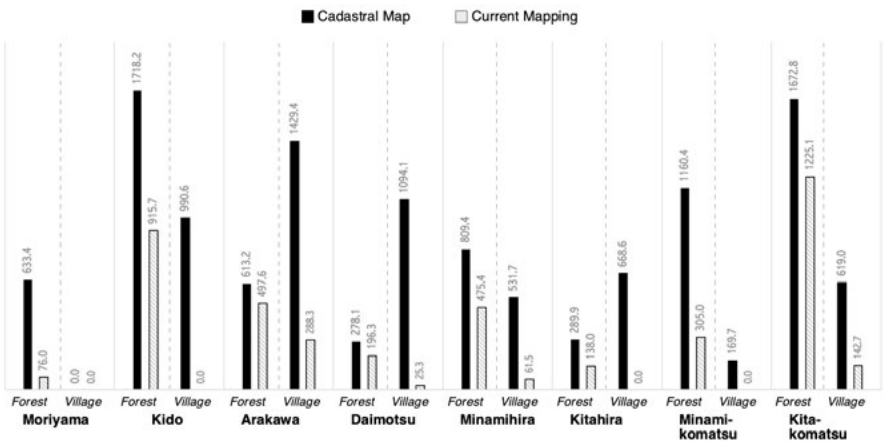


Fig. 6 Original and Current Length of Shishigaki Walls in Each Village (unit: m)

Specifically, stone walls in the forest are mainly found in Kido Village (915,7 m) and Kitakomatsu Village (1225,1 m), where large areas of farmland were once expanded into the forests. Thanks to the drystone technique, Shishigaki relics remain recognizable even under severe weathering, leaving a special scenery. However, in Moriyama village, even located in the forests, only 12% of Shishigaki walls remain (76,0 m), much lower compared to other villages. According to the interviews with locals, it probably resulted from the post-war poverty, during which Moriyama chert stones, appreciated as valuable stones in traditional Japanese gardens, were sold by villagers to the market.

Therefore, the current conditions and the cause of damage are very much related to the land-use change but also the economic activities of locals, which need to be recognized as a part of local history.

5. Conservation Strategies

Rural villages in Japan are facing issues such as aging society, depopulation, and rapid land development. It is necessary to consider feasible ways to maintain and utilize Shishigaki relics by developing dialogues with local communities, as values are made visible in learning from each other and sharing “the story of the landscape” (Lisitzin & Stovel, 2002). Shishigaki walls have been promoted with varied methods in different regions of Japan. In the case of our study area, the strategies are proposed based on the geographical context.

Eco-tourism is considered a sustainable approach to preserve Shishigaki relics left in the forest, considering the reputation of Mt. Hira as a popular hiking spot. Currently, a non-profit organization established by the local residents is working on map production, showing walking, cycling as well as hiking routes for visitors, with special notes on existing stone monuments. It aims to promote visitors to travel around and experience the rich natural and cultural attributes of the area. Therefore, traces of Shishigaki relics are suggested to be integrated into the maps and mutual communication between researchers and residents can be achieved through the process of collaborative map-making. Visits to Shishigaki relics could add extra enjoyment for mountaineers and visitors, that not only enhance the recognition of Shishigaki walls as part of the cultural landscape, but also enrich the identities of Mt. Hira among the public and possibly create additional economic income for locals.

In particular, Shishigaki relics in Kitakomatsu Village are found right along installed hiking trails. Thus, we contest that coordination with the maintenance of existing trails could contribute to reducing the burden of maintenance of Shishigaki walls.

6. Conclusion

With locally harvested chert and granite stones, or even disaster debris, villagers at the foot of Mt. Hira have collaboratively constructed Shishigaki drystone walls with a total length up to 12,7 km, stretching from the shore of Lake Biwa to the deep forest. Varied stone techniques were adopted, including uncoursed/coursed rubble masonry and random rubble masonry.

Currently, only about 4,3 km of stone relics remain, mostly in the forest. The main reason for the demolition of Shishigaki walls is identified as the expansion of village territory and land development. Still, seeing the popularity of Mt. Hira as a hiking spot, it is proposed that Shishigaki relics left in the forest could be integrated into existing walking, cycling, and hiking routes, through collaborative map-making with local residents.

6.1 Research Limitations

From village to village, different customs, livelihoods, and cultural traditions can be observed. Thus, research limitations mainly lie in the lack of detailed studies of Shishigaki walls in the context of each village individually and specific conservation strategies responding to their cultural identities.

6.2 Future Prospective

There is an emerging view of emphasizing the importance of all landscapes to their inhabitant as described in the European Landscape Convention, which encourages efforts to define heritage value presented in all landscapes and ensure their protection in development (Lisitzin & Stovel, 2002). Therefore, methods that are proposed by this research, namely heritage interpretation based on historical studies and conservation with community involvement, could be adopted in studies of cultural landscapes worldwide.

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The paving of ancient paths, testimony of an ancient culture: recovery of a traditional route in Genoa (Liguria, Italy)

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
One of the characteristic features of villages and towns is the paths that run through them. These often bear the traces of an ancient culture, which is manifested both in the materials used and in the construction and maintenance practices implemented in different territories. Rediscovering these traces is essential to understanding and safeguarding this significant component of the material history, which is often distorted or obliterated during urban interventions, owing to lack of knowledge. This paper presents a project for the enhancement and recovery of one of the traditional routes that run through Genoa from the coast to the mountains. These so-called "crêuze" are frequently made up of a central strip of bricks flanked by cobble-stones. In rainy weather, these bricks facilitate the passage of people, while proper drainage is ensured by the cambered profile and the cobble-stone side channels, which slow down the flow of water. To maximise the durability of these paths, both the construction techniques and the wise choice of materials and their processing were fundamental. Thus, this research also aims to ascertain the durability of the different materials used through their compositional and physical analysis. Awareness of the material culture that enabled such a high level of expertise to be achieved in the construction of these particular paths constitutes a valuable resource for correct interventions. The project involves private and public partners and also provides an opportunity to protect the territory through the proper management of water. In the past, water management was well organized. However, the various urban stratifications have given rise to evident problems.

Keywords: *paving, crêuze, brick, cobble-stones, material culture.*

1. Introduction

The image of villages and towns is characterized not only by their architecture, but also by their paved footpaths. These have long been neglected, as they are often regarded as being of little relevance to the local building culture. In reality, however, they constitute an important element in the perception of the architectural quality of the urban landscape, as was recognised by the European Landscape Convention, signed in Florence on October 20, 2000. Streets and paths bear the traces of an ancient culture, which is manifested by the materials used and the practices of construction and maintenance, which are different in each territory (Fig.1 and Fig. 2) (Musso, 1999; Bosia et al., 2006; Conforti et al., 2006; Decri & Volpato, 2006; Fatta et al., 2006; Gabbaria Mistrangelo, 2006; Galli et al., 2006; Laviscio, 2006; Mannoni et al., 2006). Unfortunately, this significant component of our material culture is often distorted or obliterated during urban interventions, owing to lack of knowledge, high maintenance costs and the needs of vehicular traffic (Ambrogio et al., 2006; Branduini, 2006; Cazzani & Sangiorgio, 2006; Giambruno & Simonelli, 2006)

Fig. 1. Traditional sandstone paving in the village of Stiappa (Pistoia Apennines-Tuscany) (credits Fabio Fratini).

Fig. 2. Traditional paving made of Pietra Panchina in Volterra (Tuscany) (Source: Fabio Fratini).

This paper deals with a project for the study, enhancement and recovery of one of the traditional paths that run through Genoa and its territory, from the coast to the mountains. These so-called "*crêuze*" are made up of cobble-stones and a central or lateral strip of bricks laid by side (Fig. 3). The brick strip (called *pagliolo*), which is about one meter wide, facilitates the passage of people in rainy weather, while the cobble-stones made it safe for pack animals to walk. Drainage is facilitated by the cambered surface, while the cobble-stone side channels slow down the flow of water (Fig. 4).

Fig.3. Genoa, *crêuza* with lateral cobble-stones and central brick strip (Source: Fratini)

The water flows into appropriately positioned sandstone storm drains; these have rectangular apertures (from three to five) or are made up of several elements called “cords” (from two to six) (Fig. 5).

Fig. 4. Cambered profile of the central brick strip and lateral cobble-stone channel (Source: Fratini).

Fig.5. Sandstone storm drain (Source: Fabio Fratini).

To maximise the durability of these paths, the wise choice of materials and their processing, in addition to the construction techniques used, were fundamental. For example, the ancient bricks have proved to be much more resistant than more recent bricks, which sometimes favour the formation of a biological patina and often display little resistance to freeze-thaw phenomena. Through the analysis of materials, this research also aims to determine the reasons for this different behaviour. Indeed, knowing how past builders were able to construct impressive works so skilfully can constitute a valuable resource for correct intervention. This project involves various partners, such as local associations, universities, municipalities etc. It also provides an opportunity to address the protection of the territory through the correct management of water. Indeed, in the past, water management was better organized than in later periods of urbanisation, which has given rise to evident problems.

2. The project "*Ultima crêuza*" (the last *crêuza*)

The project "*Ultima creuza*" was launched in 2015 by the Faculty of Architecture of the University of Genoa, the municipality of Genoa, the ISCUM (Institute of History of Material Culture) and some associations active in the territory, the aim being to promote and preserve a particular historical path in Genoa. Interest in this path was aroused by an epigraph in the square in front of the Convent of Santa Barnaba, which recounts the fate of the inmates who were locked up in the Prisons of the Doge's Palace. Having been sentenced to death, these prisoners were led along the *crêuze* up to the Convent of the Capuchin Friars, where they underwent "last rites" before being taken for execution to the Castellaccio Fort, on the heights of Genoa. Apart from this dramatic implication, the path provides a panorama over the city and encounters various sites of historical interest. Indeed, the intention was to raise awareness of the city and its history, not only in the area of the city's historical centre, but also outside the medieval walls, on the hills and towards the hinterland.

2.1 Objectives of the first part of the project

This project has several objectives. The first part of the project aims to: a) reveal the scenic beauty of this part of Genoa; b) observe the historical stratification of the city from the Middle Ages to its 19th century expansion and subsequent development in the 1960s; c) promote "mobile", "ecological" and "low-cost" tourism. Moreover, from the upper stretch of the path, it will be possible to observe endemic species of fauna and flora. Indeed, the idea is to promote an active type of tourism. Moreover, given that the path will be exclusively pedestrian and that transport to the starting point situated in the upper part will be by a public electric bus, this will be ecological tourism. The sustainability of the proposal is also considered important by minimizing the affixing of indications and panels but at the same time seeking effective communication.

2.1.1 Elements of intervention in part 1 of the project

Although the path is largely practicable and well defined, the following interventions will be necessary: a) signs will be affixed (involvement of urban design experts) in order to strengthen the user's perception of the entire path; b) along the way, the landscape, environmental and historical-artistic beauties will be explained. This information may be of a traditional type (signs) and innovative ("QR codes" applied at strategic points). In this part of the project, it is essential to involve the following partners: local associations, local administrations, designers and IT experts in communication.

2.2 Objectives of part 2 of the project

The second part of the project has the following objectives: a) to recognize the aspects of the material culture that allowed the creation of the *crêuze* (installation of paving, specific work on surfaces) and in the subsoil (canalizations.); b) according to the data obtained in the previous point, to draw up guidelines for conservation/recovery interventions; c) to restore the correct flow and drainage of water at the sides of the path. This second part of the project must also identify the areas of intervention by carefully designing the construction sites and, if necessary, implementing "micro-construction sites". This second part of the project will involve local associations, ISCUM (Institute of the History of Material Culture), the University of Genoa, SSBAP (School of Specialization in Architectural and Landscape Heritage) of the University of Genoa, and Geomorfolab, ISCP-CNR (Institute of Heritage Sciences) of Florence. The objectives of this second part of the project are to highlight problems and propose solutions that can also be replicated in the other paths (*crêuze*) in the city.

2.3 Problems and opportunities of the project

"*Ultima Crêuza*" also offers an opportunity to address a much wider context that concerns the monitoring and protection of the territory by implementing correct water management, which takes into account the conformation of the land. This aspect was clearly borne in mind by those who constructed the ancient paths, but in the urban stratifications that have ensued in the last two centuries, problems have arisen. Indeed,
the inadequate regulation of water has been implicated in the environmental disasters of recent years (in the catchment area where the *crêuza* is located there have been six cases of major hydrogeological instability in the last 15 years). Specifically, it will be necessary to distinguish: a) the upper portion of the path (from Castellaccio Fort to the district of Santa Barnaba) from b) the lower portion, from the district of Santa Barnaba to *Porto Antico.* Indeed, the problems are different: a) in the upper part, disruptions have been caused by abandonment, the growth of weed vegetation, and localized collapses of the side walls due to the activities of wild boar; b) in the lower part, the progressive expansion of the city has intercepted and channelled streams, interrupted historical communication routes without controlling surface waters, and created retaining walls of considerable height without adequate water regulation. Many smaller interventions have also been carried out, partly to install utility systems (telecommunication cables, gas pipelines, water conduits, etc.) and partly in unsuccessful attempts to repair disconnected parts of the paving (Fig. 6). All too often, these interventions change the slopes of the path, impairing the correct flow of surface water.

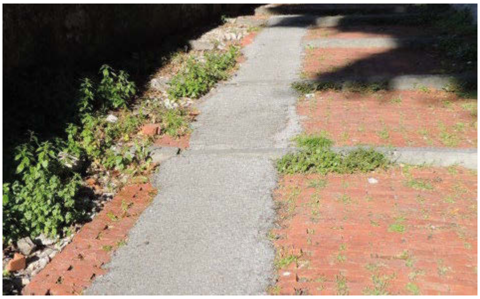

Fig.6 The installation of water systems has damaged the paving (Source: Fratini).

In some sections of the path, it is therefore necessary to carefully redesign the water disposal system; in most sections, however, the most pressing need is to implement constant maintenance. If performed constantly, this maintenance can even be carried out by volunteers working under the guidance of only a few specific instructions (e.g. constant cleaning of drainage channels, repositioning of unstable elements) (Mannoni, 2006). This type of maintenance could be carried out by the inhabitants of the buildings adjacent to the lower portion of the *crêuza.*

3. An opportunity to know, a chance to preserve

Beyond the specific case, the importance of this study is that it will highlight the most common problems facing paths of this type: i.e., the relationships between the materials used, the know-how required for their installation, the wise insertion of these paths in the territory, the correct disposal of water and the need for constant observation and maintenance. Elements of innovation of the project "***Ultima Crêuza***" are therefore: a) involvement of the population; b) continuous monitoring at low cost; c) small-scale action, restoration workshops; d) interaction with the users of the path; e) knowledge and monitoring for preventive maintenance.

3.1 The bricks of the *crêuze*

As mentioned above, one of the particular aspects of the *crêuze* is the bricks, which are most frequently placed in the centre of the path. In the past, the bricks used for such purposes were often called "paving bricks" and had specific prices (Pittaluga, 2001); very detailed descriptions can be found in the manuals (Maura, 1998). In the documents, specific categories of bricks have different denominations, each with a different price (Pittaluga, 2001). This suggests that many aspects of the ancient construction skills still elude us today. In the previous interventions that these paths have undergone, the bricks have sometimes been replaced, with unsatisfactory results in terms of aesthetics, functionality and durability. With regard to aesthetics, new bricks, which sometimes have an extremely smooth surface, tend to look out of place. With regard to functionality, when it rains or humidity is high, new smooth and fine-grained bricks tend to maintain a liquid film on the surface; over time, this favours the growth of a slippery biological patina (Fig. 7).

Fig.7. New, smooth bricks on which a thin biological patina is forming (Source: Fratini).

Sample	technology	Grain size	P%	γs gr/cm³	decay	Age* century	laying
C1 - Salita di S.Barnaba	new, extruded	fine	23	1.95	flaking	20th	correct slopes
C2- Salita di S. Barnaba	new, extruded	fine	30	1.83	biological patina	20th.	correct slopes
C3 - Salita di Porta Chiappe superiore	old, handmade,	coarse	25	1.93	unweathered	19th	correct slopes.
C4 - Salita di Porta Chiappe superiore	new, extruded	fine	20	2.01	unweathered:	20th	correct slopes
C5- salita di Porta Chiappe superiore	new, extruded	fine	21	2.00	unweathered	20th	incorrect slopes
C6 - salita di Porta Chiappe superiore	new, extruded	fine	31	1.84	biological patina	20th	incorrect slopes
C7- salita diPporta Chiappe superiore	new, extruded	fine	26	1.90	unweathered.	20th	correct slopes
C8 - salita di Porta Chiappe inferiore	old, handmade	coarse	14	2.18	slight decohesion	19th	correct slopes
C9 - Salita di Porta Chiappe inferiore	old, handmade, variegated	coarse	32	1.62	slight decohesion	17th	correct slopes
C10- Salita di Porta Chiappe inferiore	old, handmade, variegated	coarse	42	1,42	unweathered	17th	correct slopes
C11-Salita di Porta Chiappe inferiore	old, handmade	medium	20	1.92	unweathered	19th	correct slopes
C12- salita di Porta Chiappe inferiore	new, extruded, sand on surface	fine	32	1.73	biological patina	20th	correct slopes
C13 - salita di Porta Chiappe inferiore	old, handmade, variegated,	fine	27	1.72	unweathered	18-19th	correct slopes
C14 -salita di Porta Chiappe inferiore	new, handmade	medium	28	1.76	biological patina	20th	correct slopes

Table 1. Analysis of the samples according to technology, grain size, water accessible porosity (P%), bulk volume (γs), decay, mensiochronology dating (*) and laying.

Taking into account these considerations on the importance of the materials, their finish and installation, an on-site check was conducted; this is briefly explained below (Table. 1). For each stretch of *crêuza* involved in the study, stratigraphic investigations were made in order to identify the different parts in their correct chronological sequence (Pittaluga, 2009a). In some cases, it was also possible to obtain information from indirect sources. Regarding the brick layer, mensiochronological analysis of the elements was also carried out (Pittaluga, 2009b). Macroscopic observations of the type of mix (colour, grain) and presence/absence of other surface features (incisions, scratches) were made. All this information was then related to the specific characteristics, such as porosity, of the material. These data were analysed with reference to macroscopic decay (chipping, cracks, disintegration, biological patinas, etc.). In order to obtain as many interpretative elements as possible, observations were also made on the laying of the paving (correct slope, cambered profile, good regulation and channelling of surface waters) and any "anti-slip" measures implemented. In selecting the pavement sections to be analysed, the environmental conditions (high humidity, low insolation) were also considered. Indeed, the purpose was to verify the durability of the materials in particularly extreme conditions. With regard to durability, new bricks sometimes have a greater tendency to splinter than old bricks, which, in some cases, tend to disintegrate (Fig. 8 and Fig. 9). Splintering is the consequence of the action of freeze/thaw cycles and particularly affects materials with a high number of capillary pores (0.1-1µm) in comparison with larger pores.

Fig.8. New bricks display chipping due to freeze-thaw phenomena (Source: Fratini).

Fig.9. Old bricks with a rough appearance, with a slight tendency to disintegrate (Source: Fratini).

Thus, in this study, ancient bricks and bricks laid during various interventions carried out on the *crêuza* were sampled, in order to highlight the features of their composition that influence their behaviour. These materials were studied by means of the following methods: a) the mineralogical composition was determined through X-ray diffraction (X'Pert PRO diffractometer from PANalytical, equipped with an X'Celerator detector and HighScore software for the acquisition and interpretation of data according to the operative conditions: Cu $K\alpha 1$= 1,545 Å radiation, 40 KV, 30 mA, 2Θ = 3-70°); b) determination of water-accessible porosity and bulk volume through the hydrostatic balance method; c) a petrographical study on thin sections, by means of optical microscopy under transmitted light to evaluate microstructural parameters, will be carried out in a further phase of the research.

With regard to the old bricks, all of which were hand-made, different types were observed: coarse-grained dark red with low porosity (14-20%) (C3, C8); coarse-grained, varicoloured with relatively high porosity (27-32%) (C9, C13); medium-grained, varicoloured with very high porosity (42%) (C10). This high porosity of the varicoloured bricks can be explained by the composition of the "clay" used to produce them. Indeed, it is a marly clay (with a high calcite content), as evidenced by the presence, in the fired material, of calcium silicates (gehlenite and diopside), as revealed by the diffractometric analysis. These minerals are formed above 800 °C, by reaction between the silica of the clay minerals and the calcium oxide resulting from the dissociation of calcite. The dissociation of calcite occurs by loss of CO_2, with the formation of porosity (Fratini et al., 1993).

With regard to the new bricks, most of them are extruded (Table 1). Some are fine-grained with a smooth surface and medium porosity (20 to 26%) (C1, C3, C4, C5, C6, C7), some are fine-grained with sand on the surface (porosity of 30-35%) (C12), and some are medium-grained (porosity of 28-30%) (C2, C14). This first study on the bricks of this Genoese *crêuza* reveals the great variety present. Certainly, it is the ancient bricks, from the dark coarse-grained ones to the varicoloured ones, that arouse the greatest interest, as they really represent the territory. The petrographic study will also allow us to trace the origins of both types of brick, which differ markedly, just as the geology of the Genoese territory is extremely diverse. With regard to the replacement bricks used in recent interventions, we believe that the ones that yield the best results from the aesthetic, functional and durability points of view, are handmade bricks, which unfortunately are more expensive. Otherwise, bricks extruded with sand on the surface are also acceptable.

4. Conclusions

> Indeed, it is not too difficult to lay the sub-base by using only sand and gravel, without installing an electro-welded mesh to seal the support; nor is it difficult to obtain the bricks and stones. By contrast, it is no easy matter to acquire the optimum technique of juxtaposition of the various components, which must create such a force of cohesion that they cannot move (Mannoni et al., 2006, p. 252).

As seen in this research, traditional skills underpinned the choice of the most suitable bricks for the central strip, and of the particular laying technique to be adopted: cobbled, paved, bricks laid side-by-side etc. In the pre-industrial era, both urban paving and that of territorial roads required interventions over time. This was:

> not strictly maintenance which harmoniously updated the image of the city and territory as building techniques evolved. It was a dynamic of ordinary use and consumption that determined sedimentation processes of the various construction technologies connected to the progress of urban, architectural and economic evolution, and which, at the same time, guaranteed their current readability (Mannoni, 1994).

It is therefore increasingly necessary to recover this culture of construction. With respect to the problems of decay of historical itineraries, such as the ancient Genoese *crêuze*, two lines of action can be followed: 1) one that makes greater use of collaboration and participation (by associations, individual citizens, users of the itinerary) (Pittaluga, Fratini, 2019). This line of action is based more on the timely reporting of any decay phenomena, on the establishment of restoration teaching sites and on the preparation of guidelines that allow small, targeted and timely repairs to be carried out autonomously; 2) scientific investigations of the performance of the different materials, and their potential and compatibility according to their composition and structure, in order to carry out interventions of maintenance and restoration that do not upset the delicate balance of these extraordinary road constructions. The present study may be seen as a first contribution to this long journey of discovery.

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Constructive and earthquake-resistant aspects of modelled-earth, a technique in ancient Peru

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Topic: T1.3. Studies of traditional techniques and materials

Abstract
Modelled earth was a pre-Inca construction technique used extensively in ancient Peru. It comprised placing portions of mud in horizontal rows to build walls and large buildings. It comprised placing portions of mud in horizontal rows to build walls and large buildings without the aid of molds, unlike the rammed earth of European origin. Unfortunately, there is a lack of written, graphic or oral evidence that would help to better understand how pre-Columbian walls were made. Therefore, the research was based on the study of the buildings to plan hypotheses about the construction procedure and their structural performance, given that the area where they were built is highly seismic. The research showed that the ancient Peruvians used seismic-resistance strategies in their buildings comprising the use of segmentation of the earth structures, with the criterion of keeping the blocks joined to each other using support planes to form the final architectural volume. The article suggests that seismic energy was dissipated through these joints, and it got a greater deformation capacity without the total collapse of the structure.

Keywords: *Seismic behavior; pre-Columbian constructions; structure; traditional buildings.*

1. Introduction

Modelled earth was a building tradition used in ancient Peru that comprised placing superimposed layers of mortar in a damp state, without using compaction or molds. In Peruvian archaeological sites, it is possible to see the layers or courses that show how the mortar was laid. In pre-Inca times, this technique was used to build walls and massive structures. On the Peruvian coast, and especially in the city of Lima, there are examples of the use of this construction technique. Modelled earth was not used after the Spanish Conquest and was replaced by rammed earth, a European technique, since then, the modelled earth was forgotten.

1.1. Historical and geographical context

The constructions studied are on the southern coast of the central Andes in present-day Peru. Architectural evidence was restricted to the altitudinal level known in Peru as costa or Chala (Pulgar Vidal, 2014), which in cauqui, a language originating in Peru, means a sparsely inhabited place with sandy soil. The coastal zone of South America registers intense seismic activity, because of the phenomenon of subduction between the Nazca Plate and the continental plate of South America.

As for the temporal development of this construction technique, using the classification of the archaeologist John Rowe (Ramón Joffré, 1994), in the period from 800 A.D. to the 15th century, it should be noted that this classification takes the ceramic styles as an indicator and not architecture. As for the civilizations that used this construction procedure, we can mention the Yschma and other coastal lordships, such as the Collique. They also used it in Inca times, although with changes.

Fig. 1. A segmented wall, built by modelled earth in Tambo Inga archaeological site - Lima (Source: Torres, 2021).

2. Methodology

It was necessary to compile information on the archaeological sites. The search began with bibliographic sources, scientific articles, publications in magazines, books, images from archives, etc. Precious were the books of European travelers of the 19th century who, with a particular vision, described in great detail the pre-Hispanic architecture in the surroundings of the city of Lima. The publications on Peruvian architecture during the 20th century, whose descriptions were useful for this work, were invaluable.

Visits to the archaeological sites were part of this research, which included measurements, observations, photographic recordings, diagrams, drawings, etc. The state of conservation and deterioration, the processes of degradation of the earth material, were registered.

It is important to note that most of these settlements have not been excavated, but this had not restricted their evaluation for this research. The walls have several meters high, which facilitates recording.

For the visits, we had the support of various professional archaeologists who allowed to enter the sites under protection the Peruvian Ministry of Culture, such as the huacas of the Maranga complex, La Huaca Centinela, the Fortress of Campoy, or the Sanctuary of Pachacamac. In other cases, Several sites haven´t been protected by the authorities, it hope will soon be protected and conserved.

It is important to mention that many archaeological sites that would have been part of the record of this work have disappeared throughout the 19th and 20th centuries because of the urbanization process of the city. The *huacas*, how archaeological sites are called, that formed part of this research were:

- Pyramid with Ramp III in Pachacamac
- Huaca Tambo Inga
- Huaca Tres Palos
- Huaca La Palma
- Huaca Mateo Salado
- Huaca Mangomarca;
- Fortress of Campoy;
- Walls of Chuquitanta
- Palace of Oquendo
- Huaca Cerro Respiro.

3. Constructive features

The monolithic construction of the earthen walls was developed by placing portions of mud in a humid state in horizontal layers. According to the observations made at the sites visited, the texture of the mortar used in the modelled earth walls corresponds to mud in a humid plastic with light manual pressure and without the use of compacting tools for its construction. They placed it in horizontal layers of varying thickness, ranging from 10 to 20 cm in height. This technique was used to build walls and platforms, essential elements of the Andean architecture. In archaeological contexts today, it is possible to see the horizontal bands of mortar overlapping each other.

The surfaces were worked to get a smooth finish. In the enclosures, the walls were plastered by covering the joints of the mortar layers, achieving the appearance of a monolithic wall. The stacking of the mortar in courses was important to increase the compressive strength of the wall. Upper rows were placed like layers of sediment, compacting the lower tiers of mortar. This procedure did not completely prevent the wall from cracking because of shrinkage during the drying process.

Fig. 2. Mud layers in a wall, it can see the concavity formed. Palace of Oquendo – Lima (Source: Torres, 2021).

The layers show a concavity both towards the center of the wall's plane and the center of the longitudinal axis of the wall. This concavity is a sign of the weight that the upper course exerted on the lower course when the mass was fresh. It should be noted that if excessive weight was placed on the lower course, there would be a risk of cracking because of excess weight or crushing. Two or three courses of a maximum thickness of 20 cm could have avoided exceeding the stresses on the lower layers in the drying process.

Once the mortar courses of the wall had been laid, the surfaces were treated, as the fingerprints of the workers could be found on the walls. The work was probably carried out by applying a layer of very fluid mortar to fill the voids that formed on the sides of the wall. It carried this work on facing out on all the faces of the block, including the one that was to receive the adjacent block.

Fig. 3. Modelled earth blocks, with segmentations. Fortress of Campoy- Lima (Source: Torres, 2021).

3.1. The planning of construction

In the archaeological sites visited and others of which there are bibliographical references, modelled earth blocks presented common elements in their structural design, finding earth blocks that order, confine or adjust the structure.

Guide blocks

It was the trapezoidal blocks, which formed the first construction phase of the wall. From this, other blocks were added, which were attached to it, forming the large masses of the final structure.

It is so-called because it has inclined sides that "order" the other blocks that are added to it, and this block is recurrent in the constructions recorded, including others that were built with adobe masonry.

It can have different dimensions and is formed strictly with inclined sides with variable angles of inclination, maintaining a joint with the adjacent blocks that start at the base at the upper end, guaranteeing continuous contact.

This block can comprise several construction phases that finally form the trapezoidal section.

Confined blocks

These blocks are those that are built attached to the computer block in the form of inverted trapezoids, parallelograms, and other irregular shapes and are generally confined and compressed by the adjustment blocks.

Adjustment blocks

They could be defined as trapezoidal-shaped blocks of molded earth with the minor base downwards, which serve to give adjustment to the other adjacent blocks by behaving like a wedge or keystone. These were placed at certain points foreseen with a clear purpose of adjustment of this mega-masonry, according to the stratigraphic analyses carried out on several archaeological walls, they were built as the last phase of the wall in such a way that their construction was important for the stability of the structure.

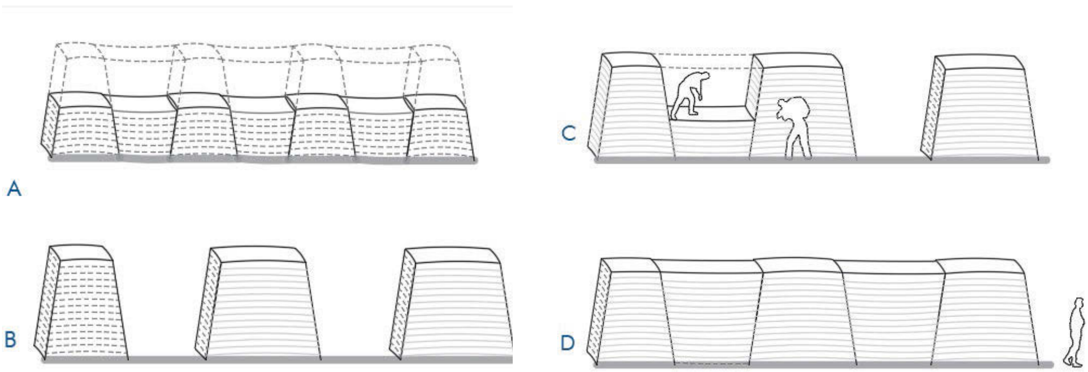

Fig. 4. A sequence of possibilities in the construction of segmental walls. A: Blocks built simultaneously. B, C, and D: Alternating construction (Source: Torres, 2021).

4. Structural hypotheses

Earth structures can only develop properly under compressive stresses and, even then, they are extremely fragile. Once cracked, because of seismic vibrations or the drying process of the mud, they lose their initial stability conditions to behave unknown.

Thinking and analyzing this phenomenon to give stability to these constructions could be the way to the design of the segmental walls. The deformation capacity of monumental earth structures once they crack is of an uncertain magnitude. A real structure does not behave as in a laboratory test with perfectly known or controlled conditions.

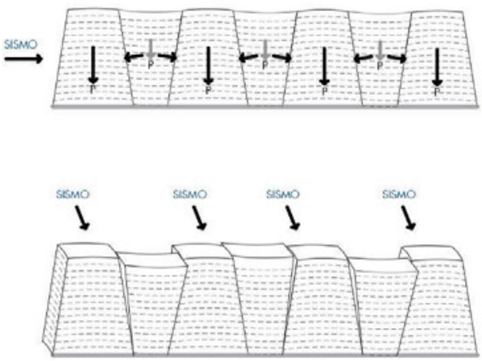

Fig. 5. Forces act on the walls when they are built-in segments (Source: Torres, 2021).

One response to the condition of stiffness and fragility of earthworks seems to have been the modulation or use of wall segments. There are examples of constructions that employed it, both with adobe and modelled earth walls.

Their appearance was mistaken for drying cracks in the mud. However, the archaeological record has made it possible to verify that they are not. Chronologically, the criterion of segmentation and modulation was used from around 200 AD. Today, the triangular-trapezoidal section blocks can still be seen, which are grouped, wedged, and adjusted by supporting each other as if they were wedges or keys to compress adjacent blocks. It carried the modulation to build massive structures (platforms) and walls (enclosures).

The present work proposes that this is an original construction system with seismic-resistant and well-planned virtues. This research has been directed towards walls made with this construction technique.

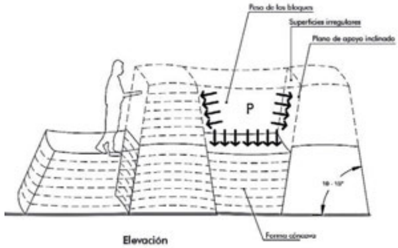

Fig. 6. Diagram of forces favoring transverse restraint in walls (Source: Torres, 2021).

It proposed that the geometric segmentation of the walls made the structure behave in such a way that it can be predictable and rational. The criterion was to establish how such a structure would behave during earthquakes, the stacking of blocks forming large walls responds to a need to convert a monolithic block of the earth of fragile into a ductile behavior. It is a criterion for solving the behavior of structures in a deterministic and simple way.

Segmentation was a procedure to provide the wall with sufficient strength to improve the response in case of earthquakes, in such a way that the contact joints between the blocks formed plastic hinges in predetermined locations to form a mechanism similar to a ductile behavior of the structure. The joints planes were formed on the sloping sides of the blocks, where it make contact. Through these joints, seismic energy was dissipated, and they got greater deformation capacity, each contact zone thus becoming an element capable of deformation.

The construction of walls divided into segments required foresight of their components. The arrangement of the construction segments with inclined sides ensures they converted lateral forces of seismic origin into compressive forces that were distributed along the length of the wall. It successively transmitted the force between blocks with compressive stresses, and as long as the blocks had the right dimensions, they could absorb these stresses and not crack.

Fig. 7. Joint between modelled earth blocks. Huaca Tres Palos – Lima (Source: Torres, 2021).

This type of structure was not physically embedded or articulated. Each joint there was the principle of a ball and socket joint, which allowed the dislocation of the structure, thanks to which it could experience some variations in profile and move without collapsing with small movements. This balance of forces shows how the bending stress because of the earthquake can be converted into compressive stress that guarantees the stability of the structure. An interesting detail is the wedge elements, the trapezoid-shaped segments with the smaller base facing downwards, which adjust the other blocks. They placed these at certain intended points with a clear purpose of adjusting the assembly. These wedges were used in massive platforms from the time of the Lima Culture and the mechanical principle is also very simple: the wedge element, because of its weight and the time factor, generates great forces perpendicular to the surfaces in contact, adjusting them similarly to the behavior of the keystone in a voussoir arch, exerting the compressive forces for the mechanical system to function. It achieved the transverse bracing of the walls in a more complex way because it linked several factors to achieve it. The horizontal earthquake restraint in the longitudinal direction of the wall, i.e. in the wall's plane, was because of the transmission of forces between blocks through the joints. In the transverse direction, i.e. for forces outside the plane of the wall, there were several factors that we can analyze.

Fig. 8. Modelled earth wall, showing the layers of mud and the segmentation that allowed the displacement of the blocks. Fortress of Campoy- Lima (Source: Torres, 2021).

5. Conclusions

Earthquakes have conditioned the development of architecture because of their recurrence and severity in a region with intense seismic activity. With a rational, deterministic, and simple way, it tried to resolve the stability of their buildings, although there is still a lot of research to be done in this respect.

An important feature to highlight is the use of "mega-masonry", which comprises the formation of a wall, with the successive placement of parts, fractions, or blocks that were made in situ and which were joined using diagonal and straight joints. It assembled the wall in an order that ensured the stability of the parts of the wall as if it were a large puzzle. The superimposition of the blocks can predict the order of placement of the blocks following a reinforcement model that takes advantage of the geometry of the parts to guarantee an adequate interlocking between the mega-masonry. This technique has been identified in Yschma walls, also built with adobe. Therefore, it is of "traditional" use. This mega-masonry owes its name to how the megaliths were used in the Inca walls, with which we suggest that there are certain similarities. The shape and proportions of these walls was conceived differently to how engineering is understood today, unlike what happens in the present where the material is chosen accord to the design of an object. It is an original, rational and natural way of finding a seismic resistance solution that the ancient Peruvians developed and which should be appreciated, studied and, perhaps, recovered as a useful lesson for today.

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Research on Technique "Banzhu" Used in Traditional Dwellings in China from the Perspective of Formwork

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Topic: T1.3. Studies of traditional techniques and materials

Abstract

In China, "Banzhu" refers to the traditional construction technique using formworks and ramming for buildings. Based on a literature review and oral testimonies of builders, this paper describes the areas where Banzhu was the dominant building technique in ancient China. This paper provides a classified study of this technique from the perspective of formworks, according to the unit arrangement and fixed approaches, in order to show the characteristics and distribution of different variations. It is found that all kinds of formworks need to comply with the basic requirements of blocking the earth, controlling the wall section, and fixing themselves, and the reasons for variations are the requirements for wall quality, height, and labor availability.

Keywords: *Banzhu; Formwork; Rammed earth; China.*

1. Introduction

"Banzhu（版筑）" is one of the traditional construction techniques widely used in ancient China. It refers to the use of formworks and ramming to form a structure with a certain strength. From the Shang Dynasty (about 1600 BC - 1046 BC), it was widely used in building walls (Du, 2005), and continues to be used today because of its simple operation and easy availability of materials.

In China, the material of Banzhu is mainly earth, and the research on it is mostly subordinate to the concept of rammed earth and earthen architecture, which makes more emphasis on materials while ignoring the most fundamental content under the definition of this technique - formwork. The natural and social conditions in various regions have given birth to different types of dwellings, resulting in different types of Banzhu techniques, and the formworks used are also different (Fig.1).

Discovering the wisdom and rationality in it is of great significance to inheriting and developing these traditional techniques. Although the technique was once used in most areas of China, this paper concentrates on areas where Banzhu was the dominant building technique in the ancient period (before AD.1840). The research method consists of oral testimonies of builders in typical

Fig. 1 The classification and distribution of Banzhu. (Own elaboration based on the map of China, bzdt.ch.mnr.gov.cn)

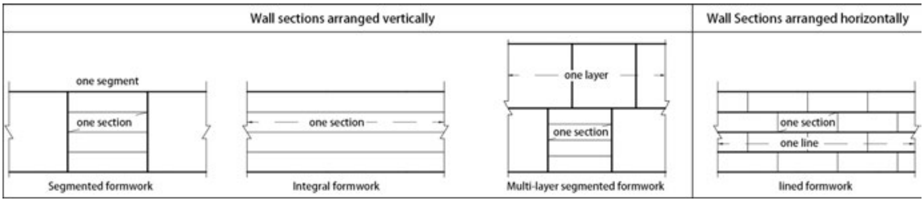

Fig.2. The classification of formworks (author)

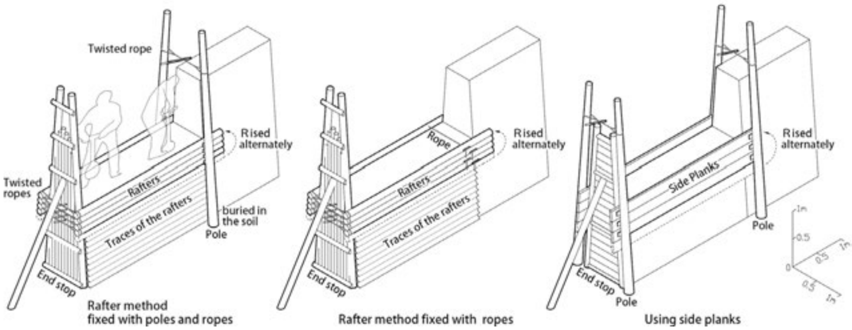

Fig.3. The segmented formworks (author)

areas to confirm the basic techniques and a literature review to make sure the variations and distribution.

The walls built by Banzhu are often divided into multiple units, which are separately rammed. One part of the wall corresponding to a side plank is called one "Ban (版)" which means one wall section and can be arranged vertically and horizontally (Fig.2).

When wall sections are arranged vertically, they can be divided into segmented formwork, integral formwork, and multi-layer segmented formwork. Segmented formwork means dividing the wall into several segments, and a segment of the wall is formed by stacking several wall sections vertically; extending one segment to the whole wall is the integral formwork; superimposing the method of segmented formwork forms the multi-layer segmented formwork. When wall sections are arranged horizontally, only have one kind of division, namely lined formwork. It means each section is spliced horizontally until completing a circle of the wall called one line. Different unit divisions affect the use of formwork, including the way of moving and fixing.

2. The segmented formworks

In the segmented formwork, wooden poles are used on both sides of the wall to fix the side planks or directly fix them with ropes, and end stops are used to control the wall cross-section and are located at the end of each segment of the wall.

In the Loess Plateau area, "rafters(椽)" — thin logs — are used instead of planks, which is called the "rafter method (椽筑法) ". When a segment is being constructed, the side rafters are fixed on both sides of the end stop using poles or ropes (Fig.3, 4).

Fig.4. Rafter method used in Shanxi (Source: Zhang, 2017)

The shape and size of the end stops are determined by the cross-section of the wall which usually is a trapezoid with a small top and a large bottom. This shape was probably inherited from the earthen city walls because of similar construction methods and distribution areas. The city walls originated from mounded earth, giving them the initial shape of a trapezoid. The shape of walls lowers the center of gravity making them more stable and allows the foot of the wall, which is the most vulnerable part, to withstand more erosion. The end stop is framed with wooden sticks and then filled with other simple materials such as thinner sticks. The rougher the trace left by the end stop, the better the connection between the two segments.

The side rafters are stacked and placed on both sides of the end stop. One rafter corresponds to one ramming layer. After the height of one side rafter is rammed, the next one is placed. From about the fourth rafter, the bottom rafters can be pulled out and placed on the top, and the rafters can be raised alternately up to the desired height. The unmoved rafters protect the newly rammed earth wall. The end of rafters near the end stop is tightened with ropes. The end near the built earth wall can be fixed with a pair of poles or ropes. Using poles, the upper end is tightened with a twisted rope, and the lower end is buried in the soil. Wooden wedges are placed between the rafters and the poles to adjust the spacing of the rafters and to facilitate their removal. Using rope, the inner rope is rammed into the earth wall, and the outer rope is cut to remove the side rafters. The unevenness of the side rafters and the inclined sides of the wall just solve the self-weight of the rafters, so that no other support is needed at the bottom.

In the Loess Plateau, the rafters are similar in size, about 10cm in diameter and 3m long, forming segments about 2.6m long and less than 3m high. (Zhang,2017; Lu, 2015).

The method of using side planks is similar to that of side rafters, constructed in segments, fixed by poles on both ends, and raised alternately. To prevent the side planks from sliding down, wooden braces are sometimes added below them.

Using rafters to replace planks is a simplified way of building. Almost all of the formwork is made of rod-shaped materials, which are easier to obtain and process than planks. These rafters can be used to build a roof after the walls are finished. However, the rafter method also has obvious shortcomings. The gaps between the rafters are not rammed, resulting in poor wall surface quality. The inclined sides limit the height of the wall and increase the floor space.

In addition, two rafters can be spliced at the middle poles to extend the length of one segment (Regional Feature Library in Anding, 2017), which can reduce the movement of the whole formwork, speed up the construction, and reduce the wall joints.

3. The integral formworks

By splicing the side planks, the length of one segment is extended to the overall length of the wall including corners, forming the integral formwork (Fig.5). It facilitates simultaneous ramming and allowed the building of rows of wall sections without vertical joints. The work efficiency is improved in the case of abundant manpower and the integrality is improved. This method is mainly distributed to Tibetan areas in Tibet, Sichuan, Yunnan, and Qinghai provinces.

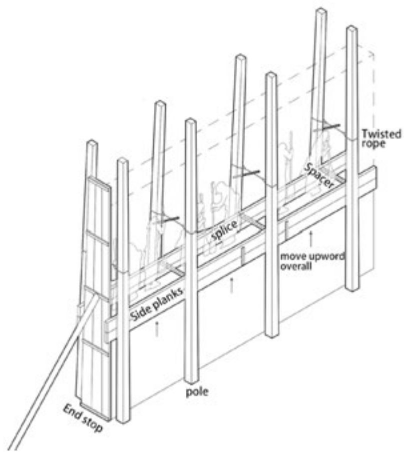

Fig.5 The integral formwork (author)

In integral formwork, side planks are still fixed by poles, and the end stop is fixed at the end of the wall. But, the side planks are generally larger. In the east of Qinghai, it is 45cm high and 4.5m long (Zhang,2016); in Tibet, it is 30cm high and about 5m long (Muya, 2009). Due to the large height of the side planks, a wooden spacer is placed between the two opposite planks to avoid falling inwards under the pressure exerted by the poles. At the same time, the distance between side planks is controlled to form a slightly trapezoidal section of the wall. Each time a section is finished, the entire side planks are pushed up (Fig.6).

Fig.6 People were pushing up side planks of the integral formwork (Source: Shu, 2016, https://www.poco.cn/works/detail_id5245000)

The height of the poles depends on the height of the wall. Taking buildings in Qinghai as an example, the height of the buildings there is generally three-story, so the height of the poles is also increased accordingly, about 12m or more, and the diameter is about 15cm, and the distance between poles is 1~1.5m or so (Jing, 2013). During construction, after the foundation wall is completed, all the poles are erected, which is convenient for construction. The inside surface of the wall is often kept vertical, and the outside is slightly inclined, so the poles are also vertical on the inside and inclined on the outside.

The scenes of Tibetan construction are often very grand, with many people building together at the same time. In this labor scene, the action of ramming is accompanied by the singing, forming a rough dance (Muya, 2009).

Sometimes due to the influence of the internal wooden structure, the construction of earth walls needs to be alternated with wooden structures. In Diqing Tibetan Autonomous Prefecture, Yunnan province, dwellings are usually two to three stories, with rammed earth walls outside and wooden structures inside (Fig.7). After the foundation is completed, the walls are first built to the height of one story, then need to be dried for a few days to increase strength, at the same time, the internal wood structures are assembled. The walls and wood structures of the second story are built the same way, and so on for three or four stories (Zhao, 2018).

The poles were erected differently in this area. The inner poles, which are slightly higher than one story, need to be removed when the wooden structure is being constructed and erected again after it. The poles on the first floor are buried underground, and on the second and third floors are fixed in the gaps between the wooden beams and the earth wall. There also are beams tied between the outer poles to stabilize them and serve as ladders.

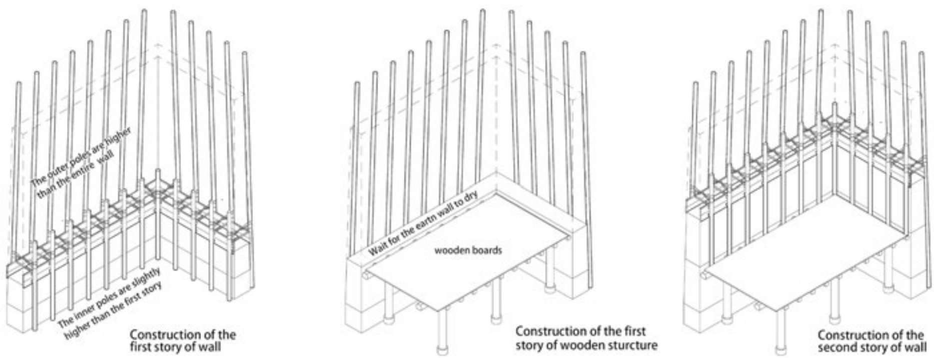

Fig.7 The integral formwork in Deqin, Yunnan province (author)

4. The multi-layer segmented formworks

Multi-layer segmented formwork is used to build higher walls. During construction, the entire wall is divided into several layers (unequal to the height of the building story, but related), and the height of formwork is not the overall wall height, but the height of one layer. In the scope of each layer, it is similar to segmented construction, but it needs to solve the support problem because poles are raised. This method is mostly distributed in the northeast of Fujian and the southwest of Zhejiang province. The outer walls of the buildings there are 2 to 3 stories high, most of them are enclosure walls, and the internal wooden structures are load-bearing.

The wall here is almost vertical, so the end stops are in the rectangle. Two pairs of side planks are generally used and raised alternately (Fig.8). The dimensions of the side planks and the end stops are different in different regions. The length of the side planks in northern Fujian is about 4~4.5m and the height of the end stop is about 4.5m (Wu, 2019). In Zhejiang, it is much smaller. The length of the side planks is only 1.2~1.5m, and the height of the end stop is about 1.7m.

The side planks are fixed by the poles, and the poles need to be supported by putlogs. in northern Fujian, bamboo tubes whose length is equal to the width of the wall are pre-buried 30cm below the top surface of the first layer. When ramming the second layer, wooden putlogs are inserted into the bamboo tubes and hung the two ends out of the wall. Then simple wooden boards are laid on the putlogs and the poles are placed on them. The upper ends of the poles still use twisted ropes, and the lower ends are fixed with ropes or iron wires through the wall where small bamboo tubes are also embedded to facilitate pulling out them. In the Zhejiang area, poles are directly fixed with putlogs, the poles are slotted at the end and ride on putlogs, and wooden wedges are used to fasten them (Fig. 9). One end of the putlogs is slightly larger than another to facilitate putting out by tapping the end.

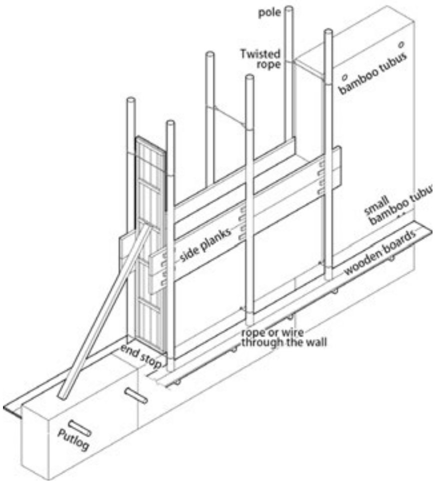

Fig.8 The formwork used in northern Fujian (author)

Fig.9 The formwork in southern Zhejiang (author,2019)

The segments of the upper and lower layers should be staggered to avoid straight joints. But this stagger is small, usually, only one wall thick, formed by intersections at corners. Layers and segments need to be connected by uneven surfaces and concaves shaped by the sharp end of the rammer, or pre-buried woods (Zhang,2015). Between segments, bamboo tubes and wooden sticks are embedded to connect each other in some regions.

During construction, the earth wall was first constructed followed by the wooden structure, but the two were not completely separated, combined with wooden pins or stringers at the top. Such weak connections make the wall have a certain stability, in the meantime, avoid problems caused by different shrinkage of different materials.

The walls here are amazing in the ratio of height to width. In northeastern Fujian, the bottom width is 0.5~0.6m and the height is about 10m. They are not load-bearing walls, and the need for multi-story buildings makes them thin and light, while also meeting the needs of thermal insulation and defense. The joints left by the construction can also be regarded as reserved expansion joints to protect the interior of the wall from cracks. The construction of each section maintains the speed of segmented formwork, while the height is increased through putlogs.

5 The lined formworks

The lined formwork means that the whole formwork moves horizontally after tamping each section and completing a circle of the wall is as one line. The modules are small, the formwork is light, the operation is flexible, and the quality of the single section and the integrity of the whole wall is guaranteed, making the method common in the world.

The formwork is generally composed of two side planks and an end stop with the same height of side planks, which can be fixed in a variety of ways.

5.1 The formworks with putlogs and wooden ribs

With the end stop, one end of the side planks can be mortised with the end stop and another end fixed with putlog below them and a pair of wooden ribs outside. Putlogs are placed on notches cut on the top of a previously built wall and protruded slightly over the wall. A hole is made at the protruding end to fit the wooden ribs preventing them from spreading out. (Fig.10). The end stop can be omitted, another set of putlog and ribs is placed at the position of the end stop, and a space is added to prevent side planks from tilting inward.

This method is used in various regions, and there is no centralized distribution area. However, the size of the template varies in different regions. In the Daliang Mountain of Sichuan, the side planks is about 2m long, 0.33m high, and the end stop is about 0.5m wide (Lu, 2015). The size of the formwork in Tibet is larger, and two doors are directly used as side planks, with a length of 2m and a height of 1m. The diameter of the putlogs is 15cm and of the poles is 13cm (Muya, 2009).

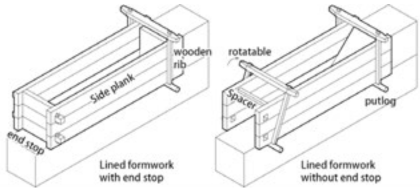

Fig.10 Two kinds of lined formworks fixed with putlogs and wooden ribs (author)

5.2 The formworks with wooden locks

In southern Fujian, where Tulou is commonly distributed, the side planks are fixed at the open end with a wooden lock. The wooden lock is generally composed of two vertical wooden bars and two horizontal wooden bars. The vertical bars are curved inside and fixed in the middle with a horizontal bar. Another horizontal stick is pressed down from the top to open the vertical sticks to both sides by taking advantage of their curved sides (Fig.11,12). As a result, the bottom of vertical sticks is tightened inward due to leverage. There are also putlogs under the side planks, but much thinner, to support the weight of the side planks and people standing on them when ramming and to mark the thickness of the wall when placing planks (Lin, 1995).

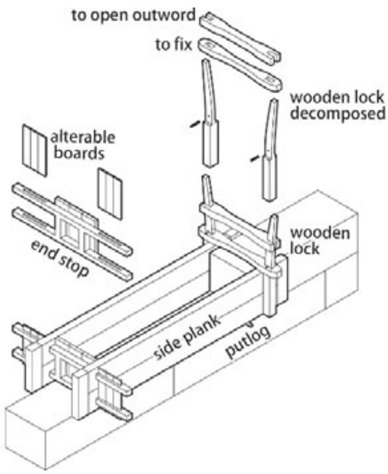

Fig.11 The formwork with a wooden lock (author)

In some areas, the putlogs will be replaced with bamboo wedges to avoid the holes (Huang, 2009). The end stops here are slightly different from the other methods. Because the height of Tulou is mostly 3 to 5 floors, and some walls can reach more than 20m, each story of the wall is gradually thinned in a stepped shape from inside to stabilize the wall. To adapt to the different thicknesses, the end stops are made in a frame structure to adjust the width by increasing or decreasing the wooden boards in the middle. However, if the wall is too thick, reaching more than 1.5m, two walls should be built along both sides of the wall firstly, and then fill in the middle to prevent the end stops and the wooden locks from being too large.

Fig.12 The formwork used in Tulou (Source: Chen, 2016, www.163.com/dy/article/E9GLU3K10521AJ1J.html)

5.3 The formworks with poles

Poles are rarely used to fix lined formwork since every time the formwork is moved, the poles have to be re-installed, which undoubtedly increases the workload. This method is only seen in the Jianchuan area of Yunnan. Dwellings are two-story high with load-bearing wooden structures inside, and earthen walls outside.

The side planks are about 4m long, 0.4m high and 7cm thick, fixed by three pairs of vertical poles. Inclined poles are used below them to prevent slipping. After tamping one section, move the formwork horizontally to the next, and reinstall all the poles (fig.13).

Using poles eliminates the holes caused by the putlogs and reduces the weak points of the wall. In addition, the installation of the side planks also breaks the restrictions of the putlogs. It can be used diagonally, and the triangular hypotenuse is directly rammed at the gable.

In the meantime, the formwork here has another feature, no end stop is used, except for the first line, corners, and ends of the wall. Therefore, each section is intersected by inclined planes, which enhances the connection between them. This advantage is also reflected in the corners and where the partition and exterior walls meet.

Jianchuan is an earthquake-prone region, and the anti-seismic requirements result in the use of poles, no use of end stops, and diagonal ramming.

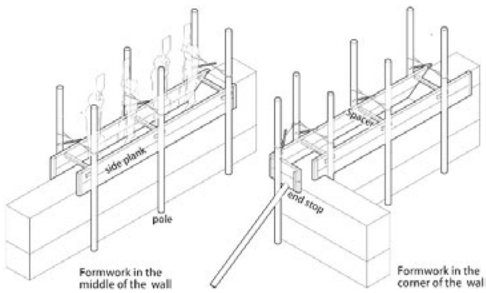

Fig.13 The formworks used in Jianchuan (author)

In addition, the rammed earth wall is also closely integrated with its internal wooden structure to be stable mutually.

6. Conclusions

The combination of wall sections is affected by multiple factors, such as the height of the wall, the quality requirements, and the manpower. The way that the sections are stacked vertically, similar to the rammed layer, may be applied earlier than that arranged horizontally. Furthermore, the rafter method is more simplified, which may have existed long before people could handle finely processed wood, and with the improvement of processing tools, it gradually evolved into a convenient and suitable thickness of the wooden planks. The integral formwork can improve efficiency while achieving the best integrity if there is sufficient manpower. The multi-layer segmented formwork has both the quickness of segmentation in the meantime solving the problem of construction of the high wall. The method of lined formwork has the characteristics of flexible operation of small units and closer horizontal connection.

From loose earth to stabled walls, formworks play an indispensable role in shaping. The side planks are used to block the earth. The end stops limit the spacing between side planks and determine the thickness and walls cross-section, and this function can be replaced by spacers. The fixing methods such as tensed by ropes, erecting poles, using putlogs and wooden ribs, and wooden locks are mainly used to resist the lateral pressure during tamping and prevent the side planks from being stretched out. Fixing with ropes directly is only found in the rafter method. Erecting poles is widely used, and it is buried if it is on the ground or supported and fixed by putlogs if not. In the latter case, the problem of high walls can be solved, and the poles can be reduced to wooden ribs, making the whole formwork more compacted. The use of wooden locks can fix the side planks from the top, reduce the diameter of the putlogs, and even make them replaced with bamboo wedges, reducing or eliminating the impact of the holes on the wall.

These traditional technologies, which once created wonderful architectures, are being rapidly lost under the impact of modern technology. With the rise of green, low-carbon, and vernacular architecture, they have become a hot spot for architects. If we understand them more precisely and comprehensively, the more chances we have to develop their strengths and potential.

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VERNACULAR ARCHITECTURE:
MATTER, CULTURE AND SUSTAINABILITY

SUSTAINABILITY
OF VERNACULAR ARCHITECTURE

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Traditional Bukharian Houses and Mahallas: A Shared Vernacular Heritage at Risk

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Topic: T1.4. Sustainability of vernacular architecture

Abstract
Beyond being a form of community expression, the traditional Bukharian houses and mahallas – neighborhoods - illustrate a close relationship with the environment as the use of earthen materials and the design of its urban fabric respond to the harsh desert climate. This World Heritage listed vernacular architecture and mahallas in Uzbekistan are a vulnerable and rapidly changing heritage. Traditional techniques and know-how are getting lost and replaced by new construction techniques that most of the time are causing irreversible changes. In addition, their special attributes that make them unique are also disappearing due to changes of ownership, alterations, and adaptive reuse. In this context, a fragment of this heritage, the Traditional Bukharian Jewish Houses, was identified and included on the 2020 World Monuments Watch program to advocate for their preservation while maintaining the diversity and livelihood of the communities. Since the Watch inclusion, the World Monuments Fund (WMF) and International Institute for Central Asian Studies (IICAS), in partnership with the Bukhara State University and other local partners, have been working on the Documentation and Conservation project. The team assembled for this project is carrying out an updated inventory of the three Jewish mahallas using digital technologies and documenting and assessing the physical conditions of the houses. Ultimately, the project seeks to create best practice conservation guidelines not only for the Jewish houses, but also for all the traditional Bukharian houses that will foster community awareness of traditional construction techniques. This paper presents the process, challenges, and preliminary results of the project contributing to the protection of this outstanding Bukharian vernacular and shared heritage.

Keywords: *Bukhara, vernacular architecture, heritage documentation, shared heritage.*

1. Introduction

1.1. Bukhara

The history of Bukhara, situated along the Silk Roads, is exceeding over 2000 years. As a vital economic, cultural and educational centre in Central Asia, it served as a major centre of Islamic culture for many centuries from the Caliphate period in the 8th century to the Sheibanid period of Uzbek rules, which started in the 16th century.

In 1983, the historic city of Bukhara, with over 100 monuments, including historic ensembles, mausoleums, madrasas, mosques trade cupolas, baths, caravansaries, was designated as a museum-reserve by the Council of Ministers of Uzbek SSR (Decree No.308-16.05.1983). Ten years later, in 1993, Bukhara was inscribed on the UNESCO World Heritage List, as the most complete example of a medieval Central Asian town, preserving its urban fabric and historic buildings and structures. In addition, the urban fabric of the

Historic Centre of Bukhara is characterized by its traditional vernacular architecture organized in traditional mahallas *neighborhoods*, including three Bukharian Jewish mahallas.

From 2008 to 2013 the UNESCO Tashkent Office together with the Department of Cultural Heritage, the former Board of Monuments of Uzbekistan, in cooperation with local and international universities, surveyed 131 historic monuments, 203 municipal buildings, and 4063 residential houses in the Historic Centre of Bukhara. The large-scale field campaign highlighted the emerging threats with an adverse impact on the traditional vernacular architecture of Bukhara (Vileikis & Allayarov 2015; 2014). These threats affect even more the traditional Bukharian Jewish houses due to the migration of the Bukharian Jewish community and the shared nature of their heritage in a multicultural and multiethnic city as Bukhara.

1.2 Historic Background

The exact date of the appearance of the Jewish community in Central Asia, and in Bukhara in particular, is currently unknown. However, the majority of authors consider the existence of several migrations of Jews to Central Asia mainly from Persia from the 6th century until the 15th century AD, resulting in the emergence of the unified community of Jews, referred to as Bukharian Jews, although living in various Central Asian cities, including Bukhara.

The Bukharian Jews lived in Muslim Central Asia in separate mahallas preserving their traditional culture, and, at the same time, absorbing Persian and Central Asian elements. This context ensured the development of the distinct culture and occupations of Bukharian Jews, also reflected in their unique vernacular architecture and the urban public spaces of their mahallas (Sukhareva, 1966).

As regards to Bukhara, the historic records of the 16th-century mention three Bukharian Jewish mahallas within the city walls: Kukhna, Nau, and Amiribod. The number of Bukharian Jews in the city was counted approximately at 800 families in the late 19th century. The Revolution and the inclusion of the Bukharian Khanate into the Soviet state also affected the Bukharian Jewish community. According to the 1926 census decreased to 3314 people in the city (Almeev, 1998).

The further gradual decrease of the Bukharian Jewish population was related to the loosening of the policy of the Soviet Union in the 1970s. This allowed Soviet Jews, including Bukharian Jews to migrate to Israel. In 1980s the Bukharian Jewish population reached over 27 000 in the 1980s in its highest pick. This process developed further into a mass migration of Bukharian Jews to Israel and the USA following the disintegration of the Soviet Union and the establishment of independent Uzbekistan in 1991. As of 2021, there are 170 Bukharian Jews living in Bukhara (IA Regnum, 2021) with a rich and vivid collection of traditional Bukharian Jewish vernacular architecture left in the urban fabric of the historic centre of Bukhara.

2. The Traditional Bukharian Jewish Houses: Documentation and Conservation Strategies Project

The Traditional Bukharian Jewish Houses two-year project was launched in 2020 by the World Monuments Fund (WMF) and the International Institute for Central Asian Studies (IICAS), in partnership with the Bukhara State University, Turin Polytechnic University in Taskent, UNESCO Tashkent Office, National Commission of the Republic of Uzbekistan for UNESCO, the Bukhara Branch of the Department of Cultural Heritage, and the City of Bukhara. The project is supported by the David Berg Foundation and World Monuments Fund (WMF, 2020).

Conditioned by the significance of vernacular architecture within the Historic Centre of Bukhara and its value for the diverse communities of this city, the project seeks to document and develop conservation strategies for the traditional Bukharian Jewish Houses and Mahallas.

3. Methodology

The methodology of the project follows a multidisciplinary approach including historians, architects, archaeologists, archivists, and heritage documentation specialists.

The first phase of the project included an assessment that was conducted at two levels of scale: mahalla (urban scale) and traditional houses (architectural scale). The mahallas were mapped with aerial photogrammetry. The limits were based on the area of the survey identified. The assessment of the houses was based on the archival documentation complied by academics of the Bukhara State University, a literature review, the national heritage list of traditional houses (Republic of Uzbekistan 2019) in Bukhara provided by the Cultural Heritage Agency Brach in Bukhara, and aerial and terrestrial digital documentation, 3D heritage recording, door to door site survey, and questionnaires to owners/residents carried out by the WMF/IICAS team.

The houses surveyed were compared and ground-thruthed with the UNESCO Tashkent Office survey of 2008-2013, to update and identify changes.

4. Identification of the Traditional Bukharian Jewish Houses and Mahalla

4.1. Traditional Vernacular Architecture of Bukhara

The traditional vernacular architecture of Bukhara evolved over many centuries under the influence of economic, religious, and climatic conditions, shaping its unique features. The economic conditions overtime impacted the size of houses, the number of rooms, the building material and its quality and the number of floors reflected in the rational use of land resources in the historic center of Bukhara.

Only wealthy people could afford to build large houses with the use of imported timber, which ensured the durability of the constriction. Such houses usually had rich interior décor and required additional resources for heating in winters and conducting repairs.

The religious conditions affected parameters such as the height of buildings, their facades, entrances, and structures. One of the key differences for Islamic houses was conditioned by the strict division of the living space into female and male parts. Additionally, the traditional Islamic houses had two yards, one of them was the *tashkari* -external, accessible for guests, another was the *ichkari* – internal, used only by family members (Yusupova, 2004). In contrast the Jewish houses had only one living space and one yard.

The climate conditions played the most significant role. The Bukharian traditional houses usually did not have windows on the exterior facades. This was for their residents to be protected from the heat and the sand. There were usually two types of premises: summer and winter. Winter rooms were facing south and usually had a low ceiling. The summer hall facing north had very high ceilings. This was done to keep during the hot summer the hous cool and comfortable (Vileikis et al 2017). These conditions applied to both types of traditional houses, Islamic and Jewish.

4.2. Traditional Jewish Houses

The traditional Bukharian Jewish houses had similar features as the rest of the traditional houses in Bukhara, but also differed in some. The following six specific features were determined based on the archival sources analysis, field documentation, and stakeholders meetings.

Feature 1: Location. In Bukhara, there were three Mahallas of Bukharian Jews formed at different times in history: 1) Mahalla-i-Kukhna, starting around the 15th and in the early 16th centuries. Then the Jewish community was allocated additional land in the 17th and 19th and new mahallas developed: 2) Mahalla-I Nov, the new mahalla, and 3) Amirobad (Sukhareva, 1976). Later in the 19th Century, due to the growth of the population, the extension area appeared (see Fig. 1).

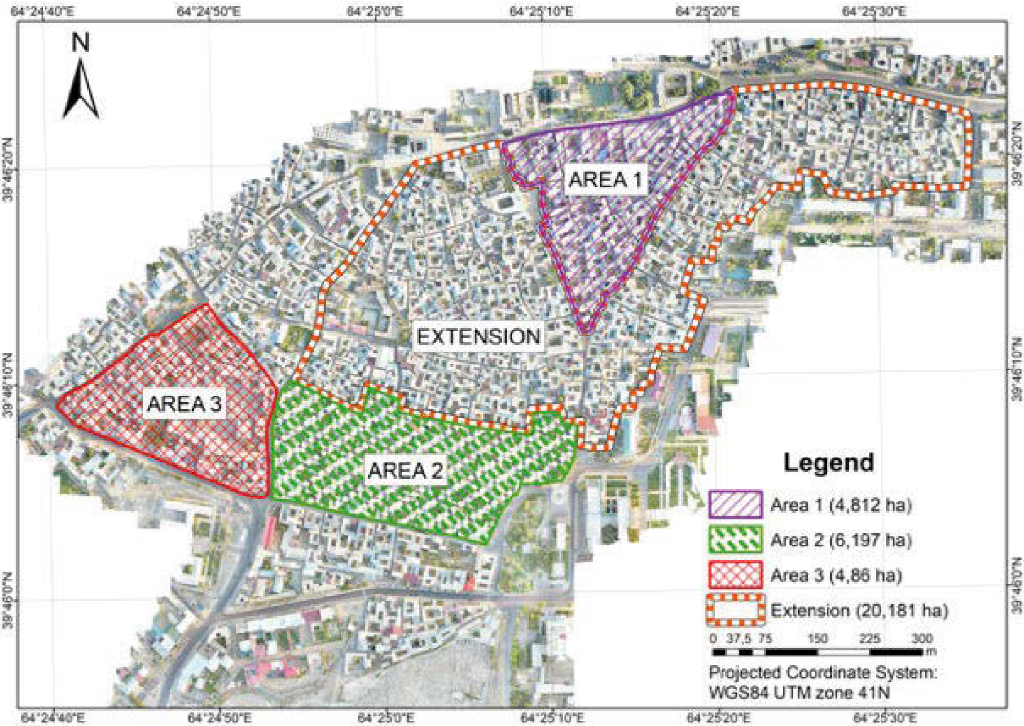

Fig. 1. Feature 1 of the traditional Bukharian Jewish houses: location, Mahalla-i-Kukhna is given as Area 1, Mahalla-I Nov is given as Area 2, Amirobod is given as Area 3 (Source: IICAS, 2022).

Fig. 2. Feature 2 of the traditional Bukharian Jewish houses: a mekhmonkhana oriented to the west (Source: IICAS, 2022)

Feature 2: Mekhmonkhana – *guest room*. The decoration of the mekhmonkhana was distinguished by some originality, especially in houses where it could serve as a home synagogue (see Fig. 2). Torah scrolls and prayer accessories were kept in niches of the wall facing west to Jerusalem. In large houses of rich Jews in Samarkand, mezzanines with separate entrances were built near the eastern wall, on which women prayed (Arshavskaya, 2004).

Feature 3: Jewish decoration. In addition to the traditional floral and geometric ornaments for the Muslim East, the wall paintings included inscriptions in Hebrew, images of a six-pointed star, fish and birds, landscapes of holy places for Jews (Arshavskaya, 2004; see Fig. 3).

Feature 4: Low narrow entrance door (see Fig. 4). This feature of traditional Bukharian Jewish houses was initially conditioned by the fact that the Bukharian Jews were not allowed to have horses in the city, and, therefore, compared to Islamic houses, there was no need to have high and wide entrance gates (Yusupova, 2004).

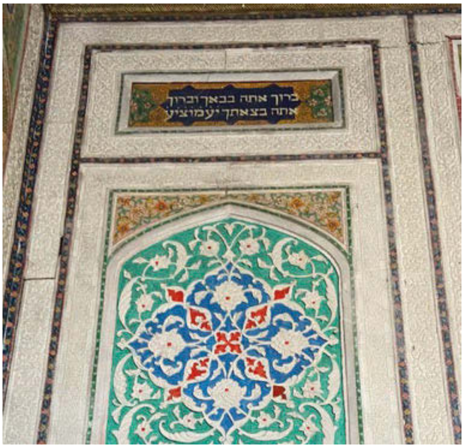

Fig. 3. Feature 3 of the traditional Bukharian Jewish houses: Jewish decoration (Source: IICAS, 2022)

Fig. 4. Feature 4 of the traditional Bukharian Jewish houses: low narrow entrance door (IICAS, 2022)

Fig. 5. Feature 5 of the traditional Bukharian Jewish houses: a corridor (Source: IICAS, 2022)

Fig. 6. Feature 6 of the traditional Bukharian Jewish houses: cellars system, a brick staircase connecting the cellars system and the lower courtyard with the upper courtyard (Source: IICAS, 2022)

Feature 5: Dolon – *corridor*. The low narrow entrance from the street led through a covered L-shaped corridor (see Fig. 5) to the cellars system and lower courtyard (rui howli). The L-shaped corridors usually had two doors, including the entrance door and a door, closing the junction of the corridors, creating closed entrance space separated from the cellars system (Yusupova, 2004).

Feature 6: Sytem of cellars. Many Bukharian Jewish houses had a basement for storing food and wine vessels. However, in Bukhara, to compensate for the lack of land area, the basements were transformed into comprehensive cellars systems with household and traditional crafts production and storage facilities. The cellars system was arranged around the lower courtyard, which had a brick-paved roof and served as the floor of the upper open courtyard (Arshavskaya, 2004). The courtyards were connected by a central brick staircase.

Although, the absence of separation in the structure of the houses for male and female parts could be considered a feature of traditional Bukharian Jewish vernacular architecture, it was decided to omit this characteristic due to its dynamic nature. The internal structure of the houses was always changing due to family extensions and other needs. Moreover, in the 1930s, the majority of the traditional Bukharian Jewish Houses were nationalized by the Soviet government and were re-used as public facilities or communal houses, therefore, their internal structures had overcome subsequent transformations and adaptations for new functions.

4.3. The Survey

In 2021, a survey was launched to identify the current state of the mahallas and the traditional Bukharian Jewish houses. The area surveyed was within the three Jewish mahallas and the additional adjacent extension. 68 traditional Bukharian Jewish houses and two Bukharian Jewish synagogues were identified on the map based on the address or on the knowledge of the team members. It is relevant to highlight that only the rich houses in the surveyed area were preserved over time due to the durability of the materials used for their construction and its high importance.

In accordance with the preliminary results of the survey, only 22 houses from 70 have preserved all the features introduced before of traditional Bukharian Jewish vernacular architecture.

The small number of the well-conserved houses in terms of features is conditioned by the gradual decrease of the Bukharian Jewish population. This has led to the acquisition of these houses located in the Historic Centre of Bukhara by local hoteliers or residents. The change of function and consequent adaptation resulted in 1) the conservation of all features, as it is in the hotel on Turkijandi Street; or 2) the loss of one to three features. In some cases, the hotel owners have been able to buy several neighboring traditional Bukharian Jewish houses and transformed them into a single property, as it happened at one of the houses on Eshoni Pir Street. This interventions are ultimately transforming the interior structure of the historic mahallas.

Regardless the process, which affects the traditional houses, the mekhmonkhana and the cellar systems remain in 96% of cases as the most stable features of the traditional Bukharian Jewish vernacular architecture. In this light, low entrances and corridors are considered to be the most endangered features of traditional Bukharian Jewish houses surveyed, wherein 38% of cases, these parts of the houses were significantly modified.

As regards of feature 3, the current preservation trends in the area surveyed are the following: (1) both Jewish decorations and Hebrew inscriptions are preserved (23%), (2) Jewish decorations are preserved, Hebrew inscriptions are covered, whitewashed or replaced by Muslim inscriptions (23%), (3) both Jewish decorations and Hebrew inscriptions are whitewashed (about 30%).

It is important to highlight that the religious, cultural, and ethnic identity of the current owners of the houses do not always impact the state of conservation of the features. For instance, one of the best-preserved traditional Bukharian Jewish Houses on Eshoni Pir Street is currently owned by a Muslim family, who conserves all original Bukharian Jewish features of their traditional house, including Jewish Decorations and Hebrew inscriptions (see Fig. 7).

Fig. 7. The Traditional Bukharian Jewish house on Eshoni Pir Street: the Islamic shamail on the left and preserved Hebrew inscriptions on the right. (Source: IICAS, 2021).

5. Conclusion

The preliminary results of the 2021 survey of the traditional Bukharian Jewish houses in the World Heritage Historic Centre of Bukhara confirmed the vulnerability and rapid change of this type of vernacular architecture caused by either change of function or change of ownership of such houses. This demonstrates the need for rigorous conservation guidelines to support the local stakeholders, including home owners, authorities, and professionals to conserve these unique examples of vernacular architecture in Uzbekistan. At the same time, the majority of the identified features of the traditional Bukharian Jewish vernacular architecture, including the mekhmonkhona, cellars system, and partly Jewish decoration, are preserved regardless of the nature of the above-mentioned changes.

The examples of traditional Bukharian Jewish houses that are currently owned by Muslim families and have all features preserved, represent an outstanding example of intercultural and interreligious dialogue common to the Silk Roads city of Bukhara.

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A look on the intrinsic sustainability of Aeolian vernacular architecture

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Topic: T1.4. Sustainability of vernacular architecture

Abstract
The vernacular architecture of the Aeolian Islands can be seen as the result of a stratification of empirical knowledge, linked to socio-economic, cultural, and environmental needs of local communities. This homogeneous and specific heritage is characterised by a constructive code which is the direct expression of the necessities dictated by the geo-morphological context, the environmental conditions and the availability of local resources. These constraints have strongly influenced the local "modus aedificandi", characterised by an intrinsic sustainability. In particular, adaptation to local orography and climate, and to main wind directions, has promoted the adoption of several bioclimatic strategies (as the use of massive walls and roofs, cross ventilation and shading systems provided by verandas/porches) and of resources reuse (like rainwater collection). The smart use of traditional and locally available natural building materials for the realisation of the main constructive elements is another manifestation of this heritage sustainability. But the arrival of "modernity" (closely linked to industrialisation) has often compromised these aspects, neglecting the concept of continuous maintenance, choosing new, synthetic and (quite often) not compatible materials for recovery interventions, repurposing spaces and substituting and/or altering original uses.This contribution highlights the sustainability of Aeolian architecture and the traditional technical solutions used in this peculiar archipelago composed by volcanic islands. It also reports some "bad practices" introduced in the 60s and 70s to refurbish traditional buildings. Finally,a programmatic and more conscious approach to the recovery of Aeolian architecture, by the use of more compatible and sustainable interventions, is proposed. This choice is fundamental to respect the memory of vernacular heritage in general and, in particular, of Aeolian one, included in the UNESCO World Heritage Site list since 2000.

Keywords: *Aeolian islands; vernacular architecture; sustainability.*

1. Introduction

Vernacular architecture represents the physical and cultural result of the long process of trial and error adopted by local communities to design their life-spaces, in close relationship with the morphologies of places, local available resources, climate conditions, environmental constraints and socio-economic contexts (Oliver, 2006). In a world conscious of globalisation, industrialisation and cultural (and architectural) homogenisation negative outcomes, the vernacular architecture has been interpreted as a huge database (Rashid & Ara, 2015) of environmental, architectural and technological solutions with strong features of sustainability. As a matter of fact, in the last years (Nguyen et al*.*, 2019) vernacular architecture has become a topic which is investigated all over the world at an increasing rate because it is believed to be an important resource from which programmatic and specific principles for contemporary sustainable architecture (Correia et al*.*, 2014) can be derived from. Local building cultures offer a catalogue of solutions which can be addressed in terms of environmental, socio-cultural, and socio-economic sustainability (Dipasquale & Mecca, 2016). As clearly exposed by these authors, environmental sustainability refers to the ability of vernacular settlements to be integrated in the environments without inducing negative impacts (as changes in the climate or in the landscapes, production of pollution or waste materials) thus benefitting from natural or climatic resources available on site and protecting communities from the risks intrinsically connected to territories. Concerning socio-cultural sustainability, vernacular architecture embodies building cultures as a fundamental aspect of identity, for the entrenched local knowledge and know-how, care of personal and community welfare and social cohesion, reflecting a certain ensemble of intangible values. Finally, concerning socio-economic sustainability, the authors highlight the capacity of vernacular architecture of producing an added value in a certain region to guarantee social welfare, as well as favouring autonomy, promoting local activity and employment and saving resources.

It is interesting to note that transformations can occur over time, especially from a social and economic point of view, leading to an obsolescence of the tangible heritage even more than the intangible one (see, in this regard, the issue of the abandoned villages). In order to avoid the abandonment that could follow obsolescence, it is necessary to intervene by rediscovering tradition, recognising its vocation and potential.

Vernacular building and landscape solutions can be assumed as the ground from which contemporary sustainable architecture can root and derive its methods and techniques, enhancing them through contemporary know-how and technologies, to answer the social and environmental challenges of the 21st century.

Sicilian territories are constellated with vernacular architectures that have intelligently and wisely responded to the characteristics of places and times.

Our research group had previously carried out a study on the constructive characteristics of Aeolian architecture. Technical elements were classified according to the technological system scheme indicated by the Standard UNI 0051, and the durability of the units belonging to the load-bearing structure and to the envelope was investigated. To this end, inspections, photographic and technical-constructive surveys and graphic representations were carried out.

By means of statistical surveys, the presumed average durability of each technological element (traditional or "modern") was assessed, specifying the most recurrent pathologies and indicating the causes that produced them. A representative sample of professionals from the building sector (technical offices, building firms, professionals) was involved in this process.

In the following contribution we propose a reflection on the intrinsic sustainability of Aeolian vernacular architecture, focusing on the peculiarity of the geo-morphological context in which it is built and the resources it make use of. Finally, considerations are made on possible safeguarding strategies of its distinctive features, which were "betrayed" by disrespectful interventions in the 60s and 70s.

2. Sustainability of Aeolian architecture

Aeolian architecture denotes a homogeneous and specific housing style, which is intrinsically linked to local culture. It is characterised by a construction code, which is direct expression of necessities linked to environmental conditions, historical genesis and locally available resources. The geomorphological characteristics of volcanic places, the climatic factors (high degree of solar radiation, minimum temperature range, low amount of rain) and the limited quantity of available economical and material resources have strongly influenced the traditional constructive technology (Todesco, 1995). The archipelago is included in the catalogue of the Intangible Cultural Heritage of Humanity: in 2000, UNESCO placed the Aeolian Archipelago among the 691 sites in the world protected by virtue of their “environmental and/or cultural characteristics” (World Heritage List).

Traditional Aeolian architecture was strongly influenced by the architecture of the sixteenth century of Campania region, which was grafted onto a previously Greek-Roman and Islamic architecture. Before that, the first settlements occurred as far back as the Neolithic age between 5500 and 4000 BC. During the following centuries, the archipelago was populated by Etruscans, Carthaginians, Greeks and Romans, then by Arabs, Normans and Spaniards; nevertheless, most of the current villages were built in the nineteenth century (Todesco, 1995).

The original element of the typical architecture is a single cubic or parallelepiped shaped box, with only one entrance door and two windows, generally round (Caponetto et al*.,* 2003). Inside the house, the kitchenette was located on a side, and the beds on the other. The building had the function to defend the inhabitants from possible external attacks.

Today, it is possible to identify two possible different building types in the Aeolian archipelago: the vertical one (in steep areas) and, most frequently, the horizontal one (in flat areas). Both types are generated using a box - type construction, through the superimposition or combination of cubic elements (rooms), and have similar building characteristics. The other vernacular buildings are a combination of these two types.

Figure 1 shows the combination of cubic elements for the "horizontal type": originally, only a single cubic box and a terrace composed the house. Subsequently, another "box" was put beside the first, in place of the patio. This one rotated and adapted to the needings of everyday life by the use of several functional elements. Typical elements of the traditional building are:

- The *bagghiu*, a large terrace placed at the front of the building.
- The *bisòlo*, small masonry walls which delineate the terrace, at times adorned with colourful majolica tiles.
- The *loggia*, the roof of the terrace, composed by a trellis of wooden beams covered by canes. This element had the important function to create a filter shaded space between indoor and outdoor, protecting the terrace floor from direct solar radiation thus ensuring a reduction of temperature during the warmest summer days.
- The *princu*, a washbasin made of stone that lies on the *pila*, an outdoor tub employed to do the laundry.
- The *furnu*, a domeshaped oven positioned at the side of the terrace, which lies on a base where firewood is stored.
- The *astricu*, the horizontal roof. This element has two important function: as massive element of the envelope, it dampens the effects of the cold winters and the warm summers; as functional roof element, it collects rainwater thanks to the raised edge of the terrace (element which is called *petto di palumba* - dove's breast -), and conveys it to an underground tank.
- The *occhi di ventilazione* (ventilation eyes), located in the upper part of the walls and used to convey outside the heat stored inside the building box during the warm summer days.

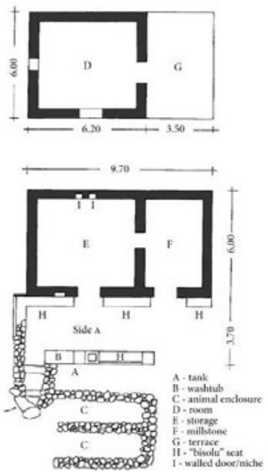

Fig. 1. Example of horizontal type house (Source: Todesco, 1995)

As mentioned above, the typical architecture of Aeolian Islands is strictly linked to the environmental conditions and to the locally available resources. The geomorphological characteristics of the locations and the climatic factors have strongly limited the local *modus aedificandi*. Architectural and technological choices delivered unique places and cultural facts of the Mediterranean area (Sapienza et al., 2021).

Footings are made of lava stone, with lime and pumice mortar. They are very shallow: the height is less than 40 cm for a single-storey house and less than 70 cm for a multi-storey one.

Walls were usually built with shapeless stone (quarried in the islands) and mortar (rich in lime and pumice, a coarse lava lapillus locally called *rupiddu*). Subsequently to the Messina earthquake (1908), rough-hewn stone masonry was used, with horizontal mortar layers (spaced vertically every 70 cm). For the internal walls, either tuff or lava stones were often used. The solid ground floor was made of lime and pumice stone (sometimes with a crawl space).

The traditional intermediate floor was made of timber beams, with a main and a secondary order or unhewn chestnut trunks, on which a canes mat was laid. On the top of the mat, a special conglomerate, composed by volcanic lapilli, lime mortar and fine pumice, was then casted. The *astricu* flat roof was usually 12 -15 cm thick. It was realised similarly to the intermediate floor, by installing beams made with local chestnut trunks, on which was placed a canes mat, a layer of broken stones whose flat side rested on the canes mat and finally, the conglomerate for the screed (realised with volcanic lapilli, lime mortar and fine pumice).

A careful ramming of the surface layer was performed when it was still fresh, to completely saturate the voids and therefore reduce porosity, thus ensuring the water tightness of the terrace.

The *astricu* had the important function to collect the meteoric waters, which were channeled and thus transported into the cistern, generally located under the house, through the drainpipes realised with *terracotta* elements.

The external staircases, connecting the ground floor with the first floor, generally consisted of solid basalt steps laid on a rampant masonry arch; inside, wooden stairs were used for all the floors. The traditional plaster, applied in two layers, was made with a lime-based mortar with very fine lapilli aggregate. Lapilli, used in both plaster and astricu mixtures, were readily available in the volcanic archipelago and reduced capillary water absorption. A lime-based painting was used until the 1970s, to protect plasters and to sanitize walls: indeed lime is known to have caustic properties (it eliminates mould and prevents its reappearance) and hygroscopic behaviour (it allows walls to breathe). As regards the floor, for interior and exterior spaces coloured ceramic tiles (coming from the town of S. Stefano di Camastra, in Messina province) or pressed cement tiles (sometimes decorated with marble flakes) were used. The external floors (for storage spaces and terraces) were often made of lime and pumice. Traditional frames of doors and windows were made of chestnut wood and coloured wih oil paints.

Over time, several factors have influenced and modified the building process. This has led to a progressive technological transformation extraneous to the local culture, which will be discussed in the following paragraph.

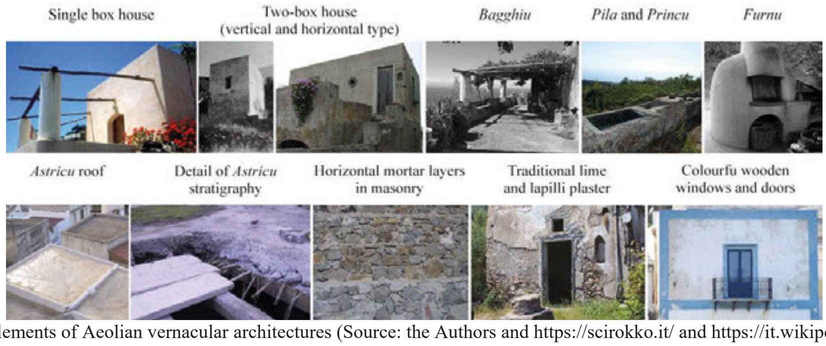

Fig. 2. Elements of Aeolian vernacular architectures (Source: the Authors and https://scirokko.it/ and https://it.wikipedia.org/)

3. The betrayal of modernity

As abovementioned, local building procedures were influenced by various factors: the exhaustion of several natural resources; the closure of stone quarries and the consequent introduction of new (and industrial) building materials imported from Sicily and southern Italy in general; the higher cost of building materials arriving by maritime transport; the low availability of experienced workers; new building procedures considered appropriate for a rapid execution of the work, but not thought for a long-lasting maintenance of the technological units' performances.

All these factors have radically transformed the Aeolian built environment. Building technologies and typological models foreign to the local culture, have sometimes been passively imported, determining a relevant and diffused technological and environmental decay.

For instance, starting from the 1920s, the *pomicemento* blocks (for loadbearing walls and partitions) made of pumice and cement mixtures, were produced in Lipari Island and exported. The *pomicemento* blocks did not resist well to shocks, and they also showed durability issues when left unplastered: in this case the blocks experienced chalking phenomena.

In the 1960s, the reinforced concrete conglomerate (cast in place) was introduced for the realisation of loadbearing frames (with hollow bricks infill) and for hollow block floors. This technology was soon abandoned as concrete reinforcements were severely damaged by the marine environment.

Floors made of lightening bricks (*pignatte*) and reinforced cast concrete were used between the 60s and 70s but were abandoned due to the insufficient expertise of the workers (especially with regard to the execution of the conglomerate casting). Today, this type of floor is being replaced. From 1970 onwards, the floors have been made of prefabricated joists and lightening bricks.

For the exterior surfaces, from 1970s a plaster made of marble powders with a new finishing in lime paste and white cement was used. In the last decades the "Terranova" plaster (a premix plaster composed of lime, a small amount of cement, selected silica and quartz sands, solid inorganic pigments) began to be used, but its high cost hindered its diffusion. Since the mid-1980s and up to the early 1990s, coloured plastic paintings (whose use is absolutely not recommendable from a restauration point of view) were introduced onto the Islands. This type of paintings immediately showed widespread exfoliation linked to their poor breathability, which, together with moisture present in the wall, led to the formation of bubbles that then cracked; its use ceased in the early 90s. Another "modern" plaster used is the *bucciardato*, it is realised in three layers with finishing in cement, lime and marble flakes and it has a better performance (in terms of durability) compared to other new plasters. Nonetheless, this type of plaster is also less breathable and sustainable, both in environmental terms (due to the presence of cement) and in economic terms (due to higher installation costs).

Fig. 3. Examples of inappropriate interventions on vernacular Aeolian architectures (Source: the Authors)

The durability of the *astricu* relies on that of the floor below: if this element undergoes slight deflections, cracks are caused in the waterproofing layer. Cracks can also be caused by thermal excursions. In the past, lime mortar and pumice were periodically (every 1-2 years) injected into the cracks (in dialect, *ciacche*) to carry out the necessary maintenance of the extrados, to avoid water infiltration and damages of the layers. In recent decades, the use of asphaltic and bituminous sheats to waterproof the external surfaces of flat roofs began. Waterproofing sheats have little durability (when not protected by pavings) and they are totally incompatible with the aesthetic properties of traditional buildings: Aeolian houses roofs contribute significantly to characterise the local landscape and should not be transfigured by such visually impactful technologies.

Another solution, recently introduced, for waterproofing roofs, consists of two-component elastic cementitious mortars. This intervention in itself may not be inappropriate, but it is often accompanied by the closure of underground cisterns, which being walled up, do not longer perform the function of collecting rainwater.

Traditional windows and doors realised in chestnut wood, were usually recovered every two years by using paints with waxy products to soften the wood essence. Some of them have been substituted with PVC and aluminium framings which present deformations, due to high temperatures, chromatic alteration, due to solar radiation, and diffuse corrosion due to marine aerosols.

4. A new environmental awareness

In addition to the unappropriated interventions on the historical built heritage of the 60s – 70s, the Aeolian islands have also witnessed a phenomenon of unrestrained urbanisation in the same years, with a proliferation of interventions (at urban, landscape and naturalistic scales) that posed a risk to the environment. Indeed, from the second postwar, the Islands were introduced in a wider circuit of mass tourism, which determined a heavy anthropic pressure on their fragile environmental system, especially in summer seasons. After the inclusion of Aeolian archipelago in the UNESCO Heritage List in 2000, the need to safeguard and sustainably develop the territory became more pressing. For this reason, in 2001 a Landscape Territorial Plan of the Aeolian archipelago was approved (*Piano Territoriale Paesaggistico*, 2001) which led to the imposition of various protection regimes on the territory. In 2007 was designed the management entity of the National Park of the Aeolian Islands (2007), and in 2012 was published The Unesco Aeolian Islands Management Plan (Angelini, 2012). The Management plan offered a program of actions for the knowledge, protection, and valorisation of the heritage, and a plan of action for social, cultural and economic growth, aiming at creating differentiated offers from the territory, and wishing to regulate the tourist flow.

It is important to highlight that there are Islands (as Lipari or Vulcano) that have suffered more than others the advent of modernity. Today, the Islands are under greater observation as the Landscape Territorial plan of the Aeolian archipelago requires all Aeolian municipalities to adopt a suitable urban planning instrument (regulatory plan) before any tranformation activity can be authorised in the area. At a building scale, the possible interventions today are limited to the renovation of existing buildings, without extensions, changes in type or intended use (also in the case of ruins). Residential or tourist activities are considered incompatible if not carried out in existing structures. Buildings and artefacts of architectural, environmental, cultural, historical and testimonial value are subject to building recovery with focus on cultural and productive re-functionalisation.

At a glance, Aeolian Islands are still in an embryonic state of environmental sustainability. It is worth to mention that the recommendations of the Landscape plan found important oppositions from Island's property owners, who perceived them more as an obstacle to satisfy a general demand for building growth than as an adequate response to the enhancement of the area's specific resources.

In the 2017 Legambiente report it is affirmed that the minor Italian islands are an ideal laboratory for sustainability. The major challenges which must be there addressed regard innovative and economically sustainable solutions on energy and water, on circular economy and sustainable mobility (Legambiente, 2017). Regarding energy, Legambiente report suggests a system based at 100% on the use of renewable resources (as sun, wind, tides, water and earth). Contemporary Islands energy system relies on obsolete and contaminating energy plants, powered by diesel or fuil oil, with supplies arriving via tankers at high costs. Yet, in the Aeolian context, the installation of plants for the production of energy from renewable sources (such as photovoltaic, solar thermal, wind power) seems to be incompatible with the need to preserve the landscape, while the hypothesis of geothermal energy does not seem to be feasible due to the costs and the nature of the soil.

As a matter of fact, an essential objective for changing the energy model on the islands concerns the push to energy efficiency interventions, i.e. those which could reduce the need for electrical and thermal energy, for instance in buildings. These interventions pass through a recovery of historical building techniques (with appropriate processes and materials), attentive to thermal insulation and rainwater recovery, to be integrated with efficient technologies for the energy distribution from renewable sources, even if produced off-shore. Attention to sustainability must start from a recognition of the intrinsic qualities of the built environment, from a focus on reproposing and preserving traditional expedients aimed at limiting resources consumption. A virtuos management model is intended to be achieved for water resources as most of these Islands nowadays rely on barges and desalination plants (Legambiente, 2017). At the same time, reduction of consumptions and recovery of water are not even addressed (whereas they were in the past, as testified by the abovementioned rainwater collection system). Similarly, waste represents an emergency on the Islands: the strategy in this case is the push towards waste sorting, recovery of organic waste for production of compost, which must be accompanied by adequate informative campaigns and collecting protocols (Legambiente, 2017). In fact, these strategies represent a return to a sustainable approach intrinsic in traditional culture: in the past, living on an island meant regimenting the consumption of raw materials and minimising waste, facilitating recycling. Finally, access on the islands to vehicles of non-residents should be limited if not outright banned, especially during the tourist season. This limitation is already present in many Aeolian islands (Legambiente, 2017). Sustainable mobility on islands should also aim to the creation of a public mobility alternative, and to the diffusion of lighter forms of mobility.

5. Conclusions

This work focused on the sustainability of Aeolian vernacular architecture. As all types of vernacular heritage, Aeolian architecture represents the result of a stratification of empirical knowledge, linked to socio-economic, cultural, and environmental needs of local communities. Traditionally, local communities were in charge of maintaining their own traditional constructive processes or system of knowledges.

During the 60s and 70s, Aeolian vernacular architectures have experienced strong and inappropriate modifications, due to the increased housing pressure caused by the advent of mass tourism. This caused a crisis of cultural and constructive knowledges' system, which is fragile and sensitive to social, economic and environmental changes. The effects of globalisation and industrialisation on vernacular architectures have brought to cultural homogenisation and adoption of standardised project solutions which can imply high resources consumption and inappropriate material choices. The main risks of interventions on vernacular buildings are due to the replacement of existing materials and to the contrast between industrial and craft production.

The adoption of correct management tools, encouraged by the UNESCO, for a wise and sustainable use of local environmental, natural and built resources is a first step towards the safeguard of traditional constructive processes or system of knowledges. These can be seen as key elements for the sustainable development of our built environments as well as expressions of social diversity and sources of practical and technological culture connected to places. The new sustainability must be rooted in tradition, culture and history of the places. The new way of living must, on the one hand, take into account the renewed needs and, on the other, rediscover the sustainability of the *modus aedificandi* and the *modus vivendi* of the past. It is necessary to minimize energy and resources consumptions by reusing waste (both in everyday life and in construction), in a circular economy approach. Today, Aeolian islands live an important transition towards more sustainable forms of living, being energy, water, waste and mobility management the sectors where more control is needed. Due to the connection that vernacular buildings have with these sectors, it is important to define new valorisation strategies which can, at the same time, preserve the identity of the architectures and improve their environmental performances. As regards the cultural built heritage, it is necessary to realise the necessary interventions (as those aiming at decreasing energy needs and improving envelope's performances), thus avoiding the mutation of peculiar characteristics and materiality of these architectures, also by adopting sustainable building materials and compatible processes. A precarious balance between tradition and innovation, fragile and dynamic, which must focus on the preservation of the past through its enhancement in the future.

Acknowledgements

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The Z Free Home – inspired by vernacular architecture

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Topic: T1.4. Sustainability of vernacular architecture

Abstract

The Z Free Home is an eco-cycle home that is meant to represent a return to natural design solutions inspired by the passive and low environmental impact principles found in vernacular architecture. Throughout the centuries, vernacular building has exemplified climate resilience, resource efficiency and circular economic principles. The house will thus use these principles as design guidelines. It will be designed to offset all of its carbon emissions and aim to reach a negative carbon footprint. The Z Free Home will be built using bio-based fibres that can be repurposed from agriculture waste, meaning that when it is time to demolish the building, all its main components can be re-used again as building materials, food for animals, or biofuel. Even if an uninhabited Z Free Home is not demolished, most components will eventually rot and return to nature as compost. Building materials from the kitchen and toilet should however be recycled and reused so as to maintain the standard of zero waste. The house will be designed so as to construct in only 7 days with the help of 7 volunteers through a 'do-it-yourself' methodology and using only screwdrivers. All of these factors - zero energy, zero waste, zero carbon, zero labour cost (if you build it yourself), zero impact on the environment when the building is demolished – make the Z Free Home a unique challenge to design and build. This paper will discuss the methodological approach and show some preliminary results from the proposed low impact building envelope using natural materials (clay and plant-based materials like straw, reeds, wood, kenaf and jute) together with the passive and eco-cycle systems. As the project is still underway, this paper will describe outcomes to date and ending with a discussion on the next steps.

Keywords: *negative carbon building material; bio-based building envelope; natural fibre reinforced composites (NFRCs); biodegradable building material.*

1. Introduction

1.1 Study background

Limited global resources and the mounting climate crisis are among the greatest challenges faced by mankind today. There is a growing recognition that there is no planet B and that addressing climate change, biodiversity loss, mass extinction and environmental damage and pollution may be the principal challenges of our time (Hes & Du Plessis, 2015). Building and construction account for more than 36% of global energy use and 39% of energy-related carbon dioxide (CO_2) emissions (IEA, 2019). Moreover, over four million deaths each year are attributable to illness from household air pollution (IPCC, 2018). In recent years, the building sector has moved towards energy and resource efficiency, yet still not enough has been done to offset the rising energy demands from the building construction industry. Over the next 40 years, it is expected that 230 billion square metres in new construction will be built worldwide, the equivalent of adding a city the size of Paris to the planet every single week (REN21, 2018).

In conventional mass building, using industrial materials is the quickest and easiest solution. Environmental impact is not considered a high priority. Fortunately, many opportunities exist to deploy energy-efficient and low-carbon, passive and eco-cycle solutions for buildings and construction (Dabaieh, 2016; Dabaieh & Serageldin, 2020). While such ideas are not yet mainstream in the building market, especially within the residential sector, the Sustainable Development Goals are giving new purpose to businesses, their buildings, and how they are designed, constructed and used (French & Kotzé, 2018). Ambitious action is needed without delay to avoid locking in long-lived, inefficient buildings assets for decades to come.

1.2 The Z Free Home idea

The ‘Z Free Home’ aims to have a net zero environmental footprint using a return-to-nature design for a residential unit. Short construction time, low building costs and zero environmental impact are the main outcomes that this project strives to accomplish. The final project aims to exemplify how a 25 m^2 eco-cycle home prototype can reach nine ‘Z’ targets – zero emissions, zero energy, zero heating, zero cooling, zero waste, zero life cycle costs, zero labour cost, zero indoor air pollutants and zero impact on the environment after the building is demolished. The house’s main components, roof, walls, and floors, together with interior furniture, are to be built out of plant-based materials. The house will be equipped with passive and eco-cycle systems aimed at closing the loop so the building will be self-sufficient with no pollution, waste, or harmful impacts on the environment or occupants. The house’s innovative design intends to eliminate the energy demands for heating, cooling and power needed for water heating and cooking by using natural energy from the sun and wind together with household bio-waste. It is expected that these innovative passive and eco-cycle architectural design solutions will perform better than current energy efficient buildings and should save up to 60 % of household energy consumption compared to the current international and Swedish standards for energy efficient housing. As an energy self-sufficient house that uses renewable energy sources, the goal will be for the house to produce more energy than it consumes so that excess energy can be put back into the grid for later use or in case there is a deficiency in energy production. The idea behind the passive eco-cycle systems is that they should be low-tech and easy to install as plug and play systems for flexible use by the residents. They should also be easy to operate and maintain throughout the lifetime of the building. The house prototype will be built and tested in a cold climate urban living lab. The architectural design is shown in figures 1,2 and 3.

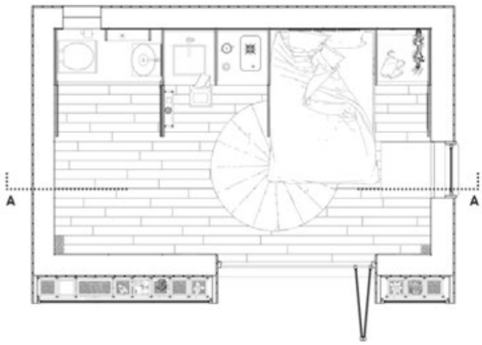

Fig. 1. A plan of the Z Free Home, showing interior amenities for eco-cycle compact living.

Fig. 2. Section AA showing the detailed design for all eco-cycle details in the bathroom and kitchen integrated with furniture.

Fig. 3. The house south façade showing the integrated design of the hybrid Trombe wall and the green wall as passive systems.

The aim of this paper is to document the preliminary investigative process of designing a carbon negative building material for the roof, walls, floor and furniture of a Z Free Home inspired by vernacular and traditional building construction materials in Sweden. The idea is to form a bio composite material consisting of natural fibre from agricultural waste as a reinforcing agent and filler for binding the building skin. The composite material will be used to form the Z Free Home's building envelope in order to reach carbon negative emissions during the building's lifetime.

1.3 Literature overview on bio composites & natural fibres (NFs)

Bio composites have been investigated by researchers and industries as a means of developing sustainable and biodegradable products. They come at various scales through using natural fibres as reinforcement as they are biocompatible, biodegradable, created from renewable resources and have superior physicochemical and mechanical properties (AL-Oqla et al., 2017). Due to their superior physio-chemical and mechanical qualities, natural fibres play a vital role in the composite industry. As a result, they are widely employed in many applications to replace expensive and non-renewable synthetic fibres such as glass fibre, carbon fibre, and aramid fibre (Syduzzaman et al., 2020).

Previous research on natural fibres in composites concentrated mostly on thermal, mechanical, and structural aspects. According to reports, the usage of natural fibres has various benefits owing to their inherent features, such as their light-weight, low density, renewable, and environmentally friendly structural composition. Despite these advantages, natural fibres have certain disadvantages, such as their hydrophilic nature and excessive moisture absorption. These disadvantages could be overcome by applying various surface treatments to the fibres and through using coupling agents (Jamaluddin et al., 2020). Natural fibres are classified as vegetable, animal, or mineral fibres. All vegetable fibres (e.g., cotton, flax, hemp, jute, etc.) are composed of cellulose, while animal fibres are composed of proteins (e.g., hair, silk, wool). Natural fibres can be utilized directly or in the form of chopped fibrous strands, non-woven matting, or fabric (Nickel & Riedel, 2003; Saba et al., 2014). The reinforcing fibres in bio composites must have high tensile strength and stiffness. The reinforced fivers act as embedded matrix gives the composite structure its shape, transmits shear forces between the fibres, and protects them from radiation and harsh conditions. The stiffness and tensile strength of a composite is the main factor for selecting the suitable fibres. Other factors to consider when selecting the reinforcing fibres include elongation at failure, thermal stability, fibre-matrix adhesion, dynamic and long-term behaviour, price, and processing expenses (Nickel & Riedel, 2003).

It has been shown that natural fibres can be utilized in a wide range of applications outside textiles, including composite materials, construction materials, heat and sound insulation materials, among others. Composite materials may be made with almost the same qualities using these components as a replacement for glass fibres. For example, they could replace glass fibres in composite materials, as they have virtually the same material qualities as those of glass fibres.

In recent years, lignocellulosic fibre reinforced composites (such as hemp, flax, and jute) have been employed effectively for light-weight applications, particularly in the automotive and construction industries. This is important in order to reduce the estimated 75% of energy used by automobiles, which is mostly due to vehicle weight. However, significant limits on the structural applications of these composites remain (Dhakal et al., 2018). The cultivation of fibre plants like hemp and flax has become more common in European agriculture over the last two decades.

The conventional construction industry plays a large role in environmental pollution and the scarcity of natural resources as it is heavily reliant on the extraction of fossil fuels and raw materials. Building industries all around the world are researching alternative sources of lignocellulose fibre due to a lack of wood, forestry laws, and the presumed lower cost of non-wood products (Halvarsson et al., 2009). Cereal straw (wheat and rice), flax, cotton, corn stalks, rapeseed stalks, bagasse, reed, and other non-wood plants are gaining attention as a possible cellulosic fibre source (Cheșcă et al., 2018). Several studies have discussed a possible solution in biologically enhanced materials, which are manufactured by cultivating mycelium-forming fungal microbes on natural fibres and organic waste rich in cellulose, hemicellulose, and lignin. Organic waste streams, such as agricultural waste, can be valorised by using natural binders like mycelium that produce a biodegradable substance at the end of their life cycle, which is compatible with the circular economy.

2. Methodology

The study followed an investigative explorative approach, which included a literature review, field visits and interviews. Initially, the literature search allowed for an introductory mapping of existing sources on natural materials. The focus was mainly on bio-based materials and materials that have the potential to be used in a composite to enhance building envelop properties. Sources include mainly handbooks, encyclopaedias, and journal articles. The search also extended to published experimental research lab reports together with video documentation on experimental work for bio-based materials testing. The literature helped to set a foundation and knowledge base for bio-based material availability, properties, uses, and cost efficiency.

After the literature review, structured interviews were carried out with 5 researchers, 4 craftsmen and 3 factory owners who have experience in using bio-based materials. The researchers are experts in using natural materials in building construction. One is specialized in using bio-based materials for temporary structures and for furniture, one in substrates, one in composites and the other two in using natural fibres from agriculture waste as construction materials. The interviews with the expert researchers were important for understanding the latest advances in bio-based materials and their use in industrial products.

The interviews with the craftsmen were important for understanding traditional as well as contemporary techniques in building with bio-based materials. about the craftsmen shared particularly useful information on the durability of natural materials and specific building techniques that are employed when working with natural materials today.

The investigative approach extended to exploring which materials are available around farmlands in southern Sweden (Scania region). Several field investigations were carried out to explore available biomaterials along with their cost and the implications of transporting them for the experimental use of the project. The local materials that were selected to be tested as a filler or substrate for mycelium in the material composite. The information gathered from the literature and interviews were helpful in putting together an inventory of available materials that could be used in the project.

Material selection started with mapping potential natural materials. These materials were then filtered to ensure they met the following requirements:

- Biodegradable and bio-based
- Ability to be utilized in low-tech construction methods
- Thermal and acoustic qualities

- Breathability
- Carbon sequestration
- Water and fire resistance in a composite material

Some materials were replaced with others due to local or regional availability. Then the materials were classified as natural fibres and filler/substrate according to their mechanical and physical properties and their role in the material composite for the building envelope. The outcome of the literature review will be the focus of this paper's results and discussion section.

3. Results and discussion

3.1 The selected natural fibres for the experimental study

The outcome of the literature study and the investigative field visits resulted in choosing flax and hemp as the two fibre sources and reinforcing agents to the composite. The main reasons for selecting the two materials are their availability regionally and their physio-chemical and mechanical properties. However, the research also revealed the need to explore the limitations and possibilities of flax and hemp as structural components in natural fibre composites. As for the filler and substrate, reeds, hemp hurd (shives), wheat straw, rapeseed straw, corn stalks and seaweed were selected. While for the binding technique, which also relies on bio-based and natural bonding materials, the choice was between two approaches. The first option was to employ Mycelium, which is mainly found in the vegetative part of mushrooms and can be used to create a foam like, lightweight, biodegradable composite material that acts as a natural binder. The second option was to use bio-based adhesives. These can be found as raw material in renewable and organic resources. Fig. 4. shows the classification of the selected materials for reinforcement, filler and the binding technique.

Fig. 4. The classification of the selected materials (natural fibres and fillers/substrates) and the targeted binding techniques.

3.2 The building envelop proposal

The outcome of the interviews with expert researchers and craftsmen together with the literature search informed three experimental trials with the selected materials. The outcomes of these trials should help inform the construction of the Z Free Home's building envelope.

The first trial will involve a one-layer composite. This method will be used as an introduction to using the selected bio-based materials. All materials will be combined with one another in different combinations and then tested for their binding properties.

The second trial will test sandwich composites consisting of two stiff exterior layers and one softer interior layer. The composite will contain two primary components: a multi-layered skin from fibre-rich woven textile and a loose core material combined with mycelium. The outer layers should be hard and filled with a mixture utilizing the selected binding approach (in the case of mycelium, the previously colonized substrate will regrow and integrate into the outer layers).

The third trial will test a multilayer composite inspired by the papyrus making process. Layers of various materials will be layered one on top of another to create a strong and rigid composite. Each layer has a certain function that must be defined before the start of the test. For example, one martials is for compressive strength, one for water resistivity and so on, to specify the materials used in this approach, more data from the previous two composites methods (one layer composite and sandwich composite) is required. When all layers are interlocked, the composition should exhibit a rigid structure that may be employed as a building unit to create a hard surface that is water and fireproof. Mycelium will play a main role which is to bind all the layers together for the final product before pressing or final heating. The layers could be added together before killing mycelium activity in the first stage, or after killing mycelium activity and then drying and pressing the layers to create inner parts that are more rigid and dry.

4. Conclusion

The Z Free Home project is an eco-cycle home that targets 9 different zero (9 Z's) in its design. To achieve this goal, the careful selection of building materials is essential. This study focused on the process of choosing natural materials to use in the building's envelope. The study took cues from vernacular building materials and methods. For example, using natural materials available in the surrounding area. The Z Free Home aims to revitalize vernacular principles through the use of natural and bio-based materials in a contemporary context. This paper reviews the outcome of one main method used in collecting data on the use of natural materials. Material selection was discussed in view of required properties and potential uses. This paper lays the foundation for next steps, which include testing the materials in a lab and then building a full-scale prototype. We hope that this pilot project will provide a proof of concept for the use of traditional natural materials that meet modern standards and demands. The benefits of using natural materials are numerous; however, there are still challenges (e.g., building codes) that hinder the wider use of natural materials in buildings.

The authors of this paper hope that future projects like the Z Free Home will soon bring credibility to natural material in mainstream building, at least in the residential sector.

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Proposals for the sustainable recovery of dry stone buildings in Puglia, Italy

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Topic: T1.4. Sustainability of vernacular architecture

Abstract
Rural architecture in Puglia (south of Italy) is characterized by the mutual relationship between buildings and environment, typical of the spontaneous architecture of the Mediterranean basin. In fact, traditional rural buildings are an example of sustainable development, and their construction features respond to three fundamental issues: climate, building materials and morphology of the territory. Currently, the state of abandonment of the rural areas and the lack of awareness of their heritage have brought about irreparable degradation, followed by interventions incompatible with the identity of the territory. Through the conservation and recovery of sociocultural and environmental identity and the protection of biodiversity, the Puglia Region aims to protect and enhance the architectural and landscape heritage in a sustainable way with the implementation of a regional landscape plan. This study focuses on the small town of Ostuni (Brindisi), in the Apulian area of Murgia dei Trulli, known for its typical dry stone constructions. The different architectural typologies are examined and described, listing the intrinsic bioclimatic peculiarities of their components and specifying the different bioecological actions suitable for any kind of intervention: restoration, recovery, reuse, or even ordinary and extraordinary maintenance. The aim of the project is to develop guidelines for the sustainable recovery of different types of rural buildings in order to suggest minimally invasive technological systems, oriented to the use of renewable energy sources and the maintenance of traditional elements. The proposals aims to respect green building principles, using locally sourced bio-sustainable materials and finishes belonging to the local construction tradition. But also, merging traditional construction techniques with modern technologies and following the principle of "minimum impact" on the existing constructions.

Keywords: *cultural heritage; biocompatibility; sustainable development.*

1. Introduction

Dry stone buildings are typical of the rural environment of Puglia. They are the result of profound changes which aimed to restore uncultivated fields or to transform unoccupied ones into inhabited areas with areas of agricultural activity between the late 17th and 19th centuries. Since then, with the adoption of long-term management contracts such as sharecropping and emphyteusis, land occupation was not always synonymous with ownership. This meant that farmers and shepherds needed to build structures that could meet their living and working needs, often in dry stone. They used local stone, either stratified limestone or the scattered stones hindering agricultural activities on the ground. The territorial heritage of Apulian rural areas is therefore characterized by different kind of constructions including residential buildings; storage and food product processing buildings; shelters for livestock and farm tools; storage and auxiliary elements (wells, cisterns, water troughs, etc.).

At present, the situation of rural building heritage is two-fold. Firstly, these buildings are in a state of abandonment as they are becoming progressively obsolete and fail to meet modern housing standards. Secondly, they appeal to new users attracted by the architectural and environmental quality, but often unaware of their historical value. Consequently, recovery interventions have often been incompatible or unsuitable, partly due to the work of technicians with little regard for the preservation of heritage, leading to alterations of the morpho-typological identity of the rural buildings.

At this point in time, when the COVID-19 pandemic has completely altered social and living dynamics, rural areas also represent an opportunity and a resource to mitigate the psychological and physical discomfort resulting from urban lockdown. To users, life in a less polluted environment, far from overcrowded cities, could represent an undeniable benefit which could improve their quality of life. Therefore, interventions on the existing buildings would be needed to adapt rural areas to the new requirements that have arisen. This includes aspects such as the recovery and enhancement of rural heritage, with a view to environmental sustainability.

The Puglia Region, with the adoption of a regional landscape plan (P.P.T.R. – Piano Paesaggistico Territoriale Regionale, D.G.R. 16 February 2015), aims to promote and achieve self-sustainable socioeconomic development through the conservation and recovery of sociocultural and environmental identity, and the protection of biodiversity.

This research aims to implement and establish the guidelines of the plan in order to create a reference tool for all those involved, from specialists to the general public, raising awareness and promoting involvement in the protection of our cultural heritage.

2. Research objectives

This research follows the reflections developed during the lockdown period caused by the COVID-19 pandemic, which forced us to live indoors without access to social spaces or green areas. This situation has inevitably changed our lives, testing both our physical resistance and our mental health. Forced cohabitation in spaces which were often small or unhealthy, not designed for certain daily activities (work, study, sports, socializing, etc.), has revealed the inadequacy of housing and has made it vital to rethink the concept of physical and mental well-being.

Professionals and academics are currently reflecting on the challenges to architecture and urbanism highlighted by the coronavirus pandemic.

The overall picture is complex. On the one hand there is the emerging collective demand for air quality, nature and spaces for social interactions, while on the other it has become increasingly difficult to provide answers for a highly individualized society, where even intermediate organizations are losing relevance (Nigrelli, 2021).

Moving to decentralized rural areas is a potential solution to this post-pandemic challenge. An example of this can be seen in southern Italy, with the phenomenon of *south working* (Magliaro, 2020), where workers and students were able to return to their place of origin. This meant that they could benefit from the possibility of working from home, which grew in popularity immediately after lockdown restrictions first eased. In this respect, rural settings may well offer the answer to the new needs which have arisen, and also provide residents with a chance to improve their quality of life. In fact the region's typical constructions show great potential given their shape, proportions, and relationship with nature, as all these elements can create a suitable atmosphere ensuring both physical and inner well-being (Flore &Venezia, 2020).

However, given the state of abandonment of this rural architectural heritage there is a need for recovery and redevelopment, adapting the existing rural buildings to the new requirements, and preparing for any similar situations in the future.

Following personal experience of the circumstances in the rural area of Ostuni, both as a freelancer and during a work experience in the Local Landscape Commission[1], a series of statements can be made.

Many of the interventions carried out between 1960 and 1990 were characterized by design choices which ignored the value of local architecture. At a later stage, a process of pseudo recovery-reuse, especially in areas with a large amount of tourism, was expressed through design solutions and execution processes typical of modern construction. Thus, the traditional construction technique of dry stone was slowly but surely forgotten, replaced by the more convenient reinforced concrete (Pecoraro, 2012). The use of non-traditional materials and construction techniques, the typological distortion of the housing unit, the arbitrary removal of lime plaster from the walls, the demolition and reconstruction of vaulted systems rather than their restoration, are just some of the most common aspects of the phenomenon. This highlights the problem of awareness of our cultural heritage and our approach to it. This concerns not only some technicians and building companies, but also private clients, who are often unaware of the value of their properties and guided by their personal preferences.

Although existing urban and landscape tools contain extensive information about the correct planning of building interventions, they require detailed study and constant comparisons. Moreover, as the current master plan has not yet been adjusted to P.P.T.R., there are occasional problems when interpreting the legislation. Hence the need for an instrument to outline the information contained in the plans, a table summarizing the specification of the possible types of degradation, as well as the recovery measures, and the permitted materials and techniques.

3. Methodology

The research began with the study of the guidelines found in the P.P.T.R., the regional planning tool, including the design criteria, materials and intervention techniques contained in the master plan, and the indications contained in the building code of Ostuni. At the same time, the characteristics of the territory and the recurring architectural morphotypologies were analysed, focusing especially on their intrinsic bioclimatic peculiarities. A review of the bibliography helped identify the relevant information sources. The most appropriate sources were obtained from research into books, publications, articles and documents related to the subject. The quantitative methodology followed identified the strengths and weaknesses of the existing documents using data compiled from the land management tools mentioned above. Although the information obtained was extensive and detailed, at times it appeared fragmented and could give rise to confusion. Therefore the existing information was then cross-referenced and implemented after a search of local biocompatible materials in use and/or proposed by research entities.

4. Subject of study

4.1. Territorial framework

The region of Puglia is divided into 11 territorial areas, considered on a subregional scale and characterized by specific relationships between physical-environmental, historical, settlement and cultural components. The area of *Murgia dei Trulli* is located in the southern part of the Murgian plateau. It is almost entirely made up of a ridge of dolomitic limestone, covered by patches of recent calcarenitic or clayey deposits (red earth). In addition, the landscape is shaped and fragmented by many karstic formations. The area's characteristically rural landscape alternates vineyards, olive groves, forests and arable

[1] The Local Landscape Commission is a collegiate technical body which delivers mandatory opinions, delegated to Municipalities and established pursuant to art. 148 of DLgs 42/2004 and art. 4 of LR 32/2008. Any intervention carried out in areas considered to be landscape heritage is, in fact, subordinate to the issue of a landscape authorization.

land. This can be seen as the manifestation of the agricultural workers' ability to adapt the stony ground of Apulia, one of the harshest and most resistant elements, to their productive purposes.

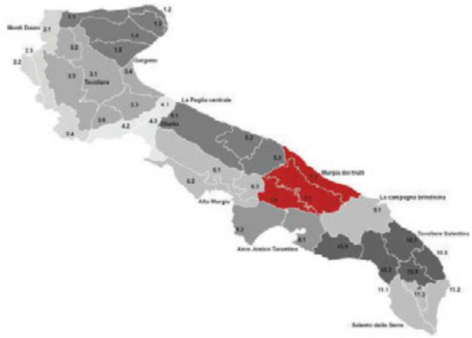

Fig. 1. The territorial area of *Murgia dei Trulli*. (Source: P.P.T.R., 2015)

Ostuni is bordered to the west by the Murgia slope going northeastwards, toward the Adriatic coast. The area is known as *La Piana degli Ulivi Secolari*. The main element of this landscape is the olive grove, recognizable by a thick density of centuries-old trees, irregularly distributed throughout the territory. Its widespread rural architectural heritage, composed of different typologies of dry stone buildings, is a vast wealth of natural and cultural resources to be protected, conserved and enhanced.

4.2. Rural housing: building morphotypes

In rural and traditional Apulian buildings, construction techniques are based almost exclusively on one recurrent material, stone.

Dry stone construction, a technology strongly integrated with the environment and rural tradition, can be identified based on the following:

- the use of calcareous and/or calcarenitic stone, small and medium in size and extracted locally;
- the minimum processing of materials and installation without binding agents or connections;
- self-build buildings;
- the integration of these buildings into the agricultural context;
- the need for continuous maintenance and initial acceptance of the precarious character of the artefacts, both historically and culturally.

The typical building structures of the rural landscape of Ostuni are represented by elementary or complex systems, classified into different typologies, depending on their function.

4.2.1. Elementary systems

There are many forms of "spontaneous" architecture found in the countryside of Ostuni, including storage rooms or dwellings for the harvest periods, such as barns, trulli, *lamie*, *casedde*, etc. These building structures can be classified as monocellular, bicellular or multicellular (when combined with previous units).

The **trullo** is characterized by a regular floor plan and conical roof, externally covered by *chiancarelle*[2] arranged in concentric circles that narrow upwards and closed off by a disk-shaped stone supporting a decorative pinnacle. Thanks to this roofing method rainwater is collected and then transported to an underground cistern. This system provides not only a precious supply of rainwater but also a resource for cooling the air around the water and lowering indoor temperatures during the summer.

Fig. 2. An abandoned trullo (Source: Farina, 2022).

[2] Limestone elements obtained from the removal of stone from the natural soil, carried out during its preparation for agricultural use. These thin plates between 3 and 7 cm thick function sinulaneously for waterproofing and recovering rainwater.

The perimetral load-bearing wall has an average thickness of 0.8-1.5 metres and consists of two walls separated by a cavity filled with smaller stones and earth. The base and the pinnacle were originally limewashed to increase water resistance.
The most frequent construction type, the trullo, consists of a circular cell which opens out onto two small rooms or alcoves. Originally, the central room was the kitchen with the fireplace on the floor, while the side alcoves housed the double bed and closet or a small room for offspring.

The ***lamia,*** a rural building with a square base, had sloping supporting dry stone walls (sometimes incorporating mortar), and the base was completely limewashed. The roof is usually made with a lowered barrel vault or a dome. These characteristically simpler constructions consist of a single room, used as a temporary shelter for the agricultural workers. It has only one low door with a window above it; the opposite wall always features a smaller window at the same height for the purposes of cross-ventilation.

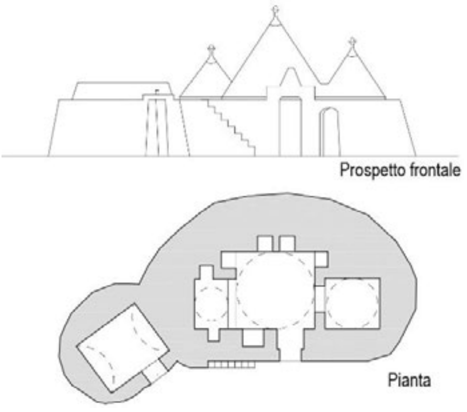

Fig. 3. Aggregative type of trullo and *lamia* (Drawing by the author, 2022).

The ***casedda***, typical architectonic structure of the territory, is built with a variation on the construction procedure used for the trulli. It is a mixed construction combining the base of a trullo with the roof of a *lamia*. The floor plan is rectangular or circular and usually consists of a single room, divided into two or three spaces in linear succession. The external volumes are characterized by three overlapping components. The first, the base, is the same height as the entrance door; the second is a truncated ellipsoid with a perimeter smaller than the base, while the third resembles a dome or semisphere. The masonry, built of small stones, is plastered and whitewashed and the roof is flat and semispherical. The limewashed surface finish is also a frequent feature of these buildings. These were regularly limewashed both for the purposes of hygiene and aesthetics.

Fig. 4. A typical *casedda* (Source: Farina, 2022).

4.2.2. Complex systems

The complex systems consist of freestanding buildings like farms and auxiliary elements such as farmyards, barns, cisterns, kilns, dry stone walls or millstones.

Fig. 5. Detail of a dry stone wall (Source: Farina, 2021).

The **farm**, known locally as a “masseria”, is a large complex permanent rural residence, often with multiple overlapping floors, central to the agricultural organization of large estates. This typology spread throughout the rural territory, and was particularly common between 1400 and

1800. It consists of various extensions of privately owned land and related buildings, which combine residential and productive needs and are managed completely independently. The layouts of these constructions are usually compact farms, linear closed courtyards, fortified enclosures etc. In general, these take the form of a real rural village, composed of several buildings such as the manor house, the accommodation for servants and farm workers, the out houses, animal shelters, stores and other additional elements.

Fig. 6. Masseria Fontenuova (Source: Farina, 2021).

4.3. Bioclimatic characteristics

In line with the principles of modern bioclimatic architecture, Apulian rural architecture represents the response of a society culturally linked to its territory, in terms of climate, orography and landscape.

The construction features are a response to three fundamental issues often encountered:
- Climate: the relationship with a climate alternating between winter frosts and hot summers;
- Building materials: a limited variety of building materials available on-site;
- Morphology of the Territory: the adaptation to geo-morphology, orography and hydrology of the territory (P.P.T.R., 2015).

The main concern for rural buildings is the provision of solutions to counter the long summer heat. The system of orientation to limit exposure to prevailing winds highlights the in-depth knowledge of the characteristics of the territory, together with the development of bioclimatic constructive strategies and systems which exploit the few local resources available to satisfy basic comfort and living needs.

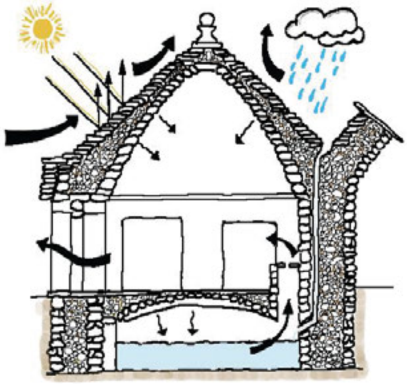

Fig. 7. Bioclimatic characteristics of a trullo (Drawing by the author, 2022).

A recognizable and predominant feature is that of the thick external masonry which protects from extreme external climatic conditions (harsh winters and long hot summers), combined with few small openings (doors and windows). In fact, this system exponentially increases the thermal inertia of buildings and implements a thermal shift between night and day, giving rise to real heat exchanges. The mixture of lime, red earth and clay used to seal the ashlar (stone masonry) helps to delay the entry of the thermal flux of solar radiation and to insulate and protect from heat dispersion during the winter. The external finishes are also of importance: the typical white limewash reflects the solar radiation, thus avoiding heat accumulation. The collection and reuse of rainwater, stored in underground cisterns waterproofed with hydraulic lime, is an example of sustainable water management.

Fig. 8. An example of sustainable intervention (Source: Farina, 2019).

Fig. 9. An example of sustainable intervention (Source: Farina, 2016).

Fig. 10. An example of sustainable intervention (Source: Farina, 2018).

Fig. 11. An examples of incompatible intervention (Source: Farina, 2018).

Fig. 12. An examples of incompatible intervention (Source: Farina, 2016).

5. Conclusion

The protection and enhancement of architectural and landscape heritage is a fundamental task for the preservation of our history and culture. Among the heritage, rural architecture is one of the most typical elements, witness to the local population's capacity for adaptation to geographical and environmental conditions.

At present, with a pandemic affecting the entire world population, the rural context has acquired greater importance as a result of the requirements made apparent by the lockdown period. Thus, greater emphasis is placed on the need to enjoy open spaces, in contact with nature, in a less polluted environment, far from physical and structural limitations imposed by the city. For residents it represents, in essence, a possibility to improve their quality of life. At present, part of the rural building heritage is in a state of abandonment or degradation. This can be attributed to several factors, including lack of maintenance, necessary for its conservation. It is precisely this kind of intervention, carried out by the agricultural workers and inhabitants themselves, which has preserved the typical rural buildings. However, inadequate interventions have stripped these places and territory of their natural identity. It is therefore essential to put into practice building interventions aimed at the enhancement of architectural and landscape heritage through the conservation and recovery of sociocultural and environmental identity, the protection of biodiversity and sustainability. In this regard, greater awareness and involvement of the local population are necessary and should be encouraged. This research attempts to provide a tool which can be of use to technicians, building companies or individuals, as well as serving as a model applicable in other territorial contexts.

Thus, the general principle to be pursued is that any maintenance work, recovery, etc. should be part of a collective action, tending for landscape and architectural conservation.

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Casa Nautilus Solar – Organic contemporary Architecture based on Vernacular Heritage

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Topic: T1.4. Sustainability of vernacular architecture

Abstract

The common ground between vernacular architecture and contemporary ecological organic architecture (Ecohabitar, 2011pp21) emerges from regional activity adapted to local climate while using natural materials from the surrounding area. A healthy environment is created through the principles of Habitat Biology, which is based on the empirical wisdom of past generations. These actions were, and still are, highly sustainable and regenerative through a "closed circuit" of resources without any damage to the ecosystem. We propose a family home with building biology criteria and bio-climatic design, based on the use of high quality building materials: load bearing walls of sun-dried earth blocks with hemp insulation, earth and lime renders with natural paints, a timber structure and an organic green roof, working together to create healthy, pleasant spaces. This house sets the stage for a life project in a rural setting, focused on a farming and livestock initiative. Independence from the water and energy grids is made possible by rainwater harvesting, a well, a compost toilet, grey water treatment with aquatic plants and the use of renewable energy with simple technology (photovoltaic panels, thermal panels and a heavy Kachelofen-type wood burning stove). The design and form are adapted to the agricultural landscape and emerge from the interior and exterior needs of its inhabitants: solar orientation, exposed construction systems, the proportions of the golden section and appropriate interior and exterior colours.

Keywords: *building biology, organic architecture, green roof*

1. Introduction

Our client´s objective is to create a respectful life project in the remote rural setting of the Sobrarbe region in Huesca, Aragon. Self-sufficient and off-grid, using sustainable building materials and focusing the project around a farming and livestock business, which includes the farmyard, an energy systems structure and a renovated agricultural barn.

A carefully created micro-climate provides the interior and exterior comfort required, in terms of temperature range, humidity, colour, plant-life, natural light and controlled artificial light. Nature is always the basis (Cook,1996).

Fig. 1. Main facade from the southeast

The project meets the standards of the 25 rules of building biology (www.baubiologie.es/25-pautas/) wherever possible (IBN-IEB).

The used materials are:

- Load bearing walls with clay and hemp fibre sun-dried bricks
- Lime mortars and renders (avoiding cement)
- Minimum of reinforced concrete: only for foundations and ring beams
- Mud render for interiors
- Timber for the horizontal structure and all carpentry treated with natural oils and resins
- Natural fibres and granulates for insulation
- Carefully chosen paints: natural products with no added synthetics or VOCs (Volatile organic compounds)
- Tadelakt instead of tiling
- Terracotta tiles treated with natural oils and resins
- Polypropylene (PP) and polythene (PE) tubes with no added PVC or halogen products

The four buildings form a small survival nucleus: the house, a structure for the energy systems (car porch), which permit energy independence, the agricultural stable for the livestock and the renovated barn – along with the water well, the reed bed and the planting of a variety of trees and a vegetable garden.

The built area of the house is 223 m^2 (including 34 m^2 of garage and 30 m^2 of conservatory) and 118 m^2 of outbuildings (car porch, stable and renovated barn).

Fig. 2. Main living aerea

2. Good intent and participation of the owner

Teamwork has been a key element right from the start, with a high level of collaboration and good intent with special focus on achieving close harmony at every stage of the process: not only in the development of the project between architect and client, and communication with the local authorities, but also with the different trades throughout the building process.

Fig. 3. Rural aerea: casa Nautilus and energy systems structure

The owner explains:

"This is a two headed project. On one hand is the desire to finally have my ´farm´, made up of a home and an integrated livestock business, brought about by combining age-old local techniques with more recent ideas on energy efficiency, zero waste, sustainability and integral management. On the other hand, given my experience in the tourism sector, there is the challenge of promoting the ´farm´ as a tourist attraction with two aims: purely for tourism (truffle-tourism, animals and farm jobs) and raising social awareness of this integrated way of life within our environment, while always looking for the correlation between our different needs and the resources that the earth provides. In this way we can work towards a rational use of natural resources, which, as society is starting to understand, are limited and ever more scarce. This is basically about applying Social Business Responsibility to the tourism sector and to livestock farming. That's why the house, as well as being totally integrated into the landscape, is self-sufficient in terms of water and energy. The only waste it produces are plastics, glass and paper, while organic material is composted and grey water is processed by the reedbed. In addition, we'll try to ensure that our crops as well as our livestock come from 100% local species; from local holly oak to latón pork, olive trees, fruit trees and horticultural seeds in a totally organic way".

3. Sensitive architectural design

The form of this single storey house arises as a sensitive response to the land that it sits in. Its geometry, free of straight lines, and with gentle movements, adapts comfortably and in harmony to the natural forms that surround it (Van de Ree, 2001). The main spaces in the building are facing south where it has a conservatory for the capture of passive solar energy. The impressive views to the north are taken into account, as well as protection from the cold northerly winds. There is a central skylight which illuminates all the rooms. The compact volume of the house results in savings on building materials and energy.

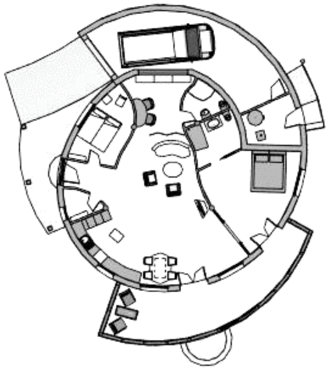

Fig. 4. Ground Floor

The house's floor design is like a spiral, following the path of the sun, with a large south-facing living room/kitchen/dining room leading onto the en-suite master bedroom, the guest room, the bathroom, the larder and the conservatory. This glazed structure, thanks to its position and shape, is exposed to a large part of the sun's journey from east to west with notable solar energy benefits. The heat passes through the interior windows and doors into the living room and bedroom. In summer the glass-roof is covered with an awning, and by opening all the windows it is transformed into a shady porch area that cools the south facade.

Fig. 5. Conservatory

The main entrance to the house is on the west facade giving direct access to the vegetable garden. In addition, there is a vehicle access from the track. The garage-workshop along with the energy systems plant room acts as a barrier against the cold northerly winds.

4. Simple construction

4.1. Ground floor in contact with the earth

Once the earth had been cleared of vegetation and compacted, a 20 cm bed of gravel for drainage was laid. Then a double layer of polypropylene was applied, and a 15 cm slab of "bio-concrete" composed of hydraulic lime, sand, gravel and polypropylene fibres to prevent shrinkage. On top of this a 10 cm layer of insulating screed made up of a wet mix of natural cork granules, sand and hydraulic lime was applied. The floor was finished with terracotta tiles laid with a lime mortar.

Fig. 6. Fireplace and Skylight in Living Aerea

4.2. Exposed structure

Use of reinforced concrete has been kept to a minimum, only used for foundations and ring beams. Continuous reinforced concrete foundations were topped with a rubber damp proof coarse (EPDM). Then a 30 cm load bearing wall was built using sun-dried bricks of earth, lime and hemp fibre ("Cannabric") up to the height of the concrete ring beam (Canapalea, 2018). The ring beam's exterior was insulated with 3 cm natural cork boards to avoid cold bridges.

Fig. 7. Skylight, north-window and visible clay bricks

The primary structural beams are supported by four central timber posts. The basic timber framework supporting the building is exposed so that the roof structure is clearly visible, thus contributing to the interior aesthetics of the house.

Fig. 8. View from Southwest

4.3. Healthy building materials

Natural building materials were selected because of their minimal processing and therefor low environmental impact and low carbon footprint. Dubious chemical products were avoided and technical data was rigorously examined for all materials used on the buildings. The materials used have a good balance between hygroscopicity, humidity regulation and thermal mass, ensuring optimum air quality. The main elements used are earth, wood and lime.

Natural cork insulation was sourced and ample layers were applied to the floors, the exterior walls and the roof, leading to a significant reduction in energy consumption.

Cannabric blocks were also used for the interior partition walls, with a width of 9.5 cm and a height of 2.30 m, leaving the roof structure exposed.

All windows and doors were made from timber and the exterior double glazing was specified at 4/16/4. The conservatory exterior windows have single glazing while the roof is glazed with reinforced laminated glass.

The interiors are rendered with various shades of earth based mortar. Instead of tiles, tadelakt is used as a finish on the kitchen surfaces and splash areas, as well as in the showers and bathrooms: an artisan technique using lime and striking natural pigments with a surface texture that is very pleasant to the touch.

The exterior walls are rendered with several layers of slaked lime mortar and finished with silicate paints. All paints were chosen without added synthetics or VOC's. Natural oils and resins were used on the terracotta tiles and woodwork.

4.4. An earth roof – a natural "sunhat"

Fig. 9. Green Roof from the North

An organic green roof acts as a protective sunhat. The plant life that covers it is an ecological solution and has considerable economic advantages (Minke, 2005):

- the plants produce oxygen and absorb CO_2

- it compensates for the loss of the original ground space the house was built on

- it absorbs particles from pollution and dirt

- it prevents overheating in summer and reduces extreme temperature and humidity changes, in dry season it acts as thermal and generally acoustic insulation

- it will last nearly indefinitely.

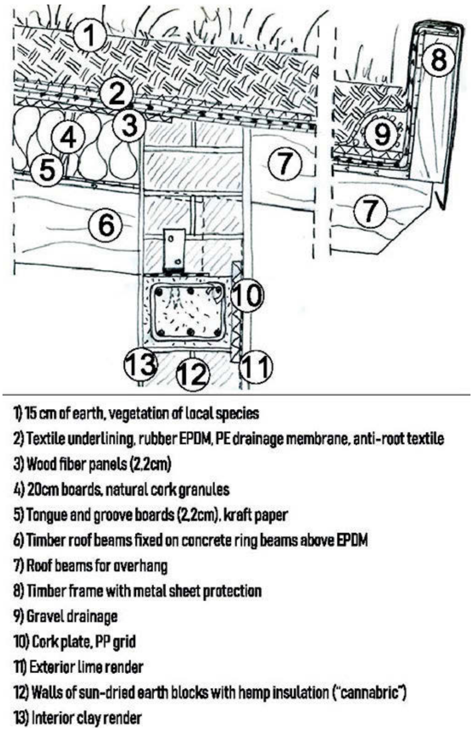

Fig. 10. Constructive section of the green roof

In this case it was built around a central skylight. The roof opens out to the south and drops steeply to the north, where there is an arched dormer window. As already menctioned the interior timber structure is visible - in the shape of a radiating mandala - and can be seen from all the rooms. Tongue and groove boards were laid on top of the structural timber beams, followed by kraft paper membrane and a 20 cm layer of a wet insulation mix of natural cork granules and a small amount of sand and lime. Textile underlining and rubber EPDM were put under a polyethylene studded drainage membrane with an anti-root textile lining followed by 15 cm of earth. Local species like lilies and sempervivums were planted, avoiding any need for irrigation.

5. Independent water treatment in a closed circuit

Water self-sufficiency has been achieved with several important water capturing elements: a tank for harvesting rain water, a well, and also natural water saving and water purification systems. Rain water and well water are used for sanitary water; both have their own filter systems.

5.1. Compost toilet

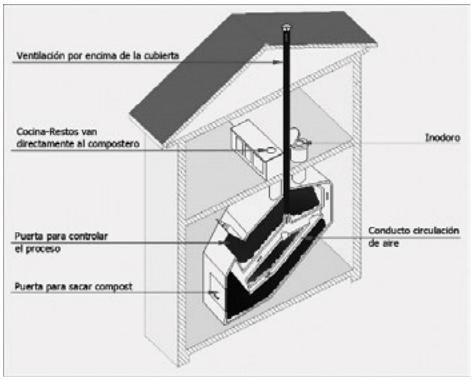

Fig. 11. Function of a compost toilet

Water use is reduced through the use of a clivus multrum type compost toilet which also produces natural fertilizer. This system has been invented in 1930 by the Swede R.Lindstroem. It is a dry system: water is not used, so there is no need to treat it. Organic material decomposes into compost which can be used as fertilizer on fruit trees. The system comprises a toilet bowl in each of the two bathrooms with two wide, straight tubes feeding into a collecting tank in the garage where the compost is harvested. A perfect environment for micro-organisms is created inside the tank with continuous air ventilation provided by a chimney that goes through the roof. With the chimney effect- the warm air in the tank rises – and with the help of a ventilator, a constant upward flow of air is guaranteed, avoiding bad smells on opening the toilet lid. The collecting tank is insulated to maintain an optimum temperature for the biological process in the interior. With a base inclination of 30º, the contents slowly slides down and forward so that only decomposed material reaches the front of the tank where the compost is harvested. As the material is dry, only 0,02 m^3 (2 buckets of 10lt) of compost is produced per person per year.

5.2. On-site waste-water treatment with a reed bed

Grey waste-water is treated with a reed bed system. These aquatic plant systems have existed in several guises since their invention in Germany in 1973 and are being used for villages of up to 120,000 people as well as for family dwellings. Efficiency studies and water testing have demonstrated them to be more than satisfactory. In 1995 the German Ministry of Environment completed an eight-year study about the functioning of 20 different types and sizes of reed bed water treatment systems for black water. The results showed that the effects of this treatment and its hygiene conditions are far superior to those of conventional water treatment systems. Treatment of organic material was more than 95% and it was up to 99% for nutrient substances. The biochemical DBO5 demand was 5 mg/l and the biochemical DQO oxygen demand was up to 80 mg/l.

6. Self-sufficiency with efficient systems

Fig. 12. Kachelofen built out of Bricks

Most of the heating needs are met by the considerable amount of passive solar heat coming from the glazed conservatory. As a back-up, at night or on cloudy days, there is a heavy brick build wood-burning stove (Kachelofen), plastered with clay, providing radiation heat to the main space. The smoke passes along several metres of chimney through two bathrooms and the bedroom, heating them on its way while only minimal amounts of fire wood are used. Additionally, provision has been made for the installation of a biomass burner for under floor heating, however this has not been necessary during the first few winters.

In summer, with natural nocturnal ventilation, there is little cooling requirement. This is due to the high level of insulation and moreover, the thermal inertia provided by the floors and walls.

Hot water is produced all year round by two thermal solar panels with a total area of 4 m^2, installed on the roof of the car porch.

Electricity is provided by an off grid 5 kw photovoltaic system, also installed on the same roof of the car porch where the batteries, inverter and generator are stored.

All cables and tubes are PP or PE, avoiding halogen materials and PVC.

7. Conclusions

Organical architecture, together with the sustainable aspects of Building Biology (Baubiologie), is deep-rooted in vernacular heritage.

In this contemporary arquitectural project the three main principals of vernacular heritage are fullfilled:

- Environmental: respection of nature (e.g. materials), appropriately situated (e.g. integration), reduction of pollution and waste materials, health quality (e.g. ecological materials), reduction of natural hazards effects (e.g. compact form).
- Socio-Cultural: protection of cultural landscape (e.g. green roof), transfer of

construction cultures (e.g. loard bearing walls), enhance creativity (e.g. organic design).

- Socio-Economic: support of autonomy (e.g. off grid systems), promotion of local activities (e.g. farming), extention of building´s lifetime (e.g. valuable materials and constructive details), saving of resources (e.g. water and energy).

Casa Nautilus is a self-sufficient house and requires active participation on the part of its inhabitants in terms of understanding the workings and maintenance of its systems. Our client has been highly involved in both the development and the construction phases of the building and as a result is familiar with every detail of the buildings as well as the off grid systems and their maintenance. He therefore has no need to depend completely on tradesmen and specialists which is an important step on the path to independence and self-sufficiency.

Also the performance of the building's passive systems relies on the active participation of its inhabitants in order to achieve appropriate general and bio-climatic conditions: opening and closing of windows, awnings and shutters; harvesting compost from the dry toilet etc. The owner understands these needs and is prepared to live in his house in harmony with the different seasons of the year.

Fig. 13. View from the Living Aerea to the Conservatory*

Individual perception of the healthy environment, comfort and well-being is processed by the senses: pleasant smells, lively colours whose shades change in different light, shapes that are easy on the eye and surfaces that are pleasant to the touch - and with a high level of thermal comfort.

This initiative, a life project in a rural area, serves as a prime example within the framework of cultural regeneration (Wahl, 2020) and as a format to be followed: an example of a home that has opted for an innovative organic design integrated into its surroundings, healthy recyclable materials, energy and water self-sufficiency – in effect, a profound commitment to the rural area which it forms a part of.

Fig. 14. Location of the life project

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Making our Rural Landscape visible. A way to defend Anonymous Cultural Heritage

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Topic: T1.4 Sustainability of vernacular architecture

Abstract
As a result of the energy transition, traditional rural landscapes are being threatened by renewable energy macro-projects, often promoted by foreign companies. In response to this threat, our project aims to bring to light the cultural heritage concealed in these landscapes, built over centuries by wise hands and minds, using the natural resources available at the time, in order to highlight their value and later defend them from this threat. The specific case under analysis are the surroundings of El Perelló and L'Ametlla de Mar, in Baix Ebre (Tarragona, Spain), a site with Neolithic, Iberian and Roman settlements, in a calcareous geography, situated between the mountains and the Mediterranean Sea. This is a rural landscape, built on a human and family scale, protected by the mountain of Tossal de Montagut, its agrarian mosaic drawn by winding paths and dry-stone walls, with beautiful geometric outlines. A series of domestic elements (houses, wells, hunting shelters and farmyards) represents an organic complex and defines a settlement in balance with nature. It is a place that, if we give in to the threat of these projects, will become an industrial estate, destroying its cultural heritage. We propose reflection on the identity and fragility of these anonymous places, the need to keep alive their memory and their cultural heritage, both natural and built. From the viewpoint of their architecture, we aim to contribute to the debate on the current conflicts between rural landscapes and renewable energies. Our project aims to analyse, record, catalogue, redraw, etc. the architectural elements in the affected landscape (approx. 800 Ha), highlighting the historical value of the place by means of historic archival work and recording the tradition and daily life of local people.

Keywords: *dry-stone, vernacular architecture, rural landscape, Terres de l'Ebre*

1. Introduction

Fragile rural Mediterranean landscapes, made up of a very fragmented parcellation structure, and a minor, anonymous, traditional architecture with no protection or any kind of registration are being threatened by renewable wind and photovoltaic energy macro-projects (Saladié, 2018). Landscapes of great beauty and dignity, shaped by men and women in the course of recent centuries, that reside in the memory of the people and build our identity, now, with the energy transition, in times of democracy, are in danger of disappearing (Nogué, 2010).

The project presented here seeks to value one of the hidden territories affected: to review its history, emphasising the contribution of the community to its configuration, and highlighting its formal, architectural and environmental values for its consideration as cultural heritage (López Daufí, 2010), affording with the appropriate tools to defend it.

A case study is presented of a rural area located to either side of the old N-340 road (Via Augusta) where it passes through the municipalities of El Perelló and L'Ametlla de Mar, in the Baix Ebre county, south of Tarragona. In this specific area, the records of built heritage are very scant (Navarro, 2007) and do not represent the weight of history perceived when passing through it.

A place built some centuries ago by the local peasant farmers, who harnessed its resources to transform an inhospitable place, a desert, into a habitable and fertile place, a paradise (Martínez, 2021). They did so by following patterns of behaviour and construction adapted to the climate, the place and the time: "built by the inhabitants of a territory on the basis of shared models, created collectively over generations" (Gencat, 2018).

This territory remains practically intact and continues to be inhabited, with its inherited culture and ways of life, an example of sustainability, with an economic and social system that keeps it alive. And it remains a place rich in biodiversity: flora, fauna, soil, air, water. Because when people settled there, they established a pact of balance with nature.

With this project we aim to explore the characteristics of this pact from the point of view of built heritage, to propose strategies for its protection, and, finally, highlight the risks involved in implementing this type of project in historic rural landscapes.

We aim not only to create a register of traditional architectural elements, but also to take into account the communal structure of the settlement: the paths, the stone walls, the terraced crops, the water catchment and climate protection systems, and, finally, the buildings related with living and working.

2. A brief historical and geographical description of the place

The town of El Perelló is located on a hillside (150m) on the N-340 road that connects the entire Mediterranean coastline, while L'Ametlla de Mar (which split from El Perelló in 1891 and is also known as La Cala) is located on the coast, between the castle of Sant Jordi d'Alfama and the river Ebro delta.

The area in which study is concentrated is located on the inland plain, between the historic centres of the two towns. The calcareous crust of this rocky geology often outcrops, forming caves that have been used for refuge since Neolithic times (Cova del Duc, Cova de la Masa), including during the Spanish Civil War (Cal Català). The need to collect water in this area crisscrossed by streams prompted ingenious feats of construction and beauty.

The original town of El Perelló has a founding charter dated 1294. It was a walled city, and a royal hospital was built there (1313) (Boyer & Pallarés, 1978). A difficult and perilous journey through the Alfama desert ended at Les Fonts (original name), on the road between Tarragona and Tortosa.

Archaeological remains found in both municipalities place the Via Augusta (Izquierdo, 1989) on the layout of the old N-340 road, today still the backbone of the territory. This is, then, a place of transit and defence, of a mixture of peoples, which in modern times was on the front line of the Battle of the Ebro. Later, in the 1960s, the curves of the N-340 as it passed through the town mark the memories of our parents and grandparents first tourist trips along the Mediterranean coast.

This territory is a small example of the transformation of the Mediterranean coast, beginning in the early eighteenth century, promoted by an economic-legal system of contracts, the *censals*, and real property-useful property, which, together with a major demographic increase, the *fam de terra* or hunger for earth, allowed access to land and, as a result, economic independence for a very large sector of farmers and their families (Congost, 2010). This immense collective effort "was the people who changed the face of the landscape" (Olivas, 2010), which meant razing the scrubland: uprooting bushes, flattening terraces, removing stones and building walls gave the territory the form it still has today. An absolutely visual, geometric, organic shape, built on a human scale.

Scattered across these small properties, of a size that was manageable for each family with their manual work or the help of livestock, are constructions for living, sheltering, farming and animal husbandry, and collecting and supplying water. A cultural heritage written in the margins, a traditional architecture that names no builders, "older by far than any school or any academy" (Sert, 1934), is the foundation of a great Mediterranean culture.

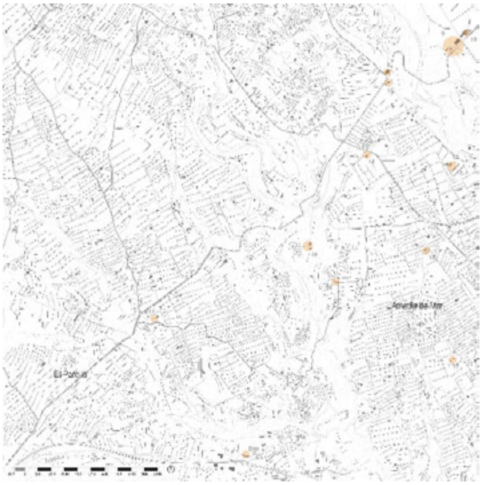

Fig. 1. Map of landscape elements: roads, dry-walls, and buildings. (Source: Authors, 2021)

This type of landscape based on the dry-stone construction technique extends throughout the Mediterranean and was listed as Intangible Cultural Heritage of Humanity by UNESCO in 2018, since "Such structures testify to the methods and practices used by people from prehistory to today to organize their living and working space by optimizing local natural and human resources. They play a vital role in preventing landslides, floods and avalanches, and in combating erosion and desertification of the land, enhancing biodiversity and creating adequate microclimatic conditions for agriculture […]. Dry-stone structures are always made in perfect harmony with the environment and the technique exemplifies a harmonious relationship between human beings and nature" (UNESCO, 2018).

Almost 300 years later, buffeted by the mistral wind, this territory between El Perelló and L'Ametlla de Mar, included in the Terres de l'Ebre Biosphere Reserve (2013), is still alive, with a mixed traffic of cars, tractors, bicycles and walkers, and people who produce quality oil and honey, collect almonds and carob beans, and live in small scattered houses that, in the twenty-first century, remain self-sufficient in water and energy consumption, retaining their original free, family character. It is a place with very high levels of silence, clean air and clear light, with a great diversity of fauna and flora, one of its assets being the traditional constructions and dry-stone walls. They include plant and animal species that are protected or in danger of extinction, such as the European fan palm (*Chamaerops humilis*), bats and eagles.

3. Functions and Values of the landscape

The dry-stone landscape of the Terres de l'Ebre is considered a Landscape of Special Attention by the Generalitat de Catalunya Catalan Government, due to its territorial range (65% of the territory), and for the fact of having a high productive, cultural and aesthetic value that forms part of the identity, the sense of belonging to a place and the landscape imagery of the county (Observatori, 2010).

The transformation of this landscape in the area under study has been minimal, a sign of its resilience as a result of the pact of balance between humans and nature. Characteristics of this current place are:

3.1. Elements in the landscape

- The Cardó-Boix and Tivissa mountains dominate the plain, which extends to the coastline with the river Ebro delta beyond. The closest mountain is the Tossal de Montagut (394 m), the Cathar pass between the Ebro and the Mediterranean, and the backdrop to the lowlands (Observatori, 2010).

These rocky mountains are a reference to the landscape and memory of the place, because each mountain has a symbolic meaning that anchors us to the territory. They are a sacred place and the home to return to. To keep their silhouette clear is to preserve the memory of the place.

- The ravines of La Figuera de l'Hora and Les Bordes, El Sabre and L'Arrevansador, and L'Estany and Pixavaques crisscross the territory. These ravines are almost always dry and force the road and the paths to wind between their straight sections across the plain.

- On the cultivated terraces, hundred-year-old carob and olive trees, planted in regular, orderly layouts by wise minds, produce an oil with a delicate balance of species and flavours, their *raïls* (roots) exposed in a dry, windy terrain. A continuous horizontal plane, a few metres above the ground, that of their canopies, protects the farmers and bind them to the earth. They have a high aesthetic value thanks to the order of their planting, the lines that define the dry-stone walls, and the contrast of colours (Observatori, 2010).

- This cultivated plain is the visual link between the environmental unities of mountain and coast, and has proven its value as a defence against fire.

3.2. Territorial structure

- The old N-340 road (popularly known as the Via Augusta), structures the territory, following the same layout in the plans drawn during the Mancomunitat of Catalunya (1914 c.), and in the Cadastre of 1931 c. Narrow paths to either side, between stone walls, follow the topography, closing circular circuits, and crossing along the territory when they become paths for livestock: *pasos de ligallo*, *veredas* and *cordeles*. The superimposition to current plans shows a structure of paths in balance with the landscape, valid then and still in use today.

- A land division that forms an attractive Mediterranean agro-environmental mosaic based on a small plot (over 40% are less than 2 Ha) called *lo tros* (a size), that can be worked by a family, its boundaries marked by dry-stone walls. Unlike those of other areas, this land division has been consolidated and increased.

- The landscape places no limits to the passage of people or animals, or to the views that extend into the distance, beneath the canopy of olive and carob trees. The perception of a unitary space underscores the sense of belonging to a community, of shared property and joint laws.

Fig. 2. Historic map from the census of properties of L'Ametlla de Mar (Source: Authors, 2021)

- The dry-stone walls organize the land in horizontal terraces to retain the scant rain and prevent the soil from being washed away. Their layouts shape the topography with their pure geometry: straight and staggered lines, sinuous curves. They were built by the peasant farmers, some of whom specialized in the profession of marger, or dry-stone wall builder.

There are different types of walls: The *marges*, one-sided walls, are built to retain earth. The two-sided *parets* mark the boundaries of the property and paths, and, within a property, form stone storehouses, as much as 2-3 metres wide with considerable heights. These walls also provide the basis for shelters for hunters, huts or bee hives, housed in spaces built inside them. They may integrate steps, and gateways or *portells* when they cross a path.

They are built using simple practices of loading and bonding, without *cues de sargantana* (lizard tails), that use all formats of stone. The role of the reble, or infill, is fundamental, often carried out by children and women, and consists of introducing small stones mixed with gravel, sand and mud into the centre-rear and upper part of the wall, which, due to friction and solidification, helps to strengthen it. Crowning the wall with a rastell, large stones placed on edge from side to side of the wall, with variable depths for better bonding, is specific to this area.

Fig. 3. Dry-stone wall (Source: Anna Martínez, 2021)

3.3. Built elements: Character, Typologies, Forms

The constructions of the place are smaller in size, but no less serviceable or lacking in architectural quality. Simple built elements form organic complexes, with close relations and shared geometries. Some of the elements, with a high level of abstraction, are specific to this county.

The *mas* is the small, permanently inhabited farmhouse. It takes the name of the place, or the owner's name or nickname: Mas Pons, Mas del Metge, Cal Català, Mas de Molinos, El Bon Mosso, El Ventero or La Peixo. The central volume, facing south, has one or two floors, with an Arabic-tiled shed or ridge roof and doors made of painted wooden boards, surrounded by auxiliary buildings: sties and farrowing pens, haylofts, workers' homes, circular threshing floors, porches or shelters, cisterns and bread ovens. Masia Pons is an exception in this area for its size and importance, a vestige of an old farmstead that stands beside the N-340 road.

Fig. 4. Mas del Metge, El Perelló (Source: Anna Martínez, 2021)

The *caseta de tros* or *tortosina* is a small building that offered shelter to the family during sustained periods of work, so they did not have to go back and forth every day. South-facing, its position in the property varies, though it is generally central with a rocky foundation; on sloping farms they stand on the lower terraces, working with gravity for harvesting.

The basic typology specific to these counties is the rectangular floor plan, with a steeply sloping shed roof, a central door under a timber lintel in the side façade, protected from the wind, and a small square opening for the loft. It is built of clay masonry, a wooden log structure, reed-mesh ceilings, a ceramic tile roof, and clay or mortar rendering. On the inside, which may be whitewashed, the floor is compacted earth or rock, with a fireplace with a hood and chimney in the corner, at the lowest end.

The same typological solution, unvarying, extends throughout the area, one per plot. Its characteristics are minimum dimensions, harmonious lines and proportions, pure geometry, proportioned openings in the façade, and a simple and exquisite sense of form.

Another typology, of more recent tradition, is the *caseta de volta*, popular at the time of the railways (García Lisón & Zaragozá, 1983), covered with a lengthwise barrel vault. Combinations of the two typologies serve to enlarge the basic small house.

Rainwater is collected via a system of special ceramic pieces leading to a cistern at the side, covered by a barrel vault. A small water tank is built against the façade, next to the door.

In the space in front of the house there is an olive or carob tree at a short distance, with a low circular wall that contains the roots. This marks out a protected domestic space which the family uses to celebrate, rest and eat, "as is the tradition, a house for working, celebrating and meeting" (GenCat, 2014).

Fig. 5. *Caseta del tros* (Source: Anna Martínez, 2021)

There are also separate cisterns on the plot, the cocós or aljubs, used to supply water for livestock. They were situated according to natural hollows in the rocky crust, or wells were dug to collect runoff water. They are enclosed with walls and vaulted ceilings or corbel vaults. An earthenware jug was left to offer water to passers-by.

Fig. 6. A cistern covered by ceramic vault (Source: Anna Martínez, 2021)

Other separate constructions are the folds and the stone huts. The large Corral de Molinos still stands in the centre of the area, at the foot of the Arrevensador path. The huts, with a circular or square floor plan, and a vault or corbel vault of stone and clay, are built into edge walls, or free-standing. They were used to keep tools in, as drying sheds, and for temporary accommodation. This area, beyond La Figuera de l'Hora, or the One-hour Fig Tree (the time needed to get to the town of El Perelló), has few huts compared to the large number of *casetes* it has.

Fig. 7. An *aljub* made by dry-stone walls and vault (Source: Anna Martínez, 2021)

4. Possible shared actions for protection of anonymous architecture

Recording this landscape structure and its anonymous architecture (drawing it, photographing it, understanding it) is the first step to appreciating its value, making it visible, and promoting its maintenance as a result of the appreciation of its people. There are still steps in the project to be taken, in recording architectural elements (walls and constructions), dating them chronologically and, for example, determining the geographical extension of the *tortosina* type and the existence of possible documents with guidelines for its construction.

This architecture of the landscape, in the logic of its implementation and constructive solutions, must continue to be useful and appropriate for its inhabitants and their current ways of life.

The ultimate aim of the project is to provide the owners, local councils and associations, with simple tools to maintain this living tradition (Coderch, 1961).

The following actions are proposed:

- To extend the practice of dry-stone construction. Specific training courses to recover the trade, but also workshops to teach owners the basic principles to recover terraces and constructions. An initial workshop was carried out in collaboration with L'Ametlla de Mar Council and the Cova de la Masa association during Drystone Week 2021 (Col·labora per paisatge, 2021).

- To provide architectural guidelines for measurements and forms to transform the houses and adapt them to current uses and parameters, maintaining the traditional laws of implantation, scale, volumetric fragmentation, geometry, etc.

- To incorporate and use traditional heating and cooling systems (thermal inertia, ventilation and breathability), lighting, sun protection, natural building materials (stone, ceramics, mortars, and lime and clay rendering), and to recover water collection circuits.

- To organize outreach actions to promote the value of this landscape, its balance with nature, in order to maintain and be aware of the fragility of this living system.

5. Final reflection and harsh reality

What began 300 years ago with a collective transformation of the territory, through the achievement of individual freedom, maintaining patterns of behaviour and construction adapted to the place, and facilitated by a prevailing legal regime, could now, in the renewal energies implementation, be repeated by means of the dissemination of knowledge about the place, and an fair distribution of public funds.

On the contrary, a company from outside the territory has proposed the installation, in the area described, of a macro-wind farm, comprising 10 wind turbines located to either side of the N-340 road, each 180 metres high, 3.6 MW and 115.5 dB, between the two existing HV lines. In a diameter of 500 m around the tower, each turbine affects an average of 10 casetes or masos that are inhabited or in use. The over 7km of tracks built in the mosaic of farmland to access the blades of the turbines, each 64m long, the assembly platforms at the foot of each turbine, each 1Ha, the foundations and the troughs to house cabling, the power plant and the new evacuation section and its connections have been designed with no attention to the layout of the territory, its history, nor its inhabitants. If this project, like others in our country, goes ahead, it will turn a rural landscape, community and human-scale built area into a noisy, private and industrial estate, made for machines, and possibly deserted, empty of people. In short, we are facing the destruction of a historical heritage site and, with it, part of our memory, our collective imagination and our identity.

Fig. 8. Superposition of the wind farm project over the rural landscape (Source: Authors, 2021)

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Shuar architecture as a model of sustainability

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Topic: T1.4. Sustainability of vernacular architecture.

Abstract
In recent decades modern architecture has focused excessively on the search for new construction techniques to facilitate and improve the construction process in cities. This has reduced the application of local construction techniques and materials, leading to the neglect of cultural heritage and architectural landscape. As vernacular architecture relates to historical inhabitance of the territory with no theoretical or aesthetic pretences it is a viable model of sustainability. At no point do poverty and nostalgia for the past correspond to the way in which this type of architecture was conceived. The ways of thinking and life of indigenous cultures open a viable path towards the conservation of their architecture. Although nowadays there is an inclination to build following the new tradition of modern materials and typologies, and leaving aside the close connection between the forms of inhabiting and their surroundings, it is necessary to create a heritage awareness of place, where its architecture can be adapted to a new way of conceiving architecture and its spaces to fulfil the needs of a modern society.

Keywords: *Identity; shuar; vernacular architecture; sustainability; cosmovision.*

1. Introduction

The indigenous population of Latin America is extremely diverse. This is especially noticeable in Ecuador, where 6.5% of the total population is made up of 14 indigenous nationalities[1] (Tsachila, Chachi, Epera, Awá, Kichwa, Shuar, Achuar, Shiwiar, Cofan, Siona, Secoya, Zápara, Andoa and Huaorani), principally the Kichwa in the mountain regions and the Shuar in the Amazon region.

Besides, there are 18 indigenous peoples who unlike the nationalities have no ownership deeds to their ancestral territories. However, they both have their own system of social, economic, legal and political organization.

The Shuar[2] people are an ethnic group from the Jivaro[3] linguistic group, consisting of six ethnic subgroups in the southeast region of the Ecuadorian Amazon region, along with other surviving ethnic groups, Shuar and Achuar in Ecuador, and the rest are in Peru, as Figure 1 shows.

Shuar people have a vision of the world which directly affects their way of life and how they interpret space. In shuar language, "*Arútam*" is considered the most important spirit, which governs nature and is present in natural features such as waterfalls, rivers, forests and orchards and can present anthropomorphically, zoomorphically or in natural phenomena. The conception of life is "continuous" for Shuar people; the

[1] This group of people have their own historic identity, language and culture, going back thousands of years. They organize their own social, economic, legal, political, and authority system in the territories they occupy (source: CARE & FLACSO).

[2] Term from the Shuar language meaning "people" or "person".

[3] Spanish-language term derived from the Shuar term.

human being does not have an end when the natural death comes. Therefore, the Shuar people build their own cosmos into sacred spaces such as dwelling, to being connected through a spiritual world (Chiriap, 2012).

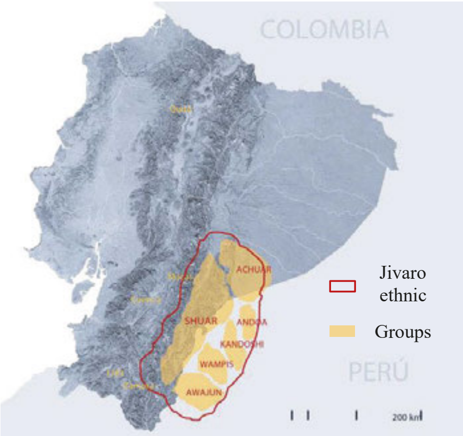

Fig. 1. Ethnic groups of Jivaro linguistic origin. Shuar nationality in Ecuador (Source: Author, 2020).

1.1. The *Jéa*, Shuar dwellings.

The *jéa,* which translates as Shuar dwelling in the Jivaro languages, is a cabin with an elipsoid floor plan located in an enclosure within the jungle. The structure and enclosure are made of palm while the large pitched roof is made of leaves (*kampanak*) (Johnson, 1977).

Historically the Shuar settlements were made up of scattered dwellings, which were not based on groups as such but were rather dwellings occupied by families from the same group. These were not exactly close together, but scattered throughout the virgin forest. Each dwelling represented a social unit, independent from the rest, where the head of the family was in charge of decision-making for the group (Karsten, 2000; Harner, 1978).

The construction of new dwellings was usually linked to new marriages. Initially, any Shuar man marrying a Shuar woman was obliged to spend time in the home of his parents-in-law before subsequently building his own home on different land (Sanz & Herrera, 2017). Families usually abandoned their homes when the land was no longer fertile and there were no longer enough resources to feed themselves and build. It was at this point that they migrated in search of new territories.

Hence, the dwellings are not limited to a given territory but rather are dependent on the natural abundance of the place, as nature itself is the only true legacy that the Shuar feel they have a duty toward.

Shuar dwellings are not just shelters in the middle of the jungle but are the reflection of how the Shuar inhabit space, felt to be a spiritual temple[4] where spatiality corresponds to a microcosm within a macrocosm. The elements that compose it are connected with Shuar spirituality. For this reason the enclosures have no openings and are connected solely by a door at either side, heightening the spatial perception between the (sacred) interior and (profane) exterior (Eliade, 1981).

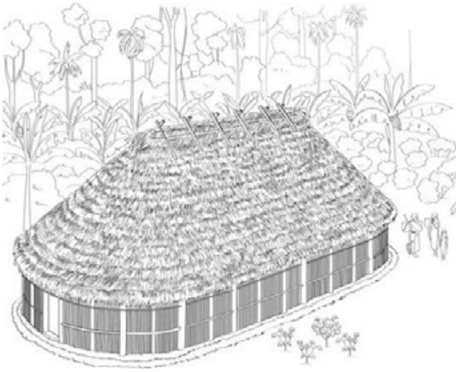

Fig. 2. Shuar dwelling, jungle and vegetable garden. (Drawing by the outhor, edited from Bianchi, 1978).

The interior space is divided into two parts with different connotations, where furniture as important simbolisms marks out this distinction.

On the one hand there is the masculine space (*tankamash*) where more sociable activities are carried out. This space is used to hold ritual

[4] "Todo espacio sagrado implica una hierofanía, una irrupción de lo sagrado que tiene por efecto destacar un territorio del medio cósmico circundante y el de hacerlo cualitativamente diferente" ["Any sacred space implies a hierophany, a sudden appearance of the sacred which highlights a territory of the cosmic surroundings making it qualitatively different" (Translation by the author)] (source: Eliade, 1981).

activities and manufacture weapons or artisanal baskets. Its most important element is the or central post (*pau*) of the house, representing the connection between heaven and the underworld.

Meanwhile, the feminine part (*ekent*) is the most intimate part of the home where everyday family life takes place. The most characteristic element is the shelf (*untsuriri*) resting on two central posts and used to store kitchen utensils and anything relating to household chores (Sanz & Herrera, 2017).

Fig. 3. Dwelling Elements (Edited from Karsten R., 2000).

The interior space is in direct contact with the exterior through an individual access found at either end of the dwelling. The *tankamash* leads to the jungle which represents the macrocosm while the *ekent* is used to connect with the Shuar orchard (*ajá*) used to grow everyday food such as banana, yucca, corn, cotton, barbasco, natem, tropical fruits, etc (Allioni, 1978).

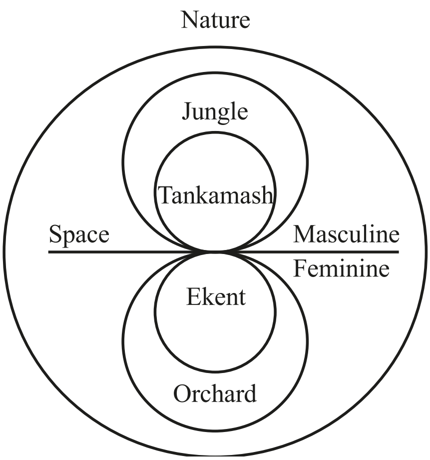

Fig. 4. Diagram of the spatial organization of the Shuar dwelling (Source: Author, 2020).

1.2. Major changes

Shuar settlements have been subjected to a series of influences which have modified how they settle in the territory as well as their way of life.

The first wave of changes in their culture – either direct or indirect – was the result of the Spanish conquest coinciding with the arrival of the first colonizers from the religious missions to the as yet untouched virgin rainforest. There, "internados"[5] or institutions were set up to recruit the younger inhabitants, teaching religion and Spanish and banning the use of their native language. It was considered that they were very far from being able to integrate into the ways of life established in the rest of the country (Gnerre, 2014; Izaguirre, 1978; Rubenstein, 2005).

This was a process of alienation and othering of their identity (Santos, 1996), widely promoting the idea that the indigenous culture has negative aspects at odds with a Westernized way of life. The first students of this process realized they were being marginalized as they were being removed from the family nucleus and the whole cultural universe which identified them as a people (Almeida, 1995).

This new way of life directly affected the Shuar, since practising rites and teaching myths was banned as these were considered to be incompatible with Western doctrine. However, the most important change introduced by religious missionaries was not really the change of ways of thinking, but the shift from the nomadic way of life of the Shuar to a sedentary one, teaching them to work and agriculture. The Shuar settlements ceased to be independent family nuclei and went on to be grouped into centres founded by religious missions. These were made up of a

[5] "Internados" became not only spaces for religious conversion, but also sites which supplied the Shuar with tools and utensils usefull for shuar people. As the natives began to see the need for communication with the incomers in order to be able to defend their land, the arrival of missionaries was accepted in these communities. (See Bottasso, 1993 for more information)

central square where the most important buildings were located, including the church, the “internados” and surrounding dwellings, which came to be modified typologically.

Subsequently, in a second post-independence stage most of the Amazon was left in a legal and administrative void. However, in many of the Shuar communities the development of extraction and production activities led to economic migration, while the migration of urban peoples, particularly to the mountains, rapidly established new cities. These changes brought about a loss of traditional ways of life, the establishment of bilingualism (Shuar and Spanish) and the abandonment of a large part of tangible and intangible material culture.

Finally, a third wave was the globalization process in which we are immersed at present, where the modernization of communication and technology channels and economic migration between countries define this stage as a process of capitalist expansion.

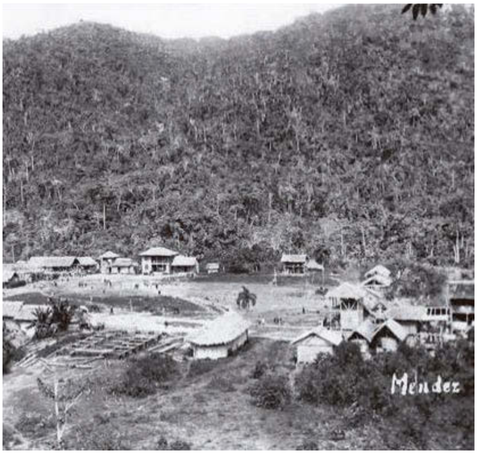

Fig. 5. Méndez, Shuar colonist settlement in 1920 (Source: INPC Photographic Archive).

Nowadays cultural landscapes are no longer solely made up of families, given that groups are no longer strongly territorialized, particularly limited, historically aware of themselves or culturally homogeneous. Instead they are made up of a series of stakeholders characteristic of a world in constant change – workers, tourists, immigrants, refugees – as well as other migrant groups, affecting the policies and regulations of a people.

1.3. Dangers to Shuar architecture.

Frequently, when a person leaves their land and ways of life they also abandon their feeling of identity. This often results in anomia and these individuals no longer feel identified with any of the cultural values of a society.

However, Shuar communities paradoxically find themselves fighting for their ideals based on the way they interpret the world, while trying to assure a higher level of wellbeing for their people. Thus, to some extent multicultural integration is the starting point for better development. Shaping an awareness of heritage is essential in order to prevent this from being damaged by the modern way of life.

Architectural space in Shuar dwellings provides a precise representation of the Shuar cosmovision. Even if forms of construction change this space will find a way to adapt to them, providing the Shuar conserve their heritage values.

This type of vernacular Shuar architecture is directly linked to identity, but is not merely a way of clinging to what is characteristically theirs. If this were the case they would run the risk of being fossilized at a time when globalization makes it necessary to consider multiculturalism. Identity is not only represented by dress or traditions, but also by thinking and how this is reflected in the way of life. In the case of the Shuar, their identity is shaped by their cosmovision and intangible values.

In 1977, Böll wrote what a group of Shuar students stated of their own culture nowadays:

> “Nadie tiene derecho a clasificarnos de no identificados porque no nos vestimos como nuestros ancestros, porque nosotros podemos vestirnos como otros pero, nuestra mente será de un shuar (…) Para

eso están los mitos, ritos y el lenguaje, que son paradigmas que nos inspiran a una tarea verdadera que nos exige la sociedad de hoy, aunque algunos puedan creer que vivimos contemplando el pasado, éste se ha convertido en pasado-presente-futuro." ["Nobody has the right to class us as unidentified because we do not dress like our ancestors. We may dress differently, but our thinking is still like a Shuar (…) That is what myths, rites and language are for, they are paradigms that guide us towards a true task which this society demands of us, even though some believe we live in the past, it has become a past-present-future." (Translation by the author)] (p. 174)

Fig. 6. Religious celebration in 1928 (Source: INPC Photographic Archive).

1.4. Shuar identity

While it is hard to speak of the identity of a people which has undergone different periods of change, today the links between these circumstances can be viewed from many different angles.

On the one hand, the younger generations have lost almost all feeling of belonging to the group, affecting their sense of cohesion. Meanwhile, some groups still conserve a sense of unity with authentic values which strengthen their identity as an ancestral people.

Obviously, the current globalized world does not accept hierarchization and it is necessary to adapt to multiculturalism. In terms of architecture, which reflects social, economic and environmental aspects, forms of conservation have a duty to a constantly evolving social panorama.

Two different paths are observed. In the first, identity can eventually and subconsciously assimilate what the city has to offer without question while the second shows the ability to distinguish what is characteristic of one's own from what is alien to it. The shuar people are lucky that their ancestral territories are still preserved under family usufruct, where an independent social organization is in place and can take over based on the community's needs and interests.

Myths and legends contribute to the conservation of this sense of identity, as they refer to the living identity of the shuar people, passed down through generations with the *anet*[6], paradigms of the evolution process. They are not merely entities for contemplation but rather translate into fact through an awareness of values built into a modern society, values such as firmness, bravery, solidarity and responsibility within society, or respect for others. These are the response to a society in search of greater humanity (Böll, 1997).

The family setting with its close communication and cooperation where activities were shared has become a thing of the past. It was faced with a new society of values which did not involve the same way of cohabitation, establishing norms of conduct increasing the individuality of groups and families. Nevertheless, it is enriching to take the best from both cultures, both indigenous and Western or mixed, countering the idea that one culture is better than the other, so that this inevitable cultural fusion is an opportunity for improvement.

[6] Anet (prayers) are forms of identification as man or woman, used to invoke each prototype for a given task or situation (Böll, 1997).

Fig. 7. Shuar children in Morona Santiago when evangelization arrived (Source: INPC Photographic Archive).

2. Methodology

This article proposes a methodology to evaluate the vernacular heritage in indigenous territories. And this shows the sustainable importance of the rescue of vernacular architecture nowadays. The understanding of the change to which we are continuously undergoing is adopted in architecture; it is what is labeled as "the new tradition" (Antoniades, 1971). For this, the methodology used to rethink architecture and its valorization in indigenous territories could be reflected in the following phases:

Firstly a data collection is carried out, based on historic antecedents to decipher the changes and issues which have led to the loss of value of heritage as manifested in architecture.

A second phase focuses on the assessment of all the factors which can affect the architecture and current urban organization. This will make it possible to identify typologies, forms of spatial organization and the material adoption of architecture. The assessment of the setting and its relation to the settlements will provide a clear vision of changes to the landscape. The analysis of traditional architecture and its spaces is evaluated from an anthropological perspective which contributes to critically valuing its most important symbolic parts and elements. In this case, as the materials adopted are so vulnerable to time, with a useful lifespan historically dependent on a nomadic lifestyle, it is important to seek out archive sources, identifying the architectural heritage which has now been altered.

Finally, the third phase establishes a series of strategies for protection, conservation, recovery and management, where following the same analysis criteria as in the previous phase, strategies are promoted to reincorporate Shuar vernacular architecture into local architecture, and thus rescue it culturally.

3. Sustainability

The knowledge and expertise of indigenous communities contribute to alternative sustainable development improving the wellbeing of people and their natural surroundings. It is therefore important to learn about and improve on aspects such as nutrition, methods for cultivation and production, enrichment of biodiversity, mitigation of CO2 emissions and maintenance of the integrity of natural and multicultural landscapes (Correia, 2015).

3.1. Socioeconomic level

Amazonian indigenous inhabitants have had to take up new economic activities to satisfy the appearance of a new group of consumers who seek products characteristic of the place, the extraction of fine timber, the cultivation of products such as coffee, livestock, etc.

Although large-scale mining is one of the major production activities carried out in the Ecuadorian Amazon, this barely sustainable extraction may potentially cause future complications (Cedenma, et al. 2017). In addition, the importance of the services sector has increased in recent years with ecotourism agencies organizing "traditional" shows for tourists. The internationalization of Amazonian cultures brought with it alliances with NGOs which have provided investment in different projects, with the collaboration of financial organizations, development promotion, human rights defence, environmentalists, etc.

Fig. 8. "Nankais cultural interpretation centre" as an example of new architecture (Source: Design by Author, 2020).

The connection of these agents made it possible to regularize the situation of indigenous leaders, also contributing to the management of several production, health, education and environmental handling projects. However, the increased levels of communication with the rest of the world and the world view, forms of bilingual education, forms of market integration, or forms of land ownership are all aspects which jeopardize the indigenous way of life.

3.2. Environmental level

The search for the correct use of resources in harmony with the laws of nature will allow our ecosystems to be preserved for future generations. It is a proven fact that construction is one of the top energy consumers compared to other fields of production. Therefore, construction must be able to use resources responsibly through passive strategies like those inherently found in the forms of production of many types of vernacular architecture (Correia et al., 2015).

An overwhelming awareness of place, through the understanding of the different changes observed in the territory, is essential to guaranteeing guidelines to allow heritage to be conserved in the future.

Social and territorial recognition must provide incentives for the safeguarding of ecosystems as collective resources for indigenous peoples, resources which, as in the case of the Shuar, are not physically limited to nature but rather represents a cosmos in and of itself.

A singular aspect of these territories is that the ecosystems which remain unaltered by colonization constitute true legacies of biodiversity conserving numerous living experiences of biocultural memory.

The reconstitution of the urban limits of the cities contributes to a strengthened community life. It is therefore essential to create linking systems between populated nuclei, which must be surrounded by different ecosystems, such as agricultural and natural (Magnaghi, 2012).

3.3. Sociocultural level

Ancestral knowledge underlies the sustainable handling of the local natural resources, use of soil, crop rotation - all concepts passed down through generations.

Historically, the sustainability of each Shuar settlement was determined by distinct independent economic and social units. These settlements may well have been so scattered due to the local topography and form of the territories conditioned by the need not to exhaust their fertility. Therefore they used to rely on the subsistence farming of the scattered lands which could provide for themselves. However, Shuar centres currently group several family nuclei, reflecting a sense of community. The Shuar culture attaches particular importance to their cosmovision, considered a determining factor for the positioning of the dwelling in relation to its habitat (sacred sites and vegetable garden). The dwelling is the nucleus of the Shuar people, who established their own laws. At the same time it was connected to their everyday surroundings. The vegetable garden (*ajá*) represents the domesticated site they use for their survival and is also a way to transmit family knowledge as it is where ancestral knowledge is put into practice. The same occurs with other natural sites such as waterfalls, forests and rivers where a heritage memory of the place is recorded through the activities dictated by the *anet* and the symbolisms of their cosmovision.

4. Conclusions

Due to the cultural changes and the influence of modern globalization the loss of vernacular heritage, an invaluable legacy of Shuar culture, is hard to recover. It is therefore important to search for viable paths for the rescue of indigenous cultures. However, many of the actions in the territory can have an environmental, social or economic impact on its landscapes, so that it is necessary to contribute aspects which promote wellbeing. Dwelling will be a true reflection of the needs and desires of its inhabitants, thus satisfying the cultural and physical aspects of the time (Rapoport, 1969).

The study of methods for the conservation of this architectural heritage not only helps to maintain invaluable cultural knowledge. It also promotes sustainable development based on the recovery of local identity and a comprehensive revalorization of the landscape in keeping with ancestral knowledge and beliefs.

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Dry stone architecture: the survey as a tool to safeguard the risk of morphological or formal homologation

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Topic: T1.4. Sustainability of vernacular architecture

Abstract

There are unique and varied examples of dry stone constructions in the Mediterranean region, whose interest, in Puglia (Italy) and attested in recent decades, has determined a speculative attitude that has made possible for these vernacular architectures to gain considerable economic value. Consequently, in addition to the actions supported by municipal regulations and both local and regional planning instruments, it is necessary to identify their cultural value and their peculiarities, all of them required for implementing conscious policies for a correct protection and preservation. We particularly aim to focus on the survey of these architectures within this contribution, a neglected subject of certain complexity, in order to propose a series of reflections that support the activity of those who intend to intervene on these artifacts. In fact, their plastic component and morphological uniqueness allow them to blend with sculptures that require the usage of modern and refined methodologies and technologies for their documentation. Thus, the lack of recognition on features and peculiarities has resulted in actions regarding their restoration with a general formal homologation and the loss of the original morphological singularity during interventions for their conservation.

Keywords: *Dry stone architecture; Architectural survey; Minor architectural heritage.*

1. Introduction

Puglia is a region that has buildings that are extremely interesting because of their dry stone construction, making it one of the territories with the greatest concentration of these particular vernacular architectures.

Its position made it open to influences from other geographical areas, in particular from the Near East, and its geological conformation - characterised by the presence of stratified rocks and scattered stone materials - shows, in relation to the theme of stone constructions, families of architectural and structural forms characterised by a strong dependence on available materials and the construction culture of the local populations. An attempt at classification suggests the presence of various types of accumulations of stone that have given rise, over time, to *Trulli, Pagghiare, Specchie* and boundary walls.

It must be said, however, that dry stone does not just indicate architectural solutions without binding material (known), but rather particular and common constructions characterised by features related to the geology of the territory that, on the one hand, prevented more profitable agrarian activities and on the other hand provided the raw material for the development of this type of construction phenomenon.

2. State of Art

If scientific studies during the twentieth century have (Ambrosi et al., 1990; Galizia & Santagati, 2012; Sánchez, 2020) determined a progressive increase in attention paid to vernacular architecture, it was the tourism economy that, at the beginning of the new millennium, recognised how valuable it was.

The presence of particularly popular buildings such as the trulli, in the renowned Valle d'Itria, permitted a consolidation of the professional practice of functional recuperation intended for accommodation facilities, even if, paradoxically, a new issue linked to their conservation emerged. In fact, over the course of a century, we have gone from the total lack of recognition of the environmental/landscape cultural value, which also led to serious forms of abandonment and demolition, to a new contemporary attitude of casual dismantling and reconstruction actions, with a speculative purpose, for the reuse of the buildings.

The international economic crisis at the end of the first decade of the new millennium, however, created an inevitable slowdown in construction work, permitting a slow critical process based on the observation of the restructuring operations, carried out especially at the turn of the 20th and 21st centuries, in a period when construction was heavily strongly facilitated by Euro-Community financing measures. The restoration of the old dry stone walls delimiting the land of the entire territory, the conversion of the stone buildings into tourist accommodation, were some of the most significant actions in the Apulian territory.

In this cultural context, the study tends to move towards an interpretative reading of building transformations through the tools of architectural survey and a comparative approach between the pre and post-intervention realities.

An iconographic and bibliographic analysis shows that a substantial part of the stone buildings of the scenic landscape of *Valle d'Itria* underwent various transformations during the 1980s and 1990s (Marinò, 2019) with interventions aimed at changing their intended use, from rural shelters to forms of housing.

This situation, due to the lack of adequate urban planning tools, has progressively changed their original agricultural image. (fig. 1)

Fig. 1. Old view of the Idria Valley (1960?)

The subsequent rediscovery of the taste for the vernacular, thanks to a renewed interest in the tourism economy, has instead generated partial demolition and reconstruction provisions. This approach also extends to the south of the region - in *Salento* (Ponzi, 1981; Barletta, 2009 ; Dimitri, 2002) - near the coasts, where there is also interest in accommodation related to seasonal marine tourism.

In every case, since it is a private initiative, if it is difficult to document any transformations to the interiors of the buildings, observation of the exteriors allows us to clearly understand the alterations of the famous cuneiform structures. In the case of the trulli, the supporting part of the pseudo-dome and the thick volume consisting of the filling with its extraordinary thermal inertia was replaced in the initial interventions of the 1980s with shaped reinforced concrete structures covered in stone to emulate the original dry construction, not respecting the original characteristics and above all the geometrical shapes with a view to better use of the internal volumes for residential purposes. In the successive decade, the disassembly operation developed with the idea of an intervention that demanded greater material consistency, using a part of the stone slabs that have been removed - *chiancarelle* - to be integrated with the semi-new and/or new ones for the reconstruction.(fig 2 and 3)

These were years when the absence of adequate urban planning instruments left a certain degree of autonomy to economic operators who were less than scrupulous in protecting the original building, but rather were animated by a new speculative market in which to invest. Only recently, with the new Regional Landscape and Territorial Plan (PPTR) of 2015, did the landscape commissions at the municipal or inter-municipal level implement the project proposals to express an authorisation opinion, which contemplated the protection of the landscape and the buildings. However, the diversified geopolitical structure of the territory, fragmented into numerous provinces, would still create the absence of a clear and homogeneous model regarding conservation aspects.

Fig. 2. Disassembly and reconstruction without preservation of original geometries (Source: Authors, 2008)

In the territorial context, referring to the so-called trulli of Valle d'Itria, where the environmental/landscape value of these buildings appeared to be quite consolidated, there was an attempt to intervene with greater respect towards the original building. However, where it was necessary to redo the entire covering of the roofs, there was a continuation of the disassembly and reconstruction operations that were not really respectful of the original geometries inherited from the past. These forms, in fact, which we could define as plastic, in order to enhance their geometric irregularity, appear to come from an empirically acquired knowledge with which the problem of the connection of the various extrados surfaces was solved, giving life to a genuine sort of mash of stone slabs.

Fig. 3. comparison between original roofs, dismantled and reconstructed roofs and new roofs (Source: Autores, 2008)

Today's reconstructions are more geometric because of the mass-produced construction material, which is often different from the ones originally used and therefore not fit to the original roof-shapes of these buildings. Then, we are witnessing a progressive standardisation of these constructions and the loss of their original shape.

The complexity of the structures, whose shapes, at first glance, would appear to be comparable to a cone, a truncated cone or a truncated pyramid, poses complicated implications from the point of view of the documentation, which would require the use of sophisticated methods of architectural survey to reveal their morphological contents.

With a survey, in fact, it is possible to demonstrate how the original geometries have a series of adaptations to connect the various surfaces, modifying the initial geometric matrix and generating a complexity that poses many problems in the survey phase.

The need to know the correct extradosal surfaces of these buildings has prompted us, depending on the objects, to resort to various techniques for acquiring metric and masonry texture information. In general, the laser scanner technique for the buildings and GPS for the so-called "specchie salentine" have made this survey campaign possible.

3. Methodology

The methods for interpreting the external forms of the existing pseudo-domes use comparative studies based on photographic, iconographic and previous documentation sources.

The simple photographic comparison between the state of the places before and after the intervention provides an approximate, although acceptable, perception of dimensional and morphological alterations. However, it is necessary to use methods that make it possible to identify the metric aspects of the buildings on the Cartesian level, using the usual techniques of architectural surveys, to provide these geometric realities with greater clarity. (Leserri & Rossi, 2013)

The methods that are presented in support of the text are just some of those developed and tested for establishing documents with which to examine, from time to time, aspects related to specific objectives. (Mallafrè et al., 2021).

If the laser scanning technologies provide a rigorous definition of the metric data, other technologies provide geometrically reliable but only partial representations due to the lack of control of the information regarding the apparatus and the wall structure. These latter aspects, on the other hand, appear to be a major feature of these accumulations of stone elements, whose geometries do not correspond either to pure shapes or to regular planes with a textured mapping. Therefore, the main issue is to represent as much irregularity as possible of these constructions, whose dates of origin are unknown and which were built to carry out the simple function of storing agricultural tools and products, without pursuing a refined aesthetic and using purely manual work. The acquisition of metric data takes place using devices equipped with active sensors emitting a signal that is recorded by the instrument itself in order to indirectly calculate the coordinates of the collimated point. The improvement of three-dimensional structured light TLS (Terrestrial Laser Scanners) survey technologies in recent times have seen an increase in their use, since the ease with which data relating to simple objects or highly irregular structures can be acquired has improved considerably. Each station acquires a single point cloud that, through the use of natural or artificial targets, allows the scans to be roto-translated to reconstruct the model that has been scanned. Therefore, the survey for the acquisition of the morphometric features of the selected cases is carried out with a phase shift TLS of the CAM70/Faro, Focus3D model. (fig.4)

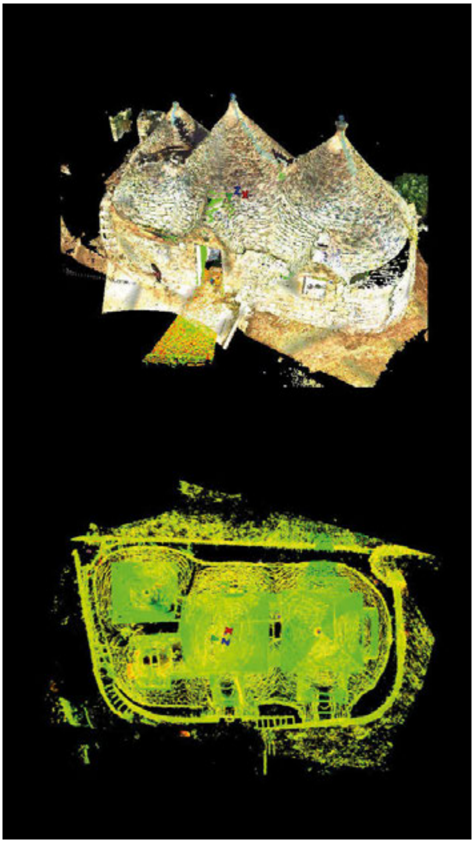

Fig. 4. Better control of metric and morphological solutions with the laser scanning techniques (Source: Authors, 2012)

The data processing provides an orthographic rendering to represent the building, which constitutes an initial graphic-documental form. Since we are dealing with highly irregular shapes, characterised by the absence of straight lines and flat surfaces, the quality of the data obtained would also permit a *Scan to BIM* transfer to allow, in the future, the management of the dimensional data of the irregular surfaces, which the orthography as obtained reproduces from a graphic point of view, but not to quantify.

4. Results and conclusionss

The results of the research direct attention towards the need to survey dry stone constructions, before any type of intervention, as a fundamental moment for understanding the building in order to preserve its most characteristic aspects from a morphological point of view, as products of an established rural tradition capable of slowly and manually creating these irregular constructions marked by skillful joints and geometric mediations. One of the most collated reasons, which would justify these particular extradosal patterns, is to be found in the need to transport the rainwater from the roof into special internal and external cisterns, to be used as a water supply for the support of agricultural activities. (fig.5)

Fig. 5. Plastic solutions - without geometric regularities - resulting from empirical knowledge of rainwater runoff. (Source: Ambrosi, 1990)

Rural buildings, then, but at the same time architectural devices, whose external and internal spaces were formed by the farmer, an emblematic and central figure of the entire production process, in which it is possible to bring together the roles of owner of the land, farmer, extractor and supplier of materials, builder and maintenance worker. (fig.6)

Fig. 6. The farmer's tool shed. (Source: Postcard, 1958. Paolo Semeraro Editions)

Today, far removed from the time when the buildings were constructed, we are witnessing renovations carried out by modern companies (Nuria & at.. 2020), the results of which show a careless and only approximate reconstruction. In addition, the rebuilt geometries appear highly stiffened, degenerating into an evident morphological repetition, where even the chromatic and dimensional aspect of the material used confirms this standardisation. The risk to which this intangible cultural heritage (Jiménez de Madariaga,2 2021), is exposed, consisting of construction know-how, means that the remaining unaltered constructions are extraordinarily unique, and so require precise methods and strategies to guide their legitimate restoration through practical knowledge, where morphometric data can be essential information for the conservative restoration, especially when dealing with disassembly and reconstruction. (fig. 7 and 8) The use of digital scanning technologies would make it possible to facilitate the work of both professionals and companies in this delicate recovery operation for the preservation of this particular vernacular architecture.

Fig.7. Conservative replacement operation respecting geometric-formal solutions. (Source: Ambrosi, 1990)

Fig. 8. Bisassembly and reconstruction. (Source: Authors, 2014)

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At the roots of sustainability: Mediterranean vernacular architecture

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Topic: T1.4. Sustainability of vernacular architecture

Abstract

As numerous examples show, bioclimatic architecture is an historical, ancestral design practice. The whole history of architecture is marked by the search for living comfort resulting from the link with the land and the correct use of natural resources. In vernacular architecture, we also find this 'holistic' conception of living in which design choices (compositional, constructive, material, and technological) are deeply connected to climatic and functional issues. However, until now, studies on these typologies have usually focused more on formal aspects, leaving out sustainability ones. The spontaneous constructions of the Mediterranean area – the Sicilian dammusi, the trulli of Val d'Itria, the Sassi of Matera, the Scirocco rooms in Sicily or the houses on the Amalfi coast – are sincere, rational, and logical, and have always sought living comfort through energy and economic efficiency, even without pre-established rules or standards. For example, the absence of wood and clay, the abundance of limestone and sand, led to design the Amalfi Coast dwellings essentially of stone, abandoning tiles, bricks, and wooden floors. The structure without sharp corners results from the limestone which was not tender enough to allow a good squaring. The dammusi were built with the same stones used to reclaim the land to form the terraces on which they stood. Their domed roofs were made of stone covered with a layer of earth and a mixture of volcanic pumice as insulation, and a layer of red tuff and milk of lime as waterproofing. The paper aims to investigate these peculiar vernacular typologies to trace the remote origins of sustainability in their morphological and technological characters. This study could also trigger a reflection on strategies for the contemporary design of sustainable architecture inspired by the tradition of these climatic regions.

Keywords: *Mediterranean architecture, sustainability, vernacular buildings.*

1. Introduction

Today's interest in sustainable architecture began in the 1970s, when the oil crisis and rising energy costs posed the great challenge of sustainable design, combining energy saving, health and living comfort. As numerous examples show, bioclimatic architecture is an historical, ancestral design practice. In fact, the whole history of architecture is marked by the search for living comfort resulting from the link with the land and the correct use of natural resources. In the Italian vernacular architecture, we also find this 'holistic' conception of living, in which design choices (compositional, constructive, material and technological) are deeply connected to climatic and functional issues.

In fact, since ancient times Mediterranean architecture has been an effective example of bioclimatic construction where the use of local materials - exploited for their physical and mechanical characteristics such as permeability, porosity, resistance, thermal inertia, etc. - led to an initial inevitable reduction in energy waste. The anonymous designers of vernacular Mediterranean architecture tried to contrast the summer heat and achieve thermal comfort, always acting with deep respect for nature and the landscape. These spontaneous constructions adapted to the geomorphology with compact and elementary volumes, employing local materials and techniques and promoting the correct use of natural resources such as water and wind.

The sassi of Matera, the trulli of Puglia, the Sicilian dammusi and scirocco chambers, as well as the houses of the Amalfi coast, have been built and modified for centuries, following only a few rules based on vital needs and regardless of pure aesthetic research (Niglio, 2007). Thus, Mediterranean vernacular architecture represents the archetype of a primordial sustainability resulting from the deep complicity between nature and man (Moretti & Bori, 2005).

2. Sustainability, structure and form

Traditional southern Italian dwellings, despite their specific constructional and formal features, are always a response to climatic conditions such as the need for shade, lighting, thermal insulation and ventilation. These constructions generally fit into their environmental contexts, adapting to the territory without altering its harmony and image. In hypogean structures, such as the Sassi of Matera or the Scirocco chambers, protection from summer radiation and the maintenance of an optimal temperature were obtained by exploiting the depth.

Fig. 1. The Sassi of Matera

The famous Sassi of Matera, included in the UNESCO World Heritage List in 1993, have their origins in the Paleolithic period. They were articulated structures dug into the soft tuff, grouped in a real urban settlement on several levels. The bioclimatic performance of these caves dwellings resulted from the thermal inertia of the rock mass and the almost total absence of external openings except for the entrance. During the winter, the sun's rays penetrated right through to the bottom of the cavity, thanks also to its inclination, which prevented the summer sun from reaching the interior (Giuda, Pagliuca & Rospi, 2008).

A similar structure characterised the chambers of the Scirocco, dug underground beneath or near the villas in Palermo and the surrounding area. These hypogean rooms, with a square or circular floor plan and vaulted roof, became widespread from the 16th century onwards as a shelter from the hot African wind. Their construction was encouraged by the geological nature of the subsoil, made up of calcarenite, a very resistant but soft rock that was easy to excavate, with good thermal and acoustic insulation: characteristics that have also made it an excellent building material (Todaro, 2002). Most of the rooms date back to the 18th century, the period of the 'great holiday', when many families from Palermo left their urban houses to move to the countryside and take advantage of the coolness offered by these large caves (Di Cristofalo et al., 1989; Firrone, 2014).

Fig. 2. A chamber of the Scirocco in Palermo

But the search for thermal comfort through passive cooling was not a prerogative of hypogean structures. In the so-called 'additive' architecture, such as trulli, Amalfitan houses or dammusi, it was expressed through the use of compact forms, thick walls, and extrados roofs able to take advantage of the sun's radiation but at the same time protect against excessive radiation[1].

[1] Sometimes, however, as in the case of dwellings on the Amalfi coast, where there was the possibility of finding wooden beams to build terraced roofs, the vaults were missing. Cfr. Niglio, 2004.

Fig. 3. The Amalfitan house by Camillo Jona (1923)

The Apulian trulli, rustic architectures originally circular in shape and initially used as agricultural storage buildings, spread from the middle of the 16th century and were gradually transformed into permanent or seasonal dwellings (Bertaux, 1899). Their name comes from their peculiar dome-shaped roof (from the Greek 'trôullos'). The arid hills covered with a layer of limestone - which crumbled in layers of varying thickness to form smooth, parallel slabs - were certainly at the origin of the type developed by the Apulian farmer (Bertacchi, 1940).

Fig. 4. The Apulian trulli

The dry stone used to build them gave the structure static resistance and made it similar to a hypogean structure in terms of bioclimatic characteristics. The high thickness of the masonry and the materials used, apart from the permeability of the walls caused by the presence of micro gaps, guaranteed strong thermal inertia, acting as a thermal regulator of the internal microclimate. The advantageous bioclimatic qualities were also made possible by the conical shape of the roof, made of rings of overlapping and projecting limestone ashlars. The inclination of these slabs served to reflect oblique summer sunlight while allowing the passage of almost horizontal winter ones (Montanaro, 1989). The interiors of the trulli were completely whitewashed with lime milk, obtained from cooking the stones themselves, for hygienic reasons, but also to increase the reflection of sunlight coming through small openings. The heat stored during the day by the masonry masses was released at night through the effect of ventilation (Chiesa, 2019). In the winter months, however, the massive stone envelope facilitated the condensation of humidity inside, making the rooms inhospitable and forcing the inhabitants to open the door during the day to keep the interior dry. In order to overcome this problem, the use of planking with the function of a false ceiling was sometimes introduced to isolate the inhabited environment from the roof and prevent the rising of heat, produced in winter by the chimney, and mitigate the excessive summer radiation (Stefanizzi et al., 2016).

The dammuso, a traditional building on the island of Pantelleria, was very similar to the trullo both in terms of its original use (seasonal and agricultural) and of certain constructive aspects, such as the limited presence of openings, the vaulted roof - from which its name (from the Arabic mdamnes) also derives - and, above all, the large mass of masonry made of local stone assembled 'dry' and whose square shape derived from the cutting of the rock (Valenza, 2015). Thermoregulation was ensured not only by the thickness of the walls, built using the ancient 'casciata' technique but also by the particular shape of the dome with its lowered extrados, made of squared lava stone ashlars (Niglio, 2007). This roof condensed the hot air underneath, allowing temperatures to be kept cooler in the lower part of the house (Valenza, 2015).

Fig. 5. A dammuso in Pantelleria

Even in the traditional houses on the Amalfi coast the considerable thickness of the masonry (0.80-1.00 m) and the presence of planking inserted at the height of the vaulted ceiling contributed to thermal comfort. These dwellings were often built with dolomitic limestone rocks obtained from the excavations carried out to transform the rugged cliffs of the coast into a series of terraces. In some cases, the use of materials of volcanic origins, such as pumice and lapillus, made it possible to achieve the same objectives with smaller sections (Ribera et al., 2020). Moreover, the white lime coverings and the layout of the buildings, with porticoes, patios, pergolas, and gardens, shielded the sun's rays and created shady areas (Chiesa, 2019). Throughout the Mediterranean area, the wise use of traditional materials and construction techniques has allowed for the best possible regulation of heat inputs as well as defining a continuum between landscape and architecture (Butera, 2004; Guida et al. 2008).

3. The use of natural resources

The wise use of natural resources, such as air, water, and greenery, has actively contributed to the sustainability of these vernacular architectures (Moretti & Bori, 2005).

The morphology of the constructions, which includes cavities and domes, was designed to make the best use of the air currents thanks to them. In the Scirocco chambers, the small opening in the vaulted ceiling creates a chimney effect (Todaro, 2002, 80), allowing steam to escape, pushed upwards by the air refreshed by the flow of water through the rooms[2]. In other cases, such as Villa Ambleri Naselli Agliata (1552), one of the oldest examples, ventilation was instead achieved through an external tapered tower and a series of skylights that illuminated the long access corridor (Firrone, 2014).

Fig. 6. The corridor of Villa Ambleri Naselli Agliata in Palermo

The conical section of the roof of the trulli and the hole at the top also promoted thermal comfort, allowing the suction of hot air, which was also enhanced by the presence of a chimney in the centre of the main room (Montanaro, 1989). Sheltered from the north wind, the entrance door faced south and was normally the only opening. But in some cases, there were also small windows placed opposite each other at the top of the dome to catch the sun's rays and create a natural circulation of air.

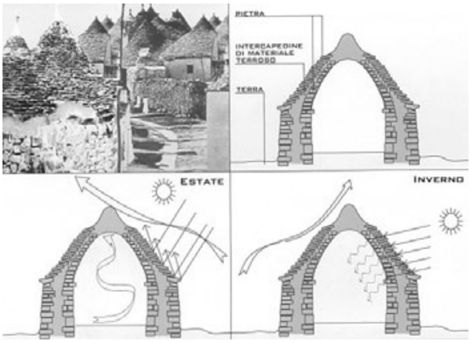

Fig. 7. Natural air circulation in the trullo

The domes of the dammusi also had the same thermal regulating function; in addition, the slits above the lintel of the entrance door caught the summer breeze and allowed the heat accumulated during the day to dissipate at night (Chiesa, 2019).

[2] The air cooling system is based on the phenomenon of evaporation. This suggests that the echo of the wind towers, which were widespread throughout much of the Muslim world, had reached as far as Sicily. The custom of finding refreshment in an underground compartment cooled by qanats (channels through which cool water flowed) is particularly reminiscent of the underground rooms of the dwellings in the historic Iranian city of Yazd.

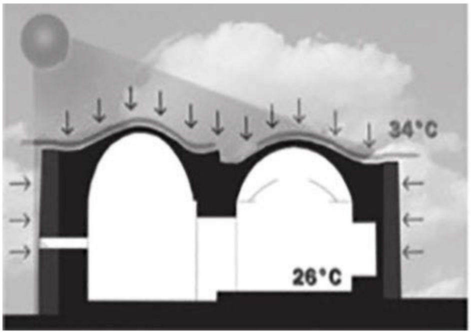

Fig. 8. Natural air circulation in the dammuso

The spontaneous architecture of the Amalfi coast was based on equivalent criteria: domes, vaults and small cracks guaranteed the circulation of air (Guerriero & Fiengo, 2021). But it is the composition of these buildings, leaning against each other and perched on high ground overlooking the sea, that played an important role in their energy efficiency. The urban layout, which followed the orography of the land, and the particular 'cluster' shape, the presence of porticoes, stairs, and terraces, protect the dwellings from the sun's rays and at night allow cold currents to be channeled through the narrow, winding alleys (Ribera et. al. 2020).


Fig. 9. The Amalfitan urban layout

In the case of the Sassi, on the other hand, an attempt was made to overcome the problems of ventilation and humidity control, typical of hypogean environments, thanks to the layout of the caves, dug obliquely into the ground (Correia et al. 2014) and to a simple opening located above the entrance door (Frediani, 2012).

The structures in Matera for the management of water resources (rain and condensation) were very complex and were made even more necessary by the aridity of the area (Guida et al. 2008). Over the years, a new man-made underground network has been added to the one created naturally since the Neolithic (Bernardo & De Pascale, 2016). A real system of rainwater capture and storage was developed, which included large storage tanks (about 2200), the so-called 'palombari'[3], fed by waterproofed and buried pipes. Each house had its cistern into which the water was channelled, previously filtered through jute sacks (Grano, 2020). This testified to the genius of a population that had to deal with the scarcity of this precious and important commodity.


Fig. 10. The structures for the management of water resources in Matera

The inhabitants of the Palermo area, who created a true underground urbanism (Todaro, 2002, 11), also dug wells and conduits to supply water. The Scirocco chambers were built close to a natural or artificial watercourse to intercept the passage of fresh water, which evaporated and helped to refresh the air inside the cave (Firrone, 2014). In the absence of natural aquifers, the water flow was diverted through a network of canals similar to Persian qanats. This is the case in the chamber of Villa Savagnone, where there was even a waterfall. The construction of the trulli was also closely linked to the presence of cisterns, which were built near or underneath the dwellings «to guarantee the supply of wa-

[3] The largest known hand dug cistern is the 'long palombaro', 18 meters high, 50 meters wide, with a capacity of about 5 million Litres of water.

ter... and to increase the humidity of the interior spaces during the driest periods of the year». (AA.VV., 2009, 52). The inhabitants of the island of Lampedusa, on the other hand, preferred to exploit pre-existing cisterns of Punic or Roman origin by building their dammusi in the immediate surroundings (Niglio, 2007). In Apulia as in Sicily, the shape of the roofs themselves and their material composition – conical with stone slabs in the case of trulli, or vaults finished with a waterproofing and insulating layer of ground made of volcanic pumice, red tuff and lime milk in the dammusi – promoted the correct drainage and accumulation of rainfall.This was also the case in the houses on the Amalfi coast, where rainwater was collected for agriculture through channels dug into the extrados vaults (Guerriero & Fiengo, 2021).

The vegetation also contributes to regulating the microclimate of this spontaneous architecture. Pergolas, gardens, and trees, appropriately positioned, provide adequate shielding from the summer sun's rays and, at the same time, allow heat and light to penetrate the rooms during the cold months. Just think of the vine pergolas placed in front of Apulian trulli (Montanaro, 1989).

Fig. 11. Vine pergolas in front of the Apulian trulli

The ‘jardinu’ of Pantelleria's dammusi, on the other hand, has a different function: spaces next to the residences, defined by a high circular wall with citrus trees inside. The purpose of the enclosure, in this case, was to protect the plants from the island's strong and frequent winds and to create a water reserve. In fact, the shade generated limited the evaporation of the rainwater accumulated in the ground in winter and the condensation at night (Di Cristofalo et al. 1989).

Fig. 12. The ‘jardinu’ in Pantelleria

4. Conclusions

Man has always sought to create a dwelling in harmony with its context, capable of satisfying both living needs and thermal comfort requirements. This has led to the emergence of what Rudofsky called ‘architecture without architects’, which «does not go through fashion cycle... is commensurate with human dimensions and human needs, without frills, without the hysteria of the designer» in which the simple reliance on local building materials guaranteed the persistence of construction methods ennobled over time» (Rudofsky, 1964, n.p.).

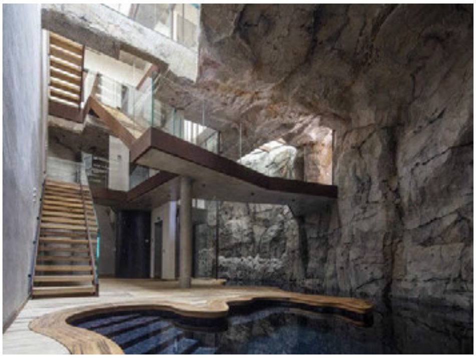

Fig. 13. Villa Troglodyte, Principality of Monaco

Today these spontaneous constructions, resulting from a slow process of evolution and adaptation to the site, are a precious legacy and a model from which to draw inspiration to make contemporary ones more sustainable. Villa Troglodyte in Monaco, designed by Jean-Pierre Lott’s Paris studio, for example, is a house set in the rock and inspired by tradition. Its compact volume and the right balance between full and empty volumes create a shell with great thermal inertia which blends into its surroundings. The use of geothermal energy, photovoltaic panels, and the recovery of rainwater and greywater make this building an example of sustainable design based on the use of natural resources.

The Villa Francesco retirement village in Mottola (Taranto), opened in 2010 and located on a promontory 320 m above sea level, is perhaps one of the most emblematic reinterpretations of the principles of Mediterranean architecture (Lembo & Marino 2012). The orientation of the buildings promotes passive solar heating in the winter, while the pergolas of vines and trees on the southern façade shelter them from excessive sunlight in the summer. The high thermal gradient between the two elevations generates air currents which are also triggered by skylights at the top - their pyramid shape reminiscent of trulli - which act as ventilating chimneys to help the rooms cool down.

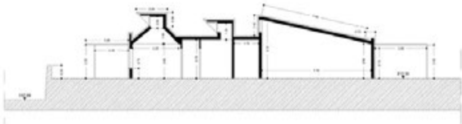

Fig. 14. Villa Francesco, Mottola (Italy)

The sustainable future comes from the past, says Mario Cucinella in a recent lecture in Milan. After talking about the wind towers, he says: «This is the past, I am not nostalgic, nor do I have the idea that the past is always better than the future. I believe that the future will always be better. But I am curious about it» (Cucinella, 2018). And this same curiosity should inspire contemporary architects to look to the past as a source of inspiration.

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Lessons from the past, architecture for the future. Coupling historic preservation with sustainable architecture

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Topic: T1.4 Sustainability of vernacular architecture

Abstract
Restoration of built heritage can serve not only to preserve historical documents of the past but also to provide models for new sustainable architecture. Vernacular and, more generally, historic architecture is by its nature sustainabile and resilient. It is largely the result of experience and acquired knowledge, and shows how local resources can be used in a thoughtful and rational way in new construction. For this reason, it can inspire low-energy solutions necessary to address the current climate crisis. Conservation projects, in their turn, allow us to analyze the fabric of historic buildings, to understand which materials were used, how they were transformed and assembled, and how they offered the best response to the needs of use and resistance to the elements and natural hazards. In this paper, conservation of traditionaly-built architecture and new sustainable architecture are discussed as two partners pursuing the common goal of reducing the effects of climate change. The author investigates the way conservation and analysis of historic buildings allows us to interpret the complex and articulated reality of regional architecture. By retrieving the analysis of historic construction as a fundamental component for understanding architecture and adopting manual graphic records as a tool for expressing the complexity of the fabric of a building, it is possible to identify local building traditions and inspire new sustainable architecture.

Keywords: *preservation, building culture, traditional architecture, craftsmanship, building archaeology.*

1. Introduction

At a moment when discussion of sustainable architecture is critical for adaptation to and mitigation of the effects of climate change, the role of traditional architecture must be reconsidered. Traditional buildings are not merely a testimony of a past that needs to be protected but they can contribute actively to meeting the goals of the Paris Agreement, the international treaty on climate change adopted in 2015. As pointed out in C. Elefante's famous sentence "*the greenest building is….one that is already built*" (Elefante, 2012), existing heritage has a lot to offer to current discussion on sustainability. Preservation of existing building stock and its refurbishment can achieve the goal of reducing the carbon footprint generated by the building sector, provided that accurate evaluations are conducted. At the same time, recent policy documents, such as *ICOMOS' Future of our Pasts* (ICOMOS, 2019) and the *European Cultural Heritage Green Paper* (Potts, 2021) highlight the untapped potentials of cultural heritage to contribute to climate action.In the last few years, the active role of traditional buildings in meeting the needs of sustainability and resilience and, more generally, the Sustainable Development Goals set by the United Nations Agenda 2030 has been studied within the perspective of the use of traditional practices in new buildings, as for instance in the work of Anna Heringer. However, one aspect that has not been fully acknowledged is how much conservation and reasoned recording of heritage can contribute to regenerating traditional practices that have been lost. While many traditional building trades are still practiced by some artisans, many others have been forgotten and remain documented only in historic buildings. This is the case in regions where the building industry has succeded in replacing traditional building trades entirely and offers building solutions which appear to be more advantageous in terms of cost. Restoration works offer an opportunity to investigate historic construction in depth; learn from the building culture that generated it; and come to know about materials, crafts, technology, buildings, and settlements that were less energy demanding. Structures are analyzed, materials are investigated, and building techniques that otherwise would be left covered by plasters and other finishes are exposed. Until recently, this knowledge was considered useful only for purposes of preserving the past. What we now propose is to use that knowledge to inform the construction of new sustainable buildings. To that aim, we consider that there is a need to adopt the methodologies used for analyzing built heritage developed by Building Archaeology – *Archeologia dell'Architettura* in Italian- a discipline with strong ties to conservation and originating from the stratigraphical archaeological disciplines (Brogiolo, Cagnana, 2012). The study of the *anatomy* of a building is meaningful in the process of *rediscovering* traditional architecture, because its methods help in identifying local building traditions and rules in construction. Thus, it can be a strong tool for recovering historical knowledge and practices in architecture.

2. Climate crisis and traditional buildings

The contribution of traditional architecture in achieving the goals of the Paris Agreement has not yet been entirely acknowledged beyond the circle of those who work on historic heritage. The building sector, one of the major contributors to the climate crisis, continues to offer solutions to reduce energy consumption and the carbon footprint mainly by developing new technologies and innovation, applied at a global level. The contributions of historic building cultures, which were inspired by a sustainable use of local resources, is still not being taken into consideration. These cultures were based on a participatory approach in which knowledge about rules, trades and technologies was shared and resources were rationally sourced and used (Davis, 2006, p. 131). Against the belief that nature is an inexhaustible resource, as the consumerist approach suggests, traditional building processes were aware of the material resources that were used in construction, where they came from, their properties, and their best use. Having become unaware of the origin of our products, the way they are transformed, and the processes that are used in their production, we have lost our capacity for thrift or for responsibly avoiding waste.

Necessary change must be achieved taking advantage of the technological progress gained in the last decades, but also reconsidering the role of new materials and technologies in terms of their longevity and sustainability. Among the many topics that need to be addressed are mass-produced, low-cost materials, short-term life-cycle products and artifacts, high-energy production processes, long-distance sourcing that increases transportation, design that disregards functionality, and individualist design approaches that aim to glorify the designer even to the disadvantage of the user. In contrast, traditional buildings sourced materials locally, thus reducing transportation, allowed reuse of materials, and were community-centered.

Less-privileged countries will be heavily impacted by global approaches promoting new and rapidly changing technologies. They will depend more and more on industrialized countries. The threat of increased social inequality in fragile contexts is proportional to the current trend in migration to urban centers as the countryside is more exposed to the consequences of extreme meteorological phenomena and natural hazards (The White House, 2021). In this context, we urgently need to identify alternatives and more nature-based approaches without losing the progress gained by humanity in the last hundred years. Again, the study of traditional architecture can contribute to identifying viable solutions, as it allows us to learn from building cultures which were in balance with nature, and varied from region to region. One of the most significant obstacles in revitalizing traditional building practices lies in the loss of craftsmanship, expertise, and all the intangible culture that supported them. Traditional buildings resulted from processes that used knowledge gained through experience, trial and error, and know-how transferred through training from generation to generation, elements which are not directly or easily deducible from the study of the buildings. Take, for instance, the renowned gypsum plasters in Paris (plaster of Paris mortars) documented since the Middle Ages and used for external surfaces with impressive aesthetic and mechanical properties. These plasters were progressively abandoned in the nineteenth century, when industrialization focused on the use of lime as a binder (Le Dantec, 2019). Since then, the higher energy and carbon footprint lime technology replaced gypsum plasters and expertise was lost. Today, as we begin resuming their use, we understand that these plasters resulted from a know-how that we cannot easily retrieve. However, with the need to preserve the facades of the historic buildings of Paris, research was promoted aimed at recovering the quality of traditional gypsum plaster techniques (Le Dantec, 2019, pp. 378-381). Thus, preservation projects can inspire and lead the recovery of lost practices. As the French writer Françoise Choay wrote, "*we restore to recover our competence to build*" (Choay, 2001, p. 176).

3. Learning from Preservation

At the Conference of Athens (Athens Charter, 1931), modern materials and technologies were admitted in historic preservation, following the wave of excitement for their mechanical properties and versatility. Since then, materials which were alien to historic masonries, such as iron, cement, and resins, were employed in structural interventions, replacing or reinforcing traditional masonry buildings (Jokilehto, 2018, p. 291). It was only when these interventions started to fail for lack of material and mechanical compatibility that their invasive character became apparent and traditional building techniques were resumed. Today, one of the core principles of preservation is the "like for like" principle: damaged masonry must be replaced with new masonry similar in materials, composition, and technique of the original.

One of the early examples of this approach is offered by the restorations of the Domus Tiberiana on the Palatine Hill of Rome (fig. 1), which, in the first phase of intervention, included several structural masonry works (Giuffrè & Martines, 1988; Vitti, 2006). Here, for the first time since the the Second World War, materials and building techniques for the restoration of Roman masonry were inspired by the ancient materials and practices, including the manufacture of *ad hoc* bricks, such as the *bipedales*--large square bricks measuring 2x2 Roman Feet (60x60 cm).

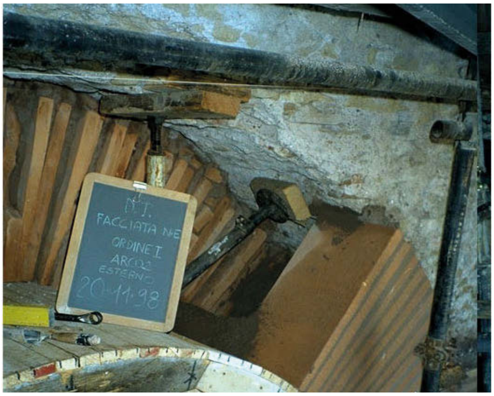

Fig. 1. Reconstruction of a Roman arch with *bipedales* at Domus Tiberiana, Rome. (Source: Vitti)

The philosophy behind the intervention was to identify the "*regola dell'arte,*" an Italian term expressing *conformance to best practice*. The preliminary study consisted of surveys that examined the way the materials were selected, manufactured, and assembled, so as to reintroduce them in the conservation project, removing all those shortcomings that typically can occur when the *regola dell'arte* is translated into construction by the masons.

In this context, it is useful to highlight that in the 1980s Paolo Marconi promoted the recording of regional building traditions and the recovery of expertise and know-how that had been lost due to the prevailing faith in modern materials and techniques. His visionary approach resulted in a series of Manuals, the first one published in 1989 (*Manuale del recupero del Comune di Roma,* 1989) meant to record building traditions in regional contexts.

The new conservation practice made it possible to re-use building techniques that otherwise had all but disappeared. Some masons who had built arches, vaults, and traditional masonry earlier in their careers retained the expertise and know-how that could be successfully employed in conservation projects. Over four decades, much expertise in the building trades was retrieved in Italy through conservation projects and, currently, numerous contractors are capable of applying skilled workmanship and traditional building techniques.

However, in Italy as in many other countries, most of the surviving traditional building practices are directed to the conservation of monumental architecture, a consequence of the nature of funding, mainly public or controlled by public administrations. Notwithstanding the recognized value of monuments and their need for protection, vernacular architecture continues to be mutilated by users who adopt materials and techniques offered by the current building industry and professionals who promote invasive structural interventions, mostly to adapt traditional buildings to current codes. A few exceptions to this are owed to architects who recognize the values of vernacular architecture and intervene according to the original materials and building techniques, as in some interventions in Germany (Bocco Guerrieri, 2020, pp. 76-89) or in the Valencian Region (Mileto *et al,*. 2021; Villacampa Crespo *et al,* 2018). Also in Italy, a country with an exemplary tradition in conservation, vernacular architecture is mostly preserved for its external/aesthetical values, and the “like for like” principle is not applied to the fabric of buildings. The path shown by Giuffrè in his studies for vernacular architecture (Giuffrè & Carocci 1997; Giuffrè & Carocci 1999) and codified in the “*Codici di Pratica*” -manuals promoting the use of traditional building techniques in historic centers- did not prevail over the faith in modern materials and techniques. Conservation and renovation continue to resist interventions that reproduce the “weak bonds” of most vernacular architecture. For this reason, traditional earth-mortar masonry, as the one employed in England (Morton-Little, 2015), is not recognized as a potential solution for new buildings.

4. Assessing the identity of a building and learning the local tradition

The seminal work of Marconi and Giuffrè was principally focused on the preservation of heritage. They understood the importance of traditions and local practices, with their adaptations to building rules. Once we acknowledge that preservation can inspire sustainable architecture, we can further develop the ideas of our predecessors and assign to restoration not only a passive role focused on the preservation of the “documents of the past” but an active role as a tool for learning from the past and inspiring new architecture.

To that aim, it is necessary to approach the local building traditions through an intensive work of analysis, documentation, and interpretation, going beyond the limited variety expressed in the manuals. The manuals are a codification of disciplinary expertise and give general instructions on construction according to the *regola dell'arte*, but generally do not include deviations from it. The reason is simple: there are infinite local variations to the *regola dell'arte* due to adaptations, misunderstandings, or simply unskilled workmanship that are not considered in codifications whose purpose is to define best practice. However, these variations are of particular interest to us, since they can express the traditions developed locally after a more or less long trial and error process.

In principle, high-quality construction will be compliant with the "ideal model" (the *regola dell'arte*) and its structural behavior will be at a higher level than a construction that deviates from the *regola dell'arte*. However, most of our vernacular heritage does depart from the *regola dell’arte*, as it truly expressed local building cultures. Thus, understanding the model and the way it was translated in construction is fundamental for assessing how vernacular interpretations occurred in the process of applying the *regola dell’arte*. Understanding the specificity of a place is important, as it can inspire new construction according to the *regola dell’arte* as well as adaptation to the local context.

As we depart from the principles of current (unsustainable) construction and its dependence on strong structural bonds – as in iron and concrete construction– and strong binding mortars, vernacular practices become meaningful, showing us how they achieved sound construction using weak structural mortars based on lime or gypsum and frequently mixed with earth, particularly in their core (Markley, 2018). Lime and gypsum were used parsimoniously in vernacular construction, either because they were expensive or because raw materials were scarcely available. We can learn from this how to satisfy our need for low-energy construction processes and circularity.

Solutions vary from place to place and each building tradition reveals how solutions were tailored to the availability of local materials and responded to the local climate conditions. We can appreciate the appropriate choice of the setting of the buildings and their structural behavior, designed to stand local environmental loads. In other words, the buildings expressed the result of long-term processes in which methods were adapted and innovated as needed, expressing resilience and sustainability through the thoughtful use of resources and capacity to change.

Our historic centers, villages and country buildings have plenty of such examples that are worth studying and learning from. Why should we not retrieve this amazing knowledge for our future sustainable and resilient architecture?

5. Graphic analysis and the role of education

In Italy, the importance of recording building techniques as a fundamental component of the identity of historic architecture, beyond formal, spacial and structural matters, dates back to G. Giovannoni (Esposito, 2005) and connects to the French and German nineteenth century scholarship of scholars such as Choisy, Viollet-le-Duc, and Durm. Drawings were and remain the best way possible to achieve this task.

As a fundamental tool of the architect, drawings have always had an important role in guiding the learning/interpretative process of architecture. The graphic analysis of construction, taking advantage of the cognitive process activated by hand drawing, shows building elements in a critical way and thus is of paramount importance if we want to recover building traditions that are lost. The interpretation of a construction process and its building phases means understanding the way materials were selected, transformed, and assembled and the process which was adopted, not differently from the Building Archaeology methodology in analysing historic buildings. Such diagrams need to be created on site, since they are developed through a close analysis of the building. They can be a useful means of tracing building processes of past building cultures. As such, they can become a useful tool in defining our capacity to reconnect to the past and define the future of architecture. As it happens, the past meets the future. We can use laser scanners but, at the same time, we should not forget how important hand drawing is!

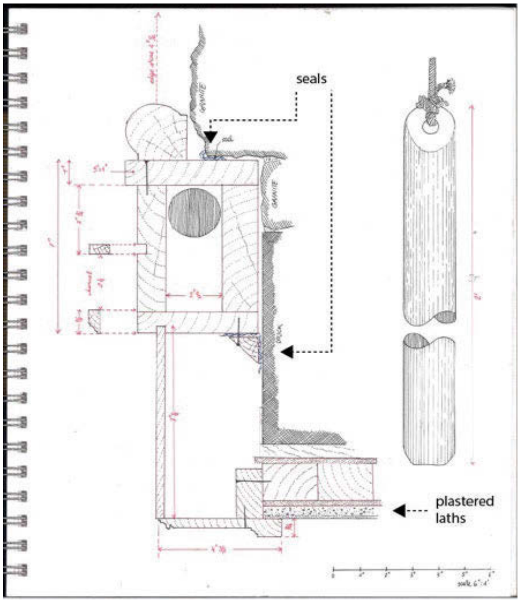

Fig. 2. Detail of the casing of a sash-window in a 19th century house in South Bend (IN-USA). The diagram shows the plastered laths employed to insulate the interior stone wall and horsehair and vegetable fibres to seal joints. (Source: Vitti)

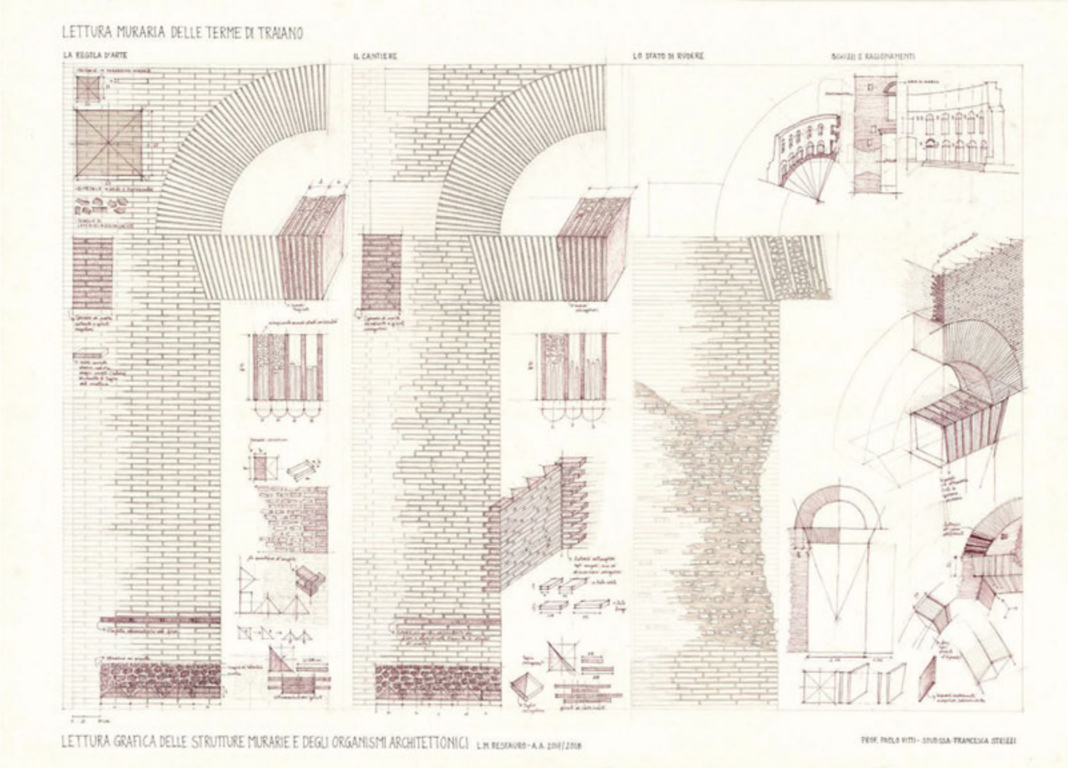

Fig. 2. Diagram of the archaeological remains at the Baths of Trajan in Rome (Source: Strizzi)

As an example, I would like to show the student work conducted on archaeological buildings (fig. 3). The graphic analysis aims at identifying the materials that were used, the way they were transformed, and then how they were assembled. The drawing in the middle shows the wall facing as executed. Bricks used in the actual construction were not uniform. Their length varied because bricks were made by cutting square bricks into triangular ones. Small differences in the thickness made the mortar joints irregular. The diagram on the right shows the relationship between the facing and the core, thus giving all the relevant information on the core of the wall. This includes the dimension and density of mortared brick fragments, the careful placing of the fragments in horizontal layers, and the lack of cavities, showing that the material was tamped to achieve a higher density. The left diagram shows the model which stood behind the execution.

The same critical approach can be adopted also for the analysis of buildings belonging to a more recent past to understand, for instance, how the insulation at the openings was traditionally addressed (fig. 2).

Reasoned drawings can be used also to analyse parts of a building through three-dimensional diagrams, as to understand the relationship between the different structural elements (fig. 4).

Axonometries where similarly used by Auguste Choisy. The difference is that Choisy focused on the "model", whereas we are interested in the actual execution. This makes it possible to develop a hermeneutic process and, at the same time, customize the intervention in the best way possible for the preservation of built heritage. It also gives a lively understanding of how local materials influenced local practice.

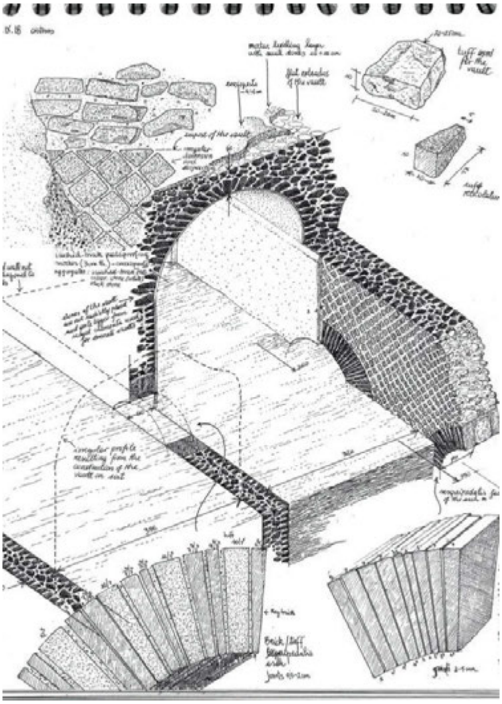

Fig. 4. Three-dimensional diagram analyzing the construction of the cistern of the Roman Villa at Capo Sorrento. The drawing shows materials, the way they were transformed and assembled. (Source: Vitti)

Graphic analysis guides the understanding of a building culture and becomes a fundamental tool in our attempt to reconnect with the past. For this reason it is necessary to train new generations of architects to develop their skills not only in understanding the specificity of earlier building cultures, but also in using appropriate methodologies for analyzing built heritage. By a matter of fact it is necessary to form a new class of architects who can identify and understand local building practices, the materials used for construction, and the way they were used to form buildings, starting with increasing their capacity to analyse and record existing heritage, prevailingly in vernacular architecture. This will allow architects not only to preserve heritage in the most appropriate way, but to establish new approaches to the design of new buildings and new codes reflecting local traditions. Ultimately, the goal will be to encourage the employment of traditional construction in contemporary architecture and support regional building solutions and local craftsmanship.

As a matter of fact, local craftsmanship who practice local traditional building techniques are a substantial resource for sustainable architecture. Not only do they keep the trades alive by passing their know-how from generation to generation, but with their expertise and knowledge they can address the execution of new forms of architecture in continuity with the lessons of historic building cultures. An example is given by the tile-brick vaulting tradition in Bétera – Valencia, Spain. Expert masons, such as Salva Gomis and his brother Jesus, who were trained within the practice of tile-vault staircases in concrete buildings, have become an inspiring resource in the construction of demanding tile-vaults, where forms express new architectural ideas (fig. 5).

Fig. 5. Salva and Jesus Gomis working at the construction of an inclined sail-vault reinforced with ribs. This tile-vault has a 7:30 m span end a rise of 25 cm on the back and 12 cm on the front. (Source: Vitti)

6. Conclusions

While many voices acknowledge the role of culture and cultural heritage as drivers in climate action, we recognize that it is time to establish ways to reinforce their role in developing sustainable architecture. The tangible and intangible components related to past building cultures need to be incorporated into the narrative of contemporary architecture. To that goal, we believe there are two fundamental actions that can positively contribute. The first is developing studies on built heritage which are based on graphic analysis of the buildings, as to determine their local character (materials, technologies, typologies, ways to relate to the geomorphological context) and the way they developed best practice. The second is to use knowledge gained into conservation projects, in which historic construction is analyzed in depth and traditional building techniques are reintroduced, to recover intangible knowledge and train new specialized workmanship in traditional trades. These actions may stand at the base of a new approach to architecture, where building codes and local practices are reintroduced against the trend to globalization, and the "poor" dimension of vernacular architecture is reincorporated into building practices. Ultimately the aim is to reconnect architecture to the collectivity and its capacity to determine, control and produce architecture.

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Community School Museums as a tool for education

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Topic: T2.1. Research in heritage education

Abstract
Community Schools Museums (COSMUS) is an initiative that has been developing an approach to school education from a perspective of multi-dimensional diversity, creativity and community involvement under the Erasmus+ programme in six different countries (Portugal, Greece, Italy, Romania, Poland and Turkey) and in different kinds of schools (arts, music, primary school, high school, VET). This initiative, relies on different educational and multicultural principles, such as the European Youth Charter on Inclusion and Diversity in Education or the European Education Area, and uses a combination of three dimensions that compose the new concept of Community School Museum. The first dimension refers to the local community in which each of the schools is located. This not only enhances concepts such as local traditions, society, or sense of belonging, but also connects with them and involves them in the school activity and curricula content. The second dimension is the school, where education curricula and physical space interact to support those types of knowledge that are essential to sustaining human development, using critical thinking, using creativity or cooperation to promote multicultural meanings. The third dimension is the museum, understood as a flexible tool acting as a communication channel (bi-directional), with elements that act as significance bearers. It uses the approach of learning by doing in order to learn to be, one of the four pillars of learning. It also employs the recommendations of the International Committee for Education and Cultural Action and applies the seven areas of the UNESCO Creative Cities Network. Results of the Community School Museum projects show a sound diversity of approaches, which points to the success of the methodology, given that diverse educational, social and cultural contexts give rise to diverse museum contents and designs. One of these results focuses on vernacular heritage.

Keywords: *Community School Museums, Education, SDG, Multiculturality, Involvement.*

1. Introduction

The project Community School Museums Cosmus, funded by the Erasmus+ programme of the European Union, explored school education from a perspective of multi-dimensional diversity, creativity and community involvement principles. The axis to develop this perspective is creating a museum in the school, using the creation process –conceptualization, design, realization, management– to include the principles aforementioned in the education programme. Consequently, the first task of the Cosmus project was to define a new concept, the Community School Museum. The process of definition was open until the end of the project, in 2022, and ran in parallel with the museums' development.

The museums were created in six different partner countries: Portugal, Greece, Italy, Romania, Poland and Turkey. There were different kinds of educational centres developing the museums: schools of arts in Greece and

Romania, including music, dancing or design; primary and secondary schools in Portugal and Turkey, and a professional education group in Italy with different locations and courses.

The great variety of pilot cases was not only challenging, but also provided valuable input to the Community School Museum definition, as it enhances its applicability to a wide variety of contexts, both educational and socio-cultural. This work shows the results obtained in the process of defining a Community School Museum (CSM), concluding with a proposal of the definition and the process developed by six schools. Finally, it describes a case developed in one of the schools approaching cultural diversity through the vernacular heritage.

2. Conceptual framework of CSM: Principles

The exploration of the Community School Museums concept started with the idea that they are conceived as an educational tool and are created within a certain social and cultural context. With this core idea in mind, the approach to the definition addressed the three main words that compose CSM: the school (space, subjects, curricula and learning methodologies based on ‘learning by doing’), the school community (culture, history, knowledge, etc.), and the museum, with multiculturality being the transversal focus.

In order to identify the principles that will inspire the museum creation, and thus, pursuing the CSM concept, a framework was designed using the three words that compose this concept: community, school, museum. Hence, some core ideas and concepts are approached within this frame.

2.1. Museums and their social role

Museums, from the largest institutions to the smallest initiatives, must have at every stage of their design and construction the desire to seek the active participation of communities (Moutinho, 2022).

According to the ICOM (International Council of Museums) Statutes (Declaration of Vienna, 2007), the current definition of museum is as follows:“*A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment*”.

Since the last decade of the 20th century museums have placed education as one of their main missions (Antas, *in press*). The use of the terminology that defines museum education as non-formal education was established in a UNESCO document, called “Learning to be - The Fauré Report” (1972), which sets the goals for education to lifelong education and the learning society.

The social role of museums was highlighted by the Declaration of Santiago de Chile (1972), implying that museums are vital public spaces that should address all of society and can therefore play an important role in the development of social ties and cohesion, building citizenship, and reflecting on collective identities. They can constitute spaces for reflection and debate on historical, social, cultural and scientific issues (UNESCO, 2016).
What characterizes the so-called Sociomuseology is not so much the nature of its goals, as is the case with other areas of knowledge, but the interdisciplinary focus which makes it draw on consolidated areas of knowledge and relate them with museology itself. Sociomuseology is not a technique, it is part of social sciences (Moutinho, 2021).

2.2. Sustainable Development Goals (SDG)

The United Nations urge us all to take action in 17 Goals, through different actions. Among the SDG´s most relevant to Community School Museums are Quality Education and Sustainable Communities.

Nevertheless, all of them will be of relevance throughout the development of the museum, from SDG1 No Poverty, when talking about social contexts or economic issues, to SDG17 Partnerships, when working on cross border topics or disseminating CSM activities e.g. with the town hall or organising visits with local associations.

The UNESCO framework on Education for Sustainable Development (ESD) is based on the conviction that it empowers learners of all ages with the knowledge, skills, values and attitudes to address the interconnected global challenges we are facing, including climate change, environmental degradation, loss of biodiversity, poverty and inequality.

This is more than linked to the SDGs, because it is not only recognized as an inherent element of SDG4 on Quality Education but also a key enabler of all the other SDGs (UN, 2020). Thus, building an effective global approach to SGD and ESD needs to address respecting, protecting and maintaining the cultural diversity of the world now and in the future. Particularly, Cultural diversity exerts strong influence on ESD in that (UNESCO, 2022):
- All ESD must be locally relevant and culturally appropriate;
- Culture influences what this generation chooses to teach the next generation including what knowledge, skills, ethics, languages and worldviews are valued;
- ESD requires intercultural understanding if people are to live together peacefully, tolerating and accepting differences amongst cultural and ethnic groups.

2.3. Diversity

The Universal Declaration on Cultural Diversity (UNESCO, 2001) provides a useful description of Cultural Diversity, in which cultural diversity rises to the level of "the common heritage of humanity", "as necessary for humankind as biodiversity is for nature" and makes its defence an ethical imperative inseparable from respect for the dignity of the individual. The Declaration is structured on four principles (Identity, Diversity and Pluralism; Human rights; Creativity; and International solidarity), and proposes 20 lines of action for the implementation. Among the actions, those more connected with CSM are the following four (Fig.1).

7— Promoting through education an awareness of the positive value of cultural diversity and improving to this end both curriculum design and teacher education.

8— Incorporating, where appropriate, traditional pedagogies into the education process with a view to preserving and making full use of culturally appropriate methods of communication and transmission of knowledge

14— Respecting and protecting traditional knowledge, in particular that of indigenous peoples; recognizing the contribution of traditional knowledge, particularly with regard to environmental protection and the management of natural resources, and fostering synergies between modern science and local knowledge.

19— Involving all sectors of civil society closely in framing of public policies aimed at safeguarding and promoting cultural diversity.

Fig. 1. Lines of actions for the implementation of the Universal Declaration on Cultural Diversity at CSM (Source: UNESCO, 2001).

Later, the Convention on the Protection and Promotion of the Diversity of Cultural Expressions adopted in 2005 by UNESCO, stated that "Cultural Diversity" refers to the varied ways in which the cultures of groups and societies find expression. Additionally, it is manifested through diverse modes of artistic creation, production, dissemination, distribution and enjoyment, whatever the means and technologies used.

It also refers to "Interculturality" as the existence and equitable interaction of diverse cultures and the possibility of generating shared cultural expressions through dialogue and mutual respect.

Among the rights and obligations of Parties in this 2005 Declaration, the following are of interest for CSM:

—Art.11 Participation of Civil Society. Parties acknowledge the fundamental role of civil society in protecting and promoting the diversity of cultural expressions (…)

—Art.10 Education and Public Awareness. Parties shall encourage and promote this Convention through educational and greater public awareness programmes; (…) and to encourage creativity by setting up educational, training and exchange programmes.

There are many ways to reveal the diversity that exists in the community and its different dimensions in the museum. A useful one, quite extended in the education in diversity is using one or more dimensions that forge our personality to explore and explain it (Fig. 2).

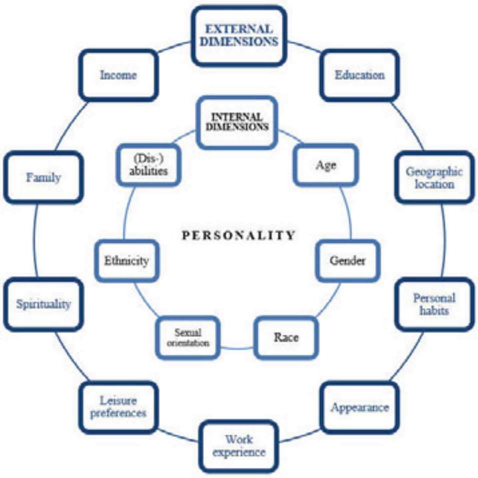

Fig. 2. Dimensions of the personality.

2.4. Creativity

Creativity allows us to express our diversity in the CSM, therefore the museum can be considered as a "communication channel". Fortunately, creativity provides plenty of means to express our identity in different artistic ways. The approach to the creative fields that aligns well with CSM is the one of UNESCO's Creative Cities Network. This creative network was started in 2004, and in 2021 it reached 246 cities.

The Creative Cities Network aims to strengthen cooperation with and among cities that have recognized creativity as a strategic factor of sustainable development as regards economic, social, cultural and environmental aspects. Thus, it is not only a platform for reflection on the role of creativity as a lever for sustainable development but also as a space for action and innovation, notably for the implementation of the 2030 Agenda for Sustainable Development. Creative Cities Network covers seven creative fields: Crafts and Folk Arts; Media Arts; Film; Design; Gastronomy; Literature; Music

2.5. Education principles

The European Commission has agreed to achieve the European Education Area by 2025, where it proposes to consolidate ongoing efforts and further develop the European Education Area along six dimensions (Fig.3). Of those six dimensions, the most relevant for CSM are 1, 2 and 4.

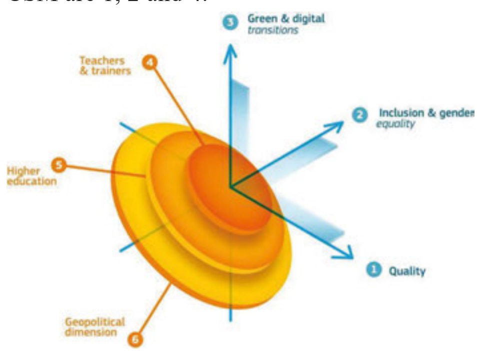

Fig. 3. Dimensions of the European Education Area (Source: EC, 2020).

Regarding dimension 4 (perhaps the least evident among the three considered most relevant to CSM), the OECD's (Organisation for Economic Co-operation and Development) Teaching and Learning International Survey (TALIS) shows the need to develop competences for teaching students with special needs, the use of digital technologies, and teaching in multilingual and multicultural classrooms.

Beyond the European Education Area, one of the most influential approaches to learning was expressed in the Delors Report (Delors, 1996), that of the four pillars of learning. The report argued that "formal education tends to emphasize certain types of knowledge to the detriment of others that are essential to sustaining human development". It affirmed that equal attention should be paid, in all organized learning, to each of the four pillars (Fig.4).

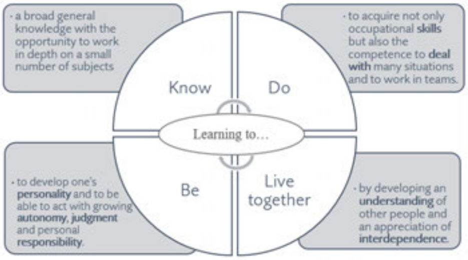

Fig. 4. The four pillars of learning (adapted from Delors, 1996).

To develop these pillars, a more fluid approach to learning is needed. This approach, in which schooling and formal education institutions interact more closely with other less formalized educational experiences from early childhood throughout life, is what CSM aspires to.

Finally, Delors Report also expresses that the right to quality education is the right to meaningful and relevant learning. However, learning needs vary across communities in a diverse world.

This diversity across communities is precisely one of the strengths that CSM wants to enhance, and the official school curriculum is structured perfectly to do so. In education centres, the concepts and contents are organised in different subjects. These subjects and their curricula vary depending on the education level, country, and even region. Moreover, there is a widespread pedagogical body able to connect and enhance the different subjects to build the museum, and Project-Based Learning (PBL) is probably the one that best fits the CSM proposal.

PBL is an instructional approach developed through learning activities and real tasks that bring challenges for students to solve. It teaches students not just content, but also skills (Stevers, 2010). Some skills that can be trained with PBL are time management, communication, participation and leadership, or critical thinking.

3. Methodology

The applied research, done during the project in order to define and develop Community School Museums, includes the common research approaches such as literature review, manuals, directives or study cases. Moreover, it also included more participative methodologies, such as in-depth interviews with experts from different disciplines (pedagogy, museology, heritage interpretation, museum curating, communication, etc.), focus groups, and short training sessions with professionals (including professionals of heritage management, archaeology, sociology, history, heritage interpretation, non-formal educators, museum guides or culture dynamizers among others) held during the Cosmus project development. The combination of these research methodologies with the research-action perspective resulted in the progressive development of six CSM in six different countries.

4. Community School Museum definition

As a result, the Community School Museum is defined upon its three pillars (Fig.5).

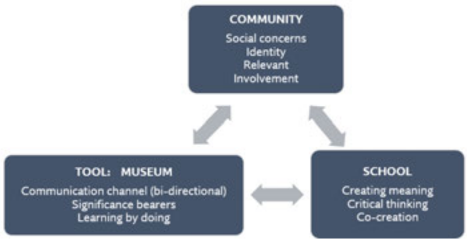

Fig. 5. Pillars of the Community School Museum.

4.1 The three pillars of CSM

I. COMMUNITY

The community linked to the school or education centre can have different meanings, ranging from the education centre itself (students, teaching and administrative staff, families, school services like kitchen or maintenance, etc.), to the neighbourhood, the town, country or even the continent.

The territorial scale of the Community concept can be adapted to the meanings, values, knowledge and approach that will be taken by the museum. Originally, the community concept is devoted to enhancing the nearby culture, history, nature, etc. in the education centre, in order to strengthen the sense of belonging and to promote identity.

Community is also an approach to engage more people and profiles to the museum. They can engage as donors, content creators, curators, visitors, experts, among other roles.

II. SCHOOL or education centre

The core of CSM is the school, and it is meant not only for teaching, but also for educating. The museum is devoted to embracing the educational curricula, but beyond that, to create meaning and develop skills thanks to the elements that are implied in the museum process. Thus, it is intended to promote critical thinking, learning by doing, active participation of the students, co-creation and cooperation among the students and school staff and community. Consequently, the education centre broadens their boundaries and incorporates more tools to the teaching process with a higher number of possible paths for learning.

III. MUSEUM

It is the communication channel, with the peculiarity of being bidirectional, as Community and School co-create and contribute to the contents, which facilitates learning and understanding.

Museums are a significance bearer, that can be interpreted and managed to provide different learning and education. The students actively learn about the past and the present of their cities, and share their views with others, increasing their sense of place and spreading multiculturality.

4.2 Interaction among pillars and principles

Although planning a CSM is a living process tailored to each school, it is necessary to establish at least a basic and flexible process to guide the process (Fig.6). The general approach to any project usually starts with an idea and finishes with the realisation.

The objective with planning a CSM is to keep in mind that it is a tool, meant to drive a learning process through the exploration of as many topics as each educational centre requires. It is also a tool to open the school to the community and to nourish from/to it.

The general process to plan a CSM (Fig.6) starts with an idea, or a brainstorm of ideas, that get more and more defined, until they reach the point in which they can be physically developed into exhibitions, both through personal and non-personal means, using different creative expressions. These exhibitions are materialised through the construction of the materials and activities which are finally delivered to the audience with an objective and a result that was previously established in the education and interpretation programmes.

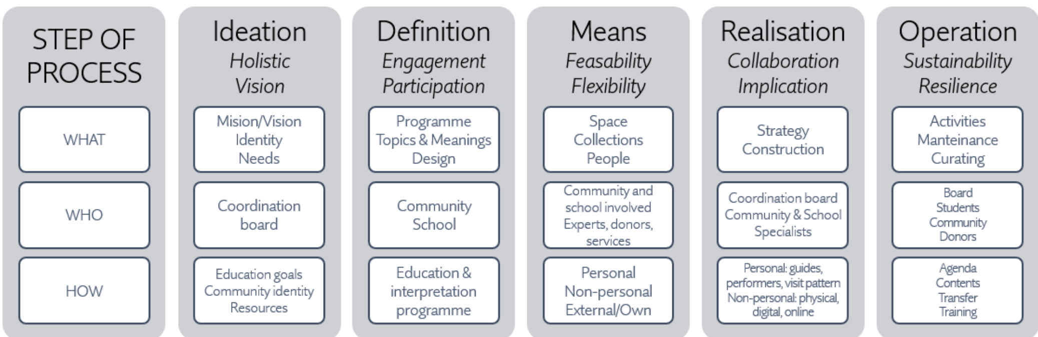

Fig. 6. Process to create and run a Community School Museum.

4.3 Vernacular heritage exhibition

Six schools developed the applied cases during the Cosmus project. All identified different topics to develop at the museum, with cultural heritage as a central element of diversity and intercultural dialogue. One of them, a vocational education school of arts (from 6 to 19 year old) at Iasi (Romania), teaches artistic fields of visual arts, architecture and industrial design, choreography, musical instruments and classical canto as well as theatre performance.

This school defined three main sections to address in the museum based on three territorial scales: Local, using the history of the school to develop social and cultural evolution in the city through the music, fine arts, but also the stained glass tradition. European, focusing on the Unesco Heritage Sites in different countries as well as on their art of words in the fine arts and music.

And finally at national scale, Romania, the school focused on the multiculturality topic. They wanted the students to explore the similarities and differences among the Romanian regions, their history and the geography of the country. To do so, teachers decided on the subjects that would be involved in this part of the museum, as well as the education levels participating. They followed a process, limited by the COVID19 situation, and agreed that the communication tool capable of developing the curricula contents, to create meaning but also to transmit to the public all the ideas that arose through the museum creation process was the vernacular architecture, mainly housing (Fig. 7).

They studied the vernacular buildings from different approaches: the reasons for their design (roof, size, distribution, etc.), the origin of the materials, the evolution, but also the uses of the different chambers. The intangible culture was also studied, not only with literature research, but also with some interviews with members of the older generations as well as with guided visits to the museum and city buildings.

The result was an exhibition with 12 models of vernacular housing made by the students themselves during the lock down due to pandemic situation. Later, the students prepared a panel with some information as well as a guided visit for other students or visitors of the CSM.

Fig. 7. Guided visit to the vernacular building section of the CSM of Iasi made by some students to the Cosmus project partners during the transnational meeting.

5. Discussion and conclusions

The Community School Museum is a new concept where museum is conceived as an education tool, capable to educate in diversity, promote creativity but also conceived to open the school to the community, encouraging the permeability of the education centres to and from their social environment.

Defining the concept of CSM started with the exploration of some principles. After four years of Erasmus+ project Cosmus, this work proposes a definition based in those principles and how they connect with the three words that compose CSM.

Beyond, thanks to the definition process and the principles exploration, this work presents a process to create and run the SCM.

This work selects the application of this new concept to vernacular heritage in one of the six schools that participated in the Cosmus project. The implementation of the vernacular housing to the CSM demonstrated a high education potential. The process of creating this section of the museum resulted in enriched educational practice capable to link different topics in one task (geography, traditions, natural resources, etc.). It also was able to enable different skills in the students and promoted deep learning due to the fact that explaining the concepts to other people using both material and personal means, requires a true understanding of the topic presented, as well as cognitive processes broader than listening at classroom or museums. Finally, the students improved their sense of belonging to the community, because they acquired knowledge about it but also from it, thanks to the research and the interviews and visits. These new links to their community were strengthened with the design of the running phase of the CSM, where different activities take place in the museum, both organised and developed by students and the members of the community.

Obviously, the school implementing the vernacular section of the CSM also found difficulties in the process, not only derived from the COVID-19 situation, but also during the different phases. For instance, initially it was overwhelming the process of creating a museum what resulted in a compulsive gathering of traditional objects. At the latter steps of the CSM creation, the difficulty was mainly to find a physical place to install the house models and to ensure the continuity of the museum next school year. These and other difficulties were faced in the project and the solutions found were added to the methodological proposal of how to create and run a Community School Museum, an open methodology meant to be capable to fit to different education and cultural contexts.

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The interpretation of the vernacular in the modern work of Gherardo Bosio: the Albanian experience

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Topic: T2.1. Research in heritage education

Abstract

The essay investigates the relationship between some exponents of the Modern Movement and their architectural expression with the vernacular tradition. Gherardo Bosio (1903-1941) was one of the most emblematic architects of the modern transformation of Tirana. His work represents the desire to construct the image of the new city while preserving the relationship with the characters and values of tradition. Bosio's work can be ascribed to the particular trend of the Modern Movement that works in continuity with time, tradition and context. The material and immaterial cultural value of these architectures, in addition to the loss of part of the historical vernacular heritage that happens in some cases, represents the chance for the community to recognize and identify itself in a given historical and cultural contest. The relevance of the knowledge and enhancement of these assets aims to preserve the identity of a community from a process of globalization and homologation that is destroying its traces. The studio investigates the architecture of Gherardo Bosio, in his experience in Tirana. Significant in this work is the reference and reinterpretation of the vernacular Albanian Kulla. It is a typical Albanian architecture, distinguished by compact shapes and a massive structure, conceived as a defence fortification against enemy attacks.The essay investigates the contribution of vernacular architecture in some cases of Modern culture, in an effort to identify a national identity: a modernity that brings together past and future, tradition and innovation. Today, with the right distance in time, these architectures represent the contribution of the Modern in the writing of the palimpsest. These works are relevant in the definition and recognition of the characters on which to structure the values of society. The dissemination of knowledge and appreciation is useful in the constitution of a sense of local community.

Keywords: *Modern Heritage; Tradition and Innovation; Cultural Identity; Modern Vernacular*

1. Introduction

The contribution aims to highlight the relationship between the vernacular tradition and Modern architecture, through the work of the Florentine architect Gherardo Bosio (1903-1941) in his Albanian experience. The study focuses the attention on an oriented cultural strand of the modern movement, the one that seeks values in tradition and stands out for its ability to reinterpret the identity features of the local culture that are translated into singular works of great testimonial value. Architects who have considered rural architecture as a source and model of inspiration for a new architectural writing, sometimes to create a new national language in relation to local tradition. An atypical modern which works in strong continuity with history and the built heritage, without neglecting the innovative features related to the materials of the time, but reinterpreting forms, relationships and elements typical of an autochthonous culture. This paper focuses on the importance of Gerardo Bosios's work, which attempts to synthesize innovation and tradition, in the establishment of a new architectural language capable of characterizing the construction and definition of a country then emerging. The research aims to investigate the contribution of this approach in defining the character of the city, specifically of Tirana, and to underline the importance of some works in defining the identity of the place, through a virtuous operation of synthesis between typical elements of Albanian tradition and modernity. The research in heritage education represents a fundamental instrument of knowledge, preservation, and antidote to uncontrolled globalization that is flattening cultural identities and frequently erasing their traces.

1.1. Tradition and Modernity

The vernacular adjective comes from the Latin *vernaculus*, "domestic", "familiar", which concerns the vernacular. Although at first, it had a derogatory meaning, since speaking in "vernacular" meant not using a refined lexicon and not knowing neither Greek nor Latin: the vernacular was the language of the plebs, of the humble and uneducated. However, today the adjective refers to the second meaning of the term, which is linked to the "local" characteristics of a specific limited territorial area. It takes on a positive meaning, as it represents something we could almost define as unique and refers to the specificities of a community, to the cultural features that distinguish it and define its identity. "*The interest in spontaneous architecture in Italy had indeed a long tradition: since the book of Pagano and Daniel Rural Architecture in Italy, it was considered the natural ally of rational architecture as it demonstrated a connection between the natural way and the functional way of building.*" (Gregotti, 1969). The value of rural architecture was revived and highlighted already in the 1920s by various figures such as Pagano, Daniel, Michelucci, Group 7, although with different approaches and interpretations. The aim of the knowledge and analysis of vernacular architecture is to stimulate the understanding of the minor built in order to generate a sincere contemporary architecture, capable of assimilating tradition: "*Not to point it out as an example but to see the beauty of this proud modesty so similar to the feeling of contemporary architecture and to remind how necessary is the coherence with the time, with the climate, with the technique and the economic life to do an honest architectural work*" (Pagano 1936). The research aims to identify the contribution of Gherardo Bosio's work in his brief but intense experience in Tirana.

2. Gherardo Bosio and the Albanian experience

Tirana became the capital of Albania in 1923 and underwent a radical transformation in a few years. Thanks to the synergic relationship with Italy, which immediately deals with an investment program of public works (S.V.E.A.) (Giusti, 2006), a process of urban modification was set in motion right away. The first design dates back to the 1920s with interventions by Giulio Bertè and Armando Brasini, followed by Florestano di Fausto. These were years of great development, the ground was fertile for the creation of a new urban model, "*the result of the interest and encounter of several Italian "schools", from Rome and Florence*" (Giusti, 2006). In 1939, Gherardo Bosio went to Tirana as director of the Central Office for Construction and Urban Planning of Albania. "*He observed and analyzed the existing city which, unlike other Albanian cities, did not have a historical core of great interest, due to the absence of buildings of major importance, exclud-*

ing the two main mosques, the old Mosque and the Mosque of Eth'hem Bej, the former Royal Villa and the old Bazaar. Tirana was a conglomerate of Pisè built houses, plastered and white, with overhanging roofs, private gardens and winding streets, a city heavily affected by the eastern influence for having been under the rule of the Ottoman Empire for many centuries" (Vokshi, 2012). Gherardo Bosio was an integral architect, his work developed between 1939 and 1943, his contribution will be fundamental to the definition of the *Forma Urbis* of the Albanian city: an approach that begins with the understanding and study of the existing city and is aimed at establishing a dialogue, while respecting the few pre-existing environmental elements (Rogers, 1957). The Florentine architect's contribution played a crucial role in determining a modern conception of construction reinterpreting Italian and Albanian vernacular features in a classicist way. In this sense, an approach to tradition is determined, "*mediated by a populistic vision of local folklore"* (Giusti, 2006). The interest in the vernacular is therefore placed in a context of profound change which stimulates reflections on the environment and the relationship between man and nature, on technological progress, on the relationship between craft production and industrial production, and between modernity and tradition. The search is for an «architectural style» that was able to express a new and clear national identity. The research for a language of national style often looks at vernacular architecture, at rural craftsmanship. "*Architecture seems to have always sought, especially in the moments of its own re-foundation, a "native" or rustic antecedent, as a first sign of change (and tradition)"* (Pane, 2010). "*Italian rational architecture in Albania was filtered through elements of rural architecture and medieval cities. Towers, loggias and houses of various types were analyzed, transformed and reinterpreted. The Mediterranean architecture and the spontaneous Albanian one constituted an inexhaustible deposit from which to draw, in which from immemorial time, those principles of constructive honesty, functional clarity and economy, typical of the Modern Movement, were preserved"*(Vokshi, 2012). For most of the regime's architects, who had espoused the Fascist ideology, rural architecture resulted in a catalogue of forms to be inspired by in the research for a new style based on tradition as a recognizable "*part of the ongoing modernization process, in which a mutual influence between modern and ordinary architecture can be observed, representative cases of affirmation of modernity in ordinary architecture, vernacular and traditional"* (Rossi, 2015). Although the city of Tirana did not have a deeply historicized fabric, the architects who were involved in the design expressed certain attention to the few pre-existing environmental elements. In particular, "*with the process of rediscovery of tradition in relation to the context (...) we can see the possibility of establishing a relationship with a specific place, not through a process of mimesis, but as a cognitive instrument of culture and traditions, capable of becoming a device for the construction of urban aggregates and the rediscovery of the values of ordinary architecture as a design reference"* (Rossi, 2015). Repeating the concept of tradition stated by Adolf Loos "*a tradition is not the repetition of past formal models, but a profound understanding of the principles and reasons which generated traditional architectural forms. Only the knowledge of these profound reasons can avoid the "picturesque" repetition of past forms, and can facilitate their innovation, in order to adapt them to changing needs and new technical possibilities"* (Loos, 1972). In this sense, the work of Bosio and his colleagues in Tirana is significant and interesting from a double point of view: on the one hand, in the definition of general principles and rules for urban design, which, relying on the lessons of the past, reinterpreted the elements of the pre-existing city: loggias, porticoes, dimensional relationships; on the other hand, in a clear reinterpretation of some models of rural architecture, for instance the Kulla, a fortified house, widely present in Albania and Kosovo (Fig.1).

Fig. 1. Kulla houses (Peter Moore)

The Albanian "kulla" is a dwelling "*of elevated type, sometimes crenellated with a few windows at the top, while at the bottom it has only one entrance door, resulting in a prevalence of solid surfaces*" (Cresti, 1996). It is a typical vernacular architecture, a domestic house designed mainly for the wealthy class: generally with a square plan, built with thick masonry, to defend families from possible enemy attacks (Fig.2). This reference, reinterpreted and combined with the desire to create an iconic architecture, was fundamental in the construction of the *Casa del Fascio* in Tirana. The Casa del Fascio 1939-1940 (today the Polytechnic University of Tirana), is quite probably the most iconic building of the fascist regime in Albania; placed at the back of the Brasini axis, it was to mark the southern limit and be the culmination of the new axis. Placed in prominence on a base, it is a scenographic and highly symbolic piece of architecture composed of a continuous slat that intersects a compact block in the center: the tower.

The Piazza del Littorio, also designed by Bosio, tried to define a new public space. The urban system and the relationship with the buildings of the National Stadium, the "Gioventù Albanese" and the "Opera del Dopolavoro Albanese", defined and configured the end of the monumental axis. The Casa del Fascio is a formal and linguistic reinterpretation of the vernacular character of the Albanian model of the Kulla, mixing it with the tradition of the Florentine Renaissance palace, revisited in a modern key. At the same time, it expresses, through a courtly, academic, and modern language, the affirmation of the young forces of imperial Italy (Fig.3).

Fig. 2. Residence of Kulle type (Mat, Albania)

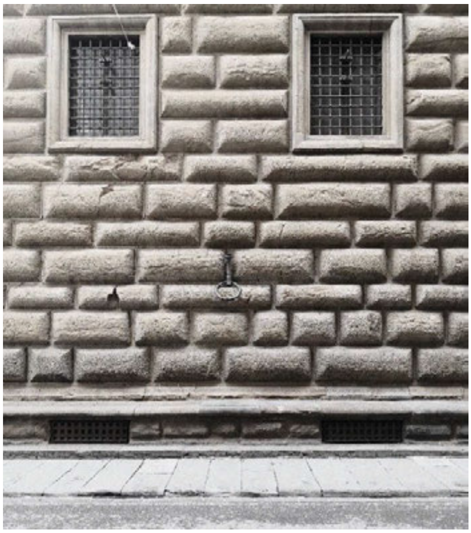

Fig. 3. Florence, Palazzo Pitti (Corrado Castagnaro, 2021)

A language which is presented by Bosio himself at the Levante fair in Bari and at the Prima Mostra Triennale delle Terre Italiane d'Oltremare in Naples *defining the lines of his new way of designing, made up of massive, rationally arranged elements, always aggregated in parts but made solemn by a widespread use of stone on the surface, rusticated or not, as in the best Italian historical examples* (Renzi, 2012). In its compositional and formal simplicity, the work contains meticulous attention to detail (Fig. 4).

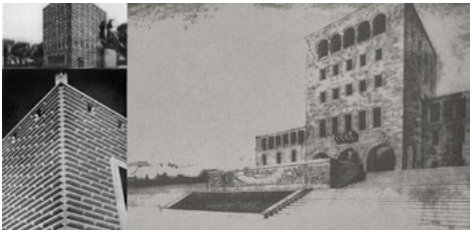

Fig. 4. Pavilion of Albania: Fiera del Levante in Bari top-left;, Pavilion of Albania: Mostra d'Oltremare in Naples bottom-left; Casa del Fascio in Tirana, right in *Giusti M.A. 2006, AQTN.* (Collage: Corrado Castagnaro 2022)

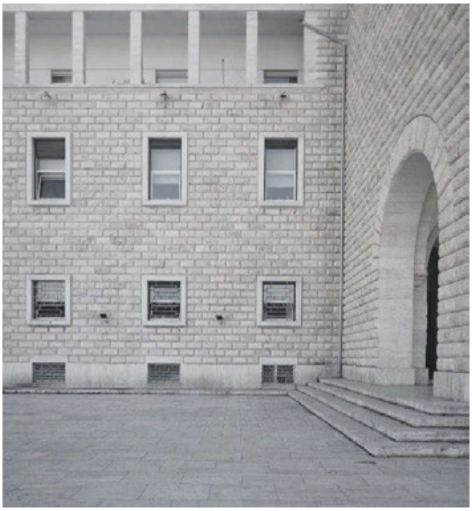

Fig. 5. Former Casa del Fascio (Corrado Castagnaro, 2019)

The architecture is full of contrasts: it oscillates between the expression of a vernacular Mediterranean character and an austere monumentality. A compact block, with a severe element, defined by a clear and regular scanning in the definition of the perforations, elegantly highlighted with a travertine frame (Fig.5). The surface is entirely covered by ashlar blocks, and its continuous façade generates interesting chiaroscuros whose gradations of light and shade make it almost appears as vibrating. *The Casa del Fascio is not conceived as an isolated building or as disconnected from the overall compositional language; on the contrary, it dictates a new system of figurative references capable of becoming a new symbol of the city and the country* (Renzi, 2012) (Fig.6).

3. Conclusions

Today, with the right temporal distance, these architectures represent the contribution of the Modern to the writing of the palimpsest, but mainly in the definition of those characters in which we can recognize and structure the material and immaterial values of the collectivity for the construction of the sense of local community. In a context as complex as the Albanian one, the knowledge and valorization of these assets are aimed at making the local community and the political class aware of the need to safeguard their identity and cultural heritage from a process of globalization and homologation that is, unfortunately, destroying its traces. Tirana seems to live, despite the temporal distance, the same story as the Walls of Sana described in Pier Paolo Pasolini's wonderful documentary on the destruction of Yemen's heritage. In this masterpiece, he talks about the importance of being aware of the preciousness of the country's identity and he points out, moreover, unpleasant parallelisms all over the world. Just think that in 2016 the stadium designed by Gherardo Bosio in the Piazza del Littorio next to the Casa del Fascio was demolished (Giusti, 2021) in order to allow the construction of a new facility, the Air Albania Stadium designed by Archea Associati. More recently on 17th May 2020 the National Theatre of Tirana, the former Italo-Albanian Skanderbeg Club, was demolished, testimony to the *extraordinary creativity in the use of traditional and autochthonous building materials and in the creation of new patents, developed by Italian technicians thanks to the* *synergy between manufacturers and designers* (Menghini, 2019). Virtuous example of experimental architecture, realized through the use of *autarchic materials* (Pretelli, 2021) such as the Populit to make way for Albania's new national theatre designed by Bjarke Ingels Group. Dramatic episodes, leading to the erasure of fragments of history and the loss of collective memory. In an area that has been a laboratory of the Modern with several significant architectural episodes that define the identity of that place, undermining the preservation of those elements is dangerous for the safeguard and definition of the city's sense of community and character.

Today the image of most architectural interventions in Tirana is superficial, ephemeral, it responds to mass society, focuses its attention and research on generating attractive and persuasive images, almost as if they were shop windows, without focusing on their intrinsic nature and without reflecting on the true essence of architecture as the art of building. *Today's globalized image-architecture claims the territories of the world market economy, the last phase of globalized capitalism* (Pallasmaa, 2014). It is necessary to profoundly reflect on space, matter, place, and context. A return to the origins and to simplicity in terms of association of cultural values and to actions of constructions, which have always marked the spaces of our cities and of the collective living. Knowledge, attention, and education about the heritage of pre-existence are fundamental. The preservation and enhancement of these architectures are fundamental for the protection of the features of the city and the cultural identity of the people who are reflected in them. At a time when the overwhelming force of globalization tends to produce cultural homogenization, in society as in architecture, it is essential to focus the attention on knowledge and education about material and immaterial cultural heritage. Examples such as Gherardo Bosio's architecture are essential in shaping the local community's sense of belonging and it is vital to protect and preserve them.

Fig. 6. Former Casa del Fascio (Sailko editing by Corrado Castagnaro, 2021)

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"For sale: empty Spain" Raising awareness on abandoned buildings and depopulated villages

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Topic: T2.1. Research in heritage education

Abstract

Population density is one of the most influential factors in the conservation of historic vernacular buildings. This factor is not directly linked with the constructive technique used but with the conservation and abandonment of traditional buildings. Since the mid-20th century many rural areas in the Iberian Peninsula, mostly inland, have suffered a loss of population. This is partly due to the start of industrialization which caused the population to move to the cities, as well as the high levels of poverty and abandonment in small inland towns which remain very isolated, even today. It is in this context that the Empty Spain teaching initiative arises, applicable to architectural preservation subjects taught at the ETS of Architecture (Universitat Politècnica de València, Spain), and encouraged by the Sustainable Development Goals of the 2030 Agenda promoted by United Nations. Raising awareness on global issues affecting society is essential in the awareness of social responsibility in education . This is even more the case for any professionals in training, especially architects, directly involved in key decisions on forms of construction and choice of materials. From the start it was felt that this involvement could help shape the framework needed to prompt motivation and undertake the changes to follow.

Keywords: *architectural conservation; learning by doing; resilience of historic buildings.*

1. Introduction

The area known as *La España vacía* ("empty Spain") or *La España vaciada* ("emptied Spain") includes agriculture-dependent regions in the vast interior of the country. Therefore, Madrid, Barcelona and Bilbao represent dynamic and adaptable zones, while a large part of Andalusia, Extremadura, Castilla y León, Aragon and Castilla La Mancha is considered representative of depopulated Spain (Modenes-López Colas, 2014). These territories missed the development wave of the larger cities, the speedy industrialization and the specific tourist-friendly coast enjoyed in the later years of the Franco dictatorship. The lack of coasts and possible associated resources is one of the main causes of historic depopulation. What was the result? This disparity encouraged migration, especially that of younger generations, to the metropoles, further accentuating the rural-urban division (Fig.1 and 2).

In recent decades the statistics have made for stark reading: only 10 percent of Spain's population inhabits 70 percent of the country. Forty-two percent of villages and towns are at risk of depopulation.

The province of Zamora, in the region of Castile and León, has seen its population drop by over 30 percent since 1975, while according to recent research featured in "The Guardian" the population of the Balearic Islands has doubled (Jones, 2019). These data made Spanish society aware of the problems in rural areas and empty Spain has become a popular phrase in political debate and the media. However, the frustration still remains as the actual policies are not changing.

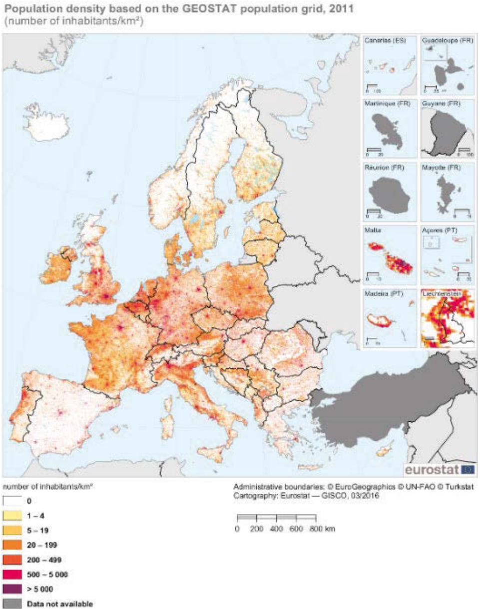

Fig. 1. Details about Population density in Europe (Geostat).

2. The role of vernacular buildings in depopulated areas

Vernacular architecture is an essential part of the concept of peninsular culture, especially in depopulated areas, both for its remote origin and different techniques, adapted to natural and cultural surroundings. In addition, despite their intrinsic resilience, historic building techniques have gradually disappeared, been abandoned or replaced by new standardized techniques, especially from the mid-20th century (Langeveld, 2013). This was to the result of a process stemming from a lack of knowledge and the rejection of this traditional architecture, considered to be poor quality and linked to underdevelopment (Fig. 3-4). For all these reasons it is important to analyse factors directly linked to architecture and certain special techniques (Mileto et al., 2019) in order to identify possible responses to these problems from a wide perspective including multi-risk vulnerability factors of depopulation (Mileto et al., 2020).

Against this backdrop, in order to raise further awareness on this issue, the authors have organized an exhibition which includes a selection of interesting case studies about

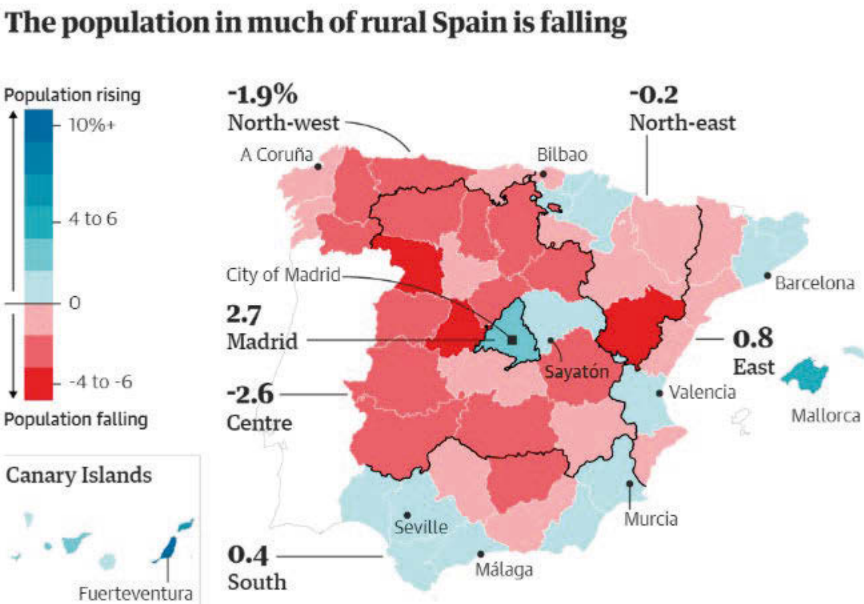

Fig. 2. Population density in Spain (The Guardian/Eurostat).

abandoned buildings in rural areas (Baró et al., 2022). The surveys and details of the case studies are drawn up by students in the subject of Architectural Conservation and PhD candidates involved in depopulation topics at the Higher Technical School of Architecture. This initiative is included within the Versus+ Heritage for People European research project in which researchers from Universitat Politècnica de València, Escola Superior Gallaecia (Portugal), Università degli Studi di Firenze (Italy), Università degli Studi di Cagliari (Italy) and the International Center for Earthen Architecture CRAterre de Grenoble (France) take part.

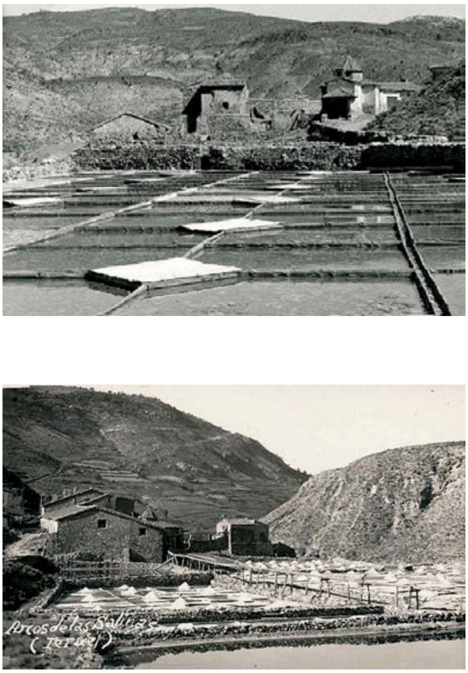

Fig. 3-4. Examples of former rural ensamble of buildings in the "Empty Spain": Arcos de la Salinas (salt marshes, now abandoned) in Aragon (Source: Archive M. Calvo).

3."For sale: empty Spain" initiative

In Empty Spain, as in other marginal rural areas in Europe, there is an extremely high number of abandoned and underused buildings in a state of conservation which is considered to be "at breaking point" despite their potential (Walkers et al., 2004). Without considering numbers, one can think of many examples in the territory of buildings considered iconic within the constructive culture of the Iberian Peninsula. In terms of rural residential buildings alone, different types of farmhouses (cortijos, haciendas, masías, alquerías, caseríos…) can be listed. At the same time, in most cases to this we must add production spaces such as mills, oil presses, stables, sawmills, farms, kilns, slaughterhouses, wash houses, etc., which due to their preindustrial status have become obsolete and in many cases been abandoned (AA.VV., 2014).

On a territorial level depopulation has also affected the loss of social and urban fabric of small villages, where spaces for worship and social gathering have progressively joined the blurred image of an architecture "without architects" but also "without inhabitants". Faced with the impossibility of quantifying this immovable heritage in the framework of the initiative, students have been set the task of selecting a case study of Empty Spain, close to their family or cultural surroundings, providing detailed definitions of all architectural characteristics, taking into consideration whether or not conservation intervention actions had been carried out in recent times.

There is a vast amount of building stock in Empty Spain (Poza & Fernandez, 2010). In many cases these buildings can be accessed safely, have been on sale for years, awaiting a return to a respectful use and dignified purpose, mostly given their resilience and relative "good conditions" in terms of conservation, despite decades of abandonment (Ahbas et al., 2013).

According to the official definition of the United Nations Office for Disaster Risk Reduction resilience is "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (AA.VV., 2015b).

The close relationship between vernacular buildings and resilience was first stressed more than twenty-five years ago (Oliver, 2006):

"vernacular dwellings and buildings are related to their environmental context and available resources, they are customarily owner or community built, utilizing traditional technologies.

All forms of vernacular architecture are built to meet specific needs, accommodating the values, economies and ways of living of the cultures that produce them". Oliver's description points out the existence of numerous parameters in the constitution of a special local building culture, above all the role of the 'micro-climate' and various environmental conditions that other authors explored decades before (Rudofsky, 1964).

4. Proposing concrete actions for conservation and reuse

In the framework of Sustainable Development Goals of the new 2030 Agenda promoted by the United Nations (AA.VV., 2015a) the authors organized students into groups of 5 or 6 and set the task of tracking the affected areas to identify buildings of interest for this initiative (Fig. 5-6). For the smooth running of the work, the case study must feature traditional techniques which are as clearly exposed as possible, a degree of deterioration (non-restored construction but with no safety issues) and be small enough for in-depth study.

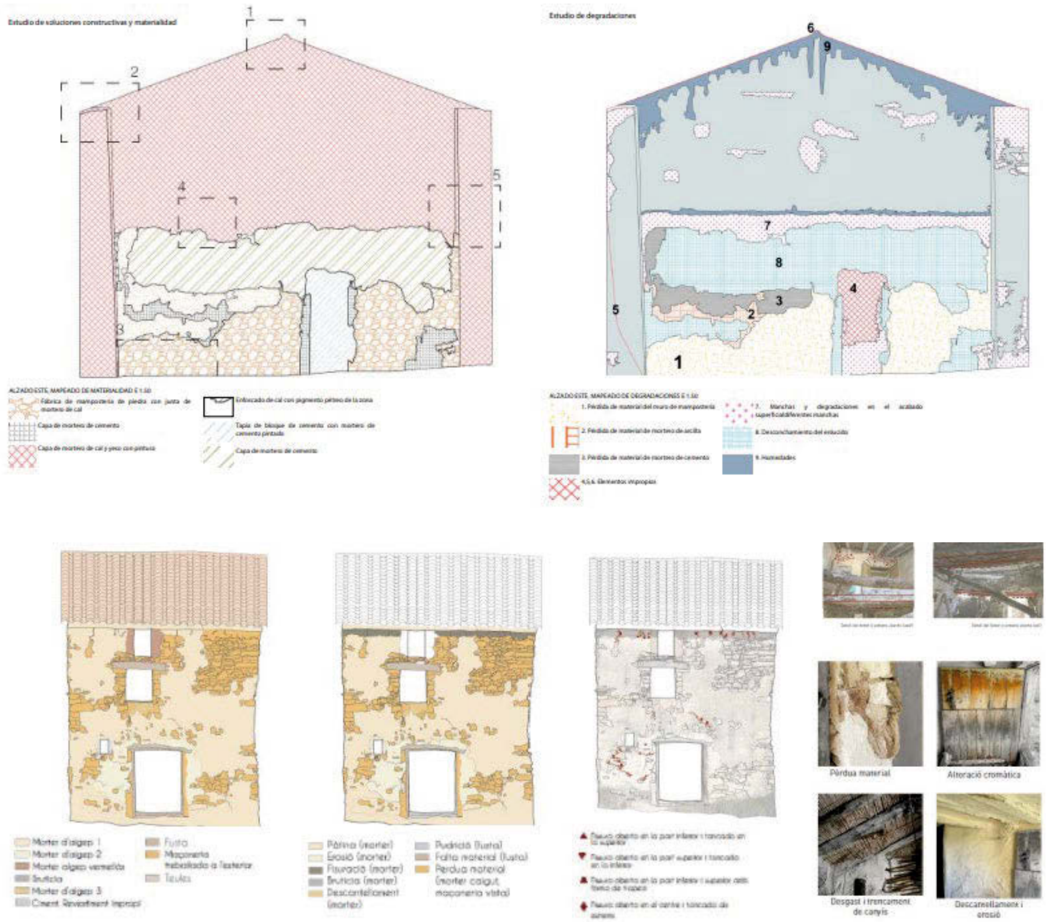

Fig.5-6 Extract from the study undertaken concerning abandoned buildings in Architectural Conservation subject. (Source: Belenguer, Colomar, Pozzi, Lara, Soriano).

As these are architecture students the obvious action is to draw up a preliminary project applied to the building studied.

This design develops architectural proposals with the firm conviction that the recovery of built legacy is possible and desirable, with no need to compromise on the current demands of living standards or to sacrifice the picturesque charm of popular architecture (Ozel et al., 2014).

First and foremost, the proposal requires a selection of criteria or rules on which to base the actions. The different restoration theories covered in the theoretical part of the subject provide the basis for this selection. The students must also set objectives and intentions prior to the initial decision-making.

The project itself includes three complementary aspects: the solutions provided for the degradation phenomena and structural pathologies (Fig. 7); the adaptation of the building to a specific but not necessarily different use; and finally, the improvement of habitability conditions without compromising the values of the building (Weber & Yannas, 2013).

Fig.7 Study of degradation phenomena and structural pathologies (Source: Authors).

5. Discussion and conclusions

Following a group discussion of all the buildings and case studies analysed it was concluded that they are all affected by variables such as depopulation, geographical dispersion in the territory, functional obsolescence, and in general, problems with specialized labour and know-how during maintenance and/or interventions.

This initiative is not intended to be exhaustive given that, as stated above, it is impossible to quantify the number of buildings which could be included in a study of this kind. However, the value of this proposal lies in the awareness raised among students and indirectly, among the private individuals, communities or administrations who own these buildings (Fig. 8).

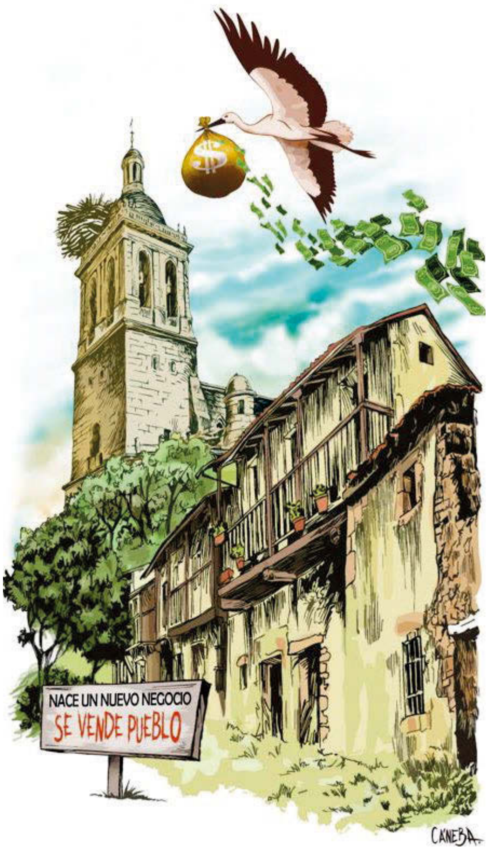

Fig.8 Example of social satire about depopulation (Source: ABC Economia/Caneba).

As a discipline architecture cannot solve the issue of depopulation and the crises affecting territorial models. However, actions like this proposal contribute to implementing a true strategy for multifunctional and sustainable rural development which is linked to very specific controlled incentives to entrepreneurs, boosting sectors which have not yet been suitably developed, such as those of restoration at local level, artisan labour and the traditional know-how of construction.

Acknowledgments

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Qualitative, historical, spatial, stylistic, and social assessment of heritage buildings in Arequipa for Cultural Heritage teaching in Schools of Architecture

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Topic: T2.1. Research in heritage education

Abstract

The old town of Arequipa - Peru was declared a World Heritage Site by UNESCO in 2000. The architectural style of the buildings in the city of Arequipa has evolved, adapting to the prevailing architectural trends over time, and to the constant earthquakes that have marked the pattern of its transformation through history. Some of the main identified styles are Andean baroque, neo-colonial, historicist, modernist, and postmodernist. This project proposes a qualitative, historical, spatial, and stylistic analysis of the buildings built in the city according to academic criteria and the collective memory of the inhabitants of Arequipa. The applied method consists of a stage-by-stage evaluation of the main representative buildings in the city using mapping and matrix tabulations from graphic documentation, in situ surveys, academic criteria according to the categories of antiquity, historicity, instrumentality and artistic value. In addition, the study aims to reflect the point of view of the buildings' inhabitants, whilst becoming a useful tool for them. It will result in the development of a catalog of relevant buildings that will help to understand their representativeness in society.

Keywords: *Teaching, catalog, Arequipa, Heritage, local memory.*

1. Introduction

The city of Arequipa is the second most important in the Republic of Peru. It is characterized by its Historic Center declared World Cultural Heritage by UNESCO in the year 2000. The city rises at the foot of the Andean Mountain range, adjoining three volcanoes, of which the closest and most representative is El Misti (5,825 m.a.s.l.). This proximity of the volcanic mountain range, added to the subduction of tectonic plates along the Peruvian coast, has caused the city to be cyclically subjected to the occurrence of strong earthquakes, leading to successive reconstructions of the old town buildings since its Spanish foundation in 1540 until the mid-twentieth century, a situation that has conditioned and characterized the evolution of the construction processes of its historic buildings (Gutiérrez, 1992). (Fig.1)

These processes are distinguished by the use of white and pinkish ignimbrite stone (volcanic material known locally as *sillar* -ashlar-) in robust walls, arches and vaults, resulting in a type of architecture that represents the integrated response of the native workforce with European construction techniques and stylistic characteristics (Huamán, 2018).

The emergence of such a particular architecture was one of the main criteria that determined the declaration of the Historic Center as a World Heritage Site, a fact that had a considerable impact on urban development and heritage protection policies in the central area promoting a series of actions aimed at its conservation which have involved the entire society, including the academic sector.

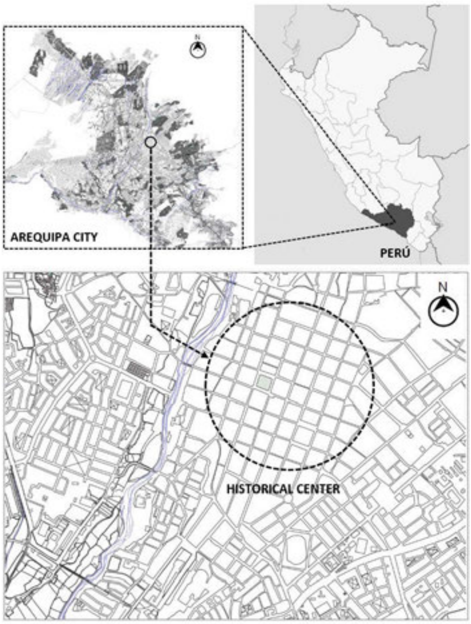

Fig. 1. Arequipa location

In general, heritage protection policies must be constantly reviewed from an academic field point of view, aiming to promote a debate that incorporates both technological aspects and empirical values (Quiroz, E. 1991), reflecting on what attitudes are harmful to monuments. In historical centers such as Arequipa, the protection of blocks declared heritage must be reconciled with their habitability conditions.

However, current policies are not adapted to the real context and are restrictive and outdated, leading to illegal alterations of heritage buildings. Likewise, it is symptomatic that many of the applied solutions consist of emptying and keeping the buildings in an unaltered state, omitting the adaptation to the new paradigms of urban living.

This research seeks to develop a reference document through a parametric methodology for the study of buildings, which will serve as an instrument for analysis and assessment of heritage for Schools of Architecture in Arequipa, through which it is possible to participate in the debate on the relevance of public policies for the protection of heritage. The analysis methodology is based on multivariable indicators, which include technological, academic and housing aspects. It is in the latter where a comprehensive view of the traits that qualify the building is obtained, as well as the level of balance based on the indicators and variables studied.

2. Reference studies

In methodological development, the opinions expressed by Colin Lankshear and Michele Knobel, referring to the verification of interpretations in qualitative research, have been taken into consideration (Lankshear C., Knobel M., 2000). They address the issue of validity as a criterion for effective research and try to show that the findings of the studies are true and justified, in the sense that they have been supported by evidence. Moreover, the broader purpose of qualitative research to study people, events, etc., in their real-life context, automatically precludes considerations such as "external validity" or "reliability" due to the unique and unrepeatable nature of such studies. Rather, "good" research from this angle focuses on verifying the findings of a given study for credibility and plausibility, rather than attempting to apply quantitative research concepts and practices to qualitative research assumptions and practices. The results of this verification largely depend on the validity of the arguments developed in the research report.

An architectural space is an arrangement that each individual makes to build and inhabit. Understanding the architectural and existential space requires "abstracting objects" (schemas, rules, categories, representations, etc.) in the minds of its own inhabitants, but it also implies determining when a methodological framework should be established to take these objects into account (Fuentes Farias, 2012). The spatial approach consists of the study of spatiality from the understanding of space itself "in situ" or from massive data capture techniques such as photogrammetry or laser scanning. The characteristics of this research make it impossible to compare volumes, so the study is chosen based on the "in situ" experience.

For the historical study of the buildings, we shall take the methodological proposal of historical study on built heritage by Jorge Rolando García Perdigón (2015) in which he proposes to divide the process into 4 parts: definition of the object, knowledge of the state of information on the object of study, process of chronological organization and preparation of the report.

Due to the lack of knowledge concerning the construction of certain buildings, stylistic affinity is used, depending on the case. Insight into the styles and direct observation allow to detect the different stylistic categories of the buildings (Rodríguez et ali., 2005).

3. Methodology

This methodology includes the approach of Garcia Perdigón, being also based on the principles of analysis of Aloïs Riegl in “The modern cult of monuments: its character and origin”, which are aesthetic, instrumental, age and historical values (Riegl, 2017).

3.1 Study Variables explanation

(i) compiling the representative buildings of the main architectural currents developed in the city according to the list of buildings declared as national heritage.

(ii) Establish the main variables that qualify the buildings studied; these must contemplate the technological, academic, and habitability aspects.

(iii) Design and apply a questionnaire sheet to evaluate existing heritage buildings.

(iv) Develop analysis graphs by building, evidencing the level of balance between variables.

3.2 Developed questionnaire

The developed questionnaire sheet is divided into eight sections: A- Degree of originality, B- Degree of Originality in space, form and construction, C- Use/Disuse, D- structural deficiencies, E- Aesthetic deficiencies, F- conservation deficiencies of the material, G- index of living conditions and H- academic criteria. (Fig.2)

A- For the Degree of originality, two classification criteria were used: if the building is unique in its type and if it is the only one standing in architectural criteria.

B- For the Degree of Originality in space, form and construction there were three classification levels. The first classification is for those that preserve their original elements, the second classification is for those buildings that have had their elements modified for reasons of adaptation to their use, and the third classification is for those buildings that have had their elements altered.

C- For the evaluation of the Use/Disuse, the current uses were taken into consideration in relation to the uses that originated the building, with the highest evaluation being those that maintain their use to the detriment of those that have seen their use altered.

D- Structural deficiencies refer to the limit states of buildings. It classifies the study of buildings themselves as being in perfect condition, if they have lost their performance due to degradation, or if they are in ruins.

E- Aesthetic deficiencies refer to pathologies that do not physically or chemically affect the material, in this case dealing with differential washes or environmental dirt.

F- The material conservation deficiencies according to the type of origin of the pathology can be chemical, physical or mechanical, referring to the vulnerability of the materials that is the manifestation of the pathological origin (Monjó Carrió, 2014)

A.- GRADO DE ORIGINALIDAD								
Úni. const. en su tipo								
Único en pie								
B.- G.DE ORIGINALIDAD ESPACIO, FORMA Y CONSTRUCCIÓN.								
Mantiene Estilo. Original								
Estado Alterado Parcial								
Estado Alterado								
C.- USO/DESUSO								
	religio	milit	Educ	Civic	Reside			
Uso tradicional								
Uso actual								
Sin uso								
D.- DEF. ESTRUCTURA								
Alt. estructura								
Tip. de la est.								
Estado estr.								
E.-DEFICIENCIAS ESTÉTICAS								
INTERIC Sala 1	Sala 2	Sala 3	Sala 4	Sala 5	Sala 6	Sala 7	Sala 8	Sala 9
% det.								
estado								
EXTERIC Fach 1	Fach 2	Fach 3	Fach 4	Fach 5	Fach 6	Fach 7	Fach 8	Fach 9
% det.								
estado								
F- DEFICIENCIAS DE CONSERVACIÓN DEL MATERIAL								
1 tipo								
estado								
2 tipo								
estado								
3 tipo								
estado								
4 tipo								
estado								

G. Índice de condiciones de Habitar		
Dimensiones	Índices parciales	Valoración
Disponibilidad de un espacio de público	Indice de personas por ambiente (área)	0 a 25 % 25 a 50 % 50 a 75 % 75 a 100 %
Seguridad y uso	Indice de incidencias delictivas	0 a 25 % 25 a 50 % 50 a 75 % 75 a 100 %
Impacto social	Indice de representatividad social del edificio en función al uso (frecuencia de uso)	0 a 25 % 25 a 50 % 50 a 75 % 75 a 100 %
Valor de reversibilidad a la sociedad	Indice de reversibilidad de usos del edificio a la sociedad	0 a 25 % 25 a 50 % 50 a 75 % 75 a 100 %
Confort del edificio	Comodidad y condiciones de estancia 1. Acceso a servicios 2. Iluminación 3. Ventilación	0 a 25 % 25 a 50 % 50 a 75 % 75 a 100 %
H. Criterios académicos		

Fig. 2. Study survey

G- The living conditions index section allows the current use conditions of the buildings studied to be measured and validated based on five dimensions of living: (i) the availability of public space considering accessibility and number of people; (ii) the level of security of the building based on its location in the urban area and the crime rate; (iii) the social and representative impact that the buildings have for the population; (iv) the reversibility value of the building to society, that is, its current usefulness; (v) the comfort of the building, observing the conditions of stay, access to basic services, lighting and ventilation. This section will be put into percentages that will later be translated into numerical values between 1 and 4 to be added to the total sum of the card.

H- The academic criteria focuses on the evaluation of values, we have those of antiquity, historical, instrumental and aesthetic. The value of antiquity consists of the value of the signs of the passage of time. The historical value has to do with knowledge, with the representation of a stage. The instrumental value has to do with the value given to the needs of its use and the aesthetic value has to do with whether it satisfies the aesthetic canons of the style it represents.

The questionnaire sheets were applied in situ, with the collaboration of members of civil society, architecture students and teachers who are members of the team.

The preliminary results gave total scores and by type of variable, these preliminary values are then weighted according to percentages.

4. Study objects

The first lists of buildings to study were based on buildings declared as national cultural heritage by the city council in the area that is part of the UNESCO declaration. The architectural styles studied are: Andean Baroque (XVII-XVIII centuries), Neoclassical (early XIX century), Neo-Renaissance (late XIX century), Neo-Gothic (early XX century), Neo-Colonial (early XX century), Eclectic (early XX century) and Modern style (mid XX century).

(i) Andean Baroque (XVII-XVIII centuries). In Andean Baroque architecture, its main characteristic is the union of the Spanish ideological and technical contribution with the workforce and the interpretation of the Andean man for the construction of civil, religious, and public buildings, in which the ornamentation on the covers of said buildings stands out with pre-Columbian motifs, of Renaissance descent of American flora and fauna as well as Christian symbols.

(ii) Neoclassical (early XIX century). Neoclassical architecture responds to an academic vision, based on compositional principles of proportions and aesthetics, devoid of ornamentation. It uses pilasters attached to the great ashlar walls to impose a rhythm, as well as entablatures to finish off the buildings.

(iii) Neo-Renaissance (late XIX century). The Neo-Renaissance style in Arequipa was introduced in 1881 and incorporates characteristic elements of the Renaissance such as curved lintels, cornices, keystones, and corbels. It also brings with it the addition of second floors on neoclassical buildings. The most characteristic building is the train station.

(iv) Neo-Gothic (early XX century). Neo-Gothic architecture in Arequipa developed at the beginning of the 20th century and stands out for the use of carved stone in the decoration of its buildings, mainly of a religious nature, its details reflected in elongated windows, spires and towers.

(v) Neo-Colonial (early XX century). The neocolonial style in Arequipa uses colonial historical elements of Andean Baroque architecture. The construction systems and structural solutions respond to the times, such as the use of reinforced concrete or ashlar veneer.

(vi) Eclectic (early XX century). The eclectic style fuses different styles that lose their essence until becoming undefined, it also brings with it the change of materials since concrete begins to be used. It uses styles from the past in an eccentric way, it takes Eastern and Nordic criteria; basically, it does not have a clear base.

(vii) Modern (mid XX century). Modern architecture in Arequipa developed mainly in the mid-20th century and is characterized by its rationalist character, where buildings with compositions generally based on simple lines, planes and volumes stand out, combining discrete colors with exposed concrete, stained glass windows and curtain walls.

The variables applied to the study are obtained from the criteria applied in the analysis and assessment of heritage buildings in the city's Schools of Architecture that concurrently appeal to the historical character and to a lesser extent to the technological character.

In addition, variables linked to the current inhabitation of the buildings are inserted, emphasizing the criteria of comfort, use, representativeness, among others, to identify the presence of these buildings in the local collective memory.

5. Results

After applying the evaluation to more than 300 buildings, the following results were obtained:

With respect to the study parameter on living conditions, 13% of the buildings are in very bad living conditions, 21% are in poor conditions, 26% are in fair conditions, 23% are in good conditions and 17% are in very good conditions (Table 1).

Regarding the material conservation study parameter, 1% of the buildings are in ruins, 1% are in very poor condition, 20% are in fair condition, 50% are in good condition and 28% are in excellent condition (Table 2).

Regarding the use/disuse parameter, 24% of the buildings are in their original use and 76% are in a modified use (Table 3).

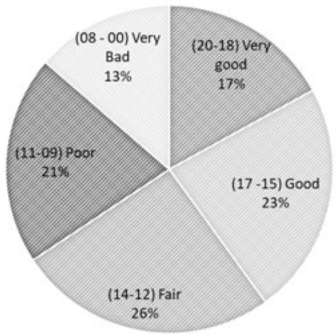

Table 1. Index of living conditions

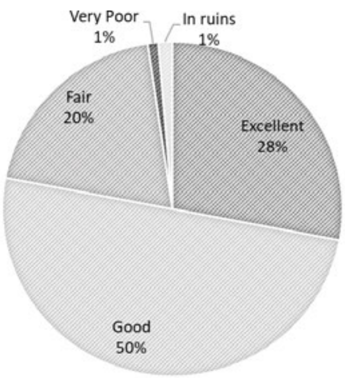

Table 2. Material conservation

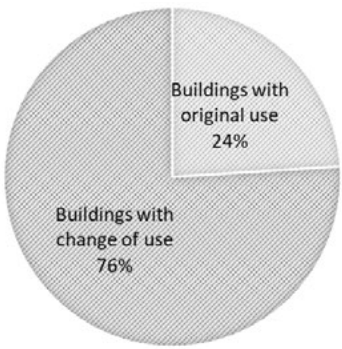

Table 3. Use/ Disuse parameter

Of the 300 buildings analyzed, the buildings with a score equal or higher than 50 points were selected, corresponding to 114 buildings, which are 38% of all the buildings analyzed (Table 4).

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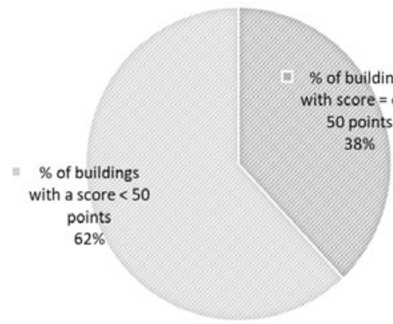

Table 4. Percentage of buildings according to the score obtained

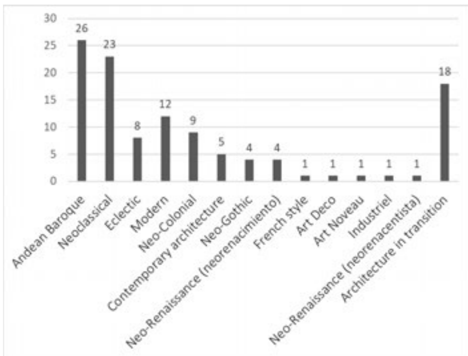

Table 5a. Number of buildings of each style

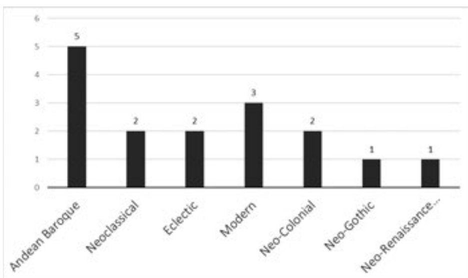

Table 5b. More relevant styles analyzed

Based on the results of the application of the study sheet to more than 300 buildings in the city of Arequipa, we obtain 16 representative buildings of all styles (Table 5 a-b).

The buildings belonging to the Andean Baroque style are Chiguata Church, Yrriberry Mansion, San Francisco Church, Cloisters of Society of Jesus and Old Santa Catalina water mill (Molino Blanco). The buildings belonging to the Neo-Classical style are the Cathedral of Arequipa and the Andean Sanctuaries Museum UCSM. The building belonging to the Neo-Renaissance style is the house-museum José Villalobos, a late 19th century house. The building belonging to the Neo-Gothic style is the Archbishop's Palace. The buildings belonging to the Neo-Colonial style are the Municipal Theater and the former Tourists Hotel. The buildings belonging to the Eclectic style are those belonging to the English neighborhood.

Fig. 3. Images of the buildings that exemplify the styles studied: (a) Andean Baroque (Tristán del Pozo mansion), (b) Neoclassical (Cathedral of Arequipa), (c) Neo-Renaissance (house from late 19th), (d) Neo-Gothic (Archbishop's Palace), (e) Neo-Colonial (Municipal Theater) (f) Eclectic (Museum of Contemporary Art), (g) Modern (housing building El virrey)

The buildings belonging to the Modern style are the Courthouse, the Chapel of the Handmaids of the Sacred Heart of Jesus and housing building El Virrey (Fig.3).

All of them mostly belong to the UNESCO declaration area, meaning this area as one of the most emblematic of the city of Arequipa (Fig.4).

It is necessary to point out that, although the architectural styles were identified according to the common stylistic elements of European origin, their own regional characteristics were found in them as a result of adaptation to the context.

6. Conclusions

In conclusion, the style of the buildings is not a mere copy of all the styles that came from Europe, one can see the adaptations that took place on the construction systems, materials, and knowledge of the area in order to shape the architecture of Arequipa.

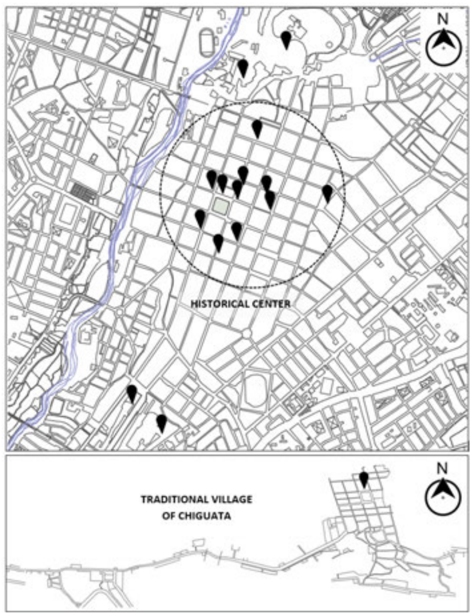

Fig. 4. Location plan (selected buildings marked)

The applied method allows a comprehensive assessment that did not occur before in Arequipa's heritage architecture. It involves the inhabitant within social parameters. From the method used, the representativeness of the architectural fact studied in society can be found.

This study seeks to generate an impact on teaching, specifically in the educational understanding of society; it seeks to contribute to the understanding of the concept of heritage and its relationship with current habitat paradigms.

Finally, the study concludes that the current heritage policies are not taking into account what is related to living as a criterion. This is evidenced in the results referring to the change of use of the analyzed buildings, as shown in table number 3.

Acknowledgments

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Vernacular architecture and art. The representation of traditional buildings in Lorenzo Ghiberti's Gates of Paradise in the Baptistery of Florence

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Topic: T2.1. Research in heritage education

Abstract
In the ten bas-relief panels of the Gates of Paradise of the Florence Baptistery, Lorenzo Ghiberti depicted episodes from the Old Testament, narrated through a succession of scenes, in which the figurative language also fulfils a catechetical function.
The master set the Istorie *(Stories) of the main characters of the Bible against a background of landscapes depicting territories and architecture known to him, and sculpting in great detail the flora, fauna and human structures. With regard to the latter, in the fifth, sixth and tenth panels, the scenery consists of monumental architecture inspired by the Classical and Renaissance style, while in the second, third, fourth, seventh and eighth panels Ghiberti depicts dwellings and shelters linked to the local tradition. In a single artefact, the goldsmith-sculptor master offers an overview of the heterogeneous built landscape, providing a faithful description of a whole series of vernacular constructions which, due to their importance and diffusion in the area, are also frequently found in other contemporary artistic works. From this point of view, the panels can be considered an unprecedented source to allow the analysis of the salient features of those widespread traditional architectures in the early 15th century, which still characterise the rural landscape surrounding Florence.*

Keywords: *Vernacular architecture, Lorenzo Ghiberti, Digital Humanities, Gates of Paradise.*

1. Introduction

“This immense handbook of man's constructive logic, creator of abstract forms and plastic fantasies that can be explained by clear links with the soil, the climate, the economy and the technology, is opened up before our eyes with rural architecture”. (Pagano & Guarniero, 1936, p.12)

With the book “Architettura rurale in Italia” (Rural Architecture in Italy), which contains the results of research presented during the exhibition held at the Venice Triennial in 1936, Pagano and Guarniero inaugurated a successful season of studies on the artefacts that populate the peninsula's countryside, which over time has offered outstanding results (for example, see Biasutti, 1980; Cataldi, 1986; Cataldi, 1988; Sereni, 1961). In the attempt to reconstruct the process that leads from the circular hut to the farmhouse, the authors agree that the chain of these gradual transitions was broken up, as agricultural crops or economic and technical conditions changed. However, their memory is still alive in the barns, tool shelters and temporary dwellings used during the work in the fields in summer and autumn (Pagano & Guarniero, 1936, p. 14 - Fig. 1).

These same constructions were often immortalised in the works of artists, particularly painters and goldsmiths-sculptors.

Fig. 1. Tuscan hut at ‘Le Croci’, Florence (Source: Pagano & Guarniero, 1936, p. 85).

This is the case of Lorenzo di Cione di ser Bonaccorto Ghiberti (Pelago, 1378, Florence, 1455), known for his creation of the Gates of Paradise in the Florence Baptistery.

The possible connection between the rural landscapes[1] modelled by the human presence and those represented by the master (the landscapes of the art) in the panels allows the reading-interpretation of the characteristics of the Florentine countryside at the beginning of the 15th century and, for the purpose of this contribution, of the different forms of living that distinguished it[2] (Zuccagni-Orlandini, 1841).

2. The Landscape of the Lower Valdisieve at Lorenzo Ghiberti’s time

Ghiberti worked in a political and cultural scenario resulted from a prolonged confrontation that can be placed around the central decades of the fourteenth century, between the great feudality that reigned in the countryside and exercised by the family of Counts Guidi, and the new bourgeois class in a *“dominant Florentia*”.

Fig. 2. Domenico Veneziano, *The Adoration of the Magi* (tempera on wood, diameter 84 cm, 1439-1441 Gemäldegalerie of Berlin).

The creation of the new Florentine State led to the marginalisation of the Guidi family, the political expression of traditional local communities, and to the progressive transformation of castles and fortresses into farms (perhaps fortified) or villas, that were necessary to govern a new order of rural territory, in which sharecropping and parcelization of land dominated (Ginatempo, 2002, pp. 49-110; Rete Rurale Nazionale, 2016).

The open countryside was covered with isolated “worker's houses”, alongside these modest dwellings, the Florentine land registers from 1427 reveal a whole network of “master's houses” and “lord's houses”. These more solid dwellings were sometimes located near the peasants' houses and offered the small and bigger bourgeois owners the possibility to control

[1] Nowadays, we define it as a "rural" landscape rather than "agrarian" landscape, since it is argued that agriculture - although it gave the landscape its distinctive imprint in the 15th century - was not the dominant activity. The agrarian landscape is therefore considered a part of the rural landscape.

[2] The experience described in this paper is part of a complex, interdisciplinary and multi-scalar project called "Ghibertiana" (see www.ghibertiana.it) aimed at enhancing the link between the cultural heritage of the lower Valdisieve and the works of Lorenzo Ghiberti.

the activities of the agricultural year on the spot, as well as being a place to spend the summer holiday (Cherubini & Francovich, 1973, p. 902).

Fig. 3. Paolo Uccello, *Saint George and the dragon* (oil on canvas, 57 × 73 cm, about 1460, National Gallery of London).

Fig. 4. Benozzo Gozzoli, *The Chapel of the Magi* - East wall (fresco, 1459-60, Palazzo Medici Riccardi in Florence).

In the works of late 14th and early 15th century artists, the *extra-moenia* territory in which these two worlds coexist is often depicted; in painting, the works of Domenico Veneziano (Venice, 1410 - Florence, 1461, Fig. 2) and Paolo Uccello (Pratovecchio, 1397 - Florence, 1475, Fig. 3), as well as those of Benozzo Gozzoli (Scandicci, 1420 - Pistoia, 1497, Fig. 4) are probably among the best known examples.

Ghiberti's high-reliefs, close relatives of these depictions, describe this landscape in the same way; in fact, it was not uncommon, especially for artists of this period, to set episodes that took place elsewhere and in previous eras in contexts known to them and in the time in which they worked.

The Gates of Paradise of the Florence Baptistery, created by Lorenzo Ghiberti between 1427 and 1452, is recognised by art critics as one of the works that marked the transition from Medieval to Renaissance art (Krautheimer & Krautheimer-Hess 1970, pp. 298-305). From the iconographical and technical point of view, the ten bronze bas-reliefs panels are extremely different from previous pieces, even by the same master.

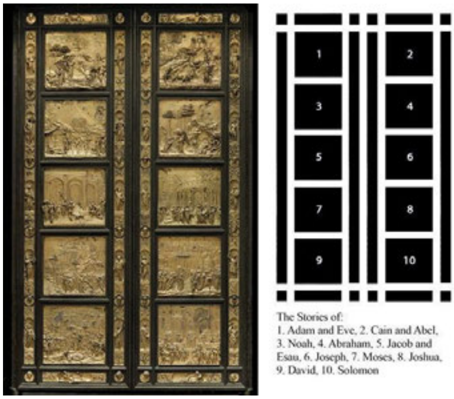

Fig. 5. *The Gates of Paradise* (Baptistery of San Giovanni - Florence) with the themes of the ten panels indicated.

Two of the three doors of the Florence Baptistery were commissioned to Ghiberti: the second (1403-1424) with the Stories from the Life of Christ and the third (1425-1452) with the Stories from the Old Testament (Fig. 5). With the latter, breaking with a millenary tradition that had seen bronze doors decorated with a great number of individual panels (twenty-eight in the case of the first door by Andrea Pisano and the second door as well), the author describes the events included in the first books of the Bible in just ten panels, abandoning at the same time the quatrefoil and using the square format instead (Giusti & Radke, 2012, p. 68).

3. Vernacular architecture in Valdisieve in the early 15th century

3.1. The Hut as Housing Archetype

The scenes in each panel (sometimes up to nine events in the same square) are depicted against a background of landscapes that recall those of

Valdisieve, where the master was born and invested part of his fortune in land and farms.

Fig. 6. Lorenzo Ghiberti, *Gates of Paradise*, second panel (gilded bronze, about 80x80 cm, 1425-1452, Museo dell'Opera del Duomo di Firenze).

In the second square, *The Story of Cain and Abel* (*second panel* - Fig. 6), the first scene depicts the Progenitors sitting in front of their circular hut, a construction made of wooden poles and reeds, covered with a thatched roof supported by poles placed radially, in turn sustained by a central support, as the top would show.

The circular form is the oldest in the history of human dwelling places. The primitive hut does not yet have perimeter walls: it only has a roof that starts directly from the ground. The need to exploit every interior part and the desire to use all the blind spots, created by the intersection of roof and base, suggested the solution of raising the roof off the ground. In the case under consideration, the walls are not yet perfectly vertical and form an interrupted truncated cone, roughly the height of an average man; the skeletal structure, similar to that of the roof, is filled with canes regularly arranged in vertical position and secured to the structure using wicker ties. The slope of the roof, the same as in the Nordic countries, is the logical consequence of the use of straw, which requires very steep pitches to prevent water from penetrating inside.

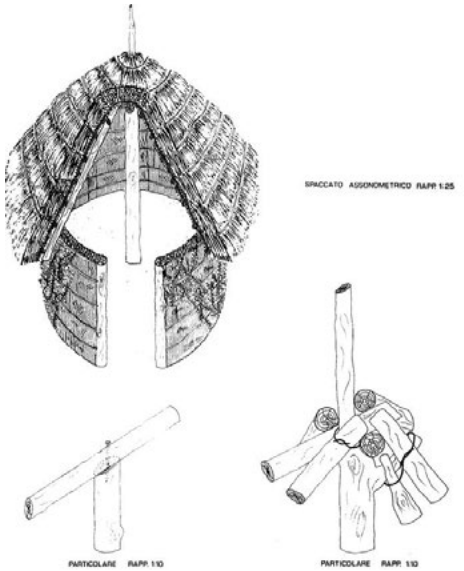

Fig. 7. Cylindrical-conical hut with central pole (from Tamburini, 1988, p. 207).

The hut is still common today in eastern Mugello and Valdisieve (municipalities of Vicchio, Dicomano, San Godenzo, Rufina, Londa), in the Tuscan Val Tiberina, in the Casentino, excluding the mountains, in the Val di Chiana and throughout the region, in the southern area of the Ombrone, excluding the Maremma. More generally, its structure is similar to the cylindrical-conical huts with a central pole found throughout the sub-Apennines area, on both sides of the ridge; this construction involves a wooden structure of poles driven into the ground along the circular perimeter, subsequently filled in with reeds, branches and straw with horizontal circles of branches. The central post with a fork termination constitutes the support for the roof beams, with a secondary frame in rafters to which the roof fronds are fixed (Tamburini, 1988, pp. 197-227 - Fig. 7).

The pair of oxen at the yoke pulling a wooden plough, widespread in the Florentine countryside and often depicted in contemporary paintings (see Virgilio Riccardiano, Fig. 8), confirm the hypothesis that the events take place against the background of a landscape contemporary to the artist.

Fig. 8. Virgilio, *Opere*, (Riccardiano, 492) c.018r, Biblioteca Riccardiana, Firenze.

Fig. 9. Lorenzo Ghiberti, *Gates of Paradise*, third panel (gilded bronze, about 80x80 cm, 1425-1452, Museo dell'Opera del Duomo di Firenze).

The hut depicted in the foreground of the third square, *The Stories of Noah* (*third panel* - Fig. 9), on the other hand, has a rectangular plan and a double-pitched roof with a wooden structure and a reed covering supported by pillars with two-part ends.

Even though it is a simple shelter, the type of roofing demonstrates a certain constructional skill; in order to realise the double frame it is indispensable to arrange the various elements with a certain regularity that, for example, the four-pitch roof does not require (Cataldi, 1986).

A vine-covered pergola, also rectangular in shape, is placed next to the shelter, a very common construction in the Tuscan agricultural landscape. In the Florentine land registers from 1427, it is often mentioned the presence of pergolas and rushes (*perghole* e *channeti*) within the vine-covered lands (*di terra vignata*) (Conti, Guidotti & Lunardi, 1993, pp. 16-27) that characterised the Florentine countryside then, and that still does.

3.2. The Tent as Iconographic Paradigm

The theme of the tent - traditionally linked to nomadism or, in some cases, to the temporary nature of living - is depicted in the fourth, seventh and eighth squares.

If analysed in relation to the forms of vernacular architecture, tents share the same structure with huts and differ from them only in their covering, which in the former is characterised, not only by its value, but also by the fact that it can be reused several times to cover the same structure, after it has been moved or built from scratch, with the same shape and size.

Fig. 10. Lorenzo Ghiberti, *Gates of Paradise*, fourth panel (gilded bronze, about 80x80 cm, 1425-1452, Museo dell'Opera del Duomo di Firenze).

Fig. 11. Lorenzo Ghiberti, *Gates of Paradise*, seventh panel (gilt bronze, about 80x80 cm, 1425-1452, Museo dell'Opera del Duomo di Firenze).

In the panel *The Stories of Abraham* (*fourth panel* - Fig. 10), a single tent is depicted near the left margin, that's where the prophet and his wife Sarah live. It is not a temporary shelter, but a real dwelling with attention to the smallest details and finely decorated, despite representing their nomadic life. In this case, the wooden structure supports a heavy fabric that has been cut and sewn on the roof to support its conical shape.

Fig. 12. Lorenzo Ghiberti, *Gates of Paradise*, eighth panel (gilded bronze, about 80x80 cm, 1425-1452, Museo dell'Opera del Duomo di Firenze).

In *The Stories of Moses* (*seventh panel* - Fig. 11) Ghiberti depicts on the left side of the panel the camp that the people of Israel set up at the foot of Mount Sinai, where they arrived after crossing the Red Sea. In this case there are five tents, three circular and two rectangular, alternating with each other. The structure is covered with fabric and, only in one case, is it supported by ropes that act as tie-rods, that extend from the roof to the ground. At the top there is a sphere, a reminder of the tufts of straw which in ancient times protected the tips of the poles, but since having lost its function, have an eminently decorative value. The same two types of tents are depicted in *The Stories of Joshua* (*eight panel* - Fig. 12); this panel shows twelve artefacts (the same number as the tribes of Israel), ten circular and two rectangular, which were part of the camp erected in Gàlgala, a settlement near the city of Jericho.

There is no direct or indirect evidence of the use of tents in the Tuscan countryside in the early 15th century, at least not for agricultural or forestry purposes. On the contrary, these artefacts are often encountered in paintings depicting battles, in this case with the function of temporary accommodation for troops and nobles, or in scenes of idleness in the countryside (Fig. 13).

Fig. 13. Paolo Schiavo (Florence, 1397 - Pisa, 1478), *An allegory of Love* (Tempera on panel, 38.7×146.3 × 1.4 cm, around 1440, Yale University Art Gallery).

Fig. 14. Piero della Francesca, *Madonna del parto* (fresco, 260x203 cm, 1455-1465, Monterchi - Arezzo).

The best known contemporary work by Ghiberti in which a curtain is depicted is probably "The Madonna del parto" by Piero della Francesca (Borgo Sansepolcro, 1412-1492 - Fig. 14). It is likely, therefore, that Ghiberti used a known and shared figurative code, which made it possible to grasp its symbolic value (the temporary accommodation) independently of having a direct knowledge of the depicted object.

The persistence of this representational paradigm is testified by the repetition of the same reference in later works, such as the fresco in the *Sala di Clemente VII* in *Palazzo Vecchio* depicting the Siege of Florence (1529-1530) by Giovanni Stradano (Bruges, 1523 - Florence, 1605), in which the troops stationed outside the City of the Lily are organised in a multitude of light structures surrounding the city walls (Fig. 15).

Fig. 15. Giovanni Stradano, *Siege of Florence* (fresco, 240x480cm, 1556-1562, room of Clement VII in Palazzo Vecchio - Florence).

4. Conclusions

The works of art generally constitute an invaluable iconographic source, which in many cases enables us to grasp the identity of landscapes that took shape in distant times. The study of paintings, for example, is probably the most effective method to document the origins of the past rural landscape, in this regard, in fact Emilio Sereni's studies are famous, he considered the analysis of the landscape depicted in various works of art at different times to be the best path for reconstruction of the history of agriculture (Zangheri, 1977, pp. 111-112; Bonini, 2018).

The same operation had never been attempted when analysing the panels of Lorenzo Ghiberti's Gates of Paradise, which set the most salient events of the Old Testament in landscapes that closely resemble the same Florentine countryside he spent time in and appreciated. Once it is accepted that, in these works, the master deliberately depicted the landscapes and the architecture style that were contemporary to him and interpreted them according to the language of art, the analysis of the traditional forms of housing, clearly reveals a countryside that is by now "domesticated", populated by both temporary and permanent structures, functional for the work in the fields and pastures, which will remain almost unchanged until the first decades of the twentieth century, and which an attentive eye is still able to discern today.

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Defensive architecture and heritage education: analysis of the National Park Service and Parks Canada actions

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Topic: T2.1. Research in heritage education

Abstract
Defensive architecture is a heritage typology of great interest for society due to various reasons, such as its monumentality, history, beauty or ability to fascinate thanks to cinema, literature or television. Like other cultural assets, its management is based on research, preservation, restoration, didactics, dissemination and participation following current approaches. In this sense, heritage education plays a fundamental role since it is a tool that connects cultural heritage with people. This fact becomes a key aspect to guarantee its knowledge, preservation, use and enjoyment over time. This paper will analyse the actions on heritage education of the National Park Service (United States of America) and Parks Canada which are focused on defensive architecture. Both offices have been chosen because they manage examples of defensive architecture and are world leaders in heritage education. Therefore, the main purpose is to know their actions and make proposals for the Spanish context. This is an interesting fact because Spain has a rich and varied defensive architecture but heritage education still has little presence, which is surprising because heritage education favours society commitment when preserving cultural heritage. To this end, the qualitative work methodology will be used, specifically the analysis technique applied to the contents of the National Park Service and Parks Canada web pages.

Keywords: *Defensive architecture, heritage education, National Park Service, Parks Canada*

1. Introduction

Defensive architecture, understood as the "structures built throughout history for the defence and control of a territory, whether land or maritime, becoming an indissoluble part of it" (Carrión, 2015a), is an interesting heritage tipolgy for society due to various reasons, such as its monumentality, history, beauty or ability to fascinate thanks to cinema, literature or television (Mira, in press a). Nevertheless, despite losing its original military function, its situation can be improved since these monuments are in a state of ruin (Fig. 1).

On the other hand and like other cultural assets, its management is based on research, preservation, restoration, didactics, dissemination and participation following current approaches (Ballart & Juan, 2001; Bermúdez, Vianney & Giralt, 2004; Campillo, 1998; Hernández, 2002; Tugores & Planas; 2006). In this sense, heritage education plays a fundamental role since it is a tool that connects cultural heritage with people. This fact becomes a key aspect to guarantee its knowlegde, preservation, use and enjoyment over time (Fontal, 2003, 2008; Fontal & Ibañez, 2015).

This aspect is well reflected on different national technical documents such as the national plans for defensive architecture, education and heritage (Carrión, 2015a, 2015b), the *Andalusian Defensive Architecture Plan* (Junta de

Andalucía, s/f: 46) and the *Heritage Education Plan of Madrid* (Gobierno de la Comunidad de Madrid, s/f: 20); as well as on international documents like the *ICOMOS Charter for the Interpretation and Presentation of Cultural Heritage Sites* (ICOMOS, 2008) and the *ICOMOS Guidelines on Fortifications and Military Heritage* (ICOMOS, 2021).

Fig. 1. Tàrbena Castle in Alicante, Spain (Source: Mira Rico)

As a result, the design and application of heritage education programmes on defensive architecture become interesting, specially in Spain: a country with a rich and varied defensive architecture where heritage education still has little presence. This is a surprising situation because, as pointed out above, it is a powerful tool to preserve cultural heritage. In this sense, this research will analyse the actions on defensive architecture carried out by the National Park Service (United States of America) and Parks Canada. Both offices have been chosen because they manage defensive architecture examples in an integral and interdisciplinary manner (something unusual in Spain) and include great heritage education programmes (https://www.nps.gov/teachers/index.htm; https://www.pc.gc.ca/en/lhn-nhs/mb/fortgarry/activ/edu).

2. Why a research of these characteristics?

A research on defensive architecture has been developed in the province of Alicante (a Spanish administrative area located in the southeast of the Iberian Peninsula) since 2013 (Fig. 2), which is focused on the management of castles owned by municipalities.

This research helped document unmanaged castles along with others managed occasionally and continuously between 2003 and 2013 (Mira, 2017). The predominance of didactics and dissemination actions over research, preservation and restoration actions was verified within castles managed occasionally and continuously (Mira, 2017). Despite being necessary, these actions –guided tours, open days, talks and lectures, etc.– were not included in short, medium and long-term educational programmes designed to promote castles knowledge and preservation. However, there was an exception only for a few years: the collaboration programme developed by the Castalla City Council and the local educational centres that wanted to join it. This programme included a series of talks and guided tours, among other initiatives, aimed to students at primary and secondary levels as well as students at adult schools and initial professional qualification programmes between 2009 and 2017 (Fig. 3) (Mira, in press a).

Fig. 2. Alicante Province (Source: Ministry of Education and Vocational Training)

On the other hand, the management of defensive architecture carried out by the National Park Service and Parks Canada (Mira, 2016, 2017) is a constant baseline for the aforesaid reasons: integral management of cultural and natural heritage, total management (research, preservation, restoration, didactics, dissemination and participation) and interdisciplinary management (environmental, archaeological, architectural, biological, historical, etc.). The Castle Hill National Historic Site (Placentia, Canada) is a good example (https://www.pc.gc.ca/en/lhn-nhs/nl/castlehill; Mira, 2017; Parks Canada, 2007). For this reason, there are some works that delve into defensive architecture management aspects of the National Park Service and Parks Canada, which are unexplored or underdeveloped in the province of Alicante. For instance, the applications for mobile devices (Mira, in press b) and heritage education with clearly defined goals.

Fig. 3. Talk about Castalla Castle for the 5th grade at the *CEIP Rico Sapena* (childhood and primary education school) of Castalla, Alicante, Spain (2015-2016) (Source: Mira Rico)

3. Methodology

To this end, the qualitative methodology (Flick, 2007, 2015) has been used, specifically the analysis of educational contents on the *Castillo de San Marcos* (National Park Service) and the Fortress of Louisbourg (Parks Canada) websites paying attention to the following fields: scope and educational level (formal, non-formal and/or informal), length, description, purposes; skills, application (*in situ*, *ex situ* and/or online), educational materials, use of new technologies and educational support.

4. Purposes

On the one hand, the main purpose is to better know the heritage education initiatives on defensive architecture applied by the National Park Service and Parks Canada. On the other hand, there are different specific purposes, such as carrying out an analysis of heritage education actions developed in the *Castillo de San Marcos* (Saint Augustine, United States of America) and the Fortress of Louisbourg (Louisbourg, Canada), determining their similarities and differences, and comparing their situation with that of Spain when implementing heritage education in defensive architecture management.

5. Castillo de San Marcos

The *Castillo de San Marcos* (Fig. 4) is the oldest European-designed fortification in the current United States of America. It is located in Saint Augustine (Florida) and it was built between 1672 and 1695 to protect the Spanish presence in Florida and the sea routes that connected the colonies with the metropolis. In 1924, it was declared a national monument and later, in 1933, it was transferred to the National Park Service (http://npshistory.com/publications/foundation-documents/casa-fd-overview-sp.pdf).

Although the National Park Service has a specific page with resources for educators (https://www.nps.gov/teachers/index.htm), this research is focused on the fortification website (https://www.nps.gov/casa/index.htm). It includes a section about heritage education named *Learn About the Park*, which can be accessed from the drop-down menu on the main page. Its organisation is confusing because some sections appear independently and are included in others too, like *Kids & Youth*. Therefore, the analysis was focused on *Education*, specifically on *Parks as Classrooms/Curriculum Materials/Coquina: The Mighty Tiny Shell* (https://www.nps.gov/teachers/classrooms/coquina-the-mighty-tiny-shell.htm).

Coquina: The Mighty Tiny Shell (Fig. 5) is a didactic unit designed for the non-formal educational field (Carrión, 2015b) with a length of 90 minutes for students at primary school (3rd-5th grade) as well as other people. This unit consists of explaining the coquina (a rock used for the construction of the fortification) and why it is important for the castle. It is achieved when students acquire a series of skills (remembering, understanding, applying, analysing and evaluating) essential for the purposes of the didactic unit: understand the importance of historical documents in order to know history, get familiar with the use of this documentation, practice unit conversions and solve real world problems through mathematical volume and area formulas.

Fig. 4. *Castillo de San Marcos* view, Saint Augustine, United States of America (Source: https://commons.wikimedia.org/wiki/File:Castillo_de_San_Marcos.jpg)

Under normal conditions, that is, without a pandemic, the didactic unit has a hybrid application: it can be worked in the classroom (*ex situ*) and in the castle (*in situ*). But with the pandemic, its contents can also be worked online from the fortification's website without visiting it: a reading to find out who built the castle explaining the role of the Spanish, the Native Americans and the African slave population; an introductory activity in which students must answer the question "Why do you think Spain built the fortress?" based on the information provided by the teacher; a reading and a summary of the contents on the coquina from the website of the National Park Service (https://www.nps.gov/teachers/classrooms/coquina-the-mighty-tiny-shell.htm); a reading of the minutes on the placement of the first stone of the castle so that students can put themselves in the shoes of a citizen from Saint Augustine with a series of questions –How do you feel? What are you thinking? Why is this an important day for you?–; and a problem solving related to volume and area with a practical application in the real world in order to understand the fortification design and building process.

Fig. 5. *Coquina: The Mighty Tiny Shell* (Source: https://www.nps.gov/teachers/classrooms/coquina-the-mighty-tiny-shell.htm)

With the aim of achieving and acquiring the aforementioned purposes and skills, some online educational materials are available on the website: information about *Who Built the Castle?*; why the fortress was built (https://www.nps.gov/casa/learn/historyculture/who-built-the-castillo.htm); a sheet to work on the volume and area calculation of the castle; why Spain built it (https://nps.gov/casa/learn/education/classrooms/images/why-spain-built-the-fort_1.jpg); *What Is Coquina?* (https://www.nps.gov/casa/learn/historyculture/coquina-the-rock-that-saved-st-augustine.htm), which explains its rare and expensive nature and the formation process; and *The Castle Has Begun* with the testimony of the beginning of the castle construction, besides other interesting historical contents (https://www.nps.gov/parkhistory/online_books/source/sb3/sb3toc.htm).

6. Fortress of Louisbourg

The Fortress of Louisbourg is a walled city that became a prominent centre of the French overseas empire (Fig. 6). It was conquered by the English in 1758 (Seven Years' War) and disappeared after 1760. In fact, it was the only important colonial city without contemporary constructions. In 1961, the Government of Canada began a project to rebuild about a quarter of the settlement. This project required an interdisciplinary research effort (archaeological, architectural and historical), which provided an excellent basis for the study of the French in North America (MacLean, 1995). Today it is a national historic site of Canada and is part of its national park system (https://www.pc.gc.ca/en/lhn-nhs/ns/louisbourg).

Fig. 6. Fortress of Louisbourg view, Louisbourg, Canada (Source: https://commons.wikimedia.org/wiki/File:Fortress_of_Louisbourg,_Louisbourg,_Nova_Scotia_01.jpg)

Parks Canada enables to discover and learn about the managed sites through programmes at local schools, some publications, its website and other media (Parks Canada, 2011). However, Parks Canada does not have a specific page for educational resources unlike the National Park Service. This fact is well reflected on the contents of the Fortress of Louisbourg website (https://www.pc.gc.ca/en/lhn-nhs/ns/louisbourg), which are very different from those on the *Castillo de San Marcos* website. In this case, it shows a presentation of the tourist offer together with non-formal educational components of the fortress. Nevertheless, Parks Canada is committed to involve young people, whether at home or in the classroom, through an informal relationship established with the Regional School Board, (Parks Canada, 2011: 23). In general terms, this can be seen in the *Culture/Our Interpretation* section and subsection, which summarises the interpretive commitment of the fortress (sounds, melodies, meals, clothing, houses, furniture, scents, smells and daily activities) so that visitors can immerse themselves in the 18th century (https://www.pc.gc.ca/en/lhn-nhs/ns/louisbourg/decouvrir-discover/interpretation). More specifically, in the *Things to Do* section, the activity *Rookie Tour* (*Children's Program*), with a length of 45 minutes and aimed at families with children between five and eight years old, enables to know childhood in a colonial city in the middle of the 18th century through gardening, livestock, fishing and military activities (https://www.pc.gc.ca/en/lhn-nhs/ns/louisbourg/activ/enfants-children). *Kids' Corner* is another interesting section aimed at children that explains how to build a lighthouse or a swallow's nest. In addition, children can answer a quiz with fun questions about the swallows or Louisbourg lighthouse as well as do a word search included in the activity book (https://www.pc.gc.ca/en/lhn-nhs/ns/louisbourg/activ/coindesenfants-kidszone - nest) (Fig. 7).

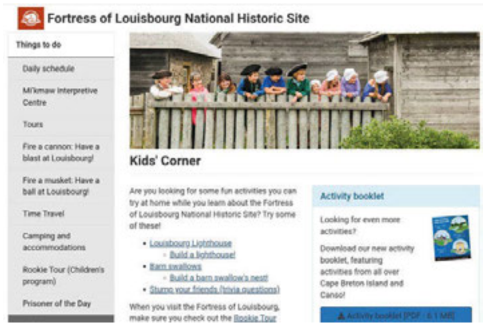

Fig. 7. Fortress of Louisbourg. Kid's Corner (Source: https://www.pc.gc.ca/en/lhn-nhs/ns/louisbourg/activ/coindesenfants-kidszone)

When comparing the actions developed by the National Park Service and Parks Canada in the *Castillo de San Marcos* and the Fortress of Louisbourg, their differences stand out despite their similarities in the non-formal educational field and the online contents committed to new technologies. Actually, the main difference is the greater quantity and diversity of information on the web pages of the castle and the resources for educators of the National Park Service, which is better than that provided by the Parks Canada.

7. Situation in the Spanish context

As pointed out in a recent paper (Mira, in press b), Spain does not have similar structures to those of the National Park Service or Parks Canada. Therefore, the heritage education on cultural heritage and defensive architecture is applied by the General State Administration, the regional administration, the local administration –provincial councils and city councils– and different private entities. This is a complex situation that does not always show optimal results. Focusing on castles owned by municipalities in the province of Alicante (see Fig. 1), whose management has been well studied (Mira, 2017), it should be noted that none of them has a website nowadays, neither those located in smaller municipalities (something that can be understood due to a lack of human and technical resources) nor in the largest ones. In fact, all the information is included on different general web pages of the city councils like Sax Castle (https://www.sax.es/conoce-sax/patrimonio-arquitectonico-y-cultural/el-castillo). Atalaya Castle (Villena), Dénia Castle, Elda Castle and Santa Bárbara Castle (Alicante), located in largest municipalities, do not have educational contents. Atalaya Castle and Dénia Castle (Figs. 8-9) have general information and a brochure (https://www.villena.es/museo-castillo/; https://www.denia.net/castillo-de-denia); Elda Castle includes general information and an audio track in Spanish and English (http://turismo.elda.es/que-ver/castillo-palacio); and Santa Bárbara Castle only offers general information (https://www.alicante.es/es/equipamientos/castillo-santa-barbara) (Fig. 10).

The exception is Orihuela Castle (Fig. 11), which includes a wider variety of technical and dissemination contents on its website in spite of being in a state of ruin: general information, technical documents, dissemination sheets, publications and videos (https://patrimoniohistoricodeorihuela.com/proyecto/castillo-y-murallas-de-orihuela/). Its dissemination sheets offer historical information about the fortification, like the artillery bastion (https://patrimoniohistoricodeorihuela.com/wp-content/uploads/2021/02/EL-BALUARTE-ARTILLADO.pdf), with some texts and graphics that can be used for educational purposes too.

Fig. 8. Atalaya Castle (Source: Mira Rico)

Fig. 9. Dénia Castle (Source: Mira Rico)

Fig. 10. Santa Bárbara Castle (Source: Bevià i Garcia)

Fig. 11. Orihuela Castle website. (Source: https://patrimoniohistoricodeorihuela.com/proyecto/castillo-y-murallas-de-orihuela/)

8. Conclusions

New technologies have become essential tools for managing cultural heritage in the 21st century, especially for promoting its educational aspects as clearly stated by the educational proposals of the National Park Service and Parks Canada.

As mentioned above, the *Castillo de San Marcos* and the Fortress of Louisbourg have two web pages with educational contents. In the first case, non-formal didactic units have been included to learn more about the fortification at different levels among other resources. In the second case, the fortress is committed to the presentation of the tourist offer with non-formal educational components. Educational heritage contents of the *Castillo de San Marcos* provide a detailed knowledge to any interested person (whether American or not) despite the location and the current pandemic situation.

This situation contrasts with the Spanish one, particularly in the province of Alicante, where there is still a lot to do as can be seen in the examples already given. In this sense, and as indicated for other aspects such as applications for mobile devices (Mira in press b), a coordinated heritage education policy lacks both in the province of Alicante and the Valencian Community, which should be focused on fortifications and new technologies in order to offer educational contents according to the different public and interests. This is something very necessary in a territory full of castles as well demonstrated by the Route of the Knights Templar (https://www.dipcas.es/es/territorio-templario.html) or the Costa Blanca 100 Castles Route (http://www.costablanca.org/Esp/Descubre_la_Costa_Blanca/Castillos_de_la_Costa_Blanca/Paginas/default.aspx) (Fig. 12).

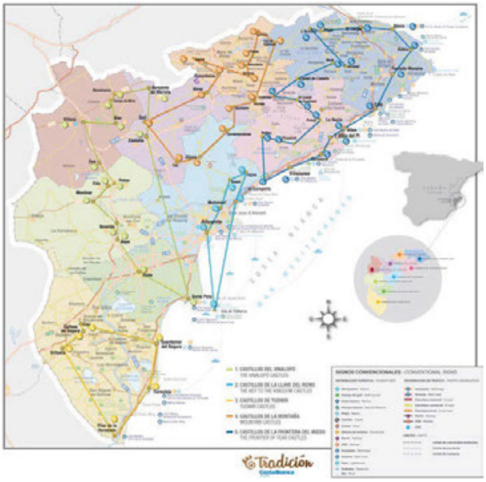

Fig. 12. 100 Castles of the Costa Blanca (Source:http://www.costablanca.org/Eng/Descubre_la_Costa_Blanca/Ruta%20de%20los%20Castillos/Pages/default.aspx)

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HERITAGE EDUCATION

HERITAGE EDUCATION AND SOCIAL INCLUSION

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Gibellina and the identity of community. Brandi, Burri and the conservation of the 'ruins'

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Topic: T2.2. Heritage education and social inclusion

Abstract

The construction of the new Gibellina is the starting point to reflect on the importance of memory. The construction of the city resulted from the destruction of the Belice earthquake of 1968. What remains of the old city destroyed by the earthquake has been transformed from a pour of concrete into a work of art: the "Cretto" by Alberto Burri. The new site arose from the design of Marcello Fabbri was the result of experimentation for the city of the future. The citizens of Gibellina had lost their place of origin, their "sacred pole". The contribution aims to highlight the links between past and future in the history of a place that pass through the relationships between the urban and social fabric in the transmission of the memories and identity of a people. After several decades, it is possible to evaluate the emotional effects of the choices made and reflect on the strategies that can be applied to heal the obvious gap between design and actual use of a place. The comparison between the settlement rituals of the nomadic tribe of the Omaha people based on the continuity of a symbolic object, the sacred pole, and the loss of the "genius loci" of Gibellina caused by the occultation of the macere, allows to identify an interesting and unprecedented parallelism in the re-foundation symbolic of the settlement principle which is at the basis of the rebirth of a community. As Torsello and Boscarino suggests, the memory of a people passes through its monuments. Etymologically it can be traced back to the Latin verb "monere" that is to remember, emphasizing the act of admonishing, warning, remembering the history imprinted in the voluntary action of building for the community.

Keywords: *Gibellina, Urban Restoration, Historic town, Modern architecture*

1 Introduction

The usual and popular image of Gibellina is the oleographic one of his architecture, fixed by the lens in the aseptic purity of style exercises (Dezzi, M., 2003, p. 87). Presented several times as an emblem of utopia (La Monica G., 1981, p.73), the city symbolizes the reality of a constantly changing society. The story of the foundation of Gibellina turns out to be rich in topics for reflection, regarding the evolution of the city and its tendency to self-celebrate in the production of art and architecture (Dorfles G., 1997, p.30). The foundation of a new city is never a painless event and the birth of the new Gibellina is linked to the events of the Belice earthquake[1].

[1] On January 15, 1968, the earthquake destroyed the towns of Gibellina, Poggioreale, Salaparuta, Montevago and damaged the town of Santa Margherita.

Fig. 1. Vista aerea del Belice dopo il terremoto (1968)

2 The reconstruction of Gibellina

The reconstruction is characterized by the decision of the residents of Gibellina to make a clear break with the past, both from a social and cultural point of view. The new city born from the design of Marcello Fabbri is characterized by a strong utopian tension, linked to the experimentation of the city of the future. In the wake of the experimental experience of the Olivetti Park in Ivrea (AA.VV., 1998, p. 120). A fertile site for the architectural experimentation of the Modern Movement of the twentieth century, consisting of a unique complex of architectures, which arose from the industrial, cultural and social vision of Adriano Olivetti. Where, with the collaboration in 1950 of architects such as Figini, Polini, Gardella and Nizzoli, the futuristic vision of the industrial city was shaped. In Gibellina's experience, having oversized development flows has led to the creation of a city with extremely dilated spaces. There is a recurring sense of "unfinished" that persists to this day. Past, present and future confront each other in the search for a new identity without finding a solution. The few ruins of the old city of Gibellina have consequently become like monads of transformation in the sign of rebirth. Architects and artists interpret, in their own way, the 'sense' of tradition, transmigrated into an object-fetish, or reminded in the serial repetition of a theory of pillars. In this *en plein air* museum, architecture becomes art and art takes on the spatiality and materiality of architecture. One of the most important monumental works of land art of the twentieth century, the Grande Cretto by Burri, for example, has a precise symbolic and programmatic purpose.

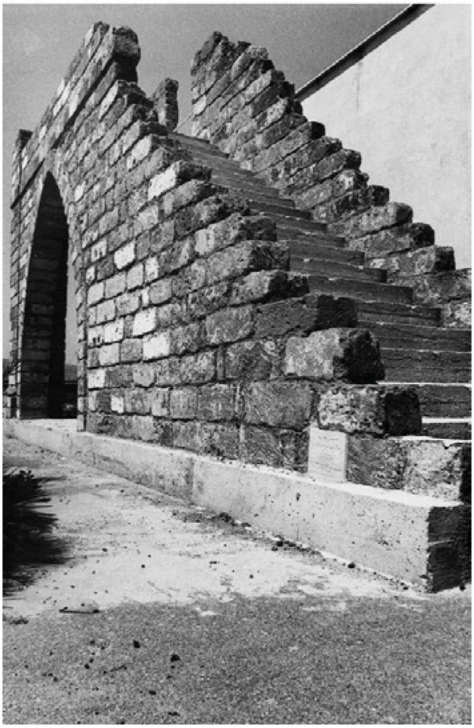

Fig. 2. Gibellina, Nanda Vigo, Tracce antropomorfe (1989)

Fig. 3. Gibellina, F. Purini e L. Thermes, Sistema delle piazze (1982-90)

The transformation of the site of the city destroyed by the earthquake, with all its dramatic heritage of ruins and rubble, into a work of art, testifies to the precise will of the administration to erase the past, hidden and forgotten under a pour of white concrete furrowed by ways - wounds.

3 Brandi and the poetics of the “Grande Cretto”

The "Grande Cretto" of Gibellina is characterized, in Cesare Brandi's reflections by a tension entirely directed to the evocative charge of matter (Brandi, 1979, p. 5).

Fig. 4. Gibellina, Burri, Grande Cretto, aerial view (1985-1989)

Even from an object that apparently does not represent anything or from a raw material, says Brandi, such as Schwitters' Collage or Burri's Sacks, it is essential that the "constitution of an object" occurs, which is not so much a choice of contents , as well as a selection of significant characters concerning the form of the expression. Although from the point of view of artistic creation, and of the appreciation reserved for the latter by the community, a general and widespread consent to Burri's work can be found, the same cannot be said for the repercussions of the artistic gesture on the preservation of the historical memory of the country. Characters and forms, in the Great Cretto, irreparably overlap the ruins of the destroyed Gibellina, hiding them forever from sight and memory. In Gibellina the remains of the old destroyed city, hidden in their dramatic materiality, participate in a transmigration of meaning and form to become an artistic representation of themselves. The transformative action does not stop at use but abruptly and 'irreversibly' invests the material. In the frantic pursuit of the new, the memory of the past becomes an embarrassing baggage, the more uncomfortable the past to remember, the more it will be at the center of incandescent negotiations, the more likely it is to give rise to ambivalent representations (Tota, 2002, p. 90).

Fig. 5. Alberto Burri, Cretto G 3 (1975)

4 Art, wreck and ruins

But what does Gibellina mean by the term ruin and its analogue, wreck? Generally the first refers to rudus, the second to ruina, a derivation of ruere, in which we can recognize the reference to a consciously destructive action on the part of man. The ruin, which can be understood as the residue of a testimony that refers to another entity other than itself, that is, to a whole, is seen as a fragment of a human work. The difference between ruin and waste consists in the fact that if the first represents a real identity statute, the second represents indeterminacy and stasis, tells remains without a trace of a possible new meaning without history, or with a history of little importance (Marini, 2010, p. 58). Yet even the gap can take on the dignity of an artifact, capable not so much of recounting past or presenting futures, but of asking for critical reflections on the methods of construction of the territories of the present. Ruin is such only in the thought of those who, observing it, are able to exercise memory and planning on it: otherwise it is rubble, waste, scraps, mute matter without ethical or semantic potential, elements looked at mostly with a certain apprehension, such as uncomfortable objects, embarrassing witnesses of painful events (Tortora G, 2006, p.10). In this referring to human work the ruins of Gibellina, which have become ruins, other than themselves, transmuted by the artistic sign, are loaded with meanings extraneous to them, but irremediably lose the strength of memory.

Fig. 5. Gibellina, Burri, Grande Cretto, landscape (2015)

If Cretto subtracts the ruins from the action of time by passing them on to the future, on closer inspection the work of Burri makes this assignment a subjective rather than an objective fact. The remains of the destroyed city were not swallowed up by the forces of nature because an artistic gesture wanted to direct the shaping of the material. The expressive power of Cretto ignores the real presence in the concrete volumes of the real houses of the Gibellinesi, of those places of memory that are now buried. After all, Burri himself has repeatedly highlighted the absolute lack of symbolic relationships between the work and the material used, seen as a mere tool of the creative gesture. Several times Burri (Caroli, 1979, p. 107) testifies to the secondary nature of the material medium[2].

Every understanding is a happening, a historical event in its turn (Gadamer, 2000, p. 55).

Fig. 6. Gibellina, Burri, Grande Cretto, internal road (2015)

The symbolic nature of the Great Cretto, its elevation to the shroud of the telluric event, constitutes the great contradiction of the choice of a zeroing with the past and at the same time of the scenic representation of the time that has elapsed. The "story of time" becomes the object of interpretations, often discordant and conflicting, leading us to reflect on a certain starting point: the 'perception' of time is not an objective fact. It is influenced by the specific way of understanding and defining time itself (Fancelli, 2003, pp. 125-154). Studies of psychology and sociology have observed how in dreams, in religion and in politics there are sensible modifications of the continuity and irreversibility of time. If Freud, for example, examines in the Interpretation of Dreams the way in which the sequence of experiences in the course of our conscious life is rearranged, to adapt to the needs of the dreaming mind, in the sacred representation of time it is implicitly discontinuous, thanks to exceptional events, such as the appearance of the divinity, which cause an interruption in the continuity of the succession of instants.

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[2] Serafini G., 1999, p. 56. Burri never supported content or symbolic interpretations of his works: «non ho mai avuto un rapporto ossessivo, come qualcuno ha detto, per i materiali su cui ho lavorato attraverso gli anni. Quello che ho cercato di tirar fuori è solo la loro ‘proprietà’. Il ferro, per esempio, mi suggeriva il senso della durezza, del peso, del tagliente. Non mi interessava ‘rappresentare’ il ferro. Che quel materiale fosse ferro, lo si vedeva subito. Volevo invece spiegare quello di cui il ferro è capace».

The time of the "pure conservative" is linear and irreversible, not cyclical and reversible as the "restorer" would like to consider it (Dezzi Bardeschi, 2003, p. 104).

So what is time? San Agostino asked himself, over fifteen centuries ago. It appears as an entity that gives meaning to human experience as it is an extension of the inner life of man through memory, in the inner continuity of consciousness that preserves the past within itself and extends towards the future. The ideological revolution carried out by novelists, psychiatrists and sociologists alters the traditional distinction between a personal time, which flows obediently alongside the progressive path of public time. Public time is built with the activity of producing new representations. Each era, in fact, has a characteristic sense of the past (Kern,1995, p. 163). The interest in the modern era for the relationship between memory and architecture has not turned so much to intentional monuments, but to the role played by memory in the perception of architectural works in their entirety, whether they are intentional or not (Minkowski, 1971, pp. 152-174).

The description of an ancient church by Marcel Proust and Simmel's essay on Ruin reveal the sensitivity of the heart of the culture of the time for the ability of architecture to impress the memory of the past on the built material. What Proust sees in a church Simmel finds in a ruin that revitalizes and completes the past in the present (Proust, 1969, p. 67). In the story “La strada di Swann”, the church of Combray celebrates the drama of history: the solidity of its walls guarded "the rough and rough ninth century", the sepulchral stones that time "had made sweet", the stained glass windows covered "with dust of the ages". The city of Gibellina does not escape the evocative power of time and remembrance. The inhabitants of Gibellina have lost their "sacred pole" and this sense of alienation permeates the fabric of the city and culminates in the negation of the memory of the Great Cretto which from the point of view of conservation represents the negation of memory and the impossibility of transmitting to the future the memory of their roots. In the Peabody Museum of Harvard University, it has been placed the "Real Omaha”. This sacred pole (Piccaluga, 1974, pp. 113-137) is made of cottonwood and bears marks of great age. Its presence affected Omaha’s life since they moved, several hundred years ago, from a homeland east of the Mississippi to their present location on the Missouri River.

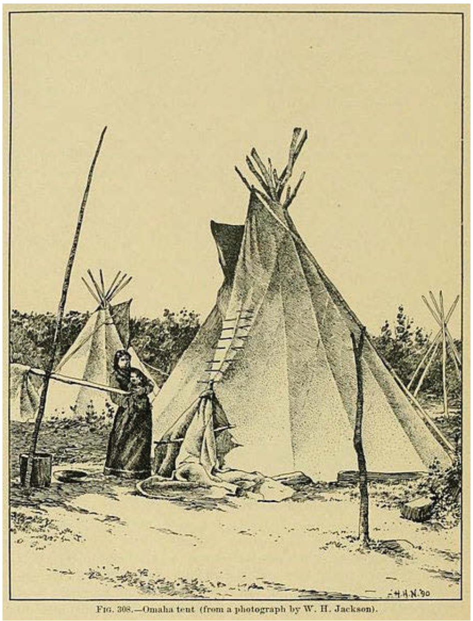

Fig. 7. Omaha tent, W.H. Jackson

Omahas’ sacred pole testifies how a society, although primitive, is an organization addressed by laws, conformable to which we recognize as instrumental in the unfolding of the human mind. Unfortunately it is worth little to regret nowadays the vestiges of a city that no longer exists. It is worth asking ourselves, in the light of Brand's reflections, on the interpretation of this voluntary action. And on the relationship between art and ruin, artifice and nature, between transformation and conservation. When and why do the reasons for art exceed the documentary value of the text? And again, when the ruin loses its memory value to become inanimate matter to be molded in the name of a higher end? The treatment of the ruins is a topic extensively investigated by Cesare Brandi. In the Theory of Restoration he places the ruin at the center of the same attention, both from the point of view of the aesthetic instance and that of the historical instance. This involves a complex work of in-depth study and the contribution of different disciplines such as aesthetics and contemporary philosophy, from Crocian reflections to existentialism, from phenomenology to structuralism, passing through the psychology of Gestalt (Gizzi, 2006, pp. 78-90). Brandi derives equally central positions, which place the ruin under the patronage of the conservation action of the restoration. Both the ruin and the ruin refer to another state of matter, different from the current one, that is, to a whole, to the finite, that is to the complete work. This initial contrast between the fragment and the whole, between the finite state of finished matter and its surviving fragment, the result of the slow wear of time or the destructive action of man or calamities, is overcome in Brand's reflection in the observation of how the work survives in the fragment, preserving its artistic potential, and its documentary value. In his recalling the whole, in the ruin the miracle of the transmigration of meaning, of the recognition and attribution of meanings that ignore the completeness of the text takes place. If in the *Theory of Restoration* this concept is widely debated and clearly supported by Brandi, the same cannot be said for the reading of *Celsus* or *Poetry*, which precedes the Theory by a few years, where some preeminence of the whole is mentioned. to the detriment of the fragmentation of the work. On the one hand, the fragment, for Brandi, fully retains the expressive potential of the whole, on the other it is seen as something that has lost its connotations, a "bare bones" that remains, so to speak, "hanging". Again in the General Theory of Criticism, in reference to the work's enough, Brandi will argue the loss of the work's expressive capacity due to its being incomplete, that is, as a result of damage to both the "form" and the "structure". With regard to Burri's work, and also with reference to the creative intent implemented in Gibellina, the aesthetic evaluation of the fact obviously prevails. The interpretation of the work of art is superior to the detriment of the testimony value of those fragments which, judged as lacking both "form" and "structure", have become the starting point for a new creative process, material to be transformed into the name of a more contralto purpose. And it is no coincidence that Burri is entrusted with the task of carrying out this transmigration of meaning. Giulio Carlo Argan (Serafini, 1991, pp. 28-29), in the 1960 Venice Biennale catalog, recognizes Burri the merit of having touched the last of the expressive possibilities of the subject. Brandi recognizes the ability of Burri's creations to resolve the antinomy of matter / form by canceling it (Brandi, 1963, p. 24). Matter assumes a fundamental role, undermining the function of form or even color from time to time. These are materials that do not imitate other materials, but are transformed to become something else. There is no hidden symbolism: their being is part of the symbolic act of constituting themselves as a new significant object. In Burri's work, what takes place is a transformation: by sewing up bags, oxidizing iron, burning plastic, as well as showing the cracking of cracks, Burri has attempted to grasp the essence of the transformation, showing its inexhaustible otherness with respect to the original matter. Art is not simply an object to be admired; the work strikes and transforms, enabling us to overcome the present and experience diversity, manifesting a new time. The kaolin of the Cretti treated with vinyl resins which during drying produces a craquelure effect, largely unpredictable, determining the spatial and temporal structuring of the entire surface, produces what Brandi identifies as a principle of rhythm (Brandi, 1979, pp. 359-361). This arbitrariness of the creation of the work, in Brand's reflections, even involves the user, in the moment of recognition and perception of the work. In Gibellina the viewer is called to relive the drama of the telluric event through the artist's creative gesture. The interpretative moment coincides with the vision and physical use of the work, which invites to be walked and crossed. In Gibellina's "Grande Cretto" contemporary art declares the deep split with the permanence of memory; and again, the role of remembrance is entrusted to the "symbolic sign" rather than to matter, detached from the consistency of the lost stones, just as lost is the hope of continuity with the past. Not the memory but the transformation, not the commemoration but the overcoming of the archaic image through the reinterpretation in an abstract key (Argan, 1964, p. 261).

The artistic sign represents the flow of things, the reinterpretation of history in constant change. A metamorphosis that the work is already facing due to the action of time that corrupts the whiteness of the concrete pour and adds new cracks to the symbolic cracks desired by the artist. It is a wound that is everywhere, that trembles everywhere. A shock, a torment, a precipitate of infinite and ungovernable cracks. As Recalcati writes in *Alberto Burri and Gibellina's Grande Cretto*, in the woods the wound is generated by the fire and the carbonization of the material but, above all, by the rest that survives the burn. In the Combustions, the crumbling of matter, the manifestation of its very human friability, of its most radical vulnerability, is returned with great poetic and formal balance. This is also what happens with plastics where, once again, it is always the use of fire that inflicts on a weak and inconsistent material, the burn of life and death (Recalcati, 2018, p. 87).

In Gibellina the symbolic vision of a past deprived of its dramatic truth has become a curtain, created by the hand of man to rework the mourning of loss. If the sublime of this work is in its appearance as a magical and archaic place, its contradiction lies precisely in its irremediably concealing the past. There are rooms, places, streets, squares, cities, houses, where you are, others where you are not, but also where you get lost, you are only in inconsolable discomfort.

There are cities (Brusatin, 2000, p. 46) that orient, others that disorient, whether they are traveled by slow or fast means, the foot or the mind.

5 Conclusions

After several decades, it is possible to evaluate the emotional effects of the choices made and reflect on the strategies that can be applied to heal the obvious gap between design and actual use of a place. The theory of architectural restoration does not only address the conservation of materials but also the perpetuation of memory and identity. There is a silent restoration made up of small cultural and political gestures, of care and attention planned for the rites of passage. In this transmigration of real and symbolic values, memory is a precious exchange currency between past and future. The comparison between the settlement rituals of the nomadic tribe of the Omaha people based on the continuity of a symbolic object, the sacred pole, and the loss of the genius loci of Gibellina caused by the occultation of the macere, allows to identify an interesting and unprecedented parallelism in the re-foundation of the settlement principle which is at the basis of the rebirth of a community. As Torsello (Torsello, 2005, pp. 134-157) suggests, the memory of a people passes through its monuments. Etymologically it can be traced back to the Latin verb monere that is to remember, emphasizing the act of admonishing, warning, remembering the history imprinted in the voluntary action of building for the community. In conclusion, the only way to heal the rift between old and new in Gibellina is that of re-appropriating the monuments, the objects that admonish and deliver the very strong message of having been to the new generations. The monuments of the old Gibellina have merged into a large, gigantic work of art, also visible from space, which restores the emotional charge of a community to the future. The genius loci of the new Gibellina must be the Great Cretto which from a burial place must become the fulcrum for the community, must be placed at the center of emotional and cultural negotiations. Only in this way will the new inhabitants be able to recognize the artistic gesture and understand its metaphysical meaning. Today the work appears too disconnected from the new center, without the right signage, cut off from the paths and from city events. The new squares of Purini and Thermes cannot replace the memory of the old city, they have the strength to generate new relationships. It is precisely the Cretto who must return to the city and if he cannot do it physically, he must do it socially and culturally in the political and educational actions of the community. It is no coincidence that all the events organized on the Cretto site involved crowds of citizens and visitors, arousing strong emotions and great clamor.

Fig. 8. Giancarlo Neri, Winning is due to fate, 2010

Suffice it to recall the light installation by artist Giancarlo Neri "Winning is due to fate" in 2010, which through the luminous helmets worn by the spectators active protagonists of the event brought life and sacredness back to that place for one night. To warm the hearts of the inhabitants you need the warmth of the past guarded by the symbolic material shaped by Burri. A matter that must return prolifically in the hands of the administration and citizens.

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The perceptive experience of the heritage landscape

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Topic: T2.2 Heritage education and social inclusion

Abstract
Education on heritage environments based on user experience is committed to understanding and enhancing the heritage landscape. The proposal prioritizes "experimenting" over "explaining" to reduce the digital divide and to guarantee equal access to information and knowledge. The urban environment of the church of the Santos Juanes is one of the most characteristic places in the history of the city of Valencia. In the same environment there are emblematic monuments such as the Lonja de la Seda and the Mercat Central of Valencia. Despite all of the above, the landscape has suffered considerable deterioration in recent decades. The lack of a safe urban space, the weak treatment of urban connections to monuments and the physical deterioration of the building have been the factors that have caused the creation of an environment conducive to alienating behaviors with the place. The high degree of alienation has led to the production of campaigns to prevent and prosecute these behaviors by the municipal administration, however there are no proposals to help understand and know these places. Currently, the redevelopment works of this environment are being undertaken, so it is of interest to propose an educational proposal about the heritage area to stimulate interest, learning, experience and exploration. Visits and workshops on the interpretation and sensitive experience of the cultural landscape bring citizens closer to experiencing the church of the Santos Juanes in a way not based on a data compilation discourse. In conclusion, experiencing, knowing and sharing these environments strengthens the relationship between citizens and their cultural heritage. At the same time, these exercises help to collect information on how citizens perceive and value their heritage environments.

Keywords: *Experience, Church of the Santos Juanes, Heritage meaning, Heritage education*

1. Introduction

To begin with, the concept of "experience" arises within phenomenology and is conceived as a generator of knowledge and knowledge about the environment. Maurice Merleau-Ponty (1908-1961) defines experimentation as the process of perception, therefore the notion of perceptual experience is formulated (Bech, 2005). In the architectural field, Steen Eiler Rasmussen (1898-1990) recognizes primary perceptual patterns in architecture capable of generating significant experiences (Rasmussen, 2000). Recognizing the perceptive experience as a perception process, Christian Norberg-Schulz (1926-2000) adds the role of cognition and underlines its importance in said process (Norberg-Schulz, 1979) . Cognition about the environment is formalized in "perceptual schemes" that provide the knowledge to order and catalog the most primary capture of external stimuli. In conclusion, the perception of external stimuli, selected, ordered and cataloged by perceptual schemes (cognition) allow us to understand and judge the built environment (Aragonés, 1998) . For this reason, as defined by environmental psychology, the perception process is a producer and indicator of the environmental meaning that people attribute to architecture. From the preliminary analysis, it is determined that the environmental meaning of each individual about the environment is constructed by the process of perceptual experimentation (Corraliza, 1987) . In this way, research on the perceptual process aims to collect the environmental meanings of various social profiles (users) on a given built environment. These individual meanings are grouped according to their characteristics in social meanings. In heritage architecture, the monument and its surroundings become a laboratory where meanings of all levels appear. For this reason, studying and synthesizing the significant complexity of this type of environment, added to a holistic analysis of the monument, could represent an advance in the enhancement of this type of architecture. The synthesis of the meanings that appear in a historical environment could be called "patrimonial meaning". To summarize, the motivation for researching the perceptual experience in historical environments is to discover the "patrimonial meaning" that citizens attribute to these spaces. The results obtained will open two main lines of action: on the one hand, incorporating the conclusions into the criteria of architectural intervention, and in this way, contributing from the design process to enhancement; and on the other hand, carry out educational activities during the restoration process of the historical environment that enhance and recover the "heritage meaning".

2. The Church of the *Santos Juanes* and its urban environment

The architectural landscape of the Mercat neighborhood located in the historic center of Valencia is one of the most characteristic places in the history of the city. In the same environment there are emblematic monuments such as the Church of the *Santos Juanes*, the *Lonja de la Seda* and the *Mercat Central* (Corbín, 1990).

Fig. 1. Diagram of the founding churches of the city of Valencia (Source: Barranco, 2022)

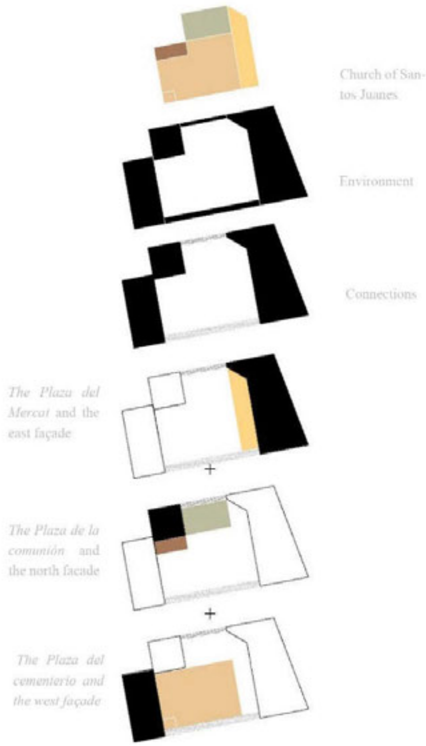

Fig. 2. Plan diagram of the influence of the environment on each of the parts that make up the church. (Source: Barranco, 2022)

for the following reasons: First, both the church and its environment are currently in a process of change, so it is perfect to investigate the perceptive experience of citizens towards the monument and its surroundings.; secondly, in the last 30 years this area has suffered considerable abandonment and depreciation. The lack of a safe urban space, the weak treatment of the urban connections to the monuments and the physical deterioration of the church have been the factors that have caused the generation of an environment conducive to conduct alienating from the place. Vandalism has degenerated the urban landscape, turning the monument into an isolated building with little functionality. This type of behavior, as the environmental psychologist Harold M. Proshansky says, is motivated by an interest in transforming a space that is not considered its own. The concept of “Place-Identity” speaks of how people create attachment relationships with places (Proshansky, 1978). Likewise, Proshansky states that if the inhabited space is not considered as their own, the user does not identify with it and therefore, behaviors oriented towards the lack of appreciation and preservation of the place are encouraged. Consequently, projects have now been initiated for the recovery and urban remodeling of the area.

For the recovery of the value of the monument during its restoration process, an educational proposal is suggested that involves perceptively experiencing the surrounding environment to experience how each urban space contributes to the "patrimonial meaning" of the monument.

The environment that has surrounded the church of Santos Juanes from its construction in the 14th century to the 19th century has been essential for the significance and enhancement of the monument (figure 2). In fact, it is a monument with a certain complexity to perceive it in its entirety. Each of its facades is oriented to a different urban space, for this reason each facade has a different treatment and a different interior-exterior relationship. The evolutionary analysis of the relationship between the monument and its environment is important to understand the development of its significance by citizens over the years to the present (figure 3). To carry out the study, the interval between 1929 and 2022 has been chosen since it is the period in which the surroundings of the monument of the *Santos Juanes* have constantly changed their morphology, degrading the perceptive experience of it. In the year 1929, the urban landscape is compact and dense, typical of the historic center of the city, as can be seen in figure 4. The voids that surround the monument somehow endow it with meaning. A relationship is established between the monument and the public space. It is a monument embedded within a dense urban fabric, so the perspectives obtained at street level are completely different from different orientations. The monument is shown differently depending on which public space its façade is focused on.

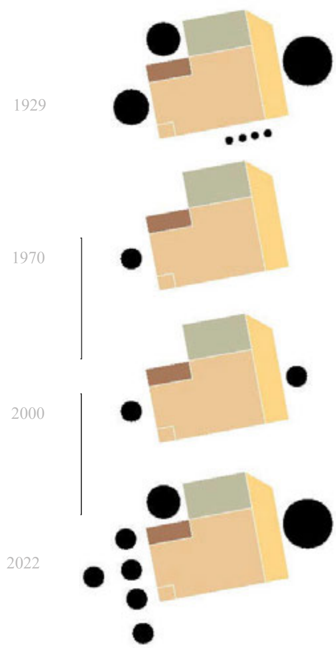

Fig. 3. Diagram of the evolution of urban nodes. (Source: Barranco, 2022)

In the first stage, corresponding to 1929, it can be seen how from the *Plaza del Mercat* the monument appears majestic due to its baroque decoration, standing out within a popular and highly traveled public space (figure 4). The pedestrian character of the square, despite crossing tram lines, allows us to contemplate the cultural wealth that the urban landscape houses. The commercial nature of the square is in the process of disappearing due to the construction of the new central market. The monument continues to contemplate elements that recall this commercial era, it was the volume on the ground floor that was designed in the Baroque era to house shops, which is called "Les Covetes de Sant Joan" (Galarza, 1990). Above these spaces, a terrace is built from which the baroque façade rises. This space overturns the square but at a different level, people with access to the terrace can see the square from a different perspective, above the rest of the citizens. On the same façade, there are two large gates that simulate two large accesses, however, they are not for public access, but for restricted access to the sacristies.

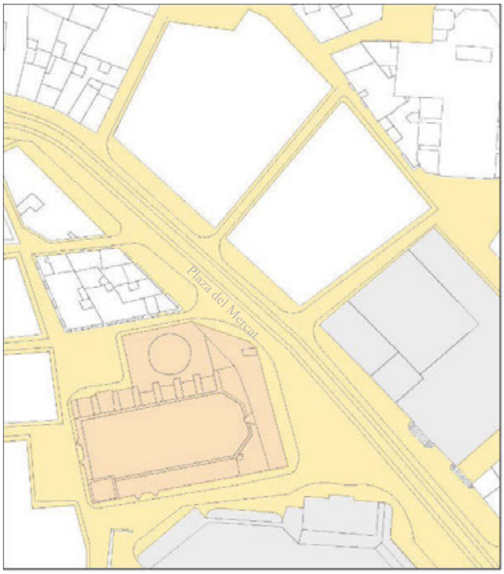

Fig. 4 Floor plan of the area in 1929. In orange, the church of Santos Juanes and in yellow, the pedestrian areas. (Source: Barranco, 2022)

In the second stage, from 1970 the urban scene changes completely with the appearance of the automobile in the historic center of the city (figure 5). The popular and commercial character is gradually lost, degenerating in the quality of public space. During the last 40 years it had been one of the most popular and important squares in the city but it was converted into a parking lot. The relationship between the monument and the square disappears since it cannot be located at a considerable distance from the east façade, it cannot be seen in its entirety. “Les Covetes de Sant Joan” begin to deteriorate as commercial use completely disappears. During this period, the majesty that the monument meant is lost as it cannot be experienced.

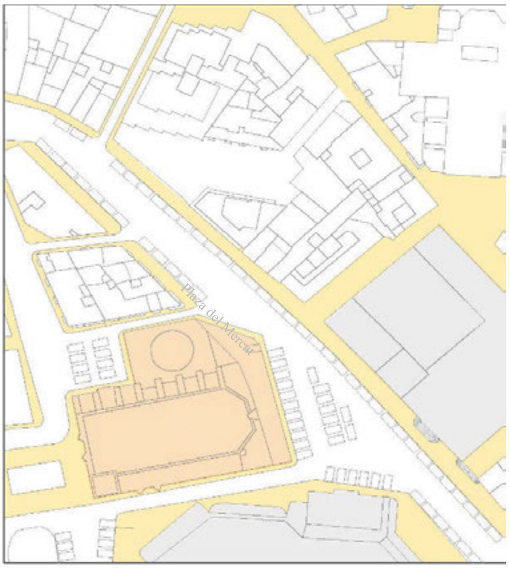

Fig. 5 Floor plan of the area in 1970. In orange, the church of Santos Juanes and in yellow, the pedestrian areas. (Source: Barranco, 2022)

In the third stage, at the beginning of the 21st century, a modification of the traffic of vehicles is carried out, eliminating the parking area and widening the section that focuses on the facade of the monument (figure 6). This change allows in some way to recover the space to perceive the complete east façade. However, it is not enough to recover the popular activity of the non-existent square since it continues to be a traffic sidewalk without establishing areas for stays. *Les Covetes de Sant Joan* are in a state of abandonment, most of them are boarded up and are beginning to be perceived as a place devoid of social and cultural value. This actions generate that alienating behaviors with the place begin to be encouraged.

And finally, both the restoration of the monument and its surroundings are currently being carried out (figure 7). The remodeling that is being carried out in the Plaza del Mercat pedestrianizes the entire surface with which it is intended to recover the perception that it had in origin. The relationship between the public space and the monument is in the process of recovery. *Les Covetes de Sant Joan* is in the restoration phase and a grandstand space will be created to help recover the perception of this volume.

To conclude, it is observed how in the last 50 years the urban the space that has meant the church has been degraded to this day. The figure 3 shows the evolution of the quantity and quality of the urban landscape. The loss of heritage landscape has motivated the urban remodeling of the surroundings, considering it as an opportunity to perceptually experience the monument. Therefore, it is a process of change that must be accompanied by heritage education exercises, to help understand the "heritage meaning" of the monument.

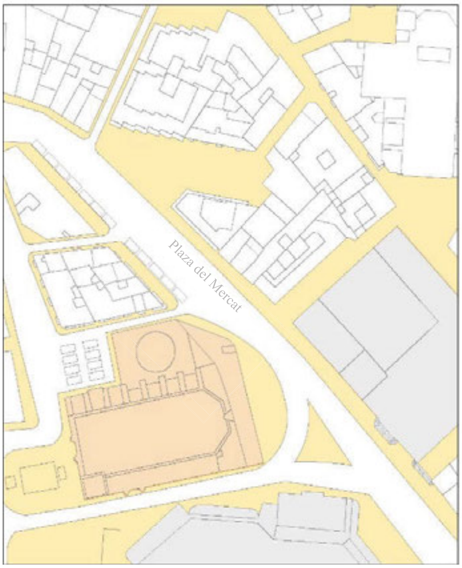

Fig. 6 Floor plan of the area in 2000. In orange, the church of Santos Juanes and in yellow, the pedestrian areas. (Source: Barranco, 2022)

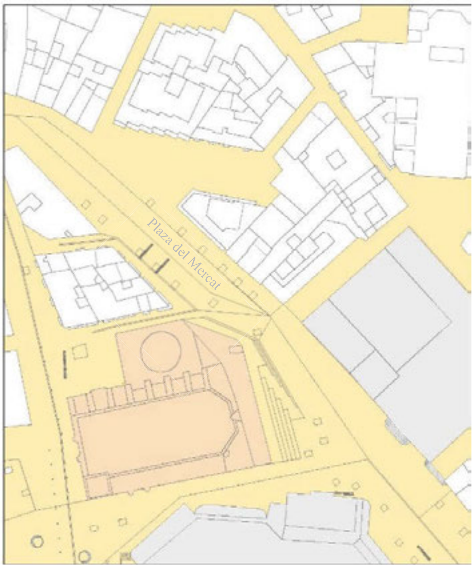

Fig. 7 Floor plan of the area in 2022. In orange, the church of Santos Juanes and in yellow, the pedestrian areas. (Source: Barranco, 2022)

3. Heritage education and recovery of "heritage meaning"

During the restoration process of a monument, constructive layers appear that help to understand its history and its meaning. At the end of the urban remodeling around the church, consequently, the monument restoration project began. This moment in which the environment is free to perceptually experience the monument, it is important to carry out heritage education activities that accompany the restoration of the monument. This stage prior to the restored state of the monument is important for its enhancement, since the restoration of this type of monument is a long process over time.

After analyzing the evolution of the environment and determining which urban spaces defined the meaning of the church, an educational tour is proposed to help experience these spaces and understand their relationship with the monument. The route is planned from the outside since it is considered that the monument is under construction. The legibility of the monument from the outside is an important aspect for its recognition and understanding. Through these visits, the unitary image of the whole is strengthened and the diversity of architectural solutions that the monument has depending on which urban space it is oriented to is experienced.

One of the references on heritage education of a similar nature with a high social impact is the proposal "Abierto por obras" in Vitoria, Spain. This is a project to enhance the value of Vitoria Cathedral during its restoration process. The organizers comment that the project stems from people's interest in sharing knowledge with archaeologists, restorers and architects. Therefore, the proposal for the church raises through experience, knowledge and sharing to strengthen the relationship between citizenship and its cultural heritage.

In summary, the proposal is based on creating a space for reflection on the valorization of the cultural heritage of the *Santos Juanes* church, where experiencing its restoration helps raise awareness and learn to value our culture. The activities are oriented towards citizens and tourists who visit the monument. In relation to the main objective of the proposal, the perspective of each individual on the monument is important to recover its "heritage meaning".

4. Conclusions

To conclude, researching the perceptive experience in historical environments is knowing the "heritage meaning" that citizens attribute to these spaces. In the case study, the degradation of urban space in the last 50 years has caused a loss of its "heritage meaning". Currently, the restoration process of the *Santos Juanes* church is an opportunity to recover its cultural and social value. It is proposed to carry out heritage education activities that accompany the restoration of the monument in this stage prior to the restored state of the monument. Based on the study of the evolution of the environment and defining the urban landscape that determines the meaning of the church, an educational route is proposed that allows perceptual experience of the relationship between the monument and its heritage landscape.

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The Role of University in Local Cultural Development Through Vernacular Architectural Conservation Education: The Case of Havran, Turkey

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Topic: T2.2. Heritage education and social inclusion

Abstract
Since the beginning of 20th century, vernacular settlements are under severe threats of losing authenticity and ruin due to changes in human lifestyles, forms of production and worldwide economic developments. Especially in small rural towns, lack of care and abandonment related to loss of young population is causing rapid deterioration of the vernacular heritage. In such towns, safeguarding is possible through initiatives of local authorities. However, as visionary as the authorities may be, knowledge on sustainable conservation of vernacular architecture is a very specific topic of expertise. At this point, the academic knowledge and experience of universities take on a new significance. Furthermore, collaboration between academia and local authorities carry great potential for each party. A similar cooperation between Mimar Sinan Fine Arts University and the Local Municipality of Havran, which was inscribed as an urban protected area in the national register in 1995, started with a protocol signed in November 2011. Between 2012 and 2019, extensive surveys were carried out in urban protect-ed area and restoration projects of over 30 traditional buildings were completed by the graduate stu-dents. Some of these buildings are approved by the local council for the conservation of cultural prop-erty and one of which was restored to be used as a town and memory museum. The aim of this study is to discuss the outcome of experiences acquired from the collaboration between universities and local authorities in the past 10 years. Moreover, mutual benefit of interaction between academia, local community, and the municipality will be emphasized. The cultural heritage preserva-tion activities in Havran have an impact on local cultural development in terms of safeguarding the architectural heritage and creating awareness in the community, as well as making a significant contri-bution to the vernacular heritage conservation education.

Keywords: *Heritage Education; Vernacular Architecture Conservation; Havran.*

1. Introduction

According to the UN Population Division, since 2007, globally, the number of people living in urban areas has surpassed the number living in rural areas. Today, the percentage differs between 55% and 80% with regard to a nation's wealth, and it is predicted that over two-thirds of the global population will be living in urban areas. (Ritchie & Roser, 2018) While there are several factors triggering these results, the prevention of the disappearance of rural heritage, which is an important part of the cultural landscape, is mostly up to the local governments' initiative. However, as forward-thinking as the authorities may be, knowledge of sustainable vernacular architectural conservation is a highly specific area of expertise. Universities' academic knowledge and experience take on additional relevance at this point, and collaboration between the two has a lot of possibilities for both parties.

In this study, it is aimed to discuss the challenges and beneficial results of partnerships between universities and local authorities based on the experiences gained over the last ten years. Firstly, the significance of Havran and the history of collaboration with Mimar Sinan Fine Arts University will be explained briefly. Next, an evaluation of experiences will be discussed in the context of challenges and contributions to education and vernacular architecture. In the conclusion section, it will be discussed in detail how and why collaboration between local governing authorities and universities is beneficial for the protection and conservation of vernacular heritage.

1.1. About Havran

Havran district is located within the borders of Balıkesir province in the Marmara Region of Turkey. Located in the valley formed between Kaz Mountains and Madra Mountain, Havran is on the shore of Havran Stream, which is fed by spring water from Eybek and Şap Mountains (Göktaş, 2019). The Havran Plain, which was formed by the alluviums carried by the Havran Stream, offers a rich land suitable for agriculture in the region. Although arable land constitutes 25% of the total land, a large part of the income of the District is based on agriculture and animal husbandry (Uzun, 2018). Olive cultivation is the main agricultural production in the region. Olives are used industrially in the production of olive oil. There are seven olive oil factories in Havran Urban Protected Area, five of which are listed and four of the listed factories are still active.

The history of Havran dates back to the Neolithic Age. According to recent studies, two richest settlements of the Late Neolithic to Iron Age were located within the Havran Province Borders (Saka, 2016). Although there is not enough information about the traces of the present settlement in antiquity, it is known that the area has been inhabited since the Middle Ages. Havran was ruled by the Byzantine, Seljuk and Ottoman empires, respectively, and hosted many people of different religions, particularly simultaneously after 15th century. In 1877, immigrants from Bulgaria and the Caucasus, after the Balkan War in 1912, immigrants from Rumelia and Lesbos were settled in Havran.

Fig. 1. Location of Havran District in Balıkesir Metropolitan Area (Source: Google Maps, 2020)

Wars and migration movemetns in Europe and the Ottoman Empire affected Havran in the beginning of the 20th century as well. It is known that a military hospital was established in Havran during the First World War (Göktaş, 2019). Many men from Havran took part in the WWI and Turkish War of Independence. One of which was Seyit Onbaşı of Havran, who was remembered and yet respected for lifting a 276 kilogram cannonball all by himself during the Battle of Gallipoli. Havran remained under Greek occupation during the Turkish War of Independence. Havran was liberated from occupation in September 1922. After the population exchange in accordance with the Lausanne Peace Treaty, the Orthodox Christian population living in Hamambaşı Neighborhood left, and immigrants from the Aegean Islands, Crete and Rumeli (Kıroğlu, 1953) settled in the neighborhood (Özdemir, 2008).

Although its population is 28000 today, about 11000 of this population reside in the city center and 17000 in the villages (Havran, 2021). Today, as a result of the young population preferring to live in city centers due to job opportunities, a large part of the population of the district consists of citizens over the age of 60.

Fig. 2. An Image Representing the Traditional Urban Texture of Havran (Source: Istanbul Municipality Atatürk Library Archive)

The protection of the cultural and natural heritage in Havran started with listings in 1990 and continued with the listing of the district center as an urban conservation area in 1995. In 1999, Conservation and Development Plan was prepared for Havran Urban Conservation Area and was approved by the Bursa Cultural and Natural Heritage Conservation Board. Havran Conservation and Development Plan was revised ten years after its approval date, and this revision was accepted by the conservation board.

Fig. 3. Urban Conservation Area of Havran (Source: Google Maps, 2020)

As mentioned above, the decrease in the population of the district and the fact that it is mostly composed of citizens over the age of 60 appear to pose a challenge to the preservation of vernacular architecture. Consequently, for age-related reasons, the residing elderly eventually leave their houses, and many listed buildings are abandoned. When there are too many inheritors for the same property, deciding who will provide the care for the building is another challenge, mostly resulting in neglect and even loss of structural integrity. On the other hand, the buildings that are still used by the elderly population have maintenance problems. Moreover, many examples of civil architecture in the district center are partially used with commercial function on the ground floors only, simply because the upper floors are no longer suitable for residency (Fig 4). Although this provides partial care for the building, the upper floors and roofs are usually neglected. Thus, besides causing structural damage, it also poses a risk to the safety of users.

Fig. 4. A partially used building, which was studied by graduate students in 2019, in Urban Conservation Area of Havran (Source: MSFAU - Department of Restoration Archive)

1.2. Collaboration between Havran Municipality and Mimar Sinan Fine Arts University

In 2011, the "Collaboration Protocol on the Protection of the Natural and Cultural Environment in Havran" was signed between the Balikesir Province Havran District Municipality and Mimar Sinan Fine Arts University (MSFAU) Architecture Faculty, Department of

Restoration under the Department of Architecture. Soon after, studies on the preservation and documentation of the cultural assets in Havran were carried out between 2012-2019[1].

Fig. 5. A Photograph with students and the Mayor, in front of the New Havran Municipality Building, 2019 (Source: MSFAU- Department of Restoration Archive)

Within the scope of the "Evaluation and Conservation of Sites" course lectured by Prof. Dr. Demet BİNAN, identification, documentation and analysis studies were carried out on the designated city blocks within the Urban Conservation Area of Havran in the 2012-2013, 2014-2015, 2018-2019 and 2019-2020 academic years. At the same time, the registered cultural assets determined by the Municipality of Havran were documented within the scope of the "Conservation Project 1" and "Conservation Project 2" courses, and conservation projects were prepared by the students throughout the academic years.

2. An Evaluation of Experiences

2.1. Challenges

Today, traditional settlements all over the world face many threats, such as population loss, rapid change, and loss of traditional knowledge. Although the problems are common, the way they are handled differs due to cultural backgrounds, management styles, and financial capabilities. Nevertheless, the case of Havran District shows similarities to Turkey in general in many aspects. Although there are many efforts by the Ministry of Culture to improve the protection of rural heritage with new laws and regulations, it is mostly up to the local governments to take initiatives for the conservation of vernacular architecture.

For instance, two important heritage management structures, the Site Management Office and the Conservation Implementation and Supervision Bureau, were inured by Law No. 5226 in 2004 in Turkey. Although there is an approved conservation and development plan for Havran, which was prepared by the local authority, a heritage management structure is not yet established. Moreover, within the municipality, there is a lack of trained employees to ensure the follow-up of the conservation processes and inter-institutional communications, such as the Regional Council for the Conservation of Cultural Properties. Consequently, the municipality is obliged to outsource heritage conservation-related technical services with the help of the university's consultancy. Most of the conservation projects that were submitted to the Regional Council for the Conservation of Cultural Properties require minor revisions. Even though these minor setbacks are manageable, with the current system, a simple conservation process can take up to several years, causing more damage to vulnarable structures.

The fact that any attempt regarding the conservation of the heritage site is at the initiative of the local administration without public participation has negative consequences. The implementation of the major interventions in the Urban Conservation Area with top-down decisions causes public reactions. The most recent attempt by the municipality was a controversial street rehabilitation project, which has been criticized by the local people and academic circles. During the first stage of the rehabilitation project,

[1] Upon the invitation of Balıkesir Province Havran District Municipality, graduate students in the Conservation and Restoration Graduate Program under the Restoration Department went to Havran for the first time in October 2010, and studies were carried out for the documentation and preservation of its cultural heritage. An official protocol was signed between the Municipality and MSGSU Department of Restoration on 3 November 2011 and this protocol was renewed in 2019.

municipal authorities attempted to interview the property owners one by one about their opinions on the proposed project, yet a common ground could not be found. Soon after the start of the construction, opposing comments arose from the users and the local property owners.

2.2. The Contribution of Collaboration to Conservation Education

The importance of conservation education has been expressed in almost all charters and conventions (Jokilehto, 2005). In 1993, ICOMOS emphasized that conservation is a subject that requires expertise by constituting the charter "Guidelines On Education And Training In The Conservation Of Monuments, Ensembles And Sites" (ICOMOS, 1993).

As stated in the charter, conservation education should produce professionals who are able to "read" a cultural asset with the aim of understand its value, history, and technology in order to plan for their conservation and work with inhabitants, administrators, and planners to develop conservation strategies (ICOMOS, 1993). Starting in the early 2000s, the Architectural Conservation and Restoration Graduate Program under Mimar Sinan Fine Arts University Department of Architecture[2] has been organizing field studies in different parts of Turkey every year, taking into account the educational values of vernacular architecture.

Field studies consist of three stages: preparation, fieldwork, and presentation. In the preparation stage before the field studies to be carried out onsite, theoretical information about inventory creation and identification criteria is given to graduate students. In addition, maps of the area are prepared, and written sources about the area are shared with students for reading.

Fig. 6. Balıkesir-Havran Cultural Heritage Conservation Studies conducted between 2011-2013 were published in 2014 (Source: Binan, Aşkun & Çobancaoğlu, 2014)

During the weeklong fieldwork stage, first, following a short introduction to the site, students in groups of two or three photograph all the buildings in the designated building blocks and prepare inventory slips. Following that, students begin surveying and documenting their designated heritage buildings. (Fig. 7) By the end of the week, measurements, photographs, and written and oral information about the heritage buildings and the site are gathered.

In the presentation stage after the fieldwork, all groups come together to gather the data they have obtained, make analyses and evaluations by carrying out a joint study. The preparation of conservation projects continues to be submitted at the end of the academic year. Students are expected to have prepared professional conservation projects to be delivered to the municipality.

Field study as an educational technique, supports students' active learning and competencies by enabling them to examine the details and construction systems on site, as well as by encountering real situations onsite. Therefore it creates and opportunity for theoretical knowledge and practice to improve together. Additionally, students can see the concrete results of their work and gain professional experience.

[2] Started in 1960 as an applied course, Architectural Survey at the undergraduate level, two decades later, the Architectural Conservation and Restoration Graduate Program under Mimar Sinan Fine Arts University Department of Architecture was established in 1982. The department's academic staff, most of whom are international and national ICOMOS members, have executed many conservation projects in several scales since the beginning of the program.

Fig. 7. A Photograph which was taken during 2019 field study in Havran (Source: Mimar Sinan Fine Arts University - Department of Restoration Archive)

2.3. Contribution of Collaboration to the Conservation of Vernacular Architecture

According to the criteria set by the Ministry of Culture and the Chamber of Architects, the cost of preparing a 100 m^2 cultural property conservation project is approximately 100 thousand Turkish liras, roughly equivalent to seven thousand Euros. This indicates that the municipality's support of the workshops also saves millions of Liras for the district. Restoration projects are prepared in accordance with the wishes of the property owners, as well as in line with modern necessities and health and safety requirements. It can be said that field studies also contributed to conservation awareness at various levels. A common challenge in the conservation of vernacular architecture in Turkey is the lack of heritage awareness. Many property owners oppose registration fearing that they will not be able to renew their building, or that the state will expropriate their property. During the field studies, graduate students spend a significant amount of time in the Urban Conservation Area, which creates an opportunity to get to know the local residents and learn about the history of the town, as well as explaining the works that they are doing. At the same time, students interact with the inhabitants over the length of their field studies as well as throughout the academic year.

There were 115 registered buildings (plots) within the Havran Conservation and Development Plan, which was revised in 2009. With the examples added as a result of the work done by the students, the number of registered civil architecture examples today has increased to 154, an increase of over 20%.

As mentioned above, one of the most important achievements of field study is that students prepare conservation projects at a professional level. The Terzizade Mansion is one of the buildings whose restoration process took place in this manner.

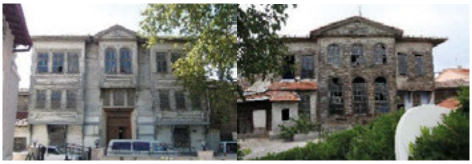

Fig. 8. Left: Front Façade of Terzizade Mansion, Right: Back Façade of Terzizade Mansion (Source: Mimar Sinan Fine Arts University - Department of Restoration Archive)

The Terzizade Mansion is recognized as one of the most important buildings in Havran and one of the most impressive examples of civil architecture in the region. Although the building was actively used as a residence until the early 2000s, it has been in need of urgent maintenance and repair since it was abandoned for more than a decade (Fig. 8). During the 2012-2013 academic year, conservation projects of the Terzizade Mansion were prepared by three graduate students with B.Arch. degrees. Projects were completed as part of the year-long Conservation Studio with the consultation of conservation expert professors. In 2014, Havran District Municipality signed a protocol with the property owners, and the building was rented for 25 years (Binan, 2019).

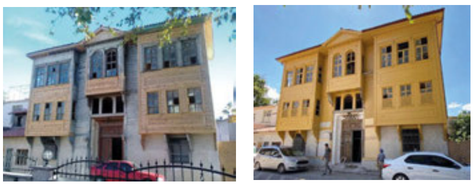

Fig. 9. Left: Front Façade of Terzizade Mansion During the Restorations in 2017, Right: Front Façade of Terzizade Mansion After Restorations in 2020 (Source: MSFAU-Department of Restoration Archive)

Fig. 10. Interior decorations of Terzizade Mansion (Source: Mimar Sinan Fine Arts University - Department of Restoration Archive)

After being submitted to the Conservation Board by the Havran District Municipality, conservation projects[3] were approved for implementation in 2015. Upon the request of the Conservation Board, additional documentation and intervention planning studies were carried out for sensitive elements such as built-in cupboards, hand painted murals, and wooden decorations within the building. Although the additional drawings were approved by the Conservation Board in 2018, Havran Municipality had difficulties finding a budget for the restorations. Finally, with financial support from Balıkesir Metropolitan Municipality, restoration work was tendered to the contractor company by the municipality. Between 2018-2021 restorations were continued under the official consultancy of Prof. Dr. Demet Binan. (Fig. 9, Fig. 10 Fig. 11) Havran Terzizade Mansion, which is still being furnished, is planned to be opened as the "Terzizade Mansion Ataturk and Seyit Onbaşı Museum" in 2022.

Recently with the guidance of the municipality, several local property owners have applied for European Union's Instrument for Pre-Accession Assistance (IPA) financial support fund to restore their buildings. One third of the applied conservation projects were conducted by the Architectural Conservation and Restoration Graduate Program under Mimar Sinan Fine Arts University Department of Architecture.

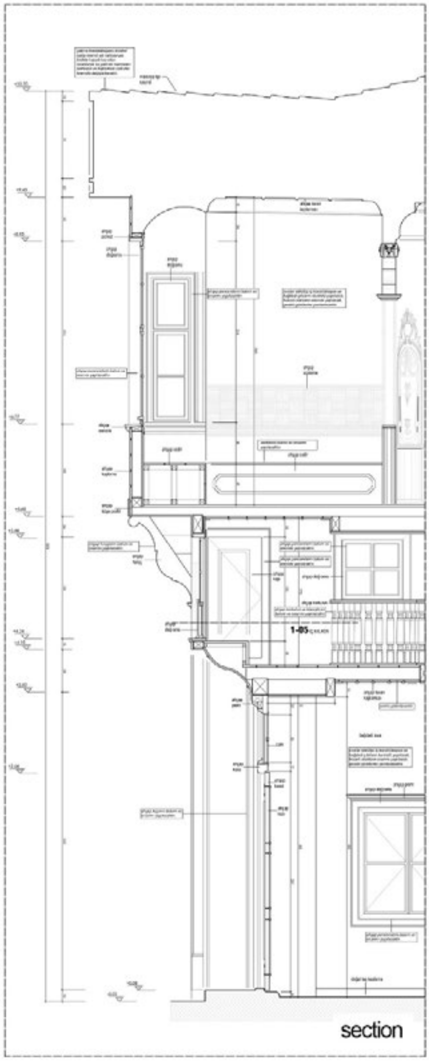

Fig. 11. System Detail Drawings of Terzizade Mansion. (Source: Mimar Sinan Fine Arts University - Department of Restoration Archive)

3. Conclusions

Collaboration between Havran and Mimar Sinan Fine Arts University has been going on for more than a decade. This is due to maintaining relations between the two parties even when different

[3] Terzizade Mansion. Project Team: Şevket Sak, Gökhan Teker, Cem Balcan. Project Advisor Prof. Dr. Demet Binan.

mayors were elected since the first protocol was signed. As mentioned earlier, for relatively small local governments, knowledge on sustainable conservation of vernacular architecture is a very specific topic of expertise. It is important to support the municipality in this regard. Moreover, it is critical to have a shared conservation vision among local government, academia, and the general public. Universities should have a leading role in the creation of this vision. Although several conservation projects are carried out in the district, the local people do not have enough resources and information about conservation. Therefore, it is important for the municipality to engage with the citizens, following a participatory approach. In this regard, municipality employees were contacted to organize community engagement organizations in the future. Meanwhile, learning from past experiences, local authorities conducted meetings with the property owners for the second stage of the street rehabilitation project, with significantly higher participation rates. It can be stated that as the number of restored buildings, such as the Terzizade Mansion, and street rehabilitation projects increases, so does the awareness of the heritage values and the motivation to protect the built environment of the local population. The third stage of the street rehabilitation project is planned to be implemented in accordance with Adalı's masters thesis; "A Proposal for the Protection of Havran Urban Conservation Area and Dumlupınar Street" (Adalı, 2013), which was conducted in the Architectural Conservation and Restoration Graduate Program under Mimar Sinan Fine Arts University Department of Architecture. Another issue that we had the opportunity to observe during the COVID-19 pandemic is that students' motivation in the field studies in the rural settlements is higher than in projects in the city. It can be said that students' direct communication with the local people and property owners enables them to create more visionary and detailed conservation projects. It can be stated that in the 21st century, conservation is mainly about the management of change, and change is constant. In this regard, along with individual initiatives, it is of great importance for Havran Municipality to create the necessary structure for the sustainability of this cultural heritage management.

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The role of cultural heritage in urban reuse

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Topic: T2.2. Heritage education and social inclusion.

Abstract
Cities face the challenge of transforming existing buildings to be reused, particularly those that are underused or not used at all. Tackling this issue, the European Commission approved in 2014 a package of measures to promote a circular economy. According to this agreement, our cities can be more sustainable and resilient by transforming these underused existing buildings with proposals for their adaptive temporary reuse, favoring the citizens' well-being and quality of life and promoting social inclusion and economic growth with respect for the environment. This paper studies the role of heritage education in adaptive urban reuse, exploring the possibilities and methodologies for the reprogramming of existing buildings for different types of activities to offer citizens and communities the opportunity to participate in the life of the city, favouring their social inclusion. In contrast to the common new-builds or refurbishment commissions, reuse offers a greater possibility of disseminating, transforming, and reinventing architectural methodologies and approaches to integrate in the design process forms of citizen participation, favouring the transition towards a model of a circular economy and more sustainable consumption. The paper analyses the possibilities of urban reuse applied to five major public heritage buildings in Barcelona: the Post Office Building, the Old Customs House, the France Train Station, the Martorell Museum and the Castle of the Three Dragons. Each of them has a particular condition regarding current uses and its public owning institution and presents specific characteristics regarding building typology, heritage protection, conservation and construction materials and techniques. The buildings date either from the late 19th century or the early 20th century and are grouped along a 1 km axis on the threshold between the historic center and the port of the city. This unique location represents a great strategic potential for the regeneration and urban reactivation of the city.

Keywords: *Architectural education; urban reuse; heritage transformation; heritage education.*

1. Introduction

Our cities can become more sustainable and resilient through the transformation of existing buildings and their adaptive temporary reuse, favoring the well-being and quality of life of citizens, promoting social inclusion and economic growth with respect for the environment. Currently, many cities continue to solve their space needs with new construction and consumption of territory. The European Commission approved in 2014 a package of measures to enable the circular economy (CE) including proposals to revise waste legislation to stimulate the transition from a linear economy to a circular one (European Commission, 2020). Furthermore, this package included as a new challenge: the reuse and transformation of existing buildings, particularly those not used or underused, with the logic of creating new economic and social opportunities aligned with the CE principles to: 1) take advantage of the existing common heritage; 2) improve the environmental performance of buildings throughout their life cycle; and 3) propose new scenarios for urban entrepreneurship.

However, the way in which we are materializing and learning architecture so far makes it difficult to achieve both the goals of the 2030 Agenda (European Commission, 2016) and our cities' goals regarding sustainable, environmental, economic and social development (Ayuntamiento de Barcelona, 2020). It is necessary to improve tools and methodologies to think more carefully about how we manage, use and reuse all the built environment that is already available, as with the rest of the natural resources.

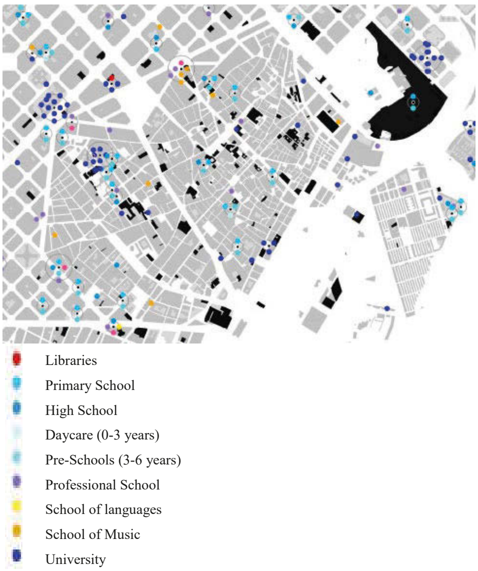

Fig. 1. Distribution of public activities and empty or underused public buildings.[1]

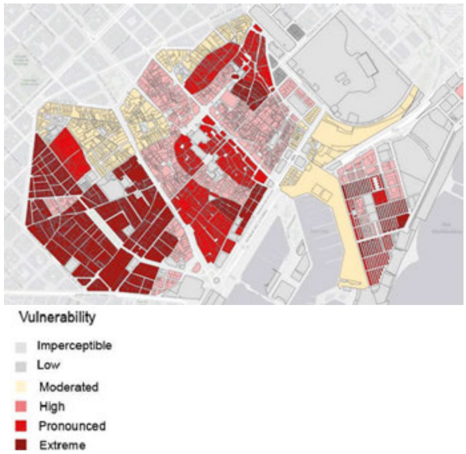

Fig. 2. Ciutat Vella district: Socially vulnerable areas (red scale) (Source: Cornadó et al., 2017).

Regarding social inclusion, the adaptive reuse of existing buildings for different activities also offers citizens and communities the opportunity to participate in the life of the city more easily (Tanac Zeren, 2013). Compared to new constructions that are normally carried out or integral rehabilitation commissions, adaptive reuse offers a greater possibility of transforming and reinventing the uses of the city through the participation of citizens, favoring the transition towards a circular economy and a much more sustainable consumption model. It is necessary to rethink the cities taking into account the real housing needs and the needs of the economic-productive and cultural sector, based on a global, sustainable, resilient and inclusive vision of the city. It has been proved relevant that being able to host new functions and accommodate flexible uses within buildings originally designed for other activities, has a positive effect on the surroundings creating a social impact through job opportunities and service (Bellamy and Palumbo, 2010). This approach on how to rethink the city must take into account the changing needs and ambitions of residents through spaces that can contain temporary uses with relatively low costs, which

[1] Participatory plan done by students from the School of Architecture of Barcelona: Sira Amat, Pau Castilló, Marta Gil.

are capable of offering access to accommodation for families at risk of exclusion and to open new spaces for new innovative economic activities (Fig. 1).

Ciutat Vella is a district in which its residents can live in poor living spaces (Fig. 2), while local entrepreneurship is drowned by rental prices marked by the centrality of the district and its great tourist incidence. Likewise, we find that large public-owned buildings are currently empty or underutilized. In addition, in the case of Ciutat Vella, the accumulation of urban land in large property holders has worsened in the last decade and the availability of urban plots for new buildings is scarce.

This educational proposal is framed in the context of the project funded by the Barcelona City Council *Co-inhabiting Barcelona - five case studies in Ciutat Vella for urban reuse and the promotion of innovative production models*[2].

This proposal arises after the social and health crisis triggered by the Covid-19 viral pandemic that has aggravated the consequences caused by the lack of housing in urban areas and also the great difficulties that local entrepreneurship encounters to grow, especially in the historic center of Barcelona.

2. Methodological approach to heritage education and social inclusion

This article describes the implementation of heritage education and social inclusion in a case study in the historical center of Barcelona and it is structured in the following methodological phases:

1. Case selection: Five strategic cases located in an axis of potential regeneration of the city of Barcelona were selected.

2. Multidisciplinary analysis: the applied methodology included a constructive analysis of the buildings and their state of conservation, an analysis of climatic data, and sociological data:

   a) Cartography and Diagnosis of the current state of buildings.
   b) Index of Sustainable Economic Welfare (ISEW or BES, "Benessere Equo e Sostenibile").
   c) Analysis of climatic data.

3. Determination and proposals of the reuse feasibility, based on the multidisciplinary approach, is defined.

2.1. Case selection

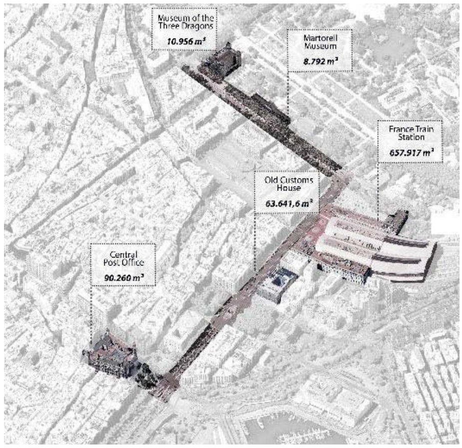

Fig. 3. Studied buildings and their strategic location in the surroundings of the Ciutat Vella district, Barcelona.

Five large buildings were selected, these are from the end of the 19th century, beginning of the 20th century, publicly owned and located in the Ciutat Vella district on the threshold between the historic city center and the port of Barcelona. The five have heritage protection and are currently underused. The number of buildings selected was five since their study was feasible within the project but, through

[2] Context of the project developed in the Universitat Politècnica de Catalunya: https://www.upc.edu/ca/sala-de-premsa/noticies/la-upc-repensa-el-model-de-ciutat-i-dissenya-solucions-per-fer-front-a-limpacte-de-la-covid-19-a-barcelona

this pilot test, the methodology could be tested and the study extended later (Fig. 3). The buildings that are proposed as objects of study are: The Old Customs House, The Central Post Office, the France Train Station, the Martorell Museum and the Museum of the Three Dragons. These are grouped along a 1-km linear axis formed by Paseo de Colón, Paseo de Isabel II, Paseo de Argentera, and Paseo Picasso.

The location close to the Parc de la Ciutadella, an area undergoing transformation (Gomà Carmona, 1997), which will foreseeably become an area focused on innovation and research, can generate an innovative axis for the grouping of local entrepreneurship to recover the port area for citizens and mitigate the effects of the overcrowding of tourist activities.

2.2. Multidisciplinary analysis

a) Cartography, diagnosis of the current state of buildings and heritage protection:

A phase of collecting historical technical information on the buildings of the existing archives was carried out. This phase was completed with systematic inspections of the buildings, obtaining the following information: constructive characterization, detection of unused or underused spaces, detection of existing damage and legal rules for their transformation. The evaluation consists of, at least, three aspects:

1. Technical, with a relative assessment of the costs and the time necessary for the adaptation of the building renovations and change of use;

2. Economic, evaluating the building in relation to actual and potential use, location and trend in the reference market;

3. Legal, checking the documentation related to the law of possible uses. Said information has been systematized in the following table:

	Selected requirements	Questions
	Potential Waste	
1	Enclosure	Is it detachable?
2	Structural system	Is it detachable?
3	Facilities	Are they detachable?
	Enclosure diligence	
4	Exterior doors and windows	Are they well preserved?
5	Roof	Does the roof need to be replaced?
6	Exterior walls	Are they well preserved?
7	Exterior enclosures	Is there insulation?
	Structure diligences	
8	Foundations	Are there settlement cracks?
9	Structural Supports	Are there cracks in the support systems?
	Facilities diligence	
10	Electric	How long are they expected to last?
11	Plumbing	How long are they expected to last?
12	Ventilation	How long are they expected to last?
13	Air Co. / Heating	How long are they expected to last?

Table. 1. Definition of the parameters for the prediagnosis for existing buildings.

b) Sustainable Economic Welfare (ISEW):

The importance of diagnosing a territory in its entirety allows to contextualize the buildings, their uses, the context in which they are inserted and the opportunities for their reuse for social, productive, sustainable purposes, etc.

In relation to the diagnostic component of Sustainable Economic Welfare (ISEW), different sources with indicators to contemplate can be found (Garcia-Almirall et. al. , 2021; Partnership on Circular Economy and Sustainable Land Use, 2019; Istat, 2021; Garcia-Almirall et. al., 2017; Hernández Aja et. al., 2018; Observatorio de la vulnerabilidad urbana; Sanchez Riera and Roca Cladera, 2021).

A system of indicators grouped into 9 axes has been established and the urban conditions of the district have been analysed through these dimensions: Health, Education, Work, Economic Welfare, Social Relations, Politics and Institutions, Safety, Subjective well-being, Surroundings and Innovation and creativity.

	Selected requirements	Questions
	Social relationships	
1	Social participation	Is the community engaged?
2	Non-profit organizations	Which concerns are addressed?
	Landscape and cultural heritage	
3	Illegal buildings	Are they representative of the total building stock and what are their implications?
4	Historical vegetation density	How dense are they and what was it like in the past?
	Environment	
6	Air quality	What is the air quality and what are its implications?
7	Urban vegetation	Are there any green areas and how do people use them?
	Innovation, research and creativity	
8	Creative companies	How many local enterprises exist and are there any interactions?
	District facilities	
9	Fiber installation	Is the area connected?
10	Existing of *district heating* facilities	Are there any large-scale heating facilities and what are their implications?

Table. 2. Definition of the indicators to take into account for the ISEW.

c) Analysis of climatic data

The energy efficiency certificates (CEE) of buildings offer valid geolocated data to assess the possible environmental impacts of buildings and their consumption of resources. CEE is also used in the construction sector, where it is a crucial part of assessing the environmental sustainability of buildings.

	Selected requirements	Questions
1	Useful area	m2
2	Qualification according to the NREC	letter
	NREC Flows and Values	
3	Building energy consumption	kWh/m2 year
4	CO2 Emissions	Kg
5	Annual cost	€

Table. 3. Definition of the climatic data.

The assessment data consists of two aspects to assess the potential waste generation and the reusability of buildings: the base values of the buildings to be compared and the potentials of noncircular flows leaving the system[3].

The Life Cycle Assessment (LCA) is commonly used in the building sector to assess the environmental sustainability of buildings and its use is recommended for the assessment of an index of reuse. However, in heritage constructions the climatic data are more useful because they are not going to be demolished (European Commission, 2020).

2.3. Re-use opportunities in heritage buildings

The possibilities and limits of the role of cultural heritage in urban reuse have been tested in the fifth-year design studio at the School of Architecture of Barcelona (ETSAB, UPC).

Fig 4. Cross section of the Old Customs House representing heritage elements to be protected. (Source: Ainhoa Varela and Africa González).

[3] See hyper map: https://sig.gencat.cat/visors/hipermapa.html#param=param&color=vermell&background=orto_ICC_grisos&BBOX=410860,4567836,419125,4572271&layers=ENERGIA_CERTIFICATS_EDIFICIS

See also available ICAEN data: http://icaen.gencat.cat/es/energia/usos_energia/edificis/certificacio/registre_certificats/index.html

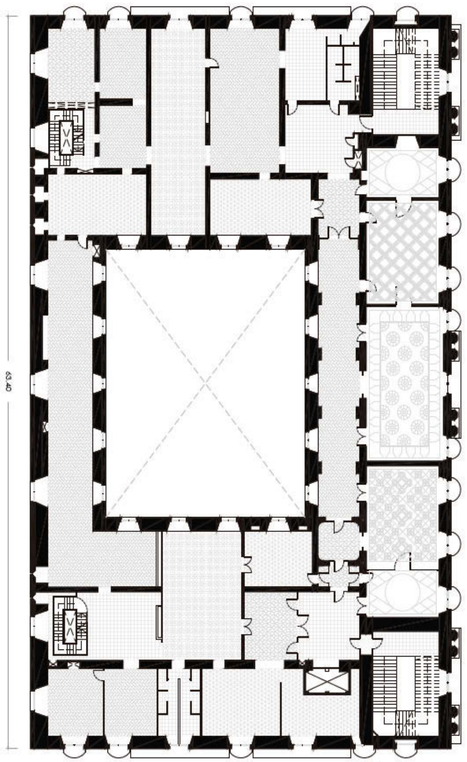

Fig. 5. Plan of the *Old Customs House* representing heritage elements to be protected. (Source: Ainhoa Varela and Africa González).

Regarding the first phase of analysis, the characteristics of the buildings were defined and the limits of architectural intervention were mapped and determined. Figures 4 and 5 show examples of the cartographic definition made in the studio.

As for the second phase, through the study of the socioeconomic parameters of the district, the possible combinations of programming activities necessary for the promotion of social inclusion in the district were extracted.

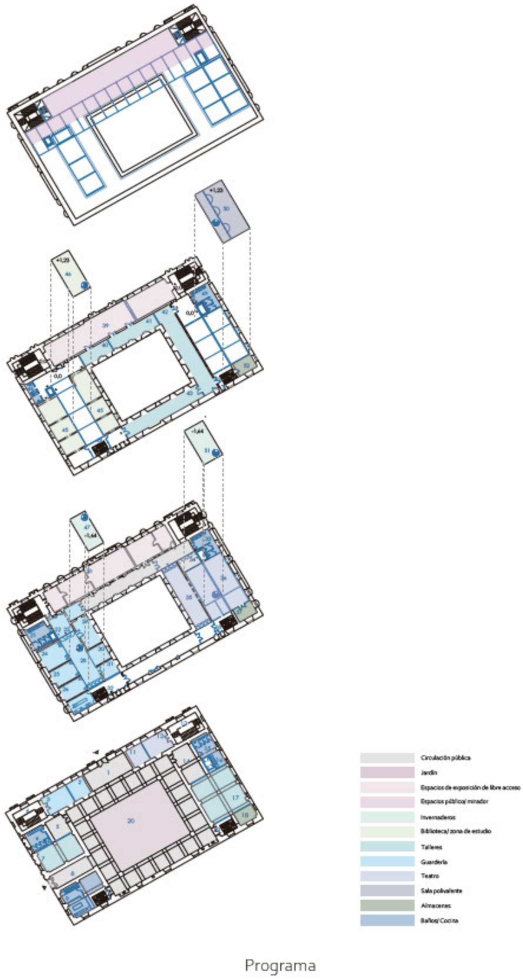

Fig. 6. Reprogramming of activities for the *Old Customs House* building. (Source: Ainhoa Varela and Africa González).

Finally, in the third phase of analysis, the buildings' energy performance together with their passive behavior were studied.

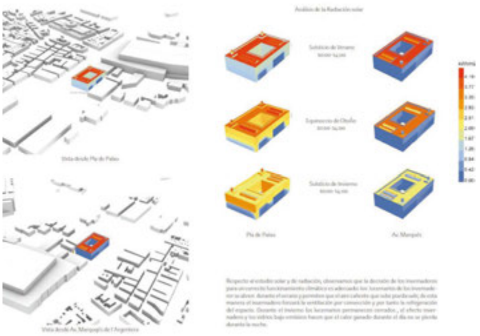

Fig. 7. Analysis of the climatic data, *Old Customs House*. (Source: Ainhoa Varela and Africa González).

The presented methodology to assess the potential and opportunities of a building to be re-used can be applied to any existing building. However, specific regards need to be considered when addressing the re-use assessment of heritage buildings.

In addition to the technical requirements reflected in the codes and the mandatory respect for the protected parts of the building, which already mean a substantial difference in the process of designing and materializing the reuse compared to a non-listed building, there are social and cultural aspects in the reuse of heritage constructions that need special attention. For the strategy of re-use to be more resilient and effective in the long term, the circularity of the approach is key to its success (Barnes, 2006; Bevir, et. al., 2003).

3. Conclusions

A methodology for the urban reuse in heritage education has been developed and allows the drawing of conclusions that go along the following lines:

1. At the level of cartography and specification of the current uses in the selected buildings, these have been redrawn in their current state with the uses that are currently present in them. This has made it possible to identify which spaces are fully available and which can vary to adapt to present and future needs.

2. At the level of the current state of the buildings, a pre-diagnosis has been carried out, which includes constructive characterization, description of damage and diagnosis. In the studied buildings, this has led to the conclusion that the buildings are perfectly usable for most current uses. However, specific restoration tasks are necessary, in general, on facades and roofs.

3. At the level of well-being, equity and sustainability analysis (ISEW), a set of available indicators were defined for the city of Barcelona. These allowed the axis of study (where the buildings are located) to be identified as an area of potential at the level of social improvement. During the propositive section, architectural proposals for reprogramming the buildings were developed to change the destination of disused spaces and be able to provide them with new functions in response to the temporary needs of each moment.

Acknowledgements

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Involving society in the enhancement of old city centres

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Topic: T2.2. Heritage education and social inclusion.

Abstract

Old city centres should be known, valued and preserved as part of the history and of the cultural and architectural heritage of cities. For this purpose, it is common practice to declare them sites of cultural interest, and to list their residential buildings with different grades of protection. However, for the inhabitants of the city centres, the listing status of their residential buildings is perceived as a problem, rather than an attractive added value for their property, since it limits their possibilities of intervention (refurbishment, expansion, elevation, etc).On many occasions, the lack of recognition of this vernacular architecture or humble architectural heritage has, as a consequence, the abandonment or reduction of maintenance as well as the alteration or destruction of the specific features that make them unique (or even essential) as part of the urban scene. In order to involve both the inhabitants of the old city centres and the visitors in the enhancement of these areas and to guarantee their preservation, different educational actions can be undertaken. To clearly define these actions, the first step is to carry out a study on the perception that owners and tenants have of this type of architecture. This paper proposes a series of questions to perform a survey among the citizens in order to evaluate the social opinion. Finally, this paper suggests a set of actions to be taken to improve the conception the citizenship has about the values of old city centres.

Keywords: *heritage education, old city centres, preservation, vernacular architecture*

1. Introduction

With the creation of the Academy of Fine Arts of San Fernando (1744), activities or proposals related to the protection of heritage began to be carried out in Spain, giving value, at that time, only to what was considered "old, artistic, aesthetic or historical", but with no legistative consequences until 1777. That year, King Carlos III established, through the Royal Order of October 3rd, the obligation of protecting the artistic heritage and inspecting the monuments that were discovered.

Ancient Monuments were defined, for the first time in article 1 of the Royal Decree of King Carlos IV (July 6th, 1803), as movable and immovable properties, whose value is based on being "ancient" (Punic, Roman, Christian, Goth, Arabic and late middle ages). In order to carry out the inventory of assets to be rehabilitated and monitored, the Historical and Artistic committees were created, by a Royal Order of June 13th, 1844, with the first declarations of "national monuments", date from the last quarter of the 19th century" (Ayuntamiento Toledo, 2017).

The first International Congress of Architects and Technicians of Historic Monuments took place in Athens, in 1931. Seven main resolutions were made, among these: "*historical sites are to be given strict custodial protection*", "*problems of preservation of historic sites are to be solved by legislation at national level for* *all countries" and "attention should be given to the protection of areas surrounding historic sites*" (ACRHM, 1931).

In Spain, the Law of National Artistic Heritage published during the Spanish Republic (May 13th, 1933), established a minimum of 100 years of age to grant historical-artistic value. It remained in force throughout Franco's dictatorship (1939-1975), and was mainly applied at the end of the 70s, when the renovation strategies that were being carried out in the Spanish historic centres had to be stopped (Carrascosa González, 2001). In 1975, the Committee of Ministers of the Council of Europe adopted, in Amsterdam, the European Charter of the Architectural Heritage, proclaiming that: "*The European architectural heritage consists not only of our most important monuments: it also includes the groups of lesser buildings in our old towns and characteristic villages in their natural or manmade settings*", recognizing that "*entire groups of buildings, even if they do not include any example of outstanding merit, may have an atmosphere that gives them the quality of works of art, welding different periods and styles into a harmonious whole*", and therefore, "*such groups should also be preserved"* (ECAH, 1975).

After Franco's dictatorship, in 1985, the Spanish Historical Heritage Law (BOE-A-1985-12534) was approved, removing the 100 years of age requirement to grant artistic historical value and replacing the term of "historical-artistic sites" with "historical sites", defining them as "*a group of immovable assets forming a unit of settlement, conditioned by a physical structure representative of the evolution of a human community as a testimony of its culture or as a value for the use and enjoyment of the community*". Therefore, the character of collective asset that historical sites have is underlined (Carrascosa González, 2001). However, in 1990, barely a dozen of the more than 300 historic-artistic sites declared in Spain had an approved plan according to the Historical Heritage Law (López Jaén, 1990).

In 2021, the law had a revision (BOE-A-1985-12534). It is worth pointing out that, according to article 20, "*the declaration of a Historical Site, Historical Asset or Archaeological Zone, as Assets of Cultural Interest, will determine the obligation for the municipality or municipalities in which they are found to draw up a Special Plan for the Protection of the area affected by the declaration. In addition, this plan should include the possible areas of comprehensive rehabilitation that allow the recovery of the residential area and the appropriate economic activities"*.

However, nowadays, it is not strange to observe the urban decline of some areas within the Spanish old city centres. It is well known that one of the causes of the decay of the residential buildings in old city centres is due to the sole interest of some owners to speculate with the commercial value of the land. With this aim, they deliberately neglect maintenance in the hope that the building is declared ruinous and can be demolished (Guardiola-Villora, Basset-Salom, 2012).

This situation, consecuence of the the lack of appreciation of listed buildings, will only be reversed by educating citizens, making them understand that residential listed buildings are an essential and valuable element of the city's urban landscape, as stated in the preamble of the Historical Heritage Law: "*in the conviction that the more historical heritage grows and is better defended the more it is appreciated by the people who live with it*.".

2. Social opinion about residential uses in Historic City Centres

Society's valuing of heritage, is a social factor included in the List of factors affecting the Outstanding Universal Value of World Heritage properties (UNESCO, 2008).

To evaluate the perception that owners, tenants, and visitors of old or Historic City Centres (HCC), together with the opinion the rest of citizens have about the residential use and the residential architecture in the HCC, an online survey, with closed multiple-choice and open-ended questions, has been designed.

The questions, based on other authors studies and methodologies to assess social vulnerabilities in heritage (Benitez et al., 2020, Turbay et al., 2020) have been organised around the following topics: monuments, Historic City Centres, streets in HCC, residential use in HCC, commercial value in HCC, modern standards, listed buildings and main issues in HCC.

The survey was randomly sent to 500 people, of which 35% responded, which may indicate the lack of interest about this topic. The profile of the survey respondents (age, gender, studies) is shown in figure 1. Among them, 10% live in HCC (with 3% being tenants), 12% own a dwelling in HCC (7% live in it), 12% work in HCC and only 1% are members of an HCC neighborhood association.

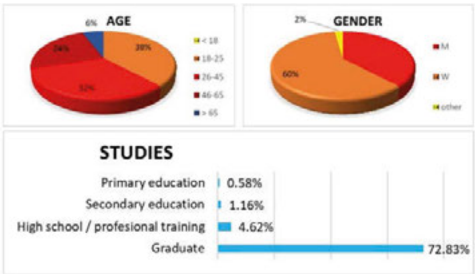

Fig. 1. Survey respondents profile

To illustrate some of the questions, additional information, related with the HCC of Valencia was provided. However, they could be extrapolated to any HCC, without a requirement to know the city of Valencia to give an answer. Questions and answers related to each topic are shown in figure 2 and analysed in the following epigraphs.

2.1. Monuments and Historic City Centres

As observed in the graphs in figure 2a and 2b, more than 80% of the respondents believe that it is important to preserve monuments and HCC, and both play an important role in trip planning (visiting monuments and walking through HCC). However, when focusing on their own city, neither politicians (27%) nor citizens (37%) are concerned about or know their city's monuments well.

2.2. Streets in Historic City Centres

The urban fabric is, undoubtedly, one of the main identifying characteristics of an old city centre. The layout of blocks, plots and streets allows us to distinguish if we are in a city of Roman, Islamic, medieval or nineteenth-century origin.

At the end of the 19th century, the theories of Le Baron Hausmann inspired the opening of new and long straight streets across the existing urban fabric. These actions were justified with the new hygienist theories that stressed the decadence, squalor and unhealthiness of the oldest parts of the city, simultaneously propitiating the demolition of the surrounding walls.These interventions, carried out with the excuse of improving air quality, the entry of sunlight and mobility (problems still identified with historic centres today), generated huge real estate deals, fostered by the revaluation of the land, as well as speculation. Which modified the new-theories' original designs, increasing the number of storeys and reducing the number of planned green spaces.

The questions and answers corresponding to the perception that the respondents have of the urban fabric are shown in figure 2c. 64% and 28% totally agree or agree, respectively, with the importance of preserving the urban fabric of the HCC (see plan of Tosca in figure 3) to the present day, with 85% affirming that it must be maintained in future. On the other hand, 52% of the respondents would live in the HCC despite restrictions on access by car and 23% despite the narrowness and darkness of the streets, however, 65% are against widening them. The 42% among those who disagree with the enlargement of the streets, but would not live in the historic centre, is linked with the next topic on the residential use of HHC.

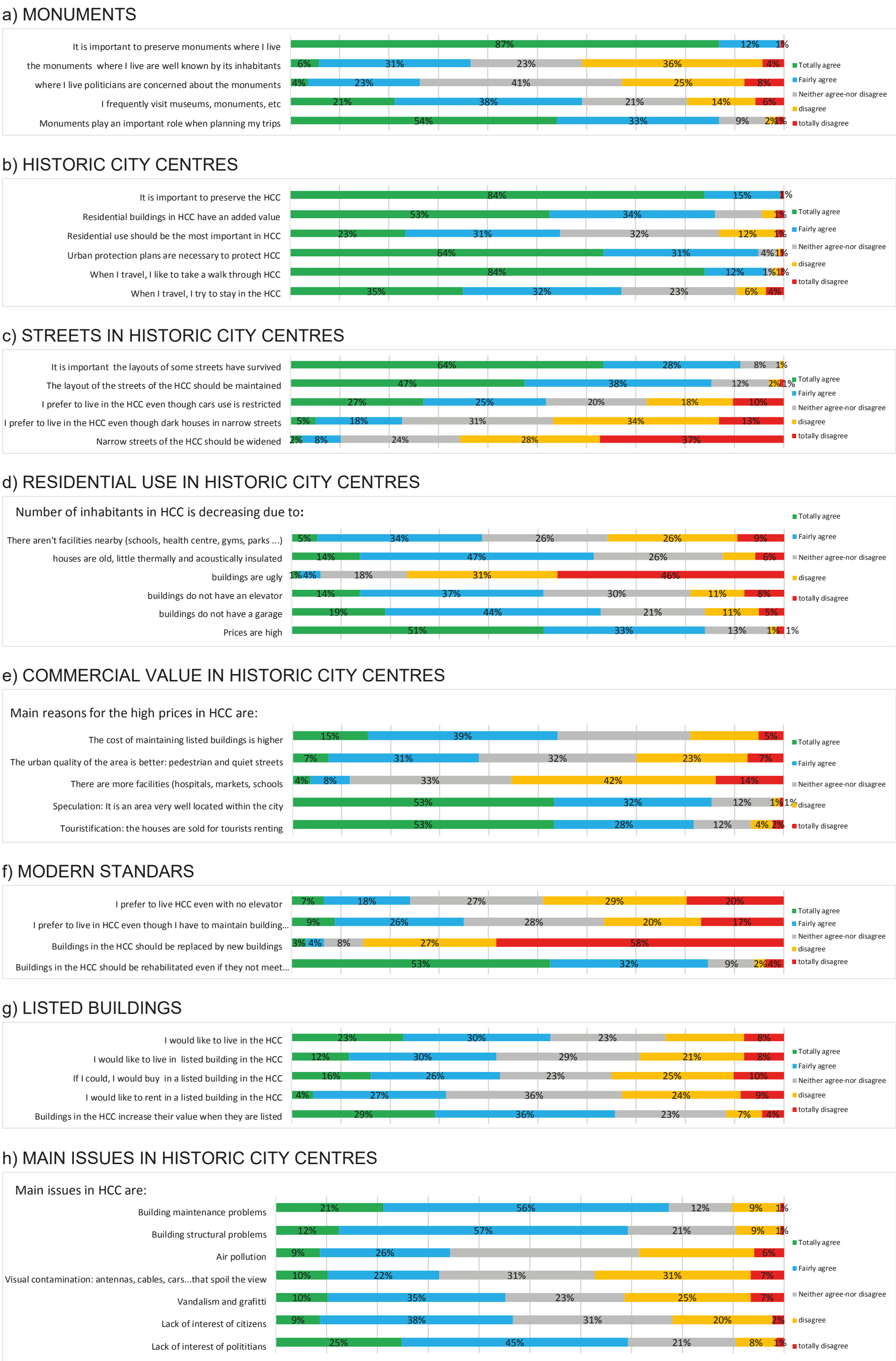

Fig. 2. Survey questions and answers

2.3 Residential use in Historic City Centres

Figure 4, showing the population density of the city centre of Valencia, was included in the survey, to illustrate the question: “Do you think that the population of the HCC centre is decreasing?”, with which 59% agreed.

All the questions and answers about the causes of depopulation of HCC are shown in figure 2d: The main cause (84%) are high prices, followed by the absence of a garage (63%), the age and lack of standard thermal and acoustic insulation in the houses (61%) and the absence of services and facilities nearby (39%).

This topic was also addressed with an open-ended question. The most repeated answers being: gentrification, speculation, tourism, transformation of houses into tourist apartments, accessibility, and lack of interest on the part of the administration in the rehabilitation of the historic centre.

Fig. 3. “Valentia Edetanorun vulgo del Cid”, T. U. Tosca, ca 1738 (Llopis & Perdigón, 2010)

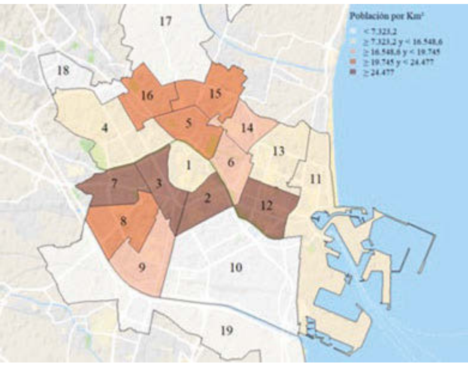

Fig. 4. Population density in Valencia (Ayuntamiento de Valencia, oficina de estadística, 2021)

2.4 Commercial value in Historic City Centres

The high prices of homes in the HCC of Valencia are confirmed by the data provided on the website of the real estate agency “Idealista”. The main causes of the high prices, according to the survey respondents are: speculation (84%), touristification (81%) and/or the buildings maintenance costs (54%).

2.5 Modern standards

With regards to the lack of compliance with housing modern standards in HCC, 85% think that buildings should be rehabilitated to avoid their ruin even if they do not meet completely these standards. 35% indicate that they would live in a building in the HCC despite having to maintain it and 25% despite not having an elevator. Only 7% strongly believe that old buildings in HCC should be replaced by new ones (figure 2e).

The improvements that can be made to the old buildings in the HCC are limited by the level of protection established by the Special Protection Plan of the area. Usual grades are summarised in the following epigraph.

2.6 Listed buildings

There are three main levels of building protection:

- Total protection: when most of its main components (façades, structure, roof, stairs, layout, etc.) are of interest for conservation.
- Partial protection: when only some of the main components are of interest for conservation.
- Environmental protection: when some morphological characteristics that are part of the scene (composition of the façades, the treatment of color, etc.) are to be conserved.

In addition, the law contemplates the typological protection when some typological characteristics (the subdivision, the construction techniques, the location of the inner courtyards, etc.) are intended to be conserved.

About 65% of the respondents were familiar with the levels of protection as well as the limitations they entail.

Regarding the appreciation that respondents have of these levels of protection, results show (figure 2g) that despite the fact that 63% would like to live in the HCC, only 42% would live or buy a home in a listed building, and barely 31% would like to rent in one of them. However, 65% affirm that listed buildings in the HCC with any level of protection would increase their economic value.

2.7. Main issues in Historic City Centres

The last topic in the survey refers to the main issues of the HCC (figure 2h). In a first series of closed-ended questions, the respondents highlighted building maintenance problems (77%), structural problems (69%), disinterest from politicians (70%) or from citizens (47 %) and, in a lower percentage, air pollution, vandalism, graffiti and visual contamination produced by antennas, cables or cars.

An open-ended question was also formulated in this section. The only added problems to the above-mentioned were: accessibility, acoustic contamination, abandonment (empty plots and ruined buildings) and touristification.

From all the responses, the lack of interest from citizens and also politicians is, undoubtedly, the key point on which action must be taken to involve the society in the enhancement of the HCC.

3. Proposals

In this section, a set of actions to improve the conception the citizenship has about the values of old city centres are discussed.

As stated previously, the urban fabric is one of the key elements that identify HCC. An example of dissemination on this point can be found in the Museu Valencià de la Il·lustració y de la Modernitat (MUVIM). In the lobby of the museum, there is a large three-dimensional model that reproduces the city of Valencia in the 18th century (figure 5), just as Tosca drew it (figure 3).

Another example is the panel in figure 6, located in "La Galería del Tosal" in Valencia, showing the original trace of the Islamic Walls and the points in which some remains can be seen.

These initiatives are interesting, however, they only reach people who visit the above-mentioned museums. Therefore, to involve the greatest number of citizens, it is essential to take them out on the streets.

A resource used with some frequency to exhibit the evolution of the different layers of the urban fabric are the so-called "archaeological windows", (figure 7) which show urban elements that have been hidden throughout history as the construction of cities evolved, providing a very good pedagogical approach, not only for visitors, but also for citizens.

A less invasive action could be to display a series of information panels, strategically located at specific points along the streets, alleys or lanes of the old city centre, representing the area

Fig. 5. Model of Valencia in the 18th century in MUVIM, made by V. Gómez Herraiz and L. Gómez Calvo.

Fig. 6. Remains of the Islamic Walls in Galería del Tossal

in the historical cartography (figure 8). This type of material could be part of a series of exhibitions that would present, in addition to the historical cartography of the city, old photographs of the buildings that are still standing, showing citizens and visitors the past and the nowadays urban scenes (figure 9).

With this very purpose, it is possible to find, in the internet, blogs, and social media groups (AC, 2008; VAHG, 2009) where citizens share pictures of their cities in the past and compare them to the present.

It cannot be forgotten that in this era of hyperconnectivity, the participation of citizens in the protection of HCC is essential. A clear example is the action taken by the citizens platform "Salvem el Cabanyal- Canyamelar -Cap de França" (SC, 1998), created in 1998 to fight against the extension of a large avenue towards the sea, tearing the grid pattern of the historical city centre and the destruction of about 500 buildings, (Hervás 2017). Thanks to their determination, and the organization of the annual open door festival to show the historical and cultural values of this neighbourhood, among others activities, it was declared an asset of cultural interest in 1993. They managed to involve all the citizenship, saving the area from destruction in 2016.

4. Conclusions

According to the survey, the HCC plays an important role in tourist travels, but not in everyday life, as 47% of the respondents are not interested in buying, renting or living in the old city centre of their town.

However, the majority do agree in maintaining the street layout and rehabilitating the existing buildings, but only 51% manifest that the main use should be residential.

This scenario shows, sadly, certain disaffection of the survey respondents towards their HCC. Despite the educational and dissemination work that some groups or societies do every day, like the Society for the Protection of Old Buildings (SPAB, 1877), this is the usual situation. It should be up to the competent authorities to take the initiative to improve the citizens' appreciation of their own historic centres.

As a conclusion, to prevent social risks that can affect the value of heritage properties, it is therefore imperative to carry on a series of awareness campaigns to involve the society in the enhancement of the old city centres.

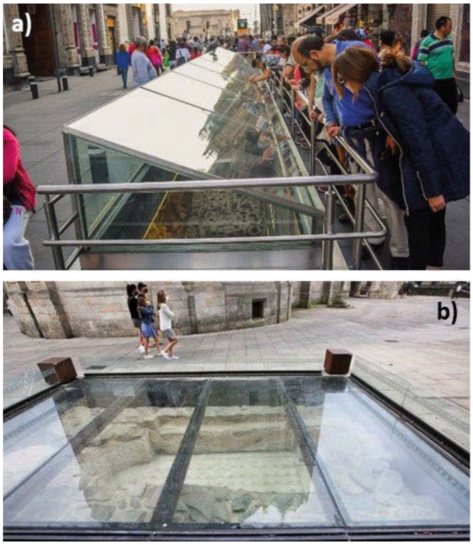

Fig. 7. a) Archaeological window in Mexico (Mancera, 2018) b) Archaeological window in Sta María, Lugo (López, 2020)

Fig. 8. Castle's square sign showing the Islamic pattern of the city on Requena (Spain) and Googlemaps satellite image ©2022 CNES / Airbus, Maxar Technologies

Fig. 9. Comparative photography of Barcelona, c.1915-2006 (Fotosdebarcelona.com, 2021)

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3D Heritage as a catalyst for social participation in safeguarding cities in conflict. A Case study of Damascus in Syria

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Topic: T2.2. Heritage education and social inclusion

Abstract

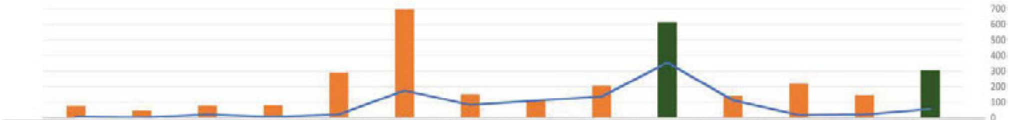
Cultural heritage is in danger in Syria, as in all the world heritage cities. Historical buildings have been radically destroyed by conflict and communities have been displaced. Many factors have contributed to this situation such as the inadequate preservation strategies before the war and the lack of local communities' awareness about the importance of their heritage. The local communities' inability to contribute to the protection of cultural sites rises from a lack of resources and knowledge in addition to their perspective of heritage as obstruction of development and an economic burden rather than a source of pride and identity. Therefore, this paper seeks to investigate the notion of heritage as a cumulative process of community cultural production over time and a key element of identity. Cultural heritage reinforces the interrelation between communities and the land by re-establishing connections that are often a part of peacebuilding. This paper investigates through qualitative surveys and statistics the problematic gap between cultural heritage and local communities in Syria. Additionally, "3D visualization" is discussed as a potential catalyst for conducting successful participation of the local community through its youth in safeguarding their cultural heritage. 3D visualization has a significant role in distributing knowledge (nationally and internationally) about heritage through the process of its creation, participation, and the 3D product. In addition, academic institutions have a significant role in distributing knowledge about heritage through heritage education programs.

Keywords: *3D visualization, Education, SDG11, Peacebuilding.*

1. Introduction

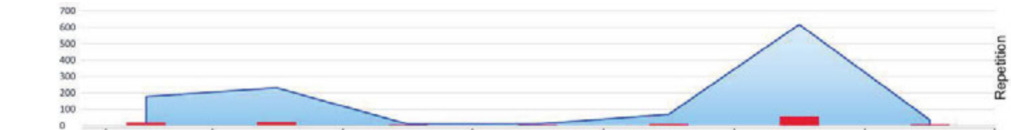
Heritage is a complex process formed by interpreting history and then using that interpretation to create a powerful narrative of what has occurred and how it should be perceived by its audience. Heritage is about negotiation, about using the past, and collective or individual memories, to negotiate new ways of being and expressing identity. Heritage artifacts, sites, and institutions become cultural tools to facilitate this process but do not themselves stand-in for it (Smith, 2006). The paper is built on this argument. Specifically, to suggest that the process of re-presenting historical architecture through technology and involving societies in its documentation could enhance people's attachment to the place and create an interpretive narrative of heritage that encourages society to adhere to the identity expressed in physical cultural heritage sites.

In Syria, the current disconnection between communities and cultural heritage is a multidimensional issue. We often observe a mosaic of competing and overlapping identities, so heritage is interpreted in different ways by various communities. Further, there is a lack of heritage education practices that present the meaning and importance of historical places. In particular, there is insufficient consideration for the memory of places and their history as connected to identity which can create a sense of belonging and attachment to the place in people's minds (Ibrahim, 2021). Given this paucity, the paper explains a pilot experiment conducted during the Syrian conflict to encourage local communities through their youth to become active participants in the process of the 3D documentation of cultural heritage. This experience could serve as a methodology for raising awareness about cultural heritage along with a sense of identity and attachment to the place, which contributes to peacebuilding and push stability of war-torn society. The gap in knowledge between communities and heritage is an influential factor in the destruction of heritage in Syria. Thus, it is incorrect to assume that the current heritage destruction is only a result of the present crisis, nor that the deterioration of historical fabric began with the crisis (Kanjou, 2018) (Ibrahim, 2020). Such loss of heritage is



City	Suwayda	Tartus	Al-Raqqa	lattakia	Hama	Al-Hasakah	Idlib	Deir ez-Zor	Homs	Aleppo	Daraa	Queneitra	Rif Dimashq	Damascus
Number of Historic Buildings and Archeological sites	76	48	78	80	291	697	152	111	206	613	142	220	148	305
Damaged Historic Buildings and Archeological sites	8	2	23	7	23	176	83	111	137	354	113	19	22	57

Fig. 1. Classification of historical buildings and archeological sites' damages according to cities, in green the two world heritage cities, (Source: The author)



	Neutral Communities	Immigration and abondonment of the place	Rehabilitation in accordance with heritage standers	Intervention to protect the site first aid	Vandalism and systematic destruction because of ideological backgrund	Vandalism and theft (using stones in a new building, stealing statues, etc.)	Rehabilitation is not in accordance to heritage standards
Number	178	231	11	12	70	617	36
Percentage	15.4%	20%	1%	1%	6.1%	53%	3.1%

Fig. 2. Communities' attitude in relation to the destruction of Heritage Architecture, (Source: The author)

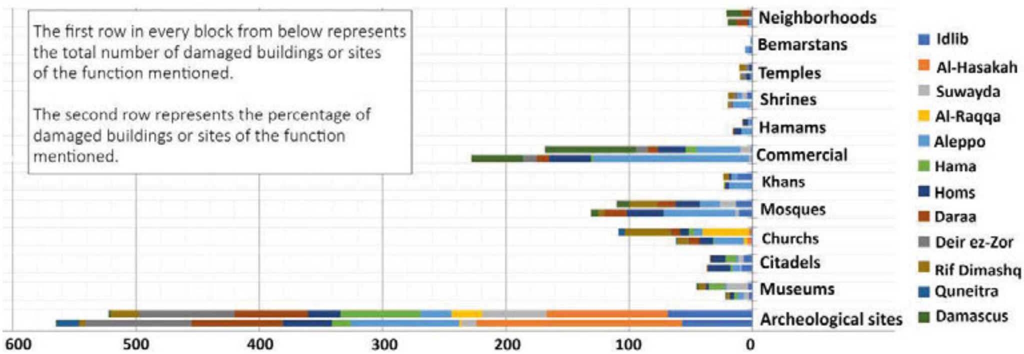


Fig. 3. Classification of buildings and sites' damages based on their functions, (Source: The author)

due to three different factors: looting, deliberate targeting, and the use of heritage sites for military purposes. Looting and the illegal trafficking of antiquities inflict the greatest damage (De Cesari, 2015). The paper initially collected a **classification of building damage** to investigate the status of the destruction. The information was collected by analyzing reports published by different organizations DGAM, AAAS, UNESCO, UNITAR, ASOR. In addition, local communities' attitudes towards heritage were investigated. Then, a method of safeguarding was suggested. The results of the investigation are shown in Fig. 1, Fig. 2, Fig. 3. Fig. 1. shows the percentage of historical buildings that have been damaged during the war in every Syrian city. The paper estimated that the Syrian ***archeological sites*** are the most damaged and 53% of cause of damage to historical sites is “vandalism and theft” as shown in Fig. 2, 3. Fig. 2 shows that vandalism, systematic destruction, and sabotage of historical buildings by using their stones or materials in new buildings are the main reasons for damages. Therefore, this paper argues that the Syrian communities suffer from a lack of knowledge and awareness to protect the Syrian world heritage. The Syrian conflict illuminated that there is a gap (disconnection) between communities and their heritage. Therefore, the problematic that this research tries to tackle is this “gap” of knowledge. How can incidents where people destroy their heritage be prevented? What are the incentives for communities in safeguarding their cultural heritage?

Since the paper has a pedagogical character, it doesn’t consecrate heritage as the "right thing" and only to be valued. But realizes that heritage is influential for diverse communities to coexist peacefully. Monuments have always been subject to restructuring, re-signification, and reuse, and the most important factor regarding the protection of heritage sites in post-conflict areas is how local communities feel about them. Therefore, the hypothesis states that involving communities through education and utilizing technology in the documentation of historical buildings can create more effective cultural heritage education approaches. Approaches that present to local communities the ***values*** of the architectural heritage and interpret the Syrian heritage as a source of identity and belonging. Furthermore, the 3D presentation techniques also have a significant role in reflecting and presenting the history of heritage sites. Previous studies have indicated potential in the higher education sector in the reconstruction and post-conflict recovery through teaching and training programs (Milton & Barakat, 2016). The Faro Convention (Fojut, 2018) stated that one objective is to take steps to improve access to heritage, especially among young people and the disadvantaged, to raise awareness about its ***value***, the need to maintain and preserve it, and the benefits which may be derived from it. Supporting the participation of young people in this process requires supporting opportunities for spatial interaction with this heritage to build an *emotional relationship* with these places of significant value. Then, this emotion is reflected in social behavior that expresses belonging and pride, and on the other hand, awareness, and responsibility to direct behavior towards respecting and protecting those places.

2. Objectives

To introduce an innovative educational approach to the documentation and safeguarding of heritage. And to increase the sense of ownership among citizens in heritage-led development processes. Furthermore, to give a model to cultural heritage institutions and educational institutions towards more participatory culture heritage preservation methodologies in times of conflict.

3. Methodology

The paper builds on the author’s work in Damascus (Ibrahim, 2019) and a literature review about heritage, destruction, and place attachment. Additionally, developing a **methodological** framework and testing the methods through a case study accomplished in the old city of Damascus and its historical neighborhoods in Syria. The *framework* was implemented in 2014 -2015 during the conflict at the Faculty of

Architecture of Damascus University and was evaluated by several semi-structured interviews conducted in 2019 and 2020 with architects who participated in the framework as students, specifically those who worked on the 3D visualization of the historical sites and buildings. Also, an online questionnaire survey was conducted in December 2021, which provided an indicative sample of the participants' perspectives about the framework implementation and a quantitative evaluation of the framework. The 47 responses yielded information on the framework's influence on their attachment to the historical context, the idea of cultural heritage as a source of identity and belonging, and the 3D heritage as a tool for safeguarding heritage. The author was a teacher and instructor at the workshops and put together a book for the 3D documentation of the different historical buildings and sites. However, the primary source this research is built on is the engagement with students and heritage experts in Damascus, including architects, planners, and people working in related fields. The implementation of the framework was done in the old city of Damascus which has 5% of the total percentage of damaged buildings in Syria, see Fig. 2. Therefore, Damascus was appropriate as a case study. It was approximately the safest city at the time of the workshop 2014 -2015 and the most accessible to implement the pilot experience. In this pilot experience, "building capacities of the

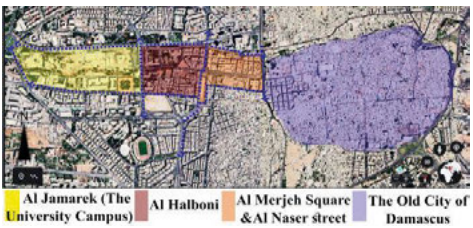


Fig. 4. The four Areas © The author

Syrian students" was the aim of the Faculty of Architecture at Damascus University. Further, the framework was implemented in four main areas within the old city of Damascus (inside the city walls) and its Historical neighbourhoods. Work areas were defined in Fig. 4.

The short-term goal was to build a three-dimensional library to simulate the urban landscape of the city of Damascus in the past, present, and future. This library includes the following elements: examples of typical residential buildings in the city of Damascus which characterize the urban properties of each area of the city; archaeological buildings or of historical and aesthetic ***values***; landmarks; significant buildings that were demolished (such as the group of buildings in the historical Al-Merjah Square); and historical urban furniture of the city (trees, light poles, etc.). The framework was implemented under the supervision of a group of professors, teachers, and instructors from the Faculty of Architecture.

The **methodological framework** consisted of multistable steps, explained as follows:

1. Students learn a visualization program (Sketchup). The learning would be a participatory experience where architecture teachers teach the students, who teach each other and practice the program at the university laboratories.
2. During the learning experience, taking into consideration safety permitting (safe times and a safe environment) the students with the teachers visit the historical building or site and survey it by taking pictures and measurements.
3. Experts and managers of the historical sites explain the history of the place and its significance. Fig. 5 shows the manager of Damascus citadel (Eng. Admon Al Aji) explaining the history of the citadel and its architectural significance in addition to details about its structural and construction techniques.

Fig. 5. Visiting the site ©The author

4. The students work on **“Standard Identification Form”** to explain the historical site’s history and importance, Fig. 6.
5. Students use the program they learned (Sketch up) to do a 3D visualization of a historical building/site of the targeted area, Fig. 8.
6. A book of students' work was designed and written by the author to be published. The page from the book contains information about the studied sites (history, location, architectural description) in English and Arabic, 3D rendering pictures from different angles and perspectives of the building model, students’ names and pictures and quotes written by the students about the framework experience, and the teacher who supervised the group, his /her picture and a quote about the workshop, Fig. 7.
7. **Social Media tools** like Facebook and Instagram were used to advertise the cultural heritage’s 3D models through video renderings that were published by the students and professors from the university (Ibrahim, 2016).

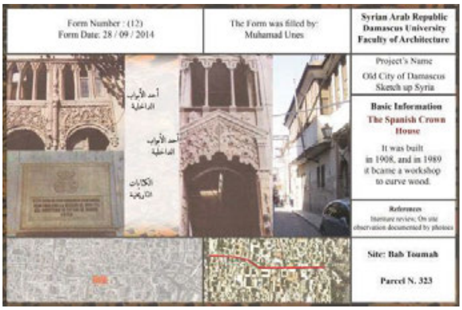


Fig. 6. Standard identification form © The author

Fig. 7. A page from the book of students’ work, ©The author

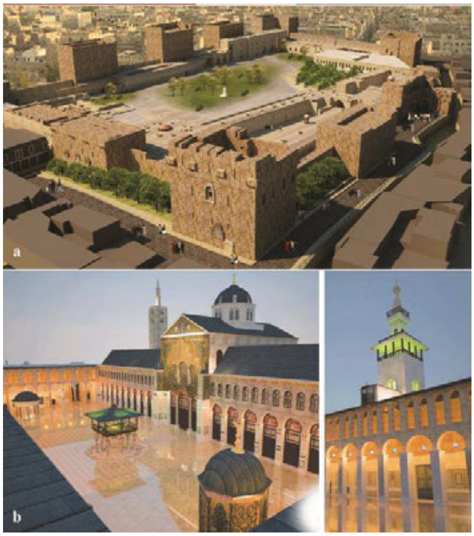


Fig. 8. 3D visualization of a) citadel of Damscus and b) Umayyad Mosque by students © author

4. Evaluation of the Framework

The online questionnaire survey conducted in 2021 indicated workshop participants’ (who are now architects) views, knowledge, practice reflections, and experiences about the framework relative to their gender, age, and place of residence. Almost 96% of respondents in the age range of 26 -35 years old and 4% in the range of 18-25 indicate that they lived through the war in Syria.

Workshop according to area	N
Old Damascus workshop - First phase	12
Old Damascus workshop - Second phase	4
Old Damascus workshop - First phase and Old Damascus workshop - Second phase	11
Al-Nasr Street & Al Merjeh	4
Al Halboni	3
Al Jamarek	3
Al-Nasr Street, Al Halboni and Al Jamarek	3
Old Damascus - First phase and Al Jamarek	1
Al Jamarek and Al-Nasr Street	2
Old Damascus - First phase, Old Damascus - Second phase, and Al-Nasr Street	4
Total Number of respondents:	47

Table 1. Number of respondents from every workshop

The respondents confirmed their participation in the workshops as specified in Table 1 and 2.

Description of the questionnaire survey
Developing the Survey
The questionnaire was designed to collect data on: Respondents' profiles (gender, age, academic level, and place of residence), in addition to their participation in the different workshops (Al Jamarek workshop, Al Halboni workshop, Al Nasr Street workshop, Old Damascus workshop (First phase – Second Phase). Respondents' experience and information gained and the influence on their research and work.
Administering the survey
The survey was shared through Facebook and students who participated in the workshops were addressed and tagged in the comments and was completed by 47 respondents. Questionnaire instructions indicated the survey's content and purpose and estimated completion time. A consent question was included in the online questionnaire, to be selected by the respondent. Duration: The questionnaire survey was available for one month, including weekends.
Respondent profiles
Gender distribution: 51% Female, 49% Male. Age distribution: 45 are between 26-35 year, and 2 are between 18-25 year. Current place of residence: 47% Damascus, 13% Rif Dimashq, 40% outside Syria

Table 2. Description of the questionnaire

The table shows that some students participated in the 3D documentation for more than one area. About 91% confirmed that they learned about the historical buildings and sites they visualized. 96% confirmed that their experience at the workshop enhanced their sense of importance in protecting the historical architecture. About 83% confirmed that the framework intensified their sense of cultural heritage as a source of identity and belonging. 83% of participants confirmed that the workshop reinforces their sense of memory of the place. **Details** of the buildings were mentioned in the respondents' answers including the ratio and patterns, which confirm the influence of the framework in creating an attachment to the place and a sense of memory. In a quote from the participant "Shady Bahsas" describing memories from the framework "*what I remember is that all windows have a similar dimensional ratio, also I was wondering about the huge difference in financial situations amongst the residents in those areas"*. Further, Words like "Alley" which means the traditional narrow streets ("زقاق" in Arabic), "Souks", and "Gates بوابات" also were mentioned by the participants which confirms the knowledge that the students got during the workshop about the old city urban structure. A quote from the participant *"*Mohammed Younes*"* highlights gained knowledge and awareness: "*The number of architectural details testifies to the significance of this historical architecture and what it could give to human memory. The modeling of buildings was not easy; thus, this is evidence that this architecture is not effortless despite its simplicity, it is the impossible easy*". 87% confirmed that the workshop can Re-establish and reinforce the connection between communities and cultural heritage.

In raising awareness, 96% of the participants confirmed that the workshop boosted their knowledge about the importance of protecting cultural heritage, ten participants specifically mentioned remembering the "**details**" of the historical architecture of the site, and another eight participants mentioned the unique building materials in addition to mentioning specific heritage patterns of the building structure. Four of the students mentioned the neglect of the historical buildings despite their significant importance. Those are indicators of the knowledge that the students got and the awareness and sense of the historical place that they gained. 77% of the students supported the hypothesis that the 3D production of the historical site could be a tool for safeguarding heritage in Syria. They confirmed that the ***3D documentation*** would be an important resource to identify and define the historical property in addition to deepening the communities' collective awareness about cultural heritage. The visits played a role in creating new meanings and ***values*** associated with the monument. "Mohammad Habeel" one of the students who is now an immigrant in Germany said that he will always remember his pride in belonging to this heritage when he entered the citadel, he said, "*The scale of the stones and the building was magnificent, I felt proud being part of this heritage*". Places become meaningful from personally important experiences, such as realizations, and milestones (Scannell & Gifford, 2010), the memory of the place was strong and present in the interviewee's mind even after his exile, he talked about his memories of war and how the workshop created a milestone in his relationship with the idea of "home", he said, "I grew up during the war, my memories about the city are memories of checkpoints and military stops, but the workshop created a difference in my perspective of identity and sense of belonging". Habeel talked about the influence of the 3D model in teaching him about heritage architecture "*Before the workshop, I did not know what a Muqarnas is. After the workshop, I did a Model of the Muqarnas of the Ayyubid hall because I was mesmerized by its structure and proud of my ancestors who build it and I wanted to learn from them. I learned that the Ayyubid hall has one of the most unique tetrastyle domes in the world. One of my beloves memories was me and my friends imagining together people who lived in this beautiful structure*". One of the students' respondents talked about the attachment to the place that the experience created "*The idea of working on a landscape model of an area would enhance its sense of importance to the student. Also, the time spent modeling with your friends will create a beautiful memory about the place and about your contribution to protecting it, which increases your sense of belonging to it*". It is not simply the places themselves that are significant, but rather what can be called 'experience-in-place' that creates meaning (Manzo, 2005). Awareness of the place history intensifies place attachment, "Place exerted its influence on place attachment through physical features and symbolic meanings" (Lewicka, 2008), through the workshop, belonging was reinforced as self-identity meets self-values, and individual behavior was directed toward social and community responsibility.

5. Discussion

The framework used for the case study in Syria has gained overall positive feedback regarding the enhancement of community participation, social cohesion and creating *emotional attachment with heritage*. The framework succeeded in raising awareness about the historical sites. The survey showed that the framework enhanced the sense of importance of historical sites among the community and encouraged the eagerness and passion to protect them. The results from the survey showed that if the presentation of the historical sites (their meaning, memory and aesthetic value) were reinforced by creating the 3D model, this can lead to the accomplishment of positive changes regarding strengthening social protection of heritage in a multicultural and multi-ethnical community during the conflict. The framework supported spatial interaction with heritage to build an *emotional relationship* with historical places of significant value. Then, this emotion is reflected in social behavior that expresses belonging and pride, and on the other hand, awareness, and responsibility to direct behavior towards respecting and protecting historical places.

6. Conclusions

The study's findings highlight the importance of embracing youth participation through educational institutions in order to develop a methodology for successful heritage safeguarding during conflicts. The protection of historical neighborhoods is related to how local communities feel about them. If they are neglected, they can be linked to negative memories. However, by intensifying their visualization and image, they could work as a tool for strengthening local communities' identity attachment and connection to the historical place. The sites are already perceived as world heritage. Nevertheless, with this framework, they could become a catalyst for social recovery. The results of this framework regarding Damascus show how participatory 3D documentation could greatly contribute to the social identity and in consequence a positive society's attitude toward the protection of heritage. Participatory approaches such as the one in the case study should be emphasized as important short-term interventions. The “3D visualization” is a catalyst for social participation and the protection of cultural heritage in conflict areas. The framework repositioned heritage as an active tool in building peace efforts, rather than merely a passive recipient of damage and restoration. 3D Heritage through the process of its creation, participation, and the 3D product could be a tool in conducting successful participation of the local community through its youth in the safeguarding of cultural heritage.

In planning and management projects of endangered heritage sites, the starting point should be the development of methodological approaches for creating positive memories and strong emotional relationships between local communities and sites. The framework could be replicated in different endangered sites to create a positive perception of heritage connected with the collective identity of complex conflict communities. As a consequence, architectural heritage becomes a carrier of positive changes, not only in a material sense but also in the recovery of the community's damaged social structure.

Higher education plays a key role in the safeguarding of cultural heritage. The 3D documentation workshop is one of the tools that could be used in other frameworks to simulate urban reminders of history, identity and protect Heritage. The study's findings highlight the importance of embracing youth participation through educational institutions to develop a methodology for successful heritage protection during conflicts.

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Heritage education as an effective approach to enhance community engagement: a model for classifying the level of engagement

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Topic: T2.2. Heritage education and social inclusion

Abstract

Seeking consensuses from the public is difficult, this also applies to the heritage sector, particularly in heritage preservation. 'What, why and how to preserve?' are the core of debates in the field and the differences between points of views are basically due to the difference in valuation. In order to know everyone's needs, views and expectations better and for sustainability, involving the community for preservation becomes fundamental. Education, an experience which does not only provide opportunities for enlightenments and widening horizons, but also introduce various concepts in terms of moral, ethical and social through systematic instructions. Having such great impact to community, promoting heritage education can be an effective approach awakening public consciousness on heritage preservation, and thus, enhancing people's responsibility towards heritage, for both tangible and intangible, and developing a sustainable future for heritage through public engagement. However, it is necessary to understand the structure or the level of engagement prior setting the goal for heritage education. A model for classifying the level of engagement from performance is proposed for clarification and appraisal. This model is part of the research project of Community Engagement with Heritage in Macau which has an intention to examine its level of community engagement and give suggestions. This essay will first discuss community engagement, then classify the levels of engagement with models and lastly argue heritage education can elevate the level of community engagement which ultimately achieves the aim of heritage preservation.

Keywords: *heritage education; community engagement; heritage preservation; promotion.*

1. Introduction

Since 1992, when the World Heritage Centre (WHC) was established, the idea of community engagement with heritage has been promoted in one of its mission statements, which is to "encourage participation of the local population in the preservation of their cultural and natural heritage" (UNESCO, 2008, p.3). With the support from United Nations Educational, Scientific and Cultural Organisation (UNESCO), the concept of enhancing community engagement was introduced to the public, and one of the key approaches is heritage education. As early as in 1994, the WHC and the Associated Schools Project Network (ASPnet) proposed a UNESCO Young People's World Heritage Education Project in order to develop innovative educational approaches in support of world heritage conservation and to encourage the young to participate in conservation activities at large (Khawajkie et al., 2002). This new concept of introducing heritage education in and out of the classroom became an essential step forward in popularising heritage and bringing heritage into people's lives. It provided a new way of building commitment and strengthening actions in favour of preserving heritage by and for the public, especially for the young generations to consolidate their knowledge about heritage from a young age.

It has been said that heritage education is one of the most fundamental and sustainable ways to conserve, preserve and promote heritage, be it cultural or natural, tangible or intangible, from local heritage to world heritage (Matsuura, 2002). However, before considering how heritage education can benefit the community and the heritage sector, it is necessary to understand community engagement. A model which classifies different levels of engagement will be proposed for the specific use for the sector.

2. Engaging the Public with Archaeology

For the past twenty years, archaeologists have started to rethink their relationships with communities. Serious attentions have been paid to public involvement, heritage management and collaboration with communities in recent years (Atalay, 2012). As early as in 1970, Fritz and Plog concerned the interconnections between archaeology and society, "We suspect that unless archaeologists find ways to make their research increasingly relevant to the modern world, the modern world will find itself increasingly capable of getting along without archaeologists" (1970, p. 412). This sentence not only seeks suggestions for sustainable development, but also highlights the importance of considering public interests as an element of archaeological research. Even though public interests are difficult to presume and understand, it is essential that they are given due consideration in archaeological interpretations because motivating and attracting the public into archaeology is important for the sustainable development of the subject. Atalay mentions that archaeological research is a luxury to non-archaeologists (2012). This is mainly due to public disengagement, where the public are not able to connect with archaeology and are unable to make use of the results of archaeological research. The lack of consideration of public interest, therefore, leads to the public failing to recognise the impact of archaeological research on people's daily lives economically, socially, religiously, politically and culturally. A better understanding of the public interest is the key to a greater level of public engagement, and bringing public awareness and interests closer to the subject is an imperative concern for archaeologists. Archaeology has so much to offer to humanity that allowing it to be lost in rapidly developing societies would be a mistake.

2.1. What is Community Engagement?

The term 'community engagement' refers to the intention of communicating with the community, as well as facilitating actions and events to enhance people's interests (Johnston, 2008). It is believed that engaging the community in programmes for specific aims and objectives could result in a better social and organisational outcomes (Adams & Hess, 2001). Johnston suggests community engagement is a communication strategy which provides opportunities to members of the community to show their interests and express their views (2008), offering ethical, socially responsive and reflexive approaches for organisations to enhance their rela-tionship with the community. Barkan argues "engagement is described as a set of attitudes that predispose an individual to action" (1998, p.64). It is an important motivator for ac-tion and emotional involvements relying on interests, knowledge and a sense of civic pride (ZimmerGembeck et. al, 2006). A "good community engagement will mean that both groups can understand and act on the needs or issues of community experiences, helping to achieve positive change" (Scottish Community Devel-opment Centre, 2019, What We Do panel). Therefore, usually the aim of community engagement is to understand the needs, views and expectations of the community.

2.2. Level of Engagement

Researchers have used different terms to describe their approaches to community engagement. These including outreach, collaborative research, participatory arts, lifelong learning, community engagement, and engagement with partners (NCCPE, 2018). Although all these strategies are geared towards better community engagement, their purposes and processes vary because their targeted levels of engagement are different (Scottish Community Development Centre, 2019).

Three different spectra of participation have been chosen to illustrate the idea of the level of engagement. They are all similar, but different from each other in some way due to their differences in purpose. The spectrum of the International Association for Public Participation (IAP2), which was first proposed and widely adapted by partitioners since early 2000s, gives a sample of the classification of the level of community engagement in general. This Fifth Level Engagement framework is initiated to define the role of the public in any public participation process. The model has been criticized on only considering positive public engagement by Saatchi in 2012 (Fig. 1). By omitting the level of disengagement, it defines levels from Inform to Empower (Fig. 2; IAP2, 2018).

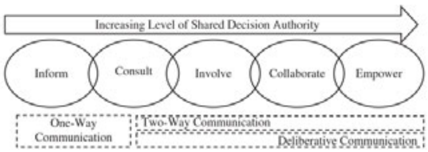

Fig. 1. The Spectrum of Participation (Source: Nabatchi, 2012).

Fig. 2. The Spectrum of Participation (latest version) (IAP2, 2018).

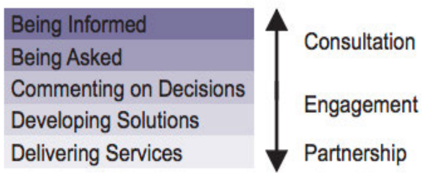

Fig. 3. The Spectrum of Participation (Source: Sunderland City Council, 2008).

The Sunderland City Council presents in the same way without explanations in their community development plan (SCDP, 2008, p. 7, Fig.3).

The National Trust has similar ideas in presenting levels of community engagement, but it includes two more levels with divisions. The spectrum is divided into three main sections, from Non participation to Substantial participation (2019, Fig. 4).

However, after reviewing the features of these three spectra, it seems that these existing spectra of participation do not fit so effectively to fulfil the aim of reflecting the progression of improv-ing the level of community engagement, partic-ularly for heritage education. As a result, a simple model for determination is needed. The following model was then developed (Fig. 5) based on the inspiration from the spectrum of SCDP (Fig. 3), in which, alongside the classification of levels, it labels the status of the levels as consultation, engagement and partnership, where engagement is the mid-range status, and selected details taken from other two spectra as well.

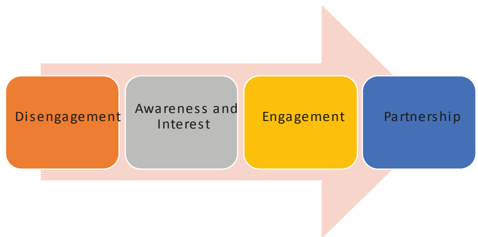

Fig. 5. Model for classifying the level of engagement from performance.

Model for classification	Disengagement	Awareness and interests	Engagement	Partnership
SDCP		-Being Informed -Being Asked	-Commenting on decision -Developing solutions	-Delivering services
IAP2		-Inform -Consult	-Involve -Collaborate	-Empower
National Trust		-Giving information -Gathering information -Inviting action -Consulting to be influenced	-Deciding together -Acting together	-Supporting others

Table 1. Equivalent classification of level of engagement.

Terminology is being considered. According to O'Connor, “community engagement is achieved through activities that develop knowledge, skills, values and motivation” (2006, as cited in Johnston, 2008, p.2). It is particularly achieved via the creation of awareness and interests (Johnston, 2008). The term ‘consultation’ is perfectly fine in usage from the organisational perspective.

Fig. 4. The Spectrum of Participation (National Trust, 2019).

Yet, in terms of representing the responses of the community, the term 'awareness and interests' would be more suitable. Therefore, this paper will consider the level of engagement based on this new model with the four key stages.

In terms of the difference between engagement and awareness, the Cambridge Dictionary defines 'awareness' as "the knowledge that something exists or understanding of a situation subject at the present time based on information or experience" (2019, 'awareness'). The Virtual Knowledge Centre to End Violence against Women and Girls (ENDVAWNOW) suggests the meaning of 'awareness' is the public's level of understanding about the importance and implications of a topic (2010), allowing people to make their own decisions after explaining the issue or disseminating knowledge to them.

There are two broad levels of awareness. High awareness suggests that a significant proportion of a society agree that the topic has great importance and a close connection to them, whereas a low degree of awareness shows an ignorance or lack of care about the topic. Raising awareness is similar to increasing engagement, where activities are designed to have a sufficient effect on knowledge, attitudes and behaviours (ENDVAWNOW, 2010). Fouts claims the difference between engagement and awareness is the depth of personal connection with the topic. He explains community engagement is people's experience with the topic which is customised or personalised for the specific needs of the participants; in contrast, awareness is more likely to be people's perception of the topic (2013). Therefore, increasing awareness could be seen as the first step in enhancing engagement.

2.3. Community Engagement with Heritage through Tourism and Education

Compared to other outlets for archaeology such as museums and field projects, community engagement in the heritage sector seems weaker in presentation. This is because the concept of heritage is too complicated to be explained clearly to the public with a unified definition (Smith, 2006; Harvey, 2001). Smith suggests that heritage could be promoted and presented to the public via multi-layered performances such as visiting and consulting (2006). Recently, the most popular way to engage with a heritage site is through heritage tourism. According to the National Trust for Historic Preservation in the United States, heritage tourism means "traveling to experience the places, artefacts and activities that authentically represent the stories and people of the past. It includes visitation to cultural, historic and natural resources" (Gibson, 2015, definition section). Those resources referred to by Gibson are mainly referring to World Heritage Sites (WHS) which are deemed to have Outstanding Universal Value (OUV) to humanity. Each designated WHS of UNESCO has its unique OUV which could determine the significance of the site formally and with unity (UNESCO, 2008). However, heritage tourism is a derivative focus from the main aims of inscribing a WHS on the list, which is to ensure "identification, protection, conservation, preservation and transmission to future generations of cultural and natural heritage of OUV" (UNESCO, 2005a, About World Heritage). Heritage tourism itself could be primarily recognised as an economic strategy and for economic purposes of which some scholars refer to 'Disneyfication' or 'the heritage industry' (Hewison, 1987; Waitt and McGuirk, 1996; Waitt, 2000). However, it is arguable that tourism also brings awareness to heritage sites or even enhances public engagement.

Heritage tourism has a great impact on promoting heritage and attracts serious attention from the public, but the level of engagement is relatively shallow, and its lasting effect is short. McKercher and du Cros have identified five categories of heritage tourists, all of whom have different levels of experience and engagement with heritage sites, depending on their prior knowledge of the place they visit (2002, see Table 2). Referring to the classification of the level of engagement given in Figure 5 above, most tourist types, apart from the 'purposeful cultural tourist' and 'serendipitous cultural tourist', fall into the Disengagement or the Awareness and Interests categories, depending on their experiences (see Table 1). Hence, in order to provide a stronger sense of motivation and a deeper level of experience, an extra approach should be added on to enhance better community engagement. Education would be a suitable approach for bringing people's awareness and interest to the subject. Matsuura (2002, p .4) states that "Education is the key to personal fulfilment, development, conservation, peace and well- being" while involving with the past via education can improve the quality of life (Schofield, 2010). Yet Molyneaux claims that "formal education is particularly vulnerable to dispute about the interpretation of the past because of its importance as an ideological tool in society" (1994, p. 3). However, this is unavoidable since history is selective and constructed "based on reselection, reconstruction and reinterpretation of past events in order to validate former, present, as well as the actions of actors" (Semian and Novacek, 2017, p. 307).

1. Purposeful cultural tourist
• Primary motive for visiting and individual has a deep cultural experience
2. Sightseeing cultural tourist
• Primary or major reason for visiting, but the experience is more shallow
3. Serendipitous cultural tourist
• Does not travel for cultural (heritage) tourism reasons, after participation ends up having a deep cultural tourism experience
4. Casual cultural tourist
• Weakly motived for visiting and the resultant experience is shallow
5. Incidental cultural tourist
• Does not travel for cultural (heritage) tourism reasons, nonetheless, participates in some activities and has shallow experiences

Table 2. Five major categories of cultural tourists (McKercher & du Cros, 2002).

The character of heritage in education is to enable acknowledgements and interpretations of different values that are ascribed to heritage sites for various reasons. The process of learning itself is "a process of active engagement with experience" (Campaign for Learning, nd, Our approach panel). Hence, heritage education provides direct interactions with the resources of social experience and the reflection of changes within the community, developing and encouraging students to build a capacity to evaluate what people see and hear critically (Molyneaux & Stone, 1994). In addition, many scholars argue that heritage sites impact on the broader community in areas such as the economy, art performance, personal development and health care (Matarasso, 1997; Gilmore et al., 2003; Seymour, 2003; Clark, 2010). The advantages of promoting heritage education would be more than just having cultural or social influences to the community. Because the roles that heritage education plays in society are more significant than people think. The Group of Education in Museums (GEM, 2018) explains how heritage education:

- offers a different kind of learning
- involves people at all stages of life and with a wide variety of needs
- brings out the best in our children and deepens classroom learning
- contributes to civic awareness and our sense of place
- and provides a sense of wellbeing.

GEM values heritage education as the best practice to advocate social welfare and individual benefits. In Europe, heritage education is widely accepted. In some countries, it has been run for more than twenty years. From an evaluation of the attitudes and opinions of European citizens regarding cultural heritage, 88% of the respondents agree that cultural heritage should be taught at school (European Commission, 2017d). Such responses from European citizens, together with academic research, strongly suggest that heritage education achieves better community engagement, cultural continuity and sustainable development in cultural and social affairs with the support of heritage sites.

In 1994, UNESCO initiated the World Heritage Education Programme to involve younger generations in the protection of heritage sites as well as encourage them to preserve our cultural and natural heritage for the future (UNESCO, 2018). Both the World Heritage Youth Forum and the World Heritage Young Professional Forum provide a platform for students, teachers and professionals all over the world to foster intercultural learning and exchange, debate global common concerns and establish a network for future development of world heritage education. One of the materials – the World Heritage in Young Hands Kit has been translated into 43 national languages for global promotion (Fig.6) while a short film – Patrimonito's (Small Heritage Guardian) World Heritage Adventures has been produced and made widely available (UNESCO, 2018; Khawajkie, Pavlic and Titchen, 2002). Many different types of events are being launched and it seems that the promotion of heritage education is on its way to succeeding.

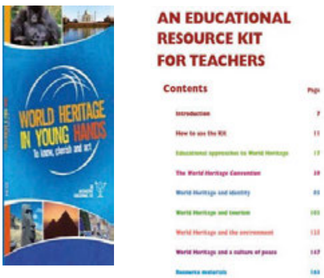

Fig. 6. World Heritage in Young Hands: an education resource kit for teachers (WHC, 2002).

There is no one way to introduce heritage education. Molyneaux suggests that "there is no simple prescription for the study of the past" (1994, p.7). Heritage is perceived as a form of the past and Heritage Studies is as complicated as history itself. It is culturally, socially, regionally and nationally subjective. However, in order to maintain a sense of identity within the society at large, particular for education in archaeology, 'the prescription of mass education' is encouraged by international organisations and professionals. It is argued by some scholars that desirable knowledge should become globalised rather than localised (Benavot, Cha, Kamens, Meyer and Wong, 1991). The development of mass education will be heavily influenced by international organisations such as the World Bank and UNESCO on a worldwide basis where institutionalised ideals are formed (Benavot, Cha, Kamens, Meyer & Wong, 1991). The threat of losing national identity through learning standardised ideology could be avoided by publishing regional or national materials which are referenced to the guidelines provided by the advisory bodies. Finding the most appropriate way for local history and heritage to be taught must consider the needs of locals while following the global trend; this seems to be favourable for the development of heritage education at both community and national levels, and also for the sustainable enhancement of public engagement.

3. Conclusions

Overall, several different approaches have been offered by archaeologists and international advi-sory bodies such as UNESCO aimed to raise public awareness through making archaeology more relevant to people's lives. Increasing public engagement in archaeology, especially in the heritage sector, is crucial for the sustainable development of the field. As education is recognized as an effective tool to promote knowledge generally, heritage education becomes one of the most possible and sustainable ways to achieve a higher quality of public engagement with heritage. Formal and informal learning, onsite teaching and outreach are the various forms of heritage education. They are the bridges upon which archaeologists and those outside the discipline can interact. Enabling the public to understand the nature of heritage and why it is important to preserve and learn about the site. Having such foreseen influences, heritage education is considerably reasonable to set its goal as elevating the level of engagement from the Disengagement or the Awareness and Interests categories, which heritage tourism often achieves, to the Engagement category (see Fig. 5 and Table 1).

The framework for heritage education has been set up by authorities for various levels of usage. Its approaches should not be limited with a certain type of materials, rather, it should be adjustable regarding to different circumstances, with up-to-date information and current crises within the sector. Continual efforts are needed to test, to review, to evaluate the results and then to revise the process of heritage education in order, ultimately, to achieve better community engagement around heritage assets.

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Preservation and promotion of the cultural heritage through University, public administration, and community engagement

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Topic: T2.2 Heritage education and social inclusion.

Abstract
Universities have long been asked to become promoters of actions aimed at increasing society's general level of well-being through interventions with cultural, social, and educational implications via technology transfer and knowledge sharing. Therefore, a mutual collaboration between different researchers of the Politecnico di Torino and local Public Administrations has been consolidated over the last few years in the context of educational and research activities on the conservation and enhancement of the cultural heritage, focusing on vernacular architecture. To provide a proactive contribution in proposing projects to preserve both the cultural heritage and social and economic development of the territories, a new educational methodology with a direct and mutual collaboration of teachers and students with local communities and policymakers was tested. Its primary purposes are to recognize local identities, identify resources and detractors, and define possible trajectories of sustainable development of case studies. Moreover, the projects propose their conservation and enhancement to improve the inhabitants' life quality and protect the local resources through technically and economically sustainable interventions paying specific attention to vernacular architecture's characters, local traditions, territory's peculiarities, potentialities, and critical issues. The results show the central role of establishing an open engagement of the local community and policymakers in complex and sustainable development projects implicating a mediator such as an architect. Hence, it is necessary to reinterpret the "symbolic" values identified by the territorial studies and to signify them (keying) into a restoration project able to frame how the local community identifies itself (framing) towards a model of a sustainable and compatible development project (modelling) for the future recovery of the sites. The case studies confirmed the pivotal role of the universities in educating the students through a multidisciplinary approach towards the complex systems of cultural heritage, engaging and moderating local community instances and the vision of the policymakers.

Keywords: *vernacular heritage, preservation, education, community engagement.*

1. Introduction

The cultural heritage is widely appreciated as an essential part of Europe's socio-economic, cultural, and natural capital. Nowadays, it is recognised both as an innovative stimulant for growth and employment in a wide range of industries and as an essential contributor to social cohesion and communities' engagement with the preservation of their legacy and environment[1]. As underlined by the Faro Convention, the States of the European Council should promote a participatory enhancement

[1] European Commission, Getting cultural heritage to work for Europe, Directorate-General for Research and Innovation, 2015 [https://ec.europa.eu/programmes/horizon2020/en/news/getting-cultural-heritage-work-europe]

process based on the synergistic collaboration of public administrations, private citizens and associations, namely a «heritage community» that, according to the definition given by article 2 of the Faro Convention, «consists of people who value specific aspects of cultural heritage which they wish, within the framework of public action, to sustain and transmit to future generations»[2].

Cultural institutions can play an essential role in this process involving researchers, students, public administrations, and local communities in the design of projects aimed at fostering the preservation, enhancement, and exploitation of the potential of cultural heritage, considered a «resource for sustainable development and quality of life»[3]. In particular, Universities have long been asked to become promoters of actions aimed at increasing society's general level of well-being through interventions with cultural, social, and educational implications via technology transfer and knowledge sharing.

In light of this, it was decided to provide an active contribution in proposing projects to preserve both the cultural heritage and social and economic development of the territories. Over the last few years, with the students' involvement in the "Architecture for the Sustainable Project" master's degree course, research and design activities have been conducted to offer compatible and practicable solutions for the protection and enhancement of the widespread cultural heritage of the examined sites.

Based on the data acquired through the discussions among researchers of the Turin Polytechnic and public administrations, projects were proposed according to the needs expressed by the local community. By paying specific attention to the living heritage, local traditions, territories' peculiarities, potentialities and critical issues, proposals were designed to improve the inhabitants' life quality and preserve local resources through technically and economically sustainable interventions.

2. The examples of Magnano and Romano Canavese

The analysis of the research activities conducted in Magnano and Romano Canavese (small towns of medieval origin located at the foot of the Serra Morenica in Piedmont), offers an example of the methodology adopted and results obtained.

Once the resources and values have been identified and recognised, problems and critical issues were highlighted to discuss the limits to their full appreciation. The presence of numerous cultural resources emerged, such as food and wine traditions (e.g. the Festival of Ides of March and Festival of Pignoletto Rosso Corn), natural resources (e.g. the Bessa' Special Nature Reserve), and cultural events (from the Early Music Festival to educational activities and the International Conferences on the clavichord). Nowadays, these elements are only known locally, while they could be appreciated by a wider audience if properly valued.

The set of the identified cultural assets defines the identity characteristics of these places and their inhabitants and, although sometimes little-known, contribute to defining the specific features of the sites. For a more in-depth knowledge of the relationship between the territories, the inhabitants, and how they perceive the more connoting elements, the direct debate with citizens and public administration turned out to be extremely useful and interesting. It is not possible anymore «to deal [only] with environmental and cultural emerging assets, but it is necessary to [...]

[2] Faro Convention, Convention on the Value of Cultural Heritage for Society, 2005.

[3] Faro Convention, Preamble.

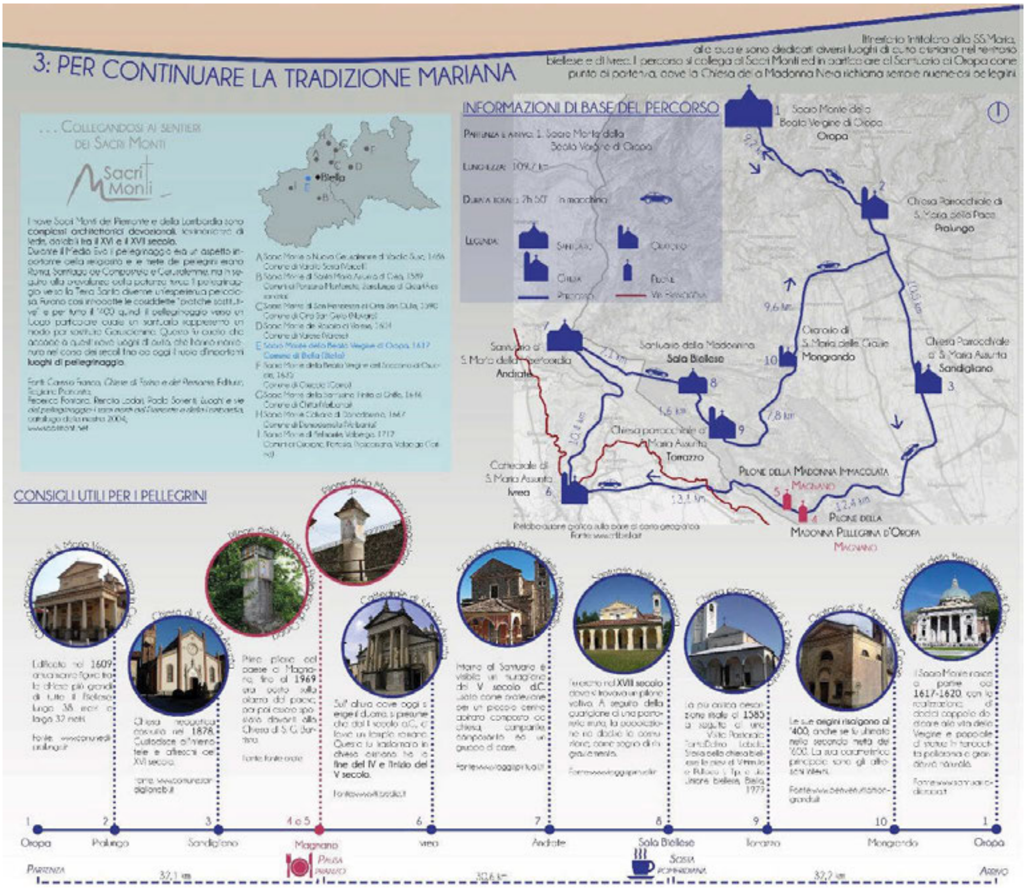

Fig. 1. Analysis of religious itineraries of Magnano’s territory.

go into a new field, still to be explored, where the “expert knowledge” of the different disciplines is contaminated with “common knowledge"[4], of those who daily inhabit the sites. This comparison contributes significantly to the identification not only of the perception that the inhabitants have of the places but also of their «desiders in terms of conservation, management and redevelopment of the landscape»[5]. Furthermore, it provides valuable support in developing possible intervention strategies aimed at safeguarding and enhancing the identified heritage.

The results of the activities conducted in Magnano and Romano Canavese and the evaluation of the preservation status of the existing heritage have revealed the need to promote actions aimed at its protection, focusing the attention not only on single well-known assets but also on the rich and varied set of resources that characterizes these territories. As Cesare Brandi states in addressing the topic of safeguarding the historic centre of a small town, if «in an ancient city the church, the palace, the square are preserved, and all the rest is destroyed, it will be

[4] «più sufficiente – anche se rimane imprescindibile – occuparsi delle emergenze ambientali e culturali, ma occorre […] addentrarsi in un campo tutto da esplorare, dove il “sapere esperto” delle diverse discipline si contamina col “sapere comune”». Una nuova “costituzione” per il paesaggio, in Paesaggio condiviso. Dall’urbanistica al governo del paesaggio, Osservatorio del Biellese beni culturali e paesaggio, 2015, p. 3.

[5] «desiderata in termini di conservazione, gestione e riqualificazione del paesaggio». Nuovi paesaggi da esplorare, in Dal vissuto alle mappe di comunità, Osservatorio del Biellese beni culturali e paesaggio, 2015, p. 3.

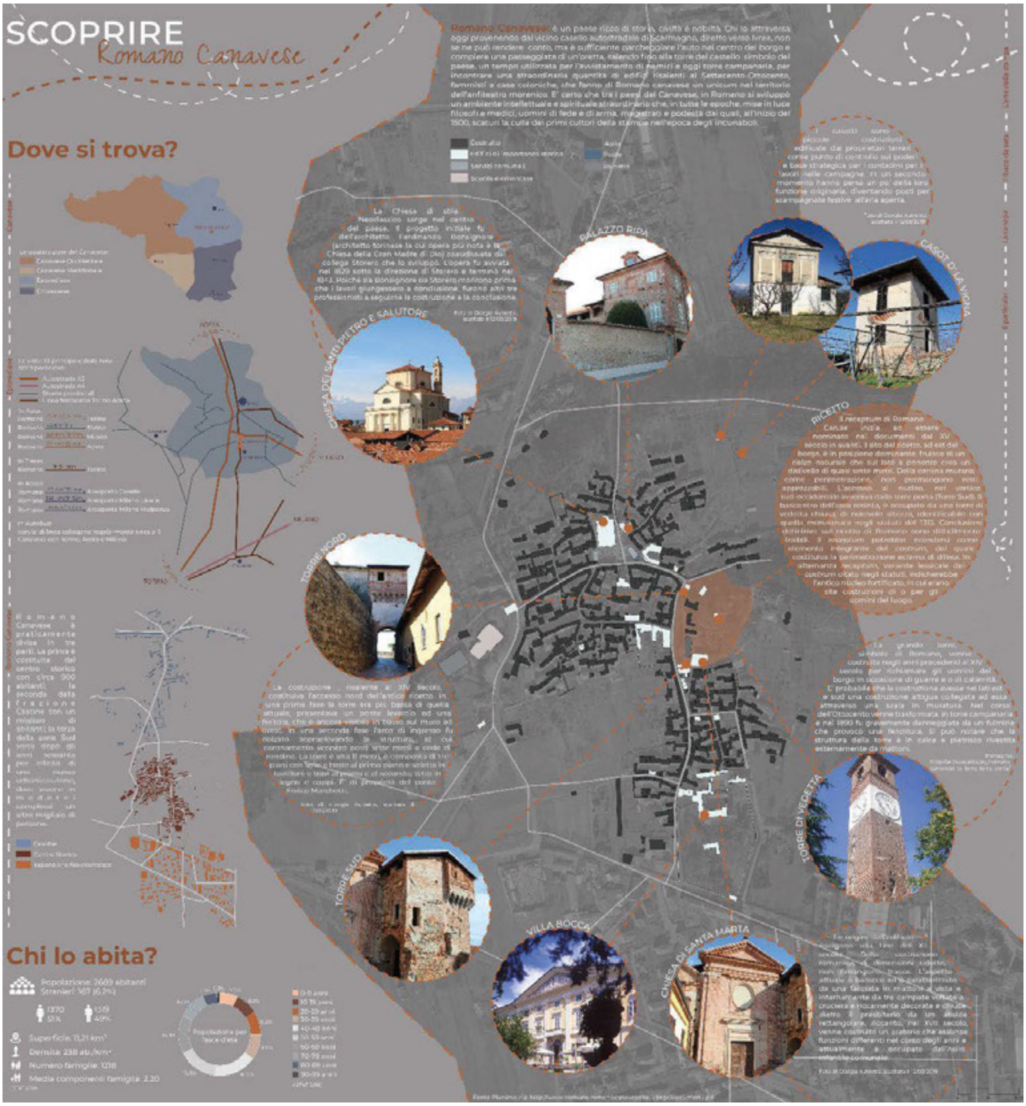

Fig. 2. Territorial analysis and identification of the architectural heritage of Romano Canavese.

like having cut a leg and replaced it with a mechanical limb» (Brandi, 2001, 132). It is, in fact, essential to implement an overall policy aimed at enhancing[6] a broader set of cultural, material and immaterial legacies, which, although fragile, characterise and define the genius loci and could be appreciated by citizens and tourists. It was therefore decided to start from both the insiders (those who habitually live in the places they intend to protect) and the identified cultural assets to arouse the interest of outsiders (such as tourists), who could contribute to acquiring the economic resources necessary to guarantee the conservation of the assets over time.

In light of these considerations, proposals for intervention at different scales have been developed.

[6] As underlined by the Cultural Heritage and Landscape Code, Legislative Decree 42/2004, enhancement represents how it is possible to pursue not only the increase in the use of the cultural heritage, but also to promote its knowledge and, above all, to improve its current and future conservation conditions.

Regarding the territorial scale, the projects provided actions to promote the network of various resources (historical, naturalistic, cultural, food, and wine) identified thanks to also the dialogue with the local community. Therefore, thematic itineraries have been proposed to contribute to the safeguarding and use of the rich cultural heritage made up of single architectural artifacts and other tangible and intangible assets. The hiking trails, highlighting the «excellent points in a plot to travel», wanted to encourage and facilitate the discovery and/or the recognition of the different resources and the attribution «of [...] value to the contexts in which the objects are located» (Lombardi, Trisciuoglio, 2013), crossing the boundaries of the single sites and involving a broader landscape.

On an architectural scale, steps were taken to promote an appropriate and renewed use of selected buildings through interventions that, by accompanying them in their evolution, intended to make them capable of responding positively to current users' needs. The necessary changes were addressed and designed according to conservative requests arising from the ascertainment of the value of the built heritage (Doglioni, 2008). Therefore, in-depth knowledge of the architectural artefacts was firstly undertaken. The study of their history, the analysis of the transformations they have undergone over time, a geometric/architectural survey, analysis of the construction techniques and materials, and their preservation status were performed. Subsequently, proposals were made to promote the "re-signification" of these assets through interventions that, by shaping, transforming, and making them capable of meeting the new potential users' needs, could both foster the restart of the preventive-maintenance process that ceased in recent years and give Them their lost vitality back (Nannipieri, 2014). During the design of the projects, particular attention was paid to compatibility and sustainability aspects. The conservation and re-use interventions should represent an adaptation of the buildings to new needs through the aggregation of new structures that, «indispensable to the new function, [...] [could give] a formal meaning and material, as well as a functional, characterization to the differences introduced in the pre-existing context» (Dalla Costa, 1994).

2.1. The educational process

The academic activities carried out in Magnano and Romano Canavese were the occasion to experiment with an interdisciplinary teaching method based on establishing a close relationship with the local community. The reference model is the iterative application of the "keying, framing, modelling" method proposed by Kroeber (1963), Shils (1981) and Schwartz (2018). As the pedagogical model was derived from the field of social studies, the two courses faced several methodological challenges such as:

- How can the interdisciplinary subjects involved in the courses be put in synergy with the fictional project-based assignment?
- How can the theoretical knowledge of the courses be operatively transferred to the students, and how can they be taught to interact with external stakeholders?
- How can the academic courses show the complexity of a conservation project to the students to critically educate them to become responsible social agents in preserving the cultural heritage?
- As interaction with local stakeholders is a crucial part of the courses, how can the courses prepare the students to answer the question about today's reasons for conservation versus the creation of new architectures?

The interdisciplinary approach developed in the two courses was designed to overcome the dichotomy of teaching and learning conservation (Keally, 2008) through the iterative process of translating the theoretical framework into a project to practice the interlocutory skills of critical thinking (as an effect of the deutero-learning approach, Bateson 1973). The "keying, framing, modelling" pedagogical model was taken as a reference to answer the questions mentioned above, with particular reference to the fundamental

concept of "value" as the keyword driving the fictional projects proposed by the students.
Therefore, they were asked to reinterpret the identified "symbolic" values and to signify them (keying) into a preservation project able to frame how the local community identifies itself (framing) towards a model of a sustainable and compatible development project (modelling) of Magnano and Romano Canavese. The first challenge was related to the definition of what the “value” is today (Scaduto, 2017) for those two territories; in particular, the students were guided to answer the following questions:

- Which are the prerequisites that enable the identified values to be the driving values of the conservation and reuse projects?
- What is today’s validity of the identified values?
- How can the identified values be communicated and explained through the project?
- How can we translate and transfer those values through a conservation project?
- What is the meaning of identifying “value” in today’s global world?
- To whom is the conservation project addressed?
- How can we communicate the limitations of the conservation project in such a way that it can still be valued as an enhancement project?
- What is the public role of the architect in the process of keying, framing and modelling the identified values into a conservation project?

The pedagogical model was used to teach a critical way of reading the pre-existence, its complexity, multi-dimensional values and relationship with the context, as well as the potential for reuse of the artefacts whose rehabilitation is designed from the recognition of their intrinsic values and the relationships woven with the territory, and in particular aimed at promoting social, cultural and economic development by leveraging the potential of the site. A second challenge was related to defining what "reuse" is in a conservation project. If the reuse is critically linked to what is existing and is not a priori data, the students were asked to think about what architectural language can translate the history and its stratifications into a contemporary preservation project that necessarily refers to the conservation and compatible reuse of the artefact as the final result of their activity.

The ateliers started with a public debate in which the local policymakers described their vision for both the cases of Magnano and Romano Canavese, followed by a shared visit to the villages. The main focus of the public stakeholders was on the economic and tourism development of the territory through an integrated enhancement project of their cultural heritage. On the other hand, the primary role of the students was to act as mediators among the instances of the private owners, the territorial vision of the policymakers, and the local legislations, conservation principles, standards and best practices. In doing so, their role as social agents was critical in recognizing the cultural heritage as an “extension of the memorial” (Dal Pozzolo, 2018), and the place from which the community can reconnect to its past through the historical memory triggered by a project that can build a relationship between the population, the landscape, the territory and sustainable development. In particular, students became the primary agents of the heritage's acknowledgment process as a cultural heritage to protect, save and enhance, and they also acquired more awareness of the principles of individual and collective responsibility declared by the Faro Convention[7] for its transmission to future generations.

Firstly, the students conducted a historical and territorial analysis of the tangible and intangible assets of Magnano and Romano Canavese to understand which values were the primary drivers of the preservation project. The study implicated a series of in-situ visits and surveys with the involvement of local communities to define a shared masterplan of the local cultural heritage system. At this stage, the main challenges among the students were mainly related to setting a common understanding of the concepts of social and historical memories, community and personal

[7] See Convenzione quadro del Consiglio d’Europa sul valore dell’eredità culturale per la società, 2005

identities, and values, landscape, restoration, and conservation principles. Once the main guidelines were settled, the students were divided into small groups of three/four to develop a detailed conservation project within the master plan to integrate the architectural heritage case studies into a recognised overall system. Through the iterative application of the keying, framing, modelling method, the students showed their proposals to the local community, obtaining immediate feedback to be readdressed by the next design iteration.

The atelier ended with a shared presentation of the student's works in front of a representative of the Ministry of Cultural Heritage and Activities followed by a public debate as a final moment of check and critical discussion of the driven cultural mediation process.

Taking up the sociological concepts described by Barry Schwartz[8], reinterpretation of the identified values through the three phases of keying, framing and modelling places the student/mediator in a preferred perspective position providing a complete and sophisticated overview concerning the involved stakeholders. The first phase of keying is identified with the territorial analysis, while the second phase of framing corresponds to the data interpretation for the preservation project; the third phase of modelling can be identified as the one in which the students translate their analysis into a project proposal. As per expectations, the most critical stage is the second one, as the framing process implies using all the taught paradigms to understand and investigate the boundaries of the conservation and reuse project (Hoadley, 2006). This process is the critical translation of the theoretical framework into the design practice, where the selection process is the most difficult to be communicated through the preservation project (Hoadley, 2006).

Fig. 3. Poster of the public presentation of the results of the Atelier "Compatibility and sustainability of architectural restoration".

3. Conclusions

The activities conducted fostered greater awareness of the identified cultural heritage values in the local community and the students. Furthermore, the keying, framing and modelling method also contributed to highlighting the importance of the role of students as social agents and mediators to guarantee a multidisciplinary approach in the preservation process and to translate the complexity of the different instances into a project of reuse starting from a shared recognition of the territory's values. The proposed teaching model has indeed facilitated an active involvement of the community and public administration in a complex enhancement process where the University assumed the crucial role of guarantor.

Animated by the desire to become the promoters of a participatory enhancement process, based on the synergistic collaboration of public administrations and research bodies, the proposals were donated to the

[8] See the article in TOTA, LUCHETTI, HAGEN 2018, p. 36-37.

community of Magnano and Romano Canavese. Implementing the interventions planned at the two territorial and architectural levels could actively promote the conservation and enhancement of the cultural resources of the territories selected as case studies and favour the recovery of that sense of belonging that local communities sometimes seem to have lost. They would help to release the lock-up potential of the cultural resources, which can play an important role both in the enrichment of the quality of citizens' life[9] and in the regeneration and sustainable development of the territories.

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Acknowledgments

The tables shown in the article are extracted from the work of the students who attended the Atelier in the academic year 2014/2015, Politecnico di Torino, Master's degree in "Architecture for Sustainable Design", Atelier "Compatibility and sustainability of architectural restoration", professors M. Mattone, P. Davico, C. Bonfanti.

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[9] European Commission, Getting cultural heritage to work for Europe, Directorate-General for Research and Innovation, 2015 (https://ec.europa.eu/programmes/horizon2020/en/news/getting-cultural-heritage-work-europe)

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'Acupuncture of Awareness': a possible path for vernacular heritage preservation

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Topic: T2.2. Heritage education and social inclusion

Abstract
This article describes an approach developed by the author in various international contexts (India, Iran and Brazil) to raise awareness in the community of the importance of documenting and preserving historic areas, comprising mainly vernacular architecture with a very high sociocultural value. Over the last two–three decades, contemporary architectural interventions have undermined the urban setting of many vernacular sites, disfiguring them with out-of-scale projects of questionable quality, transforming traditional spaces and hybridizing historic materials. This article discusses ideas that arose from several years of research and educational projects in extremely dynamic and changing environments such as those of the historic centres of various developing countries. It presents the effects of awareness-raising projects conducted collaboratively in several historic centres by professors, researchers, local authorities, professionals, young scholars and residents. The research underlined the importance of different perspectives on the documentation and representation of cultural heritage–the meaning of which depends on local culture and traditions–in identifying future developments, low-cost methodologies and working tools in the field of education for preserving and enhancing vernacular heritage. Digitization techniques, which were also shared with a less specialized public, played an essential role in establishing a methodology capable of meeting the main knowledge and understanding needs at different levels of depth. The activities conducted and experimental methods applied identified operational processes for analysing, representing and diagnosing vernacular contexts, demonstrating the potential of interdisciplinary activities, including through the use of digital tools. The involvement of the local community proved to be a crucial issue in developing a more shared and conscious approach to preserving vernacular heritage.

Keywords: *Awareness, Documentation, Acupuncture, Historic cities*

1. Introduction

In recent decades, contemporary architectural interventions, especially in developing countries, have hybridized the urban landscape to the detriment of historic cities, affecting both the tangible and intangible aspects of cultural heritage. Historic cities are pervaded by the histories of the communities that have inhabited and managed them. This intangible aspect is the probably the most difficult to adequately preserve and transmit to future generations. Meanwhile around the world, national and local governments, as well as United Nations agencies, the World Bank and regional development banks, have been seeking a sustainable urban development process that integrates environmental, social and sociocultural concerns into the planning, design and implementation of urban management. It is important to stress that this was the context within which, after a first draft in 2010, UNESCO Recommendation on the Historic Urban Landscape came into action in 2011. The Recommendation is contained in a 'soft law' to be implemented by individual UNESCO Member states on a voluntary basis. The recommended activities proposed by UNESCO and its consultants derive from different experiences around the world. Rather than replacing existing conservation doctrines or approaches, they are an additional tool that provides a broader vision for integrating built-environment conservation policies and practices into broader urban development objectives, while respecting the values of different cultural contexts (UNESCO, 2011). The Recommendation summarizes discussions among experts over the previous five years by outlining (and encouraging the use of) six main intervention activities (UNESCO, 2011) defined as crucial for the effectiveness of preservation plans in historic city centres (Fig.1). The Recommendation notes that in light of urban developments, especially rapid growth, both social and physical, we now need a better language for discussing and defining urban settings, analysing problems and proposing solutions that are meaningful and can be measured and monitored (Turner, 2013).

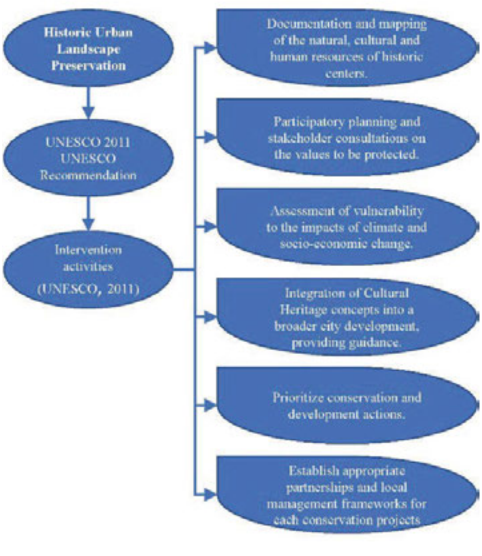

Fig. 1. The activities suggested by the 2011 UNESCO Recommendation on the Historic Urban Landscape (Source: UNESCO 2011).

The six main intervention activities could be summarized as follows:

1-Undertake comprehensive surveys and mapping of the natural, cultural and human resources of historic centres

2-Reach consensus using participatory planning and stakeholder consultations on the values to be protected for transmission to future generations and determine the attributes that carry these values

3-Assess the vulnerability of these attributes to socioeconomic stresses and the impacts of climate and socioeconomic change

4-Integrate urban heritage values and their state of vulnerability into a broader city development framework, providing guidance on sensitive areas that require careful planning in the implementation of development projects

5-Prioritize conservation and development actions

6-Establish appropriate partnerships and local management frameworks for each of the identified conservation projects, and develop mechanisms for coordinating various activities between different actors, both public and private

The concept of historic urban landscape includes the whole local context and therefore goes well beyond the simple definition of a given historic centre. Rather it is composed of characteristic elements such as patterns, spatial organization, visual relationships, soil morphology, present vegetation, including even the smallest urban-scale details such as drainage channels, pavements and public lighting systems. For this reason, specially scaled and targeted digital documentation and heritage protection strategies are required (Barazzetti et al., 2016), especially in countries with an awareness gap regarding the importance of basic historic buildings.

2. Research framework

Tools directed at addressing the protection of this heritage through effective 'capacity-building' campaigns aimed at local actors can open up avenues of redevelopment that do not alter the historical character of a place and direct new interventions in these contexts towards urban sustainability and the protection of pre-existing structures (Bopp et al., 2000). Among the most important initiatives from this point of view is the crucial involvement of young architecture students, who, if adequately stimulated and educated, can approach conservation issues with renewed interest and curiosity, even in countries where the academic syllabus does not include the disciplines of surveying, documentation and restoration. If these future professionals can be made more aware of the potential and importance of preserving cultural heritage, this could certainly facilitate its protection. From these considerations emerges the need for new control methodologies for integrating contemporary architecture into the historical fabric and for effective (sustainable) strategies for preserving older areas, especially in developing countries where conservation issues take a back seat among the countries' priorities, and architectural change is often governed by tourism development (AREF et al, 2009). In their investigations, researchers such as Moore and Graefe (1994) and D. Williams, Anderson, McDonald and Patterson (1995) used attachment, place dependence and place identity as the main concepts on which to base their research. These analyses showed that the functional and emotional experiences of the environment are the most influential in creating a sense of place and place identity. Place attachment is in fact a sense of connection with the historical environment that encompasses both emotional and functional ties. Although one person may appreciate a place because of the physical elements that make it exceptional, other people may not feel strongly attached to the area because they cannot identify with it. According to D. R. Williams and Roggenbuck (1989), the emotional experience of the environment is closely related to the level of attachment a person develops to the place and to what the environment symbolizes. In contrast, functional meanings are mostly associated with how well the place fits a user's needs. As D. R. Williams and Roggenbuck state (1989), functional meanings associated with a place are mostly related to how well the place accommodates a user's needs for specific activities. In practice, users identify a place as most suitable for achieving their behavioural goals. However, especially in more developed emerging economies, the loss of functional and emotional meaning attached to places is facilitated by economic globalization leading to less consideration of local context, culture and history (Wheeler, 2017). Despite this important sociocultural substratum, local institutions have often simply applied market rules to the preservation of buildings. It is time to identify the different actors involved and understand their interests and how they work and interact with each other; all the forces at play must be identified. Legislation is in place in almost all countries but is not enforced by the authorities and, worst of all, nobody knows how to enforce it. The monitoring activities of the inspectors must be strengthened and, at the same time, staff training must be carried out at the different management levels.

3. Research design

From the process of analysing and documenting the historic centres of developing countries and the treasures scattered within their territories, we can learn an important lesson about how cultural heritage in these contexts, both tangible and intangible, is subject to dynamics and phenomena that can slip through the nets of the most traditional management models. The involvement of local communities and construction professionals in the conservation process of historic buildings is of primary importance. For this reason, the inclusive approach proposed in this text aims for all stakeholders to consolidate concepts and knowledge (including through various digital tools at different technological levels) that can contribute to handing down built heritage to future generations, in one of the highest forms of sustainability. It could be figuratively compared to acupuncture, aiming to enhance global awareness of vernacular architectures at worldwide level (Fig. 2). This awareness campaign strategy is based on the use of both low and high levels of technology integration, depending on the main target of each task and the final objective of the project in question. For instance, with the help of private investors, a number of good restoration interventions have been successfully carried out within several historic centres throughout the world (Bjønness, 1992). All that is required it to enhance them, including through targeted technology-transfer initiatives (Rossato et al., 2018). On the one hand, the understanding of the importance of cultural-heritage preservation at different levels and the identification of possible future job opportunities in the cultural-heritage sector should be transferred to high school and university students to increase their engagement in the field. This implies a low level of technology integration i.e. low-cost and affordable activities (such as workshops or small seminars). On the other hand, stakeholders can also be drawn towards the cultural-heritage field through activities based on a higher integration of technology. To this end, the identification of agile and flexible methodologies and low-cost tools (Napolitano et al., 2018) through PhD-level research projects and the engagement of young enterprises could provide great impetus for the creation of international cooperation networks to support the preservation of historic centres. The training of professionals also plays a pivotal role in the conservation of vernacular architecture.

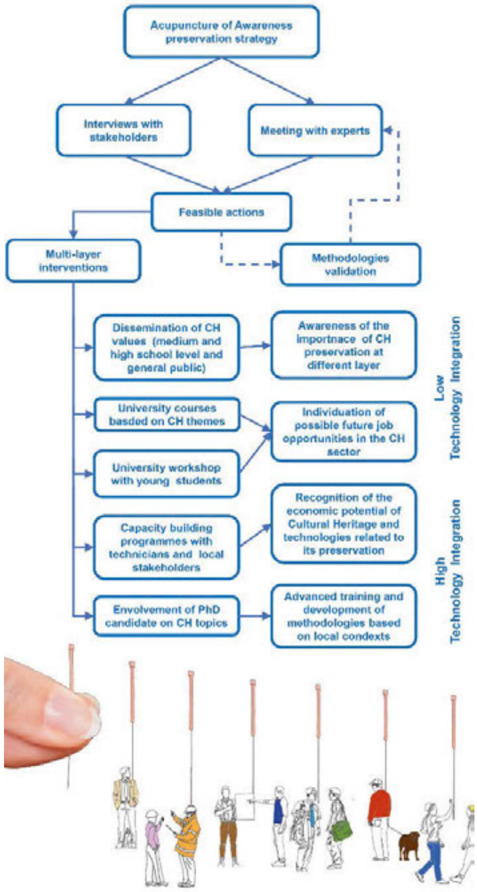

Fig. 2. 'Acupuncture of Awareness', an intervention scheme for an inclusive approach to the documentation and preservation of vernacular architecture in historic centres conceived by identifying possible ways to mitigate challenges posed by the lack of awareness, knowledge and socioeconomic vision. Each action is linked to a technological integration aspect that is divided into low and high level depending on the 'target' of the project (developed by the author).

The skills of freelance professionals and enterprises willing to work on vernacular buildings must be boosted through technology-transfer activities carried out locally in the field and not simply by examining existing literature and best practices.

3.1. Low technology integration

International educational activities (seminars and workshops) on documentation and representation for preserving vernacular heritage demonstrate the value of dialogue between international young students. This is mainly due to their attitude towards representing the layering processes that characterize historic buildings and sites, and to a lesser degree, because of their role as intelligent investigators of the cultural values of existing structures, often forgotten by the general public. These documentation, representation, and evaluation tasks in historic city centres are difficult processes that require a comprehensive approach capable of grasping and incorporating geometrical and spatial qualities, construction technologies and architectural values from both a historical and critical standpoint (Giandebiaggi, 2018).

The author has focused many years of teaching activity on constructing a methodical trail of detailed knowledge to depict both tangible and intangible qualities of vernacular architecture and historic city centre transformation processes, including at several editions of particular workshops. For example, in international teams, the author used low-cost survey approaches and digital tools for representation, exhibition design and urban analysis to enrich and preserve the cultural heritage of Global South countries on an international scale. International workshops such as ‘Along the Silk Road’ (organized in Iran by the University of Wien in Austria) and ‘Historic City Centres’ (organized by the CEPT University in India) have shown that cultural heritage can even captivate young university students if properly presented and promoted (Fig. 3).

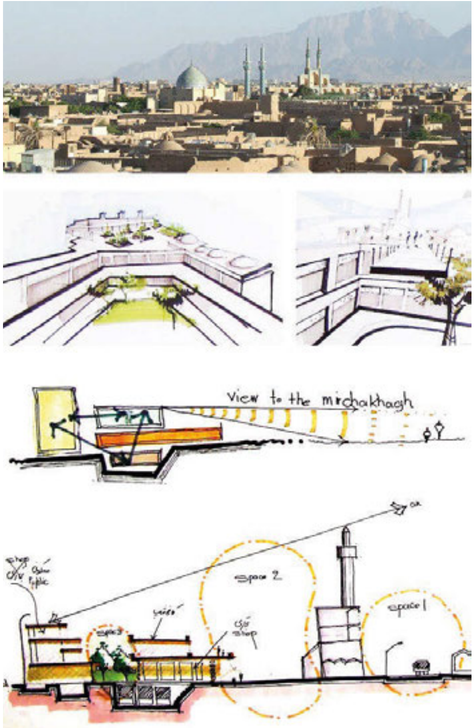

Fig. 3. Isfahan, Iran. Analyses of the historic city centre carried out by Italian and Iranian students, who shared their knowledge and skills to identify possible contemporary interventions in cultural-heritage sites (drawings from the 2009 edition of the international workshop ‘Along the Silk Road’).

There is an urgent need for projects that encourage residents to participate in protecting their cultural heritage, both intangible and tangible, through an approach that could be defined as minimal participation but considered a starting point for further capacity-building and awareness-raising among local people regarding their cultural heritage. The Jodhpur Box, for example, is a basic but effective exhibition based on a 4m×4m structure for displaying documentation gathered over five years by Italian and Indian students at the CEPT University Campus in Ahmedabad. Held in the main courtyard of Mehrangarh Fort (India’s second most visited fort), the exhibition aimed to highlight the beautiful historic residences of Jodhpur’s city centre through the analyses carried out during the international workshops 'Historic City Centres' (Fig. 4). Geometric memory, material data and colours are just a few of the aspects that the Jodhpur Box documented and transmitted, in some cases using 3D models (Fig. 5).

Fig. 4. The Jodhpur Box, an adaptable exhibition staged at Jodhpur's Mehrangarh Fort by Italian and Indian students on the documentation of vernacular heritage. Inside the wooden space, a short documentary film was projected to show the public the intangible aspects as well (rituals, lifestyles, sense of community, etc.).

3.2. High technology integration

The strategy aimed at enhancing traditional management tools by integrating them with digital tools addresses intangible cultural heritage, such as local traditions, cultural behaviours and design processes, which are frequently linked to local cultures and needs (especially in India). The addition of digital or new media to traditional approaches of cultural-heritage management has increased the range of complementary methods that can be used alongside existing ones. Digital media may be used for much more than just recreating or presenting objects. It has the potential to capture the tangible and intangible essence of cultural assets, as well as the society that built or used the sites (Bonnes et al. 2007).

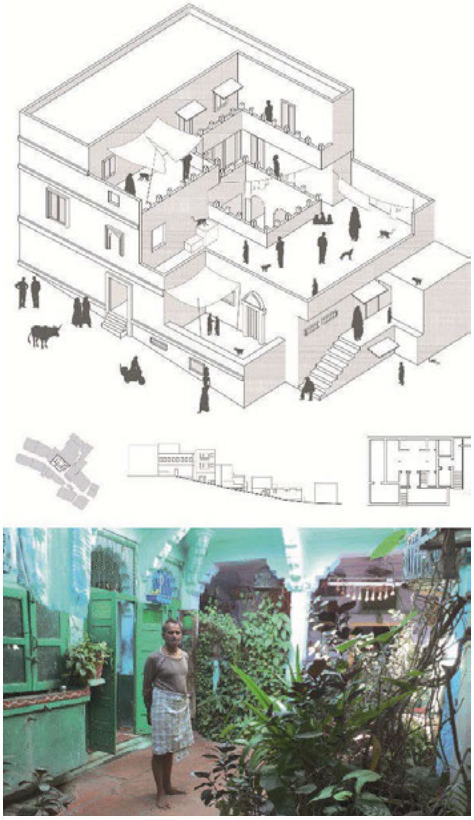

Fig. 5. One of the 3D representations presented on the wall of the Jodhpur Box, depicting a vernacular house in the beautiful 'Blue City' (images developed by students at the 'Historic City Centres' workshop series).

Over recent years, sensitivity and awareness regarding preservation have been raised by the training of local personnel and associated officials in maintenance practices. Staff of universities and enterprises were familiarized with the protection of modern heritage through a combination of classroom activities and on-site demonstrations. In Brazil, for example, the workshop's target audience has expanded to include students, professionals, university lecturers and private conservation firms. These approaches have made substantial gains in the area of architectural restoration, not only in terms of measurement precision and survey time reduction, but also of the ability to depict and visualize historic structures in their surroundings (Bevilaqua et al., 2017).

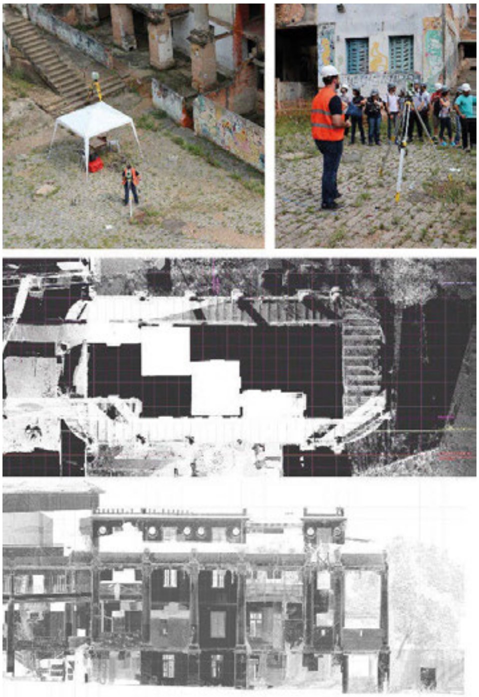

Fig. 6. Workshop on 3D technologies for documenting vernacular heritage at Vila Itororò in São Paulo, Brazil. The audience, primarily professionals and PhD students, had the chance to see how digital documentation could be used for building restoration and maintenance (Images by the author).

Vernacular building such as Vila Itororò, an eclectic house built at the beginning of the twentieth century in São Paulo, could be thought of as an important location for technology-transfer seminars. Here, academics, professionals and students met to discuss the use of digital tools for preserving cultural heritage (Fig. 6). The involvement of Italian private companies in such experiences was a key factor in enabling the technology transfer: all the activ-ities were carried out under the supervision of local staff, and methodological seminars were held during each campaign. In some activities, for instance during the digital documentation of Casa do Anhanguera, an important museum of the small historic village of Santana de Parnaiba in Brazil, a group of local stakeholders went on-site and attended all stages of the project in order to improve their knowledges of the technologies used. In this case study, the survey was carried out over a few days and collected data on the morphology of the building, a seventeenth-century vernacular house and historical-heritage site. It was restored and listed by the National Historic and Artistic Heritage Institute (IPHAN) in 1958. It is typical example of an urban residence and the only one of its kind in the state of São Paulo to have retained its architectural features (Fig. 7).

Fig. 7. Point-cloud image from the 3D database of Casa do Anhanguera in Brazil, highlighting the typical Portuguese colonial roof shape. The short digitization project involved local technicians and professionals to familiarize them with the technology and evaluate possible digital surveys on the most important vernacular buildings of the state of São Paulo (Image by the author).

4. Conclusion

Without a doubt, all other actors involved in the field must interact with local cultures in the best possible way if we are to protect priceless sites in these countries. The populations must be aware of the value of their houses and, above all, that restoration is possible and will not cost more than total reconstruction using modern techniques. At the same time, the technicians of the future (today's architecture and engineering students primarily) must be prepared to act with the most effective tools (Spiridon et al., 2015). Without recognizing the value of vernacular heritage within historic city centres, we cannot protect it: the replacement of ancient heritage by contemporary interventions will be unstoppable, with only the main monuments likely to resist the blows inflicted by progress and new life-styles. Finally, we must work on conserving buildings in such a way that citizens can use them, rather than focusing on conservation for its own sake. The establishment of rigid and economically unsustainable museum sites would lead to the loss of this world heritage forever. The ancient buildings in these agglomerations are like sponges that have absorbed the cultural traditions of populations distinguished by their craftsmanship. As a testimony to their splendid past, these extensive cultural-heritage sites should be upheld as stimuli for new generations to look to the future with pride and hope.

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HERITAGE EDUCATION

HERITAGE COMMUNITIES

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Overlooked heritage of Albania: chronicle of rescue, conservation and community involvement at Great Prespa Lake

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Topic: T2.3. Heritage communities

Abstract

A set of actions, concerning conservation policies, have been undertaken in Great Prespa Lake Region, Albania during the last years. The activities, as presented in this paper, are part of a project driven by European Heritage Volunteers in partnership with the GFA Consulting Group, the Transboundary Biosphere Reserve Prespa Project and with the collaboration of Polytechnic University of Valencia. This joined partnership has made possible the creation of a document "Guidelines for interventions at vernacular architecture at Great Prespa Lake" as following explained. The guidelines are finally aiming to all the villages of the Biosphere Reserve of UNESCO, but the result has been possible thanks specially to the study – in detail – of one of the rural communities located in the region – Zaroshke. The village has been selected and analyzed as a possible pilot project for conservation polices and community involvement, during the summer of 2021, thanks to the participation of local communities and international volunteers (students and young professionals) trough the systematic documentation of vernacular architecture of the village.

Keywords: *survey; heritage polices; data collection; local engagement; community involvement.*

1. Introduction

European Heritage Volunteers has been organising for more than twenty years training courses and volunteering projects throughout Europe that provide education and volunteering opportunities in the field of heritage. Most of them take place in rural areas where a significant number of endangered heritage sites can be found, presenting ideal circumstances for intervention by heritage volunteers. The European Heritage Volunteers Programme is very diverse and includes handicraft-based projects, projects in archaeology, restoration-conservation, and documentation and research as well as projects in historical parks and gardens and in cultural landscapes, and projects aiming towards the revitalisation of abandoned heritage sites (AA.VV., 2019a). The training courses and volunteering projects, each lasting two weeks, are led by experienced craftspeople or other field-specific professionals, and are open to both professionals and volunteers with no previous heritage-linked training or skills.

Fig. 1. Zaroshke surrounded by fields and its relation with Big Prespa Lake (Source: EHV, 2021).

Exchanges between participants coming from different cultural and educational backgrounds make up an essential part of European Heritage Volunteers' concept – students of heritage-linked subjects often obtain their first practical experiences in their study-field during training courses and volunteering projects, whereas they have the opportunity to share their theoretical knowledge with participants who have more hands-on experience. In this frame, sharing the same values as European Heritage Volunteers, Polytechnic University of Valencia was involved in a teaching summer project in order to foster and better understand intangible and tangible values of the Albanian part of the Prespa Lake Biosphere Reserve. This is to contribute to conserve the richness of the cultural frame of the region and to improve polices of conservation, above all concerning traditional and vernacular architecture.

2. A Portrait of Great Prespa Lake Region

The area of study consists of nine villages which together create the Municipality of Pustec and lay on the western and southern shores of Great Prespa Lake, South-East Albania (Fig.1-2).

Geomorphologically the area is divided from the mainland by the nearly 1.100 meters high Zvezda Mountain pass which could be passed till recent times only by a simple road what led – in combination with the during the second half of the 20th century strictly controlled border to former Yugoslavia in the north and to Greece in the east – to a quite isolated situation of the area (Fremuth, 2015). This isolation led to a high level of self-sufficiency and the conservation of traditional agricultural structures; the fact that the area is – in difference to the mainland – populated by Macedonians to a strong local identity (AA.VV., 2019b).

Fig. 2. Location plan of Zaroshke (Source: EHV, 2021).

In result, the Great Prespa Lake Area comprises a rich and diverse set of vernacular architecture which can not be found in other regions of Albania. This concerns traditional residential buildings, but in particular smaller vernacular edifices (AA.VV., 2011). This rich material heritage goes hand in hand with a rich immaterial heritage: the traditional techniques and crafts used to create the vernacular architecture.

However, both the material and the immaterial heritage are endangered to disappear due to several reasons: the traditional agricultural structures are eroding – cattle breeding and subsidiary agriculture will probably die out soon since the people currently practicing them are in their sixties or seventies; the need for economic development and the hope for raising tourism brings pressure which is not adequately balanced by the needed regulations, and the vernacular buildings and edifices are not appreciated by the local population, since they are understood as part of the everyday-life.

Fig. 3-4. Examples of rural buildings and still alive traditions at Zaroshke (Source: Cristini, 2021).

On the other hand, just the vernacular architecture of the area bears a big potential to keep and strengthen the local identity as well as for the touristic development of the region. In fact, if the value of the vernacular architecture would be well understood and conceptualised, the Prespa National Park could be the only national Park in Albania which attracts visitors by a combination of natural heritage and cultural heritage (Fig. 3-4).

Such a concept could be further developed when underlining the linking elements between the protection of the natural environment and vernacular architecture as it is the case by the use of natural materials, traditional handcrafts and sustainable techniques.

3. Vernacular identity of the region

The villages of the region have a special link with a rich set of local raw materials. Clay, rocks, timber and fibers are deeply present in all the traditional constructive details of rural architecture, due to the rich geology and special environment offered by the Prespa Lake. Historically, before World War II, the houses of the villages have been built prudently far from the shores of the lake, respecting a special plot system (Klein 2018; Stiller 2019). Builders were used to work with lime carved stone blocks (or adobes, above all used for auxiliary buildings) with modest cubature, not higher than one or two levels of structures.

Timber ties were also used, both vertically and horizontally, to add breaks within walls. This made the wall more flexible to prevent cracks and make the structure earthquake resistant (Kallamata, 2018). Traditional curved tiles were hung on top of the framework of the shed/gamble roofs in parallel rows, with each row overlapping the row below to prevent rainwater from dripping inside (AA.VV., 2007).

Above all in auxiliary buildings and storages (for forage or animals' shelters) wattle and daub structures were guarantying simply volumes with thatched roofs, made up with local canes and fibers. These materials, as simply sticks or waved in more complex structures are also visible in fences and divisions of historic plots and properties. After World War II and the establishment of communist system, constructive activities and actions borrowed from Soviet Union started to change the urban and architectural planning of the villages (Fig. 5).

Above all during 1960s, 1970s, 1980s the social change plus the progressive migration from dwellers of isolated villages to big cities increased a certain policy of abandonment of traditional constructive techniques and local constructive know-how.

The period after the 1990s has also not contributed in conservation policies. The renewal approach of the state has not helped conservation of vernacular architecture (Müller, Munroe 2008). Lacks of rules, lack of protection lists and minimal professional requirements are factors that have brought massive individual constructions. Buildings without any link with local architecture have started to fulfil the region, with new dwellings that have no link with autochthonous constructive features.

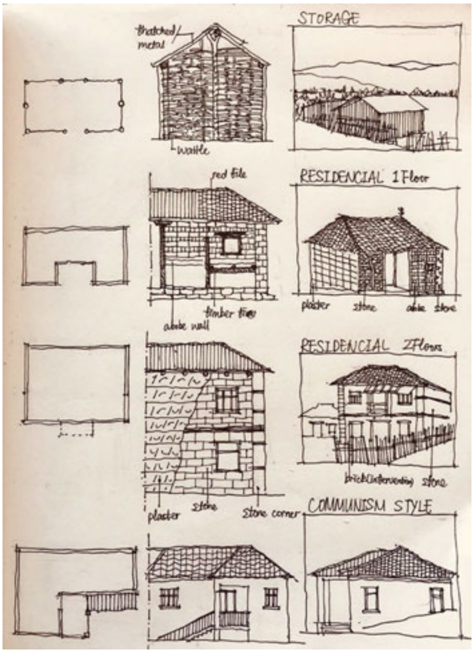

Fig. 5. Classification of local buildings "typologies" (Source: EHV, 2021).

Fig. 6. Data collection in collaboration with local dwellers (Source: Cristini, 2021).

Volumes, cubature, roof structures, openings, colours and textures among others details are absolutely in contrast with inherited constructive techniques by existing architecture.

Only in the last decades a certain interest for domestic architecture has started, also due to creation of Prespa National Park, as well as a general more conservative polices approach for the full region and its intangible value.

4. Methodology and goals of the training course

The training course was a follow-up of several European Heritage Volunteers Projects in Albania. During the years the NGO got familiar with the challenges for the vernacular architecture in the villages surrounding Great Prespa Lake and developed the idea of the European Heritage Training Course for 2021.

Thanks to the support of Polytechnic University of Valencia a methodological approach was possible in order to classify all the rural buildings of Zaroshke. This is one of the nine villages in the Great Prespa Lake area with the smallest municipality in Albania and the only one with Macedonian population – and who have altogether around 3,000 inhabitants.

The village has been chosen due to comparable well-preserved rural edifices in the village on one hand and the expected pressure for economically-caused interventions due to the village's position directly at the shore of the Great Prespa Lake on the other hand. In this frame ten young heritage professionals plus instructors, with support of institutions active in the region and local inhabitants have started to classify the sectors of the entire village defining the mapping of buildings built before World War II with historic constructive techniques.

All these pre selected buildings (150 case studies out of more than 300 buildings) have later been analysed with a special detailed set of templates.

This classification was possible thanks to interviews of local owners (Fig. 6), with technical visits at the properties and with a selection of pictures to better understand the state of art of the case studies. A common tangential analysis of constructive techniques (walls, roofs, plasters, fences, openings etc.) was finally undertaken, in order to better understand possible problems linked to further maintenance guidelines (Pompejano, 2020).

Fig. 7. Planning of work with volunteers (Source: Cristini, 2021).

5. Outcomes of the training course

The training course and the creation of a rich data base are key factors that further made possible the creation of complete guidelines (Fig. 7). Thanks to this document the village Zaroshke shall be projected as a whole, to maintain its traditional layout, historical style and features, and spatial dimensions.
The guidelines are insisting in that all intervention or development shall conserve or enhance the existing relation between the village, the natural landscape and environment with which it coexists (Scalet et al., 2014).

To promote development that acknowledges the unique traditions, culture, history and character that defines Zaroshke, the urban plan should have following objectives:
- To promote development that reinforces the value, the quality and the diversity of Zaroshke's vernacular architecture;
- To maintain and promote relatively low-density and small-scale development;
- To promote development that enhances the existing links between Zaroshke and its natural surroundings.

The recommended measures in this frame are stressing the roles of urban planning, regulations for new buildings, general conservation measures at historic residential buildings, general handling of smaller edifices, general handling of wall and fences and traditional paths (Aliaj, 2007). The final dossier counts also with maps, templates and details (Fig. 8-9), in order to recognise and a quick classification of interesting buildings at different scales.

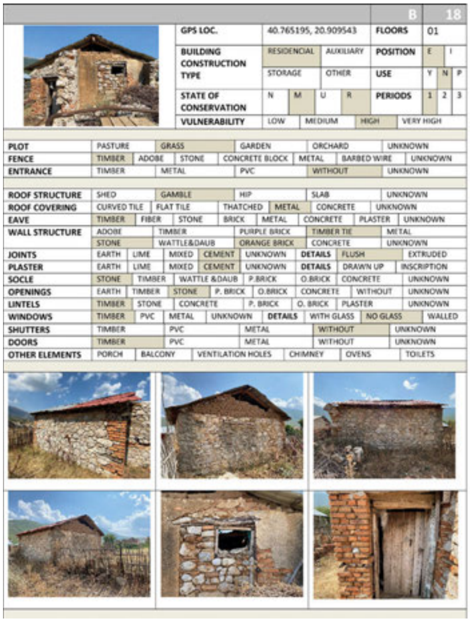

Fig. 8. Example of classification template (Source: EHV & Cristini, 2021)

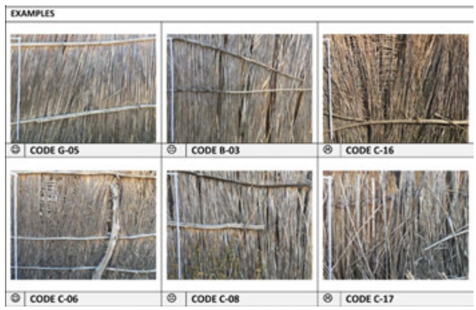

Fig. 9. Example of details collection data base (Source: EHV & Cristini, 2021).

6. Final discussion and conclusions

In Zaroshke village and in other villages of the Prespa Lake Area a big number and a high diversity of smaller vernacular edifices have been conserved. However, their situation is highly endangered. This is caused on one hand because their construction is quite vulnerable and fragile, on the other hand by the fact that the traditional agriculture with a high level of self-sufficiency is expected to terminate soon since it is currently mostly practiced by people older than sixty years. Finally, the smaller vernacular edifices are endangered because they are not understood by the local community as valuable, but as a part of their every-day life (Fig. 10).

Fig.10. Final exposition of Volunteers' work in collaboration with local authorities and GFA Consulting (Source: Cristini, 2021).

A positive aspect of the aforementioned non-appreciation of these structures is that – in difference to the residential buildings which have been mostly drastically modernised during the last to decades – the auxiliary buildings are, except some smaller repairs in one or the other case, nearly completely free of recent interventions. Assuming all these aspects, the most important aim of the training course was to raise awareness among the local population and the local administration concerning the value of these structures and to understand them as an essential part of the region's material heritage. In addition, these edifices are closely linked with various forms of immaterial heritage – given by their use for the subsidiary agriculture, but also by the applied traditional construction techniques. Finally, their conservation bears relevant potential for the touristic development of the village.

Acknowledgments

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The appropriation of traditional houses in Imbros/Gökçeada

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Topic: T2. 3. Heritage Communities

Abstract
This paper explores the transformation of locality in relation to vernacular architecture on the former Greek island of Imbros (Gökçeada) in Turkey. The people of Imbros were forced to leave their homeland due to a state-initiated policy of Turkification that started in the early 1960s. The structural evolution of the traditional Imbriotic House came to a halt due to the forced immigration of the Imbrian people. Today, the material remains of houses in villages contribute to heritage capital, while allowing returnees a chance to critically reflect on their tangible heritage. The paper aims to understand changes in the built environment and its cultural and historical contexts and records the contemporary architectural applications of the social transition of a rural community in a global age. The study shows how traditional houses are 'modernized' by 2nd and 3rd generation returnees of the Imbrian community, in line with the changing needs of their inhabitants, and questions how the local identity is reproduced by the heritage community. By analysing the spatial modifications of the typologies and the construction adaptation of the buildings, the study examines which architectural components are kept and/or changed in order to preserve the "local identity" in everyday life on the island today. The paper compiles preliminary findings based on ethnographic field research conducted in 2018-2019, which yielded qualitative data from oral narratives and participatory observations, and also uses the data obtained from architectural research tools. Focusing on the reconstruction of old houses by returnees from the Imbrian community, this paper showcases the appropriation of vernacular architecture in a contested area in relation to locality.

Keywords: *vernacular architecture; locality; local community; people-centred heritage practices.*

1. Introduction

Together with the neighbouring islands of Thasos, Samothrace, Limnos and Tenedos, Imbros is part of the unit known as Thracian Sporades (Fig.1). Located near the entrance to the Dardanelles, Imbros has been a part of a well-connected network of cultural, social and material exchange and played a strategic geo-political role throughout history.[1]

Fig. 1. Imbros in the INT Nautical Chart of the Aegean Sea.

[1] The ancient name of the island was Ἴμβρος (Imbros or Imvros), but it was called Imroz under Ottoman rule before the Turkish state renamed the island Gökçeada in 1970. The Greeks of the island refer to the island as Imvros and describe themselves as Imvrii, or Imvriotes. As a sign of respect for their self-identification practices, in my research I use the original name "Imbros" for the island and "Imbriot/Imvrii" for the Greek people of the island.

In the aftermath of WWI, the 1923 Lausanne Treaty recognized the borders of the Republic of Turkey and defined the two Aegean Islands – Imbros and Tenedos – in Turkish territory. Articles 14 and 40 of the Treaty declared an "autonomous" status for both these islands and demanded that Turkey guarantee the protection of the religious and cultural affairs of the Greek minorities on the islands under its rule. However, in the nation-building processes of Turkey, the Imbrian sense of belonging based on locality was considered a misfit to the homogenous identity constructions of twentieth century nation-states (Babül, 2006; Halstead, 2009). The people of Imbros have undergone long-term strategies of oppression, othering and discrimination under national policies. By all accounts, until the 1960s, coexistence between the 8,000 Greeks and less than 300 Muslims on the island of Imbros was relatively peaceful (Alexandris, 1980). However, this changed with the rising of Greco-Turkish conflicts in Cyprus in 1963, coinciding with unrest in Imbros (Tsimouris, 2001). Although the Imvrii had no organic connections to the Cypriots, their Greco-Christian ethnic identity labeled them as allies of the Cypriots and as a potential threat to the Turkish nation (Alexandris, 2004).

From 1964 to 1974 the Turkish State embarked upon a strict restructuring programme of 'Turkification' on Imbros. The establishment of a military battalion in 1964 defined the island as a frontier territory and acted as physical evidence of the annulment of the autonomous status granted by the Lausanne Treaty. This was followed by discriminatory measures, such as the closure of Greek schools on the island, which directly affected Greek families and prompted their first large migration wave. In 1965, the state expropriated 90% of Greek population farmland to build a state farm, the State Production Farm – Devlet Üretim Çiftliği (DÜÇ). In 1966, a semi-open prison with a capacity of 1,000 inmates was established to provide the manpower needed on state-built farms. Accounts from the Imbrian side accuse state officials of overlooking the free entry of convicted criminals into Greek villages, which led to increased crime and unrest in the community. Eventually, various acts of violence encouraged by the ultra-nationalist Turkish politics of the time forced the native islanders to leave their homeland.

In 1970, a government decree renamed the island as *Gökçeada,* replacing Greek toponyms with Turkish ones. Strategies such as topographical renaming, cadastral re-mapping and regulative re-zoning of the island (eg. heritage sites and conservation areas) have followed the expropriation of the land of Imbrian people, disrupting their everyday lives and their livelihood practices in the land. In this regard, the Imvrii felt that the conservation acts of the 1980s, which established their fields and villages as conservation areas, were instrumental in allowing the state to expropriate and monitor their properties. They perceived the heritage regulations as constraints for the further development of the community and argued that, other than binding construction restrictions, there were no concrete guidelines for conservation. This perception was further strengthened by the state-initiated construction of new settlements in the conservation areas, bypassing the law (Ercan, 2020). From 1980 onwards, thousands of Anatolian mainlanders were moved against their will to these new settler villages, drastically altering the demographics of the island. While the Turkish population gradually reached 8,000, there were about 300 elderly Greeks left on the island (Tsimouris, 2011).

In the early 1990s, the military status of the island was rescinded and the open prison was closed definitively in 1992. The island was declared a first degree development area and advertised as a site of tourist attraction. This shift to tourism encouraged the transnational diaspora community to return to the island for the annual Panaygri[2] celebrations and to reclaim their expropriated properties during their visit (Tsimouris, 2014).

In the early 2000s, during the economic crisis in Greece, Imbrian associations promoted the homecoming project which provided financial support to expatriates wishing to re-settle in Imbros. The re-opening of Greek schools in 2013 and 2015 guaranteed the return of families with children. In the last decade, the number of Greek returnees has increased to 550. However, only some Imvrii have settled back in their old stone houses in villages, as most returnees prefer to live in a more urban environment and have rented apartments in the centre of Gökçeada. The rural houses were heavily damaged, destroyed or in a dilapidated condition.

Although the material remains of the houses provide accurate data on early typologies and traditional construction techniques, they are not sufficient to reconstruct them to their original condition. Today's builders on the island (mostly Turkish or Kurdish settlers) simply do not have local knowledge of traditional construction techniques. Also, the agricultural lifestyle of the Imvrii has changed in essence and their experience in large cities has led to greater urbanization. Furthermore, most Imvrii could not afford to rebuild or restore rural houses. Therefore, the modernization of dwellings is considered critical to the continuation of a living community. In this context, Imbros is a contested heritage site, struggling between conservation of the past and the functioning of everyday life today.

In an examination of the "Imbriotic House", introduced as vernacular architecture of Imbros by Pasadaios (Πασαδαιού, 1973), this study focuses on the structural modifications of traditional houses made by returnees in an attempt to understand the re-appropriation of local architecture by the Imbrian community. It shows how local identity is produced through people-centred heritage practices in a material world in the age of globalization.

[2] to Panagyri (το Πανηγύρι): (to Panagyri tis Panaghias) is the biggest Greek-Orthodox religious festivity celebrated on 15th of August for the Assumption of the Virgin Mary.

2. Methodology

The preliminary findings detailed in this paper and based on ethnographic field research conducted in 2018-2019 have yielded qualitative data from biographical narratives and participatory observations as well as data obtained from architectural tools (sketches, photography, drawings, etc.). Following an inductive methodology, ero-epic conversations, and semi-structured interviews with key informants in the community helped to establish criteria for case studies. The data collected via group interviews conducted in collaboration with scholars from other disciplines in the field were cross-referenced. This interdisciplinary interpretation method provided a multi-layered understanding of the research subject. Further qualitative methods such as "thinking aloud" and "walking interviews" with local residents of Imbros were helpful for understanding the native perspective on landscape as well as on local houses. Individual homeowners gave tours of their houses, detailing the past uses, modifications and present uses of the dwellings. Additionally, a literature review of historical records for Imbros and detailed archival research were conducted at the Imbros Association in Athens and at Imbros Union in Thessaloniki.

3. The "Imbriotic House"

Pasadaios (1973) put together a detailed inventory of local architecture in Imbros and coined the term "Imbriotic House." He linked the historical and regional origins of the local houses to the rural Thracian houses in the mountains on the one hand, and their characteristic architectural components to those of mainland Anatolian tradition on the other. His study was based on an accurate analysis of a sample house named after its owner, *Koutoufus,* enabling a deep understanding of the spatial organization of the rural community of a certain period.

Koutoufus' house was a rectangular stone house with a north-south orientation. It was built on two floors, each of which consisted of a single room. Pasadaios defined this single-room house as belonging to the *monospiti*[3] typology.

The ground floor (Fig. 2), named *katoe,* was used for storage or as an atelier for the professional activities of the owner. The upper floor, called *anoe,* was the family residence, where everyday life took place. Each floor had a separate entrance and the residential unit was only accessible via a *petraskala*, an exterior staircase. The stone walls of the *katoe,* around one metre thick, provided the cool and humidity free environment necessary to preserve household supplies. There were no windows — just a small opening called *thyr'daki* on the east wall for ventilation. Big clay amphorae with a diameter of 100-150 cm and a capacity of 150-400 litres for olive oil or wine were buried halfway in the ground during the construction of the foundations. In most cases, the floor of the *katoe* was covered with treated soil or with stone and slates as a continuation of the courtyard floor. The *katoe* had a very low door with a maximum height of 1.80 m, the same distance as between the ceiling beam (*misodoki*) and the earthen floor. The wooden container, *ambandi,* was used to store olives, while other traditional items, such as wooden troughs called *skafes,* were placed and stored in the *katoe.*

In the *anoe* (Fig. 3), a single step of 10-20 cm called *seki* divided the upper floor into two levels: the upper house and the lower house. In Imbros the lower house is known as the *papoutslouki*[4], a place where occupants take off and set aside their shoes before washing their hands at a rectangular ewer-stand or *laenoustat* (Λ) holding a jug of water. The upper house, used as a sitting and dining area in the daytime and as a place to lay down sleeping mattresses at night, is accessed with no shoes on.

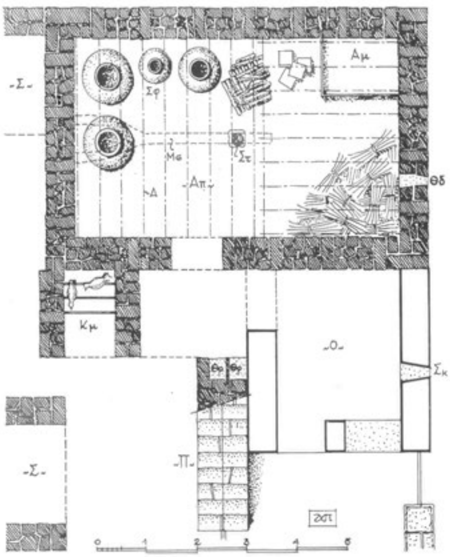


Fig 2. Koutoufus' House: Katoe (Source: Pasadaios, 1973).

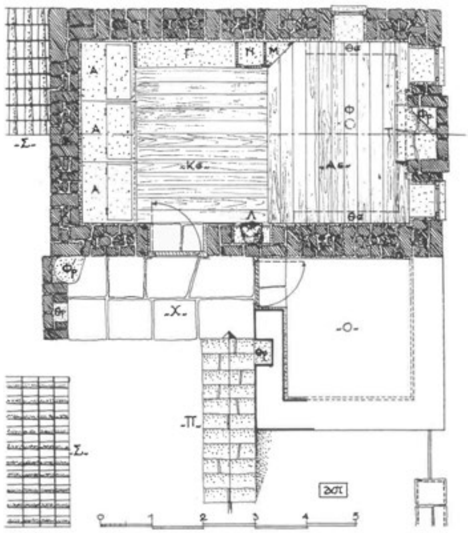
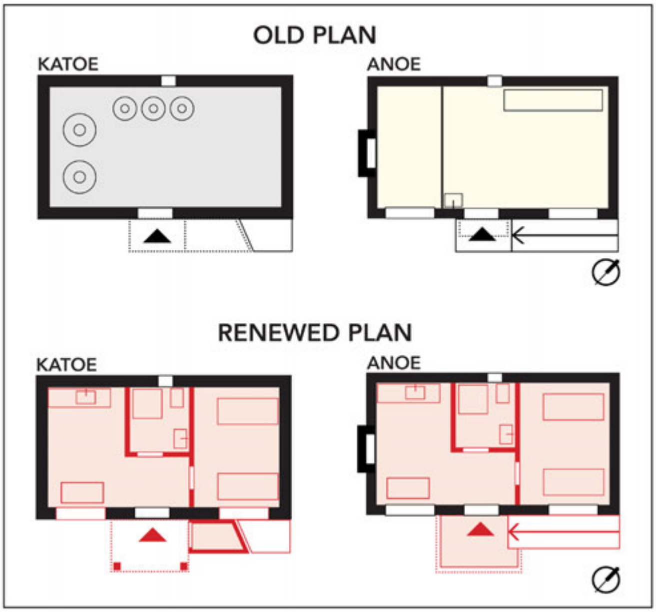


Fig 3. Koutoufus' House: Anoe (Source: Pasadaios, 1973).

[3] Gr.(pl.) *mono-spiti*; translated as single houses, descriptive of the single-room typology.

[4] Architectural terms derived from Turkish and some from ancient Greek which only exist in the Imbrian dialect. In this case; gr. *Papoutslouki* derives from the Turkish word *Pabuçluk,* meaning, "place to put shoes" (Tzavaras, 2011).



Drawing 1. One case study: The House of Agathe — drawn by the author.

The furnace was placed on the east-facing wall and was used for heating and cooking. The fittings traditionally found in the *anoe* were a large wooden cupboard, *goukeri*, for the storage of all belongings, including mattresses, as well as a granary or *ambari*, and a *thesi*, a wooden shelf on the furnace for ingredients.

4. Returnees' Houses

The Superior Council for the Conservation of Cultural and Natural Property designated old Greek villages as conservation sites under the category of 'urban site' of the second degree in 1991.[5] These regulations prioritized 'preserving the historic architectural and urban fabric of Imbros' and allowed the interiors of the houses to be transformed. It was stipulated that the materials and forms used in the reconstruction of local houses should be compatible with the initial building structures. These conservation regulations, which were perceived as restrictions to the further development of villages, were viewed as a state-monitoring instrument for property issues within the Imbrian community. As the Imbrian practices of locality transformed, they manifested in the social organization and materiality of the built environment, especially vernacular architecture.

After examining more than eight reconstruction projects in Greek villages, the case study selection depended on the typology being equivalent to the traditional houses described by Pasadaios. Other criteria required the homeowners to be natives — born and raised on the island — who had emigrated abroad and returned to settle back into their childhood homes. After years of living in apartments in the cities, the returnees sought the living standards to which they were accustomed. Some Imvrii were fiercely opposed to the image of the "peasant community" as the experience of migration had led to the formation of a fragmented community of the transnational diaspora. Their urbanized habits and desire for comforts of modern technologies were also embodied in the constructional and structural modifications of the rural houses (Drawing 1).

[5] Decision no. 1932, 15th August 1991

When rebuilding their old homes, the returnees seemed to follow a series of unsystematic practices. The first major change observed in these traditional homes was the adjustment to the scale of the interiors. The room height on the first floor previously used for storage, 1.80~2.00 m, was considered unsuitable for residential use by the returning owners. As a result, in the reconstruction, floor heights were raised to 2.20~2.50 m, a scale similar to city apartments. In addition, the upper floor was extended by lifting the roof construction approximately 30~40 cm and adding three to four rows of bricks to the masonry walls, whereas the ground floor was dug about 30~40 cm into the earth on the ground to increase the inner volume. As these actions did not affect the external appearance of the houses much, they were easily permitted.

The second change made was the integration of modern sanitary facilities, such as closed bathrooms and modern kitchen layouts. These modern installations were an essential requirement of the returnees. Therefore, the one-room houses were now divided into rooms fulfilling different functions, and occupants got their own private individual bedrooms. As a result, the one-room layout of the Imbriotic House changed completely and the indoors lost its hybrid function. Local houses could no longer be described as belonging to the *monospiti* typology.

Newly added interior rooms required the modification of the original stone façades. Some openings, such as windows and doors, were added and directly incorporated on the construction site, resulting in a variety of geometrical forms which veered away from the more traditional ones. Building permits for new features such as these were considered problematic, but were permitted as long as they did not aesthetically impair the unity of the texture.With these changes, the house was legally registered and physically connected to a state-monitored grid infrastructure system, including power lines, water and sewer systems, and satellite antennas. By gaining these technical installations the local house lost its self-sufficient character and became interconnected with global networks.

All these modern installations were produced with industrial materials. In addition, sandstone masonry was bonded using cement mortar; the handmade clay tiles were replaced with industrial tiles; and old clay chimneys were covered with manufactured tin pots. Old furnaces were often converted into decorative electric fireplaces and all wooden windows replaced with imitation wood plastic window frames. For outdoor furniture, the Imvrii chose plastic chairs and tables that were ‘easy to clean’ and ‘cheap to replace.’

In addition to this modernization process, the Imvrii have also preserved numerous inherited artefacts and the material remains of the old houses.Traditional architectural components and items of the past were deliberately collected, repurposed and integrated into daily settings. Some old items were refurbished and put on display for decoration in the houses, whereas others were recycled or up-cycled. In short, they actively fulfilled multiple secondary functions. For example, an old wine amphora could be refurbished and modified to become a barbecue grill in a garden while an old loom spindle was re-assembled as a towel rack and placed in the new bathroom. Pre-industrial items were utilized as mnemonic traces of the past that assembled a memory network in the present (Hodder, 2012).

Artefacts and architectural components of the past were entwined with everyday life settings in an attributive manner (Jones, 2007; Harrison, Schofield, 2016); they provided material settings for references which nurtured the collective memories of social groups, strengthening their narratives in the construction of their identities and communities’ sense of belonging to the place (Halbwachs, 1950).

5. Conclusions

This study examines the island of Imbros ’ transformation of locality in a historical and socio-political framework that is inseparable from its built environment. The re-making of local architecture by the native community primarily depends on the political and economic context of a larger network in a globalized age. The recent disruption of everyday life caused by the ultra-nationalist politics of the sovereign state, initiated a conscious sense of place (Tuan, 1980) and a desire for heritage among the Imbrian community. Today the returnees have the opportunity of "re-constructing home" in a critical way of heritage-making.

The case of Imbros resembles a contested heritage site that struggles between conservation regulations of the nation state and the continuity of local life in today's reality. Smith (2006) and Waterton's concept of an 'authorized heritage discourse' from their book *Uses of Heritage* could be used to further analyze this native gaze. The appropriation practices of the native community are considered as people-centered heritage-making that shows how the multi-temporality of place is created in physical settings. The place becomes a palimpsest in a processual re-making by those who, in creative and interpretative ways, carefully integrate the traces of the past in an attributive manner in the present and retain them for the future (Lowenthal,1985).

The research calls attention to the temporality of the concept of vernacular architecture — as a snapshot of a structural organisation of a society in a certain period — and it frames the idea of heritage as a processual, creative, social process, rather than a merely focus on material conservation (Ashworth, Graham, 2007; Harrison, 2013). This perspective enables heritage to be understood as a correlational multiplicity that evolves in its social (immaterial) and physical (material) environments.

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The SDGs as a useful tool in vernacular architecture management: The case of "17 objectives and a map"

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Topic: T2.3. Heritage communities

Abstract

The Sustainable Development Goals (SDGs) contribute to unite cities, organizations, local governments, and people networks, sharing transformation policies and challenges for the future of the planet. At present, cultural heritage is widely recognised as a fundamental pillar in the achievement of the SDGs in the coming years. Focused on people and their work to place culture, education, heritage, art and social development as a focal point, a project has been developed by the hand of the Jaume I University (Castellón). "17 objectives and a map" is a project based on the 17 SDGs, wich emphasizes the importance of traditional crafts, construction techniques and the heritage conservation to achieve the global goals. The history of construction shows that vernacular architecture have always been creative in adapting and optimizing buildings using the local resources available to fulfill people's needs in the best way. In this process -in a natural and sustainable way- climatic, economic, social and cultural factors have been taken into account. During the first phase of the proyect (years 2020 and 2021) workshops where heritage communities exchanged experiences and good practices improving mutual learning, were developed in a playful and fluid way, identifying and extracting SDG messages from different projects. With the help of specific designed toolkits, heritage communities became aware of the importance of sustainable actions to transform the heritage future. After several months of workshop, the results of this first phase served the participants to review their projects from an SDG perspective and to restructure some points of them in favor of a more sustainable future. Also, the results constituted an excellent starting point to work, in a pioneering way, in the field of the SDGs from a heritage perspective.

Keywords: *cultural heritage, sustainable development goals, participation, heritage communities*

1. Introduction

In 2015, all UN Member States adopted 17 Goals as part of the 2030 Agenda for Sustainable Development (UN, 2015), planning to achieve the Goals in 15 years. The Sustainable Development Goas (SDG) are, broadly speaking, a call for action to protect the planet and put an end to poverty, a priori unattainable. This global purpose must be achieved at all levels, not only as an objective imposed by central governments (global action), but also it should involve local governments, cities and local administrations and authorities (local action) as well as, and more importantly, involve society (action by people). UN also established the importance of people to achieve the objectives. In this scenario, everybody should be taken into account, since without people, associations or civil society, the SDGs could just finish being a simple list of intentions[1].

[1] Data obtained from the United Nations (UN)

The SDGs were a revision of the Millennium Goals, which were formalized in 2005. There were 8 goals and, at that moment, the role of culture was completely ignored.

1.1. SDG and culture

In the revision carried in 2015, the United Nations Educational, Scientific and Cultural Organization established that culture was the fundamental axis to articulate the 2030 agenda (UNESCO, 2014). Culture had a decisive role to play in the SDGs: each of the 17 goals could be considered in some way relevant to culture.

The research presented aims to demonstrate how small communities play a key role in the implementation of the SDG, although often, they are not aware of it, it also plans to sketch a list of lines of action and good practices to improve and measure their efforts. This study could be considered a permanent observatory framework of the SDGs in the cultural heritage sector.

Cities are hives of ideas, culture, science, productivity for social and economic development. Citizen participation is essential to preserve the historical heritage of cities as it is a key agent in the governance and management of them. For the purpose of the work, participation has been measured in the heritage communities, including both public and private stakeholders working on value-sharing practices of cultural heritage.

2. Heritage communities in rural environments

The depopulation of rural areas is a problem that affects a large part of the so-called developing countries, Spain among them. With the overcrowding of urban areas due to the feigned improvement in employment opportunities and the consequent displacement of the population, the smaller provinces and especially the interior villages, have been facing exponential losses of its younger inhabitants, for decades, generating aged and emptied towns.

This rural exodus affects the economy of the area, the basic services for its inhabitants and the maintenance of material and natural assets. Consequently, the cultural and natural heritage results unprotected, abandoned and little by little, ruined. It should pointed out that, until a few years ago, traditional or vernacular architecture was considered second-class heritage scattered throughout the territory in comparison with the first-class monuments that enrich large cities. This "emptied Spain" generates a devaluation of the rural world, a shortage of appreciation for the rural heritage value that requires an increase in effort in citizen concern and participation.

The province of Castellón is a good example of this. According to data (INE, 2021) it is made up of 135 municipalities, and 86% of them are settlements of less than 5,000 inhabitants and 19 of them less than 100.

Experts point out that the demographic recovery of these areas and the safeguarding of their cultural heritage requires the coordination of special strategies between neighboring populations achieving a more efficient use of resources. Experts also recommend to implement measures that generate benefits for the inhabitants generating specialization strategies that capitalize on their singular resources, basing the identification of opportunities on the specific resources of depopulated areas.[2]

The approach on citizen participation can, partially compensate the lack of public resources, since active communities contribute to the quality of life and well-being of local people through work and action. Above all, it can be a element of social cohesion, generator of cultural identity and pride of belonging (Ministerio de Asuntos Exteriores, Unión Europea y Cooperación, 2018).

[2] According to the Action Plan for the implementation of the 2030 agenda of the Government of Spain, in its analysis of SDG11 highlights that "there is a marked aging of the population and a high rate of rural depopulation" and poses several challenges. http://www.exteriores.gob.es/portal/es/saladeprensa/multimedia/publicaciones/documents/plan%20de%20accion%20para%20la%20implementacion%20de%20la%20agenda%202030.pdf

Among those active communities that rescue, emphasize and claim the regeneration of their territory in this work, those that work for their heritage are highlighted: "people who value specific aspects of cultural heritage which they wish, within the framework of public action, to sustain and transmit to future generations" (Faro Convention, 2005).

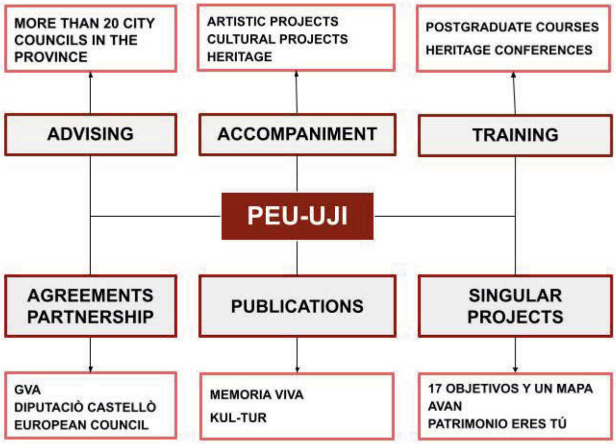

Fig. 1. Main lines of action and distribution of the projects (Source: Author based in data from PEU-UJI, 2022).

Faro Convention (2005) defined the concept of "heritage community" in such a way that it remains inextricably linked to the definition of cultural heritage. In the context of the Faro Convention Action Plan (2018) the definition was enhanced as self-organised, self-managed groups of individuals who are interested in progressive social transformation of relationships between peoples, places and stories, with an inclusive approach based on an enhanced definition of heritage (Faro Convention, 2005).

Depopulation is a fact. But so is the existence of a multitude of projects managed by heritage communities dedicated to the regeneration and safeguarding of rural areas.

3. The work of University Extension Program PEU-UJI

Since 2006, Jaume I University of Castellón, within its University Extension Program (PEU-UJI), manages a project called "Patrimoni". PEU is a transversal program that, for more than twenty years, has presented the work of the university in the territory, under guidelines of democratization and expansion of access to it in cultural fields. In this way, the work of PEU-UJI, which works from the territory for the territory, becomes a vehicle for communication, cooperation and university approach to the existing social context in populations of less than 5,000 inhabitants. PEU-UJI currently has more than 50 lines of work active, wich were born from the demand of citizens´s groups of these rural areas. This groups appeal to public university´s works for that irrefutable reality of depopulation of areas in the interior of the province, and the consequent lack of protection of its rich cultural heritage.

Therefore, it is not a project derived from a research exercise, but rather it is a service (facilities, professionals, public infrastructures) for the heritage communities that request it. In this way, a mutual commitment was born to reflect and evaluate the proactive and horizontal networking between local stakeholders the technicians of the university.

The *Patrimoni* project, born in 2006 within the PEU framework, focuses on the pedagogy of heritage through a model of accompaniment and technical assistance as well as the definition of common spaces for reflection, debate, sharing and search for heritage management appropriate to each local group (Portolés, 2019). It is a collective process of revaluation of cultural heritage and citizen dynamization in rural environments.

Patrimoni works in the territory, a collective process of revaluing cultural heritage while seeking citizen involvement through dynamic actions in rural environments. Each town works at a certain rhythm and intensity, so each of these processes is unique and unrepeatable. The towns involved today in *Patrimoni* project through a collaboration agreement are Cirat, Costur, Culla, Benlloch, Montán, Mas de Noguera (Caudiel), Sant Rafel del Riu/Barri Castell (Ulldecona), Sot de Ferrer, Suera, Teresa, Todolella, Vilafranca, Vilanova d'Alcolea, Viver and Xodos.

A network of specialists, researchers and friends of the project work together with them so that this work system is articulated according to the recommendations of the Faro Convention: administrations, professionals and civil society join forces as intervening agents in relation to cultural heritage (Schoebel, 2018).

In addition, *Patrimoni* is an agglutinator of projects in the field, in such a way that it establishes alliances between each one of the accompaniment processes, obtaining common denominators for all of them, in such a way that it coordinates and generates supra-municipal projects and, sometimes, international. Some of these projects are: "#peopleplacesstories" created for 2018 Cultural Heritage Year to define together the concept, value and complexity of cultural heritage, "Los Taulons" a project which gather people from both sides of the river Sènia with the aim of developing heritage actions together or "Tota pedra fa paret" from La Fontanella cultural association in Costur created for the dissemination of dry stone tradition. Occasionally, the goals to be achieved in the development of these projects that encompass different teams/communities are difficult to measure, and the scope and involvement of the heritage communities could be blurred.

In the case of the experience with the *17 objetivos y un mapa* project[3], the work tried to quantify all these common objectives. As Fernando Prieto (2020), director of the Sustainability Observatory, explains, "what is not measured cannot be improved". In this case, a work methodology is used to obtain concrete measurements and then employ them to improve implementation of the SDGs in the patrimonial territory.

4. Field work

The work is based on a general objective, implement the Sustainable Development Goals in all the projects that are part of the PEU groups, both in current and future practices, activities and processes.

The specific objectives to be achieved with the work are:

- Approximate the objectives of Sustainable Development and the 2030 Agenda to the social work communities of the PEU, breaking down the goals of each one of them and establishing relationships between SDGs and heritage.
- Identify goals and SDGs that characterize the work of the participants in the territorial sphere based on initiatives, actions and good practices of the different groups.
- Raise awareness among participating groups and communities about the need for all agents to work together and the potential of their actions to achieve a fairer, more inclusive and sustainable world.

[3] https://17ods-peuuji.com/

- Reach future commitments from the different communities to align their processes with the SDGs and work to achieve the specific objectives (Fig. 2).

Fig. 2. Participation process with members of PEU UJI and "Cultura y ciudadanía" from Ministry of Culture (Source: ARAE Patrimonio, 2020).

The starting point is disparate. While some participants, mainly those directly related to public administration, are familiar with the SDGs and have incorporated them into some of their daily practices, others are not familiar with them. Therefore, a flexible methodology is proposed to facilitate the indicated objectives and that adapts them to the circumstances of the participating groups.

One of the difficulties that the project has needed to resolve is the restrictions derived from the Pandemic caused by COVID 19. The work was initially conceived as a series of face-to-face participatory workshops, but the existing socio-sanitary situation in March 2020 led to a reformulation of the project and the methodology, adapting it to the circumstances existing at that time, taking advantage of the possibilities offered by technology today, but without giving up the physical tools that allow the sense of touch to be used in decision-making

4.1. Phase 1.1. Preparation of work material

A work kit (Fig. 3) was sent to each participant by snail mail It consisted of a dark blue hexagon envelope of heavy weight paper, symbolizing SDG 17 (Partnerships to achieve the goals), within which 17 tokens were included, one from each SDG. Follow-ing Zero Waste Philosophy, plastic waste from the workshop of a Valencian artisan was used for the tokens. The envelope included instructions for use and a QR that allowed direct access to the 17ODS-PEU UJI website created as a support resource for the project.

Fig. 3. Toolkit sent to all participants (Source: ARAE Patrimonio, 2020).

4.2. Phase 1.2. Work of associations

Using the toolkit received and with the support of the website, which helped them to understand different targets of every goal, each group worked on their own in the identification and analysis of the goals and objectives that were already part of their internal and external work processes. The internal work consists of discovering its strengths and weaknesses, and tries to identify them aligned with any of the SDGs. The participant's external job is to uncover opportunities and threats, and then try to aligne them with some SDGs. These analyse could be improve in the future work processed.

The first part of their work consisted of extracting 4 or 5 SDG in favor of which the organization, community or administration were actually working on. Then they selected the tokens and pasted them on the provided hexagon (around the central circle).

The second part of the activity consisted of becoming aware of the objectives that they would like to work towards throughout next months and place the tokens of those 3 or 4 goals outside the hexagon, like satellites. Participants shared their results with the community in different Social networks with the hashtags #ODSterritorio and #ODSpatrimonio (Fig. 4).

Fig 4. Example working process toolkit (Source: ARAE Patrimonio, 2020).

Subsequently, organization and participants worked on the results with the aim of understanding the interests and common points among the participants and promote effective public, public-private and civil society partnerships.

With the data collected, a big range of statistics were created to help to summarise the information.

The data showed that the heritage communities and other stakeholders work contributes in a wide range to the achievement of the SDGs, although there are a series of objectives that stand out above the others.

With the statistics created, the percentage of people who were already working on each SDG was extracted. Thus, it became apparent how some SDGs stood out from the others. For example, more than 70% were already working in their projects with the perspective of SDG number 5, *Gender Equality*..

In a general view, is possible to see in the general charts (Fig. 5) wich SDGs are the ones that are currently most worked by the participants. 4 *Quality education* and 5 *Gender equality*, and the work trends, those SDGs in which they would like to work in the future: 12 *Responsible consumption and production* and 15 *Life on land.*

Other way to analyze data is extracting results for each SDG, it allowed to note the importance of a given SDG in the activities of the participants. It's possible to see the relevance of number 4

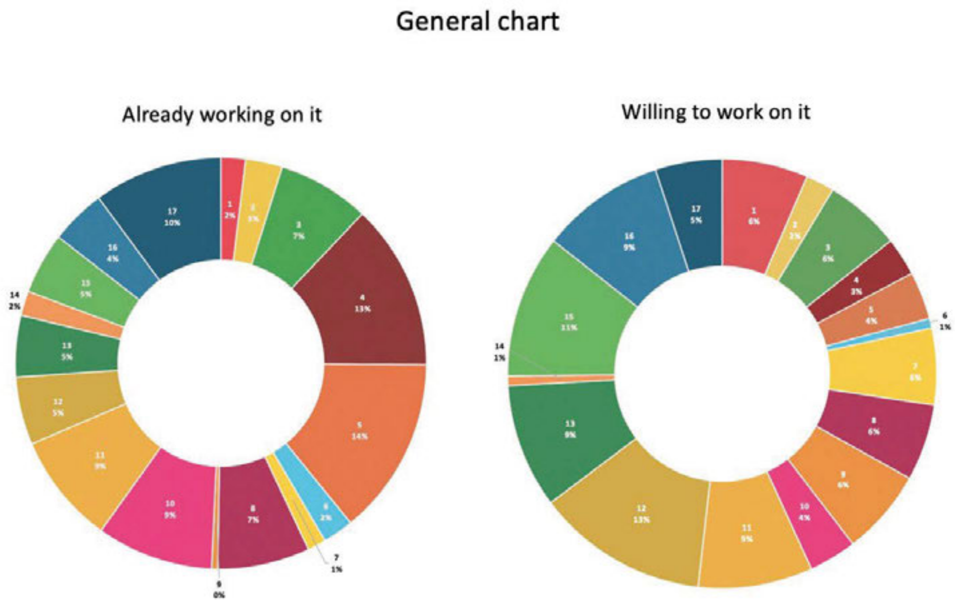

Fig. 5. Pie charts about percentage of people who were already working on / willing to work on each SDG (Source: ARAE Patrimonio, 2020).

"Quality Education" in the current practices of the different teams -more than 70% of participants were already working on it- or the future trend in working on SDG number 12 "Responsible consumption and production" (Fig. 6).

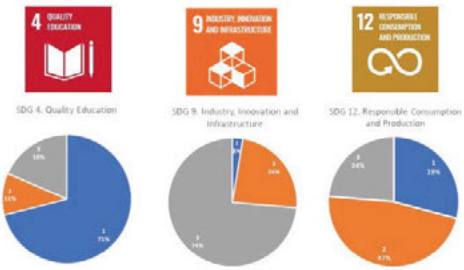

Fig 6. Pie charts extracted from the responses of participants in phase 1 (ARAE Patrimonio, 2022).

With the aim of understanding the real interests of the participants, current practices and future ones were analyzed, obtaining those SDGs with stronger presence in the participants. It allowed the organization to connect groups from different fields but with similar interest in SDG in micronets where stakeholders could share ideas, Best Practices, debate about how to focus on SDG , how to measure progress in one SDG or target etc. As can be seen in Fig. 7, Objectives 4, 5, 11, 12 and 17 stand out above the rest.

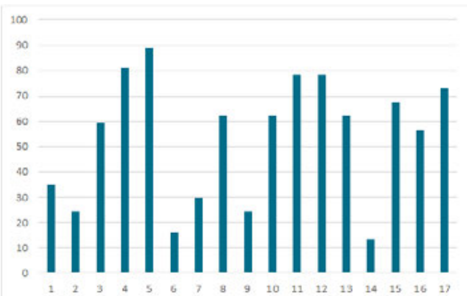

Fig 7. Statistics about SDG (% of people) interested in each SDG (already working + willing to work on it) (Source: ARAE Patrimonio, 2022).

4.3. Next steps. Phase 2

The project is currently beginning its second phase, with the main objective, after the conclusions obtained in the first one, of creating synergies that contribute to social and cultural transformation and enhance this multi-stakeholder partnerships -from different fields but with similar interest- that could share knowledge, ideas, experiences, etc. to support the achievement of the sustainale development goals.

After this first phase, it corresponds the establishment of a series of indicators, of valid quantitative or qualitative standards, that allow the monitoring and evaluation of the work carried out in each of the proposed goals. It will help the stakeholders to measure the degree of achievement of the proposed objectives.

5. Conclusions

The first phase of work allowed us to involve the community in the work in favor of a more sustainable, egalitarian future, through analysis, awareness and training on the goals related to their projects.

Specific resources and methodological tools were provided to allow individual reflection and team working, and each agent expressed their commitment to work on the SDGs from specific lines.

The results obtained in the first phase made it possible to understand the interests of the parties and to focus on those SDGs with which the different groups mostly identify. This allowed to formulate future work strategies that facilitate the continuity of the project.

After knowing and verifying the whole process of work of the heritage communities and their commitment, the aspiration in the current second phase is to build own indicators, in collaboration with these services and heritage communities, to make the hidden face of cultural heritage values visible.

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An Odyssey to Heritage Education: The Inspiring Example of Bergama and Its Communities

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Topic: T2.3. Heritage communities

Abstract

Heritage education constitutes an agenda that has an increasing influence and priority within the current conservation discourse. It is mostly because the notion of this specific type of education itself is not merely a provider of expertise anymore. On the contrary, it is a potential future-making tool whose target audience spreads to all segments of society, emerging generations in particular. By systematic theoretical foundation and applied practices, goal-oriented and innovative educational strategies may easily develop new methods of dialogue and inclusion that generate place-based bonds by propagating more sources of information. In the case of Bergama, or Pergamon and Its Multi-Layered Cultural Landscape as inscribed in the World Heritage List in 2014, the above-mentioned possibility is particularly relevant. As heritage education has become a widely recognized priority for the city, many studies have been carried out by local communities and institutions in line with a common vision. A systematic framework and the main principles of heritage education have been structured in a participatory manner. The heritage of the city, in this regard, has aimed to be transformed into an educational actor itself. This study aims to present the case of Bergama with regards to its pioneering potential in heritage education and communities, in connection with academia, whose guidance starts with the inventory of the urban cultural heritage and progresses with the nomination and inscription on the World Heritage List, and the subsequent capacity building process. Vernacular architecture, as the most fragile heritage with its tangible and intangible values, is also discussed in this holistic context. Following the traces of good practices and sharing broadening experiences provide a general understanding in a relatively new field while demonstrating an inspiring example in the wider context.

Keywords: *heritage education; heritage communities; Bergama.*

1. Introduction: Positioning Heritage Education in the Current Discourse

Education, either formal or informal, is a process by which one develops abilities, attitudes, and other forms of behaviour that have value in society (UNESCO&IBE, 2007). As a transformative tool that equips people with the necessary skills, education can take place in different places, conditions, and times.

Heritage education, on the other hand, is a specialized form of education in the field of conservation. Con Aguilar (2020) argues that definitions of heritage education examine the phenomenon under two main dimensions: content and teaching-learning strategy. However, it can be asserted that in many cases, the educational potential and the knowledge obtained by the heritage are closely intertwined. The inclusion of heritage at all levels of education, not necessarily as a subject of study in its own right, but as a fertile source for studies in other subjects becomes more meaningful in this sense (CoE, 2005).

This process may generally refer to acquiring knowledge and attitudes, developing the reasoning and judgment skills with regards to conservation (ICOMOS CIF, 2018). This education is fundamentally necessary for the search for one's full and comprehensive development with regards to all his/her capabilities and dimensions (Fontal Merillas and Marín Cepeda, 2016). Related capabilities, either existing or potential, can be realized and/or enhanced by directly experiencing, examining, analysing, and evaluating cultural heritage (Sciacchitano, 2018). Hence, while traditionally referred to as academic-based specialist knowledge, heritage education as we understand it today has a much broader connotation. This connotation takes advantage of the possibilities offered by lifelong learning as well as the evolving communication tools and is of interest to many actors at different levels. In this framework, Mendoza, Baldiris, and Fabregat (2015) argue that four heritage education models can actually be mentioned: teacher-centered, learner-centered, content-centered, and context-centered. Cody and Fong (2007), on the other hand, point to the necessity of fieldwork, collaborations/ partnerships, multi/ interdisciplinarity, global-local dichotomy, and community participation in association with heritage education. Likewise, shared historical knowledge, national identity and social cohesion, and active citizenship (Şimşek et al., 2013), as well as values, bonds, and memory as social and heritage-based ownership (Rivero et al., 2018), are among many of the concepts that can be linked to heritage education. As a result, the concept becomes one of the most central and weighty issues of current conservation discourse.

This paper thus aims to shed light on heritage education through the case of Bergama. This interesting example marks an odyssey that led to a systematic heritage education approach that has been gradually structured with various local actors. The study, therefore, addresses the exemplary aspects of a distinct and place-specific journey while researching what the fundamental and primary heritage education principles can be.

2. Bergama and the Role of Communities within the Context of Heritage Education

The city of Bergama is a multi-layered heritage area that assembles the traces of the Hellenistic, Roman, Byzantine, Ottoman, and the Republican Era of Turkey. These layers intertwine uniquely to constitute today's built environment and epitomize a rare physical and cultural integrity, where various elements formed under the prominent topography of the city. It has not only welcomed different religions, cultures, arts, and traditions but has been one of the leading cities of civilization throughout its history. In this remarkable environment, daily life and, accordingly, heritage-community relations continue to be actively shaped. Therefore, the area was included in the UNESCO World Heritage List in 2014 with its outstanding universal values.

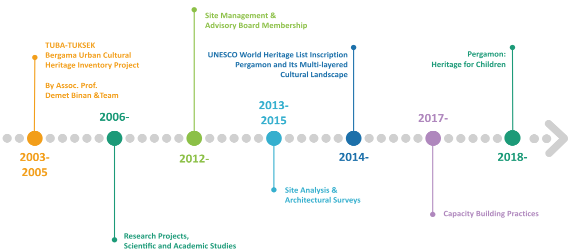

Table 1. Bergama and The Odyssey

It is a less well-recognized fact that the city is also an intriguing example due to the heritage education studies that have been carried out, particularly in recent years. These studies are twofold. First are those brought to life through the efforts of volunteers, local leaders, and community members. For instance, the "Historical Timeline of Bergama" designed with the leadership of a local primary school principal is among the first to come to mind. In addition to making the timeline available for use in all schools, the same principal and volunteer teachers have also made it a common tradition for their students to visit local heritage sites each year. Even more strikingly, the team made a pioneering effort to establish an educational history museum in their school's garden. Bergamalı Kadri Museum of Education History, named after a local linguist from Bergama, is a reuse project of a 19th-century school building restored by the Bergama Municipality. It is also noteworthy that prominent institutions of Bergama supported this project, and it later won an award in the region.

In this sense, the second contribution can be referred to as institutional. There are many well-established institutions that are contributing to the field either individually or in cooperation. In addition to well-respected universities, actors such as the German Archaeological Institute have been conducting ongoing studies in the field. These institutions, along with their direct contribution to the conservation of the area, are involved in comprehensive education and training activities aimed at acquiring professional skills and expertise.

The collaborations of Bergama District Directorate of National Education in recent years in order to expand heritage education at all levels are also remarkable. For example, conferences and projects for school principals, social studies, and history teachers as well as on-site narrations and field trips for teachers in cooperation with the German Archaeological Institute are important activities in terms of the education of educators. Learning sessions at Bergama Museum, which were implemented for more than 1300 students in cooperation with the Bergama Museum Directorate, is another pillar of these practices. Likewise, site visits and innovative on-site practices for students with the contributions of various actors including academicians and NGOs should also be mentioned in this sense.

In this context, it is also appropriate to focus on Mimar Sinan Fine Arts University Department of Architecture Conservation Division[1], another prominent actor that takes an active and invigorating role. Elaborating ongoing contributions from the institution's perspective may better illustrate how heritage education has become a key focus of the local conservation agenda.

2.1. The Odyssey

"The Odyssey" borrowed from the well-known association of a neighbouring land in the first place, is also quite suitable for describing the works carried out by Mimar Sinan Fine Arts University Department of Architecture Conservation Division in Bergama to date. The journey first started in 2003 with the "TÜBA-TÜKSEK Bergama Urban Cultural Heritage Inventory Project" led by Demet Ulusoy Binan, and continued with the participation of the Conservation Division members and graduate students, in a period spanning nearly twenty years. The institution has been contributing to the area with regular site analyses, inventory of registered or unregistered cultural assets, and preparation of architectural surveys, restitution, restoration projects. The process has been supported by various research projects, publications, exhibitions, and other dissemination activities.

Comprehensive field studies carried out in 2012-2013 and 2015 focused particularly on the fragile traditional fabric of the city. This fabric

[1] Both authors work in this division and have been actively involved in field studies of different scopes carried out in Bergama.

mainly includes two types of vernacular houses based on their different formal and structural characteristics: "traditional houses" that belong both to the Turks and to the non-Muslim minority and "houses with Western influence" generally constructed by the non-Muslims from the second half of the 19th century onwards (Ulusoy Binan, 2016). As shown in Fig. 1, they are of priority conservation, are at risk, have high authenticity but are structurally in poor condition. In this scope, the surveys, restitution, and restoration projects of 30 assets were immediately prepared and submitted to Bergama Municipality for the approval of the Conservation Board[2].

Fig. 1. Two types of vernacular houses in Pergamon

Additionally, a master's thesis (Karcılı, 2009) was prepared under the consultancy of the author (Ulusoy Binan) on the conservation of traditional houses, where vernacular architecture is most common, and contributed to other studies carried out in this process. Later on, the author also published a Turkish-German book on the issue called *"Bergama Urban Cultural Heritage Inventory and Analysis"* (Ulusoy Binan, 2018), which again was supported by important local institutions.

Two more postgraduate studies can also be mentioned in this regard. The first is a master's thesis (Pekvar, 2018) about Taşhan, one of the prominent monumental structures of the area. The second is a doctoral dissertation titled *"Capacity Building and Participation in the Conservation of Multi-layered Cultural Heritage: The Case of Bergama (Pergamon) City"* by Okyay (2022), one of the authors.

Furthermore, efforts to raise international scientific awareness regarding the definition and holistic conservation of the area as a multi-layered cultural asset should be underlined particularly. It is noteworthy that these studies (Binan and Binan, 2008a; Binan and Binan, 2008b[3]) systematically started before the nomination process and were presented at the ICOMOS General Assembly and Scientific Symposiums in order to open the multi-layered identity up for international discussion. The studies continued with the publications (Binan et al., 2014) prepared with the same approach in the nomination process.

In the same manner, it was also shared with the Ministry of Culture and Tourism that all layers are indispensable in the context of multi-layeredness of the archaeological, tangible, and intangible values of the area. In addition to the above-mentioned publications, a booklet (2014) has been collaboratively prepared by the members of prominent institutions, again including Mimar Sinan Fine Arts University. This booklet, *"Pergamon and Its Multi-layered Cultural Landscape"*, was presented to the World Heritage Centre in June 2014 by the Ministry of Culture and Tourism and the Turkish UNESCO representatives. As a result, the area has been inscribed on the World Heritage List not only with its archaeological values[4], but as a multi-layered cultural landscape with all its periods.

As exemplified above, Ulusoy Binan, and Mimar Sinan Fine Arts University, have been

[2] The municipality then applies for funds and grants for the implementation of the approved conservation projects with the cooperation of other relevant institutions.

[3] This presentation was later published as a book (Binan and Binan, 2009) of selected papers.

[4] At the initial report (ICOMOS, 2014), it was stated that justification of Outstanding Universal Value does not cover the Ottoman period, therefore, the boundary of Component 1 could be adjusted to represent the Hellenistic and Roman remains, while the Ottoman town was covered by the buffer zone.

actively involved in the World Heritage site management uninterruptedly since 2012. This process, which even began before the inclusion in the UNESCO World Heritage List, has required a devoted and consistent contribution to the holistic conservation and management of the site. In direct relation with the action themes regarding research, education, and awareness-raising included in the Site Management Plan (2017), the authors' contribution has needed to focus more on the social dimension of conservation, especially in recent years. The most recent agenda includes coordinating and leading capacity-building practices, developing new strategies, and digitalizing heritage through innovative designs. Holistic capacity building strategies focusing primarily on heritage education will make a direct contribution to site management and awareness raising as well as the interpretation and presentation of the area. For this reason, related studies aiming especially at the emerging generations have been increasingly continued following the inscription.

2.2. Pergamon Heritage For Children: Education in the Conservation of Cultural Heritage and Reaching the Emerging Generations

The search conference, *"Pergamon Heritage For Children: Education in the Conservation of Cultural Heritage and Reaching the Emerging Generations",* is named after the series of capacity building workshops held prior to it. In October 2018, the workshops, *"Pergamon: Heritage for Children"* were organized under the leadership of Mimar Sinan Fine Arts University Department of Architecture Conservation Division, and with the support of collaborating institutions.

The workshops were structured in line with the previously identified capacity needs and aimed to create an interactive knowledge transfer through experiential and creative practices in heritage areas. The event series took place with the participation of more than 150 students from six primary schools in historic neighborhoods. The artworks produced by the participant children later reached wider audiences through the namesake exhibition. This had been an important step towards contributing to the understanding of the outstanding universal value and importance of the area by future generations. This experience, which attracted a great deal of attention throughout the city, once again revealed the need for developing intergenerational education processes and new strategies on 'Cultural Heritage and Education in Bergama'. Consequently, in November 2019, the search conference was held by Mimar Sinan Fine Arts University Department of Architecture Conservation Division, Bergama Municipality, and Bergama District Directorate of National Education.

Fig. 2. Pergamon Heritage For Children: Education in the Conservation of Cultural Heritage and Reaching the Emerging Generations

The all-day event consisted of three sessions, including a conference, participatory group workshops, and a final collective assessment where all groups declared and discussed their findings. More than 100 participants, most of whom were teachers and institution representatives, actively took part in this event. At the end of the conference, all workshop groups shared reports that include their collective recommendations with organizing bodies.

Through this conference, it is aimed to increase the effective coordination of prominent actors that contribute in the field of cultural heritage and education, and to establish a cooperation network between these actors in order to further improve the prevalent capacity building processes (Fig.1). More importantly, it was targeted to create a shared path for ongoing practices by structuring a systematic framework in a holistic manner. Experts shared their experiences in addition to examining local dynamics and innovative practices in the context of cultural heritage and education. By this means, it is desired to reveal the possible scenarios that can be successfully adapted to Bergama through good examples and identify the differentiating aspects of the city, and develop strategies for the specific characteristics.

3. Lessons Learned and Achievements

The search conference turned out to be an invaluable experience with many future possibilities. One of the substantial lessons learned in the process is that it is possible to ensure effective cooperation among the key actors in the field. In this process, institutions became aware of the studies carried out in the field from a holistic perspective and had the opportunity to evaluate what they could further provide. As a result, the dialogue and cooperation network between these actors, who are traditionally considered decision-making institutions, have been strengthened.

The next level can be considered as the expansion of the cooperation network with community members. Prior to the conference, a 65-person commission consisting of primary, secondary, and high school teachers was established. Compromising volunteer teachers from various branches, this multidisciplinary commission determined the necessities for more effective cultural heritage education in Bergama as preliminary documentation. Issues mentioned in this documentation were then discussed within the scope of the workshops at the conference. Solutions, correlatively, were also developed with wide-ranging participation. In this sense, the process was instrumental in expanding participation in heritage education at the community level.

Later on, a second voluntary commission was established within Bergama Culture and Arts Foundation (BERKSAV) in connection with the renewed cooperation network. This commission, which includes representatives of institutions, experts, and volunteers, focuses on designing wide-ranging educational projects and practices. In addition to building innovative education and digitalization projects, the members contributed to events such as the Bergama Kite Festival, which was held in the city's important heritage sites in 2021 with the participation of many children at the primary school level.

Moreover, reports consisting of assessments for local needs/solutions are among the most significant achievements of the conference. For instance, prioritizing the tangible and intangible values of the city and constructing the course contents in this direction were among the most striking suggestions of the participants. This suggestion emphasized that the uniquely rich resources of the city can and should be accepted as one of the main pillars for heritage education. Thus the whole process can be shaped locally and with knowledge of the place.

Increasing the knowledge and awareness of teachers on the subject and positioning them as heritage ambassadors was also one of the ideas that came to the fore during the conference workshops. The participant teachers as future ambassadors stated that guiding educational materials would be functional and facilitating for them. Alternative tools such as storytelling, gamification, education through on-site experiences, and digitalization were also mentioned in this context.

In this light, general capacity building strategies in conjunction with the main educational principles that shaped as a result of the conference can be summarized as follows: (Okyay, 2022):

- Designing printed/digital guides for cultural heritage education, ensuring the integration of the content with the

Education Information Network (EBA) by the Turkish Ministry of National Education

- Providing regular training for teachers/educators, ensuring that they include relevant knowledge regarding the cultural values and significance of the area in their course content
- Organizing systematic site and museum trips for students, supporting these trips with guide materials and on-site practices while diversifying educational opportunities
- Ensuring the sustainability and systemization of the above-mentioned heritage education activities carried out by volunteers and institutions

Lastly, it is safe to say that the obtained outcomes also became a guide for future practices. The initiation of studies on educational materials and related teacher training, the above-mentioned events like the Bergama Kite Festival, and commission activities can easily prove this claim. The fact that an awareness-raising project was launched for the emerging generations with the cooperation of Bergama District Directorate of National Education and Bergama Municipality UNESCO WH Management Office is an important indicator for the continuation of the studies. This cooperation, which primarily targets students in peripheral neighbourhoods, is also significant in terms of contributing to the conservation of vernacular heritage. Based on these, it is hopefully possible to think that the efforts regarding heritage education in the city will continue in a sustainable manner.

4. Conclusions

Bergama's significant odyssey to heritage education demonstrates an interesting example in many ways. This process, which follows the lens of academia, in a way reflects the evolution of the very notion of conservation itself. The conservation priority was first to ensure the physical integrity of the area and its cultural assets. Afterward, effective management and the construction of a unique urban identity became prominent junctions. These comprehensive works, which also made it possible for the area to be inscribed in the WHL, revealed a more social dimension of conservation and the need for local communities to embrace their heritage.

Although the importance of heritage education is a widely known fact in terms of modern understanding of conservation, this notion mostly emerged as a result of a distinctive and organic development in the case of Bergama. Further to that, it is possible to argue that the area created its own visionary model in this process. This model aims at strengthening the relationship of the local communities with their heritage, as well as endorsing innovative initiatives for creating knowledge and altering perceptions through significant experiences. It also fosters functional mechanisms and cooperations that enable the local communities to take on responsibility instead of undertaking direct responsibilities for the heritage sites and their communities.

In this perspective, the model also highlights the idea of educating the educators who take an active role in the learning process of children and young people. Through the transfer -and acquisition- of knowledge among new heritage ambassadors, it may easily be possible to grow and expand the impact of the related education exponentially. By this means, it can be ensured that the conservation of heritage, as well as its education, becomes a cherished process shared by all members of the community.

It is a fact that the lessons learned and the experience gained in the case of Bergama are still mostly at the theoretical level. Following the full implementation of the constructed structure, today's vision will evolve and continue to develop with new experiences. However, heritage education based on these principles is more likely to reach a more inclusive meaning by transcending the boundaries of academic specialization activities and fulfilling its true potential. It will also help related communities develop strong, pluralistic comprehension and commitment to all tangible and intangible elements of the historical environment, and play a transformative role in raising generations who embrace their heritage.

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The Role of Heritage Communities in Local Development Processes through the reuse of Architectural Heritage. Some Examples in Italian Rural Areas

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Topic: T2.3. Heritage communities

Abstract

Over the last three decades, various initiatives promoted by the European Union concerning the involvement and empowerment of communities in recognising and creating cultural values have flourished. They include, for instance, the Faro Convention, programs for ecomuseums and community mapping, and have contributed to giving voice to bottom-up initiatives for enhancing not only so-called monumental architecture but also "ordinary" architecture and built and vernacular cultural heritage. In general, this approach has also contributed to focusing attention on the importance of local communities in local development processes. In Italy, the so-called inner areas are often characterised by ordinary and vernacular heritage related to rural or manufacturing activities. In these small villages, some local communities, also thanks to the Italian National Strategy for Inner Areas, recognised reuse of part of the vernacular local built heritage as a strength for the community itself and the broader context. Some cases have demonstrated that valorisation of architectural heritage is possible without creating tourism-related facilities only (hotels, museums, etc.) but also creating services needed by "local" users that facilitate the everyday life of the place. In this perspective, attention should also be focused on heritage education and the intergenerational transmission of knowledge, which should involve the entire community at different levels, starting from experiences already in place in similar contexts. In this sense, a community can be intended as a broad concept, a constantly evolving process that includes the resident citizens and a broader network related to a specific territory. Through analyses of case studies, this contribution aims to propose reflections on the role of heritage community experiences in empowering vernacular architectural heritage and its wider context.

Keywords: *rural and inner areas; architectural heritage; community empowerment.*

1. Communities and local heritage in inner areas: A relationship at risk

Since the 1990s, international bodies such as the European Union (EU) have promoted many initiatives and programmes to involve and promote communities in recognising local cultural heritage and creating cultural values. One of the most important actions supported by the EU in this field is the Faro Convention, which, for the first time, introduced the concept of community heritage with legal value[1]. Moreover, other international programmes have contributed to focusing attention on the importance of the role of

[1] Council of Europe, Framework Convention on the Value of Cultural Heritage for Society, Treaty Series n 199, Faro, 27.10.2005. https://rm.coe.int/1680083746 (last accessed 11.01.2022)

local communities in the safeguarding and valorisation of architectural and cultural heritage in general, such as the Leader approach[2], with the institution of GALs[3], community mapping initiatives and the foundation of the ecomuseums network[4]. All these projects have led to a wider awareness of the relevance of communities' points of view in identifying, reactivating and protecting local heritage, which is not necessarily already included in the listed monuments. In general, they have contributed to giving voice to bottom-up initiatives, demonstrating their central role in the broader local development process.

These dynamics can be observed especially in inner areas and marginalised territories affected by a dearth of essential services and depopulation trends. In these contexts, often characterised by stratified rural and manufacturing activities, local architectural heritage is more likely to be part of the so-called vernacular heritage[5]. If we consider vernacular architecture as the results of long-time processes of production and reproduction of knowledge, culture, society, economy, history and locality (Torre, 2011), the inner areas are precious repositories of tangible and intangible vernacular heritage, and knowledge related to ancient activities which are in turn related to production in general (Oteri, Scamardì, 2020). In some Italian inner areas, communities, the vernacular heritage, and their relationships are exposed to various risks. A decreasing population and socio-economic rarefication have led to the disappearance of those processes of production and reproduction that contributed to creating the vernacular heritage itself. Furthermore, depopulation can hinder the transmission of knowledge related to local culture and activities. Vernacular heritage is also exposed to risks such as "museification" and turistification. When ritual is separated from practice and law, it becomes folklore (Torre, 2011). When such heritage acquires functions and uses which are too far from the everyday needs of the community, the risk is the embalming of these legacies, often referring to "historical traditions" that sometimes never existed (Oteri, 2019; Bettini, 2016; Hobswbawn 1999).

2. Laws, approaches, strategies: new paradigms for relaunching cultural heritage in Italian inner areas

Following, but perhaps anticipating the prevalent tendency at a European and international scale[6], an interesting change in approaching the relaunch of marginal and depopulated areas has been recorded in Italy since 2012. The National Strategy for Inner Areas (SNAI)[7], which proposes a place-based approach to face depopulation in marginal areas, marks an important, even if slow, change in tackling this issue. Drawn up in collaboration between the National Agency for Territorial Cohesion and the European Commission[8], the Strategy is mainly based on improvements in health, education, and accessibility, and the enhancement of important cultural capitals that inner areas preserve. The preservation and enhancement of vernacular heritage and, more in

[2] LEADER European Union initiative. https://eufunds.gov.mt/en (last accessed 11.01.2022)

[3] GAL, Local Action Groups, composed of local public and private stakeholders (part of the LEADER approach).

[4] "Ecomuseums are focused on the identity of a place, based on participation, and strive to better the involved community and its heritage via an agreement". https://ecomuseums.com/ (last accessed 11.01.2022)

[5] ICOMOS, Charter on the built vernacular heritage, ratified by the ICOMOS 12th General Assembly, in Mexico, October 1999. https://www.icomos.org/charters/vernacular_e.pdf (last accessed 11.01.2022)

[6] The recent Conclusions by the European Council on culture, high-quality architecture and built environment as key elements of the New European Bauhaus initiative (November 2021) highlight the necessity of protecting the built environment and the role of communities in such a commitment. https://data.consilium.europa.eu/doc/document/ST-14534-2021-INIT/en/pdf (last accessed 15/01/2022)

[7] The first Italian policy for the inner areas. https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/ (last accessed 11/01/2022)

[8] One hundred and ninety million euros were allocated between 2014 and 2016 to finance the Strategy.

general, the so-called "minor" heritage strongly connected to the traditional way of life of rural and mountain communities acquires great importance amongst the objectives of SNAI.

The idea is also to significantly turn the town-countryside divergence into a favourable relationship that involves economy, society, and culture[9]. In this idea of decentralising strategies and initiatives, local communities play an essential role as they have been considered keepers and upholders of the important legacies that marginal areas preserve. After some years since the beginning, it has been possible to assess the early results. From Northern to Southern Italy, the Strategy has revealed the unexpected vitality of local communities, mainly among young generations. At the same time, conflicts, some opposition from local institutions and bureaucratic constraints seem to hinder the carrying out of the Strategy[10]. For this reason, valorisation initiatives that were activated very often proved to be disconnected from community issues and in many cases, the actions finally funded by the Strategy were mainly devoted to valorising cultural and architectural heritage for creating tourism-related facilities, not for providing community-oriented services. However, through the initial participation and co-planning phases to define the program for reactivation of the areas, there were diverse occasions to reflect on local potentialities and identify them in many marginalised contexts, raising awareness on local heritage. In a certain way, they rediscovered their resilience, as some of the following examples show. It is significant that most of the successful place-based initiatives activated in inner areas came from associations or private groups rather than from institutions and local administrations. Some independent groups, organised in associations or cooperatives[11] and private for-profit and non-profit foundations promoted programs and projects aimed at fostering local development processes in the inner areas. While usually the private foundations were used to fund single restoration projects, in the experiences that this contribution wants to illustrate some foundations supported broader local development processes which included not only restoration and/or reuse projects but also a management strategy and a socio-economic plan for reducing the marginalisation of these areas. The project Alpe Pedroria and Madrera, activated by the *Fondo Ambiente Italiano* (FAI) in a mountain area in Lombardy, is an example of this kind of local development process. The project aims at recovering the alpine pasture, encouraging new ways of grazing and a local cheese production chain, which required the restoration and reuse of abandoned environmental and architectural heritage. Indeed, the promoted initiatives seem to reveal a renewed interest in the potentialities of the territory.

3. Voices from the bottom: some experiences in the light of a desirable change[12]

In 2011, a private donor left a mountain area of 200 hectars in the *Orobie Valtellinesi* National Park in the province of Sondrio to FAI, *Fondo*

[9] "In the last few years, the Strategy has mobilised about a hundred persons from local and central administrations, about a thousand mayors, tens of thousand people, and many universities, associations and companies, spreading a "culture of inner areas" that is truly important for the future of our country" (Lucatelli, Luisi 2018, p. 28. The translation is by the authors)

[10] Some significant barriers have been recorded, mainly in relation to local community difficulties in accepting new protagonists and new stakeholders in their territories. In addition, a misinterpreted or rhetorical idea of participation seems to affect programs and initiatives. Lucatelli, Luisi 2018, p. 28.

[11] Associations, the third sector bodies recognised by the Italian legislation. See Codice del Terzo Settore. http://shorturl.at/kDEH5 (last accessed 11/01/2022)

[12] Analyses of the here described experiences are part of the results of Caterina Valiante's PhD thesis "Census of Practices of Preservation and Reuse of Architectural Heritage in Fragile Areas" - developed in the PhD program in Preservation of the Architectural Heritage at the Politecnico di Milano, Department of Excellence on Territorial Fragilities. The thesis is mapping and studying practices of reuse of built heritage in wider local development initiatives in Italian inner areas.

Ambiente Italiano foundation[13]. There, the FAI project ‘Alpe Pedroria and Madrera’[14], part of the wider *Progetto Alpe* for inner mountain areas[15] aims to reactivate and valorise this area by recovering the pasture, the local cheese production chain and the rural landscape and built heritage.

Fig. 1. Architectural heritage in Alpe Pedroria and Madrera (https://fondoambiente.it/).

This case study is located in the municipality of Talamona, in the *Valli del Bitto*[16]. These valleys, where the stream Bitto flows, were ancient trails and connections between Valtellina - particularly the town of Morbegno - and Bergamo, and old crossroads for trading between the Canton of Grigioni and the Republic of Venice. The area has been inhabited since ancient times, thanks to its strategic position and natural inclination to farming activities and the presence of diffused mineral veins. Legacies of this long-lasting presence are visible in the natural landscape as well as in the cultural and architectural heritage. The municipality of Talamona is currently facing a slight demographic decrease, and it is categorised as a "small municipality" by the Italian legislation[17].

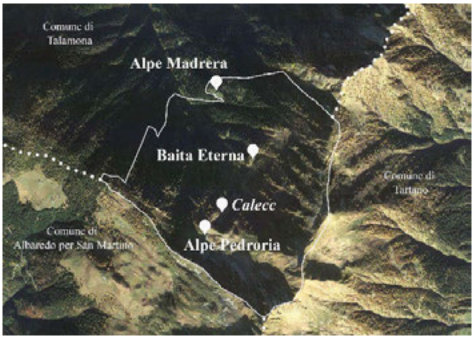

Fig. 2. Map of Alpe Pedroria and Madrera. Authors' elaboration based on Google Earth Map (https://earth.google.com).

According to the National Strategy for Inner Areas, Talamona is classified as an inner area, even if it was not included in a specific pilot area of the first planning phase, 2014-2020[18]. Although the municipality is quite close to the major centre of Morbegno, essential services (education, health and mobility) are still lacking and hard to reach. From the economic point of view, the area has always based itself upon agricultural and farming activities, and today, the results of excellent production, strictly related to specific natural and territorial features, still remain. The most important product of the area is “*Bitto*” cheese (Corti, Ruffoni, 2009)[19]. In the areas of the *Orobie Valtellinesi* National Park, the alpine pastures have a particular exposure, humidity and temperature that has allowed a specialised farming and dairy production economy since the Middle Ages. Also, the *Valli del Bitto*'s

[13] FAI – Fondo per l’Ambiente Italiano is a non-profit foundation established in 1975, using the National Trust as a model, with the aim of protecting and enhancing Italy's historical, artistic and landscape heritage. https://fondoambiente.it/il-fai/mission/ (last accessed 11.01.2022)

[14] The authors would like to thank the FAI officers (Fondo Ambiente Italiano) Isabella Spicuglia, Maria Galli and Giuliano Galli for their kind availability in providing part of the information reported in this contribution.

[15] *Progetto Alpe*, a project fostered by FAI to protect and enhance inner areas located 600 metres above sea level. https://fondoambiente.it/il-progetto-alpe-l-italia-sopra-600-metri/ (last accessed 11.01.2022)

[16] *Valle del Bitto di Albaredo* and *Valle del Bitto di Gerola.* https://www.parcorobievalt.com/ (last accessed 11.01.2022)

[17] 4638 inhabitants were registered in Talamona in 2020. https://urly.it/3jqwf (last accessed 12/01/2022)

[18] Talamona is classified as “*D-intermedio* (intermediate)”. In Valtellina, SNAI selected the pilot area “*Alta Valtellina*”, see https://www.agenziacoesione.gov.it/ (last accessed 11.01.2022)

[19] See also https://www.formaggiobitto.com/it/ (last accessed 11.01.2022)

geopolitical situation permitted commercialisation of this product in different markets: Grigioni, the Republic of Venice and the State of Milan. Nowadays, the local producers are part of a consortium "*Consorzio Salvaguardia Bitto Storico*", which in 2003 was recognised as a "*Presidio Slow Food*"[20]. As will be illustrated below, this very local production is strictly related to the vernacular cultural and architectural heritage now present in the area of Alpe Pedroria and Madrera, historically a place of alpine pasture and farming activities connected to cheesemaking.

Fig. 3. Farming activities reintroduced by the FAI project in Alpe Pedroria and Madrera (https://fondoambiente.it/).

According to the FAI project[21], the planned interventions included environmental maintenance of the entire area with the reintroduction of farming activities[22], re-establishing ancient pastures, thereby hindering abandonment of the land and hydrogeological instability. The project also contributed to safeguarding the rural built heritage, with interventions for the preservation of several abandoned lodges. In the first phase, the trails were recovered, and safe access to the site was assured. In a second phase, securing interventions were provided to all the built heritage, starting from restoring the first two lodges in Alpe Pedroria.

Fig. 4. Construction site in "Baita Eterna" (https://fondoambiente.it/).

For these two structures, destined initially to shelter for animals, a preservation strategy was activated to remove the decay patterns, which mainly affected the mortars, and to undertake structural consolidation interventions on the stone masonry and the wooden roof. Later, further buildings were recovered by replacing the missing wooden roof (Baita Eterna), adding drainage systems, restoring the interiors, and constructing a new space for sanitary facilities (Stalla Grande in Alpe Pedoria). The restored lodges aim at supporting farming, with the creation of a house for the dairyman, for recreating the cheese production chain, setting up a didactic centre to carry out activities for involving students in raising awareness of local historical legacies, and hospitality of tourists. The third phase of the project concerned some typical fundamental structures for the historic production of the local "*bitto*" cheese. These two small drystone-masonry buildings, called "*calècc*", were temporary places for the processing procedure directly after milking, an essential phase for this artisanal production. The FAI strategy is based on the idea of preserving the remaining masonry and plans to recreate the ancient light covering structure for educational purposes, setting up didactic activities with students and visitors through lectures, guided tours and workshops. Moreover, the project aims to safeguard and valorise the landscape,

[20] The Slow Food Presidia, see https://www.fondazioneslowfood.com/ (last accessed 11.01.2022)

[21] See https://fondoambiente.it/luoghi/alpe-pedroria-e-alpe-madrera https://fondoambiente.it/news/alpe-pedroria-un-identita-da-valorizzare, https://fondoambiente.it/news/il-cantiere-alle-alpi-pedroria-e-madrera (last accessed 11.01.2022)

[22] The project included the purchase of local cows and goats, which are needed for local "Bitto" cheese production. Their maintenance and care are entrusted to local farmers.

environmental and architectural features of the place to transmit traditional and material local knowledge.

Fig. 5. The remaining structures, "*calecc*", for cheese production in Alpe Pedroria and Madrera. Photo by Maria Galli, 2017 (https://fondoambiente.it/).

In general, this strategy has involved many different aspects of the local context: not only valorisation of vernacular heritage, but also environmental maintenance and safeguarding, enhancement of an economic activity which is strictly connected to the territory and still present, and the involvement of the local community, in particular for production and educational activities. A key aspect of these local development processes is the introduction of multiple functions, which can assure a more comprehensive strategy at different levels. In order to do so, the construction of a network of local entities is crucial (Carrosio, 2013). In the case of Alpe Pedroria and Madrera, this network is composed of the municipality of Talamona, the schools present in the territory, local associations, and also other private foundations such as *Fondazione Cariplo* and *Fondazione Fojanini*. Moreover, another aspect that can facilitate activation of these strategies is the type of governance of the promoter. In the case of FAI, the process for the allocation of funding is direct and immediate compared to public funds. In addition, the foundation itself is the owner of the entire property.

Fig. 6. Educational activities in Alpe Pedroria and Madrera (https://fondoambiente.it/).

Indeed, administrative factors are crucial for realising these kinds of projects. However, direct involvement of the local community is fundamental for the implementation of the strategy and its management, durability and sustainability over time. While the first promoter of this strategy is a private foundation, the final result can still be recognised as a bottom-up local development practice. In Italy, other private foundations and independent organisations or voluntary groups, such as associations or cooperatives, activated similar initiatives to reuse vernacular architectural heritage in inner areas, especially related to rural heritage. The *Fondazione Cariplo*[23] promoted the project "*Attivaree*" that aims at creating local development processes for the regeneration of inner areas of Lombardy, Val Trompia, Val Sabbia and Oltrepò Pavese. In particular, in Val Trompia, the project involved many different levels of the local community in fostering actions to enhance local agricultural production, educational activities related to territorial features, slow tourism connected to sporting activities and digital tools for cultural and economic facilities. The preservation and reuse of local vernacular heritage, an ancient farm complex in Pezzaze[24], integrated agritourism with both agricultural production and educational activities for children, establishing a local producers and farmers

[23] Originally a bank foundation, it is a philanthropic foundation that assigns grants to realise social issue projects. https://www.fondazionecariplo.it/ (last accessed 11.01.2022)

[24] *Rebecco Farm* in Pezzaze, Brescia. https://www.rebecco-farm.it/agriturismo-rebecco/

network. Also in this case, a private foundation fostered a local development process through the direct involvement of the local community, creating long-lasting networks among administrations, farmers, schools and other operators (Osti, Jachia, 2020). In an alpine area of Piedmont, the ancient mountain village of Ostana has been repopulated by new inhabitants, which reused the built heritage for residencies or artisanal activities (De Rossi, 2018). In this case, the promoter of the initiatives is a voluntary organisation born from the initiative of the new inhabitants. Also here, the strategy is based on the insertion of multiple functions (services, environmental maintenance, education, economic activities, tourism) and the construction of a wide network of local actors. But this kind of practice is not only widespread in mountain areas. A similar case, in which a voluntary group promoted the reuse of vernacular heritage, can be found in Castiglione d'Otranto. The project *Casa delle AgriCulture Tullia e Gino* started as a cultural association and then became an agricultural cooperative[25]. Its objective is to recover ancient agricultural production, involving the community through educational activities and workshops for children and cultural events for raising awareness about environmental sustainability and local products. Moreover, this organisation also provides services for the community, such as an organic mill for small local producers and a playroom for children in the unused spaces of the former primary school.

4. Conclusions

By observing the practices of reuse of vernacular heritage as part of local development processes, it is interesting to highlight their common features: the centrality of the community, the inclusion of multiple functions (in particular agricultural or farming activity) and the establishment of a network. These elements can facilitate a wider and more comprehensive approach to facing the issues of a marginalised context, tackling various criticalities from different points of view and with the help of various competencies. Moreover, local experts can benefit from the implementation of such practices, being enriched through the experience. The importance of the informal heritage communities here described is also represented by a shared process of teaching and learning. In this perspective, another project promoted by the *Fondazione Cariplo*, *Distretto Culturale Valtellina*, could be considered a prime example. It aimed at recovering the drystone-wall terracing systems of the valley, which represent a fundamental element for the economic, cultural and landscape features of the place. But above all, it trained the communities to maintain and care for this essential technique necessary to guarantee hydrogeological stability and wine production (Barbetta, Cammelli, Della Torre, 2013).

Fig. 7. Drystone wall maintenance in Valtellina. Photo Ansa.it, 2016 (https://shorturl.at/bjzE9).

Throughout the mentioned experiences, it is possible to read the centrality of the educational aspects in different ways. A first component is indeed the direct formative and educational activities that these practices promoted, aimed at teaching people of different ages. A second one can be recognised in an indirect educational contribution, in favour of the many actors involved, which derives from the implementation and management of a complex process for local development. The presented experiences aim to

[25] Casa delle AgriCulture, Castiglione d'Otranto, Andrano (Lecce). https://www.casadelleagriculturetulliaegino.com/ (last accessed 11.01.2022)

explain the potentialities that the practices of reuse of vernacular heritage in inner areas can offer when the adopted strategies consider a variety of functions and the community's involvement at different levels, leading to a learning process for the people involved. The mentioned cases showed positive feedback among the local communities thanks to the actual creation of valuable and essential services for the population. Nevertheless, difficulties related to an "inner area" context still remain. When led by a well-established, structured foundation, practices of reuse and community involvement can more easily overcome the economic and administrative issues related to a small municipality. But in the absence of such actors, practices activated by self-organised groups should be supported by national or regional programs to foster and encourage this kind of initiative that positively affects local heritage and community.

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HERITAGE EDUCATION

CREATIVITY AND HERITAGE EDUCATION

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Strategies for the recognition and the enhancement of the cultural heritage in Sant'Antioco

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Topic: T2.4. Creativity and heritage education

Abstract

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Keywords: [illegible]

1. Introduction

The paper presents part of the research carried out in the municipality of Calasetta, on the island of Sant'Antioco, within the "VerSus + / Heritage for PEOPLE" project, founded by the European Commission as part of the Creative Europe Culture Program (Ref. 607593-CREA-1-2019-1-ES-CULT-COOP1) in the period 2019-2023.

The main objective of the Versus + project is to make the general public aware of the contribution of tangible and intangible knowledge that constitute the vernacular heritage for a more sustainable future (Mileto et al., 2020, Correia et al. 2014). As part of the project, two Mediterranean islands were chosen as case studies: Sant'Antioco in Sardinia and Formentera in Spain, geographically limited territories where the vernacular heritage is under pressure, subject to the transformations of contemporary life, in particular of mass tourism. Actions of social participation, dissemination, education, communication and promotion are undertaken in the Versus + project to experiment with different operational approaches that can be adapted to different contexts and embraced by local communities in order to share with society the sustainable qualities of the vernacular heritage.

1.2. Research aims and methodologies

The objectives of the VerSus + project were implemented on the Sant'Antioco case study through a series of coordinated actions aimed at research, education, and transmission of knowledge, trying to involve different types of public. The planned activities are carried out in the municipality of Calasetta, a small town of on the island of Sant'Antioco, which, due to its cultural and environmental characteristics, is considered appropriate for the application of the strategies and actions identified.

The research activity, conducted by researchers from the Departments of Architecture DIDA (Florence) and DICAAR (Cagliari), integrates the analysis of the documentary sources with in-situ data collection. It takes into account tangible and intangible aspects of cultural heritage; cultural and social expectations; management issues and the observation of traditional and contemporary sustainable practices in the environmental, socio-cultural and economic fields.

The educational actions involve in a first step students in architecture from the Universities of Florence and University of Cagliari. From February to June 2022, students will participate in a blended thematic seminar, which as the the main objective of providing them with the necessary skills to analyze, understand, interpret and communicate the heritage values. The final results of the seminar will be the creation of a virtual seroius game that aims to enhance, communicate and transmit knowledge and values of Calasetta's heritage to a wide audience of all ages: students, inhabitants, tourists, but also technicians and scholars. The game offers itself as an educational tool for the transmission of tacit knowledge through experiential learning processes, such as informal intuitions and understandings (Sheahan, 2021). It seeks to communicate beyond didactic structures, providing instead "authentic situations" that can lead to "place-based learning" (Xanthopoulos & Xinogalos, 2019). In April 2022 the students, after a series of preparation lectures on analysis methodologies, take part in a residential workshop in Calasetta. During the workshop, students and researchers will work on three domain: interdisciplinary analysis, through interviews with craftpeople and custodians of cultural heritage, observations and direct survey; digital survey with advanced technologies for creating a virtual environment fot he game; creation and implementation of the serious game on the cultural heritage of Calasetta and its potential for sustainable development.

2. Sant'Antioco: environmental and social-cultural context

The landscape of the island of Sant'Antioco is characterized by the typical shrubs of the Mediterranean scrub: juniper, myrtle, mastic, rosemary and dwarf palms. The prevalent crops are grapes, wheat and legumes, while tall trees, vegetables and orchards are scarce due to the shortage of waterways, and the scarcity and irregularity of rainfall (400-500 mm per year). The climate is indeed warm Mediterranean, with long periods of summer drought, high average temperatures, mistral and libeccio winds in winter and warm sirocco winds in summer.

Fig. 1. The tonnara of Calasetta

The presence of the sea has always strongly influenced this area. The fishing activity is undoubtedly the basis of the economy. The sea is not only a resource for fishing, but a fundamental element of the local culture, which has generated traditions, legends, habits and rhythms of life. Even the name Calasetta is linked to the sea, in fact it derives from “Cala di Seta”, and refers to the byssus, a filament similar to silk that is obtained from the gnacchera, or pinna nobilis, once abundant in the surrounding sea (Rombi, 1988).

Although a large part of the economy is linked to tourism, some local products continue to be maintained. The production of wine has been for centuries one of the sources of livelihood of the populations: the vineyards occupy large portions of the territory, defined by fences, and have always been the fulcrum for a management of the landscape in an equilibrium relationship with the environment. The nature of the sandy soil has made it possible to cultivate the grapevine, that is, with its original roots, without resorting to the rootstock of American vine. This rare cultivation technique brings several advantages to the plant, such as greater resistance to drought, greater longevity of the vineyard and better vegetative-productive balance (Municipality of Calasetta, 2016).

Fig. 2. The landscape of the vineyards in the territory of Calasetta

The cultural identity of Calasetta is certainly influenced by the cultures of the Genoese and Piedmontese populations who founded and inhabited the city. The commonly spoken language is *3454E6;<AB*, a variant of Genovese. The *3454E" 6;<AB* language, inherited by migrants from Tabarka who founded the city, also finds expression in the stories, popular songs and serenades. The *3454E6;<A8* culture is alive and present in many aspects of the intangible heritage: from gastronomic traditions to popular festivals.

3. Urban development of Calasetta in Sant’Antioco

The island of of Sant’Antioco (Sulcis Archipel, nearby Sardinia, Italy) is known since pre- and early history, as testified by the many Nuragic and Phoenicians settlements and necropolis. After the Roman period it was abandoned for many centuries, due to the frequent barbarian raids, until the middle of the XVIII century when the village S. Antioco started to be repopulated and the settlement Calasetta began (Vacca, 2009).

Calasetta has been founded in 1769, after a request to the King Carlo Emanuele of Savoy made by 45 families from Liguria migrating from the Tunisian island of Tabarka. This small island in Tunisia belonged to the Lomellini family from Genoa, that established there a community of fishermen.

When the Tabarka population grew, *G454E><A<* people started to look for other alike places in the Mediterranean and started consequently a migration that brought them first to occupy the island of S. Pietro, founding the town of Carloforte, and later to occupy the bigger island of S. Antioco. The King entrusted the Monastic Order of the Saints Maurizio and Lazzaro for the construction of the new settlement on the north western side of the island (Zaccagnini, 1972).

The planning of the original core of the village of Calasetta in the northern part of the island was assigned to the engineer Pietro Belly. In his project two orthogonal streets constituted the supporting axes of the future road network, corresponding to the current via Roma and via Guglielmo Marconi. The lots were positioned on both sides, equipped with dwellings, with a courtyard, barn and backyard (Rombi, 2006). Parallel to the main roads, the secondary roads were located on the slope in southern part of the village. In an east-west direction, the town would have developed for a length of 120 "trabucchi" (one trabucco equals to about 2 meters length); in a north-south direction, 60; the secondary roads were about 36 trabucchi long. Pietro Belly designed thirty-nine properties, which actually hosted the first families arrived.

The chosen scheme, following the perfect Cartesian logic of all Savoy urban plans, is based on the centrality of the main square, with the church, the adjoining parish house and the water reserve tank. The supply warehouse was located in the southern part of the settlement. It was a simple and rational pattern, ready to evolve into a more defined urban program starting by a modular road matrix, on which the development of the village was subsequently organized. The planning of Calasetta had a precise agricultural vocation, as highlighted from the housing types that were chosen, accompanied by a pressing need for military protection, due to the constant danger of pirate raids. At least in the initial stage, it did not show a dense urban structure: the housing units, square shaped, with sides equal to 2 trabucchi (about 6 m.), were positioned in the corners of the properties. This system constituted the most rational solution to optimize times and costs of construction, and ensure at the same time the efficiency of the infrastructure, above all the water supply.

Fig. 3. The centre of Calasetta

After 1767, the Sardinian government increased the population of Calasetta allowing new settlers from Piedmont to come. The arrival of more inhabitants made the original settlement of Calasetta insufficient. For this reason, the engineer Giovanni Francesco Daristo designed a new expansion plan in 1773, repeating the road matrix defined by his colleague Pietro Belly. His first project showed a new arrangement of the village, with the parish church towards south facing a second square arranged along the main axis. Later, this hypothesis was abandoned, and the church was located further north, near the port. One of the innovations introduced by Daristo was the attention reserved to the military structures. His plan shows a circuit of fortifications around the village. The pre-existing defensive tower, renewed and strengthened after his suggestion, closed the perimeter of the walls to the west, in the highest relief. From the fortress, which still exists, it was possible to control the sea, and also send coded visual signals to the garrisons stationed in Carloforte and Portoscuso. Trusting in the success of the project and the arrival of new inhabitants, Daristo did not place the protection walls too close to the town, assuring an appropriate space for future expansions. With this plan, the original thirty-eight lots were increased to fifty-one, to which were added twenty-nine more, intended for later expansion (Schirru, 2013).

The agricultural vocation of the settlement has not changed much through time, but an evident densification started during the 19th century for touristic purposes. The courtyards got occupied with the expansion of the old houses or with new constructions, giving a new image to the urban center. Only the chromatic purism of the village, whitewashed with lime, stays still today as a landmark of Calasetta.

4. Gaming as a tool for the enhancement of cultural heritage

In our project, digital games and interactive storytelling were choosen as tool to promote, to comunicate and to engage the general public around the cultural heritage of Sant'Antioco.

The promotion and communication of cultural heritage through digital games has become a widely accepted notion and a widespread practice by many cultural institutions. Many museums are using some form of digital games to engage and attract the public and make their collections known (Mortara et al., 2014, Paliokas & Sylaiou, 2016). By exerting a strong motivational appeal (Ryan et al., 2006) games have proven their potential to inform about, engage and communicate the values of cultural heritage (Anderson et al. 2010), and to foster the interest for the places of that heritage, attracting visitors and even inducing tourism (Dubois & Gibbs, 2018).

In this context, we have developed an intensive residential grame-design workshop in Calasetta to develop short apps for gaming and interactive storytelling. This activity employs a peculiar formula of pervasive gaming which allows the players to experience "in first person" stories revolving aroung tangible and intangible cultural heritage, while (physically) visiting and exploring places and territory of Sant'Antioco.

The ambition of such gaming experiences is not to simply transfer information or to deploy a passivly recepted storytelling about the heritage, as is the case in traditional guided or virtual tours. It is rather to engage the user/player as a protagonist of stories, events and explorations, through devices which are typical of digital games, capable to sustain the immersion in the gameworld and its narrative universe.

Given that the gameworld and the narrative universe are in our case those related to specific really-existing places and heritage, the promise of such an approach to engagement is not only to develop interest, or to broaden the knowledge, but ultimately to kindle forms of affection, attachment and desire for the places. Digital games have certainly proven to be one possible channel through which such affection, attachment and desire for places may be encouraged and sustained (Dewailly, 1999; Plunkett, 2011; Tavinor, 2011), and how they engender or reinforce the symbolic and cultural significance of places shown in the game world, taking advantage of their affective value for the player (Murray, 1997).

5. Conclusions

The digital games and interactive storytelling choosen to promote, comunicate and engage the young generations around the cultural heritage of Sant'Antioco contain the data acquired though interviews to citizens, artisans, administrators, and through an intense *BAĀF<G8* activity of mapping architectural, natural and intangible local traditional heritage.

The set of research activities launched on Sant'Antioco is intended not only to deepen and systematize the heritage of vernacular knowledge, but also or to share this knowledge with a wide audience, in an inclusive and active way, targeting especially young generations. For this reason, the used strategies provide for different types of involvement (active, remote, creative) and different tools (traditional, digital, gaming).

These activities, conceived for the VerSus + project, will create a corpus applicable beyond the project itself to many different contexts.

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A collaborative Web App to foster a knowledge network on vernacular heritage, craftspeople, and sustainability

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Topic: T2.4. Creativity and heritage education

Abstract

Vernacular architecture provides extraordinary technological and typological solutions, which are the result of a complex system of knowledge that has evolved through trial and error, in a deep connection to the environmental, social, economic and cultural contexts. The goal of the study presented here is to propose a tool able to organise vernacular knowledge, both tangible and intangible, by systematising principles, strategies, design models and solutions in order to be more easily shared, transmitted and employed in the design of new sustainable architecture. The tool, which is developed as part of the project "VerSus+ / Heritage for People" (Creative Europe Program), is a collaborative Web Application able to map solutions and models from vernacular architecture, and to associate and classify them with sustainable strategies. In addition to physical objects (cultural landscapes, urban, typological and technological solutions), the App will also map the people involved in the knowledge management of vernacular architecture: craftspeople and professionals in the field of vernacular architecture enhancement and conservation. This tool can catalogue solutions and knowledge from different branches of vernacular architecture, and make it available to a large audience, such as professionals, researchers, artisans and citizens, who can also directly contribute to the growth of the vernacular database by adding new information and solutions to the App. The idea is to have a user friendly and easy to consult App, able to suggest new solutions to contemporary design problems, based on the observation of similar past problems, so that sustainable models developed in the past can be adapted to design and construct a more appropriate architecture for the future.

Keywords: *cultural heritage; sustainable and vernacular architecture; knowledge management; web mapping and mobile applications.*

1. Introduction

1.1. Framework

The scope of this work is to present the design and the development of a collaborative tool that enable users to organise vernacular architecture knowledge, both tangible and intangible, according principles, strategies, design models and solutions, in order to be more easily transmitted, enhanced, and used in the design of new sustainable architecture. This work is part of the project "VerSus+ / Heritage for People" founded by Creative Europe Program during the period 2019-2023. At the core of VerSus+ project there is to foster the conservation of cultural heritage, encouraging a more sustainable approach to contemporary architecture, by learning from a contemporary interpretation of locally developed-cum-traditional adaptive strategies. The VerSus+ project builds on the outcomes of the earlier project: "VerSus-Lessons from Vernacular Heritage in Sustainable Architecture" funded by the EU's Culture Programme. Starting from VerSus, several principles have been identified in order to find out strategies connected to several aspects linked to the four key levels of sustainability: natural/environmental, social, economic and cultural. Based on these assumptions, the VerSus+ People project is implemented with the aim of disseminating principles, techniques, and solutions of vernacular heritage to different audiences, and to reach a wide and varied public in order to positively impact society for a better and more sustainable development for the future (Mileto et al., 2020).

1.2. A tool based on people

In order to meet the goal of reaching a wide and varied audience, dissemination includes the development of a Web Application that can help people to access and systematize cases of valuable sustainable strategies. The Web App in this sense is collective as it is not merely a virtual catalogue to be consulted, but it becomes a tool for people to contribute to organise the vast repertoire of vernacular architecture knowledge.

The Web App is also guided by other important VerSus+ aims: 1. to strengthen the role of local artisans and craftspeople, as well as companies that work on traditional construction techniques and materials; 2. to promote the study methodology, strategies, activities and principles developed, and share results not only locally or regionally, but on a national scale and possibly even internationally. For this reason, the Web App not only includes material culture examples (e.g. buildings, landscapes, cities, etc.), but also, where possible, links to people and institutions working on vernacular heritage. Thus, it promotes the creation of a network of people that constitute, with their work, an important part of what is intangible heritage and knowledge. Intangible cultural heritage represented by people is an essential feature of VerSus+ project, as it can be considered the larger framework within which tangible heritage takes on shape and meaning (Bouchenaki, 2003). The inclusion of people, institutions and associations as integral parts of the tool allow them to be key agents in the processes for the revitalization and innovation of local architecture (Mileto et al., 2020). Cultural heritage, as a form of social construction, is related to local knowledge narratives that are co-constructed by the concurrent participation of both narrative agents and active receivers; the latter are also involved in the knowledge making process (Ginzarly & Teller, 2021). Through a digital platform, the co-constructed and participatory nature of the tool can also enable a larger participation which goes beyond localities to become more widespread in space and time.

The dissemination tool is therefore based on including people in two ways: the first is to engage with them so that they can contribute to the Web App contents (inclusive/collaborative approach), the second is to link references to people (professionals, craftspeople, communities of practice, universities etc.) for whatever material heritage examples that have been mapped.

1.3. Why a Web App?

The development of an online digital platform is a powerful mean for dissemination as it provides a 'space' not only for documenting, but also for creating networks of people. Moreover, as compared to non-digital means of dissemination such as print books, a Web App can be constantly updated and integrated with more examples, materials, and links. This emphasis on new technologies is important to also establish a connection with other digital platforms that can be associated with the tool, for example: social networks, specialised craftspeople websites, websites for video sharing, and so on. It is also important to remember that among digital platforms, the use of social media for crowdsourcing grassroots initiatives aimed at the co-production of knowledge on heritage is still limited and not yet very explored

Name	Source	Theme and objective	InfoVis methods
mapadaterra	*www.mapadaterra.org*	Collaborative map about earthen architecture.	Map
Lehmbau im Wienviertel	*http://thinkspatial.boku.ac.at/app/?init=1&auth=ASZ5HRMPYNKTG8N1YL5W*	Web App to survey and analyse clay buildings in the Weinviertel (Austria). Through digital tools, the project aims to reach a wider audience and spread the knowledge of the local architectural heritage.	Map + mosaic
Red de Maestros	*www.redmaestros.com*	National directory of good practices in the fields of traditional construction and its restoration.	Grid
Europeana	*www.europeana.eu/en*	Europeana is the EU digital platform for cultural heritage. It works with thousands of European archives, libraries and museums to share cultural heritage for enjoyment, education and research.	Grid
Atlante Architettura Contemporanea	*www.atlantearchitetture.beniculturali.it*	The atlas is a project endorsed by the Directorate-General for Contemporary Creativity of the Ministry of Culture that proposes to prompt a more effective "network" perception of modern and contemporary Italian architectural heritage combining several architectures in thematic itineraries.	Map + grid
Cultural Gems	*https://culturalgems.jrc.ec.europa.eu/*	Cultural gems, founded by JRC, is a free open source and collaborative app to map the cultural and creative places of European cities. It is a guide for tourists but also residents, city administrators, and cultural third sector representatives.	Map + grid
Cultural Heritage Interactive Map	*http://arcg.is/0TjSai*	The project invites the general public, as well as cultural heritage experts, to browse cultural initiatives and events across Europe using interactive story maps online. More than just an information source, the web tool serves as an outreach effort to increase the public's involvement in their own cultural heritage.	Map + list
Inventing Abstraction 1910-1925	*https://www.moma.org/interactives/exhibitions/2012/inventingabstraction/?page=home*	The digital diagrams allows users to explore the relationships among the abstract artists represented in *Inventing Abstraction* (an exposition presented by MoMa in 2012-2013) all of whom played a significant role in the development of a new modem language for the arts.	Network

Table 1. Benchmarking on Web Apps and Platforms

(Ginzarly & Teller, 2021). Thus, linking the Web App to other digital 'spaces', which are constantly updated and which foster more public participation, is a way to expand the limits of the tool itself.

2. Methodology: approach and design

2.1. Benchmarking on Web Apps and Platforms on Traditional knowledge

Since cultures are constantly changing, the ways in which cultural heritage aspects are transmitted should also follow these dynamics. The phenomenon of digitization has made sharing easier and extended the meaning of representation and dissemination of cultural contents, making them available to a potentially much wider audience (Windhager et al., 2019).

Already in recent decades, there is a growing interest in the dissemination of cultural heritage through digital systems and there are now many platforms which work as public repositories of digital artefacts from museums, archives and libraries, such as the well-known experience of Europeana or the Digital Public Library of America. Windhager et al. (2019) collected and assessed some recent developments of interfaces and different methods of Information Visualization (infoVis) to enhance access to cultural collections.

For the development of the VerSus plus App we analyzed other similar examples as reference. The benchmarking has been mainly focused on platforms and Web Apps that use maps as visual encoding techniques for the collection of cultural data.

A key reference is *Lehmbau im Weinviertel* platform, which was developed by the project *Think Spacial!* for the knowledge and enhancement of earthen architecture in the Region of Weinviertel, Austria (Schauppenlehner et al., 2020). An essential aspect of the project is the interaction with Citizen Science through the involvement of locals in the mapping of heritage as well as the organization and dissemination of different kinds of materials that can be downloaded.

Another valuable map-based project aimed at the dissemination of information on more sustainable ways to build is *mapadaterra*, which presents a collaborative cartography of building experiences with natural materials. One of the aims of the project is the development of a network of people interested in sustainability and natural construction that can communicate inspired by the platform's contents.

One more significant reference is the website *Red Nacional de Maestros de la Construcción Tradicional*, which is a Spanish network of artisans and masters in local know-how and a directory of good practises in the fields of traditional construction and restoration (Garcia, 2019). Its importace is the emphasis on people, therefore on their knowledge (immaterial heritage) and the involvement of craftspeople and experts in the field of vernacular heritage.

VerSus plus App, like all these projects, tries to make the best of all opportunities offered by digital technologies for documentation and dissemination of traditional knowledge. The community engagement component in this project is fundamental for two main reasons: the first one is that it helps to increase the social dimension and the feeling of being part of a group, even if virtual, and therefore contributes to the development of an awareness towards vernacular heritage; the second one is that through the production and sharing of contents, new meanings of cultural heritage can emerge (Calcagni et al., 2019).

2.2. A Case-Based Reasoning approach

The design of the Web App starts from the need to create something more than an archive, a catalogue or a map of case studies of buildings, vernacular techniques or craftspeople. VerSus plus Web App wants to be a tool to provide scholars and designers with models, examples, information to create innovative solutions, for a sustainable architecture for the future. By adopting a Case-Based Reasoning approach, the information of the app wants to provide concrete examples of past solutions, in order to use them to solve a particular issue or to better understand it today. Both Christopher K. Riesbeck, computer scientist, and Roger Schank, cognitive psychologist, are experts in artificial intelligence and focus their studies on "dynamic memory". This concept underpins the theory of CBR. At the core of this theory there is the fact that whatever experience from the past is available to us, it is likely that people will employ it as a model for future decision making (Kolodner, 1993; Riesbeck et al., 1989).

The CBR approach applied to design is based on the idea that a licit architectural solution can be drawn from similar cases from past experiences. Past scenarios can be re-used, recombined and partly revised, to satisfactorily solve a new design problem that starts from similar needs.

In order to employ suitable cases from the past to solve new problems, it is necessary to classify them in a clear and accessible way. Only by making its accessibility easier to a wider and newer audience, will guarantee that past experience will be employed (Oxman, 2003).

Indexing keys can be multiple and dynamic, as each case contains many related pieces of information. In the case of the VerSus plus App, the main reading key that we have identified for the research and resolution of design problems refers to the VerSus methodology (Correia et al., 2014). That is, the sustainability lessons learned from vernacular architecture have been chosen as attributes for indexing, archiving and researching cases and people related to both vernacular and contemporary architecture.

Furthermore, the cases were indexed taking into consideration their geographical position (they can be viewed on a map); the category (Landscape; City / town: Building; Building elements; Craftspeople; Center of documentation or dissemination); the main material or materials from which they were made of; and the type of intervention (traditional / vernacular, new, rehabilitation).

ENVIRONMENTAL SUSTAINABILITY

1 RESPECTING NATURE AND LANDSCAPE

1.1 Integrating with the land morphology
1.2 Minimizing intervention
1.3 Ensuring site regeneration
1.4 Respecting biodiversity

2 TAKING BENEFIT FROM NATURAL AND CLIMATIC RESOURCES

2.1 Applying appropriate form and
2.2 orientation
2.3 Managing water resources
2.4 Integrating soil inertia
2.5 Integrating solar energy
2.6 Adapting to dominant winds
Integrating vegetation

3 REDUCING POLLUTION

3.1 Using local materials
3.2 Recycling and reusing materials
3.3 Using low processed materials
3.4 Reducing transportation

4 ENSURING HUMAN WELL-BEING AND COMFORT

4.1 Using materials with high thermal inertia
4.2 Using hygroscopic and transpiring
4.3 materials
4.4 Promoting natural lighting and ventilation
4.5 Integrating adequate shading systems
4.6 Integrating courtyard or buffer-spaces
Using non-toxic materials

5 REDUCING DISASTER RISKS

5.1 Choosing appropriate sites
5.2 Designing robust and flexible structures
5.3 Employing compact and aerodynamic shape
5.4 Employing seismic resistant elements
5.5 Promoting building adaptation to disasters
5.6 Integrating damage mitigation systems

SOCIO-CULTURAL SUSTAINABILITY

6 PRESERVING THE CULTURAL LANDSCAPE

6.1 Respecting values and dynamics of the landscape
6.2 Supporting bio-diversity
6.3 Implementing water collection systems
6.4 Implementing erosion protection systems
6.5 Enhancing local crops

7 TRANSMITTING AND SHARING BUILDING CULTURES

7.1 Fostering constructive experiences and practices
7.2 Fostering the application of empirical know-how
7.3 Recognizing the value of masters and craftspeople
7.4 Involving young people in construction processes
7.5 Facilitating local community participation
7.6 Promoting self-maintenance processes

8 ENCOURAGING CREATIVITY

8.1 Promoting collective intelligence
8.2 Encouraging diversity
8.3 Integrating other building-cultures' influences
8.4 Allowing experimentation of different building techniques
8.5 Fostering evolution through experimentation, trial and error processes

9 RECOGNIZING INTANGIBLE VALUES

9.1 Expressing collective memory
9.2 Representing cultural identity
9.3 Enhancing a sense of place
9.4 Recognizing the value of history and mythology
9.5 Expressing peace and well-being

10 ENCOURAGING SOCIAL COHESION

10.1 Fostering pedestrian areas
10.2 Fostering a shared management ap-
10.3 proach
10.4 Enhancing public spaces
10.5 Sharing services and infrastructures
Implementing collective spaces for recreational activities

SOCIO-ECONOMIC SUSTAINABILITY

11 SUPPORTING AUTONOMY

11.1 Integrating residential and production spaces
11.2 Implementing autonomy in food produc-
11.3 tion
11.4 Implementing autonomy in water supply
Implementing local systems for goods transformation and conservation

12 PROMOTING LOCAL ACTIVITIES

12.1 Fostering local production
12.2 Fostering a short supply chain
12.3 Fostering local labour
12.4 Fostering local economy
12.5 Fostering the use of local materials

13 OPTIMIZING CONSTRUCTION EFFORTS

13.1 Adopting appropriate size
13.2 Promoting low-tech techniques
13.3 Reducing transportation of goods
13.4 Sharing common spaces

14 EXTENDING LIFETIME

14.1 Replacing building components when
14.2 needed
14.3 Implementing effective protection systems against weathering
14.4 Implementing effective maintenance plans
14.5 Fostering flexible systems
Implementing long-lasting structures

15 SAVING RESOURCES

15.1 Sharing infrastructure and services
15.2 Promoting urban density and building compactness
15.3 Integrating renewable energy sources
15.4 Reducing embodied energy
15.5 Minimizing heat losses
15.6 Integrating passive systems

Table 2. The sustainability principles and related strategies

2.2. VerSus principles and strategies for indexing, archiving and researching cases

VerSus methodology approaches the concept of sustainability from a transversal, holistic and multidisciplinary perspective. The methodology is based on three main levels of reading: 1. Three sustainable scopes: environmental, socio-cultural and socio-economic; 2. Five principles/aims or key questions related to each sustainable scope; 3. For each principle a list of strategies learnt from vernacular heritage for the design of a more sustainable architecture.

The definition of the 15 principles and related strategies is the result of a deep research work that started from the observation of vernacular architectures, which unlike standardised solutions of modern architecture, have adapted over time to local resources, to the limits and the risks defined by the natural as well as the socio-economic context.

Principles and strategies related to the environmental dimension of sustainability refer to the capacity to integrate a settlement, a building, and their related crafts with the environmental characteristics of a place, benefitting both from natural and climatic resources, and by limiting pollution and waste. Principles and strategies related to socio-cultural sustainability refer to the capacity to guarantee and strengthen the sense of belonging, cultural diversity, local knowledge and know-how, personal and community well-being, social cohesion, the recognition of tangible and intangible cultural values. Socio-economic sustainability principles and strategies refer to the capacity to produce and maintain income and social well-being within the territory, supporting autonomy, promoting local activities, and saving resources.

Indexing through the VerSus strategies and principles listed in Table 1.2 is aimed at archiving vernacular knowledge to be used in the context of problem-solving, where 360-degree sustainability is a priority for the definition of new design ideas. The list of strategies is not fixed but it can be expanded and adapted according to the choices and the entries of the users who will use the App.

3. Implementation: a collaborative and cognitive Web App

3.1. Designing VerSus plus App: concept

The VerSus plus App is a multifarious disseminating tool that brings together different aspects: documenting and mapping tangible and intangible elements coming from vernacular heritage; looking for references of architectures, landscapes, understanding people knowledge where sustainable strategies are applied; understanding the sustainability degree of a case; and creating a network where all users can contribute to the construction of this database.

The Web App came out firstly as a tool for mobile devices, emphasizing the immediacy of the use and the accessibility to anyone from everywhere. It can be used as a map where the icons suggest the category of the entries, or by browsing the list of all of them (Fig 1). In this way, it is possible to customise the experience using filters, so that the users can visualise the features they need. Users can select according to their personal interests choosing between different categories (from cultural landscape to human scale), materials, types of intervention, sustainability principle and strategies.

By logging in the app, people can insert new entries contributing to the growth of the available database. As shown in the last image of the Fig 1, the sheet of the entries contains some generic information (category, address/place, materials, period), a brief description, a gallery with images and videos, and some references that user could simply fill in together with the attribution of tags that correspond to sustainability strategies and principles of the feature.

A basic profile of the users could be a way to connect people that are members of this network. The possibility of sharing references, links, contacts goes with the idea of creating synergies and connections with similar realities. For a better understanding of the sustainability principles or a deeper investigation on the thematic field, visitors or members can find supportive materials.

The first mapping campaign of the various features has been done for the two case studies of Sant'Antioco (Italy) and Formentera (Spain) and then opened to the other inter-project experiences. The cases already documented in the previous projects (VerSus, 3d Past) are loaded. The app will be subsequently implemented by students and researchers involved in the activities that apply the VerSus methodology (Muñoz et al., 2022) and by all people that become aware of it and recognize its values. Existing networks among scholars and professionals in the fields of sustainability and vernacular knowledge will be the main channels to disseminate the VerSus plus App.

3.2. UI/UX design tools applied to the project

The design and development of User eXperience (UX) / User Interface (UI) design of the Web App has been preceded by extensive research and followed three main principles: User-Centered Design (UCD); mobile first approach; "map-first" approach in data presentation. The three principles can be considered, for this project, strongly correlated.

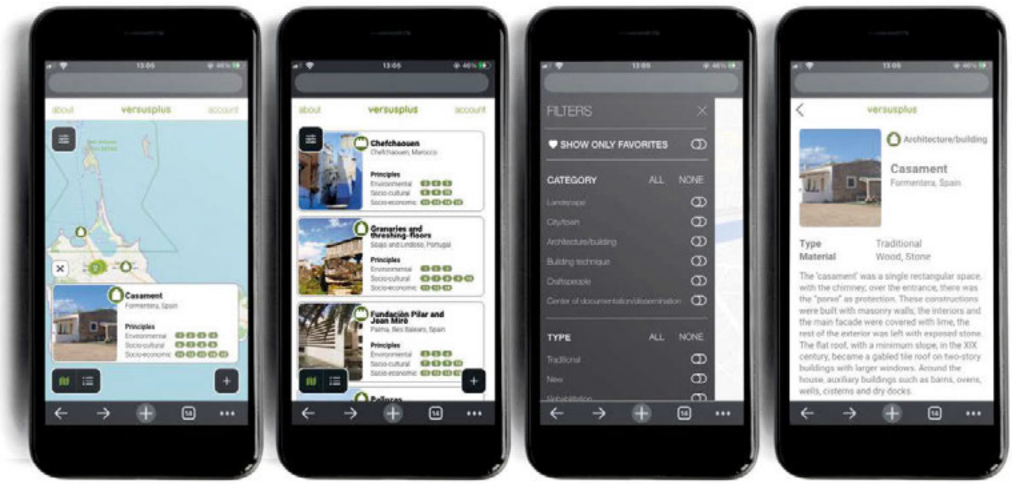

Fig. 1. Versus+ Web App interface

Mobile web cartography is a relatively recent field that in the last years has seen a significant development. Nevertheless, most of real applications are still in the commercial sector, and research-based projects are still rare or in development (Wang et al., 2017). The present case can be included according to Tsou (2013) classification in the fifth generation of apps, primarily regarding crowdsourcing of data. Mobile-first approach was applied to the design of visual elements and interactions. High value has been given to consistency between mobile and desktop versions, as well as between map-based and list-based presentation of the dataset. The preeminence of the former over the latter, as the main user interaction model, has guided the whole process of design.

The UCD, a widespread design model, was interpreted in this particular case mostly as an attentive research about current patterns and practices in largely used design of mobile and desktop geographical applications, primarily navigation apps such as Google Maps or Apple Maps (Ricker & Roth, 2018). A more specific analysis came from the research of real estate websites, whose dataset share many common aspects with the current use case. The reproduction of patterns of behviour found in existing and widely used digital tools has the specific aim of improving the ability to interact with the interface for first time users. The UX design of the application is oriented in enable users to interact in easiest way with a complex geolocalized database, organized in a highly articulated classification system. The navigation and UI is studied to be accessible in desktop and mobile environments to all kind of users, granting different levels of detail to both occasional and recurring visitors. Layouts and icons were chosen among a series of options following usability tests on a sample of potential users.

4. Conclusions: expected positive outcomes

The value of traditional and local knowledge in providing models capable of generating solutions that strengthen the identity of the community are sustainable over time from a social, environmental, economic, and undoubtedly cultural point of view is widely recognized.

VerSus plus Web App allows to connect architectural examples and related practical knowledge in a semantic network, where conceptual links are created by the principles of sustainability, through which we intend to interrogate and navigate the remarkable heritage of vernacular knowledge.

The use of the tool over time will give us feedback on the usability of the Web App, so that we can work on its strengths and weaknesses. Moreover, periodic considerations on the system provide an analysis of the citizens' approach/trends and interests in the vernacular heritage and could provide an outlook on where we are standing in terms of learning from sustainability strategies. This is also useful to bridge the gap between experts and users in order to allow decision making processes about urban heritage capable of engaging both experts and civil society (Ginzarly & Teller, 2021; European Commission, 2017).

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Cultural Heritage: Educating the Next Generation. Case Study Analysis of the Center of Preservation Research

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Topic: T2.4. Creativity and Heritage Education

Abstract
2A<H8DE<FKĀ'8AF8DEĀ6B@5<A87ĀI<F;ĀEC86<4?<L87ĀC8DE8EFD8@8IBD>Ā9BDĀ946G?FKĀ EFG78AFEĀFBĀ8AA4D47<F<BA4?Ā4A7Ā4CC?<87ĀD8E84D6;Ā4DA<A:Ā46DBEEĀ7<E6<C?<A8E$Ā1;<EĀ C8DĀI<??ĀCD8E8AFĀ4Ā64E8ĀEFG7KĀB9Ā.D8E8DH4F<BAĀ.8E84D6;ĀBC@8AFĀ4A7Ā<FEĀ6BAA86F<BAĀFB EFG78AFEĀ4A7Ā4EF8DĀB9Ā06<8A68ĀEFBD<6Ā.D8E8DH4F<BAĀ7D8EE<A:Ā4AĀ8JC8D<8AF<4?Ā?84DA<A:Ā @B78?$Ā1;8Ā9B6GEĀ<EĀBAĀ87G64F<A:ĀF;8Ā8JFĀ:8A8D4F<BAĀ4A7ĀB9ĀCD8E8DH4F<BAĀ4AĀGA78D EF4A7<A:ĀB9ĀF;8ĀD8:<BA4?ĀEĀ;<EFBD<6Ā8AH<DBA@8AF4?Ā4A7Ā6G?FGD4?Ā4A7ĀD8EBGD68Ā9BDĀ4 7D8EE<A:ĀCD8E8DH4F<BAĀ887EĀF;DBG:;BGFĀF;8Ā&@8D<64AĀ8EF$ĀF;4F<L4F<BAĀ78H8?BC# @8AF"ĀEFDG6FGD87@<A<EFD4F<BA"Ā4D84EĀB9ĀD8E84D6;Ā4A7Ā8JC8D<8AF<4?Ā?84DA<A:ĀCDB=86FE F;4FĀ8@8D:87Ā9DB@ĀD8:<BA4?ĀA887E"Ā6?4EEDBB@ĀC8DE<EF8AF<4?Ā4DB47Ā8JF8DA4?Ā6BAEF<B 8A6KĀ<AĀF;8ĀCG5?<6Ā4A7ĀCD<H4F8ĀE86FBDEĀ6BA6G?F4F<BAĀ4A7ĀEFBD<6Ā CD8E8DH4F<BA$

***Keywords:** 'G?FGD4?Ā*8D<F4:8"Ā)7G64F<BA"Ā)JC8D<8AF<4?Ā+84DA<A:*

1. Introduction

Partnerships and collaboration between universities, public and private sector organizations, and local and regional communities represent a different type of association not typically found within academia. These relationships often develop as part of a program curriculum dedicated to experiential learning, whereby students learn by doing, or within the structure of a center that links research, teaching, and service-related components.

The value of this multi-pronged connection is the capacity created for students to engage in learning and research in response to a community's needs, acquiring knowledge through experience and guidance from experts as they prepare for their professional careers.

1.1. Center of Preservation Research

Between 2010 and 2020, Colorado was one of the fastest-growing states, with a population that grew at nearly twice the rest of the nation. Colorado saw almost 15% growth while the nation's population grew only 7.4%. Development along the urban Front Range grew faster than the national average, while the state's population more than doubled in the past 40 years, with much of that growth occurring between 1990 and 2000.[1]

The impetus for the Center of Preservation Research (CoPR), pronounced 'copper' and referred to as the "Center" hereafter) was to direct the momentum from a multidisciplinary faculty involved in teaching and researching communities challenged by this type of population growth and development pressures.

[1] Colorado State Demographer, U.S. Census Bureau.

Faculty taught courses on architecture, landscape architecture, historic preservation, public history, archeology, museum studies, and geography using experiential models. The research and teaching explored the effect of urban infill on the adaptive reuse of existing buildings, the demolition of designed landscapes, the impact of suburban development on agricultural lands in creating sprawl, the loss of rural working landscapes and small-town communities, and the negative impact of tourism on natural and historical sites.

The Center would also create a mechanism for connecting the interests of the faculty with the needs of external agencies such as the National Park Service and other federal agencies, the State Historical Fund, or professionals in the private sector.

The Center was initially approved under the name the Colorado Center for Preservation Research (CCPR) in 2004 as an outcome of existing faculty-centered research and teaching, focusing on heritage and the impact on the surrounding areas experiencing accelerated growth in the region. Existing courses taught in the College of Architecture and Planning (CAP) were combined with existing courses in the College of Liberal Arts and Sciences (CLAS) history department to create a Certificate in Historic Preservation (CHP) shared between CAP and CLAS. Recognizing the students' need and interest in developing a deeper understanding of preservation and the region's opportunities, the faculty's role in CCPR was reimagined through facilitated meetings to establish a new vision, mission, and name. The Center built on the foundation established by CCPR with a reenergized vision and direction, a new commitment among faculty, and a new name that broadened its reach beyond the state to the region and the American West. The Center’s acronym conveys the historical significance of the relation to the landscape of Colorado. It directly denotes the influence of the Center on preservation and the region since it is quite literally in the “center” of preservation activities in the American West.

The Center's new mission was to be an interdisciplinary, collaborative, adaptable organization that investigated and participated in preserving the region's built environment, cultural landscapes, cultural heritage, and natural landscapes. As the interest and need for preservation education continued to grow, the Master of Science in Historic Preservation (MSHP) was created and approved by the university in 2010, aligning with the applied research in the Center. CAP housed and administered the degree exclusively, distinguishing it from other preservation programs typically found in history departments. The CHP was then administered solely through the history department. Students in both colleges participate in courses in both disciplines.

1.2 Strategic Initiatives

Heritage preservation in Colorado was and continues to be at a crucial point for embracing a change from the established building-oriented approach to exploring preservation at a large scale. The value is creating a broader understanding of cultural landscapes and the connection and interaction between built and natural environments as critical to a sustainable future.

The Center focuses on traditional and cutting-edge approaches to heritage preservation while shaping and advancing the discourse around the inherent value and challenges of protecting place and heritage. Through a series of facilitated meetings focused on developing the mission of the Center, the faculty identified two strategic perspectives for long-term planning—Regionalism(s) and Sustainable Preservation.

Regionalism(s) grew out of several critical ideas that responded to the region's preservation needs and influenced research and education in the Center. The concept articulated the importance of the geographic extent of the Center's research endeavors in the American West. The term Regionalism(s) suggests the significance of place, including the sense of identity that emerges from the specific cultural and social patterns, including the context of the built environment, vernacular forms, and cultural landscapes tied to the authenticity of the place.

The idea of the region focuses attention on Colorado, the Rocky Mountain West, and the American West. The spine of the Continental Divide, extending upward from northern Montana to New Mexico, defines the Rocky Mountain West. The land and the mountains are as important a part of the region's narrative as its geography.

Appending the (s) to the term regionalism conveys the projects' geographic diversity and breadth. At the same time, emphasizing the Western United States, mainly through educational fieldwork and local preservation endeavors, the Center recognizes and celebrates projects that extend far beyond the borders of the Rocky Mountains and the American West.

Sustainable Preservation relates to the motivation to "build green" and has gained tremendous momentum with the ever-growing concern about preserving vernacular structures and cultural landscapes associated with sustainable environments. These challenges are particularly acute in Colorado, with some of the nation's most fragile natural environments and distinctive cultural landscapes.

Historic preservation and sustainable design increasingly engage the professional, academic, business, civic and public communities. The discourse, practice, and theory surrounding these models become more complex and should encourage debate and discussion, foster problem identification and resolution, test principles against an application, and present ideas, solutions, policies, and tools that can inform decisions in the field.

These strategic perspectives guide the development of research, projects, courses, and the pursuit of external funding resources. The two identified areas are broad enough to be engaging and encourage invention, yet definitive enough to be articulated to individuals and organizations outside of the university.

In addition to the two overarching strategic perspectives, the faculty developed three initiatives that further characterize the Center's research, practice, and educational focus. Those initiatives include the Built Environment, Layered Landscapes, and Education.

Built Environment

The emphasis is on preserving historic districts, neighborhoods, and vernacular environments, focusing on understanding the context and significance of a place for potential local, state, or national designation as a significant site, assessment, documentation, and planning projects, and designs directed toward adaptive reuse. Examples of the type of projects include pattern books for historic neighborhoods, Light Detection and Ranging Remote (LiDAR) scanning of historic structures and environments, adaptive reuse, and the creation of historical contexts.

Layered Landscape

The layered landscape was evocative of the increasing awareness and importance of cultural landscapes beyond the physical to include the interpretation of the past and present, including the full spectrum of the natural, manmade, and historical forces that altered the landscape. Examples of the type of projects include surveys of historic farms and ranches and LiDAR scanning of historic sites in the CANM, creating regional historical contexts.

Education

Using the State of Colorado and the region as a laboratory, the Center's areas of foci supporting the MSHP curriculum create a synergy for experiential learning through education, rethinking traditional approaches, and advancing innovative research. The Center has become a hub of preservation scholarship, education, and community engagement in Colorado and beyond. Examples of the courses include Regionalism(s) and the Vernacular, Documentation, Analysis, Representation, and Historic Buildings in Context.

2. Historic Preservation Education

There are several educational paths available to students in historic preservation careers. A traditional course may include enrollment in an undergraduate or graduate historic preservation degree program, certificate, or developing an area of emphasis with a degree not specific to historic preservation.

Approximately forty-five degree programs related to historic preservation exist nationally, almost a 50% increase in programs over the past decade. In addition, there has been a 40% increase in programs with research centers, for a total of eleven centers dedicated to historic preservation. The growth rate in the number of programs is a clear indicator of the importance of this area of study and an interest in research and experiential learning.

A survey of the historic preservation programs suggests that the most common graduate degrees are the Master of Science in Historic Preservation and the Master of Arts in Historic Preservation. Universities also offer degrees with specializations, concentrations, or areas of emphasis in historic preservation. For example, the University of Colorado offers the Master of Science in Historic Preservation. Colorado State University offers a Master of Science in Construction Management, emphasizing Historic Preservation. Both are public institutions. The Colorado Mountain College (CMC), a private institution, offers an Associate of Applied Science Degree in Historic Preservation. Only four west of the Mississippi River provide graduate degrees in Historic Preservation—Colorado, Texas, California, and Oregon of the nationally identified programs. Up until 2020, only three of the eleven research centers were located in the Western United States—two in Colorado and one in Texas—demonstrating the substantial opportunities available for the Center and the need to address historic preservation concerns in the region and the American West.

Another educational path is involvement in a university center that conducts fieldwork and research as its primary mission. The Center aims to become a resource where faculty, students, organizations, and communities come together to serve the preservation needs of the region.

In 2008, the state's historic preservation office had identified, surveyed, or documented less than 5% of the state's cultural resources, creating an opportunity for research and teaching. The state boasted the most significant preservation funding in the nation, raised from legalized gaming in designated historic towns. Although Colorado also hosted many private and public sector preservation organizations, there was a continuing need for professionals to address the state's preservation needs.

2.1 Learning Lab

The structure developed in the Center supported the organic growth of the Learning Lab model. The Learning Lab became a vital component of the MSHP and addressed and rectified several issues relating to the management, administration, and continuity of student-centered projects. Projects would often be started and explored in the classroom during a fifteen-week period ending in a wide variety of outcomes from the various students.

Projects started in the Learning Lab involve hands-on learning and applied research, a physical space for learning, fieldwork, and pedagogy that allows students to participate in real-world projects. Under faculty supervision, students engage in fieldwork and often continue in classroom activities. They initiate, research, develop, and complete the types of projects they will undertake as professionals. The benefits of the Learning Lab are:

- Engaging in hands-on experiential learning and interacting with historic preservation professionals and communities.

- Enhancing experiential learning through interaction with various preservation constituencies and applying problem-solving activities in multiple environments.
- A multidisciplinary and professional environment to participate in real-world preservation projects with faculty, professionals, and communities.

The projects in the Center focus on three key areas: Assessment, Documentation, and Survey.

Assessment

The Center's assessment projects focus on classifying existing conditions, recommending treatment approaches and options, and analyzing potential reuse opportunities for historic buildings and structures throughout the region by producing detailed written and photographic reports. The goal of assessment is to understand the building's condition before any physical intervention takes place. Examples of the types of assessment projects undertaken include evaluating the structural integrity of a one-room schoolhouse, developing a Historic Structures Assessment for a 1917 historic grain elevator and agricultural warehouse, and evaluating the transition of the granary into a community gathering space to connect back to each other and the land.

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3;KĀ&EE8EE@8AF%

- Any treatment of a historic building needs to begin with a building condition assessment; assessments are the first step in restoring or preserving historic structures.
- Creating a permanent record of a property's physical and historical characteristics enables appropriate choices when moving forward on a project.
- Obtaining information as a basis for planning, maintaining, and managing historic resources.
- Establishing priorities and costs for preservation, reconstruction, restoration, and rehabilitation approaches.
- Making a rapid evaluation of a structure after a natural or manmade disaster.
- Locating and assessing endangered resources and documenting their current conditions and immediate threats.
- Evaluating adaptive reuse or energy retrofit upgrade plans based on the Secretary of the Interior's Standards, raising public awareness of historic resources through outreach, and disseminating assessment findings for potential funding and rehabilitation.

Documentation

The Center's documentation program strives to preserve artifacts, structures, and cultural landscapes, using drawings and data captured with a wide range of tools and strategies. The accurate recording and research of these objects and places becomes critical to creating comprehensive documentation for scholars and the public. Increased awareness of the region and how places fit into a historical and spatial context are valuable outcomes of the documentation projects and research. Examples of projects include documenting significant cultural landscapes found in the Canyon of the Ancients National Monument (CANM), traditional fieldwork and hand measuring of historic ranch complexes, and LiDAR scanning used for complex and large landscapes. All approaches meet the requirements of the Historic Architecture Building Survey (HABS) and Historic Architecture Landscape Survey (HALS). [2]

[2] HABS is the Federal Government's oldest preservation program. Drawings are included in the nation's largest archive housed at the Library of Congress and administered by the National Park Service.

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- Creating a permanent and accurate record of a place, providing information for future scholars. To promote understanding of the technology employed and why a technology used is appropriate.
- Recording threatened or endangered resources for future research and study.
- Raising public awareness of historic resources through public dissemination of digital and non-digital interpretive materials.
- Understanding artifacts, buildings, and cultural landscapes that help define communities.
- Provide agencies with data for management plans, archiving, metadata strategies, and complete documentation processes.
- Developing interpretive and heritage tourism goals based on documentation results.
- Understanding the issues facing the creation of digital documentation standards and guidelines.
- Training research associates, students, and volunteers on documentation strategies.
- Educating and inspiring students and the public.

Survey

The Center's survey program focused on identifying, researching, recording, evaluating, designating, and interpreting the historic buildings and landscapes of the region by producing detailed written and photographic records. The goal was to foster an increased understanding and awareness of the built environment.

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- Understanding the buildings and landscapes of a community, county, or region by identifying defining historical, cultural, aesthetic, and visual characteristics.
- Creating a permanent record of a property's, community's, or region's physical and historical characteristics provides valuable information for future scholars.
- As a basis for planning, identifying the properties that contribute to a community's character or illustrate its historical and architectural development by providing the data needed to make informed decisions about managing these resources.
- Establishing priorities for conservation, restoration, and rehabilitation.
- Identifying buildings of a particular type, style, or period.
- Locating threatened or endangered resources.
- Identifying buildings or landscapes eligible for historic designation on a local, state, or national level.
- Raising public awareness of historic resources through survey outreach.
- Educating through the incorporation of survey data into interpretive plans.

3. Opportunities and Challenges

In the Center, students conduct historic preservation research projects and learn about heritage in the field. The projects would not be possible without the students; the students would not have the opportunities available through experiential learning without access to the projects, and the communities and agencies benefit from the outcome. The following describes the type of projects developed in the Center:

Traditional Historic Preservation

Tradition preservation projects are conducted at the Center for a specific end-user or organization for an agreed-upon fee. They include documentation, survey, assessment, nominations, and context studies that require the provision of a clear deliverable and agreed-upon date. The process parallels the expectations encountered when working in the profession. In the Center, projects involve a faculty member as Principal Investigator (PI) who supervises paid students in conducting and completing the project. These projects have often developed initially through a course in which the students receive grades and credit for the initial work completed.

-CCBDFGA<F<8E—These types of projects educate students in basic preservation skills. Students who work in the Center are paid for the work completed; internship opportunities in the profession often emerge for individual students.

';4??8A:8E—Quality control issues associated with an inexperienced student workforce are challenging, often requiring unanticipated corrections and revisions by the PI beyond the project's original scope. The additional effort often results in more significant resource expenditure than initially budgeted. Timing also can be problematic when projects begin or run through the summer when fewer students are available.

Design, Planning, and Building

Although these projects are also conducted for an end-user or organization and include a documentation phase, they go beyond the detailed reports related to traditional historic preservation and differ in overall objectives and deliverables. These projects consist of preservation master plans, pattern books, feasibility studies, and conceptual design that often involve courses such as seminars and studio classes.

-CCBDFGA<F<8E—Critical to the success of such projects is the need for the project to align with the design and research interests of the faculty member/PI since their experience and ongoing involvement are significant. These projects substantially benefit students in their real-world application and serve as a form of community outreach.

';4??8A:8E—The challenges and disadvantages discussed in the previous section also pertain to these projects. Their scope often lasts well beyond the scope of a semester.

Applied, Leading-Edge Research

Applied research encompasses academic research to solve problems, advance technology, and contribute to professional practice. There is the opportunity to join theory and practice and advance new technologies. This type of research in historic preservation is valuable in university preservation research centers.

-CCBDFGA<F<8E—Applied research provides an exciting opportunity to achieve prominence and distinction, opening avenues to new funding sources.

';4??8A:8E—This type of research represents a much greater and more ambitious mandate and requires substantial funding to stay relevant in the use of cutting-edge technology.

Traditional Academic Scholarship

Academic research is a central component of the Center's mission and vision. Traditional academic research enables faculty to explore emerging practices, issues, and significant trends in historic preservation practice and theory. Faculty and research associates present research findings through papers at academic and preservation conferences with the intent to broaden the research or develop journal articles.

-CCBDFGA<F<8E—Traditional research is critical in creating visibility and academic credentials. These research endeavors provide a substantial opportunity to develop an essential presence in the heritage and preservation communities and discourse. A considerable amount of data was collected by teams for projects throughout the years that will inform future research and publication.

';4??8A:8E—The challenges with traditional research are based on the time required to develop a meaningful article while also being committed to fieldwork, timelines, and managing data. One disadvantage of this type of research is that it is not a substantial source of funding nor a mechanism for curriculum delivery.

4. Conclusion

Research and historic preservation education at the Center has taken significant strides forward during its existence. The Center (2008) and the Master of Science in Historic Preservation (MSHP (2010) focus on addressing Colorado's preservation needs and educating the next generation of preservation professionals.

The Center's Learning Lab serves a greater educational mission by delivering classes comprising the historic preservation curriculum and focuses on research and pedagogy, experiential learning, and mentoring for student success. The Center's Learning Lab serves as a catalyst and a forum for dialogue about cultural heritage and historic preservation.

The Center has completed approximately $1.5 million in funded projects over the past decade and employed thirty-five graduate students. The project outcomes include thirty projects focused on the documentation of built environments and cultural landscapes; fifteen projects focused on surveys of individual structures, neighborhoods, and main streets, and nominations for individual structures, complexes of buildings, and entire landscapes; four Historic Structure Assessment projects that evaluate the condition of buildings for preservation planning; and two projects focused on education including the development of the Master of Science in Historic Preservation program and a study evaluating Colorado's preservation educational needs. In pursuing its mission, the Center is:

- Engaging a broad constituency including faculty and students; the greater academic environment; local, regional, and national government bodies; the preservation and professional communities; and the general public.
- Enhancing the understanding and appreciation of culture by investigating material culture, cultural heritage, and cultural institutions.
- Advancing the research and discourses surrounding historical and cultural preservation by generating new knowledge and methodologies.
- Contributing to documenting and disseminating new historic and cultural preservation developments through education, publication, symposiums, and research sharing.
- Emphasizing the use and value of the history of the built environment as a resource in shaping the future.
- Celebrating the concept of "Regionalism(s)" in its work throughout Colorado, the Rocky Mountain region, across the United States, and beyond.
- and inspiring appreciation of place as a source of identity, value, and belonging.

The Center serves the students' education and the region's preservation needs through a mutually beneficial partnership with stakeholders. The Center develops a strong connection with the public and private sectors, preservation professions, design professions, and surrounding communities. Over the past decade, work produced at the Center has been recognized, and a reputation built in documentation, cultural resource management, and interpretation. The efforts have contributed to the significant historic preservation body of knowledge and discourse, locally, nationally, and internationally.

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ARTISANS AND CRAFTS OF TRADITIONAL CONSTRUCTION

INTANGIBLE HERITAGE: THE MANAGEMENT OF KNOW-HOW AND LOCAL CONSTRUCTION CULTURE

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The towns of the Popocateptl Volcano. Territorial symbolism, cultural identity and vernacular architecture

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Topic: T3.1 Intangible heritage: the management of know-how and local construction culture

Abstract

This paper addresses the link between territory and identity from a cultural geography perspective. Small villages that lie in the Popocatépetl Volcano in central Mexico are used as cases of study. The paper is based upon natural and social features as well as in the meaning and symbolism that underlies the attachment of the people of the Volcano villages to this place. It is supported by the results of field research carried out over three years in two villages where university students, me as professor and local people joined together. The methodology utilized for the research was basically a hermeneutical approach to interpret the socio cultural changes of the analyzed regions over the last two decades. In addition, to carry out field work an ethnographical approach was used to describe, analyze and try to understand the changes that the rural communities of the Popocateptl region are going through. The significance that ancestral territories hold for ethnic groups, as well as their attachment to these territories explain the concept of anchoring collective memory. Streets, trails, complementary spaces and elements of daily community life such as orchards and barns, hold historical identity for these people. However, governmental policies, real estate and housing, market interests and the business mechanisms of the cement companies have disrupted the local quality of life together with both the tangible and intangible architectonic and urban historical elements that were present two decades ago in the Popocateptl Volcano region. Only a few decades have sufficed for the globalization interests disguised as progress, to make local people abandon their ancestral knowledge of building dwellings and how to compose their public spaces. All this has been detrimental to the region's natural resources leading to a loss of balance between human space and nature.

Keywords: *adobe dwellings; traditional knowledge; capitalist economic order.*

1. The cultural background, crops and food staples of the volcano villagers

Popocateptl is the name in Náhuatl of an active volcano located in the center of Mexico (Fig. 1). It is part of the neo-volcanic axis, the mountain range that crosses the country from the Pacific Ocean in the West to the Gulf of Mexico in the East. About 35 hamlets and villages lie dispersed at an altitude of 2,300 meters above sea level. Subtropical mountain climate prevails and has created forests of fir trees, cypresses, oaks and cedars. During the Viceroyal period (1535-1821), diverse ethnic groups that lived under the rule of the Aztec Empire settled in this region. Indigenous population beliefs and myths were absorbed by Christianity and a certain syncretic form developed and prevails today.

The closest villages to the volcano crater have a Nahua ethnicity. Nahuatl, their language, is the most widely spoken after Spanish. Their villages and towns that do not form a political unit are scattered throughout various states of Mexico. Since flat land is scarce the inhabitants grow maize for family consumption exclusively. They cultivate vegetable orchards on mountain terraces. Plums, apricots, apples, avocados, blackberries and varieties of lettuce and cabbage are among their crops. In Mexico, the staple food since the pre-hispanic era is corn in the form of tortillas. Corn dough with added fat is used to cook other types of traditional meals. Poor rural communities in Mexico eat mainly corn tortillas and pot beans. As cutlery is generally in short supply, a spoon shaped piece of corn dough named tamal or a tortilla is used and then eaten.

Fig. 1. Location map.

2. Volcano ash: a possible additive that improves the performance of adobe bricks

Local architecture is built in adobe, featured by dwellings of two and a half stories which is theoretically too high for adobe houses, normally built as one and a half levels to prevent the risk of structural failure caused by seismic or volcanic activity. Wooden beams rest directly on top of the thick adobe walls. However, these houses have proven to resist vibrations caused by the active volcano. A compression ring could certainly help distribute the weight of the beams concentrated on points in the adobe walls that tend to develop cracks that can weaken them.

Despite their unusual height proximity to an active volcano, construction errors and sometimes scarce maintenance, the adobe dwellings in this region have stood for at least one hundred years (Fig. 2). This may be attributed to the type of clay used for adobes which contain ash from the volcano. The ash may have increased resistance. In 2018, the National University of Toribio R. Mendoza in Peru carried out a research project where 6 - 8 percent of ashes was added to an adobe mix. The result showed that the addition of ashes increased compressive strength by 65% (Mendoza, 2018). Presumably, the people became aware of the resistance of their adobes and consequently built houses of two and a half stories.

Fig. 2. Adobe house in Ocuituco (Source: Aguilar Prieto, 2001).

Fig. 3. Adobe house in Hueyapan (Source: Aguilar Prieto, 2001).

3. Ancient wisdom disregarded in long lasting dwellings villages

Another particular feature of these houses is the steep slope of the tile roof. Normally, tile roofs support an angle of up to 30 degrees with a maximum of 35 degrees. However, in the Popo region they build slopes of more than 50 degrees (Fig. 4). We believe that it is largely because of the use of flat tiles which are very light in contrast to the much heavier curved tiles. A subjacent story says that these tiles were used as ballast on Spanish ships during the Colonial period. It seems that Spaniards' ships arrived loaded with tiles and left loaded with gold. Presumably flat tiles were manufactured in some town nearby the Volcano region. To prevent adobe walls from erosion caused by rain water local builders widened the angle at the lower end of the tile roof (Aguilar, 2008). Empirical knowledge after long years of observing the natural elements guided them. They might not know other places or other building techniques but they thoroughly understand their region, its ground, climate and local materials. Besides including eaves to protect the adobe walls they know that the earthen walls should be separated from the ground to avoid erosion from ground humidity, essential in a region of heavy rain (Aguilar, 2008). To prevent erosion they extend the stone foundation above the ground level between 60 cm to 1.20 m depending on the street slope.

Fig. 4. Daily life in Hueyapan (Source: Aguilar Prieto, 2001).

4. Types of grain storage in the Volcano region

The dwellings are frequently occupied by a workshop or a store at ground level facing the street. The kitchen and dining room are on the back side overlooking the yard from a portico. Access to the second floor and to the attic is solved using a ladder through an opening in the ceiling boards. Besides being used as a grain storage room, the attic allows keeping a warmer temperature inside the house as it helps isolating the outside cold temperatures during the night, winter months and rainy season. In their patios or yards, another common element for storing grain is the *cuexcomate* (granary in Nahuatl): Large pot-shaped clay containers with a stone base. They have a thatched roof with an opening to allow pouring buckets of cobs. The cobs are pulled out by a small hole on the base. A ladder is used to reach the top (Fig. 5).

Fig. 5. A cuexcomate (Source: Aguilar Prieto, 2001).

Fig. 6. Market day in Hueyapan (Source: Aguilar Prieto, 2001).

5. Time and people have proven empirical building validity

The intuition of the inhabitants that guides them in the development of techniques and skills through trial and error should be highlighted. In this sense, vernacular building methods don't differ considerably from scientific knowledge. Both types of knowledge require vast experimentation. It is always the people who accepts or rejects the outcome. In the scientific method, the experimentation that provides empirical validity is carried out by a single person: a scientist while in the social environment it is carried out by hundreds of people over several generations until it is improved. The inhabitants test it by putting it into practice (Durkheim, 1968).

6. Territorial attachment persists as globalization policies erode socio cultural values

In the beginning of the twenty-first century, the people of the Volcano region led a life that was in harmony with their surroundings and was based on their traditions and culture. Their attachment to their territory has always proven to be very strong. For land owners land is not only where they grow their crops. It is also a fundamental part of their territory to which they are attached in a symbolic and profound way. The territory is apprehended at different levels of geographic scale. One is the local one which in a rural area would be the towns and villages. The village or town for the inhabitants, is an object of attachment and identity (Giménez, 2016, p. 154) "Globalization, like modernity constitutes an unequal process" (Giménez, 2016, p. 158). When the Volcano erupted in early 2001 and the inhabitants had to be evacuated, elderly people were reluctant to leave their land and their animals saying they would rather risk dying under the ashes than leave their homeland. Nevertheless it wasn't the volcano activity that brought destruction to the Popocateptl towns.

About two decades ago globalization disguised as progress and decadence dressed as modernity arrived in this region. Local people succumbed to the temptations of what they believed to be progress. Ignored by state governments these isolated and marginalized communities have been affected by poor health services and the low quality and shortage of schools and other public services. Therefore, anything that seems to be an improvement is accepted. Social structures condition people minds whose choices are not made according with their own culture but subordinated to the market interests. Furthermore the construction of their traditional and vernacular houses implied a way of life that had become unsustainable because of the external interference and influence of the market as well as unattractive due to the overwhelming influence of the media and marketing. Values promoted through public education have played a role as well. Westernized mass media influence and pressure is devastating and reaches so deep at the socio-cultural level that the communities tend to abandon their traditional homes and instead utilize industrial building materials. What they believed was progress caused material and intangible destruction of their construction traditions and the balance achieved in the region over centuries. Moreover, it corrupted their historical knowledge. I believe that the disdain towards their historical assets comes from the dominant sociocultural representations that associates traditional dwellings with poverty and vernacular architecture with ignorance.

At the end of the twentieth century concrete blocks began to be commercialized in the Popocateptl villages and towns (Aguilar, 2008). Local governmental building programs encouraged the suppression of traditional houses as they became obstacles to financial gain. It was and is to this day a compelling cultural mechanism that considers indigenous people as backward and don't recognize their traditional life style. As a consequence, knowledge acquired over centuries and transmitted from father to son gives way to a general contempt for adobe houses and collective building. Adobe must be made when it is not raining but block that can be used at any time of the year which contributed in a significant way, to make it popular.

Another factor that makes a dramatic contribution to the abandonment of the traditional practice of building adobe dwellings is the widespread phenomenon of immigration to the United States and to the richer northern Mexican states where poor peasants find work as laborers. Demographic movements are the consequence of the lack of means of subsistence — a desperate way to earn a salary and improve living conditions. But at the same time immigrations potentially causes the uprooting of populations and the modification of socio-cultural values. It is very strong because it underlies the narrative of discrediting one's own home and encourages competition with one's neighbor which did not exist when communities were more homogeneous and mutual aid prevailed. Their cultural heritage was colonized without the inhabitants noticing. One might ask if traditional knowledge and practice are inferior to modern technology? Even when the former has proven its usefulness and relevance (E. Dussel, 2018). Let us remember that modernity starts from an individualistic, mechanized and quantified standing point, while rural people have distinguished themselves by their collective organization and their community values (Dussel, 2018).

Had it not been for the overwhelming marketing propaganda these towns could have fought for their economic self-sufficiency and food autonomy and they would had found the resilience necessary to prevent the social and environmental collapse warned by Carlos Taibo (Taibo, 2020) among other social critics. Instead they were dragged into the maelstrom of the world economic order that has been implanted in most communities world wide.

7. Authoritarian use of force and insensitivity combined for the destruction of vernacular cultural heritage

The cobbled stone streets of these towns are built driving the stones into previously packed earth. In addition to durability the flexible packed earth pebble stone pavements allow rainwater to penetrate and recharge the water table. In these villages people are used to walking long distances (Fig. 7). Trucks are mainly used to carry crops from the surrounding mountain orchards.

Fig. 7. In these towns streets are made for walking (Source: Aguilar Prieto, 2001).

Persuaded to modernize their villages and make them resemble modern cities instead of traditional towns, together with a lack of knowledge that would encourage them to undertake sustainable projects for real community benefit, local authorities decided to invest financial resources for public works in widening the traditional cool cobbled streets and pave them with concrete slabs overlooking the consequence of blocking the recharge of the subsoil. Additionally, the concrete paving was poorly done without providing for drainage without which, the streets were often flooded during rainy season. Unlike the cool, cobblestone streets (Fig. 8) the concrete slabs substantially increase the heat of the streets blinding people as the sun's rays hit the concrete. In rural towns where life still takes place outdoors closer to nature, streets are for walking more than for vehicles.

Fig. 8. Serene cobbled stone streets (Source: Aguilar Prieto, 2001).

Fig. 9. Adobe houses ordered to be demolished against people's will (Source: Aguilar Prieto, 2001).

In the early days of this century less than fifteen vehicles each day travelled the streets of the Popocateptl Volcano towns. Yet, local authorities' goal was to widen the streets to resemble the avenues of large cities. Consequently, they ordered the demolition of one meter of all the adobe houses on both sidewalks. During the night while they were sleeping excavators were sent to the homes of the inhabitants who opposed the measures. Terrified, they fled and the intruders proceeded to partially demolish their property, obviously without the consent of the owners. These atrocities against the people's properties took place at the beginning of the century. My group of social service students and I witnessed the deliberate destruction of these towns. The urban physiognomy that had been created in harmony with the local scale and the way of life of these villages had been altered permanently (Fig. 10). The place had lost its sense of identity and its genius loci which had been born out of interpreting its natural surroundings (De Albuquerque & Ferraz, 2009).

Fig. 10. Widened cobbled stone street and concrete slab create loss or harmony in these towns (Source: Aguilar Prieto, 2001).

We shared the satisfaction of the people who maintained their adobe houses and kept them in good condition. Ernestina was an elderly lady who lived at the entrance of one of the villages. She owned several housing units on the land that made up her property; her own house and one for each of her children.

Fig. 11. Mrs Ernestina at the entrance holding pride of her house (Source: Aguilar Prieto, 2001).

She kept her yard very clean and placed flowers above the threshold to welcome travelers to stop and admire her dwelling. When we arrived she was standing in front of her piece of land smiling with pride and willing to be photographed (Fig. 11). Fortunately her property did not obstruct the project to widen the streets of the local authorities and she was not forced to demolish her dwelling.

Another neighbor was convinced of the benefits that adobe provides as a shelter from the cold and the heat. He argued that in contrast with concrete waste that contaminates and devastates nature, adobe is clay that simply reintegrates to the earth when it degrades. He opposed having his house torn down and fought to keep it safe. The intruders were unaware that the carpenter assistant was sleeping there. Fortunately the young man became aware of the smoke in time to flee to safety. However the entire workshop was destroyed. To destroy it was the mechanism to make the home owner aware that he was bound to comply. In remote towns the law is that of the strongest and in this case it belongs to the one that has the political power. There is no legal protection whatsoever.

8. Conclusions

In conclusion, I would like to state that knowledge is an essential resource for rural people. Along with their history, it forms their strength as a communities. Knowledge is a form of capital. As the sociologist Pierre Bourdieu states: knowledge constitutes a capital in itself but its value is subject to the possession of another capital: that of recognition (Bourdieu, 1986).

The historical wisdom that rural communities of the Popocateptl region possess is reflected in how they grow crops, use medicinal herb and confront different features of their territory such as volcano activity and its risks. This wisdom also includes the techniques used in building their traditional dwellings. As a consequence of the problems that the villages are experiencing, is that regional historical knowledge has ceased to be transmitted and put into practice by new generations. Cultural marginalization in rural and indigenous communities adds to socioeconomic alienation created by the prevailing socioeconomic order.

Technology is developed to improve the quality of life for millions of people. Nevertheless, scientists, engineers and politicians usually do not measure its negative effects on nature or society. In contrast, the simple life of rural communities becomes exemplary because its consumption is more balanced and does not overexploit natural resource5s (Dussel, 2018). Now, to live a simple life is a natural response to human needs as a group. Rejecting their building traditions and cultural values is not something they have chosen but the result of long internalization processes about the ethnic condition stigma that indigenous and rural people have suffered from society.

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Methodology for mapping Intangible Cultural Heritage through webGIS integral platforms. La Fontanalla neighbourhood as a case study

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Topic: T3.1. Intangible heritage: the management of know-how and local construction culture

Abstract
The identification and cataloguing of intangible cultural heritage (ICH) was defined in Paris Convention by UNESCO (2003). However, it is difficult to identify and map this type of heritage in the territory due to the lack of consensus to establish a common representation methodology. Similar technological platforms identify and geolocate the stakeholders concerned about the safeguarding and transmission of this kind of heritage, with the aim of putting together memories from each heritage item, but not the direct relationship with the specific site. This research focuses on a methodology for mapping ICH through webGIS platforms on a local scale, taking into account the following issue: the intangible elements as an attribute related with other heritage categories. This is achieved by collecting the memories of each resource generated by agents involved —citizenship and associations— and its relationship with the physical environment —tangible cultural heritage: architecture, landscape...—. In this way, the sum of related items allows to identify the connection between ICH and territory. This method has been tested in La Fontanalla neighbourhood through Malaka_net webGIS: a comprehensive platform which shows data sheets about every cultural heritage item from Malaga city. This tool allows cultural heritage to be categorized into different material heritage types —architecture, landscape, archaeology, street furniture and urban pattern— and immaterial ones. The holistic meaning between these categories makes possible to link them through the same attribute: intangible value.

Keywords: *immaterial cultural heritage, place-based memories, geographic information system, heritage values*

1. Introduction

We refer to the mapping of Intangible Cultural Heritage (ICH) to the process of geolocation of a set of intangible assets in certain area, city or territory. The diversity of areas proposed for this type of heritage (UNESCO, 2017b) as well as its nature do not facilitate its identification, cataloguing and mapping on webGIS platforms. Although progress has been made in the geolocation of the ICH —based on the location of the agents and/or places related to the manifestation of the activity—, there is still no consensus on a common methodology for its representation. This research provides a new approach to the ICH identification and geolocation methodology for its inclusion in a comprehensive webGIS platform for Cultural Heritage. This research is structured into two phases: (1) identification and recognition of the ICH by the local community —through the creation of a mixed group and participatory actions—; and (2) its inclusion in the integral webGIS platform. The different identified intangible heritage assets are represented by the geolocation of individuals, groups and organizations related to them, as well as the geolocation of physical signs of traditions and activities.

This methodology has been applied in order to map the traditional pottery trade in La Fontanalla neighbourhood from Malaga (Spain) as a case study. This process has allowed its registration in the *Malaka.net* digital platform, a comprehensive webGIS platform for Cultural Heritage, what contributes to its digital dissemination and protection.

2. State of the art

Previous experiences address different criteria for representation and inclusion of ICH in webGIS platforms. On the one hand, specific platforms on intangible assets focus on ways of transmission. On the other hand, comprehensive platforms contain records of tangible and intangible assets in the same website and show a full map of heritage.

2.1. Diversity of intangible heritage assets and emerging ICH specific platforms.

The holistic nature and the different areas of ICH —oral traditions and expressions, performing arts, social uses, rituals and festive events, knowledge and uses related to Nature and the Universe, and traditional craft techniques (UNESCO, 2017b)— have facilitated the creation of specific platforms based on each intangible heritage asset.

In this sense, the *Colombian Musical Information System* (Ministerio de Cultura de Colombia, 2018) is a platform which places music in the country of Colombia based on the location of its performing/practitioning agents —geolocation of the individuals or groups such as groups, musical entities and music schools—. The relationship of the ICH with the social agents involved in its safeguarding and transmission constitutes, in this way, one of the most used criteria for the mapping of this type of heritage.

The *Audiovisual Map of the Peruvian Intangible Cultural Heritage* (Ministerio de Cultura de Perú, 2015) is a specific ICH platform in Peru based on the location of their ways of transmission. For example, *Master craftsmen* —as practitioners/performers of any type of craft— can be found, as well as *Sound Records, Oral Stories* —any traditional music or voice recordings of the individuals who tell the stories and legends, respectively— and *Documentary records*—videos where the manifestation of the recognized activity is shown—.

2.2. Difficulty of geolocating ICH in comprehensive webGIS platforms.

The “comprehensive” term tries to unify all the cataloguing and protection tools which cover every heritage asset all over the municipality. This allows a global and whole vision of Cultural Heritage according to the concept of Historical Urban Landscape (HUL) recognized by (UNESCO, 2011).

In the scientific literature, comprehensive Cultural Heritage platforms collect information concerning the importance and manifestation of the ICH. However, these platforms do not usually include specific location of ICH in the territory because it does not depend on a single address due to its diversity unlike other kinds of heritage.

In this regard, the *Andalusian Historical Heritage Digital Guide* (IAPH & Consejería Cultura y Patrimonio Histórico, 2016) is an example of a comprehensive digital inventory which brings together the *Intangible Heritage, Movable Heritage, Immovable Heritage and Cultural Landscapes* of the region of Andalusia (Spain). Despite the fact that all the records are geolocated through a webGIS, the ICH assets do not have specific locations related to their manifestation in the territory — they are usually located in the centre of the municipality by default—.

The lack of debate on the methodology of cartographic representation of the ICH assets has generated different criteria for their geolocation, either by mapping the social agents involved or the physical places where they take place.

Faced with the lack of ICH into comprehensive webGIS platforms of Cultural Heritage, specific cultural platforms (Carrasco-Arroyo, 2013) have advanced in its online registration through webGIS. The cultural platforms identify and geolocate any manifestation, both cultural practices or events, which are related with the manifestation of ICH in the territory in a direct way, and tangible heritage assets such as monuments, archaeological zones or gardens.

Culture Gate – A Cultural Heritage Platform (Koukopoulos & Koukopoulos, 2019) is an international cultural platform which contains tangible assets *—Architecture, Archaeology and Visual Art—* and intangible ones *—Cultural Events, Music and Folklore,* among others—. This website geolocates the ICH according to the physical manifestation of the activity: the records registered in *Events and Folklore* have been geolocated by points where they take place.

SINCA Sistema de Información Cultural de Argentina (Ministerio de Cultura de Argentina, 2015) is another cultural platform which geolocates cultural heritage assets accordinnd to its location. Records such as *Material Heritage —Monuments and Sites, Cultural Routes or Libraries—* and *Intangible Heritage —mainly Crafts and Festivals and Festivals—* can be found.

The Fortaleza Cultural Map platform (Ayuntamiento de Fortaleza, 2015) geolocates all the cultural resources of the city of Fortaleza (Brazil) within two categories. On the one hand, it maps in *Agents* all the people, organizations or institutions involved in culture based on their address —musicians, artisans, researchers, writers…—. On the other hand, it locates the cultural spaces of the city. In both cases the point is the geometry of represantion although it uses a colour differentiation.

Following the same criteria of geolocation and representation, *Cultural Map of Costa Rica* (Sistema de Información Cultural de Costa Rica, 2016) provides geolocated information of cultural data of Costa Rica into two categories: *Cultural Sectors* and *Cultural Infrastructure.* The former collects cultural agents, organizations or institutions are located *—Scenic Arts, Visual Arts, Crafts, Audio-visual, Design, Editorial, Music and Advertising—* related to the transmission of the ICH. The latter shows the geolocation of places *—Buildings or Public Spaces—* with a certain cultural relevance.

2.3. Main contributions

Despite the fact that the small number of comprehensive Cultural Heritage platforms which include both intangible and tangible heritage assets, and the lack of consensus on mapping methodologies for ICH, this research aims to develop a methodology for ICH registration and geolocation in comprehensive Cultural Heritage platforms.

Firtly, it shows the experience of a process which combines field work with participatory actions related to the traditional craft of ceramics in the Fontanalla neighbourhood in Malaga as a case study. Secondly, the registration of immaterial heritage assets is taken into consideration too. To do so, a Comprehensive webGIS platform for Cultural Heritage management serves as a local tool: *Malaka.net*. Several innovations are presented according to previous works: (1) participatory actions together with the local community for the recognition of the ICH. These actions have allowed its identification in the work area for its subsequent categorization and precise geolocation; (2) the representation of the intangible heritage asset through a specific registry in the platform *Malaka.net*, as well as its associated elements: individuals, groups and organizations, and the related tangible elements.

3. Methodology

The methology is based on the identification and representation of ICH though local community in La Fontanalla neighbourhood as a case study. Thus, every heritage asset has been registered into *Malaka.net* platform (Ayuntamiento de Málaga & Universidad de Málaga, 2019). This tool is a comprehensive webGIS for Cultural Heritage management for the municipality of Malaga (Spain). It allows the geolocation, identification, dissemination, and management of economic investments on declared, protected, or recognized tangible and intangible heritage. The platform manages the heritage related to the public space, not incorporating private or bibliographic movable heritage.

The platform works with the Arches open source system (Myers et al., 2016) and organizes Heritage into six categories: one for *Intangible Heritage* and five for tangible heritage types: *Architecture, Landscape, Archaeology, Ensemble,* and *Urban Furniture.*

3.1. Phase 1: Identification and recognition of the ICH

Considering the lack of consensus in the representation of the ICH, and its heterogeneity, the identification and recognition of intangible heritage assets constitute an essential phase prior to their inclusion in any proposal for catalogues and inventories. Local communities are the ones and only who guarantee the safeguarding of traditions and knowledge over time (Frieri, 2014). There is a previous research of interest which shows the importance of participation processes in order to involve local communities in the recognition and management of their cultural heritage (Loza Ibarra, 2021; Rey-Pérez & Domínguez-Ruiz, 2020).Taking the local community into consideration constitutes a preliminary phase for the identification of the ICH on a territory. The importance of this stage has been carried out through a set of participatory actions in La Fontanalla neighbourhood.

Action 1: *Creation of a mixed group*. Creation of a focus group of informant agents involving associations, entities, neighbours and other external actors who are experts in participatory methodologies, ICH management and specific knowledge about the neighbourhood.

Action 2: *Identification of the ICH through participatory actions*. Through different participatory actions, the elements and values which local community considers as identarian heritage assets have been identified. These actions include: semi-structured interviews, meetings between informant agents, guided tour with neighbours, and specific workshops related to the intangible assets such as pottery and glass workshops with local artisans and students there.

3.2. Phase 2: Inclusion of the ICH in the Comprehensive webGIS

Action 3: *Conceptual Registration of the ICH.* Each intangible value is registered on its own through the platform. This record does not have geolocation because it refers to the intangible concept of heritage.

Action 4: *Registration and geolocation of the elements associated with the Conceptual Registration of the ICH.* Elements related to the intangible heritage asset are added to the platform. These entries are geolocated and represented according to their heritage category according to (UNESCO, 2017a):

a) Individuals, Groups and Organizations. Each one linked to the ICH in the intangible category is mapped with a specific record. Geolocation is achieved through the address of the agent involved and it is represented by a point. Different roles/profiles can be distinguished depending on the element/activity: practitioner/performer, trustee transmitters and other participants.

b) The characteristics of the element. It referes to those ones which are associated with tangible heritage assets. The intangible condition is an added value for other assets of the tangible heritage from the municipality. To do this, a registry has been created in the corresponding heritage field —*Architecture, Landscape, Archaeology, Urban Furniture* or *Ensemble*— with the aim of linking physical elements or spaces to the intangible activity/tradition. In this way, the ICH is geolocated related to the footprint of the activity. The representation of each record depends on the criteria of each category.

Action 5: *Interconnection of all records with the original intangible asset.* All related entries are linked to each other through *Related Resources* with respect to Conceptual Registration of the ICH.

3.3. Case study: Traditional pottery craft in La Fontanalla neighbourhood

The described methodology has been tested in La Fontanalla neighbourhood for the inclusion of its ICH in *Malaka.net* platform. The work with the local community has allowed to identify different intangible heritage assets such as the crafts of ceramics and glass (PTVMalaga, 2019), which are traditional in the neighbourhood (Asociación Arrabal Fontanalla, 2017).

La Fontanalla neighborhood has its origin in the new population areas outside the walls of the city of Malaga in the eleventh century. It was characterized by the proliferation of kilns for the production of ceramics and pottery, as productive sectors inherited from the Muslim era. However, this activity was in decline throughout the eighteenth century. Currently, the neighborhood maintains traces of its productive background linked to the ceramics trade. This tradition is recognized by the local community nowadays. There are previous experiences which describe participatory actions for the identification and representation of the traditional craft of ceramics as an intangible asset of the neighborhood (Nebot-Gómez de Salazar et al., 2020).

4. Results and discussion

4.1. Recognition and identification of the traditional craft of ceramics as ICH in La Fontanalla neighbourhood

As a result of applying the proposed methodology, different participatory actions have been carried out for the recognition of ceramics craft as an intangible value of the neighbourhood:

a) *Ceramic workshop between the artisan community, neighbourhood and students*. Several sessions have been held on the decoration of ceramic pots in order to promote the intangible value of pottery in Malaga. This action is part of the strategies to raise awareness of the importance of the craft tradition as an intangible value in the environment of the educational institution there.

b) *Guided tour for students by informant agents*. Through an itinerary in La Fontanalla neighbourhood, the students were able to learn about the main heritage assets of the area, as well as its history.

c) *Form about traditional craft of ceramics.* The proposal for the elaboration of a catalogue —where the craft of ceramics is included as an identity element of the neighbourhood— is considered. The preparation of these forms, according to the criteria established by (UNESCO, 2017a), together with the informant agents, has allowed the local community to be involved in the recognition and dissemination of its ICH (Nebot-Gómez de Salazar et al., 2020).

4.2. Registration and mapping of the Ceramics Trade in Malaka.*net* platform

The information collected in the file is recorded in *Malaka.net* platform through the different assets (Table 1) which show the traditional ceramics trade. In this sense, the methodology proposed for the spatial representation of the ICH covers the gap identified in other comprehensive heritage platforms, such as the *Andalusian Historical Heritage Digital Guide* (IAPH & Consejería Cultura y Patrimonio Histórico, 2016). To do so, the webGIS proposed includes geolocated records of the intangible assets linked to the territory.

In addition, the integral nature of the platform provides specific records of each heritage category, what facilitates the visualization of the intangible from other registered heritage assets. Thus, it differs from the review cultural platforms abovemetioned such as *SINCA* (Ministerio de Cultura de Argentina, 2015) or *El Mapa Cultural de Costa Rica* (Sistema de Información Cultural de Costa Rica, 2016). Both mainly geolocate monuments and places as material heritage where culture manifests. Likewise, the *Culture Gate platform* (Koukopoulos & Koukopoulos, 2014) adds *Archaeology* and *Visual Art* records —street furniture of the city— to the previous ones, but it does not offer specific information on the records.

Malaka.net platform enables the relations of the different assets between their heritage categories. Through this characteristic, the ceramic craft, as an example of an intangible heritage record, has been linked to other tangible assets —*Architecture*: chimney of the Santa Inés ceramic factory; *Archaeology*: the archaeological remains of the ovens of ceramic production in La Fontanalla; *Ensemble*: Colonia de Santa Inés neighbourhood, due to the importance of the Ceramic Industry in this area; and *Landscape*: Laguna de Barrera, public space generated from the extraction of clay for the local Ceramic Industry—.

ICH records	Heritage categories on *Malaka.net*	Heritage records	Geometry	Case study. *Traditional craft of ceramic*
Concept	*Intangible*	Domains definided by (UNESCO, 2017b)	-	*Oficio artesanal de la cerámica | Elaboración de la maceta malagueña*
Location according to individuals, groups and organisations.	*Intangible*	Expert/performer	Point	*Escuela de Arte San Telmo | Facultad de Bellas Artes | Asociación Vecinal Arrabal de la Fontanalla*
		Transmitting depositaries	Point	*Museo Picasso | Museo Unicaja de Artes y Costumbres Populares | Museo de Málaga | Museo del Vidrio y Cristal | Taller del Vidrio VIARCA*
		Other transmitting participants	Point	*IES Vicente Espinel*
Location according to the characteristics of the heritage record.	*Architecture*	Cadastral delimitation of buildings	Area	*Chimenea cerámica Santa Inés*
	Landscape	Gardens, public spaces	Area	*Laguna de la Barrera María Eugenia Candau Rámila*
		Historic roads, scenic routes	Line	-
		Viewpoints	Point	-
	Archaeology	Zonas arqueológicas	Area	-
		Archaeological traces or conduits	Line	-
		Occasional archaeological excavations or remains	Point	*Hornos alfareros Arrabal de la Fontanalla | Enclaves Alfareros Dispersos Romanos*
	Urban Furniture	Urban sculptures and fountains	Point	-
	Ensemble	Historic areas, neighbourhoods and surroundings	Area	*Colonia Santa Inés*

Table 1. Traditional craft of ceramic like ICH on Malaka.net. (Source: authors).

In addition, the specificity in the representation criteria in the mapping of each heritage category allows every heritage asset to be distinguished on the map. In this way, it advances with respect to other platforms which only distinguish by using different colours or symbology, but not different geometries.

The graph of *Related Resources* (Fig. 1) enables the visualization of the existing relationships between the ICH and the other heritage categories, which allows its identification and exploration based on the different urban elements of the city.

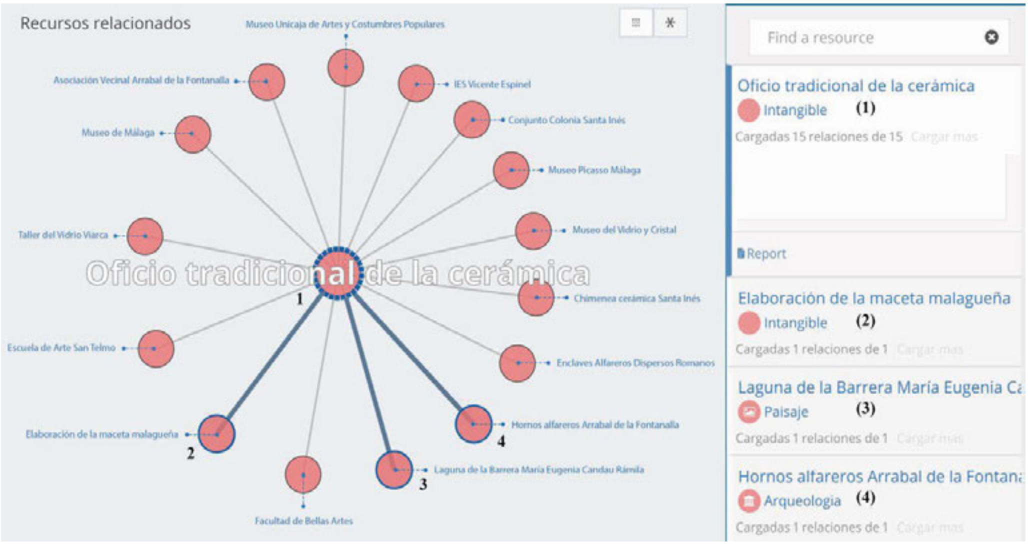

Fig. 1. Resources related to the traditional craft of pottery on the *Malaka.net* platform. (Source: authors).

5. Conclusions

The methodology proposed from the heritage management *Malaka.net* platform allows the inventory of the ICH together with the rest of the heritage assets in a city or territory.

In addition, this methodology provides a precise and complex geolocation of ICH manifestation in a specific area. On the one hand, it provides the mapping of the social agents involved in its safeguarding and transmission, due to its importance in the ICH protection processes. On the other hand, it connects the tangible elements associated with the physical manifestation of activity. The representation criteria of the platform —type of geometry and colour— allow each heritage category to be distinguished, which is of interest for locating areas of concentration or overlap of heritage elements.

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The struggle for Stone-dry walling: the ambition to protect both processes and products

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Topic: T3.1. Intangible heritage: the management of know-how and local construction culture

Abstract

Quoting from the inscription into the Intangible Cultural Heritage List (2018), the art of dry-stone walling concerns "the know-how" related to making stone constructions that explains the interest towards the product process as well as the product itself. The protection of the ability in stones selection and their placement, without mortar or dry soil at most, has moved the attention from walls to walling too. As a result, the idea of authenticity should be rediscussed to preserve not only some existing monuments and amazing landscape, but a living heritage and a sustainable land use. A risk occurs in some coastal areas, both maritime or front lake, and in the valleys, of the Alps or the Apennines. These places are the most sensitive to residential and receptive exploitation; as a result, an aesthetic landscape perception is taking advantage against its structural conception and the authentic art construction for dwelling (buildings), farming (terraced arrangements) or husbandry (cow-walls). The awareness of the role of dry building for the consolidation of the slopes, the protection of the mountain and the harmonious relationship between environments and species the inscription would preserve, is misunderstood. In Italy some evident ambiguities are occurring into practice and local behaviours. Although the inscription has invited preservation program, the governance of the art of terraced arrangement seems often reduced to a picturesque disposal; misunderstood if not betrayed in its authenticity both as a product and as a process. Some case studies are proposed to point out this slipped issue, considering the Lake of Como as an elective observation area. By the presentation of some real examples, both virtuous and critical, a discussion and comparison with other contexts, both national and international, should eventually be favoured.

Keywords: *intangible cultural heritage, landscape preservation, front-lake areas, sustainability*

1. Introduction

Everyone should recognize that a reinforced concrete wall covered with stones is something other than a traditional stone-dry wall. Nevertheless, we must admit landscape not only is becoming artificial but sometimes also reconstructed in a masked and affected manner.

It might be supported the intention for collective needs satisfaction, and the private right to change one own property must be recognized. On the other hand, it is hard to understand why false replicas should be accepted as true. We are neither the only nor the first, to say that the stone-dry wall technique is threatened. While excuses can be granted to wild animals, unwitting destroyers, they cannot be for human beings who are expected to be of a less instinctive and more sensitive attitude. Respect and protection ask for a civic sense, green and ecological awareness which are often used as ideological slogans and then dismissed into practice. One would also expect human being educated to a more sophisticated beauty ideal because we do not see how replicas and reproductions can aesthetically return lost originals. It is hard to believe they allow to respect and preserve, to rescue and protect the perceptive and formal aspects of the landscape, at least. It is believed that even these aspects are made worse as not only their authenticity is betrayed (if it has been destroyed or its features changed the replacement is evidently no longer the original), but it often changes the nature of the materials themselves.

Fig. 1. An authentic stone-dry walls made using the Moltrasio limestone (Photographed by the author, January 2022)

Not only coatings are replacing the authentic stone-dry walls, but materials are not natural anymore as they often are the result of a 'regeneration' process.

1.1. A dangerous drift

There is an undoubtful interest into the production of the so-called 'manufactured stone' when supported by an organic vision of the architectural product and its relationship with the landscape. The research on colours or for light and shadow effects related to the context, the attention for the tactile feelings and all the experiences brought by the surface finishing, as well the reference to traditional good building practices, are appreciable issues.

Some concerns arise when the outcome of this technological research is advertised as "a new material connected to the passage of time"; so that it becomes the tool to convey patinas and time passing effects. The material becomes ambiguous and, even if unintentionally, architecture will be equally false. Into the field of building conservation, where the word itself should ban the use of misleading replicas, it is thus believed that manufactured stone must be regarded with great mistrust. The point is to assure it will not be reduced to an alibi for disguising contemporary insertions into the landscape instead of honestly facing them. The aim should be to avoid a slipping onto the plane that separates truth from fiction, sustainability from speculation, reason from pretext.

Fig. 2. A catalogue type of the so-called manufactured stone 'Pietra Moltrasina' (https://www.geopietra.it)

Those who are responsible for society needs and a good design quality, can much affect the building products market. This last is based for the best profit and just adapts to demand. Until stone coatings are asked or approved to mitigate the environmental impact (without considering the shortage of original materials, the closure of quarries and supply difficulties), the producers will strive to find a replacement. Finally, the market of surrogates will be favoured, the opportunity of a discussion on authenticity and sustainability of old techniques and materials will be lost.

In the region under study, the closure of the quarries is an important aspect. It warns that the relationship between inhabitants and their environment has changed; it reminds how building practices have also changed; it alerts the disappearance of craftsmen which know how extract and collect, work and arrange local stones to build stone-dry architectures (Balzarini, Cani, Zerbini 2001).

Unfortunately, the increasing interest for the so called 'terraced landscapes' seems to clumsily deal with some of these aspects: that is, territorial and local communities' historical studies are lacking and the strategies for living and working those environments in contemporary time are still disoriented.

In those places where the holiday house market is lively and the desire for luxury real estate prevail over the local tradition, the rural landscape is under pressure. Because of the global market, the relationship between the building product and the local construction economy is changing. Customers are demanding buyers. Foreigners, looking for their own place, will partly adapt and partly will 'infect' the local culture. The most varied results will occur, not perforce the most negative intersections, anyway something to deal with.

Fig. 3. New terraced landscape in Cernobbio (CO), Italy (Photographed by the author, January 2022)

To protect stone-dry walling from dangerous short circuits (between original and replicas) and to mediate different design cultures (difficult but stimulating) wide perspectives are required. Preservation must not isolate itself in the past or manage historical places only for tourism. Even if this is done for a slow and green attitude or a pleasant and positive use, they both are reductive approaches. The highest and main concern should be the negative effect caused by the lack of a daily care and maintenance.

Albeit it is a well-known fact, it worth to repeat that stone-dry walls are not immutable artifacts but complex ecosystems (Darlington 1981). Thus, we are not just talking about amazing 'lake view terraces' to be entrusted to some economic activity exploitation but of landscapes as a fruitful and productive, a wise and expert interrelation between man and his habitat. It may offer to the architect a game of shape and volumes, but it should be essentially a balanced "result of the action and interaction of natural and/or human factors"[1].

1.2. An existing and living heritage?

The inscription of the art of stone-dry walling in the WHL as intangible cultural heritage (2018), therefore among the practices rather than the products, assumes these aspects. But the inscription is an intent that requires subsequent supervision so that too much attention does not become an aggression (Harrison & Hitchcock 2005; Cuccia 2018). The many workshops held to explain the construction rules and to investigate local variations, tend to counterbalance the risk that the art of stone-dry walling enters the market as a new product (Carminati, Invernizzi 2012; Scaramellini, Varotto 2008; Fontanari, Patassini 2008; Sangiorgi, Calvi, Branduini 2007; Spalla 1985). Because it is a matter of preserving the product as practising the technique, it is not only a matter of perception but of constructive commitment (Alberti, Dal Pozzo, Murtas et alii 2018).

Even if comparisons between different and international contexts are desirable, we assume the constructive aspects as illustrated throughout a wide literature (Ambrosi, Degano, Zaccaria 1990; Hart 1980; Radford 2001; Snow 2001; Congost Colomer et alii 2010). In this paper we would rather emphasize how terraced landscapes and artifacts that are their structural part and articulation (walls but also connections, mule tracks and paths, icehouses and barns, stables and shelters) are the result of an active and not passive attitude; stone-dry walling is a process rather than a product whose preservation requires

[1]As in the *European Landscape Convention* (2000), art. 1.

skilled workers and not only users. Restoration is not enough. An on-going program for a daily care and maintenance activity is required. It is a matter of landscape governance and management which involves civic engagement and awareness.

Before recommending uncertain and spontaneous revivals, it must be also reminded that ‘terraces’ are the outcome of the way in the past agricultural land was owned or rented, used, or improved, redeemed, or inherited. Until a recent past, some areas were still huge estates in the hands of a few figures (single private subjects but also religious or civil institutions). To protect their property and to increase their income, they assigned some portions following different agreements (perpetual contract lease or emphyteusis) (Zaccani, Palatiello 1984). In less than a century, these reasons have changed, those agreements decayed, those lands set free and inherited by a multitude of heirs. These heirs are often unaware of and disregarding the rural culture because they moved away to other activities and lifestyle (Bianchi, Merzario 1999). Anyone who has faced rural history studies knows land ownership parcelling because of modern and contemporary society.

Many difficulties occur when reactivating these places, whose renewed property asset involve many subjects. We should eventually recognize these changes in the social and economic structure and their results on the landscape. Many projects struggle to take off when this is forgotten; they fail on difficult new agreements with untraceable or detached subjects. However, it is hard to believe a solution would be to rejoint small lots in one with an institutional act.

The assignments to tenants played an essential role to produce the terraced landscapes. Since the tenancy had a fixed fee, it encouraged the tenant to improve it so to increase the income it would generate. It was in the tenant’s interest to be careful with the land. The agreement, a use right without holding transfer, also carried an implicit form of coexistence and cohabitation. The property became a place where owners and tenants interacted; they were both encouraged to a shared use, that is, not exclusive, of ‘their earth’.

Furthermore, the assignments were just few, small, separated portions inside a wider estate. There were at least two reasons for this: the intention to limit tenants from easy future collections; the choice to arrange horticultural activities according to soil nature and sun exposure. The result was a mosaic of cultivated small lots spread in a more natural one. Thus the 'greenways' that allow animals to move, remained safe; fencings too were reduced because both tenant and owner had to ensure mutual accessibility; that is, beyond the dry-stone walls, there was a network of walkways and paths, cart and mule tracks, placed not only along the borders but within the property itself; a kind of rib that made the mountain 'permeable', lively and truly inhabited. It is believed that the current slogans for mountains repopulation, for inner areas care, must push towards this direction. The suggestive idea to grant sites for a symbolic price should not allow the newcomers to enclose themselves as exhausted citizens and inexperienced, 3.0 farmers. Some case studies should hopefully clarify the concepts expressed.

2. A focus into practice

Italy and the province of Como, that is, the northern western end of Lombardy, on the border with Switzerland is the proposed case study. These sites share geomorphological features and, for the future, a perspective on Canton Ticino, at least, should be opened to compare both historical and actual practices of promotion and enhancement, maintenance, and recovery of terraced landscapes.

On this occasion, we only refer of Como, whose governing institutions are updating their planning and landscape protection tools, including the preservation of “terrazzamenti” as a pursued goal[2]. We do not refer to the entire province, characterized to the south by flat to light undulating soil. The main interest is around the lake whose steep slopes have forced men to gain their space against the wild forest and to shape them as terraces more useful for rural activities (potatoes and onions, vineyards, chestnuts, and mulberries above all).

Three different case studies will be discussed to highlight the following: the opportunity to link historical investigation and landscape management (the first case study), the ambiguity inherent in a formal and non-structural recall of these artifacts (the second one) and, finally, an experience of true preservation of both product and practice (third one).

2.1. Case study 1. Uncertain revivals

Faggeto Lario (CO) and its mountain hamlets (Molina, Lemna and Palanzo) are located on the eastern side of the lake of Como. They appear as lost in a woodland (mostly of beech and chestnut trees), furrowed by deep valleys. Everywhere, up its bank, the lake reliefs are engraved by streams and pointed with small, amazing settlements. Historical paths often connect them. The so-called Strada Regia, a medieval route which connects Brunate to Bellagio, the renowned resorts, runs halfway up the coast and crosses these the villages which are now joined as unique municipality. The actual boundaries extend from the lake bank (202 asl) to the top of Monte Palanzone (1436 asl). It is a steep, somewhat rugged ground whose inhabitants earned space by reshaping the slope. A terraced landscape shows the interaction between man and his habitat. Local stones have been placed to adapt to and live the slope: not only dry-stone walls have been built to retain soil but also connections (like stairs, mule and path tracks) and any other accessory constructions to climb and live it.

Recent scientific research has highlighted these artifacts as the landscape structure and its cultural identity. It is also proved that these terraces were historically reserved to viticulture but also to horticulture and orchards; not only in Faggeto Lario but in all the so-called ‘triangolo lariano’[3]. Some regards these studies as a paradigmatic opportunity to use historical research for planning, to use history as a guideline for ‘future’ buildings activity. Local municipalities acquired these results for the development of the Territorial Governance Plan (PGT) and now are implementing the suggested instructions[4].

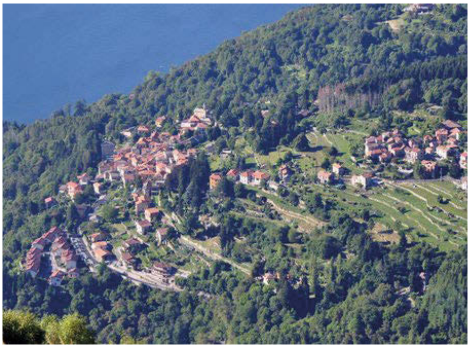

Fig. 4. The terraced landscape in Palanzo of Faggeto Lario (CO), Italy, Lake of Como is on the background.

Beyond its doubtfully connection with the town-plan, these studies strike for their cognitive framework and their transmission to practice, combining historical research and design. On the other side, the guidelines often take a very, if not too much, uncompromising, and prescriptive position[5]. They probably try to prevent some lasting but inappropriate practices; but they also deny a discussion for a high-quality contemporary design. The PGT identifies in the terraced landscape an exclusive qualitative element, a subject for territorial promotion, including tourism, even if looking at its alternative and sustainable forms.

[2]The local Territorial Provincial Coordination Plan PTCP, approved in 2006 and now (2020-21) proposed for an up-date, is focusing on the ‘traces of the agriculture landscape’; see https://www.provincia.como.it/piano-territoriale-di-coordinamento-provinciale-ptcp-e-varianti

[3] It includes Blevio, Castel d’Ardona, Torno, Nesso, Pognana, Velsio and Zelbio.

[4] The research program has been completed in 2012 by Carolina Zecchin, Vincenzo Todaro, Alessandro Verga, architects and members of the working group leads by Prof. Valeria Erba of Department of Architecture and Urban Studies at Polytechnic of Milan. See http://www.paesaggiolarioemonti.it.

[5] They deal with both architectures an open spaces; they express suggestions but also forbidden works.

This idea has some critical point, as argued by those directly involved. The first point concerns the upper-level institutions which still seem to play a weak role[6]. The second one questions the economic feasibility of an effective large scale preservation action. It cannot rely only on the public body means neither it can authoritatively be managed by the private business initiative. A private stakeholder is desired, optimistically hoping that he will act for a collective interest beyond his own.

There is perhaps also a third critical point: it touches the match between: tourism and cultural heritage, public and private interest. These are dangerous games because players are often rivals. Tourism remains a market based on products to be offered. If stone-dry walling is really a process and not only a product, we must look into tourism exploitation carefully. Eventually, it may be considered its evolution into a kind of authentic experience: that is, to propose a kind of civil service and to engage visitors in the maintenance and care of the places during their passage[7].

2.2. Case study 2. A land use excess

To focus on the active role required both by landscape and architecture preservation, we look southern on the opposite lakeside to Cernobbio. Compared to the previous area, it is closer to the chief town, Como, but to Milan, too. Cernobbio is an easy 'landing'. A fast highway which connects Milan to Switzerland is close; trains and then boats joint its eastern neighbouring area (the Brianza) and the metropolis itself to the amazing lake. A funicular, which raises from the city centre (Como) up to the hill (Brunate) proves how a network of public transport can affect a place and generate its architecture. Getting in Como by train from the centre of Milan can take the same time than crossing the metropolis in rush hour; but it is more comfortable and less stressful. The villas built along the banks, or the slopes of the lake are the consequence: the golden refuge of the bourgeoisie (De Carli 1985). This too is heritage: a legacy left by generations of seasonal guests who loved the lake over centuries and left an extraordinary and sometimes extravagant anthology of styles and villa types (from Neo-Renaissance to Liberty, from Decò to Rationalism). To all these, the PTCP assigns the same identity; without distinguishing the urban area from banks and slopes it is fostering an extensive building exploitation[8]. It seems to feed the actual lifestyle which is greedy for on-rent lake view rooms and luxury locations for private events. Less than a century is enough to feel the change. The upper Cernobbio (Rovenna), in the past an autonomous village is now a crowded place. Rovenna take the first sun of the morning. Thus, the farmers shaped the slopes to arrange flat ground more suitable for horticulture.

In 1914 a paved new road cut the thick and dense plot of paths and shortcuts, mule, and cart tracks, they have designed throughout the centuries. The new 'carriage' road crossed the terraces and connected the small hillside settlements. It is this bends snake that you still follow to climb gently and easily the hill enjoying desirable 'panorama'. While entering the First World War, the construction of the road was carried out to the detriment of the many dispossessed owners, to reach the top (where there is the state border and a military barracks) more quickly. Between the two World Wars, the modern route has favoured building activity for residential purposes. Many villas were built which have often changed the traditional orientation to get more comfortable access and panoramic views.

If this choice is permanent, the dynamics can hopefully be corrected. Overlapping of

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[6] The PTCP is under up-dating, as told.

[7] Among the many: the recent training course held in Brunate (August 2021); https://www.lariomania.it/corso-introduttivo-di-formazione-sullarte-dei-muri-in-pietra-a-secco-percorso-di-conoscenza-e-progettazione-del-territorio-comasco-brunatese/; but also the video "Racconti da Palanzo". Storie, testimonianze, memorie edited by Marzio Tomasini and the named Alessandro Verga. They also increase offerings for stone-dry walls restauration or new elevation https://www.collettivomilarepa.it/lavori-di-muratura-a-secco/.

[8] PTCP 2006, Plan A2.c: see Landscape Territoriale Unit (UTP) 21, named 'Convalle di Como e Valle del Breggia'.

cultures should be better managed. It must be said, for instance, that the accessibility should obviously be always allowed admitting easy access, but these reasons should not be admitted as an excuse to change for private use the old paths; that the false dry-stone walls do not mitigate the impact of the reinforced concrete pools but are the failure of landscape preservation which is a matter of soil permeability and not only of points of view and panorama. This land-use exploitation stresses the hydrogeological balances and ecosystems. Even the proposed house re-numbering is not harmless. The actual numbering is damned because chaotic, while 'chaos' reveals a structural meaning before formal appearance.

Fig. 5. Rovenna over Cernobbio (CO), Italy. The image has been posted in 1939, the photography shot in 1930 at least (private collection)

Fig. 6. Rovenna over Cernobbio (CO) Italy, today. (Photographed by the author, January 2022)

2.3. Case study 3. Humble existence

Cernobbio is the very place where landscape and building preservation is in a struggle with the real estate market and novelty seduction.

Piazza Santo Stefano, the third case study and formerly an independent municipality, nowadays is a Cernobbio hamlet too, but compared to others, it is differently located: lower and more internal, it offers a few panoramic points of view. Not surprisingly, one of the most extensive authentic and well-preserved stone-dry walling system and its dwellings can be seen here, outside the epicentres of the maximum values per square metre.

But this is not enough to save it. The humble maintenance work ensured daily by an elderly tenant is also required.

3. Conclusions and cultural framework

With the word 'Anthropocene', Crutzen and Stoermer identify a "a geological time unit" as "potential addition to the Geological Time scale" (Crutzen, Stoermer 2000).[9] Since then, the neologism has spread among many different scholarly communities to denote the present geological interval, in which many conditions and processes on Earth are profoundly altered by human impact. Thus, as Helmut Trischler recently argued, this word is having "a dual careers, first as a geological term and second as a cultural term" (Trischler 2016). Its final entrance as a geological time unit is under evaluation by the International Commission on Stratigraphy (ICS), the acknowledgment depending on a grid of markers (Zalasiewicz et al. 2019). According to the current definition, published by the Sub-commission on Quaternary Stratigraphy – 'Working Group on the Anthropocene', landscape change due to "erosion and sediment transport which is associated with urbanization and agriculture" is one of the phenomena associated with the Anthropocene[10].

[9] It is well known that we owe to Paul Crutzen (1933-2021), the Dutch civil engineer and Nobel prized researcher for his pioneering studies on atmospheric chemic, and Eugene Stoermer (1934-2012), the American biologist, the word 'Anthropocene'.

[10]http://quaternary.stratigraphy.org/workinggroups/anthropocene/

As architects and preservationists, we know that the way we design 'habitat' to improve sustainability and favour the green economy is important for the not too distant future. Many solutions adopted in the past could be reconsidered. Some building construction traditions should eventually be revalued, and lost cultures recalled; as they are good solutions for a respectful and safe ground use, like authentic terraced landscapes were. To reduce human impact on our Planet is not just a matter of mitigation or a sly reduction of visual impact. A structural attention is necessary along with considering how human behaviours influence rapid changes in the biosphere both on land and in the sea, as a result of habitat loss, predation, explosion of domestic animal population and species invasions.

While Anthropocene is taking acknowledgment as a 'geological era', we hopefully should enter a new one. The Planet counteract human aggression like a continuing stroke. The art of dry walling, which is an active and ongoing work, based on daily care and clever mindful maintenance, expresses this ideal for struggle. To practice this 'art' is a true preservation task because we take care not only of historical or artistic values but of the cultural and sustainable know-how it retains; thus, tangible and intangible heritage are joined. It is about satisfying not only a personal but a collective need. It involves acting on different ecosystems and at different scales, of architecture and the environment.

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From intangible to tangible.
Artisan Skills and Traditional Crafts for Preserving Venice's Built Heritage

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Topic: T3.1. Intangible heritage: the management of know-how and local construction culture

Abstract

Venice can be regarded as a test bed for any preservation strategy. From its very origins, the city has always had to withstand hostile environmental conditions, such as unstable soil, overflowing tides, and rising damp. Hence traditional materials and techniques are the result of a thousand-year-old selection aimed at improving their durability.

Since the end of the nineteenth century, however, historical surfaces have been progressively replaced by new short-lasting plasters, following the trend of systematic refurbishment meant to maximize economic output with disregard for good practices. As tourism became the driving force of a social, cultural, and architectural transformation, a sharp decrease in local population and craftsmanship has caused the loss of traditional know-how, leading to irreversible decline and low-quality interventions.

All this makes it necessary to reconsider the use of traditional materials and building skills, trusting, once again, in the Venetian craftsmen who are the repositories of local material culture and in the intangible know-how that can be crucial in protecting the city's tangible built heritage.

Joint efforts between the Iuav and local craftsmen are now underway in this regard. This synergy is making it possible to readdress an operational approach in which preservation is understood as the broadest possible care-for practice capable of providing continuous maintenance and control over architectural variances. Urgent too is the need to transfer traditional know-how from the elder custodians to the younger generations who will have the cultural and operational task of safeguarding Venice's future. Finally, fostering traditional good practices may also help develop local, cost-effective, site-specific efforts capable of promoting positive economic-and-social reversion.

Reintroducing traditional high-quality materials and artisan skills, together with controlled, compatible innovation, should be regarded as a sort of living idea of tradition, connecting past and future in protecting Venice's material authenticity – its main tangible resource and a specific requisite for a UNESCO World Heritage Site.

Keywords: *Venice, preservation, tradition, craftsmanship*

1. Introduction

In 2000 the Venetian historian Ennio Concina quoted his fifteenth-century predecessor Marcantonio Coccio Sabellico to depict the most iconic image of Venice, a city "suspended between two elements," highlighting instability as an endemic trait of its character (M. Antonii Sabellici, *Historiae Rerum Venetarum ab urbe condita*, 1556 in Concina 2000). This image encapsulates the fragility of Venice, a city constantly threatened by water (Gasparoli and Trovò 2014), and, at the same time, its ability to last, thanks to human efforts to gain soil and to make buildings withstand the unstable ground.

While the city's structures have had to be flexible enough to accommodate the ground's slow but continuous movements (Doglioni, Mirabella 2011), its architecture has actually been continuously reshaped, stratifying layers, reusing materials, and adapting elements to meet formal trends and functional needs as well as an unceasing process of physical decay.

Rather than expanding or imposing drastic renewal, the city center has grown upon itself. It can properly be regarded as a stratified architectural *palimpsest*, embodying the endurance of its diachronic development in the *longue durée* and recalling its resilience, which is deeply embedded in the consistency and durability of its constitutive matter.

These two aspects shed light on the role historical materials and surfaces still play in the city's long-established image and underscore the significance of their preservation (fig.1).

1.1. The "matter" of Venice: between past and future

Venice is the destination of a worldwide tourism attracted by its major monuments and palazzi, which – blending Roman, Byzantine, Islamic, and Northern features – reflect the city's historic role as a cultural melting pot. Yet, while the unique shapes of the city's east–west architecture are distinctively known, the materials of its construction deserve further attention.

Equally significant to the precious marbles covering the city's facades and pavements are the stones Ruskin so thoroughly explored, the simpler plasters, and the medieval painted brickwork (Piana & Danzi 2004; Squassina 2011). They provide polished surfaces and refined textures that contribute to strongly defining the character of the building or masonry of which they are a part (fig.2). These historical surfaces bear the stratified marks of centuries of natural and human alterations. They are a tangible 'stone book' that make a single building a living material document and the documentary evidence of multiplicity throughout time.

Fig. 1. Venice, Palazzo Moro: view of the inner court. The architectural features are emphasized by the medieval *regalzier* (false brickwork plaster), which is still well preserved (Source: Squassina, 2007)

Fig. 2. Venice, Palazzo Ducale: the 'noble' stone and the 'humble' brickwork, the two main material components of Venice's architecture (Source: Squassina, 2010)

As a whole, these building features and stratified signs are crucial factors in the authenticity of Venice itself, which lies, for the most part, in its tangible substance. At the same time, historical masonries and coatings have shown long- term resistance to the demanding natural conditions, granting the built heritage undeniable durability.

Venice owes its peculiar historical surfaces to a centuries-long selection of materials and to the refined processing and finish techniques whose performance has been constantly improved over time. Experience has taught its resident artisans how to make materials comply with the overwhelming environmental stress (fig.3).

Fig. 3. Venice, Calle de le oche: detail of the gothic brickwork and a later *cocciopesto* plaster that have been bearing the effects of moisture and rising damp for centuries (Source: Squassina, 2012)

Conversely, Venice has undergone increasingly rapid urban and architectural change since the late nineteenth century. New housing developments have been designed on the basis of modern criteria, introducing new materials, such as Portland cement, which had been foreign to local building practice. Though some technical experimentation has been conducted in the name of efficiency, especially to contrast rising damp (Squassina, 2016), few of these efforts have been worth the break with the traditional balance, given its long step-by-step adaptation and technical evolution.

Recent plasters and brickwork cause irreversible alterations to the facades (fig.4), often pauperizing the image of the whole city. In comparison to the centuries-old, still surviving surfaces, their duration is limited due to their chemical and physical incompatibility with the existing masonries.

This makes a care-for approach particularly appropriate to Venice's built heritage. It would make it possible to maintain and possibly repair the existing masonries and plasters instead of resorting to systematic surface replacements. Yet, even if the effort required to maintain Venetian architecture with traditional materials would be a significant step forward, it alone might not be enough; the techniques employed are equally crucial to the final results.

The *intangible* know-how of local building practice can be a determining factor for the preservation of the *tangible* built heritage. This explains the importance of fostering local artisans, who are the repositories of the traditional skills now at risk of being lost forever due to economic pressure and insufficient turnover. These factors have left fewer and fewer craftsmen available for maintenance and preservation work.

Fig. 4. Detail of medieval brickwork with well-polished lime-and-sand repointed joints (on the right) and a modern addition with a Portland cement mortar joint (left) highlighting the loss of traditional building skills (Source: Squassina, 2021)

2. Preserving artisan skills to preserve Venice's historical surfaces

In addition to the loss of traditional craftsmanship, the use of cement instead of lime-based plasters is a rather common problem that has been experienced for decades throughout the modern western world. In many countries, the massive long-term problems of old masonries have already urged the reintroduction of traditional materials. Besides the United Kingdom, where the preservation of traditional building skills has been deeply rooted since the establishment of SPAB and continues to develop (Williams, 2002), more recent efforts are also underway in Spain (Mileto & Vegas 2008) and in Italy (Lamioni, 2021).

Some active associations, such as the Italian Building Limes Forum are providing knowledge and technical support for research and practical workshops. Institutions are also officially recognizing the artistic and economic role of artisans in documents, such as the "The International Charter of Artistic Craftsmanship"[1] and in specific legislation defining the different branches of the artistic and traditional crafts[2]. The focus on Venice is due to the large number of historic buildings in the city center and to the cost of working there, which dissuades local artisans from continuing their maintenance and conservation work (Vettore, 2019). Despite the heritage offices' efforts to broaden the domain they safeguard, a large part of the built heritage is still not protected and is constantly exposed to the risk of irreversible renewal (fig.5). Some research has been done to avoid the loss of traditional skills (Piana, 2003 and 2007) and, recently, some joint projects have been developed by the University Iuav of Venice, the municipal heritage office, the Venice UNESCO office, and Confartigianato (the artisan's association). This collaboration has led to a knowledge protocol (regarding the main materials and construction elements of Venice's historical buildings), to criteria and examples of intervention, connecting theoretical principles and practice (Doglioni et al. 2017).

Fig. 5. New thick plasters cannot withstand the effect of rising damp for long in Venice: the above example is less than a decade old (Source: Squassina, 2021)

Expanding upon previous experiences and on a recent regional law promoting the 'safeguard, development and promotion of craftsmanship in Veneto'[3] (Paladini & Wacogne, 2021), further research is currently underway[4]. Conceived as a joint initiative between the University Iuav of Venice and local craftsmen, it seeks to bring the use of traditional materials and techniques to the fore as a possible strategy for preserving Venice's heritage and cultural landscape (Squassina, 2021).

2.1. Bridging academic theory and traditional construction wisdom

The synergy between the Iuav and local craftsmen strives to readdress an operational approach in which preservation is understood as the broadest possible care-for practice, capable of providing continuous maintenance and controlling architectural variances while inspiring controlled and compatible innovation.

Venetian artisans are the true repositories of traditional skills, and their direct involvement in academic work can play both an operational and a cultural role. A brief description of some of joint projects currently underway follows.

[1] Carta Internazionale dell'Artigianato Artistico, Firenze, 26-04-2010 (CNA, Confartigianato imprese, Ateliers d'Art de France, Prefettura di Kyoto). The different branches are defined following the European Classification of Economic Activities (NACE rev.2), including 'building decoration' (point III) and 'restoration' (point XII).

[2] Decreto del Presidente della Repubblica n. 288 del 25 maggio del 2001.

[3] Legge Regionale 08 ottobre 2018, n. 34: Norme per la tutela, lo sviluppo e la promozione dell'artigianato veneto.

[4] Angela Squassina, "Strategie per la conoscenza e la valorizzazione dei beni architettonici e paesaggistici", Università Iuav di Venezia-IR.IDE (Infrastruttura di Ricerca-Integral Design Environment, rep.1603/2019, prot. 61908, tit.7, cl.2).

- Artisans and research.
Involving local craftsmen in Iuav research aimed at contrasting physical decay and rising damp is one way to properly exploit their expertise[5]. In theses experiments, different samples of traditional and modern materials, including variants of components, additives, and instruments can be tested and their behavior compared over time (fig.6). The technical and operational contribution of skilled consultants can help scientific supervisors direct and possibly even refine the research. Theorists can focus on reaching cultural goals, following a correct interpretation of the tests results, and relying on experts who are able to readjust recipes and means accordingly.

Fig. 6. Detail of a research experiment undertaken in collaboration between the Iuav, the Scuola Edile Padova, and a Venetian artisan to make and test the performances of traditional plaster and brickwork samples (Source: Squassina, 2021)

- Artisans and education
Taking care of Venice in its entirety means addressing sensibility toward both monuments and simple artifacts – a goal that requires education. Undergraduate and postgraduate university students have begun to be introduced to local material culture through workshops held in collaboration with the Confartigianato. One, held in 2019, offered an opportunity to exchange information and knowledge between the university and the operational world of the craftsmen, restorers, and manufacturers. The primary goal was the intergenerational transmission of knowledge that could help preserve and maintain the ancient masonries of Venice through practical experience.

The learning goals of the WP "Construction wisdom: between past and future, for the preservation of the historic brickwork in Venice"[6] were as follows:

a – offering university classes to provide students the main instruments and theoretical knowledge to recognize and describe the characteristics of the historical brick masonries in Venice, their physical decay and preservation issues.

b – introducing students to local artisan builders and manufacturers by allowing them visit their workshops to gather documents and testimonies about traditional manufacturing-construction activities in Venice (through interviews, videos, pictures, fig.7).

c – providing students an opportunity for on-site hands-on instruction during the reconstruction of an old collapsed wall, guided by a skilled restorer who explained each phase of the intervention.

Fig.7. Some Iuav students illustrating the result of their experience in an artisan workshop in 2019 (Source: Squassina, 2019).

[5] For example, a Iuav–Ca' Foscari–Co.Ri.La interdisciplinary study is now underway, monitoring Venetian masonries that are subject to deterioration from rising damp and testing samples with the help of local artisans (Venice 2021- WP 5.3.2, scientific supervisors, Professors Antonelli, Faccio, Peron, Saetta, and Zendri).

[6] Scientific supervisor A. Squassina, with Confartigianato and 1st Framework London, a charity dealing with intergenerational exchange.

Another workshop, held in March 2022, allowed students from different schools (Scuola Edile Padova and the Iuav post-graduate school in architectural and landscape heritage) to make practical samples with traditional building practices and plasters under the supervision of local and foreign skilled craftsmen.

These experiences are hopefully the first in a longer collaborative effort that will encourage 'passing the baton' from the craftsmen to the younger generation.

- International seminars promoting the exchange of heritage experience and artisan preservation skills.
The author has taken part in several international seminars and organized study days aimed at exchanging experiences and building connections between the university and local artisans. Broadening this discussion to other countries is a productive way of revamping building tradition and inspiring technical and compatible innovation.

Some significant recent testimonies from the United Kingdom and the Czech Republic have provided the opportunity for a fruitful reciprocal reflection on the operational and cultural contribution of artisans and trained voluntary workers, the latter being an almost unexplored field in Italy[7].

Other exchanges have revealed the major effort underway in Spain to enhance traditional materials and artisan skills, both for the preservation of the built heritage and to keep the material culture of entire non-urban districts alive, reinforcing the work of local artisans (fig.8).

Particular attention has also been given to developing compatible innovative design in the field of archaeological heritage and historical routes, aimed at protecting these places as cultural landscapes (Alvarez Alvarez and De la Iglesia Santa Maria, 2017).

In the end, broad-based exchange can help identify the proper ways to keep traditional know-how alive and to transfer it from the elder custodians to the younger generations, who have the practical – and ethical – role of ensuring Venice's future maintenance.

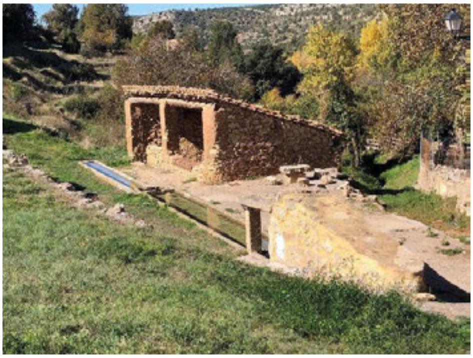

Fig.8. Sesga (Valencia): view of a traditional wash-house with a carefully preserved drinking trough, along with most of the village's vernacular architecture (Source: Squassina, 2021)

- Passing artisan skills on from past to future:
The synergy between the university and artisans aims, on the one hand, at preserving material authenticity in Venice, which is the prerequisite of any architectural and cultural or even tourist interest. On the other, it also intends to facilitate the transmission of technical knowledge and traditional skills from the craftsmen to the next generation, to hand on the responsibility of preserving Venice in the future.

Achieving such an ambitious goal cannot rely on episodic – albeit significant – efforts, and collaborative efforts are paramount.

Another step in this strategy is a training agreement between the Iuav and Confartigianato that will allow university students to visit artisan workshops and to work there for a while as assistants. This will make it possible for architecture students to gain expertise directly from expert craftsmen and to begin their profession

[7] In 2021 a collaboration was launched between the author and some SPAB volunteers and groups helping institutions carry out heritage preservation through *working parties* in the UK and the Czech Republic, such as the *Friends of Czech Heritage*, founded in 2007 to help draw attention to this rich inheritance and to promote its repair.

in close contact with the *matter* of architecture. Other interesting opportunities could be provided through grants enabling young graduates to get started in a traditional craft.

In the end, fostering local building and manufacturing activities could also help in developing a site-specific, cost-effective operational approach that could have a positive economic-and-social impact outside the academic world and on the younger generations of artisan workers.

This approach requires strong multi-level interaction. It is not about going 'backwards' but of reintroducing traditional high quality materials and techniques, alongside controlled compatible innovation as a living idea of tradition.

Fig.9. Venice, St. Mark's Basilica: "bricklayers," from the crafts sculpture cycle (thirteenth century), third arch of the main entrance. This was the icon of the Iuav study days *On The Surface* held in March (Source: Squassina, 2022)

3. From intangible to tangible and back, for the material authenticity of Venice

Donatella Fiorani has noted how the notion of heritage has shifted from the idea of "a material testimony of civilization" (Commissione Franceschini[8]) to the concept of "intangible heritage," as stated by the Icomos Australia Burra Charter in 1979, later ratified by UNESCO in 2003 (Fiorani 2014). If, on the one hand, this sort of "de-materialization" broadened the notion of heritage under protection, it has, on the other, weakened the connection with *matter* ever since.

This reflection sheds light on the crucial role of *matter* in the field of built heritage. The *matter* of architecture is not only a physical support; it is the expressive substance that stores aesthetic and technical information as well as memory. Historical surfaces record both the signs of construction and the marks of transformation over time, inextricably connecting tangible to intangible within the idea of the artifact as a material product of human activity or even the whole of human life.

Preserving local artisan practice is meant, first and foremost, to ease the protection of Venice's built heritage. Yet it also aims at reinforcing the human, economic, and social context related to the city's *material culture*.

The relationship between historical artifacts and the traditional skills that produced them underpins the cultural identity of a place, as humble as it may be, making it a cultural landscape. Venice cannot elude this criterion in bearing the burden of its worldwide fame. If the city's palazzi are jewels of art and history, the humbler building fabric embodies its technical know-how and cultural memory. Together they form an indissoluble whole.

[8] Legge n.310/26-04-1964.

This approach requires rethinking the concept of *palimpsest* in Venice. It regards not only a formal reference but also the more significant material context connoting the buildings, recording the marks of human and natural interaction that are, in themselves, worth preservation.

Riegl's *Alteswert* can act as a proper general criterion, whereby the contemporary idea of heritage would match a *development* value, which is connected to the time of nature, giving buildings an organic evolution and allowing them to constantly change their cultural meaning.

Assuming time as a peculiar dimension of architecture – and thus as a living material document – the contemporary attitude shifts from a synchronous appreciation of accomplished forms toward a diachronic reading of the stratified matter. Architectural stratigraphy becomes a highly effective tool in capturing the traces of a building's passing throughout time. Venice would definitely benefit from a similar diachronic approach to its architecture.

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ARTISANS AND CRAFTS OF TRADITIONAL CONSTRUCTION

TRADITION AND INNOVATION IN TRADITIONAL CONSTRUCTION CRAFTS

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The Craft of Stucco Mihrab carving in Oman in the 13th to 17th AD.

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Topic*:* T3.3. Tradition and innovation in traditional construction crafts

Abstract

The corpus of research about vernacular architecture in Oman presents some gaps of knowledge about its typologies and their mode of formation and development. The Omani traditional mosques, are among the typologies that deserve to be further studied. The present research aims to contribute to enrich the existing knowledge about this mosque architecture by formulating some interpretations regarding the origins and development of Mihrabs decoration in Oman between the 13th and 17th centuries. A total of 22 of such Mihrabs has been identified to have been the only remaining examples of this tradition in Oman. The paper presents the outcomes of a systematic survey and analysis of the architecture and artistic features of these Mihrabs and the mosques where they are located. It discusses the emergence of the craft of Mihrab carving in Oman, its origins and characteristics.

Keywords: *Ibadism; islamic ornaments; Omani mosques; stucco carving.*

1. Introduction

The Sultanate of Oman is among the few countries where it is still possible to find mosques built following the Ibadi school of thought: "*Madhab*". They are also present in some regions of Algeria (Wadi M'zab), Tunisia (Djerba Island) and Libya (Jabal Nafusa) (Benkari, 2019). In the sultanate, they are distributed geographically following the areas of influence of this Madhab. Previous research have detailed the main characteristics of these mosques (Benkari-Boudidah, 2014; Benkari, 2019) and some others have even interpreted these characteristics following the precepts of the Ibadi doctrine and linked them to other examples of this religious architecture in other regions where this Madhab was or still is predominant (Benkari-Boudidah, 2014; Benkari, 2016). The main specificities of the Ibadi mosques consist in their pure volumes, the modesty of their architecture and simplicity of their interior spaces. They do not present any minarets nor domes as it is common to see in the mosques of other madhabs. The only prominent volume atop their roofs consists in a coupolette punctuating one of the corners opposite to the wall of Qibla: "*buma",* a unique feature characterizing the Mosques of Oman (Benkari, 2019; Costa, 2006, p. 80). Furthermore, the Ibadi mosques in Oman are differentiated from the others by their flat Mihrabs, occurring as a recess within the Qibla wall and with no protrusion in the outer side of the wall (Kanaan, 2014, p. 232). If it was not for the elevated platform where they have been erected, and the *buma* characterizing one of their roof corners, the mosques in the Ibadi regions of Oman cannot be distinguished from the rest of the dwellings in the settlement.

It is probably due to this humble character that the Ibadi architecture of Oman did not attract much of the published research about the Islamic architecture until the end of the 20th century. It has been initiated by the work of the Arabist E. Baldissera (Baldissera, 1994) and Archeologist and Art historian M. Kervran (Kervran & Bernard, 1996). These early works were followed by a more comprehensive documentation and descriptive study by Costa (P. Costa, 1997; Costa, 2001), then a comprehensive comparative investigation by Benkari (Benkari-Boudidah, 2014; Benkari, 2016, 2019). The focus on the stucco-carved Mihrabs, has been continued with the research of Bandyopadhyay (Bandyopadhyay, 2008, 2010), Goffriller (Goffriller, Hongjiao, Bandyopadhyay, & Henderson, 2015), Kanaan (Kanaan, 2014) and some Omani writers amateur of the local architecture(Al Hadhrami, 2019). However, none of these research did study the stucco-carved Mihrabs to identify their formal composition, their stylistic typology and origins, and their production process. Similarly, these Mihrabs have never been analyzed from the point of view of their chronology or their geographic distribution or the school they belong to. The present research aims at examining this craft of Mihrab carving in Oman by shedding some light on its main formal characteristics and their origins, and the socio-economic context that accompanied the emergence and development of this craft. More specifically, this research will address the following questions:

1- How did the craft of Mihrab stucco-carving develop in Oman?

2- What are the formal and aesthetic characteristic of this craft?

3- How does this "Omani style" of Mihrab carving relate to the wider context of the Islamic art and architecture?

The main contribution of the present study consists in providing a holistic understanding of this phenomenon by examining all decorated Mihrabs still standing today. The analysis of their physical components, will identify the main formal and aesthetic characteristics of this style of Mihrab decoration. Finally, this research formulates the historic evolution of this craft and its geographic expansion. Ultimately, it will provide a corpus of themes and Design options that could be adapted and implemented in contemporary mosques in Oman.

2. Methodology

The present study relied on an extensive literature review about the subject covering the essential related publications in English, French and Arabic. This review has revealed the records of twenty five (25) traditional mosques with carved Mihrabs. However, three (3) mosques were not considered in the present research, as two of them (J. Nizwa and J. Nakhal) have been destroyed (Baldissera, 1994) and the third (J. Hujrat Musalmat) is still standing but, there are no information about its date of construction, its decorator or its patron (Benkari, 2017, 2021). Therefore, the primary data was collected through the extensive architectural and photographic surveys of all 22 remaining decorated Mihrabs and the mosques where they are still standing today.

The first documentation campaign took place during the winter of 2017. It targeted all the concerned mosques in a-Dakhiliya region. It was then followed by multiple short missions to the rest of the mosques in al-Batinah and A-Sharquiya governorates. The primary data collected was also checked against the findings of previous research about these mosques, especially in the work of Costa (Costa, 2001) as well as the recent book of Al Hadhrami (Al Hadhrami, 2019). The present research owes a lot to the meticulous work of the Arabist Baldissera who deciphered the inscriptions embedded in the carvings of the Mihrabs studied here (Baldissera, 1994). A comparative analysis between the studied Mihrabs allowed to characterize their style and component and identify the evolution of this craft. The exploration of the available literature about the history of Oman and its architecture, helped understand the sociopolitical conditions where the craft of Mihrab carving has emerged and developed.

3. Results and discussion

3.1. The art of stucco-carved Mihrabs in the socio-political context of Oman 13th -17th CE (7th-13th H)

The information carved in the decorated Mihrabs studied in this research, reveals that they were produced over a period of more than three centuries and under three different dynasties. The earliest decorated Mihrab in the studied collection is still standing in Jama` So`al (in the city of Nizwa, Interior governorate) with the date of 650H (1252 CE) carved in its frame (Baldissera, 1994; Costa, 2006; Ministry of Justice and endowments and Islamic Affairs, 1995). The different artefacts found in the constructions, dated from this period, reveal the extent of the maritime exchange that prevaild in the region at the time. The same circumstances were behind the flourishing of the Craft of Mihrab carving in the country, probably under the influence of the neighboring regions in both shores of the Arabian Gulf. This idea is even more evidenced by the presence, in the frames of many Mihrabs from this period, of porcelain plates and bowls, probably of Chinese origin, used as colorful decorative elements (Goffriller et al., 2015; Kanaan, 2014; Kervran & Bernard, 1996).

Nevertheless, the core of the Omani decorated Mihrabs, still standing today, was produced in the period 1503-1619 CE. Some of the previous studies agree on the fact that we are in presence of a "decorative style" that is specific to this region (Baldissera 1994; Kanaan 2014). The question is: where did this style come from and to which extent it is possible to identify it as an "Omani style" within the large repertoire of the Islamic decorative arts?

3.1.1 The Omani Stucco-carved Mihrabs and their geographic context

The classification and analysis of the collected data informed the development of a holistic understanding about the geographic distribution of the studied Mihrabs and how this three centuries long phenomenon had evolved in Oman. The timeline represented by the Mihrab studied in this research spans from 1252 (Jama` So`al) until 1829 (Masjid Al Aghbari). It covers the territory of three regions/governorates in Oman: a-Dakhiliya, al-Batinah, and Northern Sharqiyah. However, the core of the carved Mihrab production at its quintessence, covers the 16th century CE only, and the territories of a few cities, predominantly in the a-Dakhiliya (interior) region (such as Manah, Adam, Nizwa, Bahla and Izki), then in al-Batinah (Samail and Nakhal) and, more lately in a-Sharqiya (al-Qabil, Sinaw, Wadi Bani khalid).

It is worth mentioning that this geographic and chronologic contextualization is only based on the still standing Mihrabs that the author could survey. It is highly probable that some mosques have disappeared with their Mihrabs, either destroyed to be rebuilt (Mihrab al Jama' al-Kabeer in Nakhal) (Baldissera, 1994), or simply decayed due to the weathering or urban expansion. Therefore, it is also probable that this craft had a much longer span of expansion in the geography and the chronology than what can be deduced from the remaining Mihrabs studied here (Al Hadhrami, 2019).

3.2. The Characteristics of the Decorated Mihrab In Oman 13-17th Centuries

The comparative analysis of the aesthetic, constructive and architectural properties of the Mihrabs and the mosque where they are hosted generated a set of common characteristics that can be summarized in the following aspects:

3.2.1 The status and location of the mosques containing stucco-carved Mihrabs

It is worth noticing that with their refined carvings, these Mihrabs are confined in mosques with no specific distinction in their location, volume size and forms or architectural details. This peculiar trait could be explained by the fact that the mosque edification usually precedes the Mihrab decoration by several years. In Mihrab masjid Al-`Ali (Manah) for instance, both the date of the mosque foundation and the Mihrab carving are mentioned.

Similarly, there is no correlation between the status of a mosque, whether a Friday mosque (Jama`) or a daily prayers mosque (Masjid), and the presence of a decorated Mihrab within its prayer hall. Indeed, decorated Mihrabs could be found in mosques with both status (Jama` and Masjid), with clear predominance of masjids (15) over Jama` (8), even if the earliest carved Mihrab that reached our times stands in a Jama` (So`al, Nizwa). Furthermore, the mosques containing decorated Mihrabs are mainly found within the settlements (10 Masjids and 5 Jama`). Only a limited number of them stands isolated, either surrounded by a cemetery (masjid a-Shargah in Nizwa, masjid al-Qasr in Manal (Al Hadhrami, 2019; Ministry of Justice and endowments and Islamic Affairs, 1995) or, not far from the adjoining settlements (Jama` Manah, or Jama` Bahla). Finally, a few other mosques can be found within the meander of the oases (3 mosques in Samail and Jama` al-`Alaya in Rustaq (Al Hadhrami, 2019).

It is worth mentioning that, with the exception of this Jama`, all other Friday mosques with carved Mihrabs are located in the interior region (a-Dakhiliya). This confirms the idea, discussed above, about the fact that the interior region is the main land of propagation of the craft of Mihrab carving in Oman. Finally, if this practice has been initiated in the Mihrab of a Friday mosque (Jama` So`al 650H), it has continued to ornate the Mihrabs of Masjids for almost 200 years (Masjid al-Aghbari, 1245H / 1829 CE) after the carving of the last Mihrab in a Friday mosque (Jama` al-`Alaya, 1057H/1651CE).

3.2.2 The common features

As stated in previous research, the stucco-carved Mihrabs in Oman of the 16th CE are part of a larger and older corpus of Mihrabs that evolved, in the Ibadhi areas, independently from the carving tradition (Baldissera, 1994; Kanaan, 2014, p. 232). Such Mihrabs share some common formal features which consist in:

- Receding concentric arches within a flat framing band
- Pronounced frieze with sort of crenellations
- A small arched Qibla niche, sometimes doubled or tripled in a telescopic succession of decreasing niches
- The receding arches could be supported by short round engaged columns.
- The entire surface of the Mihrab is filled with stucco-carved patterns
- The stucco-carved panel protrudes of 50 to 80 cm. from the Qibla wall.
- The technique used is the knife carved stucco, with the exception of the Mihrabs of J. Bahla and al-`Ali mosque in Manah, where the technique of molded panels was used in addition to the common knife carving method.

The corpus of Mihrabs analyzed in this study reproduce this same scheme with some variations and the addition of other elements on which we will elaborate in the following sections:

The documented Mihrabs show an average size of 4m height and 3m width, that is common to most of those measured in this study. The Mihrabs of Friday mosques however, can be much higher (6m or a little less in the Mihrabs of J. Bahla, J. Manah and J. al-Gharidh in Nakhal (923H/1517CE) (Baldissera, 1994; Ministry of Justice and endowments and Islamic Affairs, 1995) or a little shorter (3m in the Mihrabs of Jama` So`al, and Nakhal).

3.2.3 The carved frieze

The top of the Mihrab is usually marked with a frieze finely carved with floral patterns (al-Jannah, a-Shargah, Muqazah, a-Sarooj, Bahla, a-Shawadhna, al-Brashid, al-Gharidh…) or, more rarely with a series of crenellations (J. Manah al-Kabir, J. al-Aghbari). A few Mihrabs do not have this frieze at all (J. So`al, Mukabbrah, al-`Ali, J. al-Bousaid, al-`Awina), although it is possible that it had disappeared for some of them due to the multiple decay and restoration cycles.

3.2.4 Shahada Banner

In addition to the frieze, the top of the Mihrab is usually marked by a horizontal, sometimes imposing, rectangular band where the Islamic profession of faith “Shahada” is carved in a beautiful Kufic script with floral and geometric dynamic patterns covering the spaces between the flat geometric letters. Some Mihrabs present slight differences with this common image. In the case of Mihrab J. Bahla, the Shahada is coupled with a Quranic verse, and in al-`Ali mosque, half of the horizontal band is occupied by a text in Naskhi script relating the date of foundation of the Mihrab and its patrons. Finally, the latest Mihrabs in the studied corpus did not have the Shahada on the top of their Mihrabs, instead, they have a Quranic inscription in Naskhi script (Mihrab al-Aghbari mosque), or no inscription at all (Mihrab Masjid al-Qabil al-Qadim).

3.2.5 The outer frame

The most dominant feature in the studied selection of Mihrabs is the "Outer frame", composed of a succession of stamp-like tangential circles. Sometimes, the frame is composed of alternating circles with two different diameters. All circles are filled with a variety of carved geometric and floral patterns, or incrusted with blue or green ceramic plates and bowls, creating an interesting diversity within the overall unity of the repetitive circles. In some Mihrabs the wider circles are flanked with even smaller ones on both lateral sides. This "outer frame" continues until the floor and defines the whole Mihrab. This feature can be considered as unifying trait in all stucco-carved Mihrabs of the 10th century Hijri (16th CE) (Kanaan, 2014, p. 233). It is present in the earliest version of this Mihrabs (in So`al), in the mosques of the 16th century CE, and ornate also the later Mihrabs of the 18th century CE (M. Al Aghbari). It can also be observed as a more "abstract" version in the mosques of a-Sharqiya region.

3.2.6 The intermediary, interlacing strap-work

The intermediary frame is decorated with a unified pattern of interlacing strap-work and surrounds the rectangle containing the Mihrab niche. It either continues equally ornate until the floor (Mihrab al-`Awina, and al-Mzar`a in Sama'il after restoration), or rests on short engaged colonnettes with a lozenge capital (Masjid al-Jannah, J. Adam, J. Nakhal), or with a lozenge base in addition to the capital (J. So`al, J. Bahla, Masjid a-Shargah, and a-Shawadhna, al-`Ali). Colonnettes, bases and capitals are also covered with carved floral and geometric patterns.

3.2.7 The central rectangle and Mihrab niche

The smaller niche of the Mihrab is carved within the width of the Qibla wall and could be framed by two other, smaller, engaged colonnettes, with lozenge or bulb capital. It is surmounted with a ribbed hood, sometimes composed of one or two rows of small Muqarnas. The center of the smallest niche in the Mihrab is slightly concave, divided into vertical panels and extensively carved with geometric and floral patterns (a-Shargah, a-Shawadhna). Sometimes some Kufic designed letters spell the name of Allah and prophet Mohamed in the heart of this niche.

The Mihrab niche constitutes the lower concave half of the Mihrab's central rectangle. Its upper half is occupied by the lunette/tympanum inscribed within an outer keel arch and the whole plane is covered with a profusion of floral and geometric interlaced carved patterns. The lunette presents a specific register of ornamentation, usually divided in concentric petals around a circle. The latter is emphasized with a specific decorative pattern, or incrusted with a beautiful porcelain plate. The upper part of the central rectangle and right above the keel arch framing the lunette, lies the rectangular band where more information about the Mihrab, its decorator and patron, as well as the date of achievement are transcribed in Naskhi or Thuluth script.
In later Mihrabs, the keel arch transformed into a triangular one, as it is the case in Mihrab al-`Awina (Wadi Bani Khalid, a-Sharqiya) and al-Mukabbrah in al-Ghraidh (Nakhal), or became segmented like in Masjid al-Burashid (Sinaw). The center of the triangular arch is also incrusted with a large porcelain plate, while the sides are punctuated with smaller bowls, in the case of Masjid al-Burashid, or are filled with Naskhi or Thuluth script reporting the information about the Mihrab.

3.2.8 The decorative elements:

- Calligraphic texts
The omnipresence of the banner of the Islamic profession of faith "Shahada" in Kufic script at the top of most of the studied Mihrabs is a particularity that distinguishes the Omani style of stucco-carved Mihrabs from any other style in the region (Kanaan, 2014, p. 251). It seems that

the text of Shahada and Quranic verses, carved in the Qibla wall of Jama`a So`al (13th century CE) in large bold Kufic script, has inspired the craftsmen of the 16th century CE, led by Abdullah al Humaymi. Since his first oeuvres in Manah and Bahla, the Kufic Shahada has not left the top of the Omani stucco-carved Mihrabs, until the second half of the 18th century (Mihrab Masjid al-Qadeem in Manal) and first half of 19th century (Mihrab Masjid al-Aghbari in Sama'il).

Another characteristic of this unique Omani craft, consists in the presence, in the small rectangle atop the lunette, of important information about the history of the Mihrab decoration, the artisan who carved it, its patrons, and date of completion. These texts were the source of many of the information presented in this paper (Baldissera, 1994).

The insertion of Quranic texts within the ornamental register of the Omani stucco-carved Mihrabs is not a distinctive feature in itself. However, the exclusive presence of these texts in the Mihrab is an Omani particularity in this matter. If the Shahada written in Kufic script is almost systematically present in the vast majority of the Mihrabs studied in this paper, the Quranic verses, in Naskhi or Thuluth scripts are only present in 10 mosques out of the 22 studied: 6 Jama` and 4 Masjid. 2 Jama` and 11 masjid don't contain any Quranic verses in their Mihrabs or in any other place in the building.

In addition, the number of verses varies from a mosque to the other. 6 of the 10 mosques do have only one verse written in their Mihrabs (2 masjids and 4 Jama`).

- The decoration with embedded "Chinese" ceramic plates

As part of their decorative register, 20 Mihrabs out of the 22 studied here, present a variable number of ceramic plates and bawls embedded in different places of their surface. The only Mihrabs that were originally carved without the use of ceramic plates in their adornment are: J. So`al (650H / 1252CE), J. Bahla (917H / 1511CE), and al-Aghbari mosque from early 19th century CE, (1245 H). Some of the other Mihrabs have lost their ceramic plates as a result of their advanced decay, or have been damaged and then either cladded over (Mihrab Masjid a-Shurah in Manah) or, more recently replaced by a carved inscription of the name of "Allah" (Masjid, al-Mukabbrah (Nakhal) and J. al-Bousaidi (Adam)). Some of these ceramic dishware have been introduced in Oman in the 15th century or even earlier through trading with the Ming China (Baldissera, 1994; Goffriller et al., 2015). They are a recurrent feature in the decoration of Mihrabs and other spaces such as in Suhar fort, or some merchant houses of Ibra for instance (P. M. Costa, 2006). The center of the lunette/tympanum is the most common area in the Mihrab where the ceramic plates are usually found. This element could be the only one in the central frame or even in the whole Mihrab to be ornate with a ceramic plate (Masjid al-Ain, al-Ali, J. al-Boussaidi, J. al-Gharidh or J. Nakhal). The most common situation, however, is the presence of 4 smaller bowls forming a rectangle framing the central plate (Mihrab Masjid a-Shawadhna, a-Shargah, a-Shurah, a-Sarooj, Mzar`a, J. Manah, J. Muqazah, al-Qasr and al-Brashid). In a few other instances, the central plate, which is usually the largest and most beautiful, is emphasized with two smaller bowls forming a triangle pointed to the top of the Mihrab (Mihrab M. al Jannah, al-`Awina). It is worth mentioning that in the triangular arched tympanum, the ceramic bowls are given similar distribution as those in the Keel arched ones, though the layout seems more dynamic due to the sharp angles of the triangle (M. al-Mzar`a), the lozenge (M. al-Qasr) or the segmented line (M. al-Burashid).

In addition to their presence in the tympanum, the porcelain plates can be embedded in the Mihrab's outer frame, where they occupy every other round stamp (J. Muqazzah in Izki). Moreover, they could be present in the small lateral circles (M. a-Shawadhna). In the latest decorated Mihrabs, due to weaker carving skills, the porcelain plates became the main feature in the decoraion of the Mihrab. Their distribution became freer in the different frames, their size as well as their quality became as much common (M. al-Qadeem in al-Qabil and M. al-Moghrah in Sinaw).

With all these frames and stamps, bands and porcelain dishware, with the profusion of various knife-carved patterns in the thick layer of Sarooj, the creative composition and the systematic filling of any plain surface, the Mihrab incarnates an important aspect of the Islamic art: diversity within unity. It resembles to a refined embroidery (Baldissera, 1994, p. 49).

It is worth mentioning that the themes of the designs within the porcelain plates are varied even within the same region or within the repertoire of the same craftsman. Most of the time, they depict abstract flowers, plants or fruits. Some plate contain imaginary animals, fish and birds (phoenix). As mentioned in earlier research, this whole practice of Mihrab decoration is not “encouraged” in the Ibadhi jurisprudence related to the mosque architecture (Benkari-Boudidah, 2014; Benkari, 2016, p. 60, 2019, p. 178). But it seems that such practices were tolerated in some regions of Oman (Benkari, 2016). However, this tolerance was not the same everywhere and always. Certainly, the drawings in the porcelain plates might have got a later disapproval and had to be broken or taken away from the mosque. This explains the plates erased in their center in some of the mosques, or those which bowls and plates were simply removed. In other places, (such as al-Qabil), the local community was so keen to perfectly restore their mosque, that they bought a set of vessels from the local market and used them to ornate the Mihrab of their mosque, as a replacement of the old ones that disappeared or simply broke.

In some other instances (J. al-Boussaidi in Adam or al-Mukabbrah in al-Gharidh (Nakhal)) where the Mihrab is restored by the ministry, the plates are replaced with recent but more appropriate ones, or the plate is replaced by the calligraphy of the word “Allah” (Masjid al-Mukabbrah in al-Gharidh –Nakhal). This last option as it alters tremendously the stylistic composition of the Mihrab as there has never been such calligraphy in the center of the tympanum before. At this stage of the discussion it is legitimate to question the origin of this practice of inserting the porcelain plates in the walls as a mean of decoration. Bandyopadhyay stated that it has been observed elsewhere without mentioning any example (Goffriller et al., 2015). Our own investigations led us to one case in the eastern and western minarets of Jama` al-Rawdha in San`a Yemen and which was dated from the Ottoman period (Ghilan, 2019). However, to our best knowledge there was no evidence to establish the filiation between the case of al-Rawdha mosque and the Mihrabs studied here. The number and almost systematic use of this technique in the Omani mosques make of it a specificity to those Mihrabs even if it did not originate in Oman.

4. Conclusions

The present research is a historic and stylistic study of the stucco-carved Mihrabs in the traditional mosques of Oman. Through an extensive literature review and architectural documentation of most of the still standing Mihrabs in different regions in Oman, along with the analysis of the corpus of information collected from primary and secondary sources, this study revealed the following conclusions:

- The corpus of the traditional stucco-carved Mihrabs of Oman was produced in a timeline that spans over a period of six centuries (from the Mid-13th century until the early 19th century). The Mihrabs produced during the 16th century are the most important in number and the most developed in quality of execution and rich in the aesthetic register. Similarly, it has been found that the Dakhiliya region with the city of Manah is the epi-center of the development of this art especially after its revival in the early 16th century.

- The comparative and stylistic analysis has helped in the identification of the different components of the stucco-carved Mihrabs in Oman. It has highlighted the features that are unique in the Omani Mihrabs, their possible origins and their process of evolution until they reached their ultimate forms. In addition, it has been demonstrated that we are in presence of a full-fledged Omani stylistic school of Mihrab stucco-carving which started around the 13th century and reached its peak in the 16th century before fading away around the early 19th century of our era.

This study presents certain limitations in the corpus analyzed, where a few Mihrabs could not be located and a few others could not be dated.

Based on previous research, some assumptions had to be made based on careful comparison and analysis. Moreover, due to the limitation of the publication length, it was not possible to further develop the understanding of the social and professional networks that prevailed in the production of these Mihrabs. Further research is also needed to discuss the practice of Mihrab decoration with figurative images in the light of the Ibadi jurisprudence which clearly prohibits any ornamentation in the construction, especially in the Qibla wall (Benkari, 2016). Finally, this research also opens the opportunity to further explore the practical integration of the identified style and typology in the Mihrab decoration in Oman or the region.

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From prototypes to monotypes. Neo-craftsmanship in architecture and design

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Topic: T3.3 Artisans and crafts of traditional construction

Abstract

The paper focuses on characterizing a current design trend —sometimes called neo-craftsmanship— that uses manual processes to create unique objects. About a century ago, pioneers of modern architecture and design pushed their primary trend towards prototypes definition in their massive industrial —mechanical and serial— production. Nowadays, an opposite impulse can be identified looking for monotypes definition —single products or from limited series—, with high manual intervention and capable of being customized to assume the individuality of each user. On one side, creative strategies used by modernist designers founded their design process on objective criteria: rational, functional or economic. Nevertheless, in this other case, designers prefer subjective criteria based on expressiveness, significant forms, chance or casual associations. In some way, this trend supposes a return to the art and industry debate between crafts and design that presided over the genesis of the modern movement. It is possible to find this trend not only in post-industrial societies but also in those in their process of industrialization, where it appears as a differentiated alternative. In this last case, design methodologies or strategies are applied to push an economic development best based on sustainable exploitation of local resources or applying traditional productive techniques, skills or capacities.Finally, the paper identifies and proposes study cases as representative examples in product design and architectural activities to illustrate this trend. Some of them can also be connected to design strategies aligned with environmental sustainability positions: reuse, reduction and recycling of materials and products; preference for low-polluting industrial processes; water and energy saving; life cycle management; local production and consumption; and so on.

Keywords: *Product design; Architecture design; Contemporary trends; Neo-craftsmanship*

1. Introduction

One of the most effective and common ways of defining craftsmanship is as opposed to industry. Compared to mass production with the help of machines, handmade products are characterized by their manual workmanship which, in some respects, makes them unique. After visiting the Great Exhibition (London, 1851) William Morris and, not long afterwards, his colleagues from the Arts & Crafts movement, used this contrast to attribute to craftsmanship the ethical and social values lost to industry. In comparison to the lack of identity of the mass-produced and machine-made object —reflection of the alienation of the industrial worker— the unique artisan product appeared as the bearer of certain qualities —sincerity, authenticity, memory,…—a faithful reflection of the pleasure that the honest craftsman received as a reward for his manual labour.[1] Qualities that, in some way, were transmitted to the user of handcrafted products, bringing them greater happiness than

[1]Cfr. Sudjic, D. (2009)

to those who preferred to use their industrialized equivalents, which lacked such qualities.

Many of these Arts & Crafts principles have survived to this day. Some such as social commitment, design ethics, material sincerity or sincerity of execution, among others, because, as is well known, the early historiography of modernity linked them to the genesis of modern architecture and design.[2] Others, on the contrary, because they have resisted well on the margins of this same modernity, defending the value of manual workmanship and the specific qualities of the handcrafted product against the inexorable advance of the anonymous industrialized product.

However, recent manuals[3] on history and contemporary design trends identify a certain paradigm shift that has manifested itself in recent decades in a gradual relaxation of the conventional opposition between craftsmanship and industry. This relaxation, which initially replaced the initial opposition with complementarity, later led to the establishing of certain links between the two, seeking to take advantage of synergies.

2. Modernity vs. postmodernity

Proponents of the modern project (Maldonado, 2004)[4] aimed to extend access to decent housing to all social classes, i.e. housing with minimum and sufficient conditions of habitability. Consequently, they concentrated their efforts on mass housing construction, which involved not only the emergence of a new architectural language or research into new residential typologies but, above all, experimentation with new materials and construction processes that would make production as fast and economical as possible. To this end, they turned their gaze towards industry, which, by revealing itself as the great ally, gave rise to the modern myth of the machine. In this sense, suffice it to recall the German debate between technique and culture (Maldonado, 2002), which had its derivative in the defence, by the Werkbund, of the union between art and industry, for example, later reformulated by Gropius in Bauhaus as an alliance between art and technique. In a similar sense, we can understand —in French-speaking culture— the well-known analogy of housing as a “machine for living” enunciated by Le Corbusier or —in the sphere of the Soviet avant-garde— the dazzling machinist iconography exhibited by constructivism in its different aspects.

As stated on previous occasions (Bravo, 2011, 2014), the renewal of the continent —social housing— necessarily involved the renovation of its contents —furniture and household goods in general— and, also in this area, the industry proved to be the most faithful ally of the social housing sector. Thus, during the interwar period, industrial design emerged as an academic discipline —through institutions such as Bauhaus, Vjutemas or the Cranbrook Academy of Arts— both as a specific professional activity, with pioneers such as Breuer or Wagenfeld in Europe and Teague or Geddes in the United States.[5]

During the necessary post-World War II reconstruction, the principles of modernity were applied in a generalized manner: rational project strategies; functional priority; austerity and economy; rejection of ornamentation; material and productive sincerity; confidence in progress and technology; etc. that led to a massive industrial production, the manifestation of a period of continuous economic development described as

[2] Cfr. Read (1961, 1934) and Pevsner (2000, 1936) and, on design historiography, Campí i Valls (2013)

[3] See, for example, Fiell (2000), Branzi (2010), Wilhide (2017) or, in Spain, Galán and others (2010)

[4] Specifically, ‘El Proyecto Moderno’, pp. 61-74, master class given in Buenos Aires, 1984

[5] Regarding these issues, the thesis of Campí i Valls (2015) who, after reviewing the state of the art, gives four different and complementary accounts of the history of design in the West: as a professional activity; as an academic discipline; as a morphological style; and, finally, in relation to its ideological aspect.

"Fordist-Keynesian" (Harvey, 2008). In the early 70s, however, these theses of modernity began to show symptoms of exhaustion when a series of historical events —the demise of the Bretton Woods agreements, oil crisis, emergence of economic neoliberalism and political neo-conservatism— modified the *status quo* to initiate a process of important economic, political and social transformations. The advent of the so-called postmodernity then brought about the application of design principles of a very different nature: new design strategies based on irony, playfulness, chance or happenstance; morphological priority; recovery of ornamentation and primacy of the superficial qualities of objects over the corporeal; importance of the significant and symbolic aspects; historical references; emotional qualities over rational ones; etc. In short, an alternative to the current model that proposed new relationships between art, design and production, characteristic of a new era known as "flexible accumulation" (Harvey, 2008). As a result, the focus on handicrafts was also renewed to centre on other values related to the rational use of local resources; its increased focus on sustainability through a system of proximity production and consumption; its traditional link with artistic culture; its ability to create unique, singular objects, and its decorative taste or the symbolic values associated with its products.

With the coming of the new century, we are also seeing the emergence of new consumer choices which, on the one hand, are oriented towards more sustainable, environmentally friendly, locally produced and fair trade solutions. On the other hand, more and more consumers prefer unique, personalized products that they can take ownership of and which in some way identify them. Products, therefore, far removed from the disposable industrial object, manufactured in large series, advertised and sold by catalogue. And although the industry has difficulties in providing an adequate response to these new trends, its demands, on the other hand, are closer to many of the characteristics usually offered by craftsmanship.[6] In this way, artisanal trades and techniques are witnessing a resurgence from certain residual redoubts linked to the tourist market and luxury accessories where, for the most part, they had been relegated during the decades of industrial predominance. Crafts and techniques that currently seem to be emblematic of two of the basic principles responsible for the renovation of contemporary products and architecture: sustainability and universality. These are, on one hand, awareness of resource constraints—materials, water, energy— which has incorporated techniques such as life-cycle costing[7] into the design process; consideration of cradle to cradle design;[8] local production and consumption; or preference for local materials and techniques to reduce logistical costs, for example. And, on the other hand, the recognition of social diversity and of the different capacities, metrics and individual abilities that recommends architectural and universal design solutions that do not exclude anyone regardless of their physical, perceptual or intellectual characteristics.

Moreover, in times of economic globalization and the immediacy of information and communication made possible by new technologies, this revival of craftsmanship has not only affected post-industrial societies, but has also opened up a whole new range of possibilities in developing countries. In these cases, handicrafts remain the system that preferentially satisfies numerous material and even housing needs of important social groups, while reflecting their own historical and cultural roots. Ancestral trades and processes that show the application of those human skills and the development of certain processes and technical capabilities that have made the intelligent transformation of

[6] Research on future prospects for handicrafts can be found in Martínez Torán, M. (2012), whose main conclusions have also been published in English in Martínez Torán M. et al. (2017)

[7] Cfr. Rieradevall, J. & Vinyets, J. (1999) or Capuz S. F. and others (2002)

[8] Cfr. McDonough, W. & Braungart, M. (2005)

local natural resources possible, with materials available to meet their material culture needs. Some cases of this handicraft production have become drivers of local development through small interventions by cooperation organizations and groups of designers who have contributed with their own design knowledge and techniques, such as planning and selection of design alternatives, market and target-user studies, branding, packaging, presence and visibility in digital channels and promotion in social networks, among others. Alternatives which, from a *glocal* standpoint, have been able to open cracks in the markets by appearing as bearers of these principles of sustainability and universality thanks to their manufacturing quality.

3. Contemporary craftsmanship cases

In the commodity area, it is possible to find artisan-designers of precious metal work and small personal accessories, singular products or very short series usually linked to manual workmanship. This is the case of Enric Majoral (Sabadell, 1949),[9] a designer based in Formentera since 1971, where he draws his inspiration to design and produce different series of jewellery —crafted in fair trade mined metals — which he sells from premises in Barcelona, Ibiza and Formentera to customers worldwide and, of course, also online. In 1993, his son Roc (1976-) joined the company to ensure its continuity by taking responsibility, on his own since 2003, for certain collections of the firm, some of which have been acknowledged in different international competitions. In terms of equipment and ephemeral architecture, it is worth mentioning the work of the studio led by Mariano Martín,[10] an architect from Madrid

Fig. 1. Enric Majoral: *Blat,* 2020. (Source: www.majoral.com/portfolio/colleccio-blat)

whose production includes interesting examples of exhibition and furniture design, usually resolved with an exceptional economy of means and always showing his concern for applying the three rules of responsible consumption: reduce, recycle, reuse. For example, the series designated *Botox* consists of a set of pieces based on the recovery of different discarded structures of seats and tables of different types on which new elements of dyed methacrylate —the Botox— are applied to the objects, to give them a renewed lease of life that brings them back into use. Likewise, the design of the *Serie Juste*, a set of office furniture —an electrified conference table, containers— entirely made of cardboard.

[9] Cfr. www.majoral.com/ A young Valencian company Simuero (simuero.com) is working along similar lines —promotion and distribution closely linked to social networks and digital channels— which in addition offers the possibility —to order— of customizing your jewellery by creating unique pieces.

[10] Cfr. www.marianoweb.com

Fig. 2. Mariano Martín: *Serie Botox,* s/f
(Source: www.marianoweb.com/portfolio/serie-botox)

In collaboration with architecture, it can be cited the well-known case of Cerámicas Cumella,[11] the third generation of ceramists established in Granollers (Barcelona) since 1880, with a long series of collaborations. An example of good craftsmanship in confluence with contemporary technology, he has worked on the recovery of historical pieces necessary for the restoration of masterpieces of architecture from modernism to modernity, from Gaudí or Domènech i Montaner to Antoni Bonet. But also producing new pieces designed specifically for singular works of contemporary architecture —both Spanish and international— such as, for example, the Santa Caterina Market (Barcelona, 2004) by Miralles-Tagliabue; the Spanish Pavilion (Zaragoza, 2008) by Patxi Mangado; the Museum of Architecture, Art and Technology (Lisbon, 2012-16) by Amanda Levete; or the Botín Art Centre (Santander, 2011-16) by Renzo Piano. Precisely in an interview about the pieces made for the facade of the latter edifice, the master ceramist himself described his work as "technological craftsmanship", because:

"Showing his mobile phone, he comments on how he can keep track of what is happening in the oven. The times, temperature, humidity… Everything is synchronized with the application and yet none of it ensures success; 'we live on the brink of failure'. Researching, always creating new pieces, new colours, new systems, gives rise to permanent insecurity. Doubt remains present in each new assignment, each new project." (González Blanco, 2019)

Fig. 3. Cerámicas Cumella: Restoration (2005) of the roofs of *La Ricarda* by Antoni Bonet.
(Source: www.cumella.cat/portfolio/la-ricarda-antoni-bonet)

A more specific case in the context of vernacular architecture can be the one constituted by Artifex Balear,[12] a Mallorcan non-profit association founded in 2002 whose main objective is the recovery and sustainability of the Mediterranean landscape and ecosystem. To this end, it undertakes three different and complementary lines of work: the recovery of traditional trades of popular construction;[13] soil and landscape regenerative agriculture; and what they call appropriate technology, which seeks to respond to the basic needs of comfort —water and energy for domestic use, food preservation and preparation, etc.— and to basic tools and trades— furnaces, mills, etc.—through the application of local techniques —accessible, sustainable— low impact and low consumption. The group is headed by Miquel Ramis, a master stonemason and sculptor who, on the outskirts of Palma, has assembled a varied team of people

[11] Cfr. www.cumella.cat

[12] Cfr. artifexbalear.org

[13] Along similar lines, Esteve-Sendra, Ch. and others (2012) reflect upon new and traditional uses in design and architecture of such a prolific material as bamboo.

who hold courses, seminars, workshops and conferences through which they disseminate knowledge and teach different skills resulting from their research and experience in the aforementioned triple line of work.

Fig. 4. Artifex Balear: *Drywall course in Deià,* s/f (Source: artifexbalear.org/con_tra)

Finally, an illustrative case on the contributions from the design discipline where industry is practically non-existent and the local material culture consists basically of handcrafts. This is the area of the cooperation projects of the Free Design Bank,[14] a Valencian organization led by the designer and teacher Manuel Bañó. Their aim is to provide knowledge, techniques and strategies in the field of industrial design to groups of artisan producers from different countries in Latin America, Africa and Southeast Asia, in order to improve their production, open new distribution and marketing channels and thus improve their quality of life.

Fig. 5. Free Design Bank: *Handmade soap design workshop,* El Rosal, Ecuador, 2017 (Source: asociacionelrosal.org)

3. Conclusions

At this point, it is worth asking about the characteristics of this new model of relations established between industrialized production and craftsmanship. What are these new links between design and craftsmanship? What specific advantages does the alliance between them contribute, especially in those two important and highly topical areas: eco-sustainable and universal design and architecture? In relation to sustainability, from the ideation, conception and formalization phase, the application of digital information and communication technologies to handicraft production makes it possible to explore new possibilities for data collection, analysis, study and verification of variants and alternatives, introducing the necessary modifications.[15] Tools such as algorithmic or generative design make it possible to optimize the energy savings of buildings or dynamically test geometric variants in order to select the most appropriate morphological solutions to the problem posed, be it diversity of supply, functional adjustment or material and productive optimization.

"One of the contributions of algorithmic design to the creation of objects is that it puts into crisis the classic definition of series as we have been using it (currently, craftsmanship sometimes uses moulds to obtain a repeated or serial element on which later works individually, not losing its original character). These new procedures facilitate the production of series with unique and differentiated individuals, which accentuates the concept of exclusivity and enhances the final product. The association between algorithmic design and digital manufacturing with artisanal techniques gives us a very powerful arsenal to be able to face the future with all the rigour and creativity that will be necessary for survival of the trades." (Cabrera Castro, 2020)

[14] Cfr. freedesignbank.org

[15] Cfr. Martínez Torán, M. (2020)

In the functional area, design has developed analysis and optimization methodologies which, when applied to craftsmanship, allow the evaluation of models and types in order to introduce those evolutionary modifications that make their improvement possible. At the same time, designers are accustomed to working to regulatory standards and applying quality control techniques to guarantee the homologated production required by consumer laws.

In terms of materials and production processes, scientific support makes it easier for craft workers to comply with their ethical and social commitments. For example, testing new materials to justify their preference for the most sustainable, environmentally friendly alternatives; requiring eco-labels, fair trade raw materials or recycled and recyclable raw materials; committing to local sourcing, production and consumption; life-cycle management (LCM); or incorporating responsible production and consumption criteria, among others.

In relation to logistics, distribution and product marketing processes, it provides market research and survey strategies, branding and promotion processes that help to position products or project them to new target users, optimizing packaging techniques to reduce waste, as well as storage and transportation techniques to save energy and resources. Last but not least, in the field of universal design, the production of monotypes or short series allows for the consideration of the diversity of users, taking into account their different perceptual, motor or intellectual abilities. Product customization, beyond adapting to the consumer's particular tastes, allows adjusting the dimensions of the product to the user's particular anthropometry, thus achieving a kind of "bespoke" design or custom manufacturing. Contemporary technologies such as 3D printing or computer numerical control (CNC) machines are becoming more and more accessible and allow for the manufacture and marketing of unique models, adapted to each specific user, not only in terms of finishes, to satisfy the customer's particular tastes and integrate into their environment but, above all, to fit the anthropometric characteristics or specific capabilities of each user and thus improve their user experience.

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ARTISANS AND CRAFTS OF TRADITIONAL CONSTRUCTION

PLANS AND EXPERIENCES FOR THE RECOVERY AND MAINTENANCE OF CONSTRUCTION CRAFTS

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Vernacular architecture and seismic risk. The case of Mugello in Tuscany

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Topic: T3.4. Plans and experiences for the recovery and maintenance of construction crafts

Abstract
Vernacular architecture contemplates by its nature a variety of forms and construction techniques self-designed by the communities that inhabit it in response to specific needs. In Tuscany, an area with a medium-high seismic risk and a long seismic tradition such as Mugello, local building techniques can be identified with a common purpose: to improve the resistance of buildings. Using traditional techniques, the vernacular architecture of this area has seen the use of particular expedients as protective measures, in some cases adopted precisely in response to the movements and stresses to which buildings in this area may be subjected. In the past, the choice of appropriate materials together with traditional building systems has played in some cases a precise role in preserving architecture from damage due to telluric events, through the practice of ancient constructive knowledge. In the territory of analysis, the systems or constructive elements adopted in the examples of vernacular architecture would lead to the identification of an already present concept of safeguarding structures and their use would prove the awareness of local workers with respect to the specific static functions to be performed. The documentation on traditional construction systems inherent to the historical building therefore becomes a fundamental investigation tool for the knowledge of the building. In this sense, the analysis of the material and construction characteristics of the local architecture allows to have a definition of the methods adopted over time in relation to the context and to establish their compatibility with the material culture of the territory in the individual restoration interventions.

Keywords: *Seismic risk; Mugello; local construction techniques; safeguard.*

1. Introduction

In territories where the seismic phenomenon is not isolated, but is a repeated event of endemic character, the presence of a historical built fabric undoubtedly testifies to the permanence of the local population on the site, despite the serious destruction caused by the earthquake having led to awareness of a real risk. It follows, therefore, that following seismic events the affected communities have had to undertake phases of repair or even re-construction. The same local workers have had to adapt the forms of living and building techniques over time to the particular characteristics of the place where they are located, especially if it is characterised by uncomfortable and uncertain living conditions.[1] In the practice of restoration, the cognitive project allows the investigation of past building techniques and the identification of the stratifications of the building, revealing the changes that have taken place over time on the artefact, the construction phases and previous restorations. When the analysis involves artefacts built in particularly vulnerable areas such as those exposed to seismic risk, an additional source of

[1] For an in-depth study of the topic see Pierotti P., Ulivieri D. (2001), Guidoboni E.. (2016).

knowledge can be found in the reading of the building, capable of identifying techniques common in traditional architecture and adopted in the past to ensure greater resistance of the buildings. It is therefore necessary to consider a plurality of disciplines capable of offering valid considerations and contributions to a complete and integrated documentation of the building and to a critical reconstruction of the single piece of information with respect to the entire cognitive project. For this purpose, historical and archival documentation and direct reading of the building come to the rescue, as well as broader considerations regarding the context of reference.

Fig. 1. Reinforcement wall of a house in Scarperia (Source: Bordoni P., 2021)

If in the last decades integrated studies have led to the formulation of anti-seismic catalogues or to the definition of real local seismic cultures,[2] implying in the second case a recognised awareness of the seismic risk on the part of the local workers so as to transmit the technical solutions for prevention or repair from generation to generation, it seems appropriate to dwell on some elements that distinguished the work of master craftsmen in the past, for example the choice of materials and their use, and to investigate the forms of technical knowledge experienced following historical seismic events related to the cultural aspects that involved the same populations. Before precise technical standards were established for reconstruction work in seismic areas,[3] intervention and restoration work on earthquake-damaged artefacts took place through the practice of building knowledge and empirical experience of techniques. In areas such as Mugello, where earthquakes have occurred repeatedly and with considerable intensity, the historical heritage is undoubtedly evidence of the techniques "tested" over time by local workers, determining their actual static quality.

1.1 Historical seismic events in Mugello

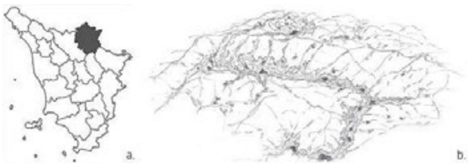

Fig. 2. a) Mugello area in Tuscany, b) Mugello territory. (Source: https://www.paesaggiotoscana.it/mugello)

[2] For more details on the concept of "local seismic culture" see Pierotti P., Ulivieri D. (2001). The study, conducted on the territories of Garfagnana and Lunigiana, allowed to identify traditional building techniques and particular "anti-seismic tecnhiques" in response to the seismic vulnerability of the territory. The question of the existence of local anti-seismic cultures is strongly debated within the scientific community. Emanuela Guidoboni, one of the leading experts in seismology, believes that the technical solutions experimented in the past by local workers were so discontinuous that it is not possible to affirm the spread of an anti-seismic culture, Guidoboni E. (2015). Further work was carried out in Tuscany by Arrighetti A., an integrated study that led to the formulation of a manual of archaeoseismology in architecture applied to the Mugello case study, Arrighetti A. (2015).

[3] In Italy, the first such measure was Royal Decree No 193 of 18 April 1909.

The Mugello territory lies on the border between Tuscany and Emilia Romagna. The Mugello valley occupies a special position, as this territory coincides with the hydrographic basin of the Sieve river, the most important tributary of the Arno river, and is surrounded by the Tuscan-Emilian Apennines (to the North), the Morello and Giovi mountain ranges (to the South), Mount Falterona (to the East) and the Calvana mountains (to the West).

Strongly linked to the history of Florence since the past, the Mugello territory has had a great concentration of settlements both because of its strategic position connecting it to the nearby city of Florence and because of the fertility of its soil. In fact, Mugello is distinguished by the presence of settlements dating back to medieval times,[4] of which there are still well-preserved architectural examples. In particular, buildings of worship, churches and Romanesque parish churches are important examples of traditional architecture dating back to the 12th and 13th centuries, or in some cases even before the year 1000. These buildings still retain their original identity, removed from the heavy urbanisation that the Mugello territory underwent during the last century, and allow the interpretation of the building that has undergone numerous interventions and reconstructions over time, largely due to the violent seismic events that occurred.

In Tuscany, Mugello is the only area after Garfagnana and Lunigiana to have recorded maximum MCS intensity degrees (IX and X). Over the centuries, this territory has seen a concentration of seismic events of considerable magnitude that have also caused serious destruction to local architecture. The main seismic events with epicentral area in Mugello and the reconstruction plans implemented following the damage recorded are analysed below.[5]

The 1542 earthquake is remembered as one of the most disastrous seismic events. The main tremor had destructive effects on private homes, religious buildings such as churches and convents, and public buildings in the towns involved. According to the sources, the centres most affected were Scarperia, where the vicar's palace and a tower of the city walls were damaged, and Borgo San Lorenzo, with serious damage to the walls, the parish church and the bell tower. Here the Palazzo del Podestà was still in ruins in the two years following the earthquake. The parish church of S. Gavino Adimari, whose reconstruction was carried out by the Medici family between 1500 and 1600, and the church of S. Agata, which suffered serious damage and collapses, together with the bell tower, suffered extensive damage.

Fig. 3. damage to the wall caused by the earthquake in 1542. Church of Sant'Agata, Mugello (Source: Bordoni, 2021).

[4] For the history and development of the Mugello territory see Romby C.G. coord. (1995); Romby. C.G. coord. (2006).

[5] The information on the effects of historical earthquakes in the Mugello region reported below was retrieved from the *Catalogue of Strong Earthquakes in Italy (461 BC-1997) and in the Mediterranean area (760 BC-1500)*, a project by Guidoboni E., Ferrari G., Mariotti D., Comastri A., Tarabusi G., Sgattoni G., Valensise G. (2018) and Guidoboni E., Ferrari G., Tarabusi G., Sgattoni G., Comastri A., Mariotti D., Ciuccarelli C., Bianchi M.G., Valensise G. (2019), historical sources from the State Archives of Florence, some of which can be consulted from online catalogues, and from more recent publications that have brought to light important documents related to the post-seismic damages recorded. These include Bellandi F., Rhodes D. E. (1987) and Brunori Cianti L. coord. (2011), Arrighetti A. (2015).

Evidence of reconstructions after the 1542 earthquake can be found for the convent of Bosco ai Frati, thanks to the *Relazione* of Frà Giuliano, which attests numerous expenses for repairs to the damage caused by the earthquake. In this case the bell tower was badly damaged, as was the vault of the convent church, which was repaired by filling in the cracks.[6] Notes of debt can be found for the convent of S. Barnaba, for which masonry work and the covering of the roofs of the cloister were carried out.[7]

Again in 1597, Borgo San Lorenzo was struck by an earthquake with an intensity of VII MCS. Here the earthquake damaged a group of houses, for which permission was sought to cut down oak trees and use the timber to restore the damaged buildings. Again in 1611 an earthquake caused serious damage in Scarperia and Cerliano, where serious damage to buildings was reported. At the beginning of the seventeenth century, following the damage caused by successive earthquakes in the previous century, scarp walls and barbicans were built to reinforce the body of the Palazzo dei Vicari in Scarperia.[8]

Mugello continued to record seismic events of medium intensity (MCS grade above 6) in the 13th century (1762) and during the 19th century (1835, 1843, 1864) until the 1919 earthquake remembered as the event of maximum intensity, reaching the X MCS grade. Once again, the earthquake caused severe damage to the towns of Vicchio, Borgo San Lorenzo, Scarperia, Barberino di Mugello and San Piero a Sieve, with widespread collapse of most of the buildings. The most serious damage occurred in Borgo San Lorenzo and its hamlets: religious buildings and public buildings were seriously damaged, and many houses collapsed, making part of the building stock uninhabitable.

2. The perception of earthquakes in history and socio-cultural aspects. Some considerations

Certainly the period in which the greatest number of seismic events occurred in Mugello was the period between the 16th and 17th centuries, with rather frequent seismic activity of medium-high intensity.

In order to understand how the earthquake was perceived by the society of the time, it is interesting to investigate the cultural aspects linked to it. This does not stop at a simple historical record, but is an extremely useful source for understanding the implications of this also with regard to the (technical) knowledge of the seismic phenomenon widespread at the time, hence the remedies consciously chosen as a response to the earthquake.

The historical sources relating to the 1542 earthquake document that a late-medieval belief that seismic motion was generated by the pressure of underground winds was still deeply rooted in Mugello.[9]

A letter sent by Cosimo I de' Medici to Giovanni Bandini on 13 June 1542[10] states that, in line with this theory, nearby Florence would have suffered very little damage thanks to the presence of the River Arno. On the other hand, Mugello, with no wells, lakes or watercourses, could not have 'exhaled' the force of the earthquake. In fact, at the beginning of the Modern Age, it was believed that wells near buildings were the remedy to defend against earthquake destruction.

If we then consider the administrative and fiscal management that followed earthquake destruction, based on the exemption of certain taxes

[6] Archivio di Stato di Firenze, Manoscritti, 167, Giuliano dalla Cavallina, Relazione sui danni al Convento del Bosco ai Frati causati dal terremoto del 13 giugno 1542, sec.XVI, copia sec.XVIII. XVIII sec.

[7] Archivio di Stato di Firenze, Conventi soppressi, S.Barnaba, filza 252, n.24, Elenco di spese sostenute per riparare i danni causati dal terremoto del 13 giugno 1542. XVI sec.

[8] Arrighetti A. (2015).

[9] This belief is reported in numerous historical sources. See Archivio di Stato di Firenze. Mediceo del principato. filza 4299; Ammirato S., (1600- 1641); Adriani G. (1583); and in a pamphlet on the 1542 earthquake in Bellandi F., Rhodes D.E. (1987).

[10] Archivio di Stato di Firenze, Mediceo del principato, filza 4299, Lettera di Cosimo I de' Medici a Giovanni Bandini, Firenze 13 giugno 1542. 1542.

from which only the wealthiest citizens could benefit, we can see that only a few properties damaged by the earthquake could benefit from specialised and careful repair work. This mainly concerned palaces and churches, while common dwellings, which often saw hasty restoration using poorer techniques and materials, were excluded.[11] It therefore seems difficult to claim the existence of a seismic culture in this area.

Yet the sixteenth century was the turning point: in 1571 the first seismic-resistant house was designed. Following the disastrous earthquake in Ferrara in 1570, Pirro Ligorio had drawn up a plan for an earthquake-resistant house. Ligorio's concept of the rule of art emphasised the importance of good quality construction to ensure greater resistance.[12] Linked to this concept were the construction principles and materials suitable for a resistant building. Ligorio's house was solid and cohesive, built on a regular plane, with well-buttressed walls and reinforced at the most vulnerable points: the corners, the door and window openings, the floors.

2.1 Seismic resistant techniques and the vernacular architecture in Mugello

An analysis of the vernacular architecture of Borgo San Lorenzo, Scarperia, San Piero a Sieve, Sant'Agata, Vicchio, Luco di Mugello and Barberino del Mugello, which have suffered the most damage from historic earthquakes, shows that various construction techniques have been adopted to make these elements more resistant.

For example, the reinforcement of cantonal walls, a concept handed down since ancient times, is a widespread technique in traditional Mugello architecture. In addition to the insertion of pietra serena chains in the cornerstones of the Pieve di Sant'Agata for greater resistance, reported by Arrighetti in his study of archaeoseismology in Mugello, the linking of cornerstones is a characteristic of traditional architecture. Ancient wall towers and parish churches, but also dwellings that retain their original configuration, have well-anchored and reinforced cornerstones.

Fig. 4. Well-anchored cornerstones. Tower of the ancient walls in Scarperia (Source: Bordoni., 2021).

With regard to the openings, it can be seen that the "anomalies" of the historical building reveal interventions carried out after the construction phase. An example of this are the restorations carried out on the portals of the churches of S. Gavino Adimari and Sant'Agata, whose repairs next to the jambs were carried out using brick, a material already in use in Mugello since the 13th century.[13]

A further interesting element concerns the exhaust arches, which are also often made of brick above the openings, in order to lighten the task of the elements below. The exhaust arch allows

[11] See Guidoboni E. (2015). The archive documents consulted would lead to confirm this trend in Mugello as well.

[12] Guidoboni E. (2015).

[13] See Arrighetti A. (2014).

to protect the stone windows and portals lintels below, which would otherwise be subject to excessive load and susceptible to shear failure.

They are in fact one of the recurring elements in Mugello. A further observation can be made regarding the configuration of the ashlars of the portal arches. The greater the number of wedges in an arch and the greater their contact area, the more energy the structure will be able to dissipate.[14] In the event of an earthquake, the protection of a built structure often depends on its ability to dissipate the energy received. An example of this is the portal of Palazzo dei Vicari in Scarperia.

Fig. 5. Portal of Palazzo dei Vicari in Scarperia (Source: Bordoni, 2021)

Moreover, given the fragility of the stone lintel, another expedient used could be to increase the height at the centre of the span, the point where the greatest deformations occur. Given the awareness of the vulnerability of the openings, in addition to the solutions adopted to dissipate the forces above portals and windows, a trick often used following earthquakes was to plug the openings. This technique in fact often had a static approach, in addition to distributional needs. The plugging is sometimes made with materials similar to those of the facing (Pieve di S. Gavino Adimari), more often brick is used, a material that proves particularly suitable for this use.

Fig. 6. Exhaust arch. Church of S. Gavino Adimari (Source: Bordoni, 2021)

However, there are many solutions that were already known in the classical world to give greater resistance to buildings, which were also used in Mugello.

Even though, as we have seen, scientific thought was not yet consolidated between the 16th and 17th centuries, there is evidence of post-seismic interventions in Mugello that precise expedients were used to defend against seismic actions.

On the other hand, systems for reinforcing buildings had been known since antiquity and tested in the classical age. The concept of stability was firmly established in Vitruvius' firmitas. In the architecture of the Roman world, precise techniques were developed to make buildings less vulnerable.[15] Some building techniques involved the use of wooden elements to be inserted into the masonry (e.g. *opus galicum* and *opus craticium*), recognising the remarkable resistant properties of wood. But other expedients have been tried since the ancient world. The use of chains, for example, a consolidation system used against the tendency of masonry structures to overturn, is present in numerous examples of historical architecture and widespread in many areas of Italy. Even in the architecture of Mugello there are numerous examples of the use of this remedy. In this regard, historical documentation is particularly interesting.

[14] See static observations for each architectural element of the buildings in Ferrigni F., Della Pietra A., Sorrentino M. C. (2017), Pierotti P. (2003), Groupe APS (2002).

[15] See Arrighetti A, Minutoli G. (2018).

Among the restorations carried out in the first decades of the 17th century, the *Ricordi* - Memories - of the parish priest Tolomeo Nozzolini attest to the use of punctual and targeted workmanship.

Here we report on the work carried out for the Pieve di S. Agata, which had already been badly damaged by the 1542 earthquake. In the text, it emerges how the choice of the works carried out was aimed at strengthening the damaged structures. In particular, Nozzolini indicates the decision to make new chains well connected to the existing ones to protect the vault of a room in the church of S. Agata, "essendo questo paese molto difettoso di tremuoti".[16]

This remark by the parish priest is extremely interesting. His statement testifies to the desire to increase the resistance of the building vulnerable to the earthquake and the awareness of the interventions needed to prevent further damage. The same text shows the work carried out for the church tower, here two oak timbers are again used for the chains at the impost of the window arches.[17]

On the other hand, the chains were made both of iron and of blocks of local stone, pietra serena or alberese. Examples are those used in the Convent of Bosco ai Frati or in the parish church of San Gavino Adimari. There is also evidence of wooden chains, such as those used inside the bell tower of the Pieve di San Lorenzo in Borgo San Lorenzo.[18] Another element considered of interest and used in Mugello is the presence of scarp walls or barbicans. The best known example is certainly the Palazzo del Vicario in Scarperia, but numerous dwellings present this type of reinforcement.

3. Conclusions

To affirm the existence of a true seismic culture is a complex operation. Such a concept should include a series of considerations with respect to the whole territory and the communities involved, to the perception of the earthquake and the awareness of the risks of this phenomenon, then to the verification of an effective development of techniques handed down from generation to generation in response to the actions of the earthquake.[19]

As seen in the past, the explanations of the earthquake were linked to popular beliefs far from recognizing it as a natural phenomenon, and issues related to administration and post-seismic management did not make possible a cohesive and homogeneous repair intervention to all the existing buildings. Therefore, some solutions aimed at reinforcing the building are found on buildings with important commissions, such as churches and palaces. For this territory there could be a further difficulty of analysis: the urbanisation of the last century has often affected the traditional architecture, changing its original aspect and often plastering the surfaces so that it is more difficult to read the constructive characters of the place.

What can be said, however, is that Mugello has an important cultural heritage, characterised by churches, Romanesque parish churches and ancient medieval buildings that correspond to the vernacular architecture that developed in the territory from the first settlements, some examples of which date back to before the year 1000. This means that throughout its long history, the traditional architecture of Mugello, due to its particular position and the vulnerability of the buildings, has adapted the forms and techniques of building to its own particular needs. Evidence of this can be found in the historical sources documenting restoration work following historic earthquakes. What was in fact well known in the

[16] Translation of the text: “since this town is very defective in tremors”. The expense register of the parish priest Tolomeo Nozzolini is reported in Lia Brunori Cianti coord. (2011).

[17] The latter reference can be found in Arrighetti A. (2015)

[18] See Guidoboni E. (2015), Arrighetti A. (2015).

[19] See the studies by Pierotti P., Ulivieri D. (2001); Arrighetti A. (2015).

past was the concept of building to the highest standards, the use of local materials and the practice of technical knowledge "tested" over time meant good building. After all, Vitruvius' *firmitas*, solidity in statics and materials, accompanied by *venustas* and *utilitas* were principles known since antiquity and became a new foundation in the Modern Age.

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Pinnettas de pedra: a guide for the valorisation of dry-stone artifacts

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Topic: T3.4. Plans and experiences for the recovery and maintenance of construction crafts

Abstract
The dwelling culture in rural Sardinia presents a wide variety of agropastoral construction. One such example still in use today are the "pinnettas de pedra", huts built entirely of drystone walls and lithic corbelled dome, with a technique common across the Mediterranean area. They are located to the north-west and centre of the island, in the areas of Meilogu, Marghine and Planargia. The analysis was based on cataloguing the artefacts: field research and data processing on a GIS platform identified around 500 pinnettas de pedra in the surveyed area. The work resulted in survey cards detailing the state of these buildings: their characteristics in terms of size and materials and the main factors of degradation and structural failure. The cards describe in detail the masonry, the lithic elements and their arrangement, as well as the construction techniques and the structural concept behind the realisation. Our line of investigation brings to light construction methods that stood the test of time. This construction code, an orally transmitted set of established rules defining the art of building, is a valuable heritage of local technical knowledge. An immaterial resource to study and preserve and pass on to future generations. The research aims to deepen and develop the knowledge needed for the conservation of such buildings by compiling a manual of good practices of intervention that respects the characteristics of the material and construction. The broader goal of promoting the pinnettas de pedra is to promote proper care of the land, reduce the factors of risk and degradation, set the standards for safe fruition for local communities and visitors, thus restoring the bond with these places.

Keywords: *dry stone masonry; corbelled dome; Sardinian landscape.*

1. Introduction

The area involved in this research is located in the north-west and centre of Sardinia, in the three historical subregions of the Logudoro: Meilogu, Villanova and Marghine[1]. A vast area where the *pinnettas de pedra*, constructions employed for agropastoral activities, can still be identified and are still in use. The geological varieties and prevalent environments define the three historical provinces and the borders with other territories[2]. In Meilogu and Villanova, volcanic remains in the shape of craters and domes – legacy of a now stable volcanic phenomenon – are interspersed with islands and basements in Miocene limestone. Conversely, the area of Marghine shows a prevalence of plateau basalt, with peculiar lithofacies insertions. These territories share the same lithological variety and agropastoral tradition.

[1] The range spans 29 municipalities, covering an expanse of 1.376,6 km^2.

[2] Examples of stone-covered huts in basalt, with other concentrations, can also be identified in the neighboring historic provinces of Planargia, to the west, and Barigadu, to the south, where investigations are underway.

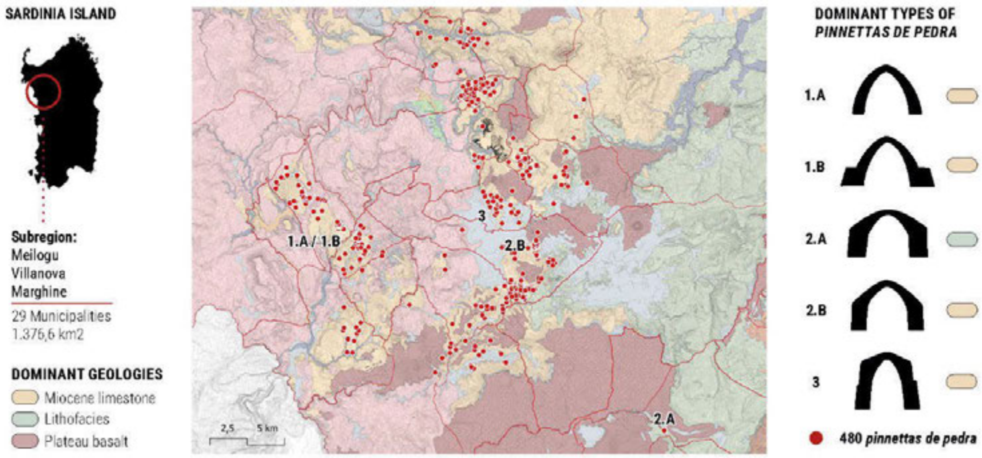

Fig. 1. Territorial framework of Meilogu, Villanova and Marghine. (Source: Cappai & Sotgiu, 2021).

Built entirely of local stone, the construction of the *pinnettas* follows construction concepts and structures originated in the Nuragic Civilisation[3]: a local construction code that stood the test of time and is a valuable resource to learn and preserve.

In the context of rural homes in Sardinia, this type of construction stands out for the peculiarity of the corbelled dome. Indeed, the areas surveyed have lithic slabs (*sas pedras ladas* in the local language) as a primary resource immediately available on site; that allows for the assembly of the dome.

The various types of *pinnettas de pedra* found throughout the island belong to "*rural architecture of historical or ethnoanthropological interest as heritage of the traditional rural economy*"[4] according to the Codice dei Beni Culturali e del Paesaggio (Law on Cultural Heritage and Landscape). The Piano Paesaggistico Regionale (Regional Landscape Plan) of Sardinia[5] identifies them as heritage assets, because they constitute elements and networks of connection, as well as artifacts of the historical and cultural landscape.

The *pinnettas de pedra* represent the agropastoral culture active until the 1970s. Although some are still in use, nowadays they are gradually being abandoned. That reflects a mental detachment from a culture rooted in the land and a physical departure from places that were once bustling with activity and people, whose significance seems to have disappeared.

2. The pinnettas de pedra: a spread rural heritage

2.1 Survey of the area and processing of data on a GIS platform

The first assessment phase is the direct field survey. It is backed by written and oral sources, linked to the memory and stories by the local people involved in the data collection. During the study phase, the information acquired is verified, to identify the *pinnettas de pedra* and assess the accessibility along the ancient rural roads.

[3] The majestic Nuragic monuments, visible across Sardinia, constitute an exhaustive model of architecture and construction with dry stone masonry, thanks to the technical solutions adopted to build complex and imposing mural facings and domes following the principle of the progressive overhang of blocks. The reconstruction hypothesis of Nuragic huts, formed through archaeological excavations, presents the same dimensions and construction characteristics as the current *pinnettas de pedra*. Cappai S. N., Marras G., (2007)

[4] Codice dei Beni Culturali e del Paesaggio (Decreto legislativo 22 gennaio 2004, n. 42; art. 10, comma 4 l;

[5] Piano Paesaggistico Regionale, Legge Regionale 25 Novembre 2004, n°5, Norme Tecniche di Attuazione, p.43/88, Art. 54 -

Tools such as QGIS software – geographic information system – as well as the Google Earth satellite platform and the regional geological map have helped identify every single *pinnetta de pedra* and their location, highlighting the areas with the greatest concentration of artefacts[6]. A land map showing the distribution of these constructions in relation to the hydrogeological characteristics and permeability routes of the area has been created.

Over time and up to the present day, such buildings have been destined for agropastoral activity. However, some examples served a community and religious function, like the four *pinnettas* around the Sanctuary of Santa Maria de Sauccu, on the Marghine mountain range.

This survey method has allowed us to identify 480 *pinnettas de pedra*, a significant number that speaks to the current state of the census. The preservation state of such artefacts varies according to the location and use of the land where they stand, highlighting the scattering of such rural heritage. The Landscape Plan of the Region of Sardinia identifies the isolated distribution in the countryside of the *pinnettas* as representative of the building culture of people engaged in working the land.

2.2 The pinnettas de pedra: morphology and construction

The *pinnettas* are single-room constructions, mostly individual, and only in a few rare cases grouped together. They are spread across the area according to the availability of resources functional to agropastoral production activities. The morphological-volumetric scheme features truncated cone-shaped walls, with an average diameter of 5.50 m at the base, defined by the inclination of the wall facing, above which a roof structure of an average height of 3.50 m is set. The circular chamber, with an average diameter of 3.5 m, is vaulted with a progressive overhang of lithic slabs, placed at an outward angle and reaching an average height of 3.30 m at the apex of the vault. The masonry structure of the main body has an average height of 1.50 m on the outside and is built of local stones of irregular shape and dry set. The construction rules dictate a double-wall facing made of stone elements: its long side integrates into the masonry parallel to the wall surface (the courses), with transversal binding elements between the two faces (diatons and semidiatons).

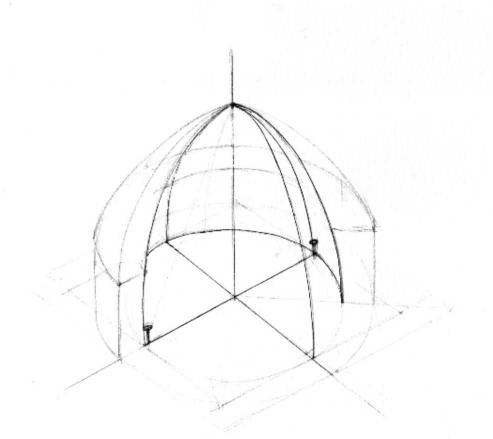

Fig 2. Axonometric representation of the hyphotetical constructive method (Source: Cappai, 2021).

The long side of these stones crosses the wall section for at least 2/3 of its thickness, and they are known as "living stones" because they perform the function of making the two facings joint and interlocked, thus making them stable. During the construction of the wall, which is laid in horizontal planes, the stones are lined with earth mortar and the layer is completed with filler stones positioned to cover the voids between the two coats. Thus, the stability is determined by the masonry engagement represented by the blocks alternated with the binding and filling elements, placed according to the staggered joints and braced with stone chips.

The inner chamber is a circular space of 9-10 square metres, covered by a vault formed by a progressive overhang of lithic slabs that follows a distinctly curvilinear intrados profile from the base to the apex.

[6] The macro areas are defined in Fig. 1.

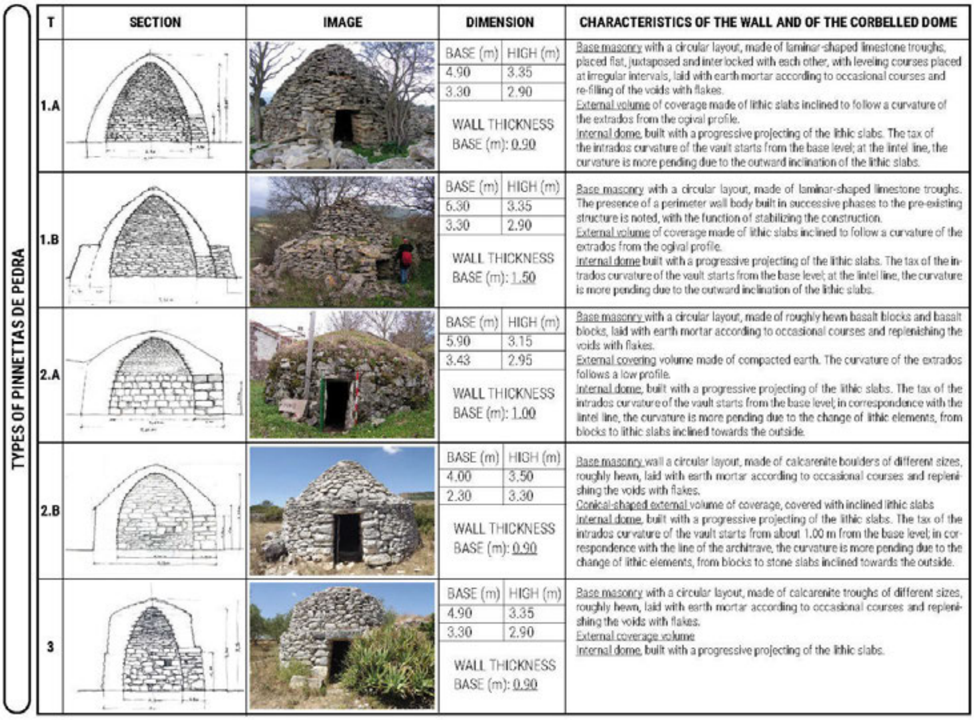

Fig. 3. Types of pinnettas de pedra. (Fig. Cappai & Sotgiu, 2021).

The volume is determined by the rotation around the main axis of the curvature of the intrados, which is described as an arc of a circle with a radius equal in size to the base diameter of the chamber. The apex of the vault coincides with the point of intersection of the two equally sized arcs of a circle.

Linking the intrados profile to a geometric construction[7] helps understand the construction methods employed for this seemingly simple structure. In particular, it helps identify the type of curvature of the intrados of the vault. This curve, far from being accidental, is, in effect, the reference system for the correct laying of the stone slabs and defines the size of the overhang that each slab must have in relation to the one below. There is a close correspondence between construction method and geometric rule. A hypothetical implementation method may be as follows: having obtained the circumference at the base of the chamber and having identified the diameter as a segment of known size, a stake is placed at the far end of the segment, point A; then, a rope with an extension the same size as the diameter is tied to the stake. A fixed point and a free end generate a curve capable of reaching and intersecting the vertical line of the pole placed vertically in the centre of the diameter. The same procedure is employed at the opposite end, at point B, the centre of the curvature mirroring the first. This simple construction method, applied to a building that follows horizontal construction plans, makes it possible to control the different projections of the stone slabs in each row; this method creates a self-supporting structure that does not require centring during construction. The *pinnettas* surveyed in the area in question share a common morphological pattern, with variations in form that result from the different masonry devices employed because of the

[7] For the geometric procedure, see the construction of the equilateral triangle given one side AB.

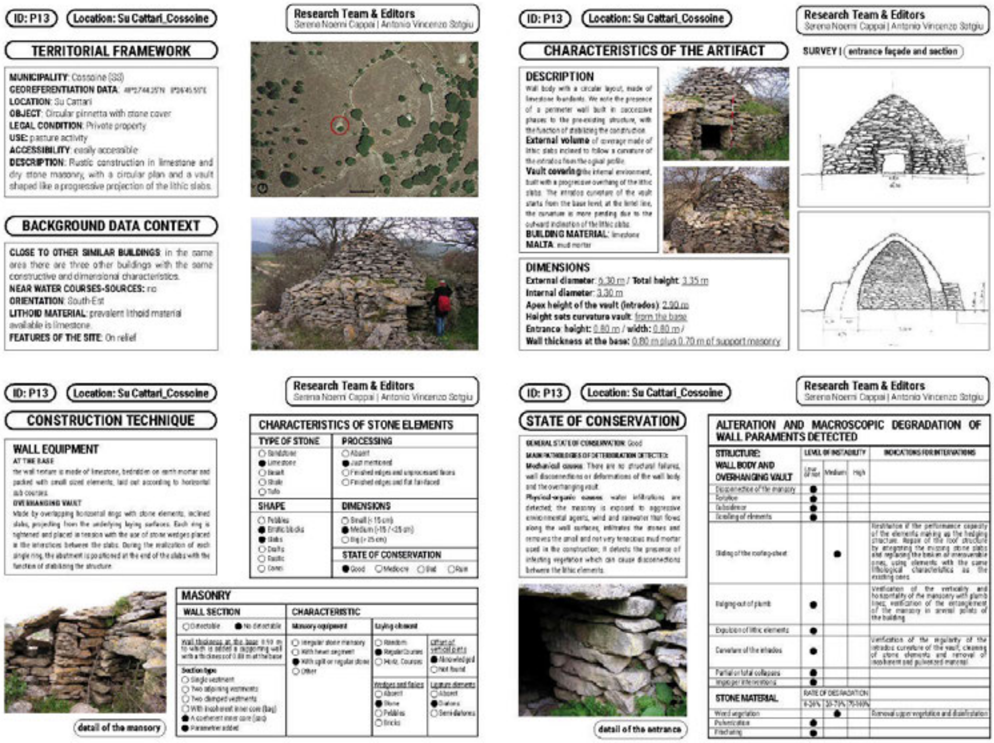

Fig. 4. Model of survey card. (Cappai &. Sotgiu, 2021).

variety of lithology used for the construction. One of the constructional features, useful to characterise the three models identified, is the reading of the external volume of the building, defined by the link between the basic wall structure and the roof structure and, in particular, by the laying of the stone elements: horizontal for the wall structure, sloping for the roof structure. The first type comprises the *pinnettas* whose external volume comprises a continuous uninterrupted line between the base wall and the roof, an ogive-shaped volume made of laminar stone slabs, laid flat in the base wall and sloped as the building rises. On the inside, the intrados of the vault has a curve starting at the base level and increasing in gradient at the lintel line. The laying of the stone slabs shows a common inclination plane between the inside and the outside: the plane follows the course of the two curves of the intrados and extrados and serves to remove rainwater. A variant of this model envisages the addition of a perimeter wall built at a later stage to the pre-existing structure, with the function of stabilising the construction. The second type found appears to have in its external volume a broken line determined by the slight slope of the base wall onto which the conical or low-profile roofline is inserted. The circular wall body is made of basalt or calcarenite stones, roughly hewn, set with earth mortar according to occasional courses, the empty spaces being filled with chips. The third type identified is characterised by a new formal feature: the superimposition of two truncated cone-shaped walls, above which the lowered profile of the roof structure is inserted.

3. The survey method adopted

3.1 The survey cards of the state of the art and preservation of the dry-stone artefacts

The analysis is based on a survey method that provides the preliminary assessment and evaluation of the physical substance of the artefacts. A survey card compiled directly on-site summarises the essential data of the construction through a direct and photographic survey featuring notes of the observations relating to the state of conservation and identifying the main factors of degradation and structural instability.

The study themes for the different levels of cognitive detail are included in the card's layout. The identification of the construction contains useful information about its geographical location, with a description of the environmental context and accessibility conditions. The card describing the artefact's characteristics details the construction features: the size and material; the analysis of the masonry, the stone elements that constitute it and their setting; the construction technique and its underlying structural concepts. The survey phase, recording the state of preservation, makes it possible to identify the phenomena of degradation and instability that have the greatest impact on the construction. Based on the findings, it is possible to identify the pathologies of degradation and instability in two distinct areas: pathologies inherent to the construction and pathologies induced by human activities and environmental conditions. The first category includes the causes resulting from an incorrect laying of the stone elements, whereby the masonry components are not interlocked properly, and the connection between the structure of the base wall and the roof structure is not solid.

In summary, the effects found to stem from mechanical causes are: through-wall cracks, disconnections of lithic elements, deformations of the masonry such as "bulging" and out of plumb, total and partial collapses of the corbelled dome and portions of the masonry body. The causes resulting from the lack of care and maintenance include physical and organic degradation pathologies due to invasive vegetation altering the wall and roof connections. Incorrect anthropic interventions deserve to be mentioned among the causes of degradation detected; they include alterations, such as replacing masonry parts with concrete blocks or additions in reinforced concrete. Neglect and abandonment, mirroring a lack of care for the land, decrease the chances of recovering these buildings, inevitably destined to collapse.

3.2 The digital manual: a tool to communicate the learning process and prepare interventions

Upon completion, the survey incorporates activities to communicate the data acquired, making the information accessible at different levels of understanding of the artefact and the geographical area in question. A database was set up using the cards that contain the entire study process. The visual structure of the cards and analytical process is based on an operational approach that follows a flow chart and leads to the programming of digital applications. Upon this basis, the idea emerged to convert the information into an interactive experience for users, fostering communication without limiting or undermining the study process.

Thus, the learning path developed according to this survey becomes a digital manual, for both fieldwork and study; a useful tool to understand the context, to categorise and guide interventions. It is a good practice guide[8] that can lead the end user on a learning path through the digital medium and back to direct study on the ground.
The prototype of the digital handbook is an application for portable devices (mobile phones, tablets, notebooks) with an interface designed to be appropriately accessible to the user. This tool, both as an atlas of the dry-stone artefacts already surveyed and as an intervention guide for recovery, is intended for public administrations and bodies responsible for the protection of historical buildings and the landscape, as a support for the design phase of recovery plans and for specific work of restoration and stabilisation. Further simplified versions of the digital manual provide a learning tool for a wide audience of local history enthusiasts, who work in the area, look after it and live and operate in it daily. As an addition to the research already undertaken, this tool supports all the activities of the architectural survey in situ: it allows geolocalisation on the map,

[8]Examples of executable interventions are visible in the Fig. 4, in the “state of conservation” section.

audio and video recording for quick notes, acquisition of images and texts and data storage in the internal memory. A tool that acts as a support for both study work and direct surveys in the field.

Understanding and intervening appropriately on the *pinnettas de pedra* provides the tools to work on all minor dry-stone artefacts (boundary walls and fences, terraces, dwellings and other rural shelters) where it is necessary to intervene locally in order to curb soil erosion and prevent hydrogeological risk, to make the ancient paths accessible and thus enjoy the natural resources. Only preserving and protecting the land makes it possible to envisage short- and long-term development scenarios.

4. Conclusions

The present research retraces the learning experience conducted on the *pinnettas de pedra* and transforms it, as mentioned, into a guiding tool for study, planning, surveying and archiving; a tool that leads to further phases of conservation and fruition, along the path of development.

Although in the past the transmission of building knowledge happened orally and through the act of doing, today such process happens through the digital medium as a dominant and accessible language. This research does not intend to attribute a dominant role to digital tools in transmitting the knowledge and enhancing the appreciation of drystone masonry; it instead acknowledges their usefulness as a support tool.

For this reason, the manual is an integrated part of a process of appreciation of the *pinnettas de pedra*, which must necessarily include a system of experiences and projects aimed at increasing the knowledge, conservation, use and communication of dry-stone architecture. Since 2015, several theoretical and practical discussions on the subject have taken place: school workshops, research opportunities and cultural gatherings in the area. Recently, an audio-visual documentary, recorded between October 2020 and September 2021, was produced as a tool to communicate and interact with local communities.

The project to enhance the significance of these constructions is closely tied to the accessibility and practicability of these areas, often hampered by neglect and lack of maintenance. The aim is to encourage local authorities to undertake maintenance work in the area and implement initiatives to enhance the landscape and make it safely accessible.

On the other hand, we rely on the active participation of those who live in those areas to recognise the value of dry-stone masonry constructions as heritage assets that are part of the future landscape in the making.

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Vernacular architecture and traditional trades. Social innovation and cultural heritage in rural Andalusia

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Topic: T3.4. Plans and experiences for the recovery and maintenance of construction crafts

Abstract
The approval of the National Plan for Traditional Architecture (2014) gave a boost to the recognition of this heritage and provided a consensual methodological tool for its safeguarding. This text included a programme for the recovery of traditional construction systems and underlined the need for a holistic and multidisciplinary approach to their treatment. As a precedent in Andalusia, the Inventory of Popular Architecture (1994-1997) was a pioneering project to document these buildings and the activities they housed, highlighting the capacity of techniques, knowledge and objects to adapt to the environmental characteristics of the territory. Subsequently, the Atlas of the Intangible Heritage of Andalusia (2009-2014) collected a significant number of construction techniques and traditional trades linked to this vernacular architecture. This contribution is presented within the framework of two projects coordinated by the IAPH: LAPat, open laboratory of heritage and SIN-PAR, Innovation System for the Heritage of Rural Andalusia. Their common objective is to analyse social innovation related to architecture and traditional trades and the interaction of diverse stakeholders for their safeguarding. They both recognise the local community as the protagonist in safeguarding, enhancing these practices as an efficient response to the demographic challenge in the rural world. We will focus on three case studies: the dry stone technique in the province of Almería, the raw earth construction in Andalusia, and the artisanal production of lime in Morón de la Frontera. The ultimate aim is to strengthen the transmission of knowledge of these constructive techniques and to reveal their link with socio-territorial development.

Keywords: *dry stone technique; raw earth construction; lime; safeguarding; intangible cultural heritage*

1. Introduction

The consideration of vernacular architecture as cultural heritage has been closely related to the cultural and social value of the traditional techniques associated with its construction. This paper attempts, through the analysis of three case studies in Andalusia, to extract the keys according to which traditional and constructive modes have contributed to the valuation of vernacular architecture, considering its contribution to local development and the contribution of the community to the construction of the process of safeguarding these heritage assets.

This work has been carried out within the framework of two projects developed at the Andalusian Institute of Historical Heritage (hereinafter referred to as IAPH) and funded by the Andalusian Plan for Research, Development and Innovation (PAIDI, Junta de Andalucía), co-funded by 2014-2020 FEDER Programme: LAPat, Laboratorio Abierto del Patrimonio Cultural de Andalucía (P18-RT-4334, PAIDI 2018), and SIN_PAR, Sistema de Innovación para el Patrimonio de la Andalucía Rural (PY20-00298, PAIDI 2020).

1.1. Plans, inventories and atlas for the safeguarding of intangible cultural heritage

Before the current heritage legislation, traditional architecture has generally been linked to the more than questionable concepts of the typical or the picturesque, or as images of context related to villages and places, but not for its values. Even so, its recognition has progressively appeared in the cultural heritage legislation that has been developed in Spain since the beginning of the 20th century. In some autonomous communities, the recognition of vernacular architecture and the interest in its protection from the heritage point of view implied the implementation of specific inventories aimed at certain typologies. In this context, traditional architecture plays an important role, highlighting, in the case of Spain, its rich cultural diversity.

In the case of Andalusia, we should highlight the importance of the Inventory of Popular Architecture of Andalusia (1993-1997), a project that consolidated the new values associated with the concept of cultural heritage, while pointing out the need to articulate strategies for the identification, knowledge and protection of an undervalued heritage (Agudo, Delgado & Sánchez, 2014). Promoted by the Directorate General for Cultural Heritage, this pioneering project aimed to highlight the diversity of traditional Andalusian architecture, proposing the identification and valuation of its spaces, as well as the breaking of the stereotypes created around it.

On this complex path, traditional architecture has also had important documents that consolidate its heritage values. One of the main ones has undoubtedly been the National Plan for Traditional Architecture (IPCE, 2014), a project drawn up between the state administration, the autonomous communities and other public and private institutions (Benito & Timón, 2014). The final document analyzed the current situation of vernacular architecture and established several lines of action coordinated between cultural heritage managers throughout Spain. One of the main reasons that justified its implementation was the disappearance of numerous examples of our vernacular architecture, as well as the need not only to identify its presence in the territory but also to apply the existing legislation on cultural heritage, both state and regional, seeking new measures to safeguard it.

At the same time in Andalusia, between 2009 and 2014, IAPH was developing the Atlas of the Intangible Heritage of Andalusia (Carrera, 2009, 2016, 2021), where 1800 expressions of the intangible heritage of Andalusia were collected from an anthropological perspective and using participatory methodologies. In the field of trades and knowledge, trades related to dry stonework, vegetable coverings, cave cutter, construction of *balates* for agriculture in terraces, paving of floors, stone masonry, decorative painting, slate construction, or construction of ephemeral buildings (fair gates, pilgrimage huts), among others, have been documented. We have also recorded mineral transformation activities, including trades related to the production of construction materials (lime, plaster, tiles, bricks, hydraulic slabs).

1.2. Cultural heritage for sustainable development facing territorial vulnerability

In recent decades, the consideration of cultural heritage linked to the territory has meant the rediscovery of a resource for the objectives of contemporary society (Sabaté Bel, 2004). The current concept of cultural heritage incorporates both human and social production, but also shared memory and identity, interpretation and the everyday use made of the environment. In this sense, the maintenance of heritage as a territorial resource must necessarily go through the consideration of its sustainability (Del Espino, 2015), which has been advocated and applied by UNESCO (United Nations, 2013).

Therefore, the conservation of heritage resources must include the protection of the social fabric and the cultural, environmental and economic values linked to heritage elements. With the recognition of vernacular architecture, ethnological and intangible heritage or, more recently, agricultural heritage, there is an evolution towards the detection and valuation of those which lack exceptional values but which bring together a large part of the life and history of their inhabitants and are intimately linked to their identity traits, thus reinforcing their links with the place and improving the possibilities of anchoring the local population. This results, on the one hand, in a progressive increase in the value of heritage categories considered *minor* and, on the other hand, in an approximation to the personal experience of citizens and the social use of its assets. In this sense, innovative and sustainable strategies based on traditional trades can contribute to strengthening the social-economic fabric of vulnerable territories through the creation of employment opportunities, the recruitment and training of qualified personnel or the rooting of the young population, among others (Del Espino, 2020).

Therefore, the consideration of vernacular architecture, as well as the traditional construction techniques linked to it, becomes urgent and pertinent. Urgent because they are precisely the territories with the largest and best examples of traditional constructions, the same that generally suffer from social and economic vulnerability, with serious risks of abandonment and desertification, so that regeneration based on the sustainable use of these techniques could be an opportunity for the survival of their social fabric. Relevant because, in the current context, it is necessary to implement actions in which cultural heritage is not only the object of protection and conservation but, beyond that, an instrument to improve social cohesion and participation in our territory (Del Espino, 2021).

1.3. Working with heritage agents to build the process of heritage safeguarding

The development of participatory methodologies related to various areas of heritage management – documentation, enhancement, training, intervention or restoration – is one of the objectives of the IAPH and, specifically, of the projects from which we approach this text on the importance of traditional trades and vernacular architecture. They both have also aim to reinforce the Network of Cultural Heritage Agents, initiated in the Atlas of the Intangible Heritage of Andalusia, and the role of the institution as an Open Heritage Laboratory, initiated in the Europeana Food and Drinks project, which sought to promote the philosophy of open government based on institutional transparency, collaboration and the creation of networks. Working along these lines and in direct relation with the social agents involved in the design of participatory safeguarding plans has been the next stage of the Atlas of the Intangible Heritage of Andalusia, carried out through the *Intangible Heritage Seminars*; the *RedPesca* project and the recent methodological proposal within the framework of the project *Methodological Guide for the design of Special Plans for the Safeguarding of Intangible Cultural Heritage* (Carrera (Coord.), 2021).

The trades and construction techniques discussed in this article are case studies of the LAPat and SIN_PAR projects. In them, we have tried to implement the theoretical and methodological precepts on which we have been working for years with a priority objective: to innovate in heritage management by making it more open, reactive and transparent and to turn it into a useful instrument for social and territorial development, responding, among other social challenges, to the demographic challenge and the objectives of sustainable development. To this end, we have started from several initial approaches or premises. On the one hand, we consider that heritage elements – tangible or intangible – can play a decisive role in the social and territorial development of the community with which they are linked, contributing to improving its quality of life, favouring integration and social cohesion and its sense of belonging, as well as the resilience of the territories in which they are generated. Secondly, we consider that social and technical innovation in cultural heritage are closely related so that the use of participatory methodologies in the generation and management of cultural heritage can improve the performance and action of heritage institutions and society to safeguard it. Thirdly, the collaboration between the administration, local actors and specialists in the field of heritage is the most effective strategy for overcoming the obstacles that normally limit the action of public guardianship concerning intangible heritage. Finally, the use of open data, free licenses and the generation and promotion of the reuse of heritage information by the IAPH can generate feedback between social and technical innovation in the field of heritage management.

The natural continuation of the Atlas of the Intangible Heritage of Andalusia was the holding of the Seminars on Intangible Heritage (Carrera, 2016, 2021) as a space for dialogue, debate and collaboration between public and private decision-makers and civil society to work on the values, risks, threats and possibilities of this heritage, placing the people who are the protagonists of this heritage on the same level as the experts. The ethnographic method was used for this purpose, relying on qualitative methods such as interviews, observation and analysis. This same format, but with an even more in-depth and intensive study on a specific case study – the fishing corrals of the northwest coast of Cádiz – was implemented in the project *RedPeSca: Redes para la salvaguarda del Patrimonio Cultura Inmaterial marítimo pesquero andaluz* (Florido & Carrera, 2019; Florido, 2021).

2. Three case studies for an approach to traditional trades in vernacular architecture

The following case studies focus on the generation of Intangible Cultural Heritage Safeguarding Plans understood as a social agreement following the models and methodologies launched and built collaboratively, intending to promote an experimental model and, potentially, become a good practice.

2.1. Dry stone

The inclusion of the dry stone technique by UNESCO (2018) in the Representative List of the Intangible Cultural Heritage of Humanity was the end of a process in which different European countries participated, as well as some autonomous administrations of the Spanish state. This significant recognition embodied an incentive for the development of proposals for the safeguarding of this technique and its inherent values. The analysis carried out for the candidacy, as well as the identification of initiatives in the Andalusian territory that are related to the transmission of the techniques and knowledge of dry stone, are now, more than ever, a necessity. On the first of these issues, it should be stressed that UNESCO's declaration focuses on the valuation of knowledge and not on construction. Undoubtedly, the diversity of this architecture and its territorial extension would be worthy of protection but, in this case, recognition must be understood from an integrating vision.

Fig. 1. *Balates* or dry stone walls in Ohanes terrace agriculture (Aniceto Delgado Méndez, 2019)

The process initiated on the occasion of the candidacy of the dry stone technique made it possible, in Andalusia, to update the existing documentation and gain first-hand knowledge of the situation of this knowledge and know-how, as well as to make an overview of the complex situation of dry stone, both in its tangible and intangible dimensions. In contrast to what is happening in other autonomous communities, we can observe the practical disappearance of the activity (Delgado, 2020), except for some areas where several master craftsmen survive. One of the most interesting examples is located in the province of Almería (Muñoz & Seca, 2020), where proposals for training, heritage protection and dissemination of dry stone are being developed.

Due to its relief conditions, the adaptation processes produced in this territory have formulated responses to solve the difficult living conditions. Dry stone constructions have played a fundamental role in the settlement of the population and the possibility of carrying out agricultural and livestock farming activities, which constitutes a great example of cultural heritage as a key for territorial sustainability. The relevance of these landscapes in places such as Ohanes, Abrucena, Lubrín (Muñoz & Seca, 2021), Chercos or Bayárcal, and the need to conserve these structures, have allowed the transmission of the techniques and knowledge linked to dry stone.

The continuity of *balateros* and *balateras* in the province of Almería, who build based on the vernacular and contribute new ways of handling stone, allows us to be optimistic about the future of these techniques. Likewise, we must emphasise the implementation of actions to disseminate and enhance the value of the dry stone in this province by institutions such as the Institute of Almerian Studies, the Laboratory of Social and Cultural Anthropology of the University of Almeria or different local entities, which are requesting the protection of dry stone constructions or the creation of exhibition spaces to show us the importance of this knowledge.

2.2. Raw earth construction

Raw earth is undoubtedly one of the most widely used materials in construction, although on numerous occasions its invisibility, especially in vernacular architecture, has greatly facilitated its ignorance and also, why not, its contempt. The plastering of façades has been understood not only from a constructive point of view to give protection to the wall but also as a mechanism to disguise its presence and promote the use of materials understood as nobler. Aspects such as sustainability and bio-construction are closely related to the development of proposals that, from a contemporary perspective, are aimed at valuing the earth as a construction material and its consequent use in construction. In this sense, different associations are beginning to design and implement programmes that are committed to training.

Fig. 2. Housing built with raw earth. Hinojales, Huelva.(Aniceto Delgado Méndez, 2019)

In Andalusia, we can find regions where the use of raw earth has been a constant, although we should point out that the 1960s and 1970s were a turning point in the abandonment of these techniques and the appearance of new materials that were initially cheaper and simpler to use. These processes, accompanied by the rural exodus and the economic transformations of a large part of the Andalusian territory, caused great changes in the use of spaces, in the way of living and, in short, in the way of building. Thus, raw earth has become a material that is scarcely used and even undervalued. Nowadays, its use is limited to interventions in the monumental heritage and some repairs to domestic architecture or constructions related to agriculture and livestock farming.

Among the proposals developed in the Andalusian framework, we can highlight the participation of the Taph-Taph Association in the Erasmus+ Project entitled *HELPS* (2020), a participatory approach to land-based construction and people in precarious situations. The main objective of this network, made up of several European associations, is to improve the habitability of housing in vulnerable areas. We should also highlight the role taken on by other associations such as the *Museo de la Cal de Morón de la Frontera* (2021) in the recognition of rammed earth and other techniques centred on the use of earth through training courses in which, from practice, traditional knowledge is taught and knowledge and experiences are shared. In addition to their training nature, these courses generate a network of professionals who, beyond putting the knowledge learned into practice, advocate learning traditional techniques and promoting different ways of building and living, understanding and sharing paradigms that bring us closer to sustainable architecture.

2.3. Handcrafted lime production

The artisan lime making in Morón de la Frontera was one of the activities in the countryside of Morón included in the Atlas of the Intangible Heritage of Andalusia, which generated a close and enriching collaboration that continues. The diverse nature of an institution such as the IAPH has allowed different actions related to the broad concept of safeguarding defined by UNESCO (2003) to be tackled at the same time, intending to jointly understand and diagnose – including the necessary institutional, social and business agents – the problems that affect them and taking measures that can serve for their continuity as a craft and productive activity, taking into account the necessary involvement with agents.

Within the IAPH, this has meant the interrelation of different types of actions, including actions aimed at the documentation of cultural heritage (*Atlas of the Intangible Heritage of Andalusia, Cal, Transhabitat*), research in the field of geology and the behaviour of materials (standardization of the use of materials for restoration, application to interventions in historical heritage), the generation of recommendations in the field of the cultural landscape, training through collaboration with the agents involved (Morón Lime Kilns Association and lime workers), the development of a cross-border collaboration project with Morocco (documentation of the activity in Andalusia and Morocco, dissemination of the cross-border lime route, participatory analysis of the activity in Morocco) and the holding of dissemination actions (European Heritage Days, open days, technical conferences, collaboration in publications, or the development of routes).

In the framework of the *Transhabitat* project, one of the actions carried out by the IAPH has been the development of a plan to safeguard the lime trade in Andalusia and Morocco (2012-2014). For its part, the Lime Route has made it possible to connect the lime kilns of the Sierra de Morón de la Frontera (Seville) with the active lime kilns in Morocco, which still practice the same artisan lime production techniques with some small and interesting variations. Thus, two spatial-temporal realities have been documented that have undergone or are in the process of undergoing profound changes in their artisan production systems, or of disappearing, if the necessary measures are not adopted from all spheres (Carrera, 2016: 376-476).

Fig. 3. Construction of the lime kiln, Morón de la Frontera, Sevilla (Juan Carlos Cazalla, 2008)

The artisan production of lime, therefore, becomes a fundamental element for the maintenance of vernacular, urban or rural architecture. It could contribute to the maintenance of Andalusian historic centres and Moroccan medinas in better conditions than those provided by other less versatile, adaptable, resilient and sustainable building materials that have been introduced earlier in one territory than in the other. In turn, the promotion of the use of this material in heritage and conservation policies for buildings, neighbourhoods or cities should be a priority for the entities and institutions responsible and competent in heritage and housing in both territories. (Carrera, 2014, 2016).

Also from the IAPH, the Geology Laboratory works on the quality control of lime from Morón de la Frontera to optimize the artisan production of this product. In the laboratory, mortars are designed and their quality is controlled to ensure their adaptability to the requirements of use and functionality in the restoration of masonry works, with special emphasis on their use on site. In this way, it contributes to the support of the safeguarding plan and the reactivation of artisan activity as intangible heritage that allows biotechnological innovation and territorial sustainability given its future commercial projection. In addition, a standardized document of recommendations for the application of lime in the conservation of cultural assets has been drafted. Training is also one of the fundamental strategies in the activities developed around lime. In this case, training actions support the safeguarding measures and enable the professional qualification of senior technicians and applicators in the use of this material and the handling of traditional construction techniques.

3. Conclusions

Although steps are slow and cautious, we currently find in Andalusia interesting proposals that envisage new spaces and contexts for traditional trades and their link with vernacular architecture. However, it is still necessary to make progress in research as a mechanism of knowledge and the main asset for safeguarding, as well as in the identification of craftsmen who know traditional techniques, promoting the use of these techniques in new constructions and not only as a procedure for rehabilitation.

Concerning the study of these techniques, the concept of participation is present in academic discourse, social movements and public administration, but the necessary instruments and resources have not yet been developed to apply it comprehensively, in a way that allows its different aspects and meanings to be spun out and its multiple and varied social, environmental and cultural functions to be defended based on social innovation and public responsibility.

Safeguarding the ICH implies defending its multiple values for society and this requires a collective effort: committing the time, technical-research personnel, spaces and means necessary to make this co-management of heritage possible. Some of the actions on which work should continue are: collaborating in safeguarding the traditional mechanisms of knowledge transmission through formal and non-formal education; promoting the figure of masters or expert craftsmen and encourage their activity by craftwork subsidies, participation as a teacher in vocational training modules or workshop schools; implementing a fiscal policy favorable to the development of crafts activities in vernacular architecture, or generating a system of incentives for the production, marketing and consumption of crafts; promoting knowledge and appreciation of traditional building materials for their great ecological and environmental values, standardizing their use in architecture through training and dissemination; promoting the traditional knowledge and know-how regarding construction techniques for vernacular architecture and their application, creating the necessary forums for their transmission; and reviewing current legislation, eliminating contradictions and regulating the limitations on access to materials.

In short, it will be necessary to achieve institutional articulation in terms of competencies and common criteria around traditional building techniques as activities related to culture, the economy, trade, innovation, housing, landscape, sustainable construction, architectural restoration, the environment, or agriculture.

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The role of craftsmanship in the conservation of Venice. State of the art and perspective

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Topic: T3.4. Plans and experiences for the recovery and maintenance of construction crafts

Abstract
The case of Venice shows how the overall image, the perception of vernacularity of the historical built aggregates, strongly depends on the ability not only to preserve as much as possible, but also to "replicate" the consolidated building techniques to ensure continuity with the actions of restoration and consolidation. This option also contemplates forms of substitution and refurbishment, in contrast with the principles of conservation which favor the criterion of recognizability of the addition and reject the replacement of components, even when executed in an appropriate and harmonious manner, often the only option possible when attempting to preserve the Venetian character of the city's buildings.The most pressing issue is that of the progressive disappearance of local craftsmanship. This is particularly dramatic in the case of Venice, where specific knowledge is needed in order to carry out interventions on elements of historical buildings. The objectives of protection are also of relevance in this case as they present particular difficulty for foreign workers or workers who have completed different training. In this regard, this text examines the measures implemented to counteract this phenomenon, particularly the effectiveness and role of each of the hypotheses examined, already partially addressed in the city, training courses for artisans and technicians; public subsidies and incentives and the role of the authorities.

Keywords: *Traditional construction crafts, Artisans, Venice*

1. Introduction. The state of craftsmanship in Venice

In 1976 Venice had 102,000 inhabitants, including 2,207 registered artisans, whereas today the population stands at just over 50,000, with the number of registered artisans falling to 1,012 in 2021. Therefore, in the space of 45 years, residents and artisan businesses have been halved11. This reflects a city with imbalances in terms of demographics, society and the labor market, brought about by a profound and inexorable selective process.

Young people and the middle classes tend to leave the historic center of the city. This mirrors what is happening in the context of crafts, where certain types of companies linked to the real estate heritage maintenance market survive, as do manufacturing activities and artistic crafts, as well as those related to the needs of nearby residences.

1 Vettore, E. (ed.), *ARIFFARAFFA. Venezia, quel che resta del Centro storico e del suo Artigianato*, a study by Confartigianato Imprese Venezia, Venice, 2019. Originally, "Ariffaraffa" was the battle cry of the Venetian children who prepared for the great pile-ups when playing in the *campi* (squares) and the *calli* (streets) of Venice, throwing themselves on top of each other for fun or to scramble for sweets, preferable to the sandwiches or cake slices served at the small parties organized for the many patronages of the city.

In the historic center, half of the artisans are over 50 years of age, with only 2% of young people aged under 30 compared to around 18% of the population aged over 60. In a similar survey conducted in 2002, the average age of craftsmen was almost six years lower: while in 2002 the average age was about 46 years, today it is close to 52. This decrease in the average age of craftsmen up to 40 years of age should be seen as a reflection of the crafts sector in the historic center failing to appeal to young people. Any intervention which aims to modify this trend must necessarily consider the safeguarding of the most authentic forms of craftsmanship, linked to the history, culture and built environment of the city. An additional challenge, to be viewed in parallel, is the preservation of urban vitality, ensuring it does not fall below a minimum threshold.

If we want to preserve the characteristics of Venice which, despite its exceptional nature, still make it a normal and vital city rather than a theme park, work is required on several fronts, including housing and labor.

To do so, opportunities and conditions must be created to facilitate the entry of new residents and the successful access of young people to forms of employment relevant to the vital functions of the city: healthcare, justice, research, liberal professions, essential services and manufacturing. Craftsmanship plays a crucial role due to the traditional close links between artisans and the city: those who both operate and reside in the island city make up 66% of the total. Focusing on craftsmanship will therefore have an effect on local residence, following the premise that the urbs cannot exist if the civitas is not also preserved.

2. A tradition of 'arts and crafts' corporations

Considering a heritage of manufacturing and building knowledge like that of the lagoon city, this contribution addresses how to restore its status and dissemination. In the emblematic case of Venice constructive properties, materials, and working techniques add value to the artistic magnificence of the city.

For many years, until the fall of the Serenissima Republic in 1797, there were corporations of arts and crafts, regulated by internal statutes, which were often very strict. In addition, specific acts were implemented for the regulation of professional secrets in order to ensure the continuity of knowledge when younger artisans took over following the retirement or death of their predecessors[2].

The skills of each building guild, including masons, carpenters, blacksmiths, stone workers, "terrazzo" floor workers, window workers, lime workers and sand workers, were very specific. This high level of technical specialization was the result of a rigid corporate and regulatory structure which determined that each corporation could achieve a high level of technical efficiency and standardization of processes, gradually becoming part of tradition.

In the specific case of the urban complex of the old city and estuary of Venice, the role of the corporations in terms of capillary organization and dissemination and their effect on the preservation of the entire city over the centuries is of great importance. If thinking of a “Fabbriceria" model as applied to the city, consisting of 20,000 buildings, the process is identical to that still observed today in individual monuments, including the Duomo in Milan and the Basilica of San Marco in Venice, "Procuratoria di San Marco", where a structure is put into place to favor the continued maintenance of the architectural asset, providing for the needs, initial construction sites, supervision of the supply of materials and intervention techniques. During the nineteenth century this system was greatly downscaled, and the end of the Republic marked the start of a much looser organization, which, although deeply rooted in the socio-economic fabric of the city has been continued within the technical

2 On these issues see the study Caniato, G., Dal Borgo, M., *Le arti edili a Venezia* (1990), Edilstampa, Rome, 307 pp.

repertoire, closely linked to construction and material culture. The achievements of the nineteenth and twentieth centuries also favored an evolution in the forms of maintenance of historical buildings, as can be seen for instance with the introduction of concrete, a technological advance which has also had a profound effect on the preservation of traditional techniques in many other historical settings in Europe. It should be noted, however, that the historical organization of the workspace and the Venetian workers, of which little is left today, for long decades after the fall of the Republic laid the groundwork for the flourishing of a series of specific craft activities. This was done under the guidance of sectors which guaranteed correct and expert practices of maintenance of the precious and fragile city, at least until the turn of the century.

3. Changes within the city

The results of Confartigianato Venezia's research show a great decline in the number of crafts businesses related to construction activities.

This trend, driven by multiple factors, can be read in many different ways.

When considering the size of the city, the amount of work that can be done by these figures is minimal compared to the physiological needs of restoration and maintenance. The spaces left empty by the craftsmen are progressively occupied by other companies, often from outside the city, and their specific operative competence to work in an urban monumental context such as that of Venice is often not suited to the requirements of protection.

Moreover, over the last 30 to 40 years Venice has experienced an explosion of its real estate market, partly due to the strong increase in the value of real estate, attributable to government funding in the 1980s[3], which resulted in speculation on the value of purchases and sales.

Fig. 1. Training for construction artisans, Schio - Vicenza (Confartigianato Venezia, 2019)

Fig. 2. Workshop. Artistic ironworking. Demonstration open to the public (Confartigianato Venezia, 2019)

Furthermore, the progressive increase in tourism has favored the use of apartments for tourist use, providing a form of income. Both these scenarios were also partly the result of the lack of carefully considered protection of cultural heritage[4] and the introduction of techniques and materials not specific to the historical building but sourced from the construction site of new buildings and from

3 See Trovò, F. *Nuova Venezia antica, 1984-2001- L'edilizia privata negli interventi ex lege 798/84* (2010), ed. Maggioli, Rimini-Milano, 340 pp.

4Approximately 85% of the houses in Venice are subject to protection in terms of landscape, and are included in the decree on the lagoon of Venice of 1985; for the most part these are the diffuse building fabric, emblematic of vernacular construction and decisive in forming the mass of the city. These require specific authorization for external works (plaster, roofing, windows, etc.). The remaining percentage refers to buildings with features of historical, artistic and architectural value, which require authorization from the Superintendence for all external and internal actions.

other markets. In addition, the working conditions in the lagoon are much costlier than in other areas: transport by boat, the provision of supplies from the mainland, the existence of a suitable laboratory and warehouse, and, in general, the expense that a Venetian shipyard requires, result in a natural selection of craft companies, which are often smaller, unable to amortize critical issues, and vulnerable to risks. In addition to other issues, widely discussed in the Confartigianato study mentioned above, attention should be drawn to the increasingly complex and peculiar regulations concerning intervention in constructions in Italy, particularly those regarding the protection of architectural heritage. According to the Code of Public Contracts and the Code of Cultural Heritage and Landscape, operators working in the field of public contracts and cultural heritage must meet a series of requirements and hold certain qualifications. While this should guarantee quality in interventions on cultural heritage, it has also excluded a large slice of the market of artisan operators who are highly skilled but cannot meet the qualification requirements introduced.

4. New rules for restoration

Before proposing useful measures and practices to counteract the trend of progressive loss of craftsmen in Venice and in historic cities in general, it is necessary to address the two norms mentioned in the previous paragraph, adding a third one, the Regulations on public works contracts concerning protected cultural assets of 2017. At the same time, and still in the context of Venice, public buildings should be distinguished from private ones. In turn, private buildings should be separated into those with direct monumental or simply landscape protection measures, because these determine the competence of each entity according to the current norms.

In the case of Public Contracts regarding cultural assets, regulations stipulate that companies must be contracted for works costing more than €150,000. This means that for works below that amount contractors may also be craftsmen, provided however that they pass other checks as laid down in regulations on other issues.

In addition, with the 2017 Regulations, regardless of the threshold amount for the work, contractors must also collaborate with a restorer of Cultural Heritage following art. 29 of the Code of Cultural Heritage and Landscape for "monitoring, maintenance and restoration of movable cultural property, decorated surfaces of architectural heritage and historicized materials of real estate of historical, artistic or archaeological interest", as stated specifically in relation to the protection of architectural heritage.

As a result, according to the Public Contracts Code and the Cultural Heritage and Landscape Code, operators working on public contracts for cultural assets must possess a series of requirements and qualifications.

On the one hand, this aspect limits the risk that cultural assets will be the object of interventions by unsuitable companies; on the other, it has excluded a large slice of the market of artisan operators who are highly competent but not sufficiently qualified to comply with the regulation requirements[5].

In order to participate in public tenders the company must at least include a restorer in its organizational chart, as a result of the profound innovation introduced by the Regulations of 2017 relating to the extension of the mandatory nature of the figure of the Restorer of Cultural Heritage both for decorated surfaces of architectural heritage and for historicized materials. The latter are often whole historical buildings which have been preserved.

5 Ministerial Decree August 22, 2017, n. 154 - Regulations on public works contracts concerning cultural heritage, art. 1, paragraph 2, letter c.

With reference to private property, there are no thresholds above which a specific qualification is required to work on cultural property, but it is still required that work should be carried out by a restorer[6], limited to decorated surfaces, in accordance with art. 29 of the Cultural Heritage and Landscape Code, and not, as in the case of Public Contracts, qualified to restore historic surfaces.

First of all, it is desirable for local companies to try to expand the interventions on cultural heritage in which they can participate by hiring a technical director for restoration. Italian law has recently introduced a system for accreditation to national lists of restorers according to the Code of Cultural Heritage and Landscape. This system establishes 12 sectors of competence, including stone, mosaic and derived materials, and book materials, aiming to ensure maximum specialization per field[7].

Considering that there are 20,000 buildings in Venice, and about 3,000 of these are subject to protection affecting both the exterior and interior, it is clear that there are many buildings in the old city where only the exterior has been monitored. This leaves ample room for the activity of maintenance and restoration, without requiring qualified companies, and this space must be occupied by local companies, bearers of know-how and local operating practices derived from tradition.

6 Cultural Heritage and Landscape Code, D. Lgs 22 January 2004, n. 42, "the interventions of maintenance and restoration on movable cultural assets and decorated surfaces of architectural heritage are performed exclusively by those who are restorers of cultural heritage according to the legislation on the subject", art 29, paragraph 6.

7 The areas of expertise for cultural heritage restorers are as follows: 1 Stone, mosaic and derived materials; 2 Decorated surfaces of architecture; 3 Artifacts on painted wood and textile medium; 4 Carved wood artifacts; wooden furnishings and structures; 5 Artifacts in synthetic materials processed, assembled and/or painted; 6 Textile, organic and leather materials and artifacts; 7 Ceramic and glass materials and artifacts; 8 Metal and alloy materials and artifacts; 9 Book and archival materials and paper and parchment artifacts; 10 Photographic, film and digital materials; 11 Musical instruments; 12 Scientific and technical instruments and tools.

Fig. 3. Venetian-style terrazzo, master craftsman training phase. Demonstration for educational use (Confartigianato Venezia, 2019)

5. Why focus on craftsmanship? Remedies to the crisis

As mentioned at the end of the previous paragraph, most of the buildings in the old city of Venice are not controlled and internal transformations are regulated exclusively by the rules of the Master Plan for the Old City of Venice, which dates back to 1999, and by sector regulations such as the Building Regulations.

The Urban Plan has had the great merit of preserving the main typological structures of the city, such as the position of the attics and the morphology of the roofs: it has substantially covered most of the building activity in the territory. However, the typological nature of the Plan itself does not define the preservation of the authenticity of the material, or prescribe to preserve it as such, but rather generates the obligation not to alter the distribution and position of the constituent elements.

It is understandable how, following this logic, many surface finishes, floors, interior and exterior doors and windows, partitions and walls are at risk of being treated not as unrepeatable documentary assets but as replaceable components. In this setting it is necessary to control the encroachment on the city's building situation, which has depended on the market, with only fiscal or corporate requirements.

This condition has probably influenced the progressive ousting of local artisan firms from the slice of the market linked to Venetian private buildings, especially to those without protection measures, thus giving rise to a progressive reduction in active firms.

In order to contrast this inexorable decrease, also determining the progressive loss of skills, which, if not passed on, often remain inaccessible after the death of the companies, it is necessary to foster continuous demand for artisan services, guaranteeing their survival and possible growth, under the aegis of Protection Bodies such as the Soprintendenza ABAP for the municipality of Venice and the Lagoon. Both these have competence in the territory over monumental protection, which concerns only the interior of the buildings, and landscape protection, concerned with the exterior.

In the case of constraints affecting monumental buildings there are many types of works which require skills specific to the execution. These can be made mandatory by indicating some operational prescriptions in the authorized actions in order to maximize the results in terms of protection and correctness of the restoration work, while not referring to decorated surfaces, which are strictly speaking the competence of the restorer of Cultural Heritage.

In the case of a *terrazzo* floor, a mixture of lime, sand and stone aggregates of various kinds, some interventions can be suggested, such as the use of linseed oil left to soak in for two days or mimetic integrations, resurfacing or traditional remaking methods. These techniques are certainly characteristic of the enterprises qualified for public works, but are also used by many artisans, who have often practiced such techniques for decades. The same is true for the treatment of interior surfaces, interior partitions, ceilings, windows and doors.

In terms of the external parts, the most important element, other than the architectural layout and the elements defining stone openings, is the plaster, which in order to protect both the landscape and the monuments, should be traditional, made of lime mortar, or marmorino, or cocciopesto, thinly laid in the masonry courses.

These directions are highly relevant to the way in which the works are carried out. They are very precise interventions, linked to a tradition of local know-how, and are often determined by the values of the buildings to be preserved, so that they generally rule out the participation of companies capable of carrying them out correctly, even though these may employ local artisan workers.

A further contribution to reversing the trend and bringing the new generations closer to crafts can be found in the institution of the "bottega scuola", as introduced by Veneto Regional Law no. 34 of 2018[8]. These artisan workshops are an ideal place to enable young people seeking employment to meet employers in possession of the "know-how". These are a basic medium for the generational transfer of business. This regional norm could help identify those continuing the business, when they are not already to be found within the company-family, by using six-month apprenticeships with public funding which could possibly be followed by apprenticeship or definitive contracts.

In addition, taking into account the fact that artisan entrepreneurs are not given to investing resources for up-to-date training for themselves or their employees and collaborators, in a

8 Veneto Regional Law October 8, 2018, n. 34 "Standards for the protection, development and promotion of the Veneto craftsmanship".

broader perspective, it could be very useful to promote training offers combined with consultancy. These could include management control, management consultancy, technical-regulatory updating, help with enrolling in the public administration market, and customer care training to deal with clients and employees correctly.

Training can also narrow the gap between labor demand and supply: a prime example of this, emblematic of Venetian craftsmanship, is traditional shipbuilding.

For about ten years in the early 2000s, a school for trainee shipwrights operated, initially able to replace the function of the shipyard as a natural source of codification of manual knowledge, composed of good practices and specific languages. These courses coordinated by Confartigianato Venezia and supported by the Veneto Region, through funding from the European Social Fund, have enabled young participants to enter the job market more quickly, both to their advantage and to that of the host companies. This laid the foundations for a stable and lasting establishment of new labor in Venetian shipyards.

This experience can be repeated: it is important to set up a "control room" to map the training offer and, above all, to cross-reference the demand and supply of internships, through a database easily accessible to both host companies and young aspiring craftsmen.

Therefore, in addition, the "factory schools" could be supported by a dedicated line of training centers for the transmission of skills and techniques of artistic, traditional and typical craftsmanship.

Recently, the experience carried out by the IUAV University of Venice and Confartigianato Venezia has attracted some interest, as it involves a series of practical demonstrations by artisans to university architecture students, aiming to raise awareness of the issues that unite architectural restoration, cultural heritage and craftsmanship[9].

Fig. 4. Laboratory execution of typical Venetian wooden *altana* (Confartigianato Venezia, 2019)

6. Conclusions

Alain Lardet, former director of the well-known furniture brand Poltrona Frau, works to promote design and creativity; he is a co-founder of the Festival du Design in Paris. He also curated the Fondation Bettencourt Schueller's exhibition promoting art crafts in France for the Homo Faber event, held in 2018 in the Fondazione Cini on the island of San Giorgio in Venice.

According to Lardet “We are witnessing a decisive move away from standardization and our societies obsessed with speed and mass consumption. In this context, the craftsmanship of excellence and its fertile dialogue with art, architecture and design offers a welcome alternative and opens the way to the renewal of

9 Squassina, A., *Una strategia di conservazione dell'autenticità materiale a Venezia: dal rivestimento murario al paesaggio urbano*, in Loggia Arquitectura & Restauración, n. 34-2021, pp. 62-85.

these professions, as well as the rediscovery of their nobility and their ability to enchant the world. Venice is the ideal stage, a city which, by virtue of its geography and its deeply human rhythms, represents a symbol of resistance against the tyranny of all and sundry, as well as concrete proof of the power of beauty that lasts in time[10]".

This is the authoritative thought of an intellectual capable of grasping the weak signals of the society of the near future. However, it clashes with the daily image of a city that has not yet acquired awareness of these changes and proceeds in a diametrically opposing direction.

To those who ask us if the complex of artistic/manufacturing handicrafts, extended to the excellence of the conservative restoration of the housing heritage, could be a candidate for the role of an economic alternative to the predominant mass tourism in Venice before the pandemic, our answer, in all honesty, can only be no. At least today.

The prediction is that once the health emergency is over, tourism will come back to oppress the city; the pressure of thirty million visitors, most of whom are trippers (75%), and the fierce competition for land use will return.

It is therefore clear that without radical and lasting interventions, without a project, Venice runs the risk of the irreversible loss of its urban complexity. It is also clear that, in this scenario, safeguarding Venice must also include the protection and the support of what remains of its craftsmanship: still a cohesive element for society, still generating income and employment, as well as beauty and well-being[11].

10 Installation panel of the *Homo Faber* Exhibition, Venice, San Giorgio island, Cini Foundation, 2018. The text is also cited in Vettore, E. (ed.), ARIFFARAFFA. Venice, quel che resta del Centro storico e del suo Artigianato, a study by Confartigianato Imprese Venezia, Venice, 2019, p. 276.

11 E. Vettore edited section 1 “The state of craftsmanship in Venice”, the second part of section 5 “Why focus on craftsmanship? Remedies to the crisis”, and section 6 “Conclusions”; F. Trovò edited the remaining parts of the contribution.

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CONSERVATION, RESTORATION AND ENHANCEMENT OF VERNACULAR ARCHITECTURE

CONSERVATION AND RESTORATION PROJECTS OF VERNACULAR ARCHITECTURE

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Is there a future for marginal communities?

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract

In relatively marginal and isolated settings, changes in socio-cultural contexts and population reduction have contributed to the decay, abandonment and gradual disappearance of traditional ways of living and vernacular heritage. Associations and foundations often play a key mediating and facilitating role in countering these phenomena, supporting the survival of local communities and tangible and intangible expressions of heritage. In the context of the seminar cycle "Rehabilitation of traditional heritage and local development", ten international case studies of unconventional practices of community-rooted rehabilitation from North and West Africa, South-East Asia, Latin America, and Southern Europe were selected. The cases were analysed through a multi-criteria approach to interpret common features and links in three dimensions: 1) organization and structure of associations and foundations; 2) technical methodology of recovery interventions, emphasizing the mobilization and transmission of traditional knowledge and skills; 3) generative potential for self-sustaining initiatives and community empowerment. Qualitative and quantitative data have been gathered based on a literature review of publications and reports, international seminars, meetings, and semi-structured interviews. The results highlighted the strong relationship between the external actors' success in rooty themselves in the local context and the empowerment of communities as well as the settling of their practices over time. The greatest opportunities for economic and cultural development are those in which a holistic vision in the care of the community and its cultural landscape was adopted. The reinforcement of the role of local craftspeople and inhabitants also proved to be crucial. The study showed that caring for a living heritage and its community implies a sensitivity for the past but also an updating and a creative reinterpretation of heritage in response to present and future demands.

Keywords: *cross cultural comparison; rehabilitation of traditional heritage; transmission of construction techniques; sustainable local development.*

1. Introduction

This article is part of an ongoing research project funded by the Inter-university Department of Regional and Urban Studies and Planning (DIST) of the Politecnico di Torino. Some associations and foundations were invited to participate in the three editions of the seminar "Rehabilitation of traditional heritage and local development" (RTHLD), organized between 2019 and 2021 by DIST in cooperation with the School of Specialisation in "Architectural and Landscape Heritage" (SBAP). Between them, ten international case studies of unconventional practices of community-rooted rehabilitation, from North and West Africa (Terrachidia, Tr), South-East Asia (Tibet Heritage Fumd, THF; Maruyama Gumi, MG; Dry Stone Walling School of Japan, DSW), Latin America (Medesus, Md; Fundación Altiplano, FA), and Southern Europe (Palombar, Pl; Associazione Canova, AC;

Fondacioni Gjirokastra, FG; Architect Aleksandar Radovic Foundation, ARF) were selected. However, this international perspective is in no way meant to flatten the differences between the various cases under analysis. The research proposes a cross-cultural, multi-disciplinary and transversal reading, focusing on the peculiarities of the single cases. The specific and heterogeneous ways of operating on heritage and their contribution the benefit of local communities are analysed.

2. Rehabilitation of traditional heritage and local development

The case studies operate mainly in the restoration of a minor and non-monumental heritage, functional and aimed at satisfying basic needs (Rudofsky 1964): dwellings in villages (FA, Md, ARF, MG, AC) or in the historic quarter of towns (THF, FG), structures connected to rural contexts and productive activities, such as dry stone walls (DSW and Pl) or dovecotes (Pl). It is often a private-owned heritage. Alongside this, public (ARF, FG) or religious heritage, such as mosques and gathering spaces (Tr), temples, churches and monasteries (THF, FA, Md, ARF). It is an indigenous, contextual heritage, that belongs to a place, and that is common and shared in a community or region.

In addition to the recovery of heritage, the thread connecting the cases studied is the relative fragility and marginality of the local contexts: border territories, in some cases recently acquired, high-altitude areas, difficult climates, rugged landscapes, distance from large centres, lack of basic services and infrastructure, lack of job opportunities, where population is shrinking and ageing. In other respects, however, these are strong areas, which have remained more protected, managing to maintain their distinctive and traditional characteristics, both in certain social structures and from a cultural point of view. The use of traditional knowledge as a human development asset, through technically and culturally appropriate rehabilitation, and the adoption of a holistic approach to the living heritage and landscape, are creating opportunities for self-sustainable local development (Magnaghi, 2010) of such marginal areas. Associations and foundations are contributing to preserving diversity, counteracting standardisation, globalisation and cultural homogenisation, and to maintaining livelihoods, enabling the survival of human communities (Bocco in Bocci et al., in print).

3. Methodology

The main sources are the testimonies offered by representatives of associations and foundations during the RTHLD seminars (in presence in 2019 and virtual in 2020 and 2021). The lectures were followed by round tables with experts and activists, to which participants from the previous editions were invited. These events aimed to establish an international network of collaborations, generating debate on relevant issues such as tourism, interaction with local communities, multidisciplinarity, innovation, generative potential. The drafting of the proceedings (Bocci et al. in print) was then the occasion for interviews and further investigations.

	Case Study	Tibet Heritage Fund	Medesus	Fundación Altiplano	Palombar	Associazione Canova	Fondacioni Gjirokastra	Maruyama Gumi	Terrachidia	The Dry Stone Walling School of Japan	Architect Aleksandar Radovic Foundation
	Acronym	THF	Md	FA	Pl	AC	FG	MG	Tr	DSW	ARF
Organization and structure (4.1)	Foundation year and place	1996 Lhasa, Tibet, CN	1997 Arequipa, PE	2000 Arica, CL	2000 Santo Adrião, PT	2001 Crevoladossola, IT	2001 Gjirokastra, AL	2007 Wajima, JP	2012 Madrid, ES	2012 Tokushima, JP	2016 Niš, RS
	Type	NGO, NPO	NPO	Foundation, NPO	ENGO, NPO	Association, NPO	Foundation, NGO, NPO	NPO	NGO	NGO	NGO, NPO
	Place(s) of intervention	Tibet: Lhasa, Amdo, Kham; Beijing (CN), Nomgon sum (MN), Sikkim, Ladakh (IN)	Valle del Colca (PE)	Arica and Parinacota and other regions of CL	Trás-os-Montes (PT)	Val d'Ossola (IT)	Gjirokastra and Berat (AL)	Oku Noto (JP)	M'Hamid Oasis, MA; Chinguetti, MR	Itinerant in all JP	Gostuša and Justiniana Prima, RS; Trebinje, BA
	Scale of the intervention	at present 1 old town and some villages	many villages in a rural area	34 communities on 16,000 km2	some villages in a rural area	at present 1 village	2 cities	some villages in a rural area	some villages	many agricultural areas	2 villages and 1 archeologic site
	Funding	grants from other NPOs, fundraising campaigns, government funding 145.000 €/year	government funding, international cooperation grants, local partner funding	government fundings, private donations, sale of services 1.2 million €/year	government funding, public institutional funding	membership dues, institutional grants, sale of courses	EU grants, donations, government funding 2.5 million € in 15 years	sale of services, public fundings	sale of courses, sale of services, public institutional funding around 30,000 €/year	sale of courses	EU grants, government funding, grants from other NPOs
	Origin of the initiator(s)	outsiders (other continents) who live there	insider (same region)	outsiders (other regions) who live there	insiders (same region)	outsiders (other countries)	insiders	outsiders (other region) who live there	outsiders (other country)	outsiders (other region)	outsiders (other region)
	Active members	5 (artist, architects, others)	1 architect	> 60 (interdisciplinary team)	12 (5 biologists, 2 engineers, others)	<5 (architects, builder)	>5 (interdisciplinary team)	2 (architect, biologist)	6 architects	2 (landscape planner, builder)	<5 (architects)
	Subject areas	restoration, handicrafts, planning	planning, restoration, handcrafts	restoration, cultural activities	environmental protection, cultural activities, education	restoration, cultural activities	restoration, cultural activities	landscape design, restoration, cultural activities	restoration, education	landscape design, restoration, education	restoration, education
	Collaborations	universities, NGOs	International cooperation, NGOs, institutions, SMEs	universities, NGOs local government, SMEs	NGOs, universities, SMEs	universities	universities, institutions, SME	universities, local schools, local government, GIAHS	universities, NGOs, local government	universities, institutions	institutions, universities, local government
Technical methodology (4.2)	Method	workshop-school in building-site	building-site school, building-site	building-site school (employment + learning), workshop	short courses (1 weekend), work camps (8-15 days)	workshops (7-10 days), building site	building-site, workshops	workshops, short courses	workshops (2/3 weeks long)	short courses (2 days)	workshops, summer school volunteer camps (2 months)
	Number of initiatives	over 60 projects in Leh	rehabilitation of 8 village houses	140 initiatives (2002-2019)	58 international voluntary work camps	around 50 workshops (2002-2019)	over 50 projects	several warehouses restored in few years	17 historic buildings (2012-2020)	around 100 courses (2013-2009)	< 5 interventions
	Object(s) of restoration	private houses, religious and historic buildings	private houses, temples	private houses, temples	dovecotes, dry stone walls and other constructions	houses, dry stone walls	monument houses, public and historic buildings	private warehouse	public and religious buildings, gates	dry stone walls	private houses, religious and public buildings
	Participants	local masters, inhabitants, young practitioners	local masters, inhabitants	local masters, inhabitants	students, enthusiasts, local masters	students	students, enthusiasts, local masters	students, inhabitants	students, local masters, young people	students, inhabitants, enthusiasts	external masters, students, enthusiasts
	Sources and documentation	buildings study, local masters, expertise from outside	old generations, local masters, expertise from outside	old generations, local masters, expertise from outside	local masters	local masters, buildings study	expertise from outside	old generations, blogs study	inhabitants, local masters, expertise from outside	old generation, buildings study, local masters	old generation, buildings study

Table 1. Organization and structure; Technical methodology.

Alongside this, the documentation made available online by the associations and foundations was used: all of them, with the exception of Md and MG (the latter only has a blog updated in 2014), have a website and use at least two social channels of communication. In addition to scientific and dissemination publications, manuals, annual reports, interviews, documentaries and participation in seminars and conferences, it was also considered important to analyse information extracted from their social channels. For space reasons, only primary sources and main websites have been listed in the references.

4. Cross cultural comparison

The associations and foundations were analysed through a multi-criteria approach in three dimensions, summarised in paragraphs 4.1, 4.2, 4.3 and in Tables 1, 2 and 3. Associations and foundations are referred to in the text following an order of relevance. A parallel multidisciplinary study was carried out between the case studies, using the information gained from each as a source of analysis and observation of the others.

4.1. Organization and structure

This section, summarised in Table 1, describes some general characteristics of the associations and foundations in order to identify their scale in terms of geographical, economic and workforce. In selecting the case studies, preference was given to initiatives that have been active for at least a decade (ARF excepted) and are still active. Many of the initiatives have evolved significantly over the years (FA, THF, Pl): it was decided to focus on the current situation, adopting 2019 as the reference year, for a pre-pandemic perspective.

Associations and foundations operate mainly as facilitators, coordinators and supervisors of interventions, and fundraisers. Rarely the initiators are people from the communities or the region (Pl, FG, Md); in most cases they are outsiders from other continents (THF), countries (Tr, AC), or regions (MG, DSW, ARF, FA), who have settled since long (this is not the case of Tr, DSW, ARF, though). Almost always increasing is the number of people involved from the sourroundings in their permanent staff; this is particularly significant in FA, THF and Pl, where they exceed 50%.

Multidisciplinary teams cooperate in some cases (FA, TH), while architects predominate in all cases except Pl and DSW. In many cases external support and collaboration are sought in universities and in sister organisations. These broad and horizontal competences allow associations and foundations to deal not only with heritage restoration, but also with environmental protection and conservation (Md, Pl, MG, Tr), landscape design (Md, DSW, AC), management planning (THF), agricultural production (MG, Md, and the Codpa Wine School of FA), improvement of basic services and infrastructure (ARF, Tr, THF, Md, FG), education (Pl, MG), and research. There is a strong focus on keeping the craftspeople’s traditions alive (FG, FA, Tr), with initiatives such as THF’s Himalayan Bauhaus: a platform to preserve, train, and adapt the wisdom of traditional arts and crafts and apply it to new creations (De Azevedo, Hirako in Bocci et al. in print). Alongside this, are initiatives related to the promotion and rediscovery of the local culinary heritage (MG, FA, FG, ARF), festivals (FA, Md, Pl, FG, AC), and the inclusion of local traditional ceremonies at specific moments in the rehabilitation processes (FA, THF) or the valorisation and use of indigenous languages (FA).

Almost all initiatives relate in some way to tourism – a possible resource but at the same time a threat. FA has developed the Ruta de las Misiones responsible and sustainable tourism plan, which involves and supports local SMEs and promotes the area through editing guidebooks and information (similar actions have also been carried out by THF, Tr, FG, and Md with the community tourism model implemented in Sibayo, Colca Valley).

Financial resources are generally obtained from public funds and/or donations and grants. In the cases of DSW, Tr, AC and ARF the main source of income is course fees. Sanada Junko (DSW) motivates this strategy with the necessity to be independent from uncertain public subsidies to ensure continuity (Sanada in Bocci et al. in print). In some cases, the population co-finaces part of the recovery (THF in Leh). The most significant costs concern building materials and – in case of paid workers involved (FA, Tr, THF, Pl) – salaries.

The scale of the areas of intervention varies greatly, from village systems spread over very large areas (FA, Md, Pl) to the single small village of Ghesc where AC currently operates. In some cases the associations and foundations have moved from one country to another over the years (THF), exported the method (Tr, FA) and provided advice (Tr, FA, Md with FA) in different countries and regions. DSW, on the other hand, is an itinerant school, working throughout Japan.

4.2. Technical methodology

The second dimension is the central theme of this research: the know-why and know-how of heritage rehabilitation interventions, emphasising the mobilisation and transmission of traditional knowledge and skills. In order to guarantee a future for the vernacular, it is necessary not only to focus on the preservation of particular artefacts and buildings, but above all on safeguarding and promoting skills to reproduce them (AlSayyad in Asquith, Vellinga, 2006; Bourdieu, 1977).

A first point is the methodologies adopted for the mobilisation of traditional skills. The transfer of knowledge generally takes place through a pedagogy that is not based on language. It is rather a practical, dynamic and reactive transmission through an "on site" apprenticeship: a traditional way of teaching based on the observation of ways of doing and practice of skills (Marchand in Asquith, Vellinga, 2006). This transmission can take place through courses ranging from a few days (DWS, Pl, FA) to one or more weeks (Tr, AC, Pl, ARF, MG, FG), to experiment with some technique, or to (re)build a portion of an artefact. In this case, the duration of the overall intervention loses its relevance: the purpose being focused on training (Cesprini in Bocci et al. in print). However, it must be emphasised that the techniques are often quite simple, and can be learnt in a short time, whereas knowing how to build with these techniques requires more experience. In addition to this, specialised labour is often called upon to complete certain parts that are difficult to manage with self-construction (AC, Tr).

The other recurring form is training field schools in conventional construction sites, with locals being regularly contracted, under the supervision of master craftspeople and experts (FA, THF, Md, Tr). This mode can directly return part of the investments locally, with a positive socio-economic impact on the community, as well as the creation of local skilled labour and teams in contexts where trained local restorers are scarce. At FA the team is organised into senior masters and monitors (often with permanent contracts), training officers and training assistants (hired for each intervention). Skills are transmitted in relays, inspired by the transmission of knowledge from one generation of builders to the next, as it is typical of the tradition, achieving a continuous, self-sustaining and self-training process (Marchand in Asquith, Vellinga, 2006). Theoretical lessons from specialists help to acquire technical and practical skills (Bocci, Yuste, 2020). In some cases, training is also provided through exchange programmes (THF) and learning journeys (FA) abroad, in order to acquire specific skills to grow locally and thus avoid calling specialists from outside – and saving the costs associated with it.

Only rarely the techniques have been codified in catalogues and manuals (MG used information present in blogs). Oral sources are still the main way to transmit traditional techniques, and are mobilised by associations and foundations through involving local residents and builders as trainers in workshops (Tr, Pl). In Tacora, for example, FA revitalised *caruna*, a family tradition for building ceilings that one of the masons remembered (Yuste in Bocci et al. in print). This knowledge is combined with a meticulous study and a careful observation of buildings and artefacts (ARF, AC, THF), following the footsteps of the craftspeople and creating a connection with past generations (Hirako in Bocci et al. in print). Frequently, experts from outside (FG; Akira Kuzumi, the plaster craftsman, in the case of MG), as well as masters engaged in previous projects, are involved, introducing occasionally exogenous techniques such as the *Arga* roof Lhasa which was used in the Beri Monastery (THF). Traditional wisdom is complemented by scientific knowledge (Hagino in Bocci et al. in print) from experts such as Julio Vargas Neumann, who supports FA in the adoption of seismic reinforcement.

	THF	Md	FA	Pl	AC	FG	MG	Tr	DSW	ARF
Beneficiaries	x	x	x	x	x	x	x	x	x	x
Requesters	x	x	x	x					x	x
Decision-makers	x	x	x			x		x	x	
Owners	x	x	x	x		x	x		x	x
Meetings	x	x	x			x		x		x
(Co)financers	x		x			x	x			
Workshops	x	x	x	x	x	x	x	x	x	x
Trainers	x	x	x	x	x			x	x	x
Employees	x	x	x	x	x			x		
Autonomous int.	x		x	x	x				x	x
Maintenance	x	x	x	x	x	x	x	x	x	x

Table 2. Involvement of the local community.

In all case studies the involvement of the local community is foreseen – both craftspeople (THF, Tr, FA, Pl) and the inhabitants themselves. Table 2 shows the different ways of community involvement both in a passive form, as beneficiaries (often as owners of restored buildings), and in an active form: taking part in strategic decisions – regarding planning, priorities, new functions, technical solutions (FA, Tr), selection of masons (Tr) –, participating in the construction and/or contributing economically (THF). FA and THF have developed community-based approaches to conservation. Learning the techniques and participating in the construction site can lead the inhabitants to achieve autonomy and responsibility in terms of subsequent maintenance operations (Davis in Asquith, Vellinga, 2006; Illich, 1973). Outsiders such as foreign artisans (THF), traditional techniques enthusiasts (Pl, DSW) and students (Tr, DSW, AC) also participate, frequently as volunteers. Several case studies carry out educational activities about the value of heritage with children and teenagers, trying to overcome the negative perception of traditional techniques (Cruz in Bocci et al. in print) (Tr, FA, DWS, MG).

	THF	Md	FA	Pl	AC	FG	MG	Tr	DSW	ARF
Social surveying	x	x	x	x		x		x		x
Inventorisation	x	x	x	x	x	x	x	x	x	x
Protection	x	x	x	x		x		x		x
Conservation	x	x	x	x	x	x	x	x	x	x
Upgrading	x	x	x	x	x	x	x		x	
Adoption in new	x	x					x			
Restoration	x		x			x				
Archaeology	x	x	x	x		x		x		x
Services upgrade	x	x	x	x	x	x		x		x
Diffusion	x	x	x	x	x	x	x	x	x	x
Consultancy	x	x	x	x	x			x	x	x
Exporting	x	x	x		x			x	x	
Management	x	x	x	x						x

Table 3. Activies carried out.

Table 3 describes the types of activities carried out by the associations and foundations.

To understand the population's needs and demands, social surveys are used (FA, Tr): THF spent two years carrying out a detailed study of three neighbourhoods in Beijing, looking at both the architecture and the social conditions.

In almost all analysed contexts, in the last decades a cultural gap interrupted the use, transmission and evolution of traditional building know-how as living processes (Laureano, 1995). To counteract the lose of knowledge, the approaches to heritage involve its documentation and inventorisation, with the drafting of technical manuals and catalogues of buildings (THF's open access Lhasa Archive project; FA's Ruta de las Misiones; ARF's catalogue of 256 houses and the draft of a priority list of intervention; Tr's survey of each ksar; Pl's database of all the 3450 dovecotes in the Northeast of Portugal; DSW's research on the state of conservation of 252 terraced fields in Tokushima). Next to this, is the preservation and conservation of the built heritage. This is often achieved by obtaining monument/heritage status (FA obtained the declaration of National Monument of 28 out of 34 Andean temples; THF worked with the local government to nominate Leh Old Town as a Heritage Zone), as well as with the recognition as cultural landscape (FA).

Heritage, construction traditions and vernacular know-how represent a dynamic, interactive, collaborative and dialogical process, that can be adapted and upgraded to meet current and future needs through (Harrison 2015, Lawrence in Asquith, Vellinga, 2006; Remotti, 1996; Winter, 2013): adaptive reuse for pilot buildings, often linked to tourism, production or cultural projects (Pl, FA, THF, FG, ARF); technical and living conditions improvement (FA, THF, AC); inclusion of "industrial vitamins" (Harper, Borer in Bocco Guarneri, 2020). In addition, traditional construction techniques may contribute to new building (Oliver, 2003; Vellinga in Asquith, Vellinga, 2006) in some kind of neo-vernacular architecture (Hirako in Bocci et al. in print) such as the 2015 Central Asian Museum in Leh by THF.

4.3. Generative potential

This section investigates the generative potential for self-sustaining initiatives and community empowerment.

A first achievement in the socio-cultural sphere is the change in the perception of heritage: the sense of backwardness and poverty, and the initial distrust, have been replaced by interest, care and collaboration. This reinforced the self-esteem of, and raised awareness among, the residents. According to Carmen Moreno (Tr), the collaboration of locals and outsiders helped this process (Moreno in Bocci et al. in print). Requests for intervention from the population (Pl, THF, FA, ARF, DSW) or local authorities (FA, Tr, FG, Pl, Md) have become frequent. Locals are even promoting autonomous bottom-up rehabilitation, just requiring technical advice from associations and foundations. Significant is the case of AC, which stimulated young locals in buying and renovating buildings (Bocci, Mazelli, 2020).

In the socio-economic sphere, the acquisition of tools and skills has enabled participants to implement indipendent interventions (Md, MG, DSW, FA), to set up local enterprises and autonomous activities, and to count on a local and autonomouse capacity to raise funding (FA).

In addition, initiatives such as Md, Pl, MG and DSW also show appreciable achievements in the preservation of environmental biodiversity and symbiotic relationships between humans and nature (Friedman, 1990; Watson, 2019).

5. Discussion and conclusions

This research highlights how fundamental is the external actors' success in rooting for the empowerment of communities, as well as the settling of their practices over time. Cases such as THF, FA, Md, after more than twenty years of cooperation with local communities have managed to create a relationship of cooperation, trust and mutual esteem. Similar results have been achieved by MG and Pl, even though there is some wariness persists (Hagino in Bocci et al. in print) and residents appear less ready to get involved in the process (Guedes in Bocci et al. in print).

Initiatives that took a holistic view of caring for a community and its built, crafts, intangible, and natural heritage offered greater opportunities for economic and cultural development, fostered the maintenance and creation of diversity, and activated circular economies and local productions (Md, FA, MG, Tr, FG, THF).

During the 2019 RTHLD seminar, participants were asked the question "What after?" (Bocco in Bocci et al. in print), i.e. at which point of the process of competence transmission and community empowerment they felt to be. Only once the independence from external actors is guaranteed, with the creation of self-sustainable local development possibilities (helping communities to earn real money, not subsidies) the processes carried out by associations and foundations can be seen as effectively and successfully concluded. According to this study, THF and FA are the most advanced on this journey. FA set up the Escuela de Conservación Sostenible Sarañani!, a participative and self-managed programme for the restoration of temples, houses and fields carried out by community members (some of whom went through previous training activities also offered by FA), where FA only contributes technical assistance and training. The research shows that caring for a living heritage and its community implies sensitivity for the past but also a creative reinterpretation of heritage in response to present and future demands. A long-term vision is needed to secure the future of marginal communities (THF, FA, Md), which looks for a holistic, self-sustainable local development through specific, community-based responses (Dematteis, 1994).

6. Future perspectives

The research will continue through field analysis of the work of FA and THF. To return the research results to the participants, a fourth edition of the RTHLD seminar is planned for September 2022.

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Restoration of the stained glass windows of the British Cemetery of Valencia

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Topic: T4.1. Conservation and restoration projects of vernacular architecture.

Abstract
Light is a phenomenon that, due to its mysticism, has often been used by different religions and philosophies. In art, this phenomenon is directly related to stained glass windows. In the Middle Ages they were made by glaziers who followed artisanal techniques. These techniques were developed in the heyday of stained glass, but afterwards they were on the verge of disappearing for several centuries. In the 19th century stained glass reappeared but the lack of knowledge about the original artisanal techniques was a great problem. Nowadays, the same problem has to be faced, stained glass windows are features worthy of preservation, but their construction and therefore their maintenance require artisanal techniques which are now disappearing. An example of the reappearance of these skills can be found in the restoration of the stained glass windows of the British Cemetery of Valencia by a special employment centre, run by specialists and carried out by artisans in glass work. This paper will present the work carried out in the recovery of this part of the Valencian traditional heritage, presenting all the stages, such as disassembly, repair and replacement. In addition, this paper will explore the results of the work, restoring the splendour of the windows to the buildings in which they are placed.

Keywords: *stained glass windows; traditional techniques; British Cemetery; Vicente Sancho Fuster.*

1. Introduction

Light is the *raison d'être* of stained glass windows. For this reason, they have always been related to the spiritual sense that light has, as an intangible medium that allows us to glimpse the world (Frenzel, 1985; Bonet, 2021; Lee et al., 1987; Nieto et al., 2019). This was one of the reasons why they were used in the Middle Ages to represent religious motifs. (*ruta cultural*, 2019) In the heyday of stained glass the glassmaker was considered a craftsman, on a par with tailors and bakers. This conception began to change during the Renaissance. In the 17^{th} and 18^{th} centuries, with the decline of stained glass windows as a feature of buildings, this skill was on the verge of disappearing. (Lee et al., 1987) However, during the second half of the 19th century, with new artistic ideas and attempts to promote craftsmanship as opposed to mass production, the stained glass window re-emerged. (Vila-Grau, 1983) The architects created a large number of windows to be covered by stained glass, but they found a problem: a lack of craftsmen who mastered the technique. Unfortunately, the old techniques had been lost, and were only relearned slowly, and with many uncertainties, during the nineteenth century. (Lee et al., 1987) New promoters of the technique appeared, such as William Morris, who dignified craftsmanship; Louis Comfort Tiffany with his research on glass; or Domènech i Montaner, who revived old artisanal techniques. The stained glass window was reintroduced in the styles of the end of the 19^{th}

century (*Art Nouveau*, Liberty, *Modernisme, Sezession*...). (Vila-Grau, 1983) (Lee et al., 1987) In most situations, the architect-craftsman dichotomy occurred. However, the glassmaker of the 20th century evolved, and was the author of his own art (Lee, 1987), becoming an artist and leaving behind the craft techniques necessary for the conservation and restoration of existing stained glass windows.

2. The British Cemetery of Valencia

In the 19th century Valencia attracted a great number of workers due to the large infrastructure projects that were being carried out, such as the port and the railway network. For this reason, several families settled permanently in the city. All these families were non-Catholic which caused them a great problem. The burials of non-Catholics were prohibited in the city cemeteries. This prohibition was constantly reinforced in the different laws about cemeteries, such as R.O.[1] 19th of March in 1848 or 30th of January in 1851 (Fernández et al., 1994). In 1872, a law that regulated the construction of cemeteries for non-Catholics was enacted. For this reason, several Protestant families acquired land in front of the general cemetery for a new one. As required in a circular of 1804, which established the documents necessary for choosing the land for the cemeteries, an architect's plan was needed to obtain the licence. This plan, by Antonio Martorell, included the construction of the perimeter wall of the cemetery and is in the municipal archive of Valencia. After an arduous struggle to obtain the permits, the inhumations began in 1889. Later, Vicente Sancho Fuster built the entrance portico and the chapel (Mora, 1912). These constructions were produced in the neo-Gothic style. The façade was a clear example of symmetry; its composition was perfect down to the smallest detail. It is composed of a central door that gives access to the entrance portico and two side windows. One of them corresponds to the chapel; however, the other has no use since it leads directly to the interior of the cemetery without corresponding to any specific space. Despite this display of ingenuity at the compositional level, the construction's greatest value was its stained glass windows. They were made using the leaded technique, just like their Gothic predecessors. During the decline of industrialization and the civil war, the British cemetery fell into disrepair with its consequent degradation. Due to the situation of extreme abandonment that this construction suffered, the British Cemeteries Foundation in Spain decided to proceed with the recovery of this historic enclave. It was not simple, since apart from the cleaning of the cemetery and the restoration of the tombs and the façade, the need for restoration of the stained glass windows was vital. As has happened over time, traditional artisanal techniques have been lost, making it difficult to preserve some elements of our heritage. In 2017, through *Consorcio de Gestión del Centro de Artesanía de la Comunidad Valenciana* (Valencian Community Handicraft Centre), *Fet de Vidre*, an employment centre specialising in manual work on glass elements, was commissioned to catalogue and restore the stained glass windows.

Fig. 1. Façade. British Cemetery, Valencia (Source: Burguete, 2017).

[1]R.O. Rule given by order of the king, not directly, but through the secretaries of the office, using the so-called reserved route. It was a characteristic rule of the 18th century. (https://dpej.rae.es/lema/real-orden)

3. Restoration method

The steps for the restoration of stained glass windows are those established for the restoration of any architectural feature: prior documentation, repair, and delivery of the restored item (Salmerón, 2022; Bill et al., 1994). The prior documentation consists of a data collection stage which includes historical and documentary analysis, graphic records, physical chemical study and structure analysis. The data is collected in a database which describes the state of the window, the damage it has suffered, the features which need repair and the action necessary. Once the study of the feature has been carried out and the process to follow established, the second phase begins. This phase must be carried out by a craftsman who is knowledgeable in the construction techniques of the feature. The steps to be followed in this phase have to be carried out in a methodical way, following the correct sequence so as not to lose information about the feature or spoil it. First, identification of the feature to ensure that it can be put back in place once restored. It is later disassembled and packed carefully for transfer to the workshop. Once there, the stained glass panes are cleaned and paper replicas are made to guarantee proper reassembly. Two different processes can be followed on the same window depending on the state of each of its parts. In those that are in good condition, the glass is cleaned, and the lead cord is repaired. In those parts where the glass has disappeared or is badly damaged, or where the welding bead is in poor condition, the part is disassembled; the glass is replaced by another of a similar colour to the original. Finally the stained glass is packed and returned to its original place, where it will be reassembled. The last step of the restoration is to write a report that documents all the work carried out, the problems that arose during the restoration, the solutions adopted and the final state of the window (Cortés, 2015; Ros, 2009; Salmerón, 2022a, 2022b).

4. Restoration process

The work entrusted to *Fet de Vidre* was the restoration of the stained glass windows of the chapel door, the chapel w door. In an initial study carried out by Rosa Benavent, the specialist of *Fet de Vidre*, the items needing work were inventoried and catalogued, including the state in which they were found.

4.1. Identification

Chapel door

The chapel door was built with a forged steel frame which is a separate feature in itself. The door is decorated with metal bats and sculpted steel panels as bas-relief.

Fig. 2. Detail from the chapel door. British Cemetery, Valencia (Source: Burguete, 2017).

Stained glass windows were located in this frame. They occupied an area of 1.7024 m^2. These consisted of three panels, two on the sides and one on the top, in which floral motifs were reflected. All three form a plant network in which daisies are located, a characteristic feature of the whole.

Fig. 3. Detail from the chapel door. British Cemetery, Valencia (Source: Burguete 2017).

Despite being located inside the cemetery, protected from vandalism, the stained glass windows showed cracks and the loss of part of their design. These panels displayed a serious deterioration of the lead, with around 10% missing. It also presented damage mainly through the passage of time (dirt, discolouration).

Fig. 4. Detail of the stained glass window on the chapel door. British Cemetery, Valencia (Source: Burguete, 2017).

Chapel window

Located on the left side of the façade, it filled a pointed arch, a characteristic Gothic shape and copied by Vicente Sancho in this neo-Gothic façade. The stained glass window occupied an area of 1.025 m^2. It had a similar design to the chapel door, a plant network with leaves and daisies. Due to its outdoor situation, this made it more sensitive to acts of vandalism which had broken the lower part. The loss of the lead had also caused the glass pieces to bulge. It was observed in the study carried out, that the stained glass window had undergone previous restorations. These were carried out in situ (without dismantling) and had caused damage to the lead, weakening the consistency of the stained glass. Missing joints had been replaced by lead adhesive and pieces shown in the original drawing had been removed.

Cemetery exterior window

Located on the right side of the façade, it completes the façade's symmetry. With the same characteristics as the stained glass window in the chapel, but without a defined use, since it faces the cemetery directly, it completes the intention of achieving symmetry in the façade.

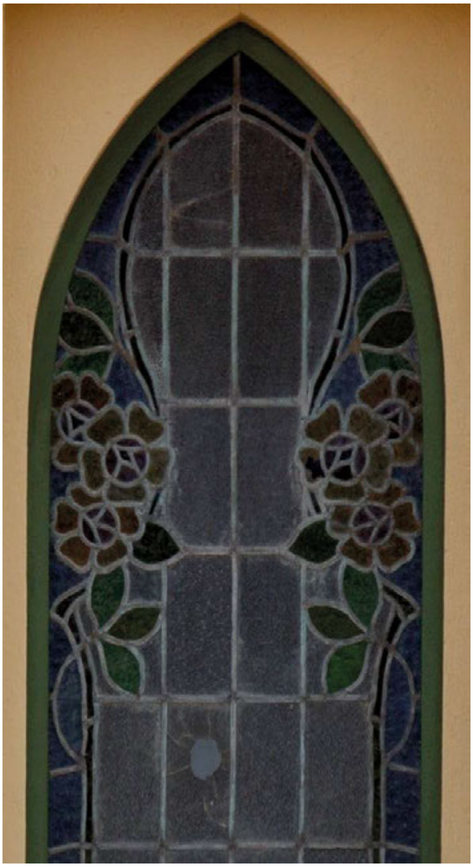

Fig. 5. Chapel window. British Cemetery (Source: Burguete, 2017).

Cemetery gate

This was the most spectacular of the four windows, both for its size and its design. The gate was built with a metal structure that contained the stained glass window and the access door. The upper part had a pointed shape following the guide of the style used for the façade. The bouquets were formed by roses and daisies that were joined by the stems of the plants. The area occupied by the stained glass window is 2.6 m^2. Its structure meant that the lower glass pieces supported a great weight due to their dimensions. This caused the lead that held the pieces to lose its consistency causing bulging and detachment of pieces over the years.

Fig. 6. Cemetery gate. British Cemetery, Valencia (Source: Burguete, 2017).

4.2. Damage assessment

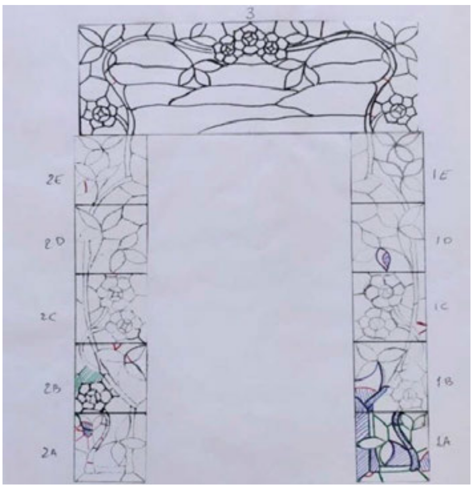

Fig. 7. Damage scheme. Chapel door. British Cemetery (Source: Benavent, 2017).

Initially, all the pieces were drawn in a diagram in which all the observed damage was recorded: broken glass (red), missing glass (blue), broken lead (green), missing lead (blue), and glass from previous restorations (green). The damage was classified into three types. One was caused by vandalism. It caused glass breakage and loss of lead sections. The second one was due to the passage of time and lack of maintenance, leading to a build-up of dirt and loss of lead. Finally, the damage caused by previous restorations that had been poorly executed. Those interventions aimed to correct the loss of parts and the deterioration suffered by the lead, and even by acts of vandalism, but they caused even greater damage to the state of conservation. These interventions were carried out without dismantling the stained glass windows. Likewise, they were not dated by those responsible for the maintenance of the cemetery. For this reason, it was believed that they were made solely in an attempt to maintain the structure of the window without any prior study. This fact not only caused damage to the window, but also complicated the restoration work and the adjustment of the budget.

4.3. Disassembly and packing

Fig. 8. Disassembly works. British Cemetery (Source: Benavent, 2017).

Once the four pieces were catalogued in terms of their shape, design, condition and damage suffered, they were prepared for disassembly. For this step, the loose parts were secured with non-aggressive adhesive tape. This step ensured that once they had been disassembled, an exact tracing of the stained glass could be made. It could then be returned to its original shape once the restoration work had been carried out.

4.4. Workshop

After dismantling, the pieces were placed horizontally on workshop tables. There, a life-size copy of each window was made by copying with charcoal on onion paper to guarantee the correct restitution of the parts that had to be disassembled.

Fig. 9. Charcoal copy (Source: Benavent, 2017).

In those parts with broken glass or where cord was damaged, the lead was removed to allow proper cleaning of glass and replacement of broken panes. The panes of glass that had been replaced in the previous restorations were replaced by glass in original colours. As an example, the daisies, incorrectly glazed with white glass, had their original yellow glass restored. Once the glass was prepared, it was welded. Following the restoration criterion that was to preserve the original glass to the maximum, the new weld beads were made with tin, following the Tiffany technique so that the restored parts were differentiated from the originals. Finally the beads were restored and cleaned. The original state was reconditioned after removing two-thirds of the stained glass to give consistency.

Fig. 10. Cardboard drawings. Chapel window. British Cemetery. Valencia. (Source: Benavent, 2017).

Fig. 11 & 12. Disassembled stained glass lead cord.; stained glass reassembly (Source: Benavent, 2017).

Fig. 13. Restoration process (Source: Benavent, 2017).

4.5. Final result

Once restored, the initial process was followed in reverse. The pieces were packed and returned to their original place. Then, it could be observed that they had recovered their transparency and original colour. In that way, they once again endowed the rooms that were illuminated with colour.

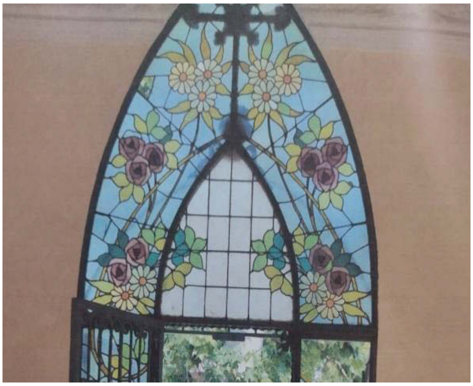

Fig. 14. Restored stained glass window, gate, British cemetery, Valencia (Source: Benavent, 2017).

Finally as the last step of the restoration, the specialist of *Fet de Vidre*, created a database in which all the necessary data for the documentation of the work carried out was collected. It contained the original state of the stained glass, the process followed for its restoration, the problems that arose during it, and the final state of the stained glass.

Finally, as the last part of the restoration, those responsible for the cemetery decided to place security glass in front of each window to protect the stained glass from vandalism. This step was effective only because the restoration was executed in a proper way and with a little maintenance could maintain their splendour for many years.

5. Conclusions

Stained glass windows are an architectural feature resulting from the joint evolution of the glass and the frame. These, in their most glorious moments, have been made by artisans but under the direction of both prestigious artists and architects. Their execution requires traditional techniques. Stained glass can be painted or covered with lacquers or enamels. These small pieces of glass are cut into the form required by the design. They are joined principally by two types of technique. One is the traditional one, using a lead cord. Each piece is surrounded by one of these cords and joined to the following one. In this way the entire space is covered with the original design. This technique must be executed horizontally and produces plain stained glass to be assembled in the window. In the 19th century, Louis Comfort Tiffany discovered a technique to break with the traditional one. This technique is known as the Tiffany technique. The main difference is the use of copper as a support material. It is used to join the glass pieces. This material is light and malleable so the pieces can be joined with great versatility. This offers more creative possibilities, such as curved stained glass or very small pieces of glass, allowing more detail. This technique allowed stained glass to evolve from a purely architectural feature to jewellery and decorative elements.

Fig. 16. Lamps (Source: Rodríguez, 2015).

The evolution of the technique has led to the loss of the traditional ones over time. But these techniques are necessary to maintain this part of our heritage through maintenance and restoration work. This fact has been demonstrated in the restoration of the stained glass windows in the British Cemetery of Valencia. Another problem is demonstrated in this restoration. As the features were not considered architectural, there were no previous projects or prior studies. The direct commissioning of the restoration process led to budgetary and time problems during the restoration, because they were detected after the commissioning. Technical problems could be solved since the company was made up of experienced specialists and craftsmen. However, it could have led to problematic restoration of the type that the stained glass had previously suffered. The economic and time factors were more difficult to understand since they are usually done on time and to a fixed price. The lack of knowledge of the required work and the need for a mediator between the property and the craftsman led to a lack of understanding. In conclusion, stained glass windows are part of our heritage since they are part of the evolution of Gothic, Renaissance and Modernism architectural styles. The traditional techniques used for its construction are necessary for its maintenance and recovery. These techniques are carried out by artisans who should be valued since our heritage depends on them. Unfortunately, at the end of this article, the representatives of *Fet de Vidre* reported the closure of this centre due to business problems, with the considerable loss caused by the repeated disappearance of the trades that allow us to recover traditional construction techniques.

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Studies and projects for the archaeological park of the Nuraghe s'Urachi (Sardinia, Italy). From knowledge for heritage conservation to project for the community

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Topic: T4.1. Conservation and restoration projects of vernacular architecture.

Abstract

This piece of research regards the archaeological area of the Nuraghe s'Urachi in San Vero Milis (OR-Sardinia, Italy). The site is probably one of the most significant and complex testimonies of the so-called "Nuragic civilization" in Sardinia (18th–11th century BC). Among the approximately eight thousand currently surviving "nuraghi", the s'Urachi complex stands out for its pivotal role in the vast and important network of territorial relations that characterized central-western Sardinia during the Archaic period. Its crucial role in terms of its political, economic, social, and military importance is displayed by its considerable size. Today only seven of the ten perimetral towers are still visible, and of the central tower — originally over twenty-five meters high — only the base remains. However, from an archaeological point of view, the Nuraghe still constitutes one of the most interesting artifacts of the region. As part of a renewed collective interest in Nuragic sites, the area of the excavations of s'Urachi is a candidate to host a new archaeological park whose formal and organizational characters are still to be defined (section 1.1). In August 2021, a workshop was organized and promoted as part of Accademia Adrianea in Rome Master's degree program on Architecture and Archaeology. The workshop focused on the site to envision four possible scenarios (section 2.1) for implementing and stimulating the preservation and conservation processes, as well as to enhance the archaeological area in accord with the municipal administration and the local community. The process of rediscovery, participation, sharing, and final "reappropriation" of this heritage's tangible and intangible value represents one of the fundamental objectives this article intends to outline.

Keywords: *Nuraghe, conservation projects, architecture, heritage communities*

1. Introduction

In November 2021, thirty-one Sardinian Nuragic archaeological sites out of the currently surviving over fifteen thousand throughout the region had been registered in UNESCO's World Heritage tentative list. The popular movement to obtain recognition of the archaeological remains of the Nuragic civilization as a world heritage site — a movement involving public institutions, universities, and civic associations — served as an important first milestone. Nevertheless, a series of questions potentially compromising the population's interest and the trial of UNESCO recognition appear critical. Currently, the only archaeological site of the Nuragic era registered on the World Heritage List is the so-called *Reggia di Barumini.* This site still has some critical issues concerning the Management Plan, the document envisaged by the UNESCO Convention for enhancing the monument and its territorial context. It is, therefore, necessary to highlight how, in light of these issues, governmental action should be primarily oriented towards the construction of a system of rules, opportunities, and actions that strengthen the link between the asset to be protected and the community that hosts it. The recent establishment of the "Mont'e Prama Foundation," namesake of the site where the famous statues of the "Giants of Mont'e Prama" were found, will have to deal with constructing the system of the archaeological areas of the Sinis Peninsula and the Campidano di Milis. This foundation constitutes an important novelty in public initiative, working in conjunction with other projects stewarded by the University of Cagliari to support the enhancement, musealisation, and accessibility of these areas. This interest, however, which includes territorial promotion initiatives, risks being thwarted by the enormous dispersion of public funding lines and by the fragmentation of decision-making centers. The thirty-one Nuragic sites registered in the World Heritage Site, certainly among the most emblematic, best preserved and legible, constitute an infinitesimal percentage of the remnants of the ancient Sardinian civilization of the Bronze Age.

Fig. 1. Aerial view of the so-called *Reggia di Barumini*

The non-World Heritage sites, although crucial for the knowledge of the ancient Mediterranean in its protohistoric phase, are at risk for being insufficiently cared for and undervalued, and thus neglected in favor of the formally recognized World Heritage sites. In this context, the Nuraghe of S'Urachi (or S'Uraki) in the San Vero Milis Municipality (Oristano, Italy) stands as an exemplary manufact. The scientific understanding and management strategies of the site must be deepened regardless of its exclusion from the tentative list.

San Vero Milis' *S'Urachi* is arguably one of the most critical sites in the area. It is one of the largest "complex-nuraghe" in Sardinia, and at its cultural peak was among the most relevant megalithic constructions in the western Mediterranean. The large basalt tower, originally over twenty-five meters high of which only the five-meter base remains, was surrounded by a long defensive stone wall and a relatively-rare deep moat. Its highly unusual territorial location in the lowland expresses the importance of claiming the political, military, and symbolic possession of that specific node in commercial relations as well as its strategic location along the exchange routes between the hinterland (the *Monti Ferru*, rich in ores) and the sea, through the ports of the Sinis peninsula. In fact, the building is among the longest-lived in terms of use, so the Phoenician and even Roman ruins are evident. Today, s'Urachi is the symbol of the Campidano di Milis community and the small town of San Vero, which was built using S'Urachi as a quarry for building material. The site, therefore, expresses an extraordinary historical and geographical depth that can be suitably leveraged (also in service of the nearby UNESCO sites), working in particular on its role as a reading device of the complex territorial relations of which it was, with all evidence, the epicenter.

Fig. 2. View from the top of the Montiferru mountain to the Sinis Peninsula

1.1. Between preservation and cultural identity

We had the opportunity to investigate and test design hypotheses aimed at the preservation and enhancement of the archaeological site of s'Urachi as part of the program for cultural and educational activities promoted by the Accademia Adrianea[1] in the context of the itinerant Master on Museography, Architecture and Archaeology, Strategic Design and Innovative Management of Archaeological Areas. In particular, the design workshop[2] was proposed to the participating students as a proactive investigation of possible design solutions aimed at the direct involvement of the local community. The s'Urachi site is well-known and has been studied by the local and international scientific communities. The excavations carried out to date are partial but sufficient to envision the complex's architectural consistency, extension, and articulation[3]. This same awareness and knowledge, however, are often not recognised by the local community. The object of the excavations is too often completely isolated from its environmental and social context to the point that the archaeological significance of the site is often unrecognized by its local community despite its profoundly-felt connection with the Nuragic civilization. There is, therefore, a “loss of memory” that makes the processes of knowledge, protection, and enhancement challenging to transmit to an audience of non-experts; such is the case with *s’Urachi*. The Faro Convention’s Article 12, “Access to cultural heritage and democratic participation,” confirms how fundamental it is to mend the relationships between the heritage and the community in which the site is situated (CoE, 2005). Therefore, it is essential to start a virtuous process for the sustainable use of the cultural assets: the economic and social aspects that leverage individual and collective participation are an opportunity to perpetuate a shared and enduring interest in the heritage itself. If appropriately used and positively integrated into this context, cultural heritage can significantly increase the knowledge of places and the “stratified memory” of territories and cities. It can also constitute a fundamental means of cohesion and social identity, as well as become a lever for development as underlined by the UNESCO recommendations on the historic urban landscape and the Habitat III agenda of Quito (2016): cities, landscapes, and cultural/environmental heritage are not static facts but active components of the dynamics of socio-economic development (United Nations-UN, 2016). The aim of the workshops, therefore, examined nexus of the archaeological and cultural contexts, in terms of both the s'Urachi complex and of the design activities already implemented by the municipality and by the community of San Vero Milis (Oristano, Italy), initiatives designed to promote a truly integrated conservation of the site. These themes have been the subject of study and research for several years. This previous research helped offer support to the preliminary knowledge phase for any activity that involves working on the site. Today, the analysis of the state of the art of the site highlights the necessity to continue with archaeological excavation activities. In addition, it reveals the need for the asset to concretely enter the territorial system on the Nuragic presences in Sardinia, particularly the area of Oristano and the Sinis peninsula. The accessibility and safe visitability of the archaeological site of *s'Urachi* was one of the design demands posed to the students of the Master's programme, on which they were called to propose solutions and hypotheses.[4]

They were given constraints related to the use of the site which took into account issues related to the management of the excavations by lots.

[1] The Adrianean Academy of Architecture and Archaeology Onlus is a non-profit organization active in the field of research and training on the issues of enhancement and rehabilitation of cultural and archaeological heritage, operating within a broad framework of institutional relations at an international level. For more detailed information, please refer to https://lnx.accademiaadrianea.net (25 January 2022).

[2] The workshop took place from 28 August to 4 September 2021 with about 30 students in Architecture from various Italian universities.

[3] Please refer to G. M. Chiri in this same contribution.

[4] For more details, see the contributions and bibliography published in Germanà M. L., Prescia R. (2021). *L’accessibilità nel patrimonio architettonico. Approcci ed esperienze tra tecnologia e restauro*, Arteferma, Treviso, Italia.

These inputs were considered as a functional constraint for the drafting of the design proposal.

Because of the findings' fragility and the open excavations danger, the inherent inaccessibility to non-experts is a critical issue that must be solved to disseminate archaeological research and heritage to the broader public. Another determining factor to which we paid particular attention addresses a more general design quality issue. The aim here was to revive and allow access to the site in order to communicate, through architectural and formal instruments, the importance of the scientific and communicative agendas at hand, namely the continuous excavations and the possibility to host cultural initiatives in connection with other sites. The formulated design hypotheses had to consider issues related to the future management and maintenance of the site, promoting (in a spirit of compatibility and sustainability for the new facilities) the use of construction techniques and materials coherent with the fragile nature of the site. Furthermore, the awareness -within both the "host community" and by visitors to the site- of the cultural meanings of the heritage and the need for its conservation reveals a physical, intellectual, and emotional impetus for well-managed "access" to the heritage, constituting both a right and a privilege (Germanà, 2021; Arenghi et al, 2011). In the formulation of the project proposals (elaborated in section 2.1), communication was deemed fundamental for the management process of the complex. These processes do not refer exclusively to the educational function of the site or treating it as an "open site" according to an idea of live restoration (Arrighetti et al, 2019) that concerns the phase of restoration and excavation -rather, it expands in scope to address a heterogeneous public, not necessarily composed of experts in the sector. This phase becomes an integral part of a cultural project through which, for example, the storytelling formula becomes a link between the asset and its users, allowing for more consistent communication (i.e. a mode of discourse that is also transmittable through the use of social networks, in some cases through networks that are quite distant from the "cultural habits" of the community) (Morezzi & Rudiero, 2021).

This methodological perspective had to be expressed formally and figuratively in order to explore some of the infinite possible actions available. Beyond the exercise's didactic objectives envisaged by the Master's program's activities, the workshop may have constituted the first initial advancement in scientific research under two hitherto unexplored conditions. The first condition was the awareness of the historical and territorial depth of the site. The lectures and numerous inspections led by archaeologists, including the former Chief Director of the excavations Dr. Alfonso Stiglitz from the local Archaeological Museum, contributed fundamentally to achieving the goal. Dr. Stiglitz provided an excellent general framework of knowledge on which the working groups' proposals could function in awareness of the unique qualities and features of the archaeological site within its historical and geographical dimensions. The second condition was liberating the design from any financial, administrative, and, to a limited extent, regulatory constraints. In the short time available for the proposal's formulation, it was necessary to focus on the emergence of the first founding principles of the design process, postponing further considerations to another context.

Only under these conditions was it possible to safeguard the "freshness" of the hypotheses, which, although sometimes naive, served its role of a probe within the spectrum of possibilities and, more importantly, served to correctly define the landscape of the problems rather than to immediately provide workable solutions. A third question concerned the expected outcomes of the process and, in other words, the final goal of the research. Naturally, we did not expect to resolve the arrangement of the *s'Urachi* area as an episodic fact. On the contrary, it was an occasion to experiment with potentially exportable approaches within the testing ground of a workshop. The peculiarity of the whole Nuragic heritage compared to the set of other Mediterranean archaeological remains is its regional coverage and dispersion.

Fig. 3. Zenithal view of the site

It is a geographic network of places that extensively build the landscape over time. In this sense, the design proposals aimed at enhancing the archaeological areas of the Sardinian regional territory can be considered primarily landscape designs. We felt the need to build the material conditions for the best integration of the excavation site vis-à-vis the local community while also identifying a coherent design expression for a large set of sites. This concept previously served as the basis for design research developed for the excavation site of the necropolis of Mont'e Prama. On that occasion, the project prioritised the site's accessibility and understanding while simultaneously relating itself to a broader system. It aimed at building an intermediate physical device between the local and the geographical network of Nuragic civilization sites through the Cartesian grid (Chiri, 2021). That experimentation highlighted the site as both a cultural asset of its local community and a constituent in the larger Nuragic anthropological context. This duality then emerged as a priority for successive projects that would be carried over to other areas on the "Tentative List", including that of s'Urachi.

2. Elements of the program

The municipal administration of San Vero Milis has long ago prepared a variant to the urban planning tool to divert the provincial road that crosses the excavation site. The old road, now abandoned, followed an ancient Roman route created when the nuraghe was already in partial ruin. The road crosses over part of the perimeter defensive wall and covers at least two towers.

Fig. 4. The nuraghe from above

A recent loan will allow the road to be razed, and the excavation of the remaining part of the bulwark and the moat that enclosed it will follow. This project is coupled by a proposal for funding the arrangement of the surrounding areas, up to the limit of the property. Although the excavations are open on a seasonal basis, there is a clear desire to interpret the theme in a way that is as open as possible to public use and collective enjoyment. The main issue will consist in identifying the acceptable compatibility level between the excavation works and public visits. A secondary issue concerns the actual perimeter of the area and the involvement of surfaces currently not included in the potential archaeological park. The surveys carried out by archaeologists suggest the existence of a vast network of multilayered, unexcavated remains, probably distributed around the emerging element of the nuraghe in the direction of the area where the town stands: a village, perhaps a necropolis. If this were the case, a somewhat elastic perimeter would have to be conceived, ready to incorporate the inclusion of new areas, gradually removed from agricultural use, ready to be reconnected to the archaeological park. Another theme concerns the possibility of building a stable structure for exhibiting the findings or even a small museum building. The workshop did not exclude the possibility of designing a small *antiquarium* or the location of a service or visitor center. There is already a small, well-managed archaeological museum, although its size remains critical. It is too small to constitute in itself an attractor of tourist flows, let alone a totally autonomous archaeological research laboratory. The network of regional territorial archaeological museums is commonly very fragmented, and despite some attempts to build a network between them or to centralize part of the collections, this has not happened due to the resistance of the local communities who feel expropriated of the precious findings, perceiving the sites as both part of their identity and as a touristic -and therefore economic- resource. The nearby "Giovanni Marongiu" Archaeological Museum of Cabras (OR), which houses part of the findings of Mont'e Prama such as statues from the site, is a more structured and sizable facility, but it still struggles to escape the encumbrance of the much larger Archaeological Museum in Cagliari. That said, if the possibility of creating a permanent structure was not completely excluded, then it is it is more likely that it will be entrusted with a function of support for the visitability and understanding of the excavations and a reference to more complete exhibitions. A further design topic concerns the formal expression and use of materials. The studies on the Nuragic civilization started systematically with the school of Giovanni Lilliu, have trickled into popular culture (especially in very recent times), also thanks to the striking discoveries of the statuary of Mont'e Prama and some -still unconfirmed- suggestive hypotheses about its origins. While this phenomenon, on the one hand, has made it possible to highlight the value of the Nuragic civilisation, on the other has produced the proliferation of images and clichés that are very strong and pervasive on the media level but not very consistent on the historical one. Hence, the caution in expressing vague assimilations with the architecture, actual or presumed, of the Sardinian ancestral past so as to avoid clumsily undermining the contribution that design can and must make to historical understanding. Nonetheless, the history of Nuraghe s'Urachi is a history of its building material. The megalithic construction was completed in the upper parts with smaller and easily transportable stones and compressed clay bricks. Both were gradually removed for new buildings in the Middle Ages. Basalt and earth are, therefore, potentially the material on which to build a future figuration — not necessarily a unique narrative, but a powerful one.

2.1. Four hypotheses

In this section, we present four design hypotheses that were explored during the workshop. We believe they encompass and represent the methodological assumptions we brought to light. The first project concentrated all the service functions in a single structure, located east of the archaeological park. In this way, the building acts as a hinge between the inhabited area and the archaeological artifact in the longitudinal sense. At the same time, transversally, it looks at the landscape of Monte Arci, a legacy of the Neolithic past, and underlines the presence of the *Su Parigheddu* grove along which lies the Nuragic village. Although very characterized and formally autonomous, the design action has the advantage of incorporating the territorial and historical symbolic dimensions, undoubtedly one of the core objectives of the project. These proposed actions on the nuraghe are expressed in the definition of a new, utterly artificial accessibility plan, corresponding roughly to the horizontal section at the altitude just above the maximum height of the ruins. This expedient confers more legibility to the monument and renders it a significant tourist attraction.

Fig. 5. Team 1, proposal for catwalks over the top

The second group's proposal does not significantly differ in concept from the previous one except that it almost entirely renounces intervening directly on the nuraghe. The singular tangential element is represented by a walkway which, in tracing the path of the Roman road, approaches the height of the top of the ruin, allowing for a close view that simultaneously expresses the site's relation with the surrounding landscape. Also, in this case, a new building serves as the central element of the park, one with a contemporary design language that still makes attentive use of locally derived materials.

In the third proposal, the solution to the space of the archaeological park is not obtained through the service building. On the contrary, the proposal favors a less volumetric approach based on a simple concentric path with a direct relationship with the nuraghe. This becomes the center of the composition and of the narrative path that develops around it. However, the external area is not "other" but is somehow included as an additional element of the relationship. The fourth proposal is perhaps the most axiomatic of the projects and the one that stands out for its remarkable originality and balance. As in the previous proposal, the museum building is absent; in addition, the supporting buildings are completely ancillary, playing a secondary service role to facilitate a "pause" or orientation in the development of the spatial sequence. Although based on a similar principle as the third project, this fourth proposal makes the geographical relationship between the nuraghe and its surroundings even clearer. In this case, the circular path is not used to access the ruin but as a device for interpreting landscape relations, thus assuming a more profound and sophisticated value.

Fig. 6. Team 2, the museum and the catwalk touching the nuraghe

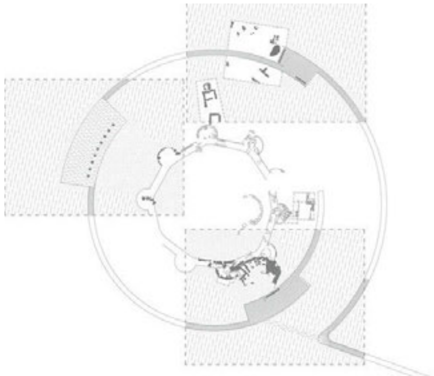

Fig. 7. Team 4, a spiral catwalk around the nuraghe

Fig. 8. Team 3, landscape design solution

3. Conclusions

The article describes both the methodological premises and the design studio workshop in the context of the itinerant Accademia Adrianea's Master's Program. Although none of the four proposals presented should be considered an exhaustive solution for the issues that the s'Urachi site has raised, they present some preliminary hypotheses on which to articulate future developments, ones to be fully confirmed also through the use of design exploration. First, as was already the case for Mont'e Prama, the case study confirms that parceling the territorial museum structures can be considered an added-value for the attractiveness of the locality; that said, it is not certain that this parceling constitutes the solution to the enhancement of the whole network of archaeological sites. Indeed, the digital dimension of contemporary museography allows cross-linking between collections and sources horizontally, from the most superficial and basic to the more detailed and academically-inclined ones vertically. For this reason, in a condition such as the one shown, the location of a new museum building near the Nuraghe of s'Urachi is not a viable hypothesis to consider. Conversely, the need to formalize a sort of "narrative device" is imperative. A "narrative device", as suggested by the philosopher Giorgio Agamben, is an object capable of interposing itself between man and space to become the vehicle of dialogue and meaning. The third question that emerged is that of the protagonism of architectural forms. It is by no means a question of supporting the cause of mimesis or rejecting *a priori* the tools of contemporary language for the solution of historical places. It is necessary and appropriate to recognize that, in this specific situation, architecture should avoid unnecessary formal expression; its design should renounce the confronting power of its signs, recognize the strength of raw materials, and subtly reinforce the geography that archaic Nuragic places still express.

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Vernacular heritage protection by the Superintendence of the Aosta Valley

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
The contribution wants to illustrate the role assumed by the Superintendence of the Aosta Valley to protect the vernacular architecture in the Valley. The particular morphological formation of the territory has been deeply conditioned by the forms, the building techniques, and the materials used.
The first actions of protection promoted by the Superintendence have tried to address the urban planning characterizing the local regulatory plans through rules aimed at safeguarding the building heritage with a classification of buildings in categories. In 1986, the Superintendence then began research into historical rural architecture, recognizing this heritage as an integral part of the landscape and material testimony to the history of the Aosta Valley. Following an experimental phase, which allowed for the fine-tuning of the survey methodology, coordinated action of knowledge was promoted. Using special courses for young people, the surveyors were trained and for over twenty years they carried out a census of rural architecture throughout the region. After collecting and organising the material, exhibitions were held, and publications were prepared to illustrate the construction techniques and the buildings' peculiarities to provide technicians with a better understanding of the architecture and the development of projects more attentive to their characteristics.

Keywords: *Planner conservation, guidelines, vernacular architectures*

1. Introduction

To present the activity of protection of the Superintendence of the Aosta Valley, it is necessary to make some preliminary remarks. First of all, the superintendence of the Aosta Valley is a regional one and this allows for greater autonomy from the central Ministry. This makes it possible to give more specific guidelines adapted to the territory, enhancing the specificities of the territory.
A second aspect concerns the close connection between territory and history. In fact, the morphological conformation has favoured the birth of a cultural enclave strongly characterized by unique artistic expressions.
Finally, it is important to note that the Valley is sparsely populated by residents. There are only 127,000 inhabitants in 3,263 km².
This area is protected thanks to the work of 43 officials divided into the Landscape and Architectural Heritage offices (18); Architectural Heritage (9); Archaeological Heritage (2); Publications (2) Exhibitions (9) Scientific Analysis Laboratory (3).

2. Aosta Valley region

Aosta Valley is an alpine region located in the North-West of Italy. It is crossed by a central river (Dora Baltea) fed by side streams that run through the side valleys. Valleys are linked with mountain passes that lead to Piedmont (Eastward and Southward), Switzerland (Northward), and France

(Westward). For a very long time, mountains were not barriers. They have contributed to cultural exchanges and trade.

Another prominent indicator is language. Until the first part of the 20th century, the Aosta Valley had been a primarily French-speaking region. There is also a German-speaking ethnic minority known as Walser. In the 12th century, part of such population migrated from the Swiss district of Goms to the northern part of the Gressoney Valley. Institutional relationships with France and Switzerland have been relevant as well. For example, the jurisdiction of the Saint-Maurice d'Agaune abbey (Va-lais, Switzerland) included the northern parts of the Ayas and Gressoney valleys. The latter was shared with the jurisdiction of the Sion (Switzerland) Bishopric. From 1416 to 1563, the capital city of Aosta Valley was Chambéry (France), under the jurisdiction of the Savoia Dukes. Seasonal migrations of the inhabitants (especially masons, chimney sweeps, and other workers) contributed to cultural diversity, that influenced local rural architecture.

Other important aspects that have influenced rural architecture and agriculture are the mountain heights, exposition, acclivity, irrigation, and soil type. For example, the large flat area below the *Bard* grapes is cultivated on slopes exposed to the sunlight. Vineyards are stuck onto terracings. Grapes also climb pergolas. The scenery is characterized by a series of dry stone walls and green pillows. Viticulture is present throughout the orographic left of the central valley. It encompasses an altitude of 1000 m a.s.l. On the opposite side, agriculture is sporadically present.

A strip of forest (prevalently constituted by conifers) is beyond high-altitude permanent settlements. Alpine pastures are located further upward. They host livestock during the summer (for around 100 days a year). The first territorial organization followed the directives of the Romans, but the medieval period was also very significant. Feudatories incentivized the colonization and reclamation of new soils through tax reductions or cancellations. Reclamations involved the construction of further infrastructures: paths, mule paths, irrigation canals, and terracing.

Along pathways, new villages were built and the weft of the landscape was enriched by irrigation channels. *Transhumance*, or the movement of animals at high altitudes, led to the formation of mountain pastures along the ridges of the mountains Saint-Jean typically, the stops to climb at high altitudes were four). Naturally, not secondary is the climate that has not always been the same. A hotter climate allowed for broader land exploitation, e.g. during the Roman period and the 15th century. The cold period implied regressions, e.g. toward the end of the 16th century.
Environmental, cultural and economic dynamics yielded diversified kinds of settlements. Villages were built in the shape of a comb and developed along the Roman road of Gaul. Large colonies have appeared in regions where cereal cultivation was well developed. German-speaking populations lived in small centres scattered around the territory. Sporadic housing units around vineyards were small as well. All such kinds of settlements were linked to their relative countryside.

Black death, from 1347 to 1350, implied a dramatic contraction. According to historians, it killed more than half of the population. At the end of the disease, society was restructured. Lands left without owners got redistributed among survivors. As a consequence, entrepreneurship became stronger than before 1347. Ownership of previously shared parcels had become privately owned. (De Tillier J. B 1968).

A second worsening occurred because of the 1630 epidemic. Woods and pastures got expanded whereas cultivation shrank.

In the second half of the 19th century, large permanent migration started. They led to the depopulation of mountains and the final decline of traditional agriculture.

Urbanization of the large centres of the central valley was fostered by the increase of trade (favoured by the arrival of a railroad in Aosta in 1886) and later, by industrialization.

Tourism took off in the 18th century with the Grand Tour (Maggi 2008). The interest in mountains started after Mont Blanc was climbed for the first time in 1786. Thermal baths became popular around that time. After that, the sport of skiing became very important: the discipline emerged as a success in the 1930s.

Ski lifts were built in Breuil-Cervinia (1936) and Courmayeur (1939). After the Second World War and especially at the end of the 1950s, mass tourism took off. In addition to historical villas and hotels, new resorts opened. Tourists bought holiday homes.

Several new buildings were entering the landscape: ski lifts, ski runs, industrial agglomerations and hydropower plants. There has been a significant building expansion. In addition, the rivers have been converted for other activities.

Collective memory preserved the original utilization of soils in toponyms, collected by the *BREL* (Bureau Régional pour Technologie et la Linguistique)., meadows (*prou, pra, mattu, …*), fields (*tsan, champ,*), tillage lands (*ronc, ronchail, …*), cultivated fields (*noveilloz, röiti,*), woods (*bioley, verney, érllji, …*), alpine pastures (*la montagne de, jatz…*) and so on. Cultural inheritance is rich and well documented in numerous archives[1]. In the context of regional cultural studies, everyone contributes within his or her field of interest, through (historical) enquiries, events, meetings, publications, and fieldwork. In addition to that, ethnographic museums (of Allein, Champorcher, Cogne, Donnas, Fontainemore, Gressan, Gressoney-La-Trinité, Introd, Torgnon, Valsavarenche and Valtournenche) represent slices of peasant life (A.A.V.V., 1984).

3. Protecting rural heritage: a specimen path of traditions guardianship[2]

The historical heritage census of vernacular architecture began in 1983. The architect Claudine Remacle[3] started it with the coordination of the architect Flaminia Montanari[4], director of the Superintendence. Since 1987, courses for detectors of rural architectural heritage have been promoted. The enrolled personnel was constituted of technical school graduates and architecture students. Fluent French was considered a must for candidates. Participants were selected through an admission exam constituted by a drawing test outdoor and an interview. Chosen candidates went through a course on history, landscape kinds (structural and constructive), understanding of historical documents and drawing techniques. The utilized references were textbooks and material provided by the lecturers. At the end of the course, candidates had to edit a dissertation on a building they chose. The study was evaluated by a commission, made up of the lecturers of the course. If the research was considered to be up to standards, the student was allowed to begin fieldwork. Later on, he or she was required to pass another exam. If successful, the candidate received the professional qualification of surveyor of rural architectural heritage. Among other things, it allowed Region[5] to engage the candidate in building studies (Remacle 1986, Remacle 2001).

Knowledge was needed to contrast bad building recovery. Such practice considers buildings as a volume right for secondary accommodations. Instead, rural architecture should be considered a historical and cultural heritage. Classification incentivized studies on historical transformations of buildings and

[1] The Académie Saint-Anselme, the Istituto storico della Resistenza in Valle d'Aosta, the Comité des Traditions Valdôtaines, the Société Valdôtaine de Préhistoire et d'Archéologie, the Association Augusta, the Association Valdôtaine des Ar-chives Sonores (A.V.A.S.), the Centre Culturel Walser, Lo Charaban, the Union internationale de la presse francophone – Section de la Vallée d'Aoste, the Centre d'Etudes Les Anciens Remède, the Association Centre d'études Abbé Trèves, the Société de La Flore Valdôtaine, the Federachon Valdôtena di Teatro Populero, the Centre d'Etudes Francoprovençales "René Willien", the Museo dell'artigianato valdostano di tradizione (MAV) and the millennial fair of Sant'Orso.

[2] https://www.regione.vda.it/cultura/patrimonio/architettura_rurale/default_i.asp

[3] http://www.remacle.it/it/

[4] https://www.regione.vda.it/gestione/riviweb/templates/aspx/environnement.aspx?pkArt=984

[5] Legge regionale 1° luglio 1991, n. 21 - Tutela e censimento del patrimonio storico di architettura minore in Valle d'Aosta; course and participants were funded by the European Union

the landscape. Thanks to the availability of new and instructed personnel, data were collected from the countryside and historical archives. Anagraphical and descriptive data, as well as drawings and pictures, were archived on a dedicated form (1) to take a census about vernacular historical heritage (Soardo 2010).

Forms were identified through progressive numbers, cadastral references of the properties (for every village of which a census was taken) and the storage number of the picture. The form is divided into sections. The first one deals with an entire block. The oldest building is identified first, followed by the more recent ones (2).

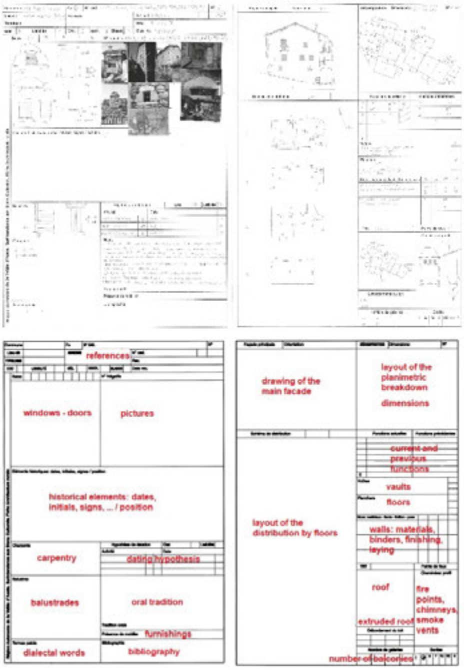

Fig.1 The form (Fontainemore).

Fig.2. Block (Fénis).

Conventional symbols are used to represent the chronological order (3). The second section represents the roofs of the entire block.

Other sections graphically report the floors of the building with their current use, the entries, the staircases, the balconies, the noticeable elements (fireplaces, sink, built-in wardrobes,…) and the main façade (4).

After reading the block, the form lists prospectus drawings reporting openings (lintel, bows, upright…) every written material, symbol and date found upon the structure, their location; chimneys; noticeable elements (balustrades, locks,…).

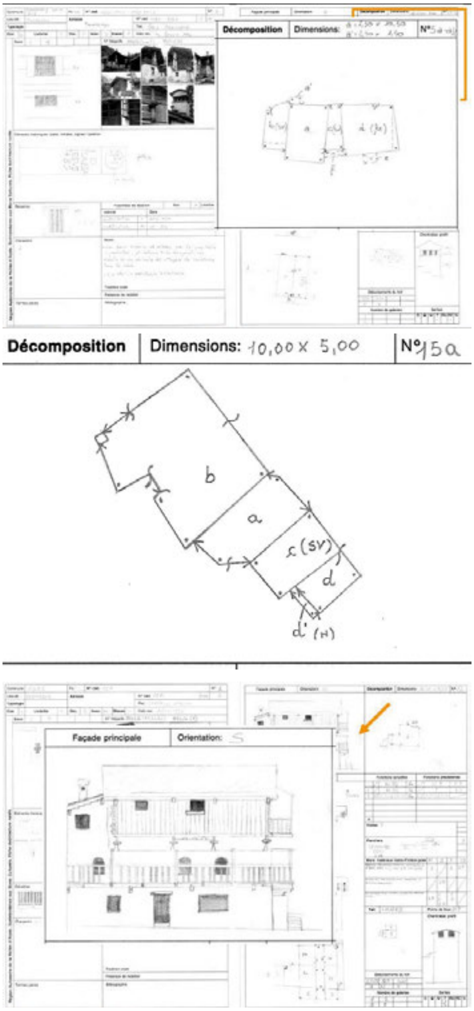

Fig. 3. Planimetric breakdown in Gressoney-Saint-Jean and planimetric breakdown Arvier.

Fig. 4 The main façade in Ayas and in Saint-Vincent.

Buildings host several signs with an allegorical meaning: the most ancient ones report feudal (Savoia shield and knot) (5) and religious (greek, Saint-Maurice and patents cross and the monogram of Christ - IHS) symbols.

Fig. 5 Savoia knot (Gressoney-Saint-Jean – particular-) and Savoia shield and symbols (Gignod).

Datings are in Arabic numbers. The oldest ones date back to the 16th century (6), and the most numerous ones start from the 18th century. The owner initials are generally on the ridge after accompanied by a dating, sometimes followed by the acronym FF (fait faire) (7). Rarely, do the initials of the builder follow.

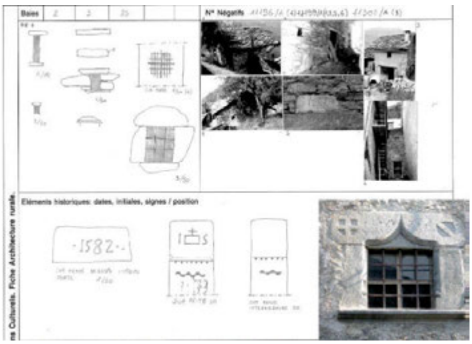

Fig. 6 16th century (Fontainemore) and 16th century (Chambave).

Another section is dedicated to the horizontal structure typologies (usually vaults and floors).

Fig. 7. Ridge in Allein ridge draw in Arvier.

A further section concerns the exterior walls. They are classified according to material, mortar, finishes and construction typology. There is a catalogue listing the recurrent varieties of stone masonries (based on typology, dimension and lying of corners of the connections of the masonries amount them). The combination of writings and signs found, as well as the kind of masonries leads to realistic hypotheses concerning the ages of the construction phases of the building at the century level.

Summarizing maps of every historical centre have been drawn (based upon the land register). They concern some constructive elements of the building: the construction and evolution of blocks (the oldest and newest buildings), their use (rural, civil, mixed,…) and their presumed age.

Forms report the historical and architectural quality of the property. Maps display the overall evolution of historical villages. Their combination shed light on alterations of functional typologies over time. They can be digitalized by assigning a code to each element (e.g. monolith-ic stone lintel, wooden arched…) to allow for quick and focused queries.

As expected, the fieldwork was often accompanied by archival research, in particular on the transcription of the main data of the cadastre Sardo and the Origin Stato. The Sardo land register (1770) concerns the entire region and it is divided by parishes. It contains only descriptive information: toponyms and parcels, their owners, their neighbours, the quality and quantity of properties and assessed valuation. It is of historical interest because it represents the situation at the end of the feudal system.

The cadastre land register was written between the end of the 19th century and the beginning of the 20th century. It includes adequate cartography sheets with parcel numbers. The latter is particularly relevant in depicting the phase of the largest expansion of agriculture and, thus, of rural inhabited areas. Furthermore, it allows to map the quality of parcels, know which families were owning which buildings and lands and verify the economic structure (who cultivates what and where). Entries can be compared with the ones of the 18th century.

Map highlighting macro crops around villages was edited as well. They shot the structural woof of the landscape (paths, mule paths, terracing, a heap of stones removed from fields,…). To favour the understanding of villages, a census has been taken of the surrounding areas, and the dossier ends with a questionnaire. It asks for a description of historical (divided by pavings, support structures, fences) and recent roads (penetration roads and parking areas). Other questions concern the list of community buildings (chapel, school, oven, mill,…), crops (presence of ancient ones, of terracings and of which kind), and irrigation (traditional canals of modern sprinkler irrigation).

The questionnaire also asks whether the sight of old buildings is obstructed by new ones, to understand the level of urban development; condition repair, state of ruin or renewal (and the quality of restorations). The last questions concern the selection of the most relevant buildings and the reasons for the choice.

4. From knowledge to a project

Research results are used to design a more cautious urban building planning. 87% of the regional territory is protected by national and regional laws. The landscape and cultural heritage are protected by the Decreto Legislativo 22 Gennaio 2004, n. 42 "Codice dei beni culturali e del paesaggio", parte terza, by the Piano territoriale paesistico della Valle d'Aosta[6] and by the Legge regionale 10.06.1983, n. 56. Cultural heritage includes monuments and archaeological areas.

For the sake of environmental protection, road advertising is regulated since the 31st of May 1956. Activities that might modify building styles and the landscape need to be approved by the Superintendence by the effect of other regional laws (e.g. solar or photovoltaic panels installation, coating of relevant buildings).

Protected areas and building classifications in historical areas are listed on the geoportal SCT (Sistema delle conoscenze territoriali)[7]. The culture of environmental protection is diffused through meetings. Invited individuals include officials and managers of the Superintendence, proposing subjects (local administrators, owners, planners or farmers' association presidents).

Fig. 8. Sketch of the raccard (Ayas) and example Raccard (Fontainemore).

Only architects can deal with monuments (articles 2 e 10). They evaluate both their internal and external parts. Structures under landscape preservation are

[6] L egge regionale (l.r.) N. 13 del 10.04.1998

[7] https://mappe.regione.vda.it/pub/geocartosct/

checked just externally (art 146). *Raccards* are frequent cases (8). They are wooden structures for hay and cereals. They are sustained by a lower part made up of stones; on which truncated pyramidal wooden supports rest surmounted by a round stone slab (defined as *mushrooms* for their appearance); the upper structure in trunks, preferably of larch, weighs on them. Keeping the two parts separate is fundamental, avoiding closures between the *mushrooms*.

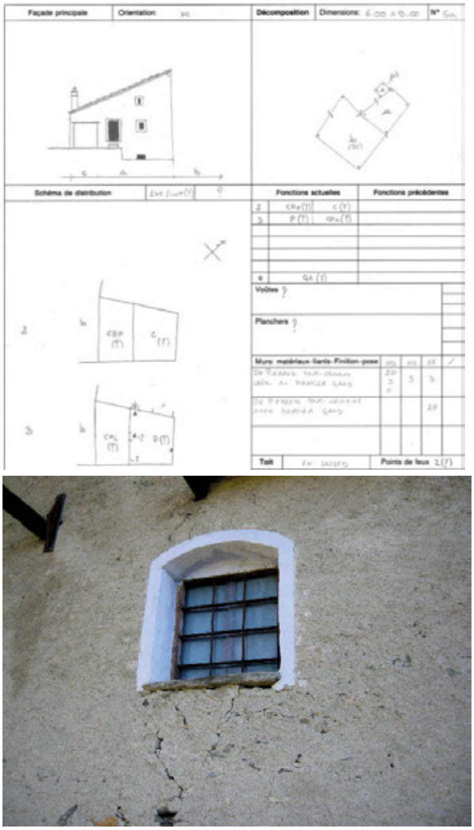

Fig. 9. Sketch of the plaster survey (Arvier) and example of plaster (Allein).

Scratching a plaster to point out the stone below is a common request. Plaster (9) is an element of good quality and richness of the house, whereas the masonry beneath was not constructed accurately enough to be shown. Explaining that to homeowners is hard. Projects need to meet requirements to be checked by civil workers: chorography, relief status and adequate scale project, for the relevance of the building, exhaustive description and pictures. If the planner falls short of presenting adequate documentation, integrations may be required (10). The Region keeps funds to intervene in real properties thanks to regional laws. Some uses of such funds are listed: the recovery of the historical-architectural heritage of the village of Bard[8], the restoration and conservation of the artistic, historical and environmental building heritage[9], the enhancement of historical itineraries, famous sites and places of history and literature[10] and the support for the protection, conservation and enhancement of the villages in the Aosta Valley[11]. To these, we can add the subsidized rate loans with the provisions on housing policies[12] and the economic benefits for the obligation to build the roof covered in stone slate[13] (Remacle 2014).

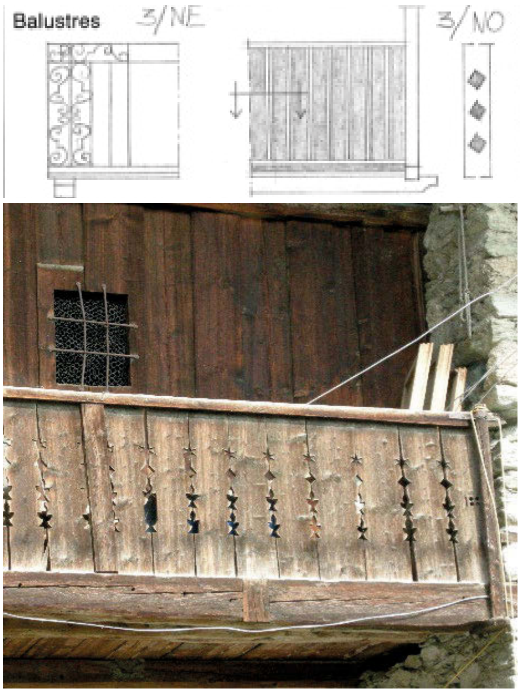

Fig. 10. Balustrades in Gressoney-Saint-Jean and Doues.

[8] l.r. N. 68 del 1992

[9] l.r. N. 27 del 1993

[10] l.r. N. 18 del 2002

[11] l.r. N. 30 del 2005

[12] l.r. N. 3 del 2013, deriving from a precedent of 1973

[13] l.r. N. 13 del 2007, deriving from a precedent of 1986

5. Conclusion

The vernacular architecture heritage of the Aosta Valley is huge, especially in the less touristy villages where recent transformations had less impact. (Martinet 2011). The Superintendence of the Aosta Valley[14] to protect the vernacular architecture through differentiating actions.

Firstly through knowledge of the heritage, with a cataloguing campaign of buildings and villages and landscape studies.

Secondary through exhibitions, publications and the possibility to consult the research carried out. Very important are the meetings with the designers to indicate the right approach to the restoration of buildings and the formation of city plans. (Mileto 2015).
Then there is the purely institutional role. The Superintendence carries out the protection, conservation, enhancement and use of the cultural heritage, providing for the release of authorizations and opinions by the law (86% of the regional territory is subject to landscape or monumental restrictions - the practices learned are about 4,000 per year).

Rural buildings are protected by state and regional laws. The intervention projects on them must be subject to specific provisions. About their classification (monumental, documentary or valuable buildings) they must obtain the authorization of the Superintendence. In any case, those built before 1945 cannot be pulled down.

Over the years, thanks to the awareness of the importance of the vernacular historical heritage (aided by the need to know to design), the interest in building filing has increased and so have the requests for their consultation.

The rules inserted by the Superintendence in the municipal urban plans during the process of approval of the same contribute to the modalities of intervention on historic buildings: 72 out of 74 municipalities of the Aosta Valley have their urban planning tool appropriate to recent regional laws.

They have included additional devices relating to the areas of the relevance of the buildings, the historical paths, and the elements characterizing the landscape (terracings, ditches, high pastures, woods, streams, lakes, falls, monumental trees, ...) and, obviously, the structure of the villages themselves.

We must never forget that we did not inherit our lands from our fathers but from our children.

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[14] https://www.regione.vda.it/amministrazione/struttura/info-mappa_i.asp?codmap=75

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Of earth, stone and wood: the restoration and conservation of a Buddhist temple in Ladakh, Indian Himalayas

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
The Dukhang Yokma is a small Buddhist temple part of the Ensa monastery in the Nubra river valley in Ladakh. The Dukhang was severely damaged by water infiltration soon after its construction at the beginning of the 20th century. Water seepage through its stone and mud mortar plinth caused a gradual bulging of the foundations which was followed by a steady shift of the whole structure. In the course of several decades this shift became irreversible and gradually damaged most of the masonry structure. The building had been neglected for several years before an active interest in its preservation emerged. During this time, several parts of the buildings were dismantled and the temple's inner chamber on two storeys tilted almost to the point of collapse. The conservation, consolidation and restoration of the temple has been undertaken by Achi Association India from 2018. This article analyses the restoration project and its many challenges, including wall painting stabilization. It explains in detail the issues faced by Achi team members and the way these problems were resolved through making use of local resources in this remote hermitage. One of the most complicated issues was to bring the inner temple's structural elements back to their original straight position, avoiding any collapse and damage of the wall paintings. The complexity of the task was due to the very fragile mixed structure on two storeys made of wood, mud bricks and stone.

Keywords: *conservation, Buddhist temple, traditional and local construction techniques, Ladakh.*

1. Introduction

1.1. Ladakh: context background

The Ensa monastic complex is located in Nubra valley (Ladakh - India), on the western side of the Nubra river bank, and in the South-eastern most stretch of the Karakorum range. Ladakh in general falls in a rain shadow area that has very scarce precipitations (< 100mm. yr^{-1}). It is a high-altitude cold desert that can experience temperatures reaching down to -40 °C during winter or rising up to 35 °C in the short summer months (Ferrari, 2018: 23). It is mostly due to climate change that summer precipitations have drastically increased in recent decades. Rain often causes devastating flash floods, which become even more dangerous due to the barren terrain that is easily prone to erosion. Precipitation is currently one of the most hazardous threats to architectural heritage, which is also jeopardized by a rapid substitution of historical buildings, reconstructed with imported materials and without local or national regulation.

1.2. Architectural Conservation in Ladakh

In the last decades, efforts towards the conservation and restoration of architectural heritage, and material cultural heritage in general, have increased in Ladakh. Nevertheless, there exists no policy structure for addressing the preservation of cultural heritage or for regulating interventions for its restoration. It is not unusual to find historical constructions that have been demolished and replaced by new ones. These acts are often prompted by good intentions to ‘renovate’ a degraded building, or improve it, and not solely out of a lack of socio-cultural and historical knowledge of a more complex discourse on material heritage. There are several national and international organizations as well as other institutions that have worked on the architectural and artistic heritage of Ladakh. The most widely recognized ones include INTACH (Indian National Trust for Art and Cultural Heritage), the Archaeological Survey of India, Achi Association, Tibet Heritage Fund, and HCHF (Himalayan Cultural Heritage Foundation). Interventions on material heritage in Ladakh have been fragmented and are of extremely varying degrees of quality partly due to the absence of a local policy and regulatory body, and partly because over the years restoration works have taken place in an arbitrary and piecemeal way.

1.3. Achi Association

Achi Association is one of the organizations actively working in Ladakh. It was founded in the 90s by individuals and scholars dedicated to the preservation of Buddhist heritage, mostly specialising in the early art and architecture of the Himalayas. Achi’s approach has always been interdisciplinary, unifying specialists from Europe and India who combine in-depth research with hands-on preservation (archaeology, art history, painting and architectural conservation). Because of the well-known lack of regulatory policies on material heritage, Achi’s main efforts have been directed towards preserving unique pieces of art and architecture, for example the Lotsava Lhakhang in Kanji, different interventions in the village of Wanla, or the fort in Skyurbuchen. For more than 20 years, the association has given priority to the most ancient and unique artefacts that risk being lost forever.

2. The Conservation of the Dukhang Yokma

An interesting opportunity emerged in 2018 for Achi that was different from previous projects on Ladakhi cultural heritage. This new occasion was fostered by Nubra’s local authorities and their concerns about a series of historical buildings in the valley. Among these constructions, a small temple (dukhang) had long fallen into disrepair. The particularity of this building lay not just in its intrinsic artistic value or rarity, but in the fact that for the first time, local authorities demonstrated interest in mobilizing public resources for a project centred on a careful conservation initiative. Achi India was appointed to lead this endeavour. The initiative began in 2018, while the major intervention took place in 2021, with long-lasting interruptions due to seasonal pauses as well as the Covid-19 pandemic and completed in 2022. This very complex process took place with the help of several national and international collaborators and often through digital communication and remote coordination due to the difficulties of working in such a remote site.

Fig. 1. The dilapidated roof of the Dukhang Yokma (middle ground) and the main monastic complex in the background.

2.1. Preliminary analysis: structural issues and oral history

The temple was initially surveyed by Achi in 2016 and another research campaign was conducted in 2018 to analyse the structural issues of the temple together with a detailed documentation of the oral history on the temple’s founder and related construction activity. The study of the oral history regarding the temple’s foundation was carried out with a series of interviews in three villages, directed to understand the monastery construction and the life of its founder, Danma Trulku. Several elders from these villages recounted anecdotes from their personal or their parents' lives which were documented. The study also focused on a folk song that is still widely known in Ladakh today, and is about the founder and his personal life in relation to the Ensa dukhang.

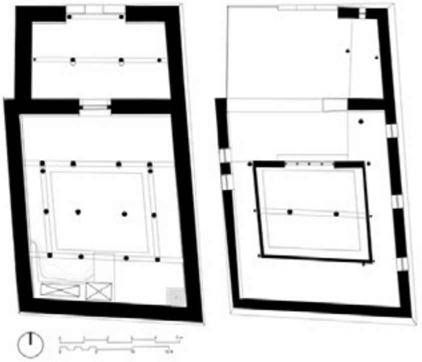

Fig. 2. Ground floor (left) and first floor (right) plans. Image credit: Hilde Vets architect.

These missions were helpful to understand the reasons behind the early damage of the foundations. This damage took place not long after the construction (approximately early 20th century), along with a steady and progressive instability of some of the main masonry sections of the temple. Following a series of geomantic speculations, the monk Danma Trulku (founder), decided to place the statue of a protector deity in a depression near the older monastery in order to prevent negative influence towards the village of Panamik, on the opposite side of the valley.

According to the monk, it was necessary to erect a small temple to host the sacred object. This is the reason why the temple, as compared to most of the local buildings, rises in a very inappropriate location for construction (Fig. 3). This concave area is prone to water accumulation due to the presence of a natural underground spring. In the past, water coming out in winter was freezing in layers and slowly flooded the porch, thereby damaging the mud mortar in the plinth. The damage caused a progressive bulging of the foundation of the highest wall, and the temple started an unstoppable rotatory and shifting process.

Fig. 3. The Dukhang Yokma seen from Panamik (centre).

Fig. 4. Main entrance and porch. The temple started to shift from this corner at the base of the walls (North-east).

This shift firstly involved the porch and the room above it, which dragged all the rest of the structure towards North (Fig. 4-5-6). Oral accounts reported that this process began early after the construction, until large cracks appeared. The upper room on the first floor was completely dismantled as a precaution measure (Fig. 4), and the deity statue inside the temple was also removed. The temple quickly decayed, especially in the last 20 years.

Fig. 5. Bulging plinth with eroded mud mortar (North-east).

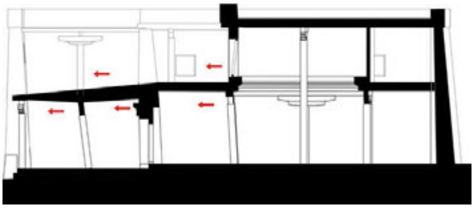

Fig. 6. Vertical section North-South (2016). The structure progressively shifted towards North. Image credit: Hilde Vets architect.

2.2. The conservation initiative and its several constraints

Only in 2021, the local authorities in Nubra secured public funding for the conservation and partial reconstruction which had to be swiftly employed before the end of the same year. Achi paired its expertise and also the work of volunteers in order to execute the project. Time was a major constraint for the project (the building season only lasts from May to September), as well as the formation of a working team of experts and craftspeople for the execution of the project. Moreover, in spring 2021, there was a paucity of building materials because of the rapid re-start of construction activities after almost two years of interruption. Regarding the temple's position, Ensa lies very close to the line of control, thus being very distant form all major urban centres in Ladakh.

Since the temple is surrounded only by steep rocky slopes, any material apart from stone which can be quarried not far from the site, should be brought from other locations. The vehicular road ends 300m lower than the monastery premises, thus all materials brought there by truck have to be carried by hand to the site. For this reason, apart from the well-known time limits, there were several logistic impediments to the successful completion of the project.

Fig. 7. The severely damaged, tilted, and detached walls on the first floor of the temple's chamber (North-west corner).

2.3. Solving structural issues: a hands-on and experience-based approach

This section presents a summary of the works that were carried out in three phases. The coverage is too short to present all details, thus the main focus is on phase two and the solution of the main structural issues, which included the straightening of the existing tilted inner structure of the temple. In phase one, the whole porch was dismantled until the foundations. A new and deeper trench of 120cm depth was dug (the original was often only 30 cm or less).

Fig. 8. Reconstruction of the porch with new dry-stone foundations.

All of the three walls were rebuilt utilizing the older material integrated with larger stones taken from the mountain to form a stronger plinth and better interconnections for the corners. All masonry that was underground was rebuilt with the dry-stone technique (Ladakhi: *skam rtsig*)[1] to avoid any possible erosion of the

[1] A stone wall built without mud mortar (Ferrari, 2021: 70).

mortar at the base. New walls were rebuilt of the same size (120 cm at the base), only enlarging the one on the western side which had to be increased due to its original thickness (60 cm only) and with an average batter on the external side of 10-12°. The main stabilisation of the wall painting was also carried out during this initial stage. With the new porch walls in place, phase two of the project could commence. Phase two brought forth the most challenging structural issues of the building, which were related to straightening the two-storey structure inside the inner chamber of the temple (Fig. 9).

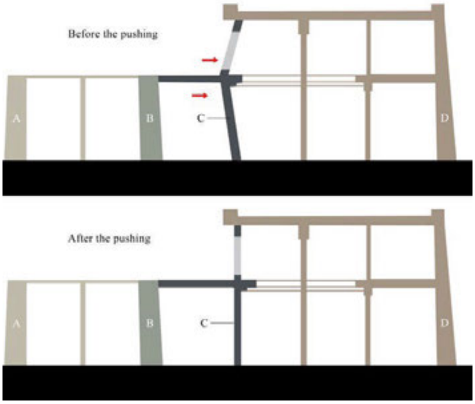

Fig. 9. Schematic view of the structural intervention concept. A - rebuilt porch (phase 1); B - tilted wall of the entrance with paintings; C - mixed structure on two storeys with paintings (phase 2); D – rest of the temple (phase 3).

This section is constituted by a mixed material structure. On the ground floor, there are four wooden columns with capitals, topped with wooden beams and a composite frieze of wood, mud bricks, and stone. While on the first floor, is a thick wall of mud bricks (50-60cm) and stones with a large wooden sky light/window (Ladakhi: *rgyam thong*) (Fig. 10). The main challenge was to preserve the integrity of the mural paintings on the first floor during the pushing and repositioning of the entire two storey structure. This meant that it was not possible to simply dismantle the wall and roof above it, straighten all wooden ground floor structural elements, and rebuild the masonry on top of it. This two-storey mixed structure had to be pushed entirely, while still attached to the rest of the temple, avoiding any collapse in order to save the murals.

Fig. 10. Tilted wooden opening on the first floor (left); covering the paintings with a protective cloth near the wooden window (right).

Fig. 11. One of the main beams slid 25cm outside its original position (North-eastern corner).

Before this operation could take place, a temporary structure had to be installed to guarantee a safe and successful operation.

This work took a considerable amount of time during phase two and consisted of: creating a composite wooden beam in three pieces propped on all sides to support the roof in between the main temple's door and the inner chamber (Fig. 12); erecting three high wooden composite props with supporting beams (9m) for the roof of the inner chamber (Fig. 13);

building a wooden frame for the projecting beams above the skylight (*rgyam thong*) (Fig. 14); fitting temporary shutters made of plywood fixed with steel rods crossing the wall through its cracks in order to stabilize the mud brick structure for the time of the pushing and avoid any severe damage to the walls and paintings (Fig. 14); and inserting a pushing system made of wooden members attached to hydraulic jacks for the mechanical straightening of the structure (Fig. 15-16).

Fig. 12. Temporary beam at the entrance of the chamber.

Fig. 13. Composite props of pre-cut timber and local poplar.

Fig. 14. Installation of plywood panels to temporarily lock the mud brick and stone walls with paintings. In the centre, a series of props are put under the cantilevered poplar beams.

Along with these preliminary works it was necessary to insert cantilevers under some of the beams resting on the entrance wall once all of the beams in the walls were uncovered (Fig. 17).

Fig. 15-16. Installation of the props with hydraulic jacks (left). Fixing a temporary load distribution timber frame on the columns and beams (right).

This operation was mandatory since the tilted stone wall could not be straightened back to its original position. The reason is that by pushing these beams back towards the inner chamber, many of the wooden elements would have fallen outside the wall edge that could not be shifted with them.

Fig. 17. Placing cantilevers under some of the beams of the entrance hall and fixing them to the stone wall.

Fig. 18. Insertion of wooden tie beams (*sket shing*).

Other works carried out in phase two were: the construction of dry stone foundations for the pillars in the porch (not existing before) (Fig. 8); the insertion of wooden tie beams (Ladakhi: *sket shing*) inside the porch wall (not existing before) (Fig. 18); the erection of new walls for the first floor room above the porch, the reconstruction of one of the lost wooden windows of the first floor based on a model of its symmetric window found on site, the new design and making of a wooden window frame with composite beam for the traditional Ladakhi balcony (*rab gsal*)[2] for the room on the first floor (based on similar examples of the same age in Nubra); the addition of a large dry stone staircase to access the building from the main terrace, and the reconstruction of a small stone stair for the porch. Phase two was successfully completed after the straightening of the two-storey structure (Fig. 19).

Fig. 19. Tilted structure with prop (left). The unpainted part of the beam marks the extent of the rotation of the column. The structure after it had been straightened (right).

Once the tilted structed was brought back to its original position, it was possible to complete the building with the roof on the main entrance and constructing the walls and ceiling of the room on the first floor above the porch. Phase three was the last stage, and involved the completion of the reconstruction process and most of the finishing works. This phase included: the reconstruction of the upper wall section on the Eastern side of the temple and its three windows; the complete reconstruction of the temple's roof with an appropriate slope (2%) for drainage. A waterproof sheet was added between the earth layers of the roof since nowadays roofs are not commonly maintained as they should. The damaged wooden beams were substituted and additional new beams were added to improve the overall strength of the horizontal structure. Water spouts made of local slate were also added since no gutters were previously inserted inside the parapet, causing water infiltration inside the temple's walls. The mud brick walls on the first floor around the chamber were reinforced with a double wooden tie beam and extra wooden columns in the corridor were added around these walls. In addition, a wooden skylight window was lifted and realigned, cracks in the mud brick walls were stitched, the parapets were rebuilt, and the outer and inner walls were replastered and white washed.

Fig. 20. View of the white-washed reconstructed porch and upper room with balcony (North-western side). Image credit: Javed Hanif architect.

Fig. 21. View of the white-washed reconstructed porch and upper room with balcony (North-eastern side). Image credit: Javed Hanif architect.

4. Conclusions: Considerations on the approach

Due to the very short time in which the project had to be planned out and executed, and the difficult conditions in which the team worked, most of the decisions were taken on site and problems were dealt with in a hands-on manner and almost exclusively without the use of architectural drawings. The temple was originally built by a group of non-expert volunteers from

[2] A large window paired with a balcony (Ferrari, 2021: 55).

nearby villages and only by eye. For these reasons, the reconstruction was undertaken in a way that was visually harmonious with the existing building. Where possible, the newly constructed structural elements were improved. This meant decreasing the overlapping of vertical joints among stone courses, employing larger stones at the base of the walls and using longer stones at the corners, drastically reducing the amount of mud mortar where not necessary, and improving its cohesion qualities by mixing the local silty soil with higher quality clay coming from a nearby source by the river bank in the valley, and adding wooden tie beams to better distribute the loads within the masonry. Overall, the construction was almost completely carried out by hands, with minimal use of mechanical or electricity powered tools. This meant relying heavily on craft skills, or in some cases, challenging the team's knowledge and experimenting new empirical ways to resolve unexpected issues which constantly emerged onsite. In this case, the possibility of engaging with craftspeople that had inherited and were trained in a traditional knowledge system facilitated the conservation process (Diodati, 2016: 232). As Marchand (2008: 257) argues, creativity in many traditional building crafts centrally involves engagement in the physical 'making'. For this reason, the finished architecture unfolds in these processes, whereby the craftspeople are merged with the material object in a hands-on interaction over time. In this way, a building, like the tools used to make it, becomes the extension of the masons' unfolding idea.


Fig. 21. The terrace. Image credit: Javed Hanif architect.

Since this was the first time that the local administration secured funds for a conservation project, Achi members understood early on the importance of carrying out this work, not merely for the historical value of the temple, but as a way to exemplify what for Achi Association is a respectful conservation project. In this case, much attention was dedicated to solve irreversible structural issues by employing local materials and know-how. Moreover, team members were fully aware that even more recent buildings like the Dukhang Yokma (and not only very historically significant ones) should be given the rightful attention. This is necessary if a wider audience were to be engaged and made aware of the value of both tangible and intangible heritage, and thus on how to approach the unavoidable decay of local material objects. The project was not only aimed at the preservation of a historical structure, but also at the documentation of its oral history and at the valorisation of traditional craft skills through the conservation works process. This experience was crucial for demonstrating that it is possible to intervene even when time and material resources are very scarce and no current policies are in place for the preservation of cultural heritage.

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The *hórreos* in Riaño Mountain, León, Spain. Vernacular architecture between conservation and musealisation

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
Hórreos, aerial or raised barns, constitute a very singular typology of vernacular architecture. The guardianship of Spanish hórreos began with their recognition as personal properties in 1926. In 1973, all the hórreos and paneras in Asturias and Galicia were placed under state protection. Later, the autonomous laws included its preservation. In 1984 an order that protected the Leonese hórreos was approved. However, this legislative protection was useless when the Remolina reservoir, which flooded several towns in the region of Riaño Mountain – León, Spain – was built in 1985. The value of traditional architecture and the hórreos in the villages of the Riaño Mountain was claimed by architects such as Leopoldo Torres Balbás or Manuel Cárdenas. The disappearance of many of them has meant an irreparable loss of a unique type of vernacular architecture. When it came to deciding which elements should be saved from the destruction caused by the reservoir, vernacular architecture was neglected. One of the hórreos was dismantled and remounted in Nuevo Riaño, the new settlement built to replace the disappeared village. Isolated from its context, it became a museum element, perceived as a cultural relic. At the beginning of the 20th century, the council of Riaño became aware of how valuable these elements are and proposed the recovery of the constructive techniques and traditions related to Leonese hórreos. In 2014 a new one was built and placed in Nuevo Riaño square. Surrounded by buildings that have nothing to do with the vernacular architecture in the territory and decontextualised, it is perceived as something beyond to the present days. Today, 142 hórreos are preserved in Riaño Mountain and they must be kept as something more than cultural relics and, additionally, the constructive traditions linked to them must be preserved.

Keywords: *Hórreos; vernacular architecture; conservation; wooden architecture.*

1. Introduction. *Hórreos*, a unique vernacular architecture and a specific preservation problem

Hórreos constitute a very unique typology of vernacular architecture. These raised barns are preserved in different parts of the world and in the Iberian Peninsula they are located in Galicia, Asturias, Cantabria, the Basque Country, northern Castile-Leon and Portugal. They have remained in Spain mainly (Carlé, 1948) and are characterised by their local features, so they might be defined as local and localist buildings (Cantero, 2019, p. 2). Since their origin, they have maintained a function related to the storage of alimentary products, although they have also been used as housing or workshop. Such versatility could be the key to its functional recovery, as it will be explained below. The Leonese *hórreos* appear in the mountainous areas, especially the eastern ones, connecting with the Asturian ones, although their conservation has been minor.

The process of patrimonialization and guardianship guidelines are different between autonomous communities, but in Galicia, Asturias and

León there are some common points: the prohibition of their removal and the ban of interventions that are not subject to the control of the institutions responsible for property protection. It also regulates the construction of new specimens, which must follow the guidelines and techniques of traditional building. Currently, there is a debate between the search for a functional recovery or its maintenance as fossilized objects, lacking any other functionality than that of constituting a kind of cultural relic of high landscape value, following partially the thesis arguing that *hórreos* can be considered as relics that would have perpetuated stilt architectures (Frankowski, 1918, p. 143). The image of the *hórreo* as testimony of the past and as an identity element has determined the way in which its conservation has been proposed and, paradoxically, has contributed to its disappearance.

2. Riaño Mountain and Remolina reservoir

The region of Riaño Mountain is a historical district located in the northwest of the province of León, Spain. The valley of Riaño is located in this area and its capital, Old Riaño, was its administrative and social centre. The region included the municipalities of Acebedo, Boca de Huérgano, Burón, Crémenes, Oseja de Sajambre, Posada de Valdeón, Priorio, Maraña and Riaño. The value of its traditional architecture was claimed by Leopoldo Torres Balbás, who emphasized the value of their *hórreos*, which still kept their thatched roof (Torres Balbás, 1930). His study was accompanied by drawings by the architect Manuel Cárdenas, which together with the photographs preserved in the Institute of Cultural Heritage of Spain, constitute documents of great value to bring us closer to that legacy. Their disappearance has prevented this analysis from being completed (Rubio y Valderas, 1990, p. 75) and has meant an irreparable loss of examples of a unique type of vernacular architecture, since before this area was flooded, eighty *hórreos* were preserved (López García, 2007, pp. 51-52).

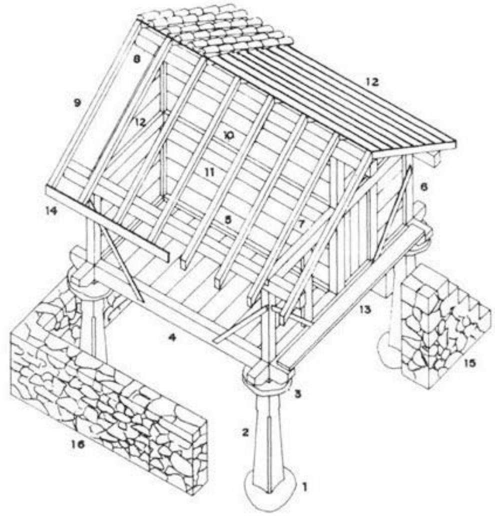
Fig.1. *Hórreos* in Riaño between 1922 and 1936. Photographic library of the Institute of Cultural Heritage of Spain. Ministry of Culture and Sports. Archive Wunderlich number of inventory WUN-07347.

The project for Riaño reservoir, or Remolina reservoir, was proposed at the beginning of the 20th century, but it was delayed and finally completed in the 1980s. This was the last high mountain dam to be built in Europe and began to operate on 31 December 1987, the day before the European Community legislation on environmental impact came into force, fact that would have made it illegal.

3. Hórreos in the valley of Riaño

3.1 Features

The *hórreos* in the valley of Riaño are integrated in the group of those spreaded across the northwest of the province of León. Some authors consider them a variant of the Asturian hórreos, while others are drawn to the Cantabrian-Basque ones. They are smaller than Asturian raised barns, with a square floor plan – although some cases reveal a slightly rectangular base – and can present gabled or hip roofs. Normally, these architectures rest on four supports, although some of them are based on six, and their height varies between 1.50 and two meters (Casado, 1980, p. 139). They were mainly built with oak wood and the *pegollos*, or supports, could be built with the same material or stone.



1.- Solera. 2.- Pegollo. 3.- Toma-ratas. 4.- Trave. 5.- Viga media. 6.- Cantonera. 7.- Sobre-trave. 8.- Viga cumbre. 9.- Cabio. 10.- Viga divisoria. 11.- Tabique divisorio. 12.- Tablero. 13.- Tanobia. 14.- Mandril. 15.- Escalera acceso. 16.- Muro delimitador.

Fig. 2. Axonometric diagram of an *hórreo* with a gabled roof in the Valdeón Valley and its main elements (Source: Luelmo Varela, 1995).

A very peculiar feature of this group of *hórreos* is the worked shape in the heads of the support beams, with quarter moulding planes, decoration that is especially common in those that present hip roofs. The body of the structure in the oldest aerial barns is composed by roughly squared trunks or planks placed horizontally and dovetails in the corners, also articulated by square section wooden supports. Exceptionally, the plank has a vertical layout. Access to these structures is made by stone stairs. If they have more than one owner, they have two different entrances. Two-sided roofed *hórreos* originally had a vegetation roof, which has now been replaced by Arabic roof tiles (García Grinda, 1991, pp. 38-39). Since they are linked to domestic tasks, meetings and complementary works – such as tool arrangement, slaughter tasks, etc –, *hórreos* are located in the surroundings of the dwelling, constituting an architectural group.

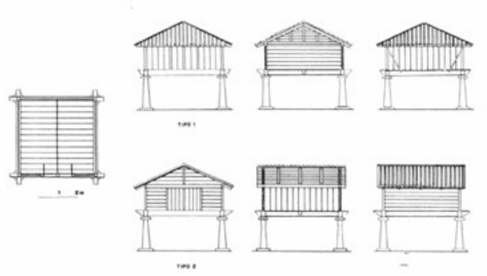


Fig. 3. *Hórreos* in Valdeón. Valley. Elevation, floor plan and section. Drawing (Source: Luelmo Varela, 1995).

3.2 Functional changes and degradation

Since the middle of the 20th century, an economic change that imposed livestock farms on those of cereal cultivation began, and *hórreos* started to lose their granary function. In addition, building materials became more expensive (González Arpide, 1987:341) and finally traditional trades were lost. For all these reasons, *hórreos* suffered a progressive abandonment, which became critical in the final decades of the century. The few ones that remained were transformed into a warehouse and storage room or tool store. In the specific case of the town of Riaño, the threat of the closure of the reservoir caused the degradation of the vernacular constructions and, finally, the demolition of its precious and unique specimens.

The villages in Riaño Valley were destroyed prior to the closure of the reservoir in July 1987 and, despite the fact that the Spanish Heritage Law of 1985 indicated the value of the ethnographic and traditional heritage, it was only decided to save five buildings, all of them related to religious, palatial and school architecture (García Cuetos, 2020). Two hórreos were rescued from Pedrosa del Rey, but only one was officially recovered, dismantled in the town of Salio and recovered in Riaño, next to the monument *Silencio de las Campanas* (Silence of the Bells), which aims to pay tribute to the disappeared villages and their inhabitants. This structure houses the bells of the destroyed churches and includes the following inscription: *These bells, in remembrance of all the churches in the valley, as well* *as the hermitage of Ntra. Sra. de la Puerta and the Hórreo in Salio, moved and rebuilt here, are the symbol of the collective memory of a people materialized in its vernacular architecture and represent the permanent tribute and recognition to the generous sacrifice of its children for the benefit of many in memoriam 1989-1996*

Fig.4. Leonese *hórreo* from Salio dismantled and remounted in Nuevo Riaño (Source: Pablo Herrero Lombardía).

As explained, reference is made to the lost heritage and it is specifically mentioned the vernacular architecture that was devastated and of which only one sample was preserved, placed next to the monumental landmark as a sculpture or a heritage relic. The *hórreo* from Salio cannot be perceived in any other way due to its decontextualisation, the isolation in its disposition and the memorial environment in which it is inserted. It may be concluded that there was not a real interest in preserving the legacy of the singular buildings that hórreos meant in Riaño Valley.

In the 1980s, due to the development of the autonomous governments and the vindication of their own identities, an interest in traditional culture was generated and *hórreos* began to be integrated into publications on the subject (Álvarez Rubio, 1982). In fact, between 1981 and 1982, a census of the *hórreos* in Castile and Leon was carried out (González Arpide, 1987). The conclusions in this census, therefore, refer to 1982, prior to the destruction of the samples in Riaño valley. In that document, it was already mentioned that the conflicting interests of the owners and the Administration, and the bureaucratization supposed serious obstacles for the conservation of Leonese *hórreos*.

The density of *hórreos* is currently located in the areas of Valdeón and Sajambre, after the loss of those located in Riaño valley under the waters of the reservoir. Priorio is one of the centres where a peculiar group of hórreos displayed in row, similar to the disappeared one of Riaño, is preserved (Saiz Guerra, 2012).

Fig.5. Tour of hórreos in Riaño Mountain. Riaño Council.

4. Difficulties for preserving *hórreos* in Riaño Mountain. Experiencies and proposals.

In 1973, the Order that established the protection for *hórreos* and *cabazos* located in Asturias y Galicia was aproved. The criteria justify that guardianship were based on the following idea: these buildings *constitute characteristic samples of the localness and the popular* architecture in both territories as well as on the will to reverse the process of disappearance and degradation of these elements. It was established that all *hórreos* and *cabazos* over a century old, and regardless of their state of conservation, should be protected to prevent their demolition and any possible intervention that could alter their configuration. Likewise, the owners could not transfer them or initiate any intervention on them without the required permission from the Ministry of Education and Science. These guidelines determined the current debate on the future of *hórreos*, which focuses on the issue of their use as well as on limiting the use of non-traditional materials, adding functional elements - such as gutters-, and the need for approval from the competent authorities to carry out any work on these elements. Its survival is evident in subsequent legislation. In 1984, the Junta de Castilla y León approved a decree that protected all the *hórreos* in the Community under the figure of Properties of Cultural Interest. The following year, the Spanish Historical Heritage Law (1985) was approved, recognizing the testimonies of vernacular architecture as an integral part of our cultural heritage. The Decree 69/1984 meant the implementation of the criteria established a decade earlier and points out that *hórreos* and *pallozas* are elements linked to typism fundamentally: *they give to the rural environments of certain provinces of our Autonomous Community a peculiar physiognomy, constituting characteristic samples of the localness and the popular architecture of the territories in which they are located*.

Likewise, it is possible that the massive destruction of the *hórreos* preserved in the villages flooded by Riaño reservoir in 1987, had the effect of implementing measures for the protection of those still standing in other areas of Castile and Leon. A pilot programme for the restoration of Leonese hórreos was initiated and implemented in the territory of Valdeón. Five intervention campaigns were carried out between 1988 and 1992 (Luelmo Varela, 1995), under the supervision of an architect. These campaigns were conceived as work camps. It was opted for the criterion of minimal intervention and damage repair, avoiding the replacement of parts. In the event that one was partially damaged, the damaged fragment was replaced. Protective products were also applied to the wood. In addition, efforts were made to maintain the tradition of the trades that had survived and the way of acting that had been documented since the 1950s in the valley. The architects considered that the conservation of a living architecture was being addressed, so it was a matter of carrying out a maintenance as the artisans had always done, using at all times the available technologies (Luelmo Varela, 1995, p. 19).

Fig.6. Restoration of one of the hórreos in Valdeón (Luelmo Varela, 1995).

It was also suggested that, in case of making use of other means, which were defined as more purist, the precedent of excessively costly processes could be set, preventing owners from maintaining the initiated dynamic. To carry out rehabilitation operations, the chosen samples were the oldest ones together with those that presented building systems considered ‘unique’ (Luelmo Varela, 1995, p. 19). In the reproduction of pieces, formal analogy was used and contemporary materials were introduced, such as steel points for piece joints and factory ceramic tile for the roofs. In conclusion, specific criteria for architectural restoration were introduced, such as the rejection of the mimetic restitution of damaged or missing elements and, although local artisans were incorporated, the truth is that unaffiliated elements with that tradition were introduced. The applied criteria may be described as questionable, since they alter the fundamental authenticity of vernacular architecture, based on the transmission of trades and the use of traditional materials.

However, account has to be taken of the fact that architects noted the disappearance of traditional trades and the lack of knowledge among carpenters about vernacular assembly techniques. They also concluded that hórreos had been degraded both by the loss of their original function and by the integration of new uses. They had been reused as warehouses and their lower space was used as a garage or clothes dryer, although these functions were inherent to the evolution of hórreos over the last centuries. As an alternative, the use of restored *hórreos* as an element of occasional support to the local innkeeper offer was proposed as an accommodation designed for visitors with limited budgets, so that the low profitability achieved would enable the owners to meet the maintenance costs. This initiative did not end up crystallizing and only two of the restored hórreos were occupied. The local population perceived the established guardianship in a negative way, while project leaders noted the need to encourage a change in the mindset of property owners. The culture of conserving structures that constituted a distinguishing heritage - that were liable to be appreciated by quality tourism - should be imposed and reflected in the model of the Alps or the Pyrenees (Luelmo Varela, 1995, p. 7). The open debate in the 1980s is still alive and closely related to the use that can be made of *hórreos*.

In 2021, the Castile-Leon regional government published the last terms of the call for grants for the restoration of traditional architecture in León. Having abandoned the criteria of the end of the 20th century, the call establishes the need to carry out interventions using traditional techniques and materials. It also specifies that the structures must maintain the uses and functions for which they were built. Thereby, the loss of functionality of hórreos as granaries in the context of a marked transformation of the economy in rural areas generates a problem parallel to that observed in Asturias and the danger of the musealization of hórreos persists at the base of this conservation policy. Another important aspect is that the prior approval of the technical document by the Territorial Commission for Cultural Heritage remains mandatory. Thus, the recovery of traditional techniques and trades and of the uses of the systematic repair and maintenance of these vernacular constructions are subjected to the same discretion as those of the monuments. The complexity of the technical documents to be drawn up also acts as a deterrent to owners, as was also evident in the Asturian case.

Fig.7. Newly-designed *hórreo* in Cimadevilla de Riaño square. Photograph by Pablo Herrero Lombardía.

In the 21st century, the desire to recover vernacular culture has crystallized new initiatives. The Riaño Ethnographic Museum was inaugurated in 2004 (Díez, 2019, p. 57). One of its objectives has been to recreate lost traditional lifestyles and crafts. Subsequently, a newly-designed *hórreo* was built in Cimadevilla Square, next to the museum. The structure was built by a local company, in oak wood from the mountains in the valley and the installation was completed with the placement of an explanatory panel on the characteristics of the Leonese *hórreo* and with a map proposing a tour of the preserved samples. Curiously, this information was not installed next to the original *hórreo* coming from Salio and installed next to the monument of the Bells.

5. Conclusions. State of the debate on the conservation of *hórreos*

Hórreos have become an ethnic-identity symbol in the territories where they have been preserved and the criterion that they should be preserved in their materiality, regardless of the loss of their real function, is maintained. It tends to be accepted that *hórreos* should be preserved as cultural relics, as testimonies detached from the social, material and community context in which they were born. However, alternatives may be considered: the functional recovery as well as the recovery and restitution of their values to the society and the community in which they are integrated, laying the foundations for a correct process of patrimonialisation, based on the recovery of the community will to preserve them. But it is not just about materiality. *Hórreos*' building and maintenance are linked to the heritage of traditional trades and, given their progressive disappearance, it is necessary to promote their revitalisation and also to establish a unification of criteria when intervening in this heritage. Another very interesting aspect is the context in which these structures are situated. After the hórreos have basically maintained their traditional configuration, the rural housing that accompanied them has evolved in recent decades. It is usual to see them inserted in an environment of buildings remodeled or replaced by others of contemporary conception. The need to maintain a suitable environment for hórreos clashes with the aspirations of housing modernisation and even expansion. In fact, in the first interventions in the 1980s in order to allow a renovation of the houses, it was proposed that the transfer of *hórreos*, which could be grouped in lands of communal or municipal property, could be allowed (Luelmo Varela, 1995). Obviously, this is a solution that breaks the relationship that gave rise to the housing-barn binomial and that also alters the composition of rural centres. The displacement and regrouping of *hórreos* would contribute to their conversion into relics and musealised testimonies of a denatured vernacular culture and at the service of a tourism of false approach to rural and traditional environment.

If *hórreos* constitute an architecture that, in its very origin, could accommodate different uses, from barn, to warehouse and even housing, recovering that versatility is presented as the only alternative to maintain not only the structure, but their community and identity values. I agree with Ana Sofía Ribeiro on the fact that it will be precisely the simplicity and functionality that characterise this architecture, which makes it possible to adapt to new functions and make it permeable to a new integration in the set of contexts to which they belong (Ribeiro, 2016, p. 35). This new vision is being progressively imposed and, therefore, a framework document of recommendations on the management of heritage assets of ethnographic nature, expressly referring to *hórreos* and *paneras* has been drawn up in Asturias. This reflection addresses the two fundamental questions: the use of non-traditional materials and techniques and new uses. The conclusion, debated, is that both practices contradict the idea of living heritage and clash with the reality of *hórreos*: *Trying to prevent this dynamism in the current situation is to go against the traditional practices of the hórreo and not to recognize that versatility has been one of its main characteristics* (Cantero, 2019, p. 16). It is proposed to break with the archaeological criterion that would have prevailed in the conservation imposed on the hórreos.

This reorientation of the debate takes into account the new needs of rural society, the possibility of equipping hórreos with housing use, the addition of elements such as gutters, etc. It is intended to break with criteria that prevent *hórreos* from being considered as heritage in use and that, therefore, may experience a process of reuse. We can see that, despite the strict conservation criteria, the truth is that *hórreos* are a well-known and appreciated element in a superficial way. The vocabulary related to its elements is unknown, local and regional variants are not identified and the loss of traditions and trades linked to them has occurred. The alternative for the future of *hórreos* must be based on uniting the initiatives of diffusion and heritage restitution with the interventions that would allow them to maintain a function that, like the case of any built heritage, facilitates its conservation. The revival of traditional trades, which can be an opportunity to generate employment linked to them, must also be includeded.

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Restoration project of vernacular architecture affected for ground subsidence: A case study in Juslibol Church (Zaragoza, Spain)

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Topic: T4.1. Conservation and restoration projects of vernacular architecture.

Abstract
At the request of the Archbishopric of Zaragoza, an exhaustive study of the situation of the parish church dedicated to the Assumption of Our Lady (18th century) in Juslibol (Zaragoza) has been carried out since 2011. It was built between 1758 and 1784. The church was built on a hillside with a medium-low slope, excavating in a loose colluvial soil formed by silt-clay materials with fragments of marl-gypsum rock. and pebbles of gravel and sand from the terrace deposits located in the highest part of the slope. Once the plot was leveled, the ground would be prepared and the foundation elements would be excavated (apparently continuous trenches) according to the design of the projected building floor plan. This church has suffered for many years from deformation and settling problems caused by the combination of several especially unfavorable factors, such as: the poor quality of the support ground, its sloped location halfway up the hillside, and leaks-filtrations from a supply network, and especially sanitation, which have favored processes of dissolution-undermining of the land below the foundations. The part facing south, including the tower, registered differential settlements with respect to the part further into the hillside. Once this situation was assessed, it was underpinned by means of jet-grouting columns and, apparently, the measure was effective. However, the cracks now observed are not explained within a differential settlement process.

Keywords: *church; sloped; settlements; leaks-filtrations; gypsum; expansive salts.*

1. Analysis of the problem

Situation on the hillside

Expanding the study area, it can be seen that the problem does not fit only the church. One aspect that had not been sufficiently dealt with until now is the situation of the recognized deformations in the church, in relation to the existing cracks and deformations in the environment closest to it. From the scheme of the cracks recognized in the pavement of the surrounding streets, and the square that is in front of the main door. These are arranged towards the upper part of the slope, in consecutive discharge arches, which give meaning to the idea of a descending flow that fits well with the morphology of the cone or ejection fan of the primitive ravine.

It can be said that the problem that affects the church, in terms of the movements that it is registering at this time, has its origin in a much broader scope, which includes at least part of the slope that corresponds to the old cone of dejection of the ravine that is located right at the head.

The first discharge arch (1) is obtained by correlating the cracks observed in the pavement of the street, just at the corner of the church, in front of the tower. These seem to be directly linked to the emptying of the lot on the other side of the street.

Fig. 1. Location plan. Situation and morphological analysis of the cracks on aerial photography (Source: ©2018 Google).

Fig. 2. Location plan. Situation and morphological analysis of the cracks on aerial photography (Source: *Investigation report for the assessment of problems in the subsoil of the juslibol church (Zaragoza)*, 2014).

Arches 2 and 3 are obtained by correlating the open cracks in the sidewalk (now repaired), which continue to cross the church's street and apparently continue along the low wall of the square, towards a more open area.

Arches 4 and 5 are the ones that project towards the interior of the hurch. From the square they are easily recognizable. One of the cracks crosses it in the middle and goes through the centre of the front door. The other (5) can be seen from the square, on the corner next to the house, breaking the low wall on the church's street in 2-3 places, and projecting towards its façade where it is very evident on the wall and especially in the stone oculus. Both cracks project through the interior of the church itself, exiting through the main altar. In his case, number 3 affects the sacristy and the adjoining house (currently being demolished).

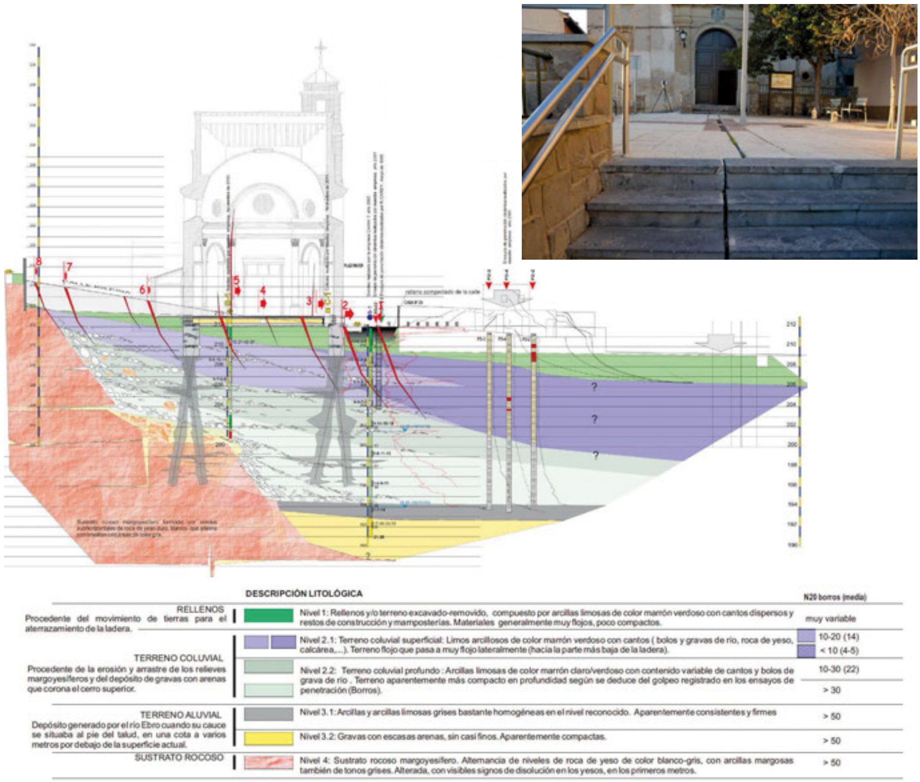

Fig. 3. Geotechnical correlation profile of all available information. (Source: *Investigation report for the assessment of problems in the subsoil of the Juslibol church (Zaragoza)*, 2014). In the photograph it can be seen the crack number 4 recognisable in the square that is in front of the main door.

Cracks 6, 7 and 8 apparently only affect the street and the old parish house, forming discharge arches towards the lower part of the slope, with the same design.

At present, it is concluded that: the process is still active. Either because the situation of the sanitation network has not been sufficiently resolved, due to deficiencies and leaks from the supply network (in the examination of February 7th, 2018, it was possible to observe, in the manhole on the corner of the church; church' street with "Calle Mayor", which was full of water). Or due to the inertia of the process in which the leaks have already established a trend and favoured channels for the infiltration of riverbed waters coming from the upper areas of the slope and/or non-localized leaks in supply and sanitation.

Fig. 4. Interior view of the church (Source: The authors, February 2022).

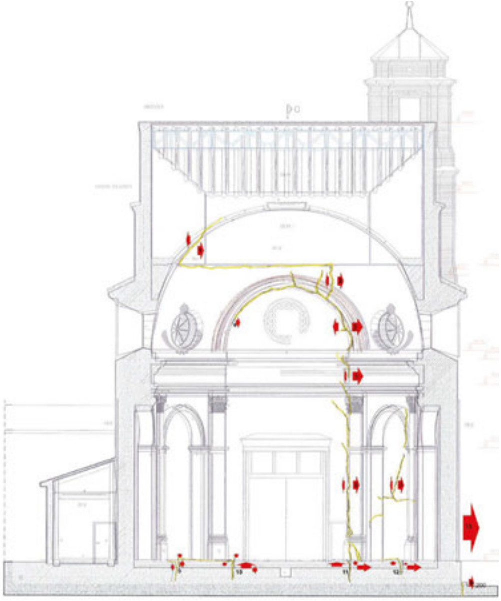

Fig. 5. Schematic profile of the main cracks and fissures that can be seen inside the church. The position and magnitude of the arrows express the apparent movement that the recognized deformation has developed. In the photograph, you can recognize some of the cracks in the part of the altar-presbytery.

Water-moisture content in the subsoil.

The phreatic level of the area is located at a depth of the order of -18.00 m. Apparently, it is associated with the coarse detrital materials of level "C" (sandy gravel from the lower terrace of the Ebro), as it has high permeability due to its high intergranular porosity. This water table is permanent and its vertical oscillations are closely linked to those suffered by the free aquifer of the Ebro river alluvial.

However, in measurements obtained in the drilling carried out, it was found that the level fluctuates a lot in this area. Specifically, in the surroundings of the church, it has been recorded at -4.00 meters from the mouth of a drilling carried out next to the south wall, taking street level as a reference. Even admitting the presence of "hanging" aquifer levels, associated with layers of greater relative permeability intercalated within the colluvial deposit, it is clearly anomalous.

The most obvious explanation relates these groundwater contributions to the frequent presence of leaks in the supply network, but, above all, from an old and defective sanitation network. The former are detected relatively early as they affect supply. But the sanitation ones remain undetected for years. Only when a sinkhole appears in the street or a façade wall or the corner of a house comes down.

One thing to keep in mind in relation to the process studied here, is that related to the abundant mud found in the layer of river bowls that was placed at the end of the underpinning and repair work on the church carried out in 1997. In the test pit carried out in November 2011, the aforementioned bowls were extracted, completely impregnated with very wet mud. This mud has necessarily had to be "injected" into this layer of bowls by a stream of water.

In addition to the normal contributions, the surface runoff accumulated by the receiving basin of the entire ravine located at the head (more than 10,000 square metres), is captured in the highest streets and channelled through the sanitation pipe (40 cm long) that goes down the street of the church. Considering the flow at times of heavy rains (storms), the relative slope (high) and the poor quality of the sanitation network in certain sections where the installation is already very old and defective (see Roads and Water Reports), it is easy to deduce the result.

It is immediate to correlate that, at certain times of intense rains, underground water infiltration occurs from the sanitation network itself, at very considerable pressures, as shown by the deep sinkholes that have been recorded for years. The water "injected" under pressure through broken pipes or with poorly placed joints, undermines loose soil that dissolves, disperses and relocates, often affecting the foundations of the closest buildings.

It cannot be a coincidence that in recent years there have been a significant number of breakdowns with chasms in the ground, located in an environment very close to the sanitation network and among them, in the high streets located just above the church.

The sanitation network around the church is made up of asbestos-cement pipes that in recent years it has been replaced by more resistant plastic-PVC pipes. However, if we look at the previous photographs, it is very clear that the very ditches that were used to lay the sanitation pipes are visibly undermined and through them, and down the slope, there is a circulation of underground water contributions with drag of materials.

Fig. 6. Supporting the previous argument, it is especially relevant to observe in the two photographs 5 and 6, the holes or highly washed areas that appeared next to the manhole and collector (indicated with an arrow). These have been filled with rubble from the excavation itself, to later proceed to pour the sealing concrete of the connection socket of the new collector with the manhole. These two points would be connected and present a clear continuity parallel to the collector and apparently towards the lower part of the church's street.

Growth of expansive salts.

As already mentioned, the differential settlement problems that had affected the building for years determined that, in 1997, it was underpinned by cement injections using the jet-grouting system. It was injected from inside and outside the church to a relative depth of -14 meters. Apparently, a sulphur resistant cement was used.

However, very few years later, deformations began to be registered that fundamentally affected the floor of the church. This began to rise forming an inner ring; a meter or so from the walls, reaching to break the floor. Control of these deformations has been carried out for more than ten years and it has been verified that it maintains a fairly constant progression. The registered relative ascents reach more than 15cm.

Drillings and reconnaissance test pits have been carried out inside and outside the church. In them, along with the remains of the cement grout injections, massive-looking materials with saline efflorescence and a gray-white colour have been recognized. Apparently "growing" from the cement inclusions themselves.

Analyses have been carried out in a specialized laboratory (Laboratory for Building Quality of the Government of Aragon) and the majority contents, within the two samples tested, of Ettringite and Thaumasite have been identified by means of X-ray refraction.

In the pit, it can be seen how these massive-looking materials, in their apparent growth, come to "force" the upper levels, generating pressures that deform the layer of gravel and pebbles and contribute to raising the floor, cracking it (Figure 8). The entire floor of the church presents deformations, with up to 15 cm of relative elevation, in an annular environment parallel to the interior perimeter of the sill.

Fig. 7. Pit nº2, (interior). Next to the foundation wall of the Church. The fractured concrete floor and the foundation are recognizable. In the second photograph, detail of the deformations of the floor. Cracks are recognized in the base of the wall due to fundamentally vertical component thrusts.

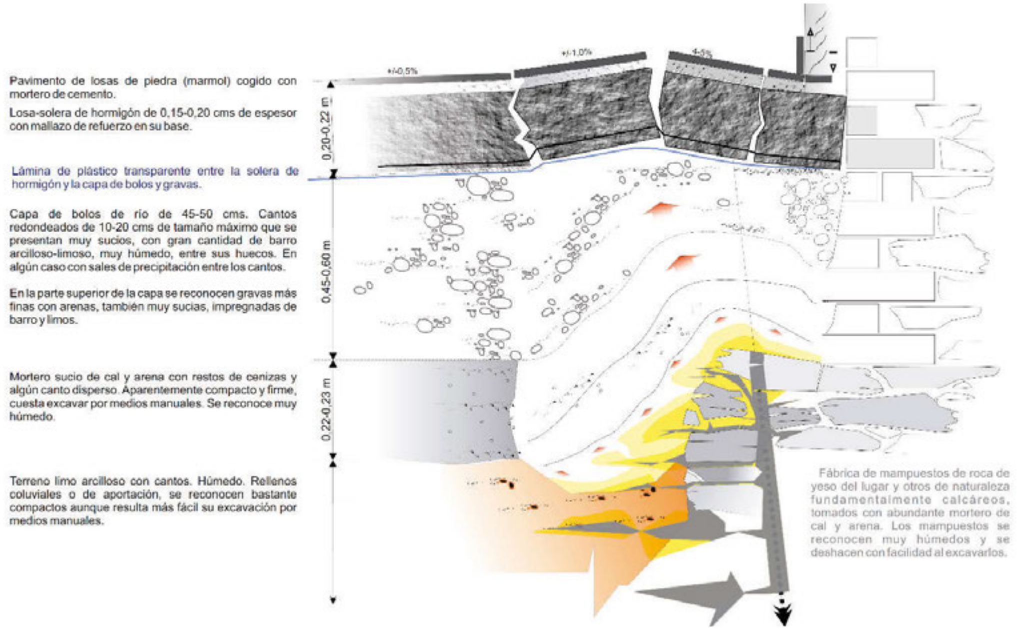

Fig. 8. Outlined explanatory diagram of the situation observed during the excavation of pit 2. The figure includes the cement grout injections, which were injected-infiltrated between the gypsum rock masonry of the very foundation of the Church walls. These gypsum rock fragments are sometimes recognized as broken and displaced; enclosed within a grey-whitish mass (in yellow).

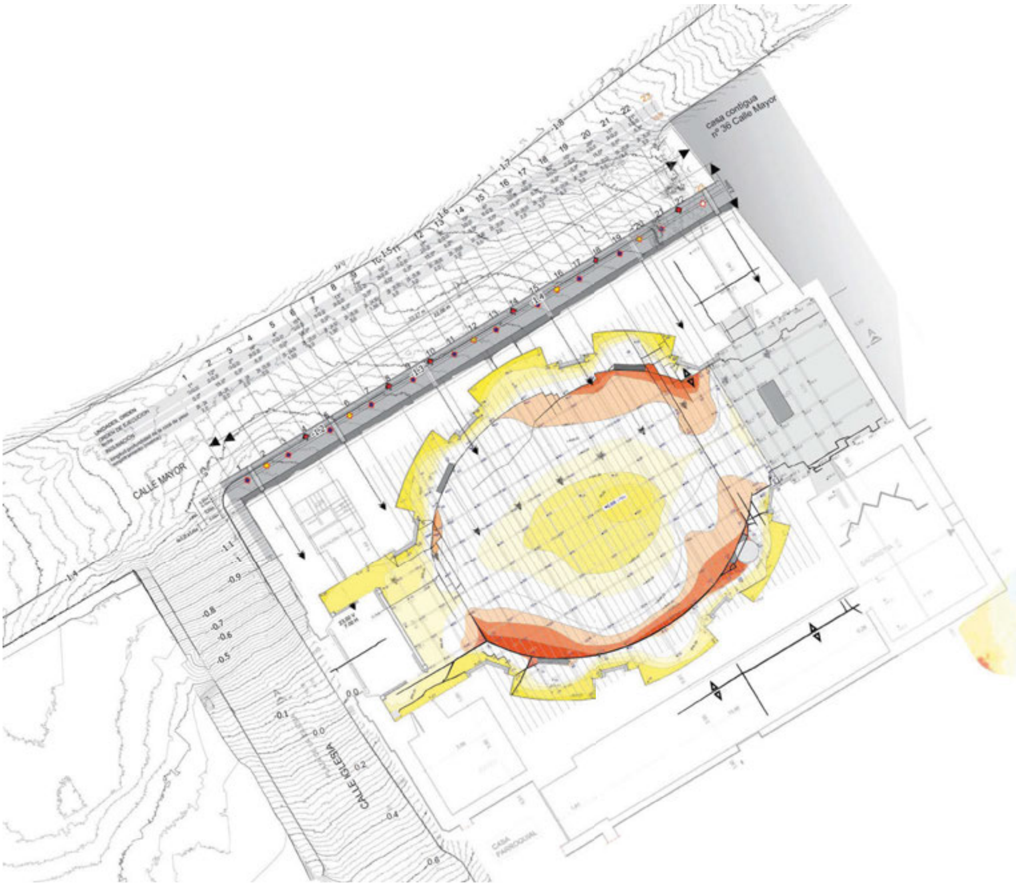

Fig. 9. Plan layout of the areas that register the greatest deformations in the floor of the church. Carried out by means of a self-levelling precision laser level, it registers the relative elevations of the floor.

2. Preliminary conclusions of the observations made

1) The cracks and fissures have a typology compatible with fundamentally horizontal relative displacements between the lateral walls (longitudinal) in an apparent direction towards the lower part of the slope. They do not indicate movements due to differential seating in the vertical.

2) Such movements have their most probable cause from pressures of hydrostatic origin of underground water infiltrated in the slope. Considering the geological-geotechnical model, the contributions that have been infiltrating fundamentally from a very defective sanitation network have generated these pressures. The inertia of the process maintains, even after partially repairing that network, the dynamics of efforts and has configured a trend that does not seem to stop.

3) The phenomenon of raising the ground of the Church seems to have a different origin. Most likely related to the growth of expanding salts under the floor. Throughout the interior perimeter, coinciding with the injections of jet-grouting carried out in the underpinning carried out in 1997.

4) Both processes are probably related and complement each other.

5) The terrain configuration; very loose towards the lower part of the slope, it favours the descent-deformation process of the colluvial land itself towards the south; towards the river valley. The cracks that affect this entire area, after performing their lateral correlation, begin to register from the upper part of the slope ("Alta" Street), so it is not a punctual effect that is concentrated in the church building. Traction cracks are also recognized from the south wall of it.

6) The process of apparent expansion that produces the lifting of the floor of the church, may also be acting laterally, favouring thrusts that contribute to "opening" the cracks in the transverse direction of the building. However, this stress system is not recorded in the longitudinal direction.

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Farmhouse interior restoration in bioconstruction

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract

The presented project deals with the interior design in bioconstruction of a family home, being a third part of the surface of an agricultural farmhouse named "Ca l'Amell", in the municipality of Premiá de Mar, in Barcelona. Founded in 1848, it is classified as a cultural asset of local interest by the Catalog of the Environmental and Historical Architectural Heritage. The purchase of the entire farmhouse has been carried out by three families through a "micro co-housing" process: they split the cost of the purchase of the entire property and then divided it into three independent units.The object of this work is the interior design of one of the 3 housing (U3), that has been carried out by recovering traditional construction techniques and materials, respecting the original character of the vernacular architecture of the agricultural farmhouses in the area. To achieve this objective the project is based on using natural and highly breathable materials (instead of synthetics) like hydraulic lime plasters, clay plasters, silicate mineral paints, recycled cotton fiber as internal walls insulation, natural waxes. Construction solutions and finishes respond to the need to control the excess of indoor relative humidity and the transfer coefficient in exterior walls, achieving a comfortable environment and taking advantage of the great qualities of the thermal mass inertia of the old vernacular constructions. At the same time, the aim was to use non-synthetic materials with a content of volatile organic compounds (VOCs)as low as possible. In the interior design project, aspects of habitat psychology have been considered too (study of color tones appropriate to the image of the farm and in accordance with the nature of the environments) responding to the need to maintain the interior warmth of the original construction.

Keywords: *restoration, bioconstruction, clay, lime*

1. Introduction

The purpose of this project is the restoration in bioconstruction of a part of an existing agricultural farmhouse located in the municipality of Premiá de Mar (30 Km north of Barcelona, in Catalonia, Spain), listed as a cultural asset of local interest by the "Catalogue of Environmental and Historical Architectural Heritage". The farmhouse was built in the mid-19th century and it was used for agricultural purposes and for cultivation of flowers. The building has a rectangular shape, with a total constructed area of 570,30 m² and it consists of a main unit in the center and two adjacent warehouses on each side. The main house is developed on two floors, and the two warehouses are developed only on ground floor, with a double height space. The main house has a gabled roof, and the sides have a single slope roof. The main facade of the farmhouse is oriented to the southeast. The building is surrounded by a garden; the whole plot of land has a total area of 1.682m².

The purchase of the property has been carried out through a "micro-cohousing" operation, by three families, who together have adquired the whole farm and took responsibility of the cost to reform common elements. Then the property was divided into 3 units (one for each family) called U1, U2 and U3.

Once the common elements were refurbished, each family commissioned the interior design of their own unit: my professional assignment and object of this work has been the development of the interior design project of Unit 3, on the east side of the farm. My task as interior designer was to detail the layout of interior spaces and quality of the finishes of Unit 3, choosing all the materials and planning for construction techniques. From the first sketch, the interior design project respects the vernacular character of the original construction (Fig.1): by my own criteria it was very logical to start proposing the use of natural materials (clay and lime plaster, stone, mud, brickwork, untreated wood), due to the intrinsic characteristics of the construction and with the goal to defend its rural and agricultural physionomy.

Fig. 1. Historical picture (Source: "Premià de Mar Historical Architectural Environmental Heritage Catalogue", 2010)

From the very beginning I proposed to introduce bio-construction criteria for the finishes, considering that the use of natural materials and traditional construction techniques is the best way to keep alive the vernacular aspect of the building I was going to renovate. For the owners (a young family with their daughter) it was very important to maintain an intimate connection between the farm and its surrounding nature.

Fig. 2. Original state of the property: interior of the main house in U3, with the wood gabled roof (Source: Li Puma, 2021)

Fig. 3. Original status of the property, with the division in 3 units: U1, U2 and U3 (Source: Li Puma, 2021)

2. Project contents

2.1 Location, layout and requirements

Unit 3 is located on the east side of the building (Fig.3) and developed in two clearly identifiable parts: the old barn (on the left side, rectangular in shape and 5x10m in plan dimensions) and the peasant house, on the right side (6x14m). The area of the barn is articulated on two levels and is volumetrically included in the main body of the property, sharing a gable roof with the other units; the peasant house is on a single level and is therefore lower than the rest of the building, and it has only a single-pitched roof. (Fig.4)

Fig. 4. The Unit 3 project: ground floor, first floor, main façade, longitudinal section. On the left side of the building: the barn. On the right, the peasant house. (Source: Li Puma, 2021)

The new interior layout of the house is composed by common areas on the ground floor (entrance hall, staircase, living-dining room, kitchen), master bedroom with integrated bathroom, dressing room, toilet; on the first floor there are two single bedrooms with bathroom, separated by a hall. The main access to the house is on the east façade. In the entrance hall, in front of the door, there is the staircase leading to the upper floor. All the main rooms, due to good orientation, benefit from very favourable lighting and natural cross ventilation conditions.

The interior design proposal responds to the family's need for large and fluid meeting spaces, a few intimate corners, a generous and well connected kitchen, small work-study areas and a fireplace that will undoubtedly be the heart of the home: organic, warm and welcoming, with the possibility of sitting close to the fire and the floor. The use of warm and tactile materials, neutral tones and natural finishes like clay, lime, terracotta and wood create continuity with the original materials. At the same time, the physical properties of those materials have been checked (consulting their commercial data sheets), to guarantee the performance required by the current Spanish regulations and to ensure that all the constructive solutions will comply with optimal thermal and hygrometric values. The proposed finishes are summarised below:

- Floors in the living/dining room area: terracotta tiles. The use of underfloor heating has prompted the decision to use a handmade terracotta floor laid with pure NHL5 lime mortar, to enhance the effect of radiant heat;

-Floors in kitchen and bathrooms: ceramic tiles

-Floors in bedrooms, corridors and dressing rooms: three-layer oak parquet (natural unvarnished finish);

-Inner insulation in recycled cotton, replacing the rock wool originally planned;

-Interior wall finish: natural calcic lime mortar, clay plaster, gypsum fibre panels, silicate paint. In the living room area and in one bedroom we have left some parts of the original stone wall without cladding, in memory of the original building structure;

-Coverings in wet areas in bathrooms and kitchen: ceramic/glazed tiles;

-Fireproofing of all wooden elements with low VOC emissions ("A" label products);

-Furniture is largely re-used.

2.2 Project narrative

2.2.1 Walls and partitions

The choice of using natural materials is due to the need to preserve the house from high levels of humidity, guaranteeing a high level of breathability of the original old stone. We have treated the existing walls differently, depending on whether they were inside the building or on the façade. The stone walls inside the farm have been restored and covered with two layers of calcic lime mortar, as Sarrau Orús (2015) explains, and then leaving a few portions of exposed stone wall in the living room and in one bedroom, by applying a pure silicate consolidating treatment. We decided not to cover the walls with ordinary plaster to guarantee the stability of the cladding against the high percentage of humidity and to establish continuity with the building's construction technique. In order to maintain the irregularity of the cladding typical of the building period, the final lime finish is hand-trowelled. All the exterior brick walls will be clad on the interior

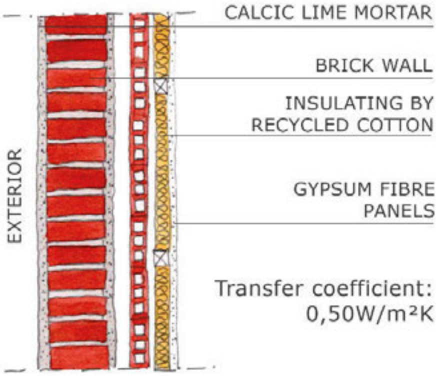

Fig. 5. Exterior brick walls details, section (Source: Li Puma, 2021)

side with a 12,5 mm.-width layer of gypsum fibre panels (a highly breathable, all-natural material) with the addition of 5 cm-width thermal insulation made of recycled cotton (Fig. 5). This material provides a 0.036W/mK thermal conductivity which is similar to that of synthetic or mineral insulation and has less polluting characteristics due to its organic origin. Thermal calculations formulas, based on Neila González (2004), demonstrate that the construction solutions guarantees a significant improvement in transfer coefficient, going from the original value of the brick (1.46W/m²K) to the current value of 0.50W/m²K. Hygrometric calculations (Corominas, 2012) that have been carried out on the new composition of the walls reveal that this solution (with initial values of 55% relative humidity, valid for home interiors) guarantees a minimum interstitial vapour production, approximately 0.4 kg/m², which is considered an acceptable quantity due to the fact that the insulating material can absorb a certain amount of water vapour without losing its insulating qualities. Any residual excess of humidity (due to the microclimate and the proximity of the sea) will be reduced by wireless electro-osmosis dehumidification and air conditioning/ventilation systems, thus ensuring optimum synergy between passive and active systems. The final finish of these walls will be two coats of pure silicate paint, maintaining the objective of the wall's breathability and stability against humidity, with 0% VOCs emissions.

Fig. 6. Cover of interior stone walls, made by calcic lime mortar, leaving parts of uncovered walls (Source: Li Puma, 2021)

Fig. 7. Detail of interior stone walls, made by calcic lime mortar, leaving parts of uncovered walls (Source: Li Puma, 2021)

In the main bedroom a different solution will be used: the final interior finish will be a 2.5cm-width layer of natural clay plaster, without painting. The use of clay in vernacular buildings is very popular, and in this very construction, during the general reinforcement works of the structure in Unit 2, some structural clay walls have been found. The choice of using clay in the main bedroom is based on health criteria (Schneider & Schneider, 2019): the earth plaster walls breath by absorbing moisture and humidity, they help to control the interior climate and air quality. Not only do they regulate temperatures during hot and cold times, they also prevent mold and bacteria to grow. Aesthetics criteria like continuity with the existing building, warmth, organic texture are considered too. As Balliu Castanyer (2020) explains, the clay mortar shall be applied in several layers of diferent thickness, one by one when the product is still fresh. The first layer shall be approximately 15-20 mm thick, the second layer 6 mm thick and the fine finish layer shall have a final thickness of 3 mm. The clay shall be locally sourced and pre-mixed by a specialised expert, in order to guarantee the optimum granulometry of the final product. This part of the work will be carried out in a workshop by an expert advice, with the participation of the owner's family too. All partitions walls in the rest of the house are made by gypsum fibre panels and filled with insulation made by recycled cotton.

Fig. 8. Insulating by recycled cotton and radiant heat, kitchen area (Source: Li Puma, 2021)

2.2.2 Floors

In the living/dining room handmade terracotta tiles are placed. The tiles measure 15x30 cm, with a generous thickness of 1.5 cm, and represent an optimal complement to the radiant heating system (Fig.9): as Neila González (2004) argued, the high natural thermal effusivity of clay (1.806-2.210 s½ *Wm²*C) and its heat distribution capacity make it work very efficiently in heating the house. We have chosen very tick tiles to increase their thermal inertia. The radiant heating system is well suited to a cold building like this, where it is very important to maintain the heat of the internal elements, and clay is an optimal and very fast distributor of heat. The mass of constructive elements (interior walls and partitions, floor slabs) helps to accumulate heat too. Terracotta tile was laid on a 0.5 cm layer of pure calcic lime, a natural product with zero VOCs emissions and no concrete. The final treatment of the tile involves the application of two coats of natural beeswax, to prevent absorption of dirt and grease. The use of terracotta has been reserved for the most intimate and warmest area of the house, near the fireplace and the dining room, also for its organic appearance and tactile properties, and its proximity to "warm" elements of the house such as the fireplace.

Fig. 9. Radiant heat and clay tiles, detail (Source: "Maestri del Cotto" catalogue, 2021)

Fig. 10. Clay tiles already placed in living room, waiting for minimum 25 days complete drying (Source: Li Puma, 2021)

The rest of the common areas of the house (hall, kitchen, bathrooms) will be finished with traditional ceramic tiles, more resistant to meet the requirements of impact and footsteps. The choice of the ceramic tiles (hall, kitchen and corridors in ground floor) is a tribute to the old house, which is located on land dedicated to flower growing. To remember and pay homage to the old house, we choose a delicate floral composition in very faint colours, forming a mosaic (Fig.11). In bedrooms and dressing rooms, three-layer natural wood parquet flooring in oak has been chosen. The flooring will be laid without varnish or paint treatments, with a natural water-based finish.

Fig. 11. Ceramic and clay tiles, between living room and kitchen (Source: LiPuma, 2021)

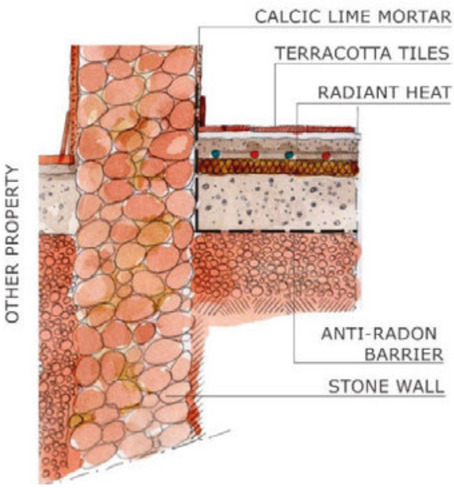

Fig. 12. Stone walls and terracotta: detail (Li-Puma, 2021)

Olive wood will be used for new furnitures in the living room; this type of wood, with its very irregular aspect, has been chosen to make some singular pieces (bookshelves, benches to sit next to fireplace side). The shape and organic aspect of the raw material will determine the final appearance of most important furniture elements.

Fig.13. Parquet pavement (Source: "Escomadera" catalogue, 2021)

Fig. 14. Olive wood for hand-maid furniture (Source: "Yevea Mediterranea" catalogue, 2021)

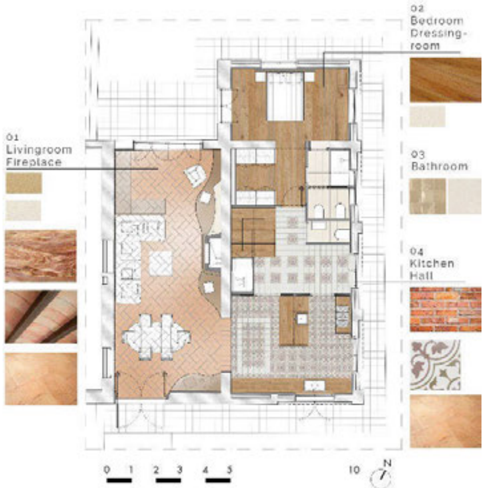

Fig. 15. Ground floor, final lay-out (Source: .Li Puma, 2021)

Fig. 16. Final render of the living room, with the organic fireplace: perspective and ground floor (Source: LiPuma, 2021)

2.2.3 Facilities and indoor environment

Mechanical ventilation and natural cross ventilation together, guarantee an optimal level of air quality and a healthy indoor environment at all times. The main problem of the house were the high levels of humidity and coldness, troubles that have been solved by the combined use of traditional and modern techniques. The radiant system powered by aerothermal energy works in conjunction with the terracotta tiles to achieve effective and pleasant heating, taking advantage of the high thermal inertia of the construction. Dehumidification systems are complemented by the great breathability of the walls. The use of materials such as calcic lime, clay, wood, ensure continuity with the existing construction in full agreement with traditional building techniques. At the same time, they contribute to the creation of a healthy indoor environment (Schneider & Schneider, 2019). To further improve the indoor environment, measurements to detect the presence of radon gas have been carried out (Sentmenat Bertrand, 2019). A protective barrier has been placed on the ground floor, to defend the house from unacceptable contamination: during 14 days of measurement, was detected aproximately an average value of 121Bq/m². This value, although it does not exceed the Spanish regulatory limits, represents a very high amount and we consider that the precautionary principle should be applied, in accordance with the SBM-2015 protocol (Standard der Baubiologischen Messtechnik) by "Institut für Baubiologie+Nachhaltigkeit" (Haumann, 2019).

2.2.4 Garden and outdoor spaces

For theoretical purposes only, I made a proposal by reconstructing the continuity of the garden on its north side, completely eliminating the rear concrete slab and remodelling the topography instead of just land excavation. The main motive is to restore the natural permeability of the soil, by re-naturalising the northern front, now partially sealed by the slab. We will restore the main drainage function to the soil, essential in this garden as the plot is at a lower level than the street, which can potentially cause rainwater to accumulate. The presence of an ancient and majestic cypress tree in the west corner of U3 prevents us from completely eliminating the current slope and makes it necessary to maintain a certain amount of fill around the base of the tree. Far from being a difficulty, the presence of existing trees at the edge of the plot suggests keeping the land where necessary, reconnecting the ends of the old pond with a series of landscaped "terraces", stepping the land progressively down to the level of the house. Soil excavated from the side strips will be reused to fill in the central area. The terraces are developed on 4 different levels (from +0.25m up to +1.00m) of natural stone laid in gravel, forming a layout of sinuous curves, with different species of plants. Species typical of Mediterranean climate will be chosen, with low watering requirements, placed according to the variable sunlight throughout the year (succulents, wild plants and ground cover in areas with more sunlight; aromatic and small flowering shrubs in areas with more prolonged shade, close to the building). The back wall will be covered with creepers and climbers (ivy, bouganvilles, jasmine). The lower level, close to the house, will be paved with clay tiles suitable for outdoor use as a passage and rest area.

Fig. 17. Sketch of the garden proposal (Source: LiPuma, 2021)

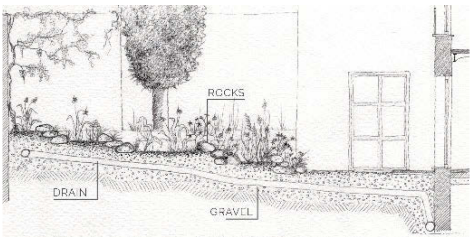

Fig. 18. Cross section of garden proposal (V. LiPuma, 2021)

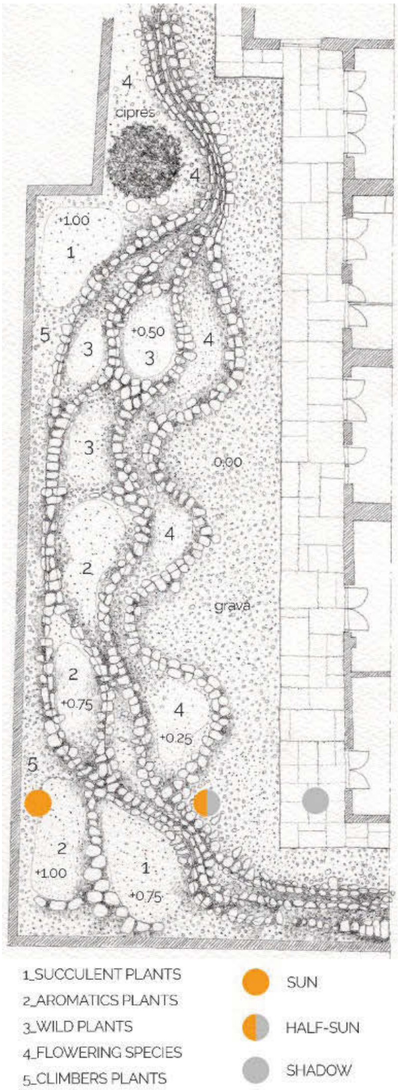

Fig. 19. Sketch of the garden proposal (LiPuma, 2021)

No lawn is planned, to minimise irrigation: as in the rest of the existing garden, small pebble gravel will be used. Underneath the paved area, the drainage will be reinforced with gravel or expanded clay, in order to defend the walls from the humidity coming from the ground.

3. Conclusions

I consider this professional task to be a great opportunity to experiment with processes and investigate with materials to an extent that might not have been possible in a more conventional situation. In this project I had the chance to test the behaviour of traditional materials by current calculation tools, demonstrating that the constructive solutions of vernacular architecture are still valid and can be recommended today. Moreover, I have been able to reconcile these solutions with very efficient installations, implementing their effectiveness and allowing them to work closely together in conditioning the house. This means that modernity and tradition are not incompatible, if the character of each material is respected and used in a way that is suitable with its physical properties. It has been very important to me investigating traditional construction techniques and finally discovering their capability to solve modern problems. Finally, the lesson I have learned from this experience is that the role of the architect cannot be limited to pure technical practice, worrying about proposing a "correct" design to the client and checking that everything is executed in the best possible way. I believe that our work has a human side that must take into account aspects of each client's psychology that make us design "houses" and not simply "living machines", as our ancestors did in the past.

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After the earthquake. Design processes for intervention on vernacular heritage in Central Italy

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
Every day, in Italy, an average of 45 seismic events is recorded (INGV 2020 data) and their impact on the built environment is intense and continuous. The most notable cases are only the tip of a widespread and systematic iceberg, especially in the Central Apennines Mountain range. The opportunity to operate on ancient and disrupted buildings, to observe materially mural stratigraphies, to interpret disconnected or hinted geometries represents the field of action of know-how that fluctuates between technological specialism and the transmission of ancient tacit knowledge, which is more evident in the vernacular heritage. Concepts like conservation, restoration and reconstruction have become crucial in the deep debate and rule formulation, in the context of the "Extraordinary Commissariat for Earthquake Reconstruction 2016". The contribution intends to investigate and describe the main features of these design procedures, focusing on the results, the perspective, dynamics, and objectives through which the reconstruction is taking place. More in detail, the paper suggests two case studies to examine the application of these ongoing procedures in relation to the enhancement and conservation of vernacular heritage in the Marche region. The two case studies are the village of Gabbiano (a small rural fabric close to Pieve Torina, Macerata) and the Shrine of Macereto (a monumental, isolated complex in Visso, Macerata). The differences in size, type and original use between the case studies offers the opportunity to compare two different interventions for either a complete reconstruction or a conservative restoration. The scope of the study is to explore the "rules of reconstruction" - applied to vernacular heritage sites - by observing how the projects and the proposed techniques represent an interpretation of the national legal framework built around the post-earthquake territories.

Keywords: *post-disaster reconstruction, Central Italy, earthquake, restoration practice.*

1. Introduction

Italian architectural heritage is composed of a great variety of artefacts, from monuments to vernacular buildings. Often, these objects are part of the so-called *fragile landscape*, conceived as a *lost landscape* "which denounces […] a wound and at the same time invite us to attempt a suture, a plausible mending" (Tarpino, 2016, p. 8). This suture is even more evident in the case of seismic damages in these vernacular contexts.

In 2020 16.597 seismic events have been recorded around the Italian territory with an average of 45 earthquakes per day, according to the report by INGV (Istituto Nazionale di Geofisica e Vulcanologia – *National Institute of Geophysics and Volcanology*) (INGV, 2020). These numbers become even more significant if cross-referenced with the 60% of National territory considered as *Internal Areas*[1] commonly characterized by vernacular heritage and agricultural and forestry landscape. This heritage must face post-disaster dynamics with a need for reconstruction, restoration, and conservation interventions where "no action strategy can be universally appropriate and effective" (Morezzi, 2019, p. 27).

A particularly meaningful case is represented by the area of the Central Apennines Mountains which was affected by a series of intense earthquakes in 2016-2017. The regions of Marche, Umbria and Lazio have therefore ended up with a vast and varied set of artefacts and vernacular settlements bearing severe material damages and in completely irreversible conditions. "Besides the restoration of the best-known monuments, problems arise in relation to how to deal with minor architectural heritage, such as that of minor valleys, towns and villages" (Carbonara, 2018, preface). In this context, the "marginal" nature of territories and settlements corresponds to not well documented and difficult to reach – in other words *out of the spotlight* – sites.

From a strategic and normative point of view, this dramatic condition has requested the establishment of an *Extraordinary Commissariat for Earthquake Reconstruction 2016* in Central Italy – as happened in the previous years in other Italian regions[2]. It consists of a public organization with the main aim to speed up and optimize the reconstruction process in these areas.

The complex condition between vernacular areas and post-seismic emergency is underlined by the governmental guidelines for which "in the 2016 earthquake crater area, the issues of peripherality, typical of internal areas as identified by SNAI, overlap with those of marginality concerning ordinary national and regional policies, as they are mainly border areas" (Presidenza del Consiglio dei Ministri, 2020, p. 2).

The 2016 earthquake crater represents a specific field of study that interweaves the Apennines' vernacular zones with a post-seismic condition. Strategic guidelines and technical solutions regarding vernacular heritage conservation offer several ways of intervention and *good practices*, requiring a priority system between frameworks, aims and tools. As well as in the common design practice, during the post-seismic condition, the difficulty is to "distinguish the regulation systems (protection) from the purposes (the conservation)" (Romeo, 2021, p. 211) in the framework of an enhancement strategy.

1.1. Research context

The context of the present study is strictly linked to two main perspectives. The first one is the work by *Extraordinary Commissariat for Earthquake Reconstruction 2016* and its strategies and prescriptions[3] with a particular focus on the vernacular and marginal areas. The second one is the technical interpretation of these rules and guidelines and the design procedures.

Right after the stroke of an important earthquake, a complex technical and bureaucratic process starts. A special office, named USR (*Ufficio Speciale per la Ricostruzione* – Special Office for Reconstruction), is set up in every Region affected by the seismic event. The scope of this office is to organize the reconstruction process, starting from the estimate of the damage, led by trained technicians who report the state of things to the USR.

From a technical point of view, design procedures for this damaged heritage firstly require the understanding of the damaged buildings' history, their constructive aspects, and their damage

[1] Regarding the "Strategia Nazionale Aree Interne" – SNAI (National Strategy for Internal Areas), intending these areas as "fragile territories, far from the main centres of supply of essential services and too often left to their own devices" (SNAI, 2019).

[2] Chronologically close examples are the Regional Agency for Reconstruction and the Deputy Commissioner for Reconstruction after the 2012 earthquake in Emilia Romagna.

[3] A recommended deepening on the topic is the research work by Carlotta Latini and her focus on legislation and regulation in emergency and reconstruction management.

characteristics. After this cognitive phase, there are many different possible ways of intervention. The decisional process is deeply affected by the availability of economic opportunities since the reparation of the seismic damages is funded by the State. To raise the funds, both analysis and design must follow precise rules and procedures. In addition to the bureaucratic requirements, the owner's desires and the regulations set by the authorities have always to be fulfilled.

The design framework which emerges is very variable from one case to another. All the externalities produced by economic, normative, and social reasons converge in the project definition too. In this vernacular context, conservative restoration is not always the unique intervention strategy: memory and material motivations together with irreparable buildings open to various scenarios of reconstruction and transformation.

1.2. Research methodology

The research represents a survey on what (and how) is happening in a specific post-earthquake area of Central Italy, characterized by a great range of vernacular architectural models and types.

To do so, the ongoing reconstruction/restoration phenomena become a useful point of view, since they produce instant frameworks on which critically apply theoretical and practical considerations. The cooperation with a design company permits to fulfil *active research*, observing the change which is taking place. With the kind graphical and documentary support by ArchLivIng (design office mainly based in Ferrara and Torino), the survey can tap into drawings and technical reports referring to the selected case studies. The research is not, however, focused on one specific design practice, contextualizing it in a wider and well-documented reconstruction approach and bibliography. Through the lens of researchers and scholars and with the tools of technicians working in these territories, the study tries to open a wider and more *pragmatic* interpretation of both the vernacular architecture conservation and the post-earthquake intervention challenges.

2. Case studies

Two case studies of vernacular heritage in the Marche region are presented as post-earthquake projects. They differ in size, construction period and monumental characteristics. Both projects are in progress bringing into play complex networks of relationships between regulation and design in the conservation field.

The first case study is the Shrine of Macereto, a religious monumental complex in the southern area of Marche. It can be considered a vernacular case of undoubted monumental value where the conservation project assumes traditional peculiarities related to the philological and memorial aspects.

The second one is the village of Gabbiano, a small settlement that has been seriously damaged by the 2016 earthquake, where demolition and rebuilding represent the only possible intervention strategy. The settlement is poorly documented, but its cultural value is demonstrated by the uniformity of construction techniques and the *tangible* presence of artisanal and "material knowledge" (Schreurs, 2021, p. 56).

2.1. Shrine of Macereto

The Shrine of Macereto is a monumental complex located on a plateau at around 1000 meters above sea level, in the surroundings of the towns of Visso and Ussita (Macerata district)[4]. The complex is composed of one main building, the church, surrounded by four other constructions[5], connected by a covered walkway. The walkway is characterized by masonry pillars and a single pitch wooden roof and was partially demolished at the beginning of the XX century.

[4] The monumental complex was one of the so-called *guaite* around Visso, a territorial control system consisting of different clusters of buildings spread in the area.

[5] The construction of the church was probably started by the artist G. Battista Lucano in 1530. There is a tradition attesting that the original project was drawn by Donato Bramante.

The groundwork for the restoration process started after the earthquake consists of historical analysis and research. A heterogeneous bibliography underlines the value of the complex as a *vernacular monument*. Since the first years of the XX century, the Shrine has been published in trade magazines and books (Pirri, 1916; Venanzangeli, 1996; Fumi, 1901), sometimes referring to the documentation located in the historical archive of Visso and Ussita, that is included in SIUSA (*Sistema Informativo Unificato per le Soprintendenze Archivistiche* – Informative Unified System for the Archival Superintendencies). The archival research reveals – together with the physical evidence – a building complex of excellent value.

A local legend talks about the construction of the first church in 1359 after a miraculous event during the transportation of a Virgin Mary sculpture. the Sanctuary was built in 1528, around the original church and, from that moment on, the place became an important pilgrimage destination.

Besides the central plan church, characterized by square honed stones (ashlar masonry), the complex consists of four main buildings: *Palazzo delle Guaite* (Guardhouse) (Fig. 1), *Casa dei Pellegrini* (Pilgrims' house), *Casa dell'Armata* (Army house) and *Fontanile* (Fountain building).

Fig.1. View of "Palazzo delle Guaite" (Source: Cristiano Tosco, 2021)

All the buildings are nowadays characterized by natural cleft stone facades, even though some plaster traces are visible. Thanks to the absence of plaster, it is possible to read different textures in the natural stone, which suggest transformations and additions in the construction history.

The quality of the masonry is adequate since the walls are not built with sack masonry, nevertheless, the mortar has a poor quality.[6] These characteristics, combined with other factors (volumes, heights, seismic intensity, etc.), have led to several cracks and some localized collapses.

The first formal step of the restoration process is the so-called *Operational Level*, which aims to estimate the damage caused by the earthquake. It includes an accurate survey and structural observations. Based on the level attributed to each building, its square meters and potential special features, the USR calculates the economic contribution needed for the restoration process.

After this assessment, the technicians involved in the process and the owner of the building – that is, the Camerino's diocesan chancery (*Curia*) – work together to set the goals for the structural and architectural design. The main objectives of this work are seismic security and accessibility, modern hygienic standards, and fire prevention. Overall, the Shrine is an important local monument: this means that memory and image of the complex become important elements during the design phase (Fig. 2).

Fig. 2. The southern elevation of "Palazzo delle Guaite" (Source: Archliving, 2020)

Before the 2016 seismic events, the architectural complex was mainly used as a base for school camps and other social activities. Therefore, a strong focus on accessibility and fire protection is required in the planning. Italian laws admit exceptions in these fields for heritage buildings, but since structural intervention is needed due to seismic security, architectural standards are also to be followed. Commonly, this leads to complex negotiations between technicians, municipalities,

[6] According to the report of analysis (2019) developed by Meccano Spa, chemical professional office Doc. Enzo Corsi, and kindly provided by the firm Archliving.

and the authority for heritage protection called *Soprintendenza per i Beni Ambientali e Architettonici*. Once the project is shared with all the stakeholders, it must be submitted to the USR.

One of the main topics is the potential reintroduction of the plaster on the natural stone façade of *Palazzo delle Guaite*. Historic research, historical pictures (Fig. 3), and an accurate survey of the masonry stone suggest that the exterior aspect of that building was historically characterized by the presence of plaster. The reintroduction of plaster, in addition to FRCM (Fabric Reinforced Cementitious Matrix), would nowadays be a proper method to increase the mechanical resistance of the masonry and, concurrently, restore the historical appearance of the building.

Fig. 3. Photography from 1988 testifying the presence of plaster on the Shrine façades (Source: Archivio Impresa Alessandrini, 2019)

The historical accuracy of this solution could be proved by the documents conserved in the historical archive of the complex, which was, however, preserved inside another monumental complex severely damaged during the earthquake: the church complex of *Collegiata di Santa Maria*. Its content was transferred to a temporary location, inside the *Archivio di Stato* in Ancona. Today, the consultation of this material is unfortunately not possible, even though there are arrangements in progress with UNIVPM (*Università Politecnica delle Marche*).

Furthermore, the reintroduction of the plaster on the façade must be discussed and approved by *Soprintendenza* and Municipality, since the architectural complex is in an area characterized by particular landscape interest. Therefore, an intervention that changes the exterior aspect of the buildings must be accurately motivated[7].

Nowadays the project for the Shrine of Macereto is waiting for approval. If some interventions are not considered suitable, negotiations and design of new solutions will reoccur, in an iterative process that will finally lead to the approved design.

2.2. Gabbiano

Gabbiano is a small and rural settlement in the hamlet of Pieve Torina (Macerata district). Standing over a hill, the village is composed of eight buildings (with different private properties) and one church on a principal sinuous path axis (Fig. 4).

Fig. 4. Drone photography of Gabbiano and its landscape (Source: Archliving, 2021)

Although there is discrete historical documentation relating to the territory of Pieve Torina, Gabbiano appears in brief descriptive mentions about more important places such as Torricchio. For instance, Gabbiano was documented in 1859 in the *Topografia Statistica dello Stato Pontificio* as "hamlet of Torricchio with about 200 souls" (Palmieri, 1859, p. 156) and earlier in 1836 as "hamlet of Torricchio annexed to Pieve Torina [...] 149 souls" (AAVV, 1836, p. 109).

[7] Memorial aspects are crucial in these dynamics and the open and dense discussion with competent authorities becomes one of the necessary conditions to intervene.

Gabbiano represents an example of a vernacular settlement embedded in the river Chienti's lower valley. It is located at the border of the *Monti Sibillini* National Park, along the road connecting Pieve Torina and Visso.

This is a small settlement, historically a satellite of larger territorial centres, in a marginal documentary condition. However, the material data, characteristic of a building tradition and a "skills society" (Sennett, 2008, p. 22), plays a crucial role in the understanding of local culture.

Although there is a considerable variety of building techniques throughout the Chienti valley, "the regular sub-horizontal technique [...] seems to be the most representative of the general technical level of the whole area under consideration" (D'Ulizia, 2008, p. 74). In this sense, about the settlement, it is the very consistency of the places, today laid bare by the traumas and wounds of the 2016 earthquake, that allows grasping the cultural emergencies as data worthy of preservation, at least in their traces. The documentary value of the ornamental features of some wall details, cornices, openings and all the elements that distinguish the architecture of the place, is mainly to be found in the local workforce. In other words, "the presence of groups of local masons, each working in their community, who apply general models (probably transmitted by an itinerant specialist master) and readapt them to the particular case" (D'Ulizia, 2008, p. 74) represents a great value. This evidence calls into question experience and technique as culturally transmitted aspects. In Gabbiano this transmission is perhaps even more hybrid because it is the result of even more indirect knowledge transmission and therefore capable of producing an unexpected built heritage where "minor or not, the old buildings of the towns do exist, and it is important to preserve and convey them to future generations" (Gron, Detry, 2019, p. 10).

The renovation process carried out on the buildings following the earthquake of 1997, resulted in transformations to both the decorative and the structural apparatus of the buildings, sometimes using solutions that were not suited to the masonry characteristics and traditional conformation of the local architecture[8]. In particular, the extensive use of cement mortar and reinforced concrete elements has distorted certain architectural details and compromised the chemical and physical aspects of traditional materials, such as their natural perishability and breathability.

Vernacular architecture of Gabbiano is largely made of masonry load-bearing structures consisting mainly of rough, unworked stone, with irregularly shaped elements of various sizes. The last earthquake (2016) has resulted in an extended framework of intense damages, such as diagonal and diffuse cracks, displacement and tilting of walls by out-of-plane bending and large detachments. The result is an almost destroyed settlement where ruins are the material trace of both a tragedy and a will for reconstruction.

The above-mentioned frameworks depict a complex situation, the investigation of which has required a constant campaign of inspections to outline the characteristics of the building with the least possible approximation and to select the most significant aspects. Damage conditions required a project that must be oriented to complete demolition and reconstruction opening the widely debated topic of reconstruction "as it was, where it was" (Fig. 5). Technical principles of the ongoing project of reconstruction try to consider Gabbiano as a unique vernacular system, where guidelines are oriented to the repetition in volumes of buildings, to the location, size, and proportion maintenance of the openings, to the restoration or similar reconstruction of shading systems in wood and the removal of evident superfetations.

[8] An example is the poorly critical use of reinforced concrete top kerbs and architraves in incoherent materials and technologies.

2.3. Ongoing results

As already mentioned, the case studies are witnesses of an ongoing design and intervention process. For this reason, the research results are necessarily partial and susceptible to further developments.

Even if the differences between Macereto Shrine and Gabbiano are unequivocal, both the sites are representative of the same legal and operative framework of post-seismic intervention. While in the Macereto Shrine this framework emerges through the tools of restoration – working on buildings that *must* be saved in their structures and architectural elements –, in Gabbiano the reconstruction asks for demolition and *recomposition* of at least the historical image. Two opposite approaches that are coordinated by the same general strategy declined on different vernacular heritage.

Far from being comparable objects, the case studies interweave strong links with the contexts of references. These contexts are made both by real stakeholders (communities, owners, municipalities) and by cultural aspects (construction techniques, landscape impact, settlements principles), converging – in these cases – in a general will for an "as it was, where it was" approach.

3. Conclusions

The current regulations on reconstruction in Italy are the result of a process that began in the 1980s[9]. Since then, the layering of regulations has intensified. Structures and superstructures, regulations, laws, and norms have been established with the primary objective of acting quickly and effectively. The current situation involves a series of consolidated steps in succession, ranging from safety measures to actual reconstruction.

There are very different buildings and contexts. The differences within the "vernacular" label in the Marche region are broad and include typological variety (churches, palaces, rural settlements), different intensity of damage, geographical location, uses (private, public, church property, holiday houses, etc.) and period of construction (with a wide variety ranging from the IV to the XII century, but also a heritage ranging from the XIX to the XX century). These profound differences that characterize vernacular architecture inevitably bring the established normative infrastructure into a continually "forced" condition to accommodate the

Fig. 5. *Plan and elevation at the project prefiguration (Source:* Archliving, 2021, with editing by Cristiano Tosco, 2022)

[9] Regarding the Irpinia earthquake of 1980.

diversity of cases. Therefore, a more shared and collective effort is required. A permanent discussion table should be set up to establish procedures on how to operate and how rebuild, during the non-seismic periods.

The presented experiences show widespread expertise among professionals that outlines shared knowledge on the topic. Looking to this breeding ground, research and studies on these ongoing procedures can be helpful in the definition of new approaches to post-seismic interventions. These new approaches should become a topic of discussion within the regulatory framework, trying to develop new tools for dealing with all the differences that a post-seismic condition in vernacular contexts could lead to, considering that there is one earthquake but many different reconstruction scenarios.

4. Acknowledgements

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Implementing the lesson of early 20th century traditional buildings for a real sustainability. The examples of Corviale (Rome) and ZEN (Palermo) districts

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract

The lesson of the early Italian 20th Century vernacular/traditional buildings and districts by ICP (Social Housing Institute), which were quickly and inexpensively built, suggests the right way to improve our cities while respecting the environment. Moreover, the socio-economic strategy of those days shows what we can do to re-train artisans and generate a vast artisanship, which could reduce the restoration costs of our heritage. As matter of fact that wise way of building aimed not only at providing new decorous houses, but also at generating labor and reducing the future maintenance costs. The success and durability of the buildings of those districts were not accidental: their authors' assessments, as well as the urban rules conceived on those days, show that everything was carefully planned of a great thanks to an interdisciplinary approach. The use of traditional masonry, that does not need to wait for the hardening times of concrete to be loaded, allowed the quick constructions of those buildings: for instance 6 months for 44 houses of the district San Saba and only 4 for the entire Lot 24 of the Garbatella. These traditional masonry houses, whose revalued building costs were roughly 50% less than current ones, have not needed to be restored for over 100 years and are among the most sought after houses in real estate, (€/sqm 11,000, like in the historical center). Furthermore, the wise construction policy of those days shows us how we can solve the problem of housing, earning public profits from it rather than increasing public debt. The cases studied in this paper regard the projects for the urban regeneration of two wretched suburbs, in Rome and Palermo. They both show how, thanks to the simple reuse of the pre-Fascist laws and tools, as well as of traditional masonry, we can achieve the above-mentioned program.

Keywords: *wisdom; sustainability; durability; economy.*

1. Introduction

As architects, engineers and restorers, we have been taught that the only way to solve the problem of housing is to build massive buildings, rigorously realized in reinforced concrete. In addition, it is a common belief that reinforced concrete and steel structures are more solid and durable. Finally, in our academic training, we all have been given instructions about the use of modern techniques, materials and technologies in the restoration of historical buildings and monuments. What we are told is that not only these modern solutions are stronger than traditional ones, but they also help avoid the falsification of history. (Mazzola, 2004 and 2010). The consequences of this monistic way of forming new professionals are evident: the majority of new buildings and districts result depressive, depersonalizing and far away from any sense of belonging (see Davos assessment on buildings). Moreover, those buildings made of industrial materials and "*light structures*", brought humans – for the first time in the whole history of architecture – to debate on a more sustainable way of building. (Neretti & Soma, 1982).

Furthermore, the lack of knowledge – or the lack of interest – both on pre-modern systems of dimensioning the structures and on their behavior, together with the theory of "*falsification of history*", caused the loss of many historical buildings. Indeed, we can simply analyze the reasons of collapsing of many of the "*restored and strengthened*" historical buildings happened in the last three earthquakes in Italy, or the one of the *Schola Armaturarum* in Pompeii, to understand that some of our beliefs need to be revised. (H. Cruz, et al., 2016). The advent of functionalism, as well as the "*damnatio memoriae*" of traditional architecture, which started in the '30s of last century, brought to a separation of interests between a small group of professionals and workers of restoration (still interested on traditional masonry and buildings) and lots of designers and workers, specialized on modern structures and architecture.

The tragedy of this separation is not only the impoverishment and flattening of the architectural quality, but also the increase of the costs of the labor force in restoration, due to the lack of competitors. Moreover, the abandonment of traditional construction methods – especially before the Seventies – has generated millions of cubic meters of energy-intensive buildings, whose existence, according to the EEA's data, is one of the main causes of global warming. (Neretti & Soma, 1982) (EEA 2010's data on Environmental Impact and Production Sectors). Refusing to admit their responsibilities, now architects look interested for a more sustainable way of building and living … often trying to *reinvent the wheel* in the name of the zeitgeist and the "*necessary experimentation*", instead of looking at the past and finding that most of the answers are already under our eyes.

At the beginning of the Twentieth Century, the inhabitants of the Italian capital were exponentially growing and the city of Rome was in bankruptcy; the reason for the financial collapse was the illogical development of the city's buildings, which saw the public administration as a mere spectator of the massive private speculation. Once they understood the problem (thanks to the work of the first mayor – Ernesto Nathan – who was not related with the clergy, nor with the bankers), the public administration created a perfect machine to work in a healthy competition with the private investors, achieving great successes in terms of economy, architecture, urbanism and sociology. The activity of the *Institute for Public Housing*, the "*Unione Edilizia Nazionale*" and "*Istituto Centrale Edilizio*" for the construction of all the mix-income and mix-functions districts indeed brought the economy of the Commune back in positive; moreover, they created marvellous "green districts", providing not only homes, but also jobs for the unemployed, i.e. life expectations for all those "*new Romans*". Thanks to traditional masonry (the only modern solution were the shallow vaulted ceilings on iron beams, that do not need to wait for the hardening times of concrete to be loaded) these constructions were extremely fast: for instance, the first 44 houses of the district San Saba were started on October 1908 and already inhabited in April 1909. (Mazzola 2010; Briotti 1988).

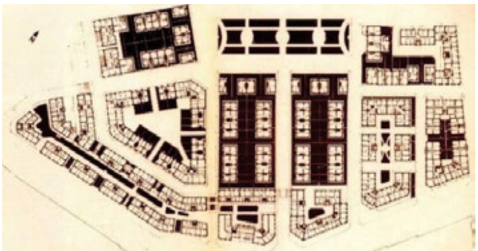

Fig. 1. Ground Floor Plan of the district San Saba in Rome.

Fig. 2. District San Saba in Rome – brick detail of cornice of one of first 44 houses built between October 1908 and April 1909.

These beautiful brick houses, whose revalued building costs are roughly 50% less than current ones, have never been restored in more than 100 years and are now considered among the most sought after in real estate, whose price is about €/sqm 11,000, like in the historical centre.

Fig.3. News of September 20th 2020 – the auction average cost per apartment (90 sqm) is € 1 mln, i.e. €/mq 11,000.

The success and the durability of these buildings are not accidental. The architect wrote in 1911, in the Report enclosed with the *Concorso per il Progetto di un Tipo di Casa Popolare per Roma* (Architectural contest for a Type of Public Housing in Rome):

«*Not only does the building "beautiful outside and clean inside" contribute to the upgrading of the classes living in it, but a proper use of durable materials, such as bricks and tiles, leads to a drop, over time, in maintenance costs, especially in buildings that have several storeys joined in a city block or district*».

The great lesson of this wise way of building should be taken into consideration today for a more sustainable way of building. With this aim, we should think of new buildings based on traditional techniques, hence on durable materials that consume little energy. That means that the use of supporting walls will have to be encouraged, as well as arches and timber structures and floors made of shallow brick vaults on steel beams.

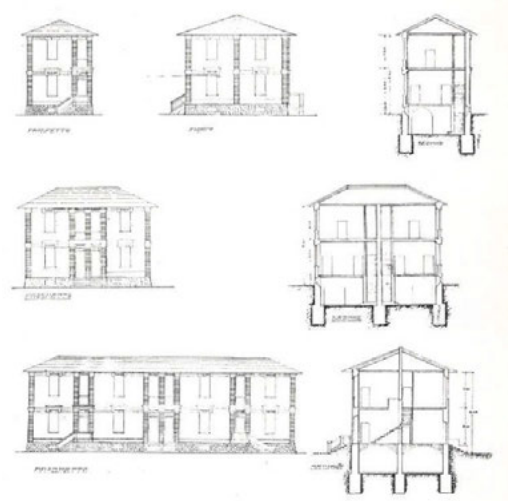

Fig.4. Elevations and sections of the first houses in San Saba.

All this will help speed up construction of buildings and reduce maintenance costs on the one hand, on the other; it will make possible the cutting of restoration costs for the existing constructions, thanks to the re-training of an extensive and specialized labor force that as such will be competitive.

Average costs "per Vano" in Liras (1930) and in Euros (2020)		
	Vertically Divided Apartment Houses (Villini)	**S. Saba 1908**
A	Structures, plastering, furnishings and systems	£ 8.042 **€ 6.390,20**
B	Roofing basements foundations	£ 3.048 **€ 2.421,95**
C	Land and ancillary accommodations	£ 1.976 **€ 1.570,13**
	TOTAL	£ 13.066 **€10.382,30** **€/mq 576,79**

Table 1. Average Building costs revalued of the "Villini with vertical subdivisión type"

Indeed, comparing the current construction costs in Italy, provided by the Association of the Architects (€/mc 451.33 = €/mq 1,353.99) to those, revalued, of the buildings built in San Saba, we notice that the costs of those buildings were less than half of the current ones. (Mazzola, 2010 and 2021; Cocchioni & De Grassi, 1984). The next chapter explains two projects developed by the author and aimed at the urban regeneration of two depersonalizing and dangerous suburbs in Rome and Palermo. These projects indeed, show

how (thanks to the simple reuse of the pre-Fascist laws and tools, as well as traditional masonry) we can achieve the above-mentioned program. In addition to the stated points, these interventions would generate labor, i.e. competitors in restoration, and would have high public profits, instead of costs that could increase the public debt.

2. Thoughts that led to the design for the Urban Regeneration of the districts Corviale in Rome and ZEN in Palermo

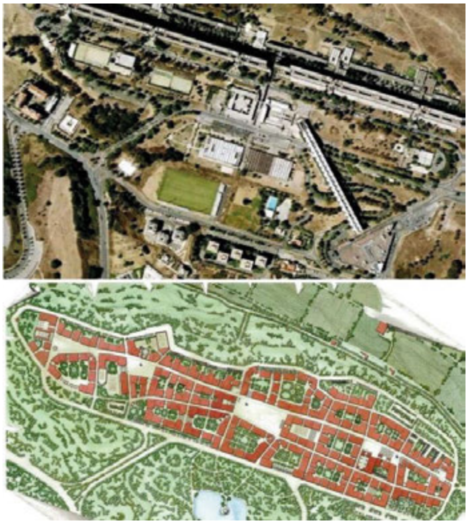

Fig. 5. Project for Corviale – Before and after.

Fig. 6. Project for the Z.E.N. – Before and after.

The projects developed for the Urban Regeneration of the social housing districts Corviale in Rome and Z.E.N. in Palermo, are not about the umpteenth hypothetical theory of reinventing the wheel. Indeed, they simply want to show what we can do through recovering either the laws, tools or policy of the earliest XX Century, tested for more than 100 years. The strategy of those days shows not only the positive effects in terms of urbanism, architecture, sociology and economy on the suburban districts, but also the reverberation on the environment, on the historical city and the historical buildings, thanks to the recreation of a large competing workforce. In both cases, the projects show the gradual substitution and re-compacting of the urban fabric, creating a dense and compact environment, consistent with the local tradition, although the buildings designed are airier than the historical models, thanks to the large garden courtyards.

As mentioned, the urban renewal of these districts can translate not only into more dignified housing and urban environment for the residents, but it can also generate employment, with different expectations in life and a concrete promise of social renewal: the relaunch of the local crafts industry can act as a driver for the local economy as a whole.

The idea of relaunching the local crafts industry and economy should proceed in step with the tackling of another problem, which is being little discussed, academically and politically, but which deserves greater attention. The collapses of buildings occurred during the recent Italian earthquakes in L'Aquila, Emilia Romagna and Amatrice, but also those occurred in Pompei, Rome and Barletta, have unequivocally highlighted the consequences of the "ideological" teachings of the last 70 years and of the construction practices, constantly ignoring preservation. The use of "modern" techniques and materials has created a class of technicians who do not have the means for restoring a traditional building. This situation has significantly harmed our heritage because of the use of inappropriate structures and materials significantly different from the original structures. (Cruz et al., 2016; Marconi et al., 2004; Ranellucci, 2009 and 2011).

This has also produced difficulties in finding laborers qualified for historical buildings that, when found, they are too expensive, because of a lack of competition in the branch. For this reason, in the age of "sustainability" indeed, it would be wise to restart building as in the recent past. Indeed, it is more than clear now as those early 20th century buildings feature no maintenance costs and have excellent performances in terms of temperature and humidity. This means that, the recovery of this way of building would help train vast numbers of skilled laborers competitors, i.e. we would be sure to have a reduction of future maintenance costs of listed buildings. Considering our enormous heritage, it could be the Italian first source of revenue.

A thought on the matter is now necessary. Speaking in terms of "*sustainability*", the A.N.A.B. (National Association of Bioclimatic Architecture) has recently declared that: «*The operating costs of conventional buildings are set to rise more and more! Faced with scarcer and scarcer energy resources, the only way man can protect himself from climate change is through architecture*».

Someone might object that it is unnecessary to start building in an "*old fashioned*" way, with stone, tufa, bricks and wood, because "green building" or "bioarchitecture" are respectful of the environment and can already reduce energy consumption, as they belong to 'energy efficiency class A' according to the European Union energy label. Actually much talk is made of Bio-climatic architecture, *Bioarchitecture, Eco-sustainability, bio-sustainable balance, LEED* (Leadership in Energy and Environmental Design), etc. … but the question we should be asking ourselves is, are the buildings presented with the "*bio*" tag really such?

According to the A.N.A.B. (Associazione NAzionale Architettura Bioclimatica), the materials and products suited to eco-sustainable building should comply with the following requirements:

1. *Re-generable and come from different natural resources*;
2. *Produced with a low impact on the environment*;
3. *Low polluting, i.e. they should not emit toxic substances, during manufacturing or use*.;
4. *Use little energy for their production, transportation and use*;
5. *Guarantee the durability and maintainability of the various products, to avoid energy and economic waste*;
6. *Feature good energy conservation properties*.

Therefore, in the light of the above, the engineers, architects and experts who support the above mentioned techniques, see themselves as technicians whose design approach is based on the principles of bio-compatibility and eco-sustainability. If, however, we carefully analyze the architectural output of these technicians (and their movements), behind which (*more or less openly*) hide the insulation system manufacturers, we will discover that all this care for the environment is only a front.

The buildings feature the usual sinister modernist look, with enormous glazed surfaces – which notoriously produce heat dispersion – justified by the fact that, in the colder countries, it is necessary to let in as much sunlight as possible. The most disturbing aspect, in all this situation, is that the construction materials used are actually the result of industrial experimentation – which is totally alien to the idea of relaunching the local economies – all the materials used and advertised in the specialized press entail a huge waste of energy during production. Moreover, since they are usually produced far from the construction sites, they also require expensive road transportation, which translates into high oil consumption and atmospheric pollution.

Furthermore, it often occurs that, at the conferences and in the magazines supporting these design orientations, you find people who claim that even high-rise buildings are sustainable, while speaking of vertical gardens and saving land, despite the fact that they know very well those vertical gardens are nonsense and are possible only in computer renderings. While high-rise buildings are, as matter of fact, the most energy intensive and biggest traffic generating buildings around. High-rise buildings, in fact, are intensely dependent on air conditioning and electricity for vertical movements. Moreover, high-rise buildings require huge car parks and large roads to absorb and convey the large numbers of cars directed to these *"concentrators of human beings*".

One can simply search the web and find out exactly how many of the so-called eco-sustainable materials suggested by these bio-architects are actually manufactured and used over very short distances, and how many, instead, are industrially produced and certified with some EEC label. … So, why spend time and energy in constantly researching and experimenting new solutions – which are often expensive, harmful and short-lived – to solve problems for which our wise predecessors had already found a viable solution? What harm is there in reconsidering the materials and technical solutions that time and experience have shown to be perfectly valid and respectful of the environment? In addition, given the bad results of industrially produced buildings, why shouldn't we once again start placing our trust in our local artisans, who have been able to produce that marvel of consistency and respect for the environment, i.e. the historic city centers that the whole world envies us? At least until 1927, people thought that:

«[…] While men are men, made of dimensions, needs, habits, many devices that served their purpose perfectly well in the past are still quite efficient today […] the old methods, if adequately transformed, or even turned right around, can almost always give new ideas to researchers. It would be unjust and (we believe) unfortunate for the craft if, in designing our modern buildings, we failed to take into due account the typical climate and environment of the various parts of our country». (Associazione Artistica fra i Cultori di Architettura, 1927).

Therefore, we must reflect on the fact that, unlike in the case of green building, Traditional Architecture, using the local materials and construction techniques, besides perfectly responding to all the requirements for the recognition of so-called eco-sustainable architecture, also features a number of added values:

1. The building materials are easily available;
2. The building techniques are inexpensive;
3. Maintenance costs are significantly reduced;
4. Supplies do not require long and polluting transportation;
5. The proceeds from the construction process remain locally;
6. The construction industry facilitates the growth of local economy;
7. Unemployment can be reduced, as a consequence of the above mentioned improvements;
8. The costs for restoring our architectural heritage can be significantly reduced, as a result of the rediscovery of the traditional building techniques and materials, and the re-training of the building industry workforce on a much larger scale, creating a competitive market;
9. Respect of the local climatic conditions can be assured;
10. Energy consumption can be reduced for heating and cooling the buildings, as a result of the use of traditional masonry techniques, with a perfect – and natural – behavior, in terms of heat and humidity, ensuring savings of up to 50% for heating and 100% for cooling;
11. Buildings integrate better in their surroundings.

We have a large amount of information on this subject, left to us by our forebears, which has been updated and (partly) used in the Architectural Recovery Manuals, a series of books fundamentally important for local technicians. To those who object that historical buildings do not comply with the applicable anti-seismic building regulations and, therefore, should not be taken as a model, we can respond with the simple evidence of fact. Earthquakes, indeed, have hit many of these regions, many times, some of which have been devastating, yet the ancient (unmodified) buildings are still in their place, long before the invention of reinforced concrete and the knowledge of modern construction science. (Ruggieri et al., 2013). Of course, not all buildings have been built according to the applicable standards and best construction practices, which means that there may be perfect buildings and less-resistant buildings. However, thanks to the recent studies on several technical solutions used in the past by good builders, those Manuals have graphically and scientifically documented the various solutions needed to ensure the perfect seismic behavior of masonry buildings.

The Manuals provide information on all parts of the building, from the walls to the vaults, from the stairs to the floors and the roof, as well as non-structural details that are fundamental for the consistency of the buildings and for defining their character, e. g. typical doors, windows, floorings, ironwork, railings, chimney pots, water drainage systems. Practically speaking, according to a historical design and nature-loving approach, the Manuals, and all the old treatises can provide a linguistic abacus for a modern architecture ensuring seamless continuity with the past; a modern architecture that is also a school for training local artisans, who are necessary for restoration work.

Fig. 7. Project for Corviale – Aerial view of the central Piazza, from the Elementary School to the Town Hall.

Fig. 8. Project for Corviale – Aerial view of the central Piazza, from the Town Hall to the Elementary School.

Fig. 9. Project for Corviale – Aerial view of the lot XII adjacent to the Elementary School.

Fig. 10. Project for Corviale – Aerial view of the Lot IV and the two piazzas with the Market Loggia and the Church.

Fig. 11. Project for Corviale – View of the Market Loggia

Fig. 12. Project for Corviale – View of the Piazza with the Church and the Market Loggia.

Fig. 13. Project for Corviale – View of the lot XX adjacent to the Public Park.

Fig. 14. Project for Corviale – View of the Piazza of the Movie-Theater.

Fig. 15. Project for the Z.E.N. – View of the Piazza of the Church of San Filippo Neri.

Fig. 16. Project for the Z.E.N. – View of the Piazza of the Market.

Fig. 17. Project for the Z.E.N. – Aerial view of the Piazza of the Market.

The business plans developed for the regeneration projects for the Corviale and Zen show how, through the simple reuse of the above-mentioned earliest 20th Century solutions, (social, technical and economic), it will be possible to regenerate these neglected places. Moreover, it will be possible to bring back land to countryside, to create self-sufficient settlements provided of all the needed life functions and finally, to have public profits, instead of increasing public debt. In both cases, the business plan shows a revenue of hundreds millions of Euros, which can be reinvested to improve other sad, dangerous and forgotten suburban districts.

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From rural house to "villa of delights": knowledge and conservation of Villa Murat in the Sorrento peninsula

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
Thanks to an innovative territorial plan, drafted with the coordination of Roberto Pane and Luigi Piccinato and approved in 1987, many exceptional examples of vernacular architecture have been preserved in the Sorrento peninsula. Some of these, initially built as rural houses inserted in agricultural estates, have been transformed over the centuries by subsequent aggregation of volumes, into more complex structures, in which agricultural and residential usage have long coexisted. This is what happened to Villa Rossi, later known as Villa Murat, in the municipality of Massa Lubrense: an initial nucleus, dating back to the 17th century, was expanded during the following century, adding volumes and regularizing an initially spontaneous architecture. Despite such transformations, Villa Murat still retains some constructive features which are typical of vernacular architecture of the Sorrento and Amalfi coasts, such as extradosed vaults covered with beaten lapillus or the loggias facing the sea. The villa, which in the meantime had become property of the Rossi family, intertwined major historical events at the beginning of the 19th century, having become the headquarters of king Gioacchino Murat - hence its name - during the "Capture of Capri" against the British in 1808. Villa Murat, located in the quiet hamlet called Annunziata, away from the centres that have undergone major alterations, has still been preserved almost intact, even in the architectural surfaces, both the internal and external ones. For this reason a thorough research was possible, also thanks to an integrated survey with both aerial and terrestrial photogrammetry and laser scanning. The final aim, as the paper will show, is to develop a conservative design proposal, with targeted actions of conservation of architectural surfaces and structural consolidation, that will allow to keep the physical integrity of the villa and its authenticity without giving up a possible but compatible enhancement.

Keywords: *Sorrento peninsula; Villa Murat; survey; conservation.*

1. Vernacular architecture in the Sorrento peninsula: features and protection

The studies conducted on the rural houses of the Sorrento peninsula - and above all on the similar and more well-known cases in the island of Capri or on the Amalfi Coast - are extensive and consolidated (Pagano & Daniel, 1936, pp. 38-44; Pane R., 1936; Pane R., 1954; Pane R., 1961; Fiengo & Abbate, 2001). Less well known is the transformation process that has affected some of these structures, which had a rural aspect at the beginning and later became aristocratic dwellings, through an expansion by subsequent aggregation of volumes. Villa Murat is an example of how many vernacular architectures of the area have been ennobled: floors have been added to organic systems, composed of cells with a Mediterranean character; the roofs have been transformed, the volumes regularized, and the surfaces decorated. The transformation of the architecture, on a larger scale, has led to the change of identity of the places, with social repercussions on a previously rural context, which later became a holiday destination for noblemen, and today a place with a strong tourist vocation. As evidence of the roots of these architectures, the materials used, belonging to the local building tradition, are still visible; as well as some morphological-spatial aspects - linked to the genesis of the building and to the functions it housed - and some recurring features, such as arches, vaults and loggias.

The rural houses, as pointed out by Roberto Pane in specific relation to those of the Campania region, stand out because they are «handmade. […] They are built without the aid of a rigorous geometry, but with a sense of approximation which is perhaps the main reason of their picturesque» (Pane R., 1936, pp. 6-7). This type of construction shows, from the volumetric point of view, the aggregation of different cells, which have grown spontaneously from a primitive nucleus, forming a composition that is the result of «pure and simple necessity» (Pane R., 1936, p. 7), dictated by new needs. The rural house is a «living thing: it forms and transforms itself» (Pagano, Daniel, 1936, pp. 26-28) according to human needs.

Another typical feature of the rural buildings of the Sorrento peninsula and the island of Capri is the use of extrados vaults. These, like most of the typical features of rural architecture, developed simply because they were more convenient, given the easier availability of the materials needed to build vaults - lime, lapillus, stone - compared to timber, used for flat roofs (Pane R., 1936, p. 9). The extrados of the vaults was coated, waterproofed and thermally insulated with a layer of beaten lapillus and lime (Cerio, 1922, p. 172; Picone, 2010, p. 315). The most common vaults are barrel and pavilion ones. The latter are often cut by a plane, «ideally assigned to a fresco» (Pane R., 1954, p. 25).

In the Sorrento peninsula the houses are adapted to the difference in height of the ground and are built on the rock (Pane R., 1936, p. 14). To counteract the horizontal thrust of the vaults and avoid the rotation of the most vulnerable wall of the building - the one which covers the greatest difference in height - buttresses were adopted since the Baroque age. By connecting these with arches and using the floor thus obtained as a terrace, they obtained the loggias (Fiengo, Abbate, 2001, p. 138).

The highlighted features are also found in Villa Murat. The growth by subsequent aggregation of volumes is evident: starting from an initial nucleus - found in the volume facing north with the terrace above (fig. 2) - the building was enlarged, probably at first only on the ground floor, whose irregular plan and rustic character witnesses its origin. Later, the construction of the first floor, organized in rows of rooms, and of the loggias regularized the pre-existing building, making it a villa. The extrados vaults can be found both in the probable initial nucleus of the villa and on the roof, where they have been hidden, as it often happens, with a double pitched roof. The loggias facing the sea solve the greater difference in height and are placed on the side elevation, to avoid introspection.

Fig. 1. The villa and its visual relationship with Capri (photo by drone, 6/6/2020).

Fig. 2. The north elevation of the villa, with the loggias and the volume identified as the initial nucleus of the building (photo by drone, 6/6/2020).

The recognition of the rural architecture of the Sorrento and Amalfi peninsula as a heritage to be protected is due to the well-known Territorial Urban Plan (PUT), drawn up in the 1970s by a commission chaired by Roberto Pane and Luigi Piccinato and approved with some variants only in 1987 (Branduini & Pane A., 2022). In the report attached to the plan a specific paragraph is dedicated to «rustic architecture with extrados vaults» (Pane R., Piccinato et al., 1977, pp. 107-108). The plan regulates the permitted interventions and proposes to catalogue and protect these minor architectures which, «happily well matched with the landscape» (Pane R., 1936, p. 16), contribute so significantly to the image and to the identity of these places.

2. Villa Murat: a historical outline

2.1 The villa in the Annunziata hamlet in Massa Lubrense

The municipality of Massa Lubrense is set at the extreme edge of the Sorrento peninsula and stands out for its polycentric settlement pattern. It does not have a real historical centre, but is made of numerous hamlets. Among them there is that called *Annunziata* which, located on a hill facing Capri, was chosen as the most suitable place for the foundation of the *Civitas Massae*, a fortified citadel that has been destroyed and rebuilt several times. The fortifications that one still see today date back to the third *castrum*, built in the viceregal period, between the second half of the 16th century and the beginning of the 17th century, together with the coastal towers, to defend a territory which had been devastated by Saracen raids (Persico, 1646; Filangieri di Candida, 1910). The building born as a rural house and today known as Villa Murat rises immediately outside the viceregal walls, along the path that leads to the Marina.

The viceregal citadel, once the raids from the sea ceased and therefore all defensive needs were over, underwent a slow decline in the following centuries. The walls were gradually incorporated into the building fabric, and the citadel became a quiet hilltop village, which still appears today as

Fig. 3. Reale Officio Topografico, Carta topografica e idrografica dei contorni di Napoli, 1817-19.

a timeless place, «unchanged for centuries» (Pane R., 1955, p. 146), in an exceptional landscape context, characterized by the stunning view on the island of Capri.

2.2 Historical events and architectural transformation of Villa Murat

The historical investigation of the villa made use of the interweaving of the so-called direct sources (the building) and the indirect sources (archival documents) such as historical land registers, Holy Visits and iconographic sources. With this methodology it was possible to trace back the history of the villa, first known only for having hosted Gioacchino Murat.

The property on which Villa Murat stands, also consisting of the olive grove called *Canfora* overlooking Capri, was quoted, in the *Holy Visit of Bishop Nepita*[1] of 1685, among the properties of the Della Noce family, who had in turn bought it from the Maldacea family. The Holy Visit mentions only rural structures located on the site, so one can infer that the transformation into villa had not happened yet at the end of the 17th century.

The Della Noce family still owned the entire *extra moenia* area of the Annunziata hamlet in 1742, when the Land registry (*Catasto onciario*[2]) was drafted. Among the assets of Giuseppe della Noce, who in those years was mayor of Massa

[1] Archivio Diocesano Sorrentino Stabiese, *Santa Visita del Vescovo Nepita*, ff, 25, 27 v, 42 v.

[2] Archivio di Stato di Napoli, Catasti onciari, vol. 171.

Lubrense (Filangieri di Candida 1910, p. 281), there is a building corresponding to Villa Murat and described as «the house where he lives consisting of several upper and lower members with all comforts». Thus, the transformation of the first rural nucleus into a villa therefore seems to have taken place between 1685 and 1742.

The subsequent owners were the Rossi family, who hosted Murat in 1808. In addition to the many writings on Murat's stay, a proof of the ownership of the Rossi family is in the Land registry (*Catasto provvisorio*[3]) of 1811, in which a very precise description allows us to know the exact consistency of the building at that time. In Massa, «Andrea Rossi[4] and his brothers from Naples» owned numerous buildings, including a stable - which corresponds to the volume with the four-lobed window, identified as the initial nucleus of the villa - and «three rooms on the ground floor, eight rooms on the first floor, two small ones on the second floor» which correspond to the rest of the villa. The current ground floor and first floor coincide with what is described in this Land registry, which testifies the existence of a second floor, which is also shown in some postcards from the early 20th century (fig. 4).

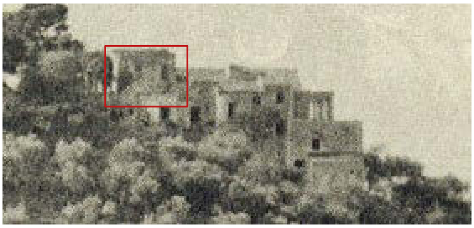

Fig. 4. Detail of a postcard from 1930s showing the second floor, demolished in the 1940s.

Fig. 5. The main façade of Villa Murat in 1939. The coat of arms of the Della Noce family was still visible.

Andrea Rossi owned also other buildings with an agricultural vocation, such as a rural house, another stable and two *trappeti*, in addition to the neighbouring cultivated land, confirming that even in the 19th century, agricultural and residential usage coexisted in the villa and in its surroundings.

In 1920 Villa Murat was purchased by Vincenzo Guerini, a Neapolitan dentist, who was responsible for the apposition on the facade of the plaque commemorating Murat's stay, the wording of which was drawn up with the help of Riccardo Filangieri di Candida. In 1925 the villa was declared of historical interest[5], pursuant to the Rosadi law no. 364 of 1909. Villa Murat has been preserved almost unchanged since the 1940s when, following the purchase by the Astarita family, the second floor was demolished.

2.3 A king in the villa: Gioacchino Murat in Massa Lubrense

As already clarified, Villa Rossi took on the current name of Villa Murat following the stay of Gioacchino Murat in October 1808, when the king chose this place as his headquarters during the second phase of the so-called «Capture of Capri» (Broccoli, 1953; Ciuni, 1990; Barra, 2011; Della Morte, 2021), a military operation with which the French reconquered the island, which had been occupied by the British in 1806.

[3] Archivio di Stato di Napoli, Catasto provvisorio, II versamento, stato sezioni 1060.

[4] We have little information about Andrea Rossi: he joined the secret society called Carboneria (Filangieri di Candida, 1910, p. 218), which may have facilitated contact with Murat, and was mayor of Massa Lubrense in 1811 (Filangieri di Candida, 1910, p. 283).

[5] Archivio della Soprintendenza Archeologia, Belle Arti e Paesaggio per la Città Metropolitana di Napoli.

The battle began with a daring landing[6], which took place on 4th October 1808 and allowed a quick conquest of Anacapri. However, a stalemate followed, because the French were unable to break through the walls of Capri, within which the British, led by Hudson Lowe, had taken refuge.

It was during these agitated days that the king moved to Massa Lubrense, from where he could better follow the evolution of the battle. Despite the abundance of writings on the «Capture of Capri», the information relating to Murat's stay in Massa Lubrense are few and often contradictory. This is because, starting from 10th October, Capri was isolated, due to a naval blockade carried out by the British, which prevented correspondence between the island and the mainland.

The date of arrival of the impatient Murat «in Massa, as close as he could to Capri» (Colletta, 1834, vol. VII, p. 97) is uncertain and fluctuates between 10th and 14th October[7]. The king did not previously know the Rossi family, who was even absent at his arrival (Fasulo, 1906, p. 187-188), he simply chose their villa because it offered the best view on Capri.

Fig. 6. O. Fischetti, *Gioacchino Murat, Re di Napoli, assiste alla presa di Capri da Massa Lubrense*, 1809, Museo della Certosa di San Martino, Napoli.

The stalemate ended on 15th October (Ciuni, 1990, p. 141), when the French artillery managed to breach the walls of Capri. The difficult negotiation that followed took place precisely in Villa Murat, where the king received the messages with the condition of surrender imposed by Hudson Lowe. Despite the indignation of Murat, who would have liked to impose harsher conditions on the defeated, the latter will get to leave Capri with his men. On the night between 16th and 17th October, Murat signed the capitolation right in the villa in Massa Lubrense (Ciuni, 1990, p. 152; Della Morte, 2021, p. 99). The next day the French troops entered the city centre of Capri. The victory greatly increased the consensus towards Murat and the fame of the sites where the feat took place, such as the villa in Massa Lubrense, which is the backdrop of the paintings made to celebrate the success against the English (fig. 6).

3. Integrated survey process

The operational methodology used for the survey of Villa Murat is illustrated below and is intended as an example of a workflow which is applicable to complexes with similar difficulties. The survey of the villa and its garden - located on terraces and with an overhanging side, not detectable with direct survey procedures - confirmed the need to integrate more techniques based on the use of active (laser scanner) and passive sensors (terrestrial and aerial cameras).

3.1 Operating methodology. Image-based and range-based

In the course of the survey campaign - which took place over two days, between the end of May and the beginning of June 2020 - the acquisition through SAPR (Remotely Piloted Aircraft System) of aerial images with both nadiral and differently inclined camera was carried out[8]. The process allowed the creation of a three-dimensional model, from which

[6] Two false attacks on the marinas of Capri were organized to divert the attention of the British from the real landing site, located on the coast of Anacapri, where the brave French soldiers, commanded by Maximilien Lamarque, climbed the rocks overlooking the sea thanks to the use of stairs borrowed from the lamp-makers of Naples.

[7] Umberto Broccoli (Broccoli, 1953, p. 154) claims that Mu-rat left Naples on the 9th and arrived at Annunziata hamlet the next day, after having stopped one night at Palazzo Barretta in Massa Lubrense. Roberto Ciuni (Ciuni, 1990, p. 135), in accordance with Gabriele Della Morte (Della Morte, 2021, p. 80), postpones the arrival to 13th October. According to Riccardo Filangieri (Filangieri di Candida, 1910, p. 216) the king arrived of 14th October.

[8] The dataset obtained was 429 frames taken by the drone DJI Phantom 4, at a height of 45 meters with overlap and sidelap of 70%, obtaining orthoprojections with GSD (ground sample distance) of 1.05 cm / px.

orthophotoplanes and sections of the site were extracted. The photographic acquisition with SAPR required a preliminary project, based on the mapping of the area of interest with "Mission Planner", a software that allows the programming of flight plans through the creation of waypoints, which define the route, the number of shots and the value of the ground resolution.

For the survey with laser instrumentation - aimed at acquiring the morphometric characteristics of the site and at defining the topology of parts of the complex that cannot be reached with other techniques - the phase shift TLS (Terrestrial Laser Scanner) CAM2/Faro Focus3D X330 was used[9]. The survey of the building, both inside and outside, and of the garden required 169 scans.

Fig. 7. Textured model of the villa in the software *Agisoft Metashape*, with the GCP used to link the two point clouds.

Fig. 8. Point cloud of the villa and its garden in the software *Pointcab*.

3.2 The integrated survey

In order to obtain a single model from the two point clouds, GCP (Ground Control Point) have been used. They consisted of checkerboard targets and RAD (Ringed Automatically Detected) targets (Mat et al., 2014), which were visible from the aircraft and identifiable in the point cloud obtained with the laser scanner. The network of control points guaranteed topographical support to georeference the two models (photogrammetric and laser), so that the gaps in both clouds were compensated. The final configuration is the three-dimensional model of the complex (Visintini et al., 2019), which consists of a system of visualization and interrogation of the spaces of the villa, with the possibility of remote measurement and exploration.

The survey of Villa Murat constituted an interesting application of integration of different technologies, which contributed to a further development of a widely tested process for the acquisition and restitution of data documenting the current state of architectural complexes.

4. From knowledge to conservation

As highlighted by the in-depth phase of knowledge, Villa Murat and its garden constitute an asset of remarkable cultural interest, as well as a complex of great relevance in the landscape of Massa Lubrense, where the villa is a landmark, which stands out on the hill of Annunziata. The conservation strategies should therefore aim to preserve the integrity of this highly stratified building as much as possible, without renouncing to a possible and compatible refunctionalization which, as it is known, when not in conflict with the protection requirements, constitutes a guarantee for the conservation of the built heritage (Kealy & Musso, 2011).

4.1 The conservation project

For the plastered architectural surfaces, the goal is to keep intact their material authenticity. It is proposed, therefore, not to completely repaint

[9] The resolution chosen was 6,136 mm measured on a plane 10 meters from the emitter, with a 3X quality. Each scan lasted 7 minutes.

them, but to proceed with light lime glazes that do not alter the fascination that the villa conveys thanks to the ancient aspect of its surfaces. These were analyzed according to the terminology established by the UNI 11182/2006, identifying the forms of alteration and degradation (fig. 10). The planned interventions include selective and gradable cleaning, mainly dry or with sprayed water (Musso, Torsello, 2003, vol. I, p. 31-34), and punctual additions made with lime-based renders and paints. Particular attention is paid to the decorations made with tempera paint on the intrados of the vaults on the first floor, which are still almost intact (fig.11).

The structural consolidation interventions were developed starting from the analysis of the crack pattern, drawn on a three-dimensional model, very faithful to reality because it has been obtained from the point cloud of the laser scanner

Fig. 9. Survey of the main facade.

Fig. 10. Survey of degradation phenomena.

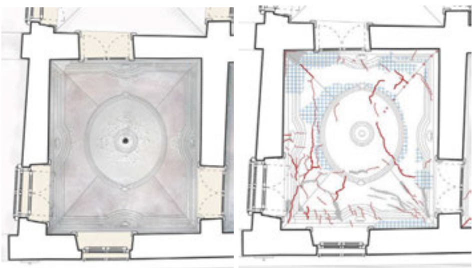

Fig. 11. Detail of the hypography of the most damaged of the painted vaults of the first floor and relative crack pattern.

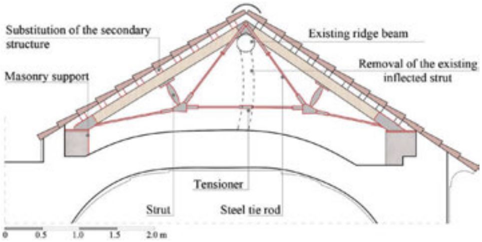

Fig. 12. Truss consolidation with steel tie rods.

survey. Among the planned interventions there is the reinforcement of the vaults of the first floor by affixing FRP (Fiber Reinforced Polymers) to the extrados, with the use of multiaxial non-woven aramid fiber fabric arranged in bands placed along the ribs and parallel to the generatrixes of the vaults (Portioli et al., 2003), where the greatest stresses develop, as reported in the crack pattern[10]. Another intervention concerns the wooden roof. The trusses that are closest to the garden, are thrusting structures, because the bottom chord is missing, and the weight is transmitted to the side walls and to the vault below through a strongly inflected strut. The proposal is to modify the structural behaviour, through the use of steel tie rods that simulate a mixed Polonceau-type truss, consisting of a tripartite tie, raised from the extrados of the underlying vault, which is in this case so high that is does not allow the use of a classic horizontal tie rod (fig. 12).

4.2 Villa Murat as an artist residency

Following an in-depth analysis of the spatial and material features of the building and of the

Fig. 13. The first floor plan converted into artist residency.

[10] The precision of the instrumental survey highlighted a different thickness of the vaults, which corresponds to a diversified crack pattern: the thinnest vault, the one near the loggia, is obviously also the most damaged.

peculiarities of the context, a new intended use is proposed: the "Artist residency" which, not far from the original residential use, allows to preserve the spatiality of the building, as well as to take advantage of the landscape context, which is of inspiration for the artists. At the basis of this choice there is also the desire to allow the public use of the villa - on the occasion of events or exhibitions - preventing its becoming an enclave destined for luxury tourism, like many historic houses in the area. The new intended usage is also linked to a consolidated tradition of the Sorrento peninsula where, since the mid-1700s, many artists have stayed in search of inspiration. The design of the interior spaces is based on minimum intervention and flexibility, to allow the artists to organize their atelier as they prefer. According to the new functional layout, the villa can host three artists at the same time, with their workspaces, diversified according to the art practiced, and organized through flexible furnishings and low-height service blocks, dry-built and therefore reversible. In addition to the artists' private spaces, there are common spaces for moments of confrontation among guests as well as rooms for events or small exhibitions of the works created in the residence (fig.13). The hope is to give new life to Villa Murat, but also to introduce a compatible form of tourism in the Sorrento peninsula, capable of bringing innovation to the world of art and to the territory that hosts it.

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Vernacular earthen architecture. Construction techniques and restoration. From the international setting to some specific Italian regional cases

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
The research focuses on vernacular architecture, in particular earth buildings, highlighting the different geographic areas involved, building types and construction techniques. In Italy, despite theoretical progress, some cultural and technical problems are still evident in earth architecture conservation. This is also due to the prevalence, among earth buildings, of vernacular architecture, that, in general, has no artistic value and with historical value yet to be fully appreciated. The characteristics of some regional areas are also considered, with particular attention to the Marche and Sardinia Regions, where earthen constructions have existed since ancient times. Knowledge of construction techniques that are the result of age-old experience is the basis for a good conservation and for the design of new ones. Today, some public administrations, on the regional and local levels, have developed operating manuals for the conservation of earth constructions, but there is still no real legislative protection for earth buildings and their material authenticity.

Keywords: *vernacular architecture; earth building; conservation; sustainability.*

1. Introduction

The issue of earth building is becoming increasingly urgent within the discipline of architectural restoration, both due to the perishability of the material when it is not properly maintained, and because conservation efforts either result in the simple reconstruction of entire portions of buildings or are transformed into operations that completely alter their structure. Within an international framework of reference, the intention is to update the state of Italian reflection on the subject through the review of the existing literature, with reference to Sardinia and Marche Region.

2. The international landscape

For several years, scant durability in the absence of maintenance has brought earthen constructions to the centre of reflections, in an international setting, within the discipline of restoration. The specialist literature on the subject has consisted mainly of frequent international conferences, which have the merit of regularly assessing the current state of thought. ICOMOS spearheaded these meetings, organizing two important international conferences in Yazd, Iran, in 1972 and 1976, aimed at defining and sharing the value of earth architectures. These were followed by a host of others: in Turkey (1980), Perù (1983), Italy (1987), the United States (1990), Portugal (1993), the United Kingdom (2000), Iran (2003), Mali (2008), Peru (2012), and in France (2016). TERRA 2022, to be held in the United States (Santa Fe) is already being planned, to be followed by TERRA 2024 in Ecuador (Cuenca). In 2021, a collaboration between the National Research Council of Italy (CNR) and the Chinese Academy of Cultural Heritage (CACH) saw the publication of the results of certain studies carried out on earthen constructions and on the different possibilities for conserving them, in various parts of the world[1]. In general, reflections on the conservation of buildings of this kind vary according to the geographic location where they are made. While there is great interest in the decay owing to weathering, in the more seismically active areas attention focuses mainly on low resistance to earthquakes and on experimenting with possible interventions to improve their structural response[2]. Recently, interest in these constructions has also related to their eco-sustainability.

2.1 Earthquake resistance

The 1998 European Macroseismic Scale lists adobe structures among those most vulnerable to earthquakes. Walls made in *pisé* are generally more resistant than those in *adobe* (by up to 40%). The parameters that influence the seismic vulnerability of *adobe* are the granulometry of the earth used, the moisture content, the level of compaction, the use of natural additives, and the treatment of the joints (which is to say the introduction of materials other than earth between the layers)[3]. On the seismic vulnerability of *adobe* structures, the studies begun in California in 1990 by the Getty Foundation with the *Getty Seismic Adobe Project* (GSAP) remain fundamental[4]. The GSAP's final report noted the inadequacy of the consolidation techniques used to that time, since they were the cause of irreparable damage unacceptable in buildings of historic and artistic value. In some of the interventions studied by the GSAP, the central part of earthen walls had been replaced with elements in reinforced concrete[5], or cages of beams and pillars in reinforced concrete had been employed[6]. The objective of the research was to find reinforcement techniques to keep the walls from toppling during a quake. The indicated solution was the use of slabs, whose beams function as chains if appropriately connected to the exterior walls as in common masonry buildings. Researchers also verified the effects of introducing vertical steel bars in the walls, steel tie rods in the masonry units, and nylon straps applied horizontally and vertically to increase the connection between the partitions, thereby improving the structures' monolithic behaviour. The various systems have yielded good results and can be employed on a "case-by-case" basis depending on whether the intention is to preserve the integrity of the surfaces and of the exterior decorations (internal bars) or to facilitate the reversibility of the intervention (straps)[7]. Reinforcement techniques using natural,

Rossana Mancini wrote paragraph 2, Maria Giovanna Putzu paragraphs 3 and 5, and Enrica Petrucci paragraph 4.

[1] The project was financed by the National Research Council of Italy (CNR) and the Chinese Academy of Cultural Heritage (CACH); Luvidi, Fratini, Rescic, Zhang 2021.

[2] Meli, Hernandez, Padilla 1980.

[3] The available literature on the seismic resistance of cob (rammed earth) constructions is quite limited. Interesting results are in Bu, Wang, Han, Li 2011.

[4] The *Getty Seismic Adobe Project* was discussed for the first time at the Sixth International Conference on Earthen Architecture, *Adobe 90* (Oct. 1990 a Las Cruces - New Mexico), after the Loma Prieta earthquake (1989) in California, which destroyed many historic buildings in *adobe* (Tolles, Kimbro, Webster, Ginell 2000).

[5] An example of this kind of intervention are the Sonoma Barracks in Sonoma State Historic Park, California.

[6] The Plaza Hotel in San Juan Bautista State Historic Park, and the Cooper-Molera Adobe in Monterey, both in California.

[7] This kind of reinforcement is appreciated for its ability to go into action only if necessary, to avoid stiffening the structure, and to guarantee structural continuity between the walls and the partitions and the bearing walls' containment. Interest in these studies is still lively and references to the obtained results are found even in the most recent international meetings (Webster 2016). A system of traditional consolidation, carried out during the building's construction phase, was discovered in Bam, in southeast Iran, after the 2003 earthquake. This involved supporting the roofs, to keep them from collapsing, not only with exterior walls, but also with wooden columns placed in the thickness of the wall sections.

environmentally friendly materials have been tested in Peru since 1972, after the long series of earthquakes coming in succession since 1940[8]. It has been shown, for example, that the insertion of bamboo canes into the adobe wall sections was able to increase their deformation capacity. Between 1990 and 2000, the Regional Centre of Seismology for South America (CERESIS), the German Agency for International Development (GTZ) and the Pontifical Catholic University of Lima (PUCP) tested the use of natural fibre ropes, wood, and steel mesh in the critical points of the constructions. In 2004, a joint project between the Pontifical Catholic University of Lima and the Getty Conservation Institute assessed the effects of external reinforcements made using natural and industrial mesh on both sides of the adobe walls, demonstrating that, in the event of severe earthquakes, flexible materials offer better performance than stiff ones.

2.2 Resistance to weathering

Earth architecture requires regular maintenance in order to keep the external protection systems (plaster and roofs) efficient. Therefore, preventive conservation is highly important in order to avoid the continuous renewal of these external elements, and the consequent loss of the building's authenticity. The constant reconstruction activity has shifted attention from conserving the work to safeguarding traditional techniques, so as to restore "in keeping with tradition"[9]. This is theorized, for example, in Central America, by the *Chilean LSC Atlas project*, which offers a critical vision of the use of non-local techniques and of industrial materials in "vernacular" architecture, for the purpose of conserving the original construction logic more than the authenticity of the material[10]. Meanwhile, a positive evolution from reconstruction/recovery to conservation and protection is found in the Chan Chan site on the northern coast of Peru. Between 1964 and 1969, major reconstructions were done, largely oriented towards formal recovery; however, at a second moment, work began to stabilize the existing structures by creating large wear surfaces. Some wall tops were covered by capping made using a clay mortar with the addition of an acrylic emulsion and other substances like wood glue, but the results were poor, due likely to the high rate of humidity at the site. Better results were attained using ethyl silicate[11]. A new phase of interventions was embarked on after 1998, following the atmospheric phenomenon known as *El Niño*, when prevention efforts were carried out by screening the ancient walls with bamboo and thatch barriers to protect them from the weather. Plant fencing has also been proposed in some sites in Saudi Arabia to defend the remains from sandstorms[12]. Only in some rare cases have restoration materials been made distinguishable from the pre-existing elements. The cases that have been tried out include the insertion, between the surface wear layers and the original wall, of layers of geotextile material, or of earth and small coloured beads.

3. The national situation

In Italy, earth construction tradition is very ancient, as witnessed by numerous archaeological finds and by classical sources that describe the employed techniques with an abundance of detail. The use of earth has thus gone on since antiquity, with variations and alternations, but always with continuity over the course of the centuries, until the early 1950s. In Italy, like other European countries, earthen buildings are present, with different intended uses and different typological characteristics (house, small building, villa, school, church, etc.), in both rural and urban settings. An examination of the data provided by earlier

[8] Vargas-Neumann, Otazzi 1986.
[9] Bartolomucci 2013.
[10] Suilan Hau Espinosa, Jarpa 2016.
[11] On the use of ethyl silicates to consolidate *adobe* structures in the late 1980s, see Chiari 1988. On the Chan Chan site, see Morales Gamarra 1983.
[12] Mancini, Putzu 2019, p. 735.

studies[13] shows that all Italian regions, with the exception (based on the knowledge acquired to date) of Valle d'Aosta, traditionally saw the use of earth construction techniques, with technical and formal solutions often differing from one another[14]. Moreover, as in the other non-Italian settings affected by the phenomenon, there is a strong link between the presence of large river or lake areas, which promote the deposit of clays, and the consolidation of an earth construction tradition (Po plain; subcoastal zones of Marche and Abruzzo; area of the Agri and Sinni River basin in Basilicata; Tirso valley in Sardinia)[15]. It is also noted that beyond the presence of clay in the subsoil, a fundamental role in spreading earth constructions is also played by climate conditions (temperature, rainfall, latitude and elevation) that condition appearance and persistence. Although Italy is home to all the construction techniques typical of the vernacular tradition of other European countries, particularly widespread among those involving the use of earth are *adobe*, *pisé*, and, to a lesser degree, *torchis*. In spite of the process of neglect that began in the second post-War period, and although, until the second half of the twentieth century, quite little was known about earth construction techniques and there was a widely-held conviction that they had fallen entirely into disuse, some studies have actually demonstrated that in the 1960s, in certain regions of Italy, earth was still used following traditional procedures[16]. Starting from the 1980s, the new approach towards a way of building that presented features of sustainability and respect for the environment saw in earth construction all the technical characteristics that suit it for the building of healthy, pollution-free environments[17]. Although the earth sector now has numerous results of international research and studies at its disposal, there is still no national-level legislation that recognizes earth as a construction material and that provides technical rules of reference to regulate and define the types of intervention suitable both for historic construction and for constructing parts or entire buildings *ex novo*[18].

4. Earthen houses in the Marche

In the Marche region, the earth construction technique was used until the nineteenth century. As late as 1934, *Indagine sulle case rurali in Italia* found about 1,401 dwellings in the Marche built in earth and thatch using the technique called *a massone* or *maltone*. In Pesaro, 14 houses were censused, 95 houses in Ancona, 931 in Macerata, and 361 in Ascoli Piceno[19]. The first to raise doubts as to the truthfulness of these data was Clarice Santoponte Emiliani, who several years later was to perform her own fact-finding survey aimed exclusively at earth constructions, discovering a reality that was quite different[20]. According to Santoponte, the number reported in the 1934 was to be considered erroneously low due to significant errors made in gathering information and due to the desire to conceal or at least to reduce the presence of these buildings.

Fig. 1. House in the Macerata area, in accordance with the typical construction technology, 2020.

[13] Bertagnin 1999; Baldacci 1958; Lasalandra 2008; Manca, Cossu, Loche 2005; Mancini, Putzu 2019.
[14] In particular, according to the data provided by CeDTerra (documentation centre on earthen houses; see also the rich bibliography provided there), on national territory, earthen houses, widespread above all in Sardinia and Abruzzo, are also present in Emilia Romagna, part of Veneto, Lombardy, Piedmont, Tuscany, Marche, Molise, Basilicata, and Calabria. Other construction types were noted for example in the Marengo plain (Alessandria), where we find buildings like the Pasturana church and the Spinetta Marengo school, and in Quartu Sant'Elena (Cagliari), where there are numerous small urban buildings (Bertagnin 1999, pp. 24, 25).
[15] Lasalandra 2008, p. 256; Galdieri 1987.
[16] Lasalandra 2008, p. 258.
[17] Bertagnin 1999, p. 285.
[18] Currently, Law no. 378 of 24 December 2003, *Provisions for the protection and valorization of rural architecture*, is the only regulation that also relates, albeit marginally, to earth constructions, for which, for now, only proposed and draft laws have been developed.
[19] Istituto centrale di statistica del Regno d'Italia 1934.
[20] Santoponte Emiliani 1941, pp. 245-258.

Santoponte's research shows that most of the earth constructions were distributed in hilly areas with concentrations exceeding 20% in the Macerata area. These were the houses of day labourers, poor people, those who made do to eke out a living in the peasant economy; during the post-War period, with the exodus from the countryside, these houses underwent dramatic phenomena of abandonment. In those that survived, their earthen nature was concealed as much as possible, almost as if it were a mark of poverty and infamy for those who continued living in them. The construction technique consisted of mashing a mixture of clay and straw to obtain a dense, plastic compound, which was then divided into clumps weighing 5-10 kilogrammes each, coarsely shaped into cylinders tapered at the ends, averaging 15 cm wide and 20-30 cm long. To make the construction, these *massoni* were laid in layers from 50 to 70 high and 40 to 80 cm wide, to form a monolithic wall structure. Each layer was allowed to dry for several days, during which the wall was trimmed and squared.

Fig. 2. The construction process involves the entire family, photograph of 1919 from a private archive

Particular attention was devoted to site selection, both to avoid the problem of humidity, and because suitable earth had to be available in the vicinity, since transporting the raw material from a distance was not cost-effective. Foundations were shallow if not absent altogether. Once the building's perimeter was established, the area was dug out to a depth of between 50 and 100 centimetres; the earth was then placed back in the hole in 30/40-centimetre layers, adding water and straw and mashing it to blend together, and then allowed to dry. Once ground level was reached, the bearing walls began to be raised. The craftsman laid *massone* along the house's perimeter in one layer after the other, in alternating courses, or more rarely in herringbone courses inclined at 45°. Once a layer was completed, the craftsman crushed it down with his feet to fill in the cracks; he then smoothed it inside and out with his spade, sometimes working the earth with water again. As the layers progressed, the *massone* grew smaller, to allow them to be put them in place more easily; the walls thus tapered in, measuring about 80 cm at the base and 50 cm at the top. Given the nature of the material, the intersections of the walls represented the most delicate points in the construction; to solve the problem, the junctions between walls were often reinforced with horizontal connections of olive branches sunken into the structure. For two-storey houses, the floor slab was made at a height of about 220 centimetres, by anchoring poplar, elm, or oak beams to the wall, placed in parallel one metre apart, and topped by a second, denser, orthogonal frame of slats, upon which was placed a layer of mud-daubed reeds woven or twined together, which served as the base supporting the burnt brick floor. The same technique was used to build the roof, whose covering was made with bricks (*penci*) resting upon a mixture of soft earth atop a layer of woven reeds. The roof was rather overhanging – usually by more than 50 centimetres – to protect the walls near the ground. In general, only the north-exposed exterior wall was plastered; far more frequently, the use of plaster was limited to the outlines of doors and windows. For the base, the protection was made using burnt brick or stone, up to the height of about one metre. The analysis shows the great historic and cultural value of these constructions, as productive and life forms, that express the region's identity. Over the past decades, great interest in architectures of this kind has developed, thanks also to the numerous research efforts carried out by universities, the Region, and local institutions that have devoted themselves to studying the most significant examples present in the Marche[21]. The analyses were brought together in a cataloguing data sheet, grouped into provincial settings in accordance with the density of earth construction.

4.1. A virtuous example. Recovery of the Village of Villa Ficana in Macerata

The heightened sensitivity to safeguarding this "minor" building heritage led, as in the case of the Ficana quarter in Macerata[22], to identifying multidisciplinary procedures aimed at recovering earth construction.

Fig. 3. The village of Villa Finacana in Macerata, after the restoration interventions, 2022.

To prevent the abandonment of this construction technique, an articulated programme was initiated in 2000. In 2014, the Municipality of Macerata held a competition for submissions of design proposals for museum interventions and the recovery of the buildings. The *Recovery Guidelines* defined the field of possible interventions, in such a way as to represent a binding basis for future recovery work, and to harmoniously and sustainably reconcile possible changes with the conservation of all the historical and cultural values that the village possesses. The *Guidelines* provide a working tool able to guarantee a high qualitative standard for future designs; at the same time, intended uses deemed compatible with the typological and size characteristics of earthen houses were identified. In recent years, this allowed the village to be restored to its original configuration, while also fostering the creation of a "museum of the earthen houses of the Marche."

5. In depth: Sardinia

In Sardinia, this technique has been attested since antiquity. Clayey earth, in fact, has been found in some early Iron Age nuragic sites, in private buildings from the Phoenician/Punic Age, and in Roman and Medieval sites[23]. The technique in mudbricks (*ladiri*), now more well-known, saw additional impetus during Spanish domination and was employed in subsequent centuries along with other materials (iron, brick, and reinforced concrete). Until the 1950s, *ladiri*, along with stone, was the building material most used in private construction (fig. 4).

Fig. 4. Earthen wall of a house in the town of Donigala Fenughedu (Oristano) (Source: Putzu, 2015).

The 1980s saw a revival of the technique, which appears widespread with certain variants in much of the regional territory; however, the historic and geographical regions where it is most prevalent are the areas of Campidano Maggiore and Campidano Meridionale, the Trexenta area, and the area of the Ogliastra plain. It is used mainly for residential construction: the courtyard house, the residential building, and the villa, but also for some industrial buildings. Absent an appropriate protocol, univocal and shared by the entire scientific world, a useful tool for

[21] Architetture di terra nelle Marche 2005. The volume collects the results of a research work on the building techniques and conservation methods of earth architecture constructions.

[22] The Village is in the northern zone of Macerata. Its origins date to about the nineteenth century, as witnessed by contemporary cadastres, and it covers an area of about 7,000 m^2. The demographic increase recorded in the nineteenth century saw houses proliferate exponentially in response to housing needs rising during those years within the poor class of farmers.

[23] Sanna, Atzeni 2009, p. 3; Putzu 2015, pp. 131-135.

construction practice may be seen in the manuals for the recovery of the historic centres of Sardinia, done at the initiative of the Region and the Urban Planning Councillorship[24]. Among the "good practices," useful reference data are provided both for structural interventions and for the technological characteristics of the individual component materials. In particular, in the case of possible reconstructions following collapse of entire walls, the use of similar and compatible materials and technologies is recommended; however, especially in buildings of particular testimonial significance, a distinction between the original and the reconstructed part (e.g: interposition of a shutter, working with undercut) ought to be made. The reconstruction of partition walls using "non-traditional" materials and techniques is not ruled out a priori, but "is deemed at any rate inadmissible, due to the incompatibility in thermohygrometric mechanical behaviour, and the use of concrete, whether or not reinforced"[25]. As concerns the interventions on the floor slabs, which in historic Campidano-area earthen construction always have a wooden structure, the support junction to the wall should advisably be well aerated, to guarantee good transpiration for the wood. In addition to the use of metal straps bound to the ends of the beams and anchored to key beams on the wall, an additional structure stiffening the masonry structure, which supplements the installation of chains and tie rods, may be made by introducing ring beams or hoops. Considering that the existing ring beams are usually made with rubble-core filling material, contained where needed by brick or stone cornices, these elements should advisably be "emptied, while still maintaining on the outer edge of the masonry a containment, to prepare the housing of the ring beam"[26]. Upon careful evaluation, it is considered admissible to use ring beams in appropriately reinforced concrete, while it is held that ring beams in cement must be excluded. Lastly, an essential component for conserving earth architectures is the plaster, based on common lime, better if in the form of slaked lime (grassello), or earth based. An excellent compromise may be found by making an earth-based mortar, adding lime in small amounts[27].

6. Conclusions

To date, the studies on earth structures, however abundant, are based on extremely heterogeneous survey material relating to existing structures, using no "univocal" criteria for interpretation. Moreover, there is still no thorough survey of existing structures that would be such as to provide a comprehensive picture of the current situation. Although some sensitive public administrations have developed targeted operating manuals and specific guidelines for restoration, there is still no legislative recognition protecting earth construction in its material authenticity and as a constituent element of historic fabrics.

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Rigour, methodology and use, success in heritage conservation: The tower of the St. Mary Magdalene`s church.

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Topic: T4.1. Conservation, restoration and enhancement of vernacular architecture

Abstract
The church of Santa María Magdalena of Matapozuelos (Valladolid) from the sixteenth century, made of Mudejar masonry brickwork combines late Gothic with Renaissance elements, is a Cultural Interest Asset. Its prominent tower is the object of this project. It was proposed the tower is restored to its original monumental value and condition, giving it a new life. The most significant change has been the installation of a fixed staircase extending the existing one to access the bell tower and upper levels, allowing controlled access for visitors and creating a more open and bright interior space, giving it a more functional sense, without losing the permeability of the bell tower. The research begins with the previous studies: historical, archaeological, petrological, photogrammetric and architectural, justifying the action theoretically. This led to the use of traditional methods and materials from the surrounding area in order to preserve the vernacular heritage: the tejar brickwork, the wood in the floorboards and woodwork (specifically elm wood), the vault cladding and the lime rendering of the walls, are highlighted. The problems were identified by classifying them according to their degree of complexity and a project diagnosis was made that served to take the necessary measures for their restoration. Three levels of intervention are established according to their volume of affection, three action groups are proposed according to the nature of the objective to fulfil, and three actions are qualified according to the contribution to the building to be preserved: repair, replacement or addition. This time of methodological study makes us achieve an exhaustive knowledge and a sensory closeness to the building, which makes us "feel it inside": History in architecture is important when it becomes blood. (Ignazio Gardella. Verona 1991. Conference: "My first 90 years in Architecture").

Keywords: *restoration, methodology, recovery, historical heritage.*

1. Introduction

Vernacular architecture can be defined as a type of local or regional construction, in which historical materials and resources of the geographical area where the construction will be built are used. Many architectural typologies built using traditional methods are different from those elsewhere in the world, becoming means of creating a distinct identity.

It is a continuous process that includes the necessary changes and continuous adaptation in response to limitations or social advances, technical and environmental.

As an illustrative example of vernacular architecture, the success story of the restoration of the tower of the Santa María Magdalena`s church in Matapozuelos (Valladolid) from the sixteenth century is exposed (Fig. 1).

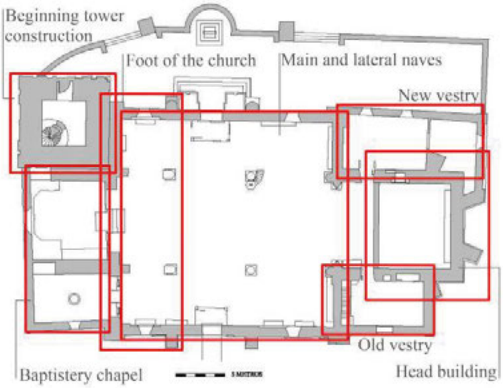

Fig. 1. Church plant with historical references.

This church underwent numerous transformations throughout its history between the transition from late Gothic, with Renaissance decorative and structural elements. Fig. 2 shows, in summary, the different parts built in its different stages.

STAGE	PHASE	MILESTONE
I. FINAL GOTHIC	1.1. Construction of the head of the church	1544
II. CLASSICISM	II.1. Main and lateral naves	1563-1567
	II.2. Old vestry	1594
	II.3. Construction of the choir	1597
III. BAROQUE	III.1. Beginning of the new tower construction	1596
	III.2. Baptistery chapel	1742
	III.3. New vestry	1754

Fig. 2. Main transition stages of the church

Its architecture was transformed according to the needs of its time and adapting to the requirements of the local people, around their main function: worship. But without forgetting other processional and ritual needs, representative and collective.

For the original construction materials found directly in nature were used, some of which, such as *tejar bricks* require a simple transformation process. The basic construction materials that were used were the limestone of Campaspero, pine and elm wood, *tejar bricks* with different types of brickwork depending on the period (Mudejar, classicist) and the areas in the work (walls, roofs), the arabic tile with construction techniques according to each period and the needs of the time and place.

Materials such as lime mortar and construction techniques such as the semicircular arches of the holes used in the church are repeated throughout the history of construction.

Its walls were built with plinth of rectangular ashlars of white limestone of Campaspero and the rest of exposed brick.

In the restoration carried out in 2012, the intervention on the imposing tower located at the foot of the Epistle nave, made of solid *tejar bricks* and the roadway with stonework had a preponderant role.

Fig. 3. 1. View of the exterior of the old tower. 2. View of the interior of the old tower with the holes for the bells.

Formerly to the construction of the original tower, another tower had been built. The tower was knocked down due to structural problems and some elements that were not demolished, still remain (Fig. 3).

Alongside the aforementioned remains the current tower was erected, changing the previous symmetrical typology, by one where the tower is not located on the axis of the church.

The main constructive objective of the restoration of the tower was to reaffirm its value and characteristics according to its monumental condition, and on the other hand to solve the serious conservation problems due to water, wind and the nests of the storks that were causing great deterioration.

The aim of this work, was also, to a lesser extent, to improve the north facade and the atrium of the church.

Focusing on the bell tower restoration, in addition to the exterior condition, served to give an additional functionality to the interior, offering the building a new, clean and functional. face unknown until then.

A spiral staircase was incorporated into the tower that extends the existing restorated, to allow access to the last two levels, without losing the permeability of the bell tower when it is observed from the exterior. This serves for the visits of tourists to the bell tower and at the same time, gives access to the gallery, now a viewpoint of the landscape of the dotted moorlands fields of Castilla.

The intervention on the interior of the tower, enhances its space, opening up blinded openings, eliminating failed additions, and reconstructing original forms and finishes. A more open and luminous space is created, giving it a cleaner and more functional feel.

This restoration achieves a greater perception of sensations of the building and its beauty, and improves its maintenance, preventing future deterioration. Prior to the start of the work, historical, archaeological, petrological and photogrammetric research, carried out, which served as a basis for understanding the building, and thus for finding the best architectural solutions. An architectural analysis of the state of the building, was also carried out.

2. Previous studies

Previous studies served to know the gradual construction process of the church during almost three centuries. The anthropic actions define the evolution of the building itself that was leaving its mark on its walls through repairs, reforms and additions.

First of all, studied historical notes (Urrea, 1977; Madoz, 1870; Arévalo, 1987) and previous technical reports (Carbayo, 2009), were studied. Archival documentation about the church and old photographs were collected that valuablely aided decision-making regarding the restoration.

Then the archaeological study (Harris, 1989; Caballero Zoreda, 1966; Mannoni, 1976) was carried out using the Harris system to know the order of the deposition of the strata and the creation of intervention surfaces. A historical study was also carried out (Heras, 1975; Bustamante, 1983; García, 1960; Urrea, 1987). Both were supported by the company AICARA, Archaeology and Cultural Heritage. A survey of the walls most affected by the weather was made in order to characterize the coatings of the building and its damage. From the stratigraphy reading of the walls, the different constructive periods were obtained in which repairs or additions were made to the walls. In addition, they carried out twelve manual tastings on the North facade due to the problems of humidity and detachment of materials. It was detected that one of the most deteriorated points of the tower was in the octagonal top and in the protruding elements.

The studies of inorganic materials (petrologic) that were carried out by the companies GEA and TECNUM, aim to support the project's approach of a comprehensive intervention of a conservative type. In addition, twelve manual inspections were carried out on the north façade due to problems of damp and detachment of materials. From this study a characterization of the materials used in the execution (bricks, adobe, stones, mud, alterable and mixed materials) was obtained, which allowed to know the architectural evolution that it had over time.

From the analysis of the architectural pathologies, it can be seen that the horizontal structure of the body of the tower is made up of vaults on which honeycomb bonds rested and which served as a support for the floor slabs. This structure was also very deteriorated. It was also observed that in the area of the chancel and the nave the brick walls had different heights which showed that alterations had been carried out over time in order to increase their size and thus be able to accommodate the faithful inside. The old sacristy was built at the time of the old tower with walls built using the traditional technique of mixed brick and rammed earth. It was found that one of the most deteriorated points of the tower were the octagonal top and the protruding elements.

With all this work, the pathologies that were present in the area of the work were determined, as well as the causes that generated them, such as the presence of soluble salts and damp.

Suggestions for intervention were made, such as using the same materials or replacing them with stone, mortars and ceramics compatible with the existing ones, respecting the dimensions.

In short, the problems were identified and classified according to their degree of complexity and a project diagnosis was carried out which served to take the necessary measures for their restoration. This determined the use of traditional methods and materials from the surrounding area, thus preserveing the vernacular heritage. The use of granite and quertzite from the rivers basin that meet in Matapozuelos (Adaja and Eresma), is a geographical identity.

3. Tower building system

The tower was built with load-bearing *tejar brick* walls with putlog holes, without intervening walls of rammed earth. The distance between bricks ranges from three to five cm. filled with mortar. Figure one shows the construction system of masonry wall with scaffolding. This will become evident in the subsequent action.

In certain interior finishes the walls were covered with a layer of lime plaster. With the previous analysis of reading of walls in the church, different types of grayish and whitish mortars of poor quality have been detected. In an area of exterior walls, the presence of iron slags (linked to the passage of the railway through Matapozuelos) has been detected, and a third layer of thick mortar that ended up causing problems of disintegration to the bricks

The levels of the tower shaft were built with vaults on which the wooden floor was laid on honeycomb bond. The rest of the floors were wooden slabs with boarding.

The main dome and the small dome were composed of solid *tejar brick* and over it and as a covering material the brick arranged flat overlapped with conformation of curved flat tile in its lower part, giving a slamate appearance.

4. Analysis and diagnosis of problems

It is the most damaged of the building by the passage of time and lack of maintenance. The greatest damages are in the octagonal bodies, and cornice of the floor of the first terrace. Rainwater and inclement weather have ruined brick walls, while the action of the birds ruins mainly those of stone and ornamental elements.

The free discharge from water above the stone bases of the balustrades, causes all the joints of the stone overhang to be washed.

The main problem is the lack of localized drainage function, flights and imposts, and big gutters, whose purpose is to prevent runoff.

The disfigurement of voids is another action of water.

The rest of the brick walls has a better appearance, only harmed by biogenic stains mainly.

This external damage are complemented on the inside by the loss of woody materials and the accumulation of bird droppings, which accelerates the process of loss: affected floors, slabs and beams are an example of this.

The maintenance and repair work is practically heroic, and therefore the proliferation of nests (in some cases twenty one stork nests have been counted) and birds, as well as the existence of leaks, are increasingly numerous.

It should be noted the good condition in which the existing spiral staircase is located, with little loss of material. However, it only leads well to the base of the plank that is on the third level, deconfiguring in the last section to the board itself, and leaving others seven metres and two levels without comfortable access without risk.

In the execution project, all these pathologies by construction systems were described in detail, and as well as the restoration work had to be focused, mainly on the tower´s octagonal tops and the protruding elements.

5. Objective and proposal

It is intended to carry out the necessary works for the recovery of an optimal state to the tower of the church of Santa María Magdalena, and for its enhancement.

The main action is the recovery of the walls, ornaments and the cleaning and sanitization of all the degraded areas of the tower and above all facilitate the access for visitors to the upper levels as well as facilitate maintenance.

The proposal was based mainly on a mimetic restoration using materials highly present in the con-structive tradition of this geographical area. These building materials and systems include *tejar brickwork*, wooden floorboards and elm woodwork, the vault cladding, and the lime rendering on walls that coexist with the striking appearance of the *tejar brickwork* in walls, cornices, imposts, window sills, spandrels and roofs. Constructive solutions for technical improvement are also provided, which support the proposals for use and maintenance.

Highlight the prolongation of the staircase as the most significant contribution by the interior that serves to facilitate the ascending route passing from the dark ground floor to the clarity of the upper levels with the largest number of openings. The ascent through the shaft of the tower is made with breaks on the two intermediate floors and ends with two final stops: the first, interior, in the bell tower; and the second, exterior, in the perimeter gallery.

The project is conditioned by the budgetary possibilities and adjusts to them, undertaking very specific parts of the church, leaving others also necessary.

5.1. Levels of intervention

To achieve the objective, three levels of intervention are proposed:

- Major repairs aimed at putting its functionality into use: it is the tower, as a body of bells and symbol. Hence the interest in the use of bells, staircases, and above all its octagonal top: good use is the best way to maintain a building.
- Shallower interventions that mainly affect the image of the building and ensure that it never suffers major losses and damages. This mainly concerns what is to be undertaken on the entrance facade: protection of north-facing side.
- Collateral work, of punctual conditioning and accessibility: it is about levelling the access staircase, as well as the improvement of the installations.

In order to achieve the objectives proposed above, and taking into account the intervention criteria, the actions to be taken are mainly aimed at achieving the following:

5.2. Performances

- Recovery of the masonry, ornaments and lines of architecture: it is about reconstruction of masonry, replacement of lost elements, and ultimately the putting in correct constructive state of all the elements, being in the most degraded areas (two last octagonal bodies, and in the lines of architecture) where these actions are concentrated.

- Protection against agents that degrade the tower:
a) avoid the stay and nesting of birds with sloping sills, carpentry that allows the ventilation of the interior, in those holes of the shaft of the tower, more hidden, that do not affect the visual permeability; and with mesh in the finishing ones, which do need that transparency.
b) prevent the access of water to the interior and facilitate the evacuation and waterproofing, on terraces, on window sills, cornices and coamings.

- Facilitating access and maintenance: improvement of the areas for acces and vertical travel, and their extension towards the furthest levels with the main aim of carriying out maintenance work in a comfortable and safe way, which will guarantee their use and therefore the achievement of its purposes.

5.3. Detailed analysis of the actions

Each part of the constructive intervention was analysed in order to classify them according to their contribution to the previous building: repair, replacement or addition. In this way, the nature of each constructive contribution to the singular building, which will last over time, is recorded in the project.

6. Execution of the work and unforeseen events

The work begins with the installation of scaffolding and auxiliary resources that allowed access and visualization of all points of the tower. In this way, as if it were a photographic zoom, the initial vision with which the project had been drafted was increased, and the severity of the pathologies seen until then from afar, and even new ones, which due to the inaccessibility of the points could not be appreciated before, was verified. It was also found that certain elements did not fulfil the functions that were expected. Significant loss of material was centred on cornices, imposts, spandrels, balustrades and pinnacles, and this loss was particularly accentuated, especially in the octagonal finial, and the cornice on the terrace level.

The biggest of the new problems encountered was the breakage of the small dome of the lantern and the top of the stone pinnacle of the top where the weather vane is located. In order to successfully repair it, the origin of the breakage was analysed, and the cause was diagnosed as being wind whipping the weather vane and the lightning rod cable, which, in a tense manner, descended through the small dome and the lantern, transmitting horizontal movements to the pinnacle.

The restoration process began with the selective cleaning of the masonry, the sanitized of the deteriorated joints, and later with the particularised grouting according to the facade plans, the replacement of the missing ceramic pieces (new pieces made by hand and according to size), and the repositioning and reintegration of all the balustrades, pinnacles and finishes.

The roof of the dome is was subject to a detailed restoration and cleaning program. This included the sanitisation and removal of lime scale from roof tiles, stone elements and cornice details with minimum degradation. All added materials, such as Portland mortars or deteriorated metal elements, are chopped and removed. It is noteworthy that two ceramic pieces with unique markings were discovered on its summit: one with the full name of Machuca, and two others with handprints, as signatures of the author or authors of the work. (Fig. 4).

This brings architecture closer to human feeling, naturally recording the people who build them.

Fig. 4. Footprints and signature found at the top of the tower.

Fig. 5. Comparison of the previous state and the renovated state. Summary images of the final state.

7. Conclusions

The spirit of the project is to return the lost prominence to the tower of the Santa María Magdalena`s church, in Matapozuelos (Valladolid), turning it again into an architectural attraction of singular beauty and majesty that can be admired by the visitor both outside and inside. The objective is complemented by a new use: the possibility of climbing the tower to enjoy an unparalleled panoramic view of the environment, simultaneous with temporary exhibitions that will accompany it on its ascent.

In short, it is an example of how the techniques, rigour and methodology implicit in a restoration are more noticeable if the program allows the public to bring the place to life.

At all times the care and protection of our vernacular heritage has prevailed through the use of both materials and traditional construction techniques present in the geographical area, which positively reverts to the development of the local activity.

After eight years of its completion, the project has achieved the expected results: as for the pathologies that the building presented, they have not become visible again, so they have managed to solve the conservation problems and return harmony to this genuine example of regional architecture, with balanced repairs and minimal impact on its historical materiality. As for its new use and point of view, the increase in visitors has been exponential. It is noteworthy that the project obtained the recognition "Special Mention of Restoration" in 2021 of the fifth Edition of the European Prize for Intervention in Architectural Heritage, and which the jury described as *an intervention that allows the discovery of an interior part of the building through the possibility of accessing the tower, which, in turn, offers a new use: the enjoyment of an unparalleled panoramic view of the enviroment. In short, this work exemplifies how the techniques, rigour and methodology implicit in a restoration are more appreciable if the program allows the public to bring the place to life.*

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Strategies to value the dispersed heritage of rural Andalusia. Lagares, paseros and vineyards: the architecture of the raisin

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
The United Nations Food and Agroindustry Organization (FAO) declared in 2018 the Malaga raisin production system as an Important World Agricultural Heritage System (SIPAM). There are 62 SIPAM worldwide, five of them in Spain and Malaga is the only one in the entire Andalusian autonomous community. The value of this declaration resides in the recognition of a cultural heritage capable of combining agricultural biodiversity with resilient ecosystems and a valuable cultural landscape where its architecture remains linked to artisan production. The SIPAM of Malaga has an area of 280 km², it ranges from the cultivation of the Moscatel grape to its transformation into raisins through drying in the sun, favoring the conservation of the landscape, avoiding erosion or desertification processes and constituting an element of linkage of the population with its territory. Since the 18th century, the production coexisted with other forms of elaboration that complemented it. Said structures associated with this industry were located on agricultural properties following various construction models, ranging from rudimentary forms of sunlight such as the almijares in the paved ring of the press, to buildings of higher production. After the phylloxera crisis and the process of constant production decline, we would end up with the destruction of a large part of Malaga's payments. The wineries, paseros and warehouses were transformed into ruins or were reconverted to other lower-yield agricultural activities. Of that material wealth we recognize scattered examples in the current rural landscape of the mountains of Malaga, which architectural qualities deserve to be rescued and valued as an example of the unique and representative traditional architecture of a declared cultural landscape. These results are directly linked to the work strategies and objectives that we follow in the Transnational research project SIN-PAR (Innovation System for the Heritage of Rural Andalusia).

Keywords: *Lagares; vineyards; heritage; Andalusia.*

1. Historical background

The Raisin Route is located in the central area of the Axarquía region, where optimal climatic and geographical conditions for the cultivation of raisins can be found. The predominant variety of grape in this area is called *moscatel.*

Axarquía occupies an area of about 585 square kilometres including the boundaries of thirty one towns, which are located in the territorry along the coast from Malaga capital to the border with the province of Granada and from this coastal limit ascends through the peaks of the Natural Park of Sierras de Tejeda, Almijara and Alhama, which forms the natural frontier between the provinces of Malaga and Granada. Specifically, the Raisin Route is formed by the towns of Comares, Cútar, El Borge, Almáchar, Totalán and Moclinejo. Around an eighty per cent of the population in these towns is mainly dedicated to this crop. Smallholder farms predominate, and ninety per cent of these are family-owned and do not exceed an extension of two hectares.

The muscatel raisin is a product of enormous traditional and cultural value for Andalusia and particularly for the province of Malaga. Its cultivation has a traditional character, which has impregnated the culture of the Axarquia of Malaga (region where the production of Malaga raisins is concentrated) for more than three centuries.

Vinery cultivation would reach the Iberian Peninsula together with the olive tree, very possibly, brought by the Punic civilization, beginning its own path in the middle of the first millennium BC. By the times when the Roman eagle got established in what we have been calling "bull skin", vine already had its own culture which was maintained even by the Arabs, as evidenced by the enormous number of documents that refer to the importance of this monoculture despite the Koranic prohibitions.The Catholic Monarchs, given the importance of the sector for the region, ordered the creation of the Brotherhood of Viñeros to "watch over and take care of the good planting of their vineyards and the formation of their wines", becoming effective on January 12, 1502. Until the crisis due to phylloxera infestation affecting the crops from 1878, the vineyards constituted the economic support of the province and promoted its economic awakening during the 18th and 19th centuries, as reflected in the work of British travelers who passed through our land including Francis Carter (1772), William Robertson (1841) and Edwin Lee (1855), among others. The description of the works for the cultivation of the vine carried out in 1787 by Joseph Townsend deserves a special mention. The existence of an abundant workforce, as a result of a strong demographic growth between the end of the 15th century and the beginning of the last quarter of the 19th century, meant that all the arable land in this region was dedicated to growing vines.

2. The agricultural landscape in the Axarquia

Axarquia, where practically all of the Malaga raisin is grown, is located to the east of the Malaga province capital. Its Denomination of Origin covers the area of a total of thirty five municipalities, although the production of raisins is concentrated in fifteen of them. This region is characterized by the proliferation of small, predominantly rural nuclei, with small-sized towns under 250 inhabitants. Alternatives to this crop are very limited, turning the Malaga raisin into the main agricultural activity.

Terrain`s orography is very variable, being mostly hilly terrain with heights that oscillate between 100 and 600 meters above sea level, characterized by an average slope excessive for intensive agricultural practices, not allowing mechanization and limiting the possible agricultural alternatives. It can be said that vines constitute the main factor avoiding desertification of these areas, which average slope exceeds of 45% in more than half of its territory.

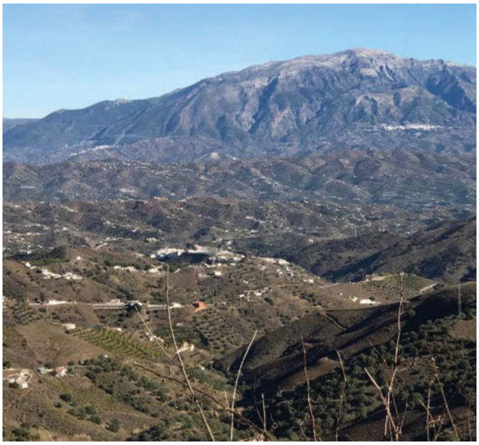

Fig. 1. Axarquia landscape.

The landscape of the Axarquia has to do with the contemporary Andalusian political and cultural identity, but also with the Nasrid and the Muslim identities as well, and even more is determined by the small farms and the scattered habitat. Until the 1870s, the province of Malaga experimented its demographic expansion, expanding farmland and overexploiting the most fertile crops. This increase in farmland was supported and stimulated by the disentailment process of the Catholic Church, which developed in a very complex way in the province of Malaga, although it did not ultimately lead to a profound change in the property structure[1]. The structure of the property remained in the hands of small owners or tenants, while the economic control or their income was held by the Malaga merchant bourgeoisie, including some landowners, who marketed the products -raisins, grapes and wine. This agrarian wealth is related to a similar architectural wealth, which can be appreciated not so much in the volume and size of the buildings, but in the architectural solutions and diversity of construction typologies.

Within the nineteenth-century bourgeoisie, the Larios and Heredia families stand out. Both owners of large agricultural estates within the municipality of Malaga would commercialize the production of wine and raisins from the Montes and would build their estates in the eastern and northern areas of the municipality. However, after the phylloxera crisis and the ruin of the Heredia house, many of its properties passed into the hands of the Larios family, a fact that would influence production in the western sector from an agricultural point of view. Until 1885, phylloxera devastated practically all of Malaga's vineyards and their owners were unable to replant the fields, which were abandoned along with their most representative architecture.

3. Cultivation and harvesting techniques in the Axarquia

On the Raisin Route, mountain agriculture continues to be performed in a traditional way and without machinery. The production of raisins requires a lot of work and dedication, and from February to October the farmers spend most of the day tending and preparing the vineyards. Work begins in February, with the pruning of the vineyards, consisting of cutting dry shoots and leaving the plant ready for new shoots to come out. The *cava* is the next step and consists of removing the soil so that the roots of the vine find more space to improve their growth. The *cava* is always carried out between the months of December and January. At present, for this process, the *esfrague* technique has become predominant, since it requires less effort and instead of acting on all the arable land, it acts only on each plant. The next step is called *bina*, whose objective is to remove the weeds and cover the vine with soil, taking advantage of the fact that the soil is looser and easier to handle. This work is done during the month of April and is also known as *hacer la piscina* ('making the pool').

Fig. 2. *Lagar* with *paseros* at Almáchar.

During the months of May and June, the grape clusters begin to fatten and in order to help in the task, pruning is carried out, which consists of cutting the tips of the different branches so that they stop growing and all the strength is carried by the clusters. After this and until August, there is a constant coming and going to see how the harvest evolves in its final stretch. The harvest of grapes is done through several passes, collecting the ripe clusters in each of the plants with the help of a knife. The grapes are then placed in boxes weighting around 20 kg each, that are usually transported by mules dressed in *pedreas*(special panniers adapted for the grape boxes). Once the grapes are harvested, they must be transported to the dryers where the grapes are spread to be transformed into raisins. They are usually the property of the farmer, or at most of a small number of neighbors, and appear laid throughout the

[1] AA.VV. (2000). *Cortijos, haciedas y lagares. Ar-quitectura de las grandes explotaciones agrarias de Andalucía. Provincia de Málaga*. Consejería de Obras Públicas y Transportes. Dirección General de Arquitectura y Vivienda. Sevilla. p. 42.

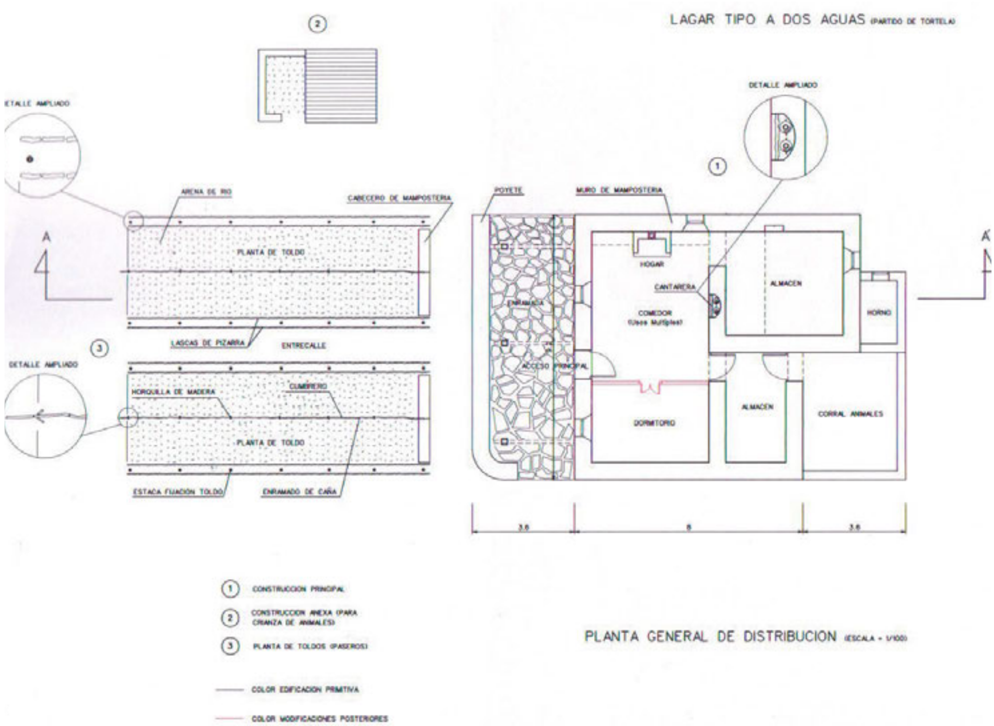

Fig. 3. Typical layout of a gable-roof *Lagar*. (Source: Gámez, J. 2004).

countryside and close to the small farmhouses that serve as temporary housing for farmers during the harvest and raisin seasons.

4. The architecture of the raisin: *Lagares* and *paseros*

The structures associated with the grape and raisin industry are located on agricultural land following various construction models, from rudimentary ways of taking advantage of sunlight such as soil flat areas or masonry ones, to the winery press (*lagar*) or industrial-type buildings intended for the large-scale production.

The basic model of exploitation of the vine in Malaga is the *lagar*. It is defined by its small size. Its characteristic elements are a counterweight wall for the press beam, the floor presses and the beam itself that will determine the layout of the building.

The first preserved examples date back to the 18th century, but its true development took place during the 19th century, when a true popular language articulated around the production of wine and raisins was defined.

The *lagar* is a small space in which residential aspects are mixed with work functions. Almost all of them have a kitchen with a fireplace, which has a double function: heating in winter and at the end of summer and kitchen service, with stone shelves arranged to place pots or pans.

As the kitchenware was minimal, hardly a place was dedicated to the utensils, which could be on a table or in a hole in the wall as a cupboard. In this space there was always room for the water pitchers called 'cantareras', and above them the 'vasar' for plates or glasses. These domestic spaces are shared by all the Axarquia wineries. In addition to this interior space, we have the bedrooms, of a varied number (from one to three) depending on the size of the cellar. They are usually small and share their main function with the wine press. Spaces such as the stable or the corral linked to the economy of the countryside are annexed to the warehouses. The exterior spaces of the winery are equally important given its dimensions, and the front arena was essential in it. The rural house has a terrace that is located in front of the entrance. In this space, multiple activities related to the tasks of the raisins are carried out during the day and it is common to place some benches on the exterior walls of the house, acting as seats or as a store for work tools. Attached to the press is the firing oven, although it can sometimes appear to stand alone. In the past, each cellar had an attached oven or an independent construction, but the ones that remain are totally abandoned, because they no longer serve. In some wineries there are also more specific interior rooms dedicated to drying the grapes by artificial means, with stoves that produce hot air. Here the shelving system is replaced by metal trays that are placed one on top of the other allowing hot air to circulate between them.

The *pasero* or *almijar* is the architectural space dedicated to the drying and transformation of the grape into raisins. The raisin dryers are located in the vicinity of rural buildings, in areas with a considerable slope, isolated or forming groups of four or five dryers. There are two types: the *pasero de mesa*, which uses boards to cover the raisins at night or on rainy days, and the *pasero de lona*, which have walls at the top and bottom with a triangular profile to protect the raisins with tarpaulins all over the catwalk.

The preparation of the raisin poses its own demands, so the position of the raisins is carefully studied to make the best use of the available space. *Paseros* are usually characterized by being located on lands with about 12% slope, with approximate dimensions between 3 and 4 meters wide by 10 to 14 meters long and always oriented to optimize sun exposure.

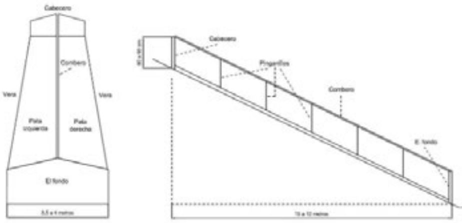

Fig. 4. Sketch of a typical dryer (Rueda García, F. 1996).

The floor of the *pasero* is prepared with slate or coarse sand and its interior is delimited by a small whitewashed perimeter wall called *vera*, which distributes the interior space in two streets or legs, separated by stakes in the center or by a higher wall, to extend the canvas to the sides. The front wall[2] made of masonry, serves as support for a rod or cane that receives the name of *combero*. The images of Malaga that illustrate the postcards and advertising of exporting companies from the end of the 19th and beginning of the 20th century bear witness to this tradition in the Axarquia area, with the advertising material of companies such as F. C. Bevan or the Sociedad Azucarera Larios being of special interest. The grapes are placed in full clusters that the farmers carefully spread out on the *paseros*, which are covered with a tarpaulin at night (wooden boards were used in the past), avoiding damage due to low temperatures or rain. As the days go by, the rotten grapes are removed and the clusters are turned over so that they dry evenly.

Fig. 5. *Paseros* with grapes dyring (Source: Archivo Díaz Escovar, N.945. 1964).

[2] The *paseros* with a triangular head wall or *peineta* (typical of the Axarquia), are also documented in the territorial area of the Montes and Hoya de Malaga.

The elaboration of the raisins requires approximately three weeks and is usually carried out between September and October, depending on the hot weather and the degree of ripeness of the grapes. The time of exposure to the sun to achieve optimal drying depends on the weather conditions. Raisins obtained with natural drying reaches a purplish tone close to black, this quality being one of the greatest values of the Malaga raisin, differentiating it from other raisins dehydrated in artificial dryers. Once the raisins have been collected from the dryers, they are chopped manually, process consisting of shelling the bunch with pruning shears. These are functions normally assigned to women and children in a family. After chopping, the raisins are classified according to size: small, normal, large/extra, which in the language of winegrowers are called: *aseado*, *medio* and *reviso*. For this classification, sieves are used, which are shaken leaving only those that have an adequate size inside. Those raisins twithout a suitable size for sale, will be used to make wine. It is worth mentioning, as an architectural variable related to the *paseros*, another tipology of buildings called *cascareros*, where oranges and lemons are handled instead of grapes. They usually appear in the areas of orchards, irrigation and terraces linked to rural areas, and are frequently present throughout the Guadalhorce Valley, in the municipalities of Álora and Pizarra[3].

Fig. 6. Distributing the grapes in the *pasero* (Source: Archivo Díaz Escovar, N.947. 1964).

5. World Important Agricultural Heritage Systems (SIPAM)

In 2017, the Food and Agroindustry Organization of the United Nations (FAO) declared the Axarquia raisin as an Important System of World Agricultural Heritage(SIPAM). Specifically, the area included in the SIPAM scope has a total extension of 28,039 hectares and is made up of 21 municipalities throughout the Axarquia region of which 1,113 hectares are dedicated to grape production for raisins. Most recently, in November 2021, the Sipam Axarquia Association was established, as a management body responsible for promoting measures to improve the production process, increase the profitability of the crop and increase the promotion and consumption of Moscatel raisins.

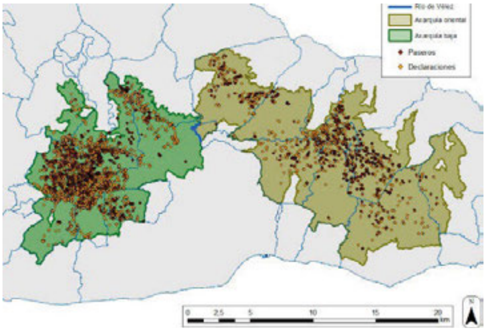

Fig. 7. Map of the SIPAM extension.

6. Conclusions

The vineyard constitutes a fundamental part of the landscape in the Axarquia region, and the Axarquia presses and dryers are an example of the unique and representative traditional architecture of an agricultural landscape of hillside vineyards, marking the identity of the declared cultural landscape. The Malaga raisin is a traditional cultivation that fulfills a set of functions beyond mere production, such as the conservation of the environment and cultural landscapes, the contribution to rural development and even the reflection of history through its own architecture.

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Guidelines for the conservation of the ancient hydraulic mills of the Valle Sabbia, Brescia (Italy)

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
The study of the hydraulic factories (mills, forges, trip hammers, etc.) of the Valle Sabbia, conducted by a University of Brescia research group, within the "Resilient Valleys" project (funded by the Cariplo Foundation), led to the definition of a protocol or guidelines with the ambition of identifying shared and adequate codes of practice to guarantee the correct recovery of this heritage. The object of the survey are artefacts located in functional positions for production activities, today often isolated and not very accessible. The architectural structure and construction features make them particularly vulnerable to deterioration, moreso than other types of artefacts. What remains of this building heritage is much closer to the conditions of a ruin which, if recovered or simply maintained, could very effectively convey some of the most characteristic features of local economic history. To conserve and maintain this heritage, operational indications and good practice suggestions are proposed, useful in interventions on buildings and hydraulic artefacts. There is neither a compendium with recipes to follow step by step nor even exemplary models, but rather a critical path method that starts from the direct and physical knowledge of the heritage, to arrive at the timely and most suitable conservation intervention. Method suggestions are proposed, which aim to help the owners, users or managers of these architectures, in choosing, within a scenario of traditional and innovative construction techniques available, the most suitable and correct ones to guarantee respect for the buildings' and hydraulic works' characteristics, their constructive, morphological, technological, material peculiarities and, therefore, to monitor and/or solve problems of decay and instability. Ample space is also dedicated to the planned conservation process, in which enhancement will contribute to respecting the material and intellectual integrity of the ruin.

Keywords: *planner conservation; guidelines; old hydraulic factory.*

1. Introduction

The study of the hydraulic factories of Valle Sabbia (mills, forges, trip hammers, etc.) was conducted by a research group from the University of Brescia, within the "Resilient Valleys" project co-financed by the Cariplo Foundation, Italian banking foundation (Osti Jachia, 2020).

The interest in these remains grew as a result of some insistence from within the area, subject to a progressive depopulation especially by young people with intensified problems relating to propositive and recognized sociality, assistance and scarcity of human resources. A cause of this human discomfort, common to many marginal areas and poorly served by technological innovation or, if present, little used due to lack of adequate user training, has been identified in the loss of a local identity of the area (Macchi Jánica & Palumbo 2019). In fact, from areas that were the centre of commercial and cultural traffic, they have turned into peripheral and marginal areas, of little or no strategic interest (Borghi, 2017).

Government policy has introduced a new term to identify those peripheral areas or on the outskirts of large urban centres (Barca et al., 2014) identifying them as "inner areas"[1] because they are subject to socio-economic distress strictly linked to their position in the area[2].

Starting from the first years of establishing the "inner areas strategy", during which we began to study new intervention theories for these areas in crisis with an approach, the growth of an important cultural and operational ferment was observed, placing at the centre of debates just what has long been forgotten (Salvatore & Chiodo, 2017).

Following this approach, the communities of the Valle Trompia and Valle Sabbia, together with numerous public and private partners (Badiani et al., 2019) participated in the "Attivaree" tender by investing human and economic resources with the aim of giving a turning point to the road in which one had let oneself be dragged to start governing one's own area again[3].

2. Identifying symbols and places of a community's culture

The research on 17 municipalities adhering to the project (Agnosine, Anfo, Bagolino, Barghe, Bione, Capovalle, Casto, Idro, Lavenone, Mura, Odolo, Pertica Alta, Pertica Bassa, Preseglie, Provaglio Val Sabbia, Treviso Bresciano, Vestone) led to the identification of 126 sites, in urban and suburban areas, with 132 factories indicated in the Land Registers of Lombardy-Veneto and the related hydraulic works. In particular, there are ovens, forges, mills, gualchiere, oil mills, sawmills, bark piles, in various conditions of preservation (some of which have disappeared).

With the desire to restart, and with a view to rediscovering a local identity (Certomà, 2013), looking inside itself, both as a physical area but also as human resources, the Community of Valle

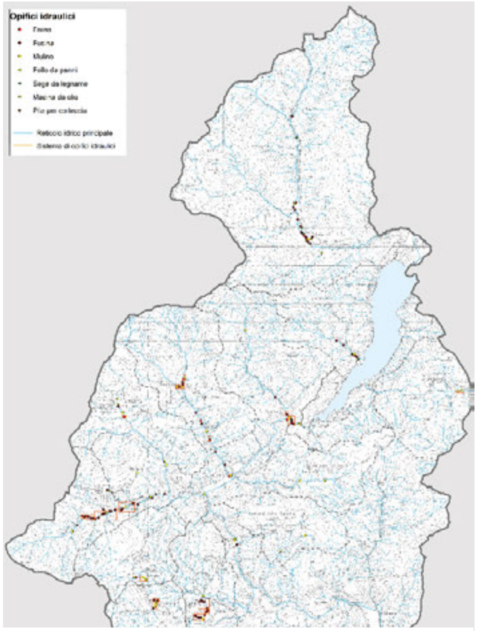

Fig. 1. Valle Sabbia Map: the ancient hydraulic mills.

Sabbia has sought those local values (Scala 2019), which can be translated into cultural and economic resources that could be the driving force for a global territorial recovery (Petraroia, 2005).

In the choice of symbols on which to leverage, for a cultural rescue and demonstration of the resilience of the area, those architectures were identified that told of a productive history which, in the past, had reached not only all of Italy but also some European countries (Marchesi 2003; Marchesi 2004) making the Valle Sabbia rich and popular.

In light of this, a study was undertaken with the aim of physically identifying the numerous places where the hydraulic factories had been built, recognizing their construction characteristics, the characteristic technological elements and everything that made them unique as recorded in archival documentation (Predali, 1980).

1 www.miur.gov.it/documents/20182/890263/strategia_nazionale_aree_interne.pdf/d10fc111-65c0-4acd-b253-63efae626b19

2 www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/regione-lombardia-aree-interne/

3 Http://attivaree.fondazionecariplo.it/it/index.html

Fig. 2. Agnosine cadastre map (1810), in brown the forges, in yellow the mills, and in green the textile processing factory.

Observing the land registry maps, it emerged that the hydraulic factories were located in functional positions for production activities, along natural or artificial waterways, carefully constructed, in order to guarantee the continuous supply of hydraulic energy and raw materials for processing (Badiani et al., 2019).

Today these architectures are mainly isolated and not very accessible, in the middle of woods that have regained their spaces (Mancini et al., 2017). The architectural structure and construction features make them particularly vulnerable to deterioration, more than other types of artefacts. In fact, what remains of this building heritage is very close to the conditions of a ruin and, if recovered or simply maintained, could very effectively convey some of the most characteristic features of local economic history (Della Torre, 2017).

The proposed census and material recognition of historical production structures, both buildings and elements of hydraulic systems, constitutes a path through which we wanted to restore a history to the rubble, to those artefacts apparently unable to communicate meanings and values, because they are deprived of the opportunity to become ruins (Augé, 2004).

The identification and attribution of significance of these presences are some of the objectives that we have set out to achieve, so that the apparent rubble can now rise to the role of ruins, suggesting the existence of a timeless past, which binds and identifies with people and companies that have lived in the Valsabbia area (Pittaluga, 2013).

In carrying out this work, we decided to give space to material culture (Scaglioso, 2020), readable in the artefacts, which is expressed both through professional habits, practices and construction skills. Construction materials and techniques make up the physicality of the artefact which, placed in the space-environment, is subject to deterioration (Rudiero, 2013). With this awareness, defining a protocol or lines of intervention that aspire to identify shared and adequate codes of practice to ensure the correct recovery of an architectural complex, is the essential step that the local community should carry out at all levels. If these principles are shared, preliminary knowledge is automatically justified because it is able to offer elements that can be used in the design phase, directing it towards more careful safeguarding and enhancement of the historical peculiarities of the site, providing operational strategies to maintain and increase its cultural value and identity within the area.

The urgency to intervene on this fragile heritage is indisputable (Oteri, 2019), but it does not always go hand in hand with the recognition of the cultural and educational role and function of the materiality of such architectures. In fact, on more than one occasion, it has happened that upon returning to the same site, the structure was found in worse conditions and some portions had already been lost compared to what was present just a few months earlier. By offering suggestions and indications of a practical and conservative nature, we want to encourage readers to take care of these signs on the landscape and of the history of the places, which in some cases, located on the outskirts of highly productive areas, were the embryo of very important industries today, and in other examples located within the woods, constitute a constellation of symbols of sacrifice and the daily work of our ancestors.

3. Guidelines for conservation

The proposed indications, to be effective, need to be conceived within a broad framework, in which a complexity of actions can be taken into account, set on several levels, able to link the interventions to the surrounding context, to the area and to people (Moioli & Baldioli 2018). The ways of activating collaboration protocols are numerous and varied, starting from simple communication to involving the population; from the search for financial incentives, to the development of joint projects; from the identification of operating conditions, to professional training.

To cope with the danger of losing the asset, staff training also plays a primary role in this sector. By personnel we do not just mean the architect-designer, but a large team of people coordinated by the architect, who cover all the sectors that can interact in order to preserve and appreciate the ruins. In particular, the topographer (who reconstructs the environment within which the asset is located), the archaeologist (capable of giving a sequence and a constructive logic to the parts found and of identifying the sources of historical materials, of the construction and processing techniques), the restorer (who converses dialectically with the architect in understanding the degradation and in assessing the interventions), and the diagnosticians and the contracting company, are fundamental. Based on the data found in the cognitive phase, the aforementioned protagonists can make some more detailed assessments, especially on the issue of vulnerability, not just referred to architecture, but in particular to the site where the ruin is located (Marino, 2019).

Although paradoxically a ruin may be less vulnerable than an entire building, for the factories of the Valle Sabbia an issue not to be overlooked linked to the conditions of the context is the management of the vegetation.

The different types of vegetation present, both shrubby and arboreal, must be identified in advance; choosing specific thinning or cutting treatment; identifying biocides to be applied in a timely manner along the mortar joints based on the vegetation specimens, without compromising the natural balance of the context; specifying the times and ways of applying the treatments; evaluating a long-term site monitoring and management programme.

In general, the criteria for choosing interventions must follow action timelines. It is necessary to start from a specific assessment of the environmental circumstances, paying attention to materials and construction technologies, and to limit the intervention to the minimum necessary, preferring reversible solutions and facilitating the identification of additions. Therefore, consolidation or additions that alter the appearance of the ruin should be avoided before the results of surveys and diagnostics are available. In case an excavation is necessary to bring to light portions covered by soil or debris, it will be necessary to put in place protections within the entire site, which ensure the balance of the system. Site management is fundamental. The company will not be able to choose materials and operations independently, but to agree on every action with the director of works. It should be emphasized, however, that the indications relating to the interventions alone are not sufficient to guarantee their conservation. Each suggestion illustrated here must be part of a broader framework that aims to harmonize, on several levels, the operational interventions and the context, giving substance to the management of transformations in the daily care that we are called on to exercise.

The conservation process culminates in the start of a planned conservation process, in which the enhancement will contribute to respecting the material and intellectual integrity of the ruin. The archaeological artefact acquires contemporaneity and urges the use of innovative technical solutions during the enhancement process and responds to social and cultural needs ensuring the progress of the site knowledge process.

A protocol has been defined for the conservation and maintenance of this heritage, with the ambition of identifying shared and adequate codes of practice to ensure the proper recovery of this heritage. Operational indications and good practice suggestions are proposed, useful in interventions on building and hydraulic artefacts to guarantee their conservation. These are methodical advice, which aim to help the owners, users or managers of these architectures, in choosing, within a scenario of available traditional and innovative construction techniques, the most suitable and correct ones to guarantee respect for the character of the buildings and hydraulic works, their constructive, morphological, technological, material peculiarities and, therefore, to monitor and/or solve problems of decay and instability.

The image of the heritage object of our attention, shows how it is mainly made up of structures whose material consistency is largely lost and the ruined character of the property is prevalent. There are several cases of reconversion of buildings, few cases of becoming a museal display and rare those in which the machines are working but no longer productive, but whose owner is available to show the mechanisms to tourists and the curious.

We did not want to propose a technical manual or a code of practice. The latter usually group together standardized technical solutions, which do not adapt well to the constructive complexity and the conditions of conservation of the historical building. The small guide proposed leaves margins of responsibility to those who will have the opportunity to leaf through it, requiring commitment during its interpretation, evaluation and choice of the alternatives proposed. Possible variables with respect to the indications given are not excluded a priori, as long as an approach is encouraged that gives "a problematic dimension to guidelines and decisions" (Torsello, 2000). Neither a compendium with recipes to follow step by step nor exemplary models will be found, but rather a methodical path that starts from the direct and physical knowledge of the heritage, to arrive at the timely and most suitable conservation intervention.

The proposed recommendations do not even replace the commitment of the designer, who remains entrusted with the governance of a complex programme of which the conservation of the architectural material is just one of the elements. Within the text, therefore, one can find ideas, suggestions, contributions that are considered useful to practically implement the design choices, consistently with the objectives of conservation and enhancement of these artefacts.

In order to make the readers and users of the "guide" feel responsible, it is necessary to share the aims, the procedures and the criteria that led to defining an operation as compatible with the characteristics of the building within this landscape and, therefore, consistent with the intentions of protecting their identity and cultural authenticity. The term compatible is associated with several concepts. Those technologies that respect and integrate the construction system, supporting without replacing it, are considered compatible; that addition which, in the event of loss of an element, intends to integrate it discreetly and confidentially; that daily practice, constantly performed, which maintains the artefacts over time by opposing its final action. Compatible are the "river of minute maintenance and repair works ... [in which] ... we must then know how to place ourselves, with certainly different tools and forms, but tending to a reuse that knows how to combine the reasons of the economy with those of a conscious, respectful culture of the memory and values inherent in the landscape and built heritage" (Musso, 2003). In short, that operation that in a balance of what is lost and what is gained in terms of matter and meaning, always gives a positive result, is compatible.

3.1. Identifying symbols and places of a community's culture

The first part of the guidelines gives ample space to interventions on the ruins which constitute a very large slice of the heritage in question, which in the context of the Valle Sabbia require particular treatment, especially since they are situated in a different and complex context, such as the natural one of the woods. These are activities aimed at the in situ conservation of architectural artefacts, in particular at removing harmful materials and elements that can accelerate the loss of the asset. Useful indications are suggested for the timely making safe of the masonry remains, through the laying of protective layers both at the top of the walls and at the joints. Lastly, constant maintenance is recommended, starting with the apparently trivial removal of leaves and soil.

The second part proposes interventions for the best preserved buildings, in which it is possible to recognize a wall. Therefore, useful operations are described to act on the various construction elements in a specific way: on structures, roofs, lofts, vaults, floors, openings and windows, mainly supporting their safety and repair, in compliance with the constructive logic.

Finally, the last pages are dedicated to the interventions on the hydraulic and mechanical works, that is the channels, the tanks, the wheels, the trip hammers, etc., still to be found, but often decontextualized and used as garden furniture, or kept inside museums. They generally feature a higher level of degradation than that of the building structures. These works are made of very different materials (wood, stone, iron and reinforced concrete), with complex conservation problems, therefore the intervention criteria that can be provided are general and classifying, based only on the use of the artefact and the materials that constitute the various elements. The intervention must be consistent with the intended use of the artefacts. If the original function is to be restored (or continuity of use, in the rare cases in which the factory is still active, even if only with demonstration functions), it is necessary to intervene on all the hydraulic works, on the wheels and on the machinery, in order to preserve what still exists of the historic plants and integrate damaged or no longer existing parts with compatible techniques, which affect their use. If the museum display of elements of hydraulic works is envisaged, or their conservation as ruins on the site where they are located, both the conservation of existing materials, removing the causes of deterioration, and avoiding remaking the missing parts are fundamental operations, preferably leaving the completion of the work to other instruments, didactic or virtual. Reconstruction by anastylosis of the elements of the hydraulic energy supply system and of the machines in order to bring them back to their original position, with the aim of having one understand how they work is possible. Lastly, if there is a project for the conservation of the asset with a change of intended use, always if the new function is deemed compatible with the material consistency of the existing one, it is recommended to maximize the conservation of the existing hydraulic works without distorting them. In general, a periodic and scheduled maintenance procedure is required on the channels.

Fig. 3. Melting furnace, Livemmo, Brescia.

Fig. 4. Melting furnace, Livemmo, Brescia, particular.

Fig. 5. Forge, Odolo, Brescia.

Fig. 6. Passerini's mill Casto, Brescia.

4. Conclusions

The consistency and extent of the cultural heritage are such that their timely protection seems to be something that exceeds current economic possibilities. Normally action is only taken to safeguard cultural heritage if serious situations of degradation or instability exist, in the case of the hydraulic factories of Valle Sabbia this situation has already been overcome, i.e. the loss is not imminent but has frequently already occurred. To surpass these situations of perennial emergency, impotence and latent danger of cultural heritage, we believe that the proposed guidelines can constitute an important point of reference from a methodological point of view and, therefore, we hope that they can at most soon be consolidated in the practices of the local commissions responsible for the conservation of the mountain territory.

On the other hand, we believe that the attempt to promote a renewed sensitivity towards such overgrown architectures can support a conservative attitude with a long-term vision (Baldioli, 2011); a willingness to plan activities; a willingness to invest in operations of even poor visibility (sometimes only preparatory to others, sometimes focused on the acquisition of knowledge that is not immediately appreciable); an openness to understanding the importance of continuous attention, of information management (with the consequent willingness to build and feed information systems in which to store new and previous knowledge); a willingness to equip oneself also in the use of digital tools, the only ones capable of managing adequate amounts of data in a collaborative way and over a long period of time, interacting with community maps, to share the new guidelines with all those involved, so that conservation is both unanimous and coordinated: which requires an effective connection between conservation and enhancement practices (Della Torre, 2017).

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Bazaars between documentation and conservation. Case studies in Albania and Macedonia.

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Topic: T4.1 Conservation and restoration projects of vernacular architecture

Abstract
The subject of vernacular architecture, as is well known, is a vast concept embracing different fields of investigation. It is a type of art created to suit specific lifestyles of single communities, such as the Islamic community. Bazaars, characteristic markets in Eastern countries, are a significant example in this context. The proposed contribution intends to analyse these architectural and urban environments in Albania and Macedonia, through the discipline of restoration aimed at knowledge, documentation and conservation. The proposed case studies represent a significant example of how the restoration of these areas is of fundamental importance for the urban regeneration of historic cities. The Bazaar in Skopjie has always been regarded as the cultural, spiritual, economic and historical centre of the capital. This site, from an architectural point of view, has managed to create an image of the old city in the new city, preserving its original identity features over the centuries. In Tirana, on the other hand, the new Bazaar is a genuine urban regeneration project that aims to preserve the Albanian cultural tradition. If the Bazaar in Skopjie is in a precarious state of conservation, while maintaining its original character, the recently rebuilt Albanian market is an important example of not only architectural but also urban regeneration. The proposed research has foreseen different operational phases: an initial analysis of the historical transformations of the areas under investigation; an identification on a territorial scale and a subsequent analysis on an architectural scale using the restoration discipline. The aim of the investigation is to identify the level of use and conservation of both Bazaars, in order to elaborate digital documents on a cognitive basis for the identification of guidelines for the conservation and enhancement project of the case studies taken as a model for the proposed research.

Keywords: *Oriental Market, Analysis, Knowledge, Enhancement.*

1.Introduction

A Bazaar, as it is known, is a place of commerce and trade located in the central part of Islamic cities in connection with the main roads. Such places can take different architectural forms, divided into sectors dedicated to the sale and production of different products, characterised by particular smells and sounds which, together with the variety of colours and goods, constitute the symbol of the city and Islamic society (Cuneo, 1986). The Bazaars are a clear example of vernacular architecture that perfectly fits into the issues related to the complexity of the urban fabric of the peripheral areas of contemporary cities and its conservation and enhancement. In this context, architect Pica Ciamarra (2014) argues that:
In order to recivilise the urban, it is necessary to start again from the network of public spaces, to reconstruct their relations, to act in appropriate

terms pursuing this single aim, but with different, specific, punctual actions. Regardless of the size, whether we are talking about cities or metropolitan areas, smaller towns, suburbs or in any case urban areas, we should ensure that whoever lives there can easily interact with at least one element of the network of reference places to be rethought in all urbanised territories. Redesigning public space, acting primarily on the void by helping to redefine it, determining a network of areas of social condensation, reachable on foot in a few minutes, able to offer opportunities for exchange, services, meetings, which are proper to a community. (p. 52).

This quote underlines the importance of knowledge and conservation of urban public spaces as places of social aggregation. In this context, the research proposes the study of two Bazaars in the Balkan territory, that of Tirana and that of Skopjie, evidence of full, noisy public spaces, as indecipherable as they are clear and simple in their geometries. The latters have contributed to the development and urban regeneration of historical cities (Mirra, 2020).

2. The method for knowledge, conservation and enhancement

The research was conducted through several operational phases: a historical analysis and of the transformations undergone over the centuries; a subsequent identification of these areas on a territorial scale; a subsequent analysis on an architectural scale through the restoration survey. The first phase made it possible to identify the historical and cultural context of the areas under investigation; subsequently it was possible to identify the points of interest in the surrounding areas; the last phase made it possible to identify their morphoglyphology and level of conservation and current use. The degradation survey conducted on the most degraded buildings represented a peculiar phase of the conservation project, fundamental for the knowledge of the site through the identification of the surfaces affected by manifestations of degradation and the state of conservation of an historic structure (Picone, 2004).

2.1. Tirana Bazaar. Historical notes

The old Bazaar in Tirana (Fig. 1) was for centuries considered the economic, commercial and financial centre of Albanian society. It was a place of meeting, entertainment, exchange and cultural and social experiences for the inhabitants of the surrounding villages and towns, a typical feature of Ottoman cities. The old Bazaar of Tirana, organised in different spaces, was the predominant hub. The latter, as well as all structures of this type, was located at the centre of the main road networks and covered an area of three hectares dating back to the 18th century. Among the most important architectural spaces in the area was the Ethem Bey Mosque, dating from 1789. The old market consisted of an open space for the sale of agricultural products. It was divided into nine main areas for the sale of specific products: *leshna* (wool market), *orizna* (rice market), *krypna* (salt market), *hasra* (mat market), *dithna* (grain market), *djathna* (cheese market), *gjelna* (poultry market), *pema* (fruit market) and *qerret* (cart market).

Fig. 1. Tirana Bazaar: historical image from 1939 (Source: OBC Transeuropa, 2010)

As the importance of the Ottoman markets increased, the importation of products by local craftsmen and those from as far away as the towns of Kruja, Elbasan and Kavaja was encouraged.As a result, by the second half of the 20th century, the old Bazaar was too small to accommodate new craftsmen, merchants and traders, as well as new shops and shops opening nearby. The situation was further aggravated by World War II, when the old Bazaar was gradually abandoned until it was demolished at the end of the 1960s. Following this event, the old Mosque and all the histori-cal pre-existences of the city were demolished and, conse-quently, the history and memory of Albanian citizens were buried in the rubble of these buildings (Krase & Uherek, 2017). It was only in 2018 that it was decided to build a new Bazaar (Fig. 2), a real urban redevel-opment project that aims to preserve the Al-banian cultural tradition by giving life to a new context with a commercial and cultural destination of considerable interest. The new configuration of the market is characterised by an innovative intervention consisting of a glass and metal structure. This space, used for the sale of fruit and vegetables, has the prima-ry objective of transmitting the memory of the roofs of the indigenous houses of Tirana, confronting a less recent reconstruction of covered areas for the sale of used goods con-sisting of geometries similar to those of the past. The new market respects the oriental traces of the past, integrating the old style of the old bazaar into the new one.

Fig. 2. Tirana Bazaar: photographic image of the current state (Source: Mirra, 2021)

Fig. 3. Skopjie Bazaar: historical image (Source: OBC Transeuropa , 2022)

Of considerable importance in the project to reconfigure the new market is the role of colour, desired by the mayor of Tirana, Edi Rama, used in the form of abstract designs of various kinds in the adjacent buildings to bring light and vital-ity to the universal grey plaster of the former communist city

2.2. Skopjie Bazaar. Historical notes

The old Bazaar in Skopjie (Fig. 3) represents the historical core of the city, a centre of economic, cultural and social interaction. In spite of turbu-lent historical events, this urban area has man-aged to preserve its identity characteristics by creating an image of the old town in the new town (Koneska & Balkoski, 2020). Some sources testify to the presence of a merchant district in the 12th century where, following a major and rapid urban development, some thirty mosques, numerous caravanserais and other monumental Ottoman buildings were built. These include the old Bazaar in Skopjie, built from the 15th century onwards, whose original configuration is connected to the new town by a bridge that divides the old Ottoman town from the new capital. Following the earthquakes of 1955 and 1963 and World War II, the original Bazaar was severely damaged. The present market (Fig. 4) is the result of successive recon-structions, which have respected the original architectural and multicultural characteristics. In the interior, there is a fusion of predominantly Ottoman structures, remains from the Byzantine era that are still evident and recent reconstruc-tions using modern languages (Mirra, 2017).

Fig. 4. Skopjie Bazaar: photographic image of the current state (Source: Mirra, 2018)

2.3. Surveying campaigns

Following the analysis of the historical informations relating to the two Bazaars studied, the research included a cognitive field survey. This method of knowledge had a twofold purpose: on the one hand, the identification of historical pre-existences in the vicinity and any connections between them and the markets, and on the other hand, the documentation of the configuration and state of conservation and use of both Bazaars. To this end, the survey activities carried out between 2018 and 2021 were of fundamental importance. At this stage, the survey was considered as a tool for critical observation and investigation, which, combined with the graphical processing of the data acquired through both historical and field analysis, allowed us to interpret the reality by serving as a fundamental knowledge base (Carocci & Circo, 2015). The latter has been useful for the subsequent identification of guidelines for the conservation and enhancement of complex historicised urban centres. The choice of the most appropriate survey technique required the analysis of different factors, such as the purpose of the research, the available budget, the morphological characteristics of the site and the level of detail to be obtained (Remondino, 2011). For this purpose, the image-based survey procedure carried out by means of digital cameras and drones proved to be the most suitable both for the need of a quick and economical measurement and for the possibility offered by the latter to obtain detailed digital models of the tangible and planimetric appearance of the analysed artefacts (D'Aprile & Piscitelli, 2019). The graphic elaboration of the data obtained through the subsequent phase of aligning the photographic images by means of corresponding points has allowed us to obtain three-dimensional elaborations, such as point clouds (Fig. 5), comparable to an interactive model between the real and the virtual (Manfredini A. & Remondino, 2010).

3. Results

The investigation carried out by means of surveying campaigns and the processing of the data acquired made it possible, first of all, to represent the planimetry of the the Bazaars of Tirana and Skopjie and their urban context. In addition, it was possible to identify the nearby historical pre-existences, possible connections, the state of conservation of the buildings within the markets and the degree of usability of the complex as a whole. The first Bazaar analysed for this purpose was the one in Tirana, whose planimetric layout (Fig. 6) shows the presence of an important Albanian square in the vicinity, namely Scanderberg Square, and of some ancient roadways connecting the latter to the new Bazaar.

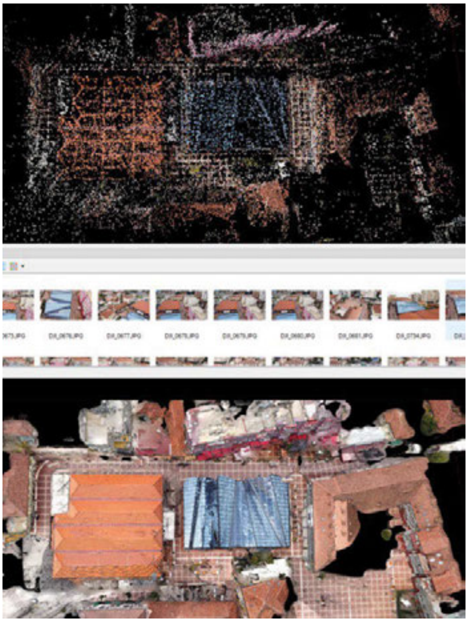

Fig. 5. Point cloud processing from photogrammetric survey (Source: Trematerra, 2022)

Fig. 6. Tirana Bazaar: territorial mapping with identification of routes and points of interest (Source: Trematerra, 2022)

These streets, which defined the layout of the old Bazaar, are wide (between seven and ten metres) and paved with cobblestones and a central drainage channel. They were named after the trades they housed, such as the butcher's street, the barber's street, the blacksmith's street, the coppersmith's street and the silversmith's street. Following the demolition of the Old Bazaar in 1960, the New Market (Fig. 7) remained for a long time the only large shopping centre for second-hand goods, meat, fish, fruit and vegetables in Tirana. From a commercial space to a 24-hour interactive space, in the mornings it is used more as a market, in the afternoons as a place for leisure and entertainment thanks to the presence of bars, restaurants and spaces for artistic activities such as cultural festivals and events. An interesting element of the design of the new Bazaar is the new terracotta flooring, which brings back memories of Tirana's old quarters of clay walls and tiled roofs.

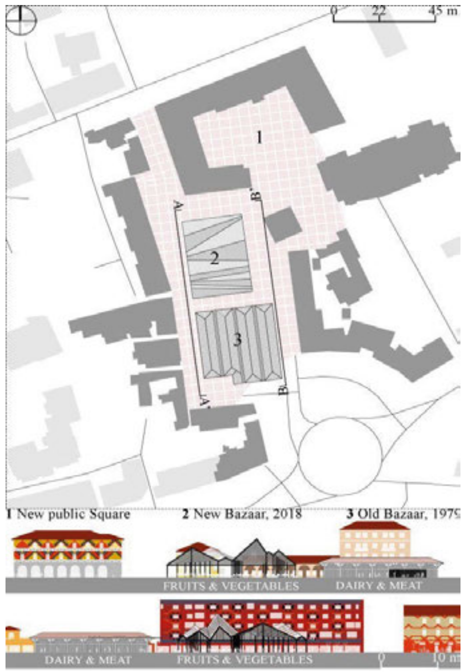

Fig. 7. Tirana Bazaar: general plan with territorial sections (Source: Mirra, 2022)

Fig. 8. Skopjie Bazaar: territorial mapping with identification of routes and points of interest (Source: Trematerra, 2022)

This project decision invites and welcomes visitors into the internal spaces of the market using a modern language, offering both merchants and local inhabitants a celebration of the memory of a lost identity. The project also included a real urban redevelopment, with the construction of a car park, a square for social gathering and further restoration of the facades of the adjacent buildings. The Bazaar in Skopjie, in contrast, does not present a project for urban recovery and revitalisation, being in a precarious state of conservation. At the same time, the site has a wealth of interesting historical pre-existences, unlike the more recently built city of Tirana, which is undergoing restoration and new construction. The current configuration of the Macedonian Bazaar is only a shadow of its former glory, but the site remains rich in interesting pre-existences, including the main mosques and churches of Skopije (Mirra, 2018). The urban context (Fig. 8), likewise, presents numerous points of interest including: a city park, a castle,

Fig. 9. Skopjie Bazzar: general plan with identification of points of interest (Source: Trematerra, 2022)

Fig. 10. Il Bazaar di Skopjie: ortomosaico di un edificio commerciale (Source: Mirra, 2022)

an opera and ballet theatre and a square. The Bazaar proper is built in oriental style and is formed by streets of different paved widths. It contains numerous historical and cultural buildings, including: Churches and Mosques, universities, museums and a monumental hammam, now converted into the National Art Gallery (Fig. 9). Many of the buildings within the Old Market, at the same time, are abandoned and, consequently, severely degraded. Many of them are characterised by a disorganised configuration, as a result of some interventions carried out on the façade according to personal taste and without regard for the identity of the place (Fig. 10). In this regard, the investigations carried out made it possible to identify the state of conservation of the most critical buildings, identifying the forms of deterioration through the Normal 1/88 Lexicon (Consiglio nazionale delle Ricerche-Istituto Centrale del Restauro, 1990).

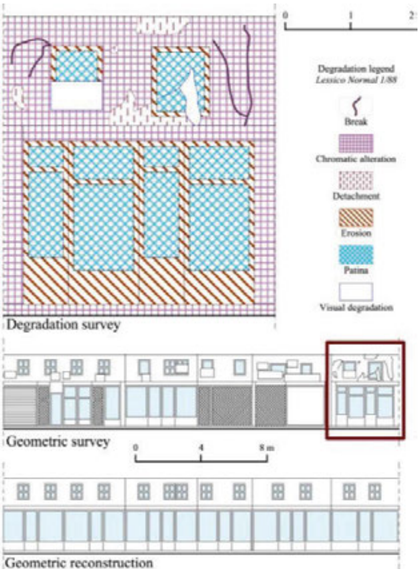

Fig. 11. Skopjie Bazaar: degradation survey and restoration of a commercial building (Source: Trematerra, 2022)

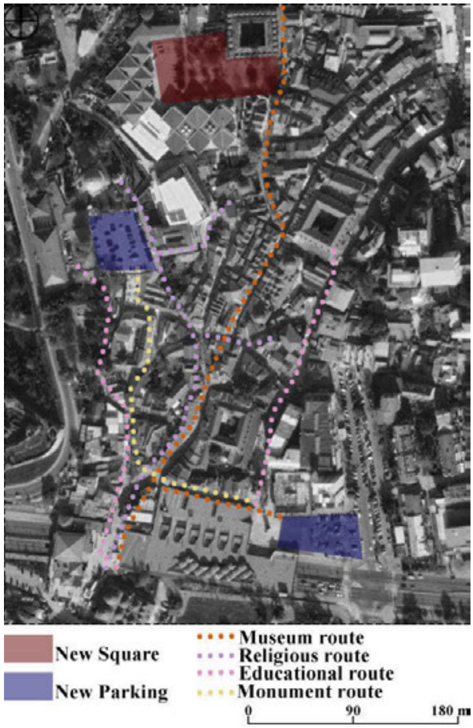

Fig. 12. Skopjie Bazzar: intervention concept for flow management (Source: Trematerra, 2022)

The aim is to restore the original appearance of the buildings inside the Bazaar in order to revitalise the site and give it a homogenous appearance (Fig. 11). In addition to the conservation of the historic buildings, the research included the development of intervention strategies aimed at the correct division of spaces and the management of turist flows. The proposed guidelines foresee the creation of a series of bicycle and pedestrian paths in order to divide the commercial spaces from those for leisure, culture and social aggregation and the creation of a new square and two public car parks (Fig. 12). The aim is to devise intervention strategies aimed at a new use of abandoned historical buildings capable of creating balanced relationships between architecture and the territorial context and between conservation and innovation (Petrucci, 2016).

4. Conclusions

The investigations carried out made it possible to compare the two Bazaars and the interventions of urban regeneration and revitalisation carried out. The Bazaar in Tirana does not have important historical pre-existences, but it is an interesting example of an intervention of memory conservation aimed at urban enhancement and regeneration. On the other hand, the Bazaar of Skopjie is characterised by an urban outline made up of numerous and important historical presences and attractive public spaces, but it has never been interested in the realisation of an adequate conservation and valorisation project. At present, in addition to the lack of a conservation and maintenance plan for the commercial buildings, there is the absence of a coherent division of space on the one hand, and of adequate flow management on the other. For this purpose, the cognitive activities carried out, characterised by both the analysis of the sources found and the carrying out of survey campaigns, have been very useful. The research made it possible to highlight the strengths and weaknesses of both Bazaars, in order to propose possible intervention strategies aimed not only at preserving and enhancing the areas analysed, but also at preserving the memory of the past through a new contemporary interpretation.

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Perspectives for the small historical centres at risk of abandonment. A pilot project for the Granfonte district in Leonforte (Italy)

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract
The town of Leonforte, in Sicily, is currently characterised by two antithetical phenomena: the abandoment of a significant part of the historic centre and an increasing urban sprawl in the peripheral areas. The paper illustrates the ongoing research on the historic district of Granfonte and the pilot project for a small block with two alternative scenarios: the restoration of the ruins and the recovery of residential use. The two proposals can be conceived as two phases of the same project, and as alternatives to the demolitions that nowadays seem to be the only answer to the daily challenge of living in this place.

Keywords: *vernacular architecture; abandonment; urban restoration; Leonforte (Sicily).*

1. Introduction

Far from the metropolitan centres and outside the prevailing flows of mass tourism, interior areas have been affected for some time by a crisis, the most visible manifestations of which are a growing demographic decline and the emptying out of the old districts. Historic centres suffer to a greater extent from the effects of deterritorialization and increasing concentration of goods and services in a few urban areas (ANCSA, CRESME, 2017).

Following the economic transformations of these territories, old houses no longer correspond to modern housing standards and have therefore lost their use value. The functional obsolescence of the dwellings has often been intertwined with social and cultural factors, such as the rejection of a way of life based on the traditional peasant economy, often associated with a condition of misery and poverty (Pazzagli, 2021). The physical displacement of the inhabitants is accompanied by their disaffection with the historic heritage, which alters the sense of belonging and attachment to a place (Teti, 2004), the collective memory, and the perception of the cultural values embedded in old towns.

The study of the Granfonte district in Leonforte (Fig. 1), a small Sicilian town in the province of Enna, offers an opportunity to reflect on the future of vernacular architecture and the changes and trends that threaten the historic centres of smaller towns in interior regions. Leonforte was founded in 1610, when the Branciforti family obtained a *licentia pupulandi* for Tavi's feudal territory. The prince developed an ambitious urban plan based on a regular layout. The northward expansion of the town, which had already begun in the 17th century, accelerated during the 20th century thanks to urban policies based on unrealistic assumptions about economic and demographic growth (Vitale et al., 2020). Today, despite the

Fig. 1. The southern view of Granfonte and Favarotta districts (1); the view of the landscape from Palazzo Branciforti (2).

continued decline in its population, the urban sprawl is increasing, further emphasizing a condition of urban imbalance: the northern part of the town and the anonymous suburbs offer more services to citizens and are more densely populated; conversely, the old town is experiencing an ever-increasing process of abandonment and depopulation (Vitale & Versaci, 2020).

So far local authorities have failed to offer any strategic vision to manage the effects of the deep decay of the old district and urban planning has not seen the recognition of heritage as a factor in sustainable development. This technical and political response, effectively classified as a 'Do nothing' policy (Verwest, 2011), is also demonstrated by the persistent lack of tools and measures for governing transformations in the historic centre, which is exposed to a great range of threats. In order to adapt the vernacular architecture to new housing needs, over the past fifty years the old buildings have undergone many alterations of their formal and structural features and specific layout. Meanwhile, many abandoned dwellings lay in crumbling ruins which compromise the safe use of streets and public spaces and constantly increase the concerns of the few remaining inhabitants (Fig. 2). Indeed, neglected buildings are perceived as evidence of a lack of interest on the part of the local council, whose main response to the growing discomfort has been allowing the demolition of entire buildings, without any strategy or even community involvement.

Our research addresses the issue of the challenging future of vernacular architecture, starting from a thorough knowledge of its distinguishing building characteristics. This research is intended to establish guidelines for securing and restoring traditional houses, with a view to encouraging residential use. This paper is a part of this ongoing research and focuses on a representative group of buildings, which is the subject of a pilot project for the preservation of Granfonte's fragile architecture and the recovery of local building traditions.

Fig. 2. The current condition of the built fabric.

2. A methodological example: the study of a group of houses

Rock-cut architecture is widespread in the Erean Mountains and particularly in the northern part of the province of Enna, where Leonforte lies. Even today, the presence of rock-hewn churches and oratories shows how building methods that adapt to the morphology of the territory and exploit the characteristics of the local stone persisted for centuries. Natural cavities on the hillsides, which originally served as shelters, over time have also been used as temples or tombs. Dwellings in the Granfonte district display echoes of this long-standing building tradition (Nigrelli, 2001). It could be claimed that the relationship with the rock and the use of natural and anthropic caves are the most noteworthy elements in the settlement.

The buildings were organised in such a way as to meet the need to follow the orography of the terrain and to take advantage of the steep natural slope. Crowned by the baronial palace that overlooks the valley, the district developed on the flank of Mount Cernigliere, in a position facing south-east and protected from the prevailing winds. The choice of settling on the hillside was also useful both in order to reduce the occupancy of the fertile soil in the valley and to protect dwellings from the disastrous floods that have historically affected the area. The configuration of the buildings followed an organic layout resulting from adaptation to the constraints imposed by the uneven topography. Nevertheless, in spite of the irregularity of the urban pattern, it is common to find buildings systematically sharing construction techniques, formal solutions, and long-term building types. Urban routes were conditioned by the drastic variations in the slope and the narrow streets which follow the contour lines are still today often connected by steep steps. Houses were built against the rock outcrop, very often without any attempt to reduce irregularities. The effective exploitation of the available resources has given the neighbourhood a unified appearance, reinforcing its coherence within the landscape.

The basic dwelling unit was a single-storey house (with a surface area of approximately 20-22 square metres), defined by two walls arranged perpendicularly to the slope and closed by the façade wall. The qualities of the rock – an easily worked coarse-grained sandstone – permitted two methods of building houses: “by taking away”, in which the rock was excavated to enlarge the ground floor generally devoted to service functions such as a fireplace and oven; “by adding”, in which the stone, once removed, was used for the construction of the walls made of roughly hewn blocks. In two-storey dwellings, the position on the slope made two separate entrances possible, one each from the lower and the upper streets, though when the difference in level between the streets exceeded the interfloor height, access had to be guaranteed by an internal staircase or, more commonly, by an external one (*profferlo*). Notably, in these very small buildings, outdoor spaces often ensured the vertical connections, or added new ones. Moreover, in everyday life, they were considered an extension of the domestic space for the preparation of food or other daily activities.

Fig. 3. Aerial view of the block.

The group of houses under study is located in the upper part of the neighbourhood, just below the baronial palace, and was selected for the representative nature of its building type and formal and construction features (Fig. 3). It is currently total abandoned and displays the most common issues of deterioration and disrepair which affect the surrounding buildings. The block is set on a steep slope and consists of three houses facing south-west which form the main front and a fourth one later built on the upper side.

The present cluster of buildings is the result of an evolution that can only be partially understood from the outside. The comparison of the historic land registry of 1878 with subsequent documentation allowed us to formulate some hypotheses on the development and transformation of the houses and to reconstruct the growth of the block. The analysis was based on the indispensable direct survey and the observation of surviving evidence of previous construction phases. An understanding of the original, natural slope which existed prior to any anthropic transformation appeared to be essential to an analysis of the relationship between the buildings and the site. It is now acknowledged that social reality – personal relationships, customs, forms of living and working – is embedded in the material culture of a place. An intertwining of the historical, archaeological, technological, and typological data helped to come to terms with the necessary preliminary knowledge and shed light on the development of the houses in relation to their cultural and historical context. Above all, it contributed to a greater understanding of their authenticity, their peculiarities, and the values which they embody and which should be preserved.

The block started with the house at the south-eastern end, which was most probably built as a single-storey building. Analysis of the masonry confirmed that the central dwelling was subsequently built against it and the constant thickness of the façade wall suggests that this was from the very beginning a two-storey building with a *profferlo* on the southern front. The third house, at the north-west end, was the last to be built and was presumably another single-storey building, with a vault on the ground floor and a small staircase leading to the roof. At a later stage, the two end houses were raised until they exceeded the central one in height and it is reasonable to assume that, on this occasion, they also underwent a significant transformation, including the demolition of the original vaults, which were replaced by the ceilings that are still visible today. Finally, a further building was erected as an in-fill addition at the rear of the central house. In fact, as shown in the 1878 land registry, it occupied a formerly open courtyard, and its construction may have involved a partial excavation of the terrain (Fig. 4).

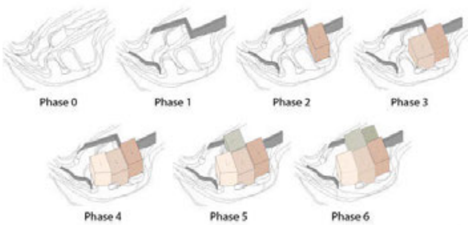

Fig. 4. Main construction phases of the block.

The three main buildings display the features of traditional local architecture (Fig. 5). They are built against the rocky hillside, the ground floor is partially excavated into it and, due to the steep slope, their upper fronts have no openings. The south-eastern dwelling offered the opportunity to identify a further constructional peculiarity: the building is built against one of several retaining walls, which are probably the result of the founder-prince's planned organisation of the urban environment, aimed at terracing the uneven slope for the subsequent division into plots to be built on. Being placed at the end of the block, the house has windows on the sidewall and external steps which provide access to the second floor.

The central dwelling keeps the typical plan of the neighbourhood, which may tell us much about the way of living and using the building. The ground floor is covered by a barrel vault which is made of pieces of stone set in mortar and is flanked by smaller counter-vaults placed at the haunches, which were also used for the storage of agricultural produce. The house also preserves an *alcove*, a noteworthy element of the local domestic architecture, which was separated from the main room by a wood-framed wall finished

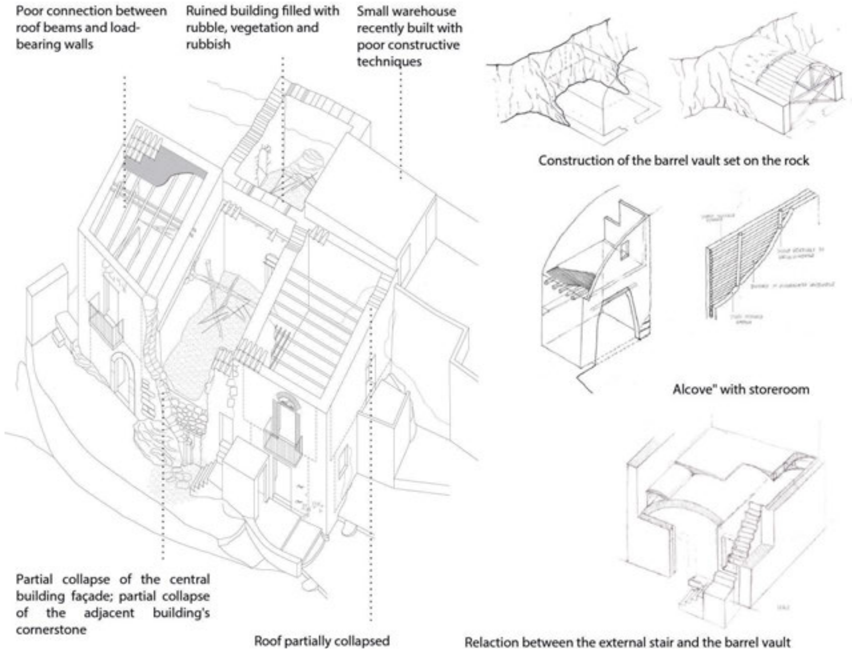

Fig. 5. Current state of the block and main features details.

with plaster laid on reeds. In the constant search for optimisation of the space, a fireplace was built under the stairs which led to the upper floor through a trapdoor. An external staircase was built on the right side of the façade, reaching the first floor along the haunches of the stone vault.

In the house at the northwest end, the connection with the slope is clearly visible. The ground floor, originally vaulted, has a small cave and a niche carved directly into the rock. Due to the demolition of the original vault, it is possible to observe the contact between the walls and the stone surface.

Long-lasting neglect has had a detrimental effect on these humble buildings. The lack of basic maintenance has resulted in increasing deterioration and rapidly worsened the condition of all the buildings though the central house suffers from a more advanced state of physical decay as the roof and the upper part of the façade have crumbled and collapsed. Due to major structural problems and issues of instability, the whole area represents a very serious risk to the safety of neighbours or passersby. However, this neglect has prevented the buildings from undergoing any heavy renovation work as well as inappropriate or careless interventions. Despite the worrying state of disrepair, the buildings preserve many of their original features, making it possible to study the particular elements that illustrate the traditional building culture. Moreover, the block being studied has a strategic position, linking the upper monumental area (site of the baronial palace and the mother church) to the lower, built-up area of the Granfonte district. It is, therefore, a suitable area in which to consider the rehabilitation of public spaces as a means of improving the urban quality of the neighbourhood.

3. Two projects, one goal

Our proposal aims to provide an alternative direction to the stalled situation in the area. The strategy is intended as a pilot project for the abandoned historic city. The idea is suitable for possible future development in other areas of the district but it is also transferable and applicable to similar historic environments. The project experiments with a flexible and sustainable approach

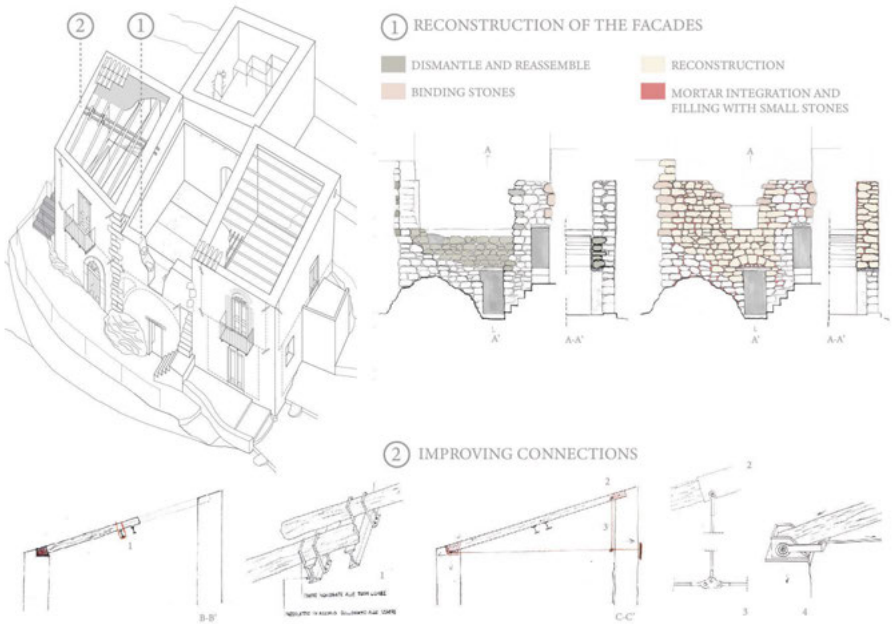

Fig. 6. The restoration of ruins.

that conceives of the project as a process. Two scenarios are envisaged: on the one hand, the management of the ruins and the design of the safety measures necessary for their preservation; on the other hand, the reintroduction of residential use. The two proposals can be conceived as two phases of the same project, and above all as alternatives to the radical demolitions that nowadays seem to be the only answer to the daily challenge of living in this place.

The first scenario has to contend with the current lack of demand for new housing. Faced with the pervasiveness of the phenomenon of abandonment and the concentration of ruins in certain areas, it may be necessary to include the hypothesis of a selective recovery (Curci & Zanfi, 2018). However, in the context of a dynamic town and a district which is still partially inhabited, the acceptance of a definitive abandonment of some urban portions would not make the provision of safety measures unnecessary. Therefore, the first proposal is to consolidate the ruins and to insert them in a new path, in continuity with the Belvedere of Palazzo Branciforti, making them places of rest and contemplation (Fig. 6). Preventive safety measures are planned (removal of rubble, supports) and the shoring up of openings fits in with the formal language of the elements (Sebastián Franco, 2020). Some minimal interventions follow, which are designed to ensure the partial use of one of the buildings. Indeed, while for the two units on the ends only consolidation is planned, for the central one the proposal is oriented towards a partial reconstruction in order to invoke the original configuration: the second floor becomes an open space, without roofing, and the partially reconstructed second-floor window will allow a view of the landscape. The connection stones along the edge of the reconstruction denote the flexibility of the project as they offer the opportunity to complete the reconstruction at a later stage.

The second scenario aims to examine the prospects of habitability of the houses in the district. The proposal aims to reconcile the search for higher housing standards with the adoption, where possible, of interventions which are minimal, compatible and reversible (Fig. 7). This has required a twofold approach: the identification of elements to be preserved (material and construction characteristics, and the building layouts) and the proposal of more transformative interventions where the constraints are weaker.

Our proposal recommends preserving the building shape and arrangement, the lot size, the layout of the façade, and the position of the openings. The caves and vaults belong to the construction history of the area and must be preserved in their entirety. On the other hand, some changes in the interior layout seemed indispensable in order to obtain two residences for young couples. The house at the south-eastern end is preserved as a single unit while a partial reunification of the central dwelling with the one at the north-western end is proposed, a mode of transformation which has been historically confirmed and observed in other cases.

The fourth house in the rear is maintained as a *hortus conclusus* for this new double dwelling. As we mentioned, the mixture of public and private space represents a particular feature of these vernacular architectures (Atroshenko & Grundy, 1991). The design of the houses maintains the redundancy of vertical connections and recovers the principle – so widespread in the local tradition – of the hybrid use of the urban space as an extension of domestic space. In accordance with the essential character of the traditional houses and the wise optimization of their living space, the arrangement and furnishings aim to give multifunctionality and flexibility to the rooms, preserving their spatial configuration. The presence of multipurpose storage units, small service volumes, and mezzanines responds to residential requirements with space-saving features which minimize clutter.

4. Conclusions

The work has highlighted not only the architectural and urban qualities of the neighbourhood but also the critical issues and risks arising from the relentless loss of residential attractiveness. Moreover, the latter is also linked to the community's refusal to fully recognize the value of the historic centre. The correlation between conditions of abandonment, unregulated anthropic transformations and persistent demolitions shows how the inability to govern this part of the city is generating serious imbalances and conflicting situations, which in turn threaten to destroy large portions of the built environment. Furthermore, the municipality of Leonforte has recently joined the project in which houses are sold for one euro – an initiative embraced positively by many Sicilian municipalities. Nonetheless, what results will this incentive produce without an overall

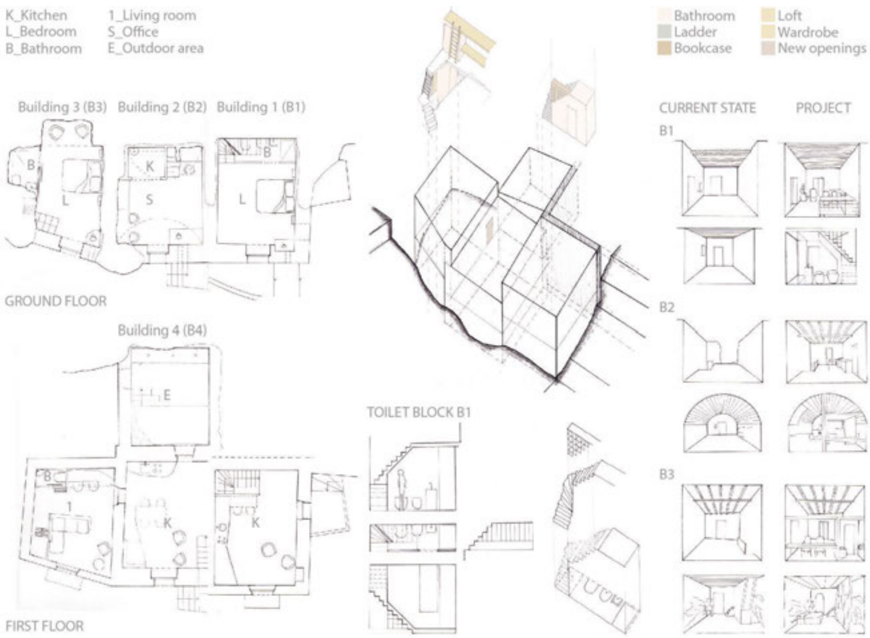

Fig. 7. Restoration of the residential use.

vision of the problems of the city and the territory, and without any project combining knowledge, conservation, and management of the historic town?

The case of Leonforte confirms that appropriate policies of urban rebalancing are needed to bring the inhabitants back to these forgotten parts of the city. From this perspective, the field of preservation and restoration can undoubtedly provide a proactive contribution, by facilitating the recognition of the value of historic buildings beyond the logic of economics and function (Della Torre, 2020). Recent studies and some virtuous initiatives confirm that the preservation of historic buildings as well as the restoration of urban ruins can play a key role in the process of reactivation and revitalization of interior regions, as long as they are embedded in a program of territorial development (Ortiz, 2018).

Looking toward possible future scenarios, it is worth emphasizing, once again, the role of the project. Working on different scales, new design proposals must result from a deep understanding of the built environment and the recognition of the qualities and peculiarities of different sites. The urban restoration is therefore part of the system of tools for governing the territory and the town and it has the specific task of identifying the criteria for compatible transformations that derive from the balancing of different situations. Meeting the needs of the place and the inhabitants requires differentiated interventions which can include, on the one hand, a more rigorous preservation (for example where a prolonged abandonment has allowed the survival of higher levels of authenticity) while exploring, on the other hand, the possibilities of a reinterpretation of the typological functioning. Anyway, it will be necessary to recognise that a transformation testifies to an effort to adapt the fabric to the evolution of the way of living and has become part of the culture of the place (Zampilli et al., 2020). In conclusion, to date, the policies implemented for the redevelopment of historic centres in Sicily have produced insufficient effects. Overcoming this long-standing problem, according to the authors, must involve the pursuit of a twofold goal. Administrations need to be challenged to adopt a tool for the governance of the historic city. Finally, a revision of the tools currently available (partial and inflexible though they are) would be useful and is necessary to achieve an integrated management of conservation.

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Repair grants for historic farm buildings in Dartmoor National Park

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Topic: T4.1. Conservation and restoration projects of vernacular architecture

Abstract

The Historic Rural Building Pilot Scheme, launched in 2018, was a collaborative project between national cultural and natural heritage organisations, government agencies and five English National Parks. Its aim was to bring life back to traditional agricultural buildings within the boundaries of participating National Parks. Funding was available for building repairs using traditional methods and materials, with the aims of preserving the distinctive character of the areas and keeping the buildings in continued agricultural use. The Author is an independent heritage consultant employed by Dartmoor National Park Authority to oversee the 13 repair projects selected there. These ranged in size from small, isolated barns to a large, late 19th century model farmstead. Typical works included masonry and cob repairs, timber repairs, roof replacement etc. A total of £1.3m has been offered in the National Park covering 80% of the cost of eligible repairs. The paper briefly describes Dartmoor and provides an overview of the scheme. Individual case studies are considered, illustrated with photos, describing the history and significance of each building, their construction, the structural problems affecting them before repair; and the philosophy and solutions adopted.

Keywords: *dartmoor; farm buildings; grant schemes.*

1. Dartmoor National Park

Dartmoor is an area of upland, situated in the County of Devon in south-west England, with an extent of just under 1000km². It was designated a National Park in 1951, and this status provides protection to its landscape, ecology and cultural heritage. While more than half of the National Park Area is privately owned, much of the high moor is unenclosed and freely accessible to walkers.

1.1 Dartmoor Geology, Climate, and Landscape

The underlying geology of most of Dartmoor is formed of a granite intrusion dating from the Carboniferous period. Mostly, the granite is overlaid by a thick layer of peat; however, many hilltops are crowned with exposed granite outcrops known as *Tors*, which are one of the most distinctive features of the Dartmoor landscape. The geology of the moorland periphery is characterised by sandstones and mudstones dating from the Carboniferous and Devonian periods.

The mild, wet and windy climate of Dartmoor is strongly influenced by the nearby ocean and the warm currents of the Mid-Atlantic Drift. Temperatures in Princetown (418m above sea level) range from an average February minimum of 0.8℃ to an average July maximum of 17.7℃. Annual rainfall is around 2000mm.

The rolling upland of the high moor is covered with hardy plants like grass, heather, bracken and gorse. It is incised by deep river valleys with woods, enclosed fields, farms and villages.

1.2 Agriculture on Dartmoor

Over a period of thousands of years, the trees that once covered the high moor were cleared by Mesolithic, Neolithic and Bronze Age settlers. From around 1000 BC, the cooling climate forced the latter group to abandon the area, leaving behind a fantastic archaeological legacy that includes remains of round houses and field boundaries, as well as earlier stone circles and funerary monuments.

The abundance of wool and tin ore on Dartmoor drove a thriving medieval economy. Transhumance was also widely practised, whereby cattle were brought up to the moor from lowland Devon farms during the summer months. Taking care of these beasts provided lucrative work for farmers on the moorland fringe (Fox, 2012).

Today, the high moor is grazed by sheep, ponies, and cattle; the valleys are also mainly pasture.

1.3 Dartmoor Vernacular Farm Buildings

Dartmoor is well known for its longhouses – where humans lived at the upper end and cattle in the *shippon* at the lower end, all under the same roof.

The earliest standing longhouses can be dated to the 14th century, though there are examples from well into the 17th century. Most standing traditional farm buildings on Dartmoor date from the 17th, 18th and 19th centuries, are usually stone-built, and most commonly would have been thatched with combed wheat straw (though in most cases thatch has been replaced with corrugated iron). Building types are often variants of those found in lowland Devon, including threshing barns (often built into the hillside), linhays, shippons, stables, ash houses and implement sheds (Beacham et al., 1990).

2. The Historic Rural Building Pilot Scheme

2.1 Overview of scheme

This grant scheme, launched in March 2018, was a three-year collaboration between Natural England and Historic England (the national public bodies responsible for the nation's natural and historic environments, respectively), five participating National Parks (Northumberland, Lake District, Yorkshire Dales, Peak District and Dartmoor),the Rural Payments Agency and DEFRA (the government Department for Environment, Food and Rural Affairs).

The stated aim was to *bring life back to traditional rural agricultural buildings within the participating National Park boundaries.* Funding was available for surveys, management plans, and restoration of historic buildings for continued agricultural use, employing traditional methods and materials, with emphasis on structural works, weatherproofing and roof coverings.

2.2 Methodology

The overall objective of the scheme was to 'halt the process of decay without damaging the historic, architectural or archaeological significance of the building, the landscape it sits in, or the wildlife habitats it provides'.

For each project, the starting point was to gain a proper understanding of the building's history, original use, construction, condition, pathologies, habitats etc. Once this was obtained, a philosophy of minimum intervention was followed, whereby existing elements were repaired or patched rather than replaced. Generally, traditional materials were required, appropriate to the building's age and condition and in accordance with the vernacular tradition of the area, though modern structural interventions, such as metal ties or braces, were permitted where these would support the retention of historically significant features. All architects preparing management plans were required to be conservation accredited and only contractors with proven experience and ability of working on building conservation projects were used.

2.3 Budget

The total budget initially allocated to the capital repair phase of the scheme for all five National Parks was £2million, though this was eventually increased to £8million in response to the amount of interest and high costs. Grants covered the following items:

- £1,100 allocated to the National Park Authority (or an agent appointed by the applicant) for each building project. This covered preparation of the project brief, obtaining quotes from conservation-accredited architects, and provision of assistance to building owners with the application process;
- 100% grants to applicants to cover architects' fees for the production of management plans and repair schemes, wildlife and technical surveys, and overseeing tendering.
- 80% grants toward building repairs.

2.4 Grant Application and Selection Procedure

The grants were advertised and expressions of interest invited from building owners. Before being considered for grant aid, all potential projects underwent a scoring process to determine their eligibility based on significance, vulnerability and public benefit. The final selection was made by a panel consisting of representatives of the different organisations involved.

Once appointed, the project architect prepared a detailed management plan for each building including a specification for proposed repairs. Other specialists contributed a structural condition survey, an ecological survey, and a historic building appraisal. Once agreed, the architect oversaw the tendering process and appointment of building companies.

3. Case Studies

In the following pages, two of the buildings included in the scheme are briefly described, together with some of the challenges that arose during conservation works and their solutions.

3.1 Beckhams

Fig. 1. Beckhams Linhay. East elevation following repairs (Source: Copyright Historic England Archive, Davies, 2021).

The architect for this project was Martin Sturley-Hayes of Jonathan Rhind Architects. The structural engineers were Paul Carpenter Associates.. The Historic Assessment was carried out by John Thorp of Keystone Historic Building Consultants.

3.1.1 Description, Significance & Condition

The building is a lofted linhay dating from the late 18^{th} century (Thorp, 2019). Open-fronted linhays are a distinctly Devon building type, being found only rarely elsewhere in Britain. The ground floor is a cattle shelter open on the side facing a fold yard, which allows the beasts to wander in and out of the building according to the weather, time of day etc. In this case, the linhay is built into the slope of the hillside at one end, allowing access to the *tallet* (hayloft above the shelter) from a ground-level door at the south end. The linhay walls are granite and mudstone rubble bedded in mortar consisting of lime and decayed granite sand (*growan*). The drystone foldyard walls are formed of moorstone granite boulders. The typical, oak A-frame trussed roof is clad in corrugated iron, but would originally have been thatched, The tallet, once also open on the side facing the yard, is now clad in corrugated iron. There is an owl hole in the north gable to encourage roosting barn owls and help control rats.

Beckhams linhay is significant as a particularly fine example of its type, complete with foldyard and still in use for its original purpose. It stands adjacent to an ancient droving route leading to the high moor from the lowlands to the south-east, and its setting on the woodland edge is very picturesque. The building is not listed.

Fig. 2. Beckhams Linhay. North elevation following repairs (Source: Copyright Historic England Archive, Davies, 2021).

The structural survey found the corrugated iron roof to be corroded and leaking, and the rudimentary asbestos rainwater goods to be inadequate.

Fig. 3. Beckhams Linhay south gable before repair (Source: Jonathan Rhind Architects, 2019).

Once abundant ivy had been removed, the masonry was revealed to be generally sound, though there was a full-height vertical crack in the west wall caused by historic differential movement. In addition, significant water ingress was occurring at the base of the walls (caused in part to a natural spring) which had washed out bedding mortar and loosened the masonry. The joists and boards of the tallet floor were rotten in places, again as a result of water ingress.

The ecological report found evidence of nesting barn owls but no bat activity.

3.1.2 Repairs

The roof cladding was replaced with new corrugated galvanised steel sheeting, and new galvanised rainwater goods were installed. Reinstatement of thatch would not have been practicable due to its high cost and ongoing maintenance liability; it would not be considered a suitable material in this wooded location (with overhanging trees preventing the roof from being dried by the sun and risking drip damage). In any case, corrugated iron has essentially gained honorary vernacular status in Devon, having been the material of choice in the 20th century to replace failing thatch. It should be mentioned that thatching today is often carried out using water reed harvested overseas in Turkey, or even China, rather than wheat from Devon, and where this is so, it is clearly neither authentic nor vernacular. On the other hand, corrugated iron provides an honest, cheap and durable substitute.

To address the crack in the west wall, stitch repairs were carried out using *Helibar* ties bedded in lime mortar. Elsewhere, masonry was consolidated with lime mortar and re-used stone.

Existing bedding and pointing mortars were analysed in order to achieve as good a match as possible. The growan originally used as aggregate would have been quarried near the site, but in this case, following mortar analysis by The Cornish Lime Company, was substituted with local sands and grits matching it in colour and grain distribution. Lime putty was used as the binder. Following replacement of rotten joists, a new floor of replacement Douglas Fir boards was laid in the tallet. The existing corrugated iron cladding was retained on the east wall of the tallet for the sake of practicality, continued wildlife use and prevention of water ingress. An owl box was introduced to encourage their continued presence in the building.

Fig. 4. Beckhams Linhay. Tallet interior looking south following repairs (Source: Copyright Historic England Archive, Davies, 2021).

3.1.3 Summary

It is very satisfying to see this traditional building consolidated and retained in its original use – as a shelter for cattle with hayloft over. It stands next to a public right of way and can be appreciated by members of the public. The building owner did raise concerns about the high cost of what was a straightforward conservation project and this was an issue that often came up on other projects as well. Inevitably, with involvement of conservation architects and other specialists, use of traditional techniques and materials, and lack of corner-cutting, the final cost of these projects tended to be higher than if grant aid had not been sought; however, the overall quality achieved was high, and the finished projects serve as an exemplar for conservation of these buildings.

3.2 Pizwell

The architect for this project was Martin Sturley-Hayes of Jonathan Rhind Architects. The structural engineers were Paul Carpenter Associates.. The Historic Assessment was carried out by John Thorp of Keystone Historic Building Consultants.

Fig. 5. Pizwell barns (north side) following repairs (Source: White, 2021).

3.2.1 Description, Significance & Condition

The ancient hamlet of Pizwell is made up of a group of three longhouses and their associated farm buildings. The earliest longhouse on the site dates to the 14th century and still has a domestic shippon; the two others are thought to be 17th century in date (Thorp, 2019). The grant-aided building comprises a pair of 17th century, conjoined threshing barns, which are recorded on the 1840 Dartmoor Forest Tithe Map as belonging to the two later longhouses, respectively. Pizwell Farm is leased by the occupants from the Duchy of Cornwall.

Fig. 6. Pizwell shown on 1840 Tithe Map (The building occupies plots 537 and 567) (Source: Devon County Council).

The barn walls are constructed of moorstone granite rubble, and the roofs are clad in corrugated iron. In the early 20th century, the building wall height was raised, and a new kingpost truss roof introduced. A photograph of 1889 shows the building with a thatched roof before these alterations. As was usual for hand threshing barns, there are opposing doors at each side of the threshing floors (those in the south wall set much higher due to the raised ground level).

These barns show how farming practices on this ancient site evolved, with the introduction of small barns for threshing, storage and processing of crops. The barns are listed Grade II.

Fig. 7. Build-up of spoil and tree growth against south wall prior to excavation (Source: Jonathan Rhind Architects, 2019).

The buildings had suffered from the twentieth century build-up of rubble and earth spoil against their south wall. This had exacerbated water penetration, washing out pointing and bedding mortar and loosening the masonry. Furthermore, both the south and west walls had been further damaged by the roots of adjacent ash trees. A full-height vertical crack in the NW corner had been made worse by attempted repairs using Portland cement. The corrugated iron roof was rusty and let in water, and door lintels were rotten, or had been replaced with slender angle irons.

Barn owl pellets on the floor indicated use of the building as a roost, but no nest was found. There was no evidence for bat use.

3.2.2 Repairs

The first task specified was to remove the ash trees and excavate the spoil build-up on the south and west sides. This allowed a thorough inspection of their outside face and revealed the extent of damage caused by tree root penetration. In the event, part of the west gable had to be rebuilt. As at Beckhams, stainless steel Helibars were used to tie old masonry to new. Another modern intervention was the placing of a root barrier membrane between the wall and earth to help prevent root penetration from reoccurring.

The extent of repointing was greater than had been originally specified due to water damage on the south and west walls; even so, it was only carried out where absolutely necessary. As at Beckhams, Full mortar analysis was carried out and matching material specified.

Fig. 8. North side of west gable following rebuilding (Source: Jonathan Rhind Architects, 2021).

The corrugated iron roof was replaced and new seasoned oak lintels put in place. As there are no gutters or downpipes, a French drain was installed along the south wall to divert water away from the building.

Fig. 9. Sleeper walls of former suspended threshing floor (Source: White, 2021).

During the course of works, the granite sleeper walls of a rare, suspended timber threshing floor were discovered and these were duly recorded by the archaeologist. The floor have been formed of oak baulks laid over the exposed void, with granite flagstones on either side. Once recorded, the voids were back-filled with subsoil from the rest of the site to match the surrounding area.

Fig. 10. South wall following repair (Source: White, 2021).

3.2.3 Summary

The upper part of the building had become abandoned due to water ingress, and was at risk. The grant aided works have consolidated the barns, made them fully useable again by the farmer, and ensured their survival as part of this important historic group. A public bridleway passes close to the building, meaning also that it can be appreciated by the public.

4. Conclusions

The two case studies above can only touch on the wider outcomes of the scheme, but at least give a flavour of the kind of issues encountered and approaches to resolving them. The other eleven projects included a diverse range of building types, including a grand 1830s bank barn; a modest 19th century mine building now used for agriculture; a former medieval farmhouse now incorporated into a farm shed; an impeccably detailed, late 19th century hunt stable; and the grand, model farm building at Great Cator (see photo below). The last two examples cannot be described as vernacular buildings, having been designed in accordance with the latest theories and practices of agriculture that swept through much of Britain in the 19th century.

Fig. 11. Great Cator Barn during work (Source: Copyright Historic England Archive, Davies, 2021).

Each project has thrown up its own challenges, whether these were technical, philosophical, or around owner expectations. However, in all of them, repair specifications were informed by a good understanding of the buildings' original construction. For example, on sites where analysis revealed that 'hot lime' or subsoil based bedding mortars were used, this same technique was successfully replicated.

Fig. 12. Flitch plate repairs to feet of principal rafters at Great Cator (Source: White ,2021).

In all cases, an ethos of repair rather than replacement has been followed; take for example the roof at Great Cator, where only the rotten ends of the Baltic Pine principal rafters were replaced, with flitch plate repairs ensuring minimal replacement of original material.

It is notable that following repair, all these buildings continue to be in agricultural use. The grants have enabled them to be conserved without being converted to dwellings or holiday cottages – a fate that that has befallen too many farm buildings in the area.

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CONSERVATION, RESTORATION AND ENHANCEMENT OF VERNACULAR ARCHITECTURE

MATERIALS AND INTERVENTION TECHNIQUES FOR VERNACULAR ARCHITECTURE

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Syrian earthen villages: recovery of construction crafts to revive dome houses

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Topic: T4.2. Materials and intervention techniques for vernacular architecture

Abstract

Mud brick construction technique has been attested for at least 5000 years in Syria, and perpetuated in the region without discontinuity is currently experiencing a painful decline. Only a handful of master masons still have the know-how necessary to build the domes. It is therefore to be feared that, after centuries of transmission, the experience and skills of these craftsmen will disappear. These specialists knew how to build modest houses which were integrated into their environment without harming it. Although international conventions and laws confirms that heritage should never be the target of any clashes , during the conflict which has raged since 2011, Syrian heritage has been the object of significant destruction, looting, and the damage. This is very significant in historic cities and rural landscapes. Among the objects damaged the most are the domed houses. This paper discusses the basic architectural details and features of traditional construction system, as well as, current threats, the maintenance and future of the domed houses during and after the war, in addition to the role of rural women in rehabilitating and applying traditional techniques and methods. Additionally, it suggests a brief documentation and digitalizing for tangible and intangible heritage of rural communities living in domed mud houses. The paper proposes documenting and preserving by detailing the tangible heritage damaged by conflict, and giving an intensive training to the young generation on the building methods and traditional lifestyles, and finally recovery and maintenance of construction crafts.

Keywords: *earthen villages; vernacular architecture; recovery endangered heritage; Syria.*

1. Introduction

The use of mud in construction, which has been widespread for thousands of years in my country, Syria, has been facing the threat of extinction for decades. This poses a threat to a part of the memory and identity of a society that is deeply rooted in history. In the second decade of the third millennium, the Syrian mud architecture is facing the danger of extinction after it was the dominant architectural model. This is due to three main types of threats :

The first threat lies in the social changes that took place before the outbreak of the Syrian war in 2011. Moreover, it is a result of the negative impact of globalization and modernity that struck all societies. This created fundamental identity crises that manifested in the lack of appreciation of the people living in this style of construction, as they don't recognize the aesthetic, climatic and environmental characteristics of these constructions They feel ashamed because they live in such houses. This is mainly due to the association between mud houses and poverty. It is also their desire to adopt concrete modernity, which is viewed as a symbol of success and social and material prosperity, that contributes to these feelings.

The second type of threat is the direct consequences of the war on the local community, mainly immigration that took place due to lack of safety.

The third type of threat has to do with the continuation of the war. A large proportion of men left the country to find work elsewhere. They often work as construction workers in neighboring countries. There they are introduced to different concepts of skyscraper housing, glass, aluminum... This will change their relationship with their traditional homes, leaving them dissatisfied with their old way of life. This threatens the tangible and intangible heritage of local architecture. The traditional building rituals are usually passed down through the generations: from grandparents to sons and grandsons and so on. But due to war and displacement, young adults who have come of age are left without any personal knowledge or experience with traditional architecture. This constitutes a major crack and challenge in the chain of transmission of traditional knowledge. To face these challenges, we need to conduct accurate documentation of the architecture and construction vocabulary of this style. This should follow three stages; the doomed houses before, during, and after the war. Then we need to contemplate the following how to reuse the mud architecture in its environment, and to evaluate its positive and negative aspects. Therefore, we decided to provide a full explanation of the building style and types of dome houses to pinpoint the architectural vocabulary of this common building style.

1.1. Types of domed houses

Domed houses vary in size and shape. Some domes start from the bottom of the ground while others rise to 40 cm from the ground, or reach the height of the door. Some of these domes are complete while others stop at half the height. It is often built of mud, and there are rare domes made of stones covered with soil. Rooms were added to the houses little by little according to the needs of the family. Usually, the dwelling or farm consists of several domes according to the family's capabilities (the minimum is a room , a kitchen and a barn). The well-to-do families, however, have additional rooms to receive visitors, a kitchen, stables, and many barns and warehouses. The number of domes often ranges between 5-8, and these are called hanging domes.

1.2. Architectural mud elements: the base, the walls and the domes

Each building has a stone base known as the "foundation"; its thickness is between 60-70 cm, its height varies according to the nature of the neighboring land and the number of stones that can be found there. In places rich in stones, the foundation can reach up to the height of the door. In this case, the wall matches it. In contrast, in areas where stones are scarce, the foundation rises slightly from the ground. But in the most common case, the builder makes two "stacks", that reach a height of 40-45 cm, and then a wall is built on them less thicker. In some rare cases, the dome starts from ground level.

When the base of the dome is square, the builder places, in the form of a triangle, in the four corners of the structure, stones called “the jarniya” or “the fox” or “the corner” and fixed bricks on them. Concerning the quality and size of the stones: we may find rubbles that are carved to a point, and others that are finely polished.

The construction of the dome is a delicate and difficult work that requires extensive professional skill and experience. The height of the dome ranges between four and a half and seven meters. In order to raise it upwards, the builder creates a transitional piece between the square of the wall and the circle of the dome. In Syria, there are two common methods of construction: the older one is based on laying a brick diagonally facing the corner of the walls. in each course, the builder arranges the bricks in the corners in the same way so that they form a circle. A spherical triangle is also laid, which forms the transitional part until the roundness. After that, the building of the courses for the dome begins.

The second method, however, involves placing a piece of wood in the direction of abutments of approximately 80 cm in length, at each corner. Thus, the base becomes a square in an octagonal shape, from which the builder starts to make the circle. In building methods, the sequence of steps is the same. In each cycle, the building advances 5 cm until the dome narrows and takes an oval shape. This architecture is based on the principle of an extrusion that does not require an arc wrench. To the south of Aleppo towards Hama, domes have a distinctive character. The builder regularly inserts large stones visible to the outside, and they are called “dawasa” for they form a staircase that allows the inhabitant to reach the top of the dome when they want to paint it. This also facilitates maintenance work.

2. Basic design of domed houses

There are few differences in design which distinguish the houses of these areas. The most obvious difference is the concept of the courtyard. According to this arrangement, all rooms face the courtyard. Thus, the only way to enter the rooms is to pass through the courtyard. Thus, the only way to enter the rooms is to pass through the courtyard. This shows that the fulcrum in the construction of rural houses stems from the concept of open space, which perhaps could be traced to the Bedouin.

All doors and some rare and small openings overlook the courtyard. Since the dominant wind bringing fresh air in summer comes from the Mediterranean, the windows are opened in the main places of residence, i.e. in the western wall. This indicates a big difference if compared to city houses with courtyards with their windows directed inward to block the view of passersby. It also cools the room with its light rays in winter, and because of the rain and the cold air that blows from the north, from the Taurus Mountains, this part of the farm has no doors and windows.

The central hall features one or two domes (double dome). This division, along with the way the house was used, shows that daily activities were moved from the courtyard, where they usually took place, to the main hall under the shades. The idea of domed houses with a central hall is seen in the old houses; of the kind that we find more in the north, in the vicinity of Ain al-Arab. Contrary to the design that allows access to the different rooms through the courtyard or the central hall, the rooms are placed one after the other or adjacent to each other, separated by doors. This would form a maze. We find the salon and the kitchen close to the entrance door while the storage rooms and stables are located in the back of the house. This design dates back to the era when thefts were very common. Using the space in this way saved the residents' modest belongings.

Fig. 1. Women and men build and maintain mud dome houses (Source: Kassatly, 2011).

Fig.2. Al-Jub/ Beer- Well (Source: Kassatly, 2011).

The mud is known by other names such as “cheese” or “jableh”, which is a metaphor for dirt mixed with water, sand and gravel with straw and hair. The type of clay used varies between simple, thin or cooked depending on the element we want to build. Simple mud is used to build:

• External Warehouses, "The Hut/ Huts".
• The chicken house, "Al-Qun/Qunun".
• The stable/ stables, which is also called according to its size (hut/huts). And (Yakhour/Yoakhir), and (Habusa/Hawabes).
*Al-Jub/ Gibb or Beer/ Abyar.
• The deck/Dakk- Aliyah/ Aliyat/(attics)Branda/ Berndat (balconies).
• basins. • Burj Al-Hamam(pigeon towers).
• The hearth/ stoves. • Tannour.
• baking oven/ baking ovens.

This type of mud is mainly made of dirt, which is sifted if necessary to remove large stones from it. Then water and hay are added to it. And women trample the mixture with their feet until it becomes soft.

Thin slime is used to build:
• Al-Kwara. • shelf/ shelves
• Kwara Al-Nahel(for bees).To make this kind of slime, the responsible woman takes clay soil and uses fine sieve to remove stones and pebbles from the clay. Then water is added to it along with finely chopped hay and fine sand to act as a detergent. And after she trampled it with her feet, she bakes it with her hands. Then she adds goat hair or some other kind of yarn.The dough resulting from the process is called “kneading” and must be assembled for two hours daily over a period of three days to become stretchable (unbreakable)and usable. Cooked slime is used in hard and highly resistant materials. We use it in the following industries :
• mound(khawabi)
• Stoves of bread ovens "Tannoor" and "Taboon" • Sometimes bees' bowls.

In order to prepare this kind of mud, women gather straw, manure and other fuels and place them inside and around the beehives or the stove. Then they light the fire regularly over a period of two days.

2.1. Mud brick fabrication

Earthen mud is used to build domed houses. It is known in Kurdish as “kerbij.” This mud- brick consists of mud and wheat straw mixed with water. The choice of this type of construction is due to the lack of wood and stones in the vicinity of the domed houses, which forced the residents to use soil as a basic building material. In earlier times, a family that wanted to build a new house would make it during the summer. This gives it enough time to dry so that the construction can be completed with its roof before winter and rainy season. After finding the place where the clay is of good quality, the landowner is asked permission to extract the soil. It is then transported by a cart and plastic containers to the area near where the mixture will be made in order to avoid transporting it manually as it might smash. In the past, the inhabitants used a basket of gum "Kufa" and carried water in jars on their heads or on the backs of donkeys.

If the dry clay contains lumps or pebbles, it is first passed through a large vertical sieve. Then a crater is dug in that heap, into which water and straw are gradually poured. One man treads on this mixture to mix it well and stirs it repeatedly to ensure that the result is satisfactory. This mixture is usually prepared the night before the work day. This dough must be left overnight to ferment and become usable. It takes 12 to 15 hours to melt the lumps otherwise the milk would remain fragile and filled with air bubbles, which makes it weak and fragile.

To make mudbrick, residents use a wooden block that they install themselves or borrow from neighbors who may own it. They often use a double-mould "nut mold", which allows two blocks to be produced at the same time. The dimensions of the molds, as well as the mudbrick, differ from one builder to another. And they also differ according to the way they are used. For the construction of walls, for example, it is possible to use molds that produce bricks with a length of 20 cm and a thickness of 10 cm. There are other molds that give mudbrick 50 cm long, 25 cm wide and 10 cm thick.

As for the dome, which is smaller, the brick is made with a length of 20 cm, a width of 25 cm, and a thickness of 8 cm, for several reasons. The most important of which is its small size, which facilitates the process of rotating the dome, and because it is lighter and reduces the possibility of collapse of the dome.

Fig. 3. Types of vernacular architecture and Dome houses in Northern Syria (Source: Kassatly, 2011).

On the morning of the work day, the mold is moistened and taken to the designated place. The builder pours the mixture directly from the cart into the mould, then smooths its surface by hand to remove any roughness, so the brick is flat and well-adjusted. Then the mold is quickly peeled off. Then the mudbrick is ready and the mold is ready for further preparation. Hundreds of mudbricks can be made in one day. When all the relatives and neighbors cooperate in the construction, the work becomes fast. Then the mudbricks are left under the sun to dry. A place is chosen close to the dwellings or to the land where the new house will be built in order to reduce the cost of transportation. After two days, it is placed vertically and within a week it is completely dry and usable.

The builder prepares the mixture that he will use as a "mortar" to bind the mud, and it is made of the same materials. Only then can work begin. Mostly, the walls of domed houses are 60 cm thick, and they need to be made of one and a half bricks. After setting a certain height, the builder is forced to crouch on the wall and then on the dome to continue his work. At the end of the construction process with the bricks, the process of painting the house from the outside and inside is done with “tal” which is a mixture of dirt and barley straw, softer than wheat straw, and it must be sifted before use. In the past, it was manual work, but nowadays a shovel is used. After the painting is finished, a family member puts his handprint on the door.

2.2 Domed house maintenance

Domed homes need to be maintained regularly to keep them in good condition. This begins with the painting process, as the coating is essential to seal the holes and cracks that may be caused by the passage of time, especially during winter. However, the regularity of this process and its restoration varies, according to the abundance of winter rains and the quality of the soil used. Houses painted with limestone do not require maintenance except once every three or four years while the house built in red dirt needs maintenance every year. The fabric used for the outer layer, like ordinary paint, consists of earth, barley straw, and water. The last stage is to paint the house with lime water to protect it from weather fluctuations and insects. However, in areas where chalk is not available, this stage is dispensed with, as these materials become very expensive.

The house is calcined every one or two years, after the great "clearing", which takes place after the winter rains. There is an additional one if an important event in the social life of the family occurs. Then the house shall be prepared and its doors shall be properly opened to receive the guests who have come to take part in the celebration of the event. This explains that the calcination process is lived as a stage of fun and entertainment, especially for children, because it represents for them a feast that precedes joys and renewal. The house, which has been carefully calcified and cleaned, becomes a symbol of the renewal of the seasons (the transition from the dark months of winter to spring), the celebration of marriage, childbirth, and more.

In order to do this decoration, women take chalk “Howara” and crush it to make it brittle and mix it with water in order to turn it into lime water that is used to spray homes from the inside and outside. However, before that, the entire house must be emptied, so that mattresses, sofas, blankets, clothes and various tools are taken out and placed in the yard. This process also helps to purify the bedding by exposing it to the sun.

After that, the women paint the walls, within this empty space, and wipe the low places with rags, then put the ladder to reach the dome, which is often at a high altitude. And they use the bowls to throw lime water on the walls, which completely stains the women and children present. Everyone comes out polluted with white spots on their faces. The houses are left for a few hours to dry before returning the pots to them. After the work on the inside is finished, the same process is repeated on the outside. The men climb to the top of the dome. They are helped by the "dawasat" which are in the form of stone steps that are inserted into the building, and they sprinkle lime water on them. This process seems risky and it is inappropriate for women to climb to such a height on top of the dome.

It is necessary to quickly document the architectural vocabulary that is widely spread in the mud villages next to the domed houses, the most prominent of which are:

The courtyard: It springs from the concept of the open space, which is a reflection of Bedouin life. A piece of land surrounding the house is identified, where the fence is raised to separate the farm from the rest of the houses inside the village.

Wells: Wells are built in the courtyard of the house or within a public place when it is to serve a number of dwellings.

Plant ponds: Residents prepare spaces in the yard of the house or around the houses for planting various types of plants. Women sometimes make clay basins of various shapes:

Al-Qun: The majority of families in the Syrian countryside keep chickens, and to keep the chickens, women make for them a jar of clay of different dimensions and shapes.

The stable: The stable can take the form of a house with domes, but its shape is often like a rectangular building, sometimes without a roof. And if the livestock is abundant, it is necessary to make holes in the walls to secure ventilation. As a result of these numerous holes, visible from afar, the stables are distinguished from the houses. The abandoned houses are often converted into stables.

Pigeon towers: In farms, nests are made as clay boxes with an opening of approximately 20 x 20 cm and a maximum depth of 30cm. The number of nests varies according to the houses, but in general it does not exceed a dozen

The ghee container: "Al-Wawi" is a metaphor for a clay pot made by women. It has the shape of an expanding cube raised by legs from the ground. It is placed in a dark place in the house, where it is used to store fat, which should be protected from moisture.

Kitchen: Meals are prepared in the kitchen, which is a small hall that contains only a portable stove and a semi-table on which the pots used in the kitchen are placed.

Kawer: The small earthen silos located inside the house. They are made by women and used to store grain, flour, salt, and bulgur.

The house from the inside: Beacuse of the asceticism that residents live, there are no signs of a comfortable life. The house has nothing but the basic necessities of daily life in addition to some decorative items. Hanging on the walls are textiles embroidered by women and carrying various drawings, some of which are plant and animal, and constitute an important part of the immaterial heritage of these societies.

Fig. 4. A person who works with a mason 'memarje' or 'muallem', sometimes making adobe (Source: Lotti, 2009).

In the thirties of the twentieth century, Rich had indicated that the population neglected decoration and did not pay attention to it in general as it lost its significance because it is old-fashioned and is no longer popular. In these conditions, it was difficult, after many years, to resist the trend of modernization. The research of "Rich" and "Tomen" was conducted nearly a hundred years. These ornaments are absent since then and the women who made this art and guaranteed its authenticity are also gone. Even if we can recover it from oblivion, there is a fear that we will not be able to know all the components of this rustic art. Even the residents living there- even before the war- were not able to give any information about these decorations.

3. Features of Dome houses in northern Syria

In the past, domed houses were the typical residential building in northern Syria, until the end of the 19th century and the beginning of the 20th century. It represented the rural world on the outskirts of the city of Aleppo, but before the Syrian war, its residents had left it and turned into warehouses and warehouses. In 2022, most of them turned into deserted villages.

These mud villages, whose architectural style extends for thousands of years, and are part of the Syrian identity, were not once a museum. They are a way of life, a lived life and not a festival or a temporary show, because of the characteristics of the mud houses, especially those spread in the north of Syria, the most important of which are: The temperature is moderate all year round, warm in winter and pleasantly cool in summer. The air humidity in it is stable and healthy, regardless of its ratio outside. Plus the construction mechanism is simple and the average person can, with a little practice, build it themselves with some help. The main advantage is that the main building material is free or almost free, reusable even after hundreds of years, and has unlimited possibilities in terms of shaping. The house is considered harmonious and harmonious with its surroundings, and stands steadfast in the face of nature's factors such as rain, snow, heat and cold, despite its "soft" and "quickish" appearance.

4. Criticisms leveled at mud houses

Negative prejudices among all classes of society, such as: “mud houses are not suitable for rainy climates, as they do not withstand water”, “mud houses need constant maintenance, especially in winter”, “mud houses live in which insects live”, “no more than One floor of mud”, “These are the houses of the poor!”

5. Dome houses future

Clay building techniques have developed tremendously in many parts of the world at the time when they were dying in our country. The many research centers concerned with the subject have come up with a wide range of solutions to traditional mud problems. Architects and engineers in all their specializations had a role in developing this type of building to be able to meet contemporary needs and requirements.

For example, the Morocco Pavilion at Expo 2020 Dubai in the “Sustainability” section was built using traditional rammed mud techniques in Morocco, a facade of 4000 m2 and a height of 33 m. It will be converted into a residential building at the end of the Expo...... Which constitutes a strong message to us and to the whole world about the need to benefit from the natural environmental resources,

Fig. 5. Expo Dubai 2020 pavillon maroc (Media, 2022). “Legacies for the future, from inspiring origins to lasting progress”.

Fig.6. The destruction caused by the Syrian war (Source: Asslan, 2018).

6. Conclusions

After more than a decade of the Syrian war, with the wheel of reconstruction turning slowly and in specific locations only for many considerations, which we are not going to discuss here, attention must be paid to the necessity of avoiding the mistakes of the past and avoiding the wrong policies that led to the growth of cities at the expense of the countryside and working on balanced development (City and Country, Modernism and Traditional Historical Architecture). We must work to develop this architectural model to suit the requirements of the times and lifestyle in the twenty-first century.

Working on offering concessional loans (short, mid, and long term loans) for locals to facilitate their settling back in their traditional environment. Beside, empowering women due to their vital role at all levels, with regard that they are the pillars of the rural society.

Training the young generation of the local community on the building methods and traditional lifestyles, in addition to improving their educational level.

Attracting architecture and archaeology students who are interested in earthen building through workshops and training courses to learn building techniques with earth, earth bricks, rammed earth, claying with earth and limestone (calcium carbonate clay), and others.

In Syria, we can consider the destruction caused by the war as an opportunity, an opportunity to re-read ourselves and our urban produces. In order to achieve Sustainable Development goals established by the UNDP through its 2030 plan, especially Goal No. 11 for sustainable cities and local communities.

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Historic tuff masonry in Naples: different approaches to its conservation

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Topic: T4.2 Materials and intervention techniques for vernacular architecture.

Abstract
Tuff, a sedimentary rock made of volcanic ash, is a traditional building material in the Campania region. Since its foundation Naples' architecture, whether monumental or vernacular, has been erected in tuff masonry and only the arrival of concrete and steel has meant its downfall. Due to the soft nature of tuff, traditionally the building material was designed to be covered by plaster and very few and monumental architectures, by selecting and sculpting to the purpose the rock, were designed to be fair-faced. In years the exposition to natural and artificial degradation agents has brought a wide variety of deterioration phenomena both on the fair-faced tuff masonry and the ones that had lost plaster. In approaching the restoration of these architectures, the conservator is faced with a challenging task. This is due to the difficulty of balancing the pursue of minimum intervention and authenticity respect, the conservation of the historic consolidated image of the architecture and the necessity of using the best restoration techniques that guarantee the highest conservation of the material in future years, with particular regard to bio-compatible and sustainable materials both for operators and the environment. By analyzing the restoration of various architectures, both archaeological and modern, the paper address this difficult task and the different decisions made by the conservators in relation to the monuments' nature, identity, history and status of conservation. The paper is based on a multidisciplinary approach due to the contribution of the expertise of an architect, a restorer and an archaeologist.

Keywords: *tuff; conservation; architectural heritage; traditional building techniques.*

1.Introduction: tuff and its traditional use in Naples

Since its first settlement, the use of Neapolitan yellow tuff as a building material has been a constant of Neapolitan architecture. Among the many volcanic stones characteristic of the area, both its large diffusion and the ease of its manufacturing has made yellow tuff the most used building material throughout the millennial history of Naples. The characteristics related to its use may be summarised in the following points. The widespread availability of the material in the Bay of Naples. It originates from the large volcanic eruption that more than 15000 years ago interested the whole area defined today as Campi Flegrei. The debris traveled a great distance from the eruptive centre up to the city of Naples and to the *Piana Campana* (Deino, 2004). The consequent affordability of processing. The economy of manufacturing is in fact due to its direct availability. In several contributions it is underlined that the stone was often quarried directly from the subsoil of the building area, so that the costs connected to transport were reduced and the "emptied" space was then reused as a deposit or cistern (Fiengo, 1998; Fiengo, 2008). This practice was so rooted and common and the dense network of caves under the city was so widespread that in 1781, aware of the potential danger, King Ferdinand IV issued an edict to forbid digging within inhabited areas and along public roads (Sottosuolo di Napoli, 1967). Its good petrophysical and mechanical characteristics. This is the reason of its easy workability, closely related to the heterogeneous composition, for the description of which we refer to specific scientific contributions (De Gennaro, 2013). This feature determines its lightness, malleability to cutting tools and chisels, but also its porosity and volumetric response to thermal changes. Over the centuries tuff has been mostly used as a structural material, plastered on both sides, but sometimes, in buildings of particular significance, the stone was selected and cut with special care in order to be left exposed. The cases like these are few and mostly date back to the Angevin period which have left us majestic architectures both religious and civil (Santa Chiara Church, San Giovanni a Carbonara Church, the Castle of Sant'Elmo, Castle Nuovo, to name a few). The diffusion of piperno in the Aragonese period, a gray volcanic stone much more resistant than tuff, has led to the progressive abandonment of the exposed tuff in monumental architecture in favour of piperno facades, like Palazzo Gravina, Palazzo Sanseverino or the Church of Monteoliveto, and later on to plaster, used to create neat surfaces or painted in order to imitate other building materials like marble or clay (Fiengo, Guerriero, 1998).

1.1. Forms of degradation and intervention issues

Because of its heterogeneous composition, tuff stone is exposed to various forms of degradation, both natural and anthropogenic. Most of them have been indexed through a standardised lexicon (first NorMaL 1/88, now UNI 11182/2006) that has thus provided a shared nomenclature of the most common forms of deterioration. In the case of historical buildings and especially for the stones preserved *facciavista* (fair-faced), most degradation phenomena are caused by the decohesion of the composing elements (the separation of cements, of single crystals, of pumice) due to the deposit of acid substances in the atmosphere resulting from pollution, often associated with complex thermohygrometric conditions, and by the formation of efflorescence and biodeterogenic phenomena.

The study is based on the work of the authors on numerous Neapolitan conservation works on historical buildings dating back to a very long period of time, from the Greek age until the nineteenth century, characterised by the use of tuff both as a building stone and as a finishing and decorative element. It has provided the authors the opportunity to monitorate and compare the most common forms of degradation and, considering the issues of architectural conservation, to choose the most appropriate conservative practices and methodologies in each case. Of course, the types of degradation change radically depending firstly on the quality of the stone, and secondly on whether tuff is protected or not by *arriccio*, plaster or fine stuff. With regard to conservation status, the challenges that often arise for the operators are basically related to these fundamental themes: sustainability of the removal operations and the delay of the biodeterogenic processes; cortical and depth consolidation of the stone; integration of small and large gaps; final protection of the surfaces, especially in relation to the masonry and the building aesthetic. For this reason the age and the use of the buildings are fundamental.

2. Case studies

2.1 Case 1: the remains of a Roman villa in Marianella. Tuff as *reticulatum*

2.1.1 The site and conservation issues

The remains known as the "villa of Marianella" originally belonged to a farm dating from the I century A.D. and frequented until the early Middle Ages (*L'insediamento agricolo* 1987).

The ancient structures were discovered accidentally, during public works for the building of a road, in the mid-eighties. The archaeological excavations were carried out in 1986 and 1987 by the Centre Jean Bérard, with the scientific direction of the Neapolitan Superintendency. The ancient walls were partially restored. The farm had a squared plan, with sides of about 30 m. The rooms were disposed on the three sides of a central courtyard, probably columned. The fourth side of the courtyard was closed by a wall. The walls show a core in *opus coementicium*, a mixture of irregular pieces of tuff and cement mortar made with pozzolan and sand. The external facings are in *opus reticulatum*, made with pyramidal blocks with a squared base (*cubilia*) left *facciavista*, that formed a kind of lattice ("*reticulum"*) with a 45° inclination. This technique, as widely known, is typical of Roman architecture between the I century B.C. and the I century A.D. in Central and South-Central Italy (Adam, 1998).

Facings in *opus reticulatum* were very often covered by plaster, but sometimes they were probably left to the sight: it is proved by some walls with blocks made of stones of different color – tuff, limestone, basalt – that gave life to decorative patterns, sometimes even letters (Adam 1988). Due to the rural function of the Marianella "*villa*", the facings in *opus reticulatum* are quite rough; the blocks are of large size, measuring about 10 cm, and the joints are very irregular. The archaeological site has been left for many years with little or no maintenance: in the last year the Superintendency has begun a project, in order to re-discover the ancient walls, covered by thick vegetation; in some points the ancient *cubilia* had collapsed. The aim of the project is to create a green area in the disadvantaged neighborhood of Marianella, in which the presence of a historical testimony could play an important social role.

Fig. 1. Roman villa in Marianella (Bosso, 2022).

2.1.2 Intervention techniques

Opus coementicium is a natural place for the growth of plants with deep roots and also for bio deterioration. The walls therefore presented widespread forms of degradation, typical of outdoor masonries, in contact with the ground, not covered and with a very high relative humidity. In summary, the following were found: biodeterogenic attacks, decohesion of the bedding layers, disintegration of the joints between tuff blocks, differential degradation. The forms of degradation have posed some typical problems of tuff conservation: the techniques for the inhibition of the processes of biodeterioration, the problem of the aggregation of decohesion, the great dilemma regarding the integration of big gaps and the wall ridges. For conservation purposes, the interventions focused on identifying the best materials to slow down the bio-deterioration processes and consolidate the bedded layers, therefore restoring the original texture of the walls, conserving them and facilitating the comprehension of the site. The results of other restoration actions carried out on the territory prove that the use of compatible and biocompatible materials is the right path for the technical and economic sustainability of the restoring intervention. However, comparative experiences at other sites suggested the use of traditional materials for chemical weeding, in reason of the proximity to the ground and due to thermo-hygrometric conditions, and the reconstitution of joints between the *cubilia* to inhibit plant growth. As for the mortars, they must be as close as possible to the original materials in order to accompany the movements of tuff to the thermo-hygrometric variations, a mechanical property mentioned above. In this regard the properties to be checked are the mechanical ones: adherence to the support; transpirability to prevent the crystallization of soluble salts that, as previously mentioned, are an important part of the damage; permeability to vapour to counteract the poor drainage of water of the original stone. Numerous tests have shown that hydraulic mortars without cements and slaked lime are suitable materials for interventions: in this case, the mixture of the mortar was made from the earth of Terzigno, a town in Campania whose proximity to Mount Vesuvius determines the heterogeneity of the earthy sediments, compatible for mechanical and aesthetic properties. As for the very important issue of the integration of large gaps resulting from the collapse of the wall due to the deep rooting of weeds, the choice was suggested by the type of degradation. The collapsed parts, in fact, threatened the stability of the entire walls and all the collapsed tuff stones were found on site and therefore could be re-collocated. It was therefore decided in this case to adopt a sort of anastylosis by moving back the integration carried out with the original stones by 0.50 cm. In modern conservation methods tuff facing in *opus reticulatum* is obviously left to the sight when it isn't covered by the original ancient plaster. This obligates the conservator to preserve the surface with a protection layer: in this case a protective fluorinated copolymer was chosen.

2.2. Case 2: the Church of San Giovanni a Carbonara. Conservation of XIV Century facciavista tuff

2.2.1 Conservative issues

The church of San Giovanni a Carbonara is one of the most relevant basilica of the city. Built outside of the fortified city starting from 1343, it still represents the Angevin and renaissance Neapolitan art at its best (Filangieri di Candida, A. 1924; Pane, R. 1975-77). In its long history the religious complex underwent numerous transformations and additions which progressively enriched the monumental architecture. Sadly the last century deeply affected its conservation, firstly by the violent bombing of the church in 1943, during World War II, which affected both the roof and the facades, the first shuttered beyond recovery, the others deeply compromised (ACS, ACC, MFAA, Campania). It was therefore necessary to carry out important works of restoration, rebuilding parts of the monumental tuff and piperno masonry characteristic of the architecture. Despite other important conservation works carried out in the late sixties and in the nineties in consequence of the terrible earthquake of 1980 (ASN, SGC), the lack of maintenance, the obsolescence of some of the intervention and the exposure to aggressive deterioration factors (heavy air pollution, strong winds, direct sun, rising dump) deeply affected its state of conservation, demanding a new and vast restoration project. The works, directed by the local Provveditorato, were closely followed by the Superintendency, which acknowledged the difficult issue of conserving the characteristic and massive *facciavista* walls, by now punctuated with numerous replaced blocks and altered by a great variety of degradation phenomena, such as biodeterioration, efflorescence and exfoliation of cortical layers. It was therefore decided to carry out numerous samples in order to identify the best ones.

2.2.2 Intervention techniques

The *facciavista* tuff was affected by biodeterioration process caused by the proliferation of molds and lichens due to the insistence on the bare stone of wastewater and the consequent growth of soluble salts, with severe decohesion of the constituent elements visible in the advanced exfoliation of the stone. In this case also, taking into account bio-restoration (Orial, 1993) and its development (Tiano, 2005) that technically accompanies the choice of minimum intervention, we have tried to operate with the utmost respect for material compatibility by first testing sustainable materials, such as essential oils, for the removal of biodegrade (Kakhael, 2019).

Fig. 2. San Giovanni a Carbonara (Russo Krauss, 2021).

Specifically, thyme oil was tested. The feasibility test gave good results, however due to the vastness and penetration of the infestation it was decided to work with quaternary ammonium salts to ensure a longer duration over time. The consolidation phase, on the other hand, was faced with the sustainable and compatible method of limewater, which gave optimal results by managing to reaggregate the surface and compact the exfoliation even in an advanced state (Fig. 2). As regards the integration phase, in this case, with existing rectangular ashlars, but strongly compromised, it was decided to integrate only the missing cortical parts with sub-level grouting, performed with slaked lime, tuff aggregates and very fine-grained brick (eco-mortar) avoiding the replacement of whole stones. The long experience in the consolidation of silicate stones has led, in the Italian and Neapolitan territory, to an increasingly conscious use of structured materials with a greater penetration capacity (Albini, 2012; Hosseini, 2018). For this reason and to ensure the longest possible life for the consolidation and integration operations, over the years numerous materials have been tested on exposed stones to replace ethyl silicate. This material has in fact been used for a long time to consolidate and protect, but gives the stone an unnatural refraction as it is vaguely saturated. In general, the monitoring of the use of other types of inorganic consolidants has shown that solvent-based polymeric re-aggregants causes serious complications on porous stones as well (Delgado, 2022). In this case, the stone was protected with an aqueous dispersion of nanometer-sized colloidal silica.

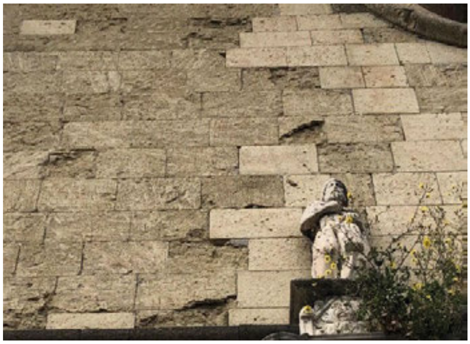

Fig. 3. San Giovanni a Carbonara (Russo Krauss, 2021).

2.2.3 Architectural choices

The beauty of the facades of the church of San Giovanni in Carbonara lay in the massive facciavista walls, mainly in tuff, but also in piperno. Conceived to be left exposed, the blocks are way larger than in traditional local architecture. They are neatly carved and with very little mortar in the joints. Except for the marble portals there are no decorations and everything is left to the texture of the masonry. It is therefore with particular care that the issue of stone conservation had to be addressed. Almost every block, both original or of replacement, presented a deterioration phenomenon in a more or less advanced stage (Fig. 3). Consolidating and protecting the stones, filling the biggest gaps, which represented both an aesthetic issue and a conservation issue, maintaining the distinction of the intervention while restoring the homogeneity of the wall surface was a difficult task. The choice has been that of the minimum intervention, accepting the aesthetic differences of the blocks, both in their colour and in their texture, consolidating the material and filling the biggest gaps with sub-level grouting. Instead of matching the colour of the mortar in each *lacuna* to the colour of the nearby stone a much less mimetic intervention was chosen. All the *lacune* were treated as one and a single colour was selected to accompany and define this new historic phase of the monument (Fig. 4).

Fig. 4. San Giovanni a Carbonara after the work of conservation (Russo Krauss, 2022).

2.3 Case 3: archeological site of Pausilypon. Tuff as a preparatory layer for frescoes

2.3.1 Conservative issues

On the top of the promontory of Posillipo, in a natural landscape of absolute beauty there are the archeological remains of the Roman villa of Publio Vedio Pollione, one of the richest men of the Republic, who chose this magnificent scenario for its *otium* Villa. Upon his death the estate was given to Augustus, becoming an imperial villa. It was therefore transformed and expanded according to the needs of the later emperors. Due to collapses and instabilities both in its acces by land and sea (the 700m long Grotta di Seiano under the Posillipo hill and the berths of Gaiola) in the Early Medieval Period the site was abandoned. Starting from the XIII century the area was repopulated and mainly used as farms and orchards while the archeological remains were sacked by local noblemen to enrich their villas (Varriale, 2015). The first excavations were carried out in 1820 by the architect Guglielmo Bechi. Twenty years later the access to the Grotta di Seiano was rediscovered and king Ferdinand II ordered its recovery. From now on the site was both excavated with continuity, although with no method or regard, and inhabited by local rich men (Günther, 1913). In the XX century no excavation was executed and the site was abandoned until in 1988 the Archeological Superintendency progressively acquired and excavated the site creating the Parco archeologico del Pausilypon. In its many hectares lay visible numerous parts of the Villa, while others still await to be excavated. As the owner of the site the Superintendency is in charge of its conservation, which constitutes a challenge due to the scale of the archeological remains and to the constant exposure to strong external agents.

2.3.2 Intervention techniques

The archaeological site of Pausilypon is an excellent site for the monitoring of the outcomeson tuff of the conservation techniques, which continued for years and have had several processes of deterioration. This evidence proved conclusively that the policy of adopting materials in mechanical and chemical-physical contrast with natural stones has not achieved results suitable for proper conservation of the surfaces over time. The site presents, in fact, some types of interventions carried out previously with more invasive materials. These include cortical consolidation, with the use of synthetic no-film-forming resins; the integration of gaps with the use of cement mortars. Taking into account the peculiar conditions of the site, heavily exposed to weathering, especially direct sunlight, marine aerosol and strong winds, the conservation project, currently under study, will be strongly oriented to the search of sustainable practices that ensure maintainability and durability through the use of biocompatible materials. The conservation project will be informed by an approach of environmental and economic sustainability: all practices will be made from biocompatible and recycled materials through the extensive use of waste from other processes. To verify this approach a first phase of feasibility testing was done for the consolidation, integration and protection interventions. With regard to consolidation, the challenge is the defense against the stress to which tuff is subjected mainly because of the strong winds and the insistence of the marine aerosol. This is because part of the walls are exposed to the sea and in any case the entire site is located on a high promontory. In this case also the feasibility tests had nanostructured materials (i.e. nanolimes) that penetrating in depth were able to saturate the material more effectively re-aggregating the stone and leaving intact the porous aspect typical of tuff. In the peculiar case of the Pausilypon's tuff facings, a great majority of them receive the layers that form the fresco. For this reason it will be necessary to make some decisive choices that are related to the protection of the ancient walls too exposed to sun and wind through structures completely different from those used in the past. In fact, the current heavy archeological coverings rest upon the archeological remains, with rods deep in the masonry and, although the wall ridges were increased by great portions, they anchor both in ancient and restoration masonries. To this end the project aims to replace the outdated coverings and install new ones in the area that have proved more sensitive to weathering.

Fig. 5. Pausilypon archeological park (Russo Krauss, 2021).

The slowing down of biodeterogenic degradation in the case of an archaeological park like Pausilypon, characterised by great biodiversity thanks to the extension of the luxuriant Mediterranean macchia, is a great challenge that imposes a choice of materials that take into account the interactions of biocides with the vegetation that surrounds and sometimes encloses the site. Therefore, the choices will be oriented to medicinal plants or to enzymatic cleaning, which, in any case, constitutes an interesting alternative to traditional chemical products, which, besides involving treatments often aggressive for the substrate, are poorly selective. Moreover, according to some studies on the control of biological degradation, enzymes are a valid alternative to traditional biocidal products, reducing completely the toxicological risk resulting from the use of such substances (Goldin, 2017). The issue of stone integration with tuff masonry is complicated by the fact that since masonry houses most frescoes, it is necessary to study the solutions of continuity between it and the painted plaster when the space is lacunose. The choices of modern conservation impose not to reconstitute the fragmented plaster on the tuff left exposed. The edges of these "painted islands" are often treated with cement mortars and it is obvious that because of their absolute inconsistency with the movements and the natural porosity of tuff, over time they will come off. In this case also it is necessary to apply a “homeopathic” principle using materials as similar as possible to the original, in order to accompany its physical and mechanical characteristics.

3. Conclusions

Due to its traditional use in every century and in every type of architecture, the challenges related to the conservation of tuff masonry are intrinsic in the work of architectural conservation in Naples. Despite its apparent constant features, however, every building raises a different conservation issue. Different approaches must be taken into account in order to identify the right intervention. Firstly the question of the original design of the architecture must be considered. Is it a vernacular or a monumental architecture? Is the masonry of prestige or not? Was it covered in plaster or not? Then the story of the architecture must be studied in order to individuate its different phases, alterations, changes, all up to the more recent history of restorations, understanding which approaches and which techniques were used over different years (for examples in presence of big gaps: sometimes they were filled with tuff and sometimes with bricks). Then the conservator must acknowledge the historicised image of the monument and set the goals of its intervention. Only at this point is it possible to ponder the different techniques, identify the feasibility tests to carry out and then, by comparing the results, select the right one. For instance in the case of the XVI century convent of Santa Caterina a Formiello (Furnari 1996), which was converted in a wool factory in XIX century and nowadays is a condominium that has long lost most of its plaster from the walls, the issue of the conservation of its facades is particularly challenging and the instance of the conservation of the historicised image of the facciavista walls collides with the needs of the material. In fact the little tuff ashlars, the wide and irregular joints, the little wall thickness, the wide variety of alteration phenomena, mostly erosion, all demand the application of a protective layer.

It can be concluded that no easy and codified solution can be given to the conservation operators in the case of tuff masonry, which must be approached case by case, considering and balancing different instances with the most different conservation techniques available today.

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Vernacular architecture on archaeological remains. Conservation and enhancement of the "Villa San Limato" in Cellole

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Topic: T4.2. Materials and interventions techniques for vernacular architecture

Abstract
The paper aims to analyze a case of vernacular architecture in Cellole (Italy) built on the roman maritime villa of Sofonio Tigellino, prefect under the Emperor Nero. 'Villa San Limato', built in the eighteenth century, includes a roman cryptoporticus and some thermal rooms of the original roman villa. The roman walls, the ancient mosaics and the marmoreal rests of San Limato were accidentally found in 1954, during agricultural works. Only in 1971 the roman villa was fully excavated by Werner Johannowsky. The roman villa of 'San Limato' is a rare example of suburban roman villa with private baths, included in a much larger archaeological area on the edge of the ancient Roman colony of Sinuessa (296 a.C. – V century). The ruins of Sinuessa are still visible on the seacoast of Mons Massicus and, underwater, off the coast of Mondragone. The 'Masseria San Limato' is an interesting case study because it testifies the coexistence between archaeological remains and rural architecture. The rural farm have been developed often re-using the archeological rests, as foundations for the new buildings or employing archaeological materials inside the building. The 'Masseria San Limato', which is largerly in a state of disuse and abandonment, is not yet fully known and constitute an important example of local built heritage for the values of construction tradition, materials and techniques that they preserve. The study is characterized by an interdisciplinary approach. It will illustrate the characteristic values of an emblematic vernacular architecture and his state of conservation analyzed with respect to the structural instability and degradation in order to identify guidelines for the conservation, enhancement and the storytelling, at the same time, of the rural and archeological heritage.

Keywords: *archeology; vernacular architecture; conservation; Sinuessa.*

1. Introduction

This article follows some older studies concerning the restoration and fruition enhancement of Villa San Limato in Cellole (Italy). Villa San Limato is an interesting case study in the field of built, vernacular heritage, as it embodies the coexistence of the rests of a Roman maritime villa (that probably belonged to the prefect Sofonio Tigellino) with the surviving structures of a farmhouse (that was built on the rests of the Villa in the eighteenth century) (Fig. 1).

Fig. 1. The rests of the Villa San Limato with the surviving structures of a farmhouse (Source: Cappelli, 2021)

Today the archeological remains of the Roman Villa and the architectural ruins of the rural building are in state of abandonment and degradation, therefore it is very difficult to distinguish and read the different layers.

The current state of the Villa represents the last phase of a process, during which the two architectural manufacts were built, overlapped, and degraded, always depending on the environmental and cultural conditions.

The coexistence of the archeological dimension and the architectural component of the site requires a multidisciplinary and multiscale approach. The main aim is to preserve, understand, maintain, and share the ancient pre-existence. There are several problematics to deal with, especially regarding the structure and materials’ conservation, the accessibility and use of the site.

The uniqueness of the materials and the traditional technics of construction of both the vernacular architecture and the archeological remains that lay underneath require a history-aware restoration work.

2. The Roman villa of San Limato: from the understanding to the valorization of the archeological remains

The maritime villa of San Limato was built north from the Roman colony named Sinuessa, along the low, sandy area, that is typical of the north coasts of the Campania region. The villa represents a certain social and cultural category, as it is geographically placed in an area, where there was a heavy concentration of luxury houses during the imperial era, in line with the near south coasts of Lazio. It is probable that the amoenitas locorum of these places was essential for the Roman aristocracy, who decided to build so many villas, that the coastline “looked like a city” as Strabone said (Strabone, 1988).

The villa has a thermal plant, which is the only testimony of the Roman period, and it is the only villa that has been excavated on the Domitian coast area. The current state of the site does not allow to fully understand the original appearance of the villa, that must have had an important architectural plant and rich decorations, as testified by several important sculptures, that were found during some agricultural works in 1954 and are now kept in the National Museum of Naples.

According to the historians’ most likely hypothesis, the Roman villa of San Limato was built in the first century, during the Julian-Claudian age. At this time, the typological, morphological, and functional evolution of the villae maritimae had already established a precise style and clear political and social intentions.

Up until that moment, maritime houses were considered as normal architectonic complexes, linked to few typological categories, and characterized by different features, mainly determined by the fantasy of the architects and by the needs and economic sources of the commissioners (Mansuelli, 1958; Mansuelli, 1961).

The villas were considered in two different ways, they were “productive”, maritime houses but also houses built for the *otium*, as places to rest (Lafon, 2001; Gros, 2001). Either way, both were characterized by a perfect coexistence between natural environment and architectonic building.

Several archeological studies of the many coast houses from the Imperial age highlighted how at some point the original inhabited nucleus, centered around an atrium and a tablinum, becomes richer and richer of new spaces, such as oeci, exedra, peristyles, and nymphs, sumptuously decorated with statues, mosaics and frescoes. These additions came with different planimetric configurations and are not traceable to a unique type. In fact, every villa offers its own solution, determined by the environmental situation and by the needs of the highly hierarchic Roman society.

The data emerging from the archeological research and the interpretations of the planimetries allow to identify the presence of certain architectonic forms, useful to human amusement and to state a clear social condition. The plants of the maritime houses are characterized by rooms where the power was wielded and that

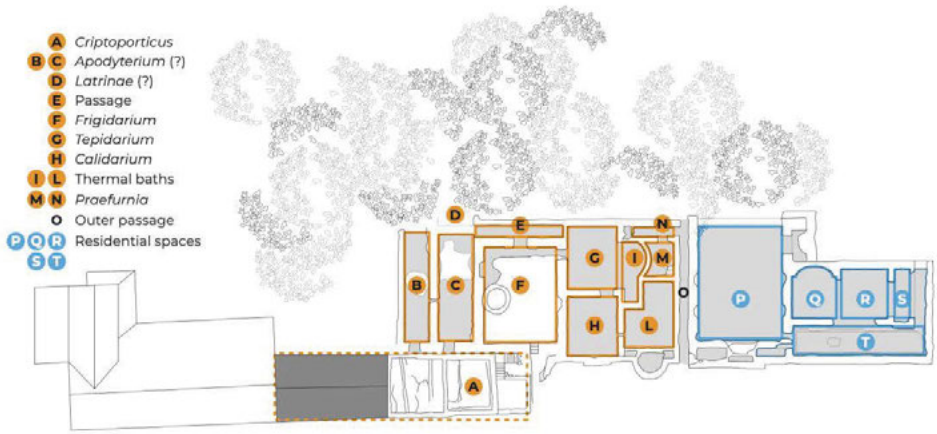

Fig. 2. General graphic elaboration of Villa San Limato's plan: the area of the private baths (orange) and the residential area (blue) (Cappelli, 2021)

symbolized the public dimension (like the thermal plants), creating a transposition of the urban building model into the private sphere.

Therefore, the maritime villas gradually evolved into the forms of living and became a place of social self-representation. Their luxurious architecture and fine furnishings increased "a key phenomenon of the reception of Hellenistic culture by the Roman upper-class» (Zanker, 2012).

In the case of San Limato, the planimetric position of the remains, which are parallel to the coastline, demonstrates the original scenic dimension of the building, most certainly reminiscent of the typological development of the maritime villas during the Neronian and Flavian age. There was the tendency to emphasize the fruition of the external areas, saw as the background of wellness activities and otium. This emphasis was created through a planimetry based on curved profiles of apses and exedras, open on the green and towards the sea.

Such configuration was complemented by luxury furniture and architectonic decorations, that enriched the terraces and the arches, highlighting the outlines and geometrical lines. All these features increased the quality of the wellness experience and the representativity of all the spaces and the whole house.

The remains of Villa San Limato that are currently visible, are on two levels: the lower one includes a cryptoporticus with a wall perimeter in a fine workmanship mixed style, that supported the noble floor. The upper level is composed by several spaces, that were partially excavated in 1971, during an excavation coordinated by W. Johannowsky (Johannowsky, 1975).

The results of the excavation, carried out in the Seventies, does not allow a precise reconstruction of the planimetry of the villa. The graphic rendering is rather rough (Fig. 2), and it is hard to figure out how people used to enter the villa and live its spaces. What is clear is that there are two distinct buildings, that were probably built in different moments and are separated by a 1,20 m wide corridor [O]. The first nucleus of spaces is the most north-western and was most certainly a balneum. The second one is placed on the southeast corner and has a far more residential outlook (Cascella, 2017).

In the side facing northwest, the cryptoporticus is near to the areas [B] and [C], that probably correspond to the ancient apodyterium. Besides the presence of some service rooms [D, E], it is possible to identify the thermal spaces, with the frigidarium [F], the tepidarium [G] and the calidarium [H]. The frigidarium, a pool for the cold bath, is characterized by some remains of the apsidal and rectangular niches and a black and white mosaic floor, decorated with sea creatures. This mosaic was one of the first to be realized during a full restoration of the villa in the first part of the II century a.C. and was partially sacrificed to leave space to a round bathtub, leaning against the frigidarium wall.

The wall of tepidarium and of the calidarium show the signs left by the tegulae mammatae and by the clay tubules, their floor still presents clear signs of the marble crustae. As usual, the floor plane of these rooms laid on suspensurae, that were brick or tile columns that allows the circulation of the air heated in the prefurnia, furnaces that fuel the hypocaust. These furnaces, one with a rectangular plant [N] and another with an apsidal plant [M], are visible on the east side of the archeological complex. All the rooms are made in opus latericium, except some wall portion, made in opus reticolatum and opus mixtum.

In the southern part, it is possible to distinguish only four rooms [P, R, S, T], originally of residential character, with niches, apsis, and rests of floor coverings with mosaic and marble plates. It is probable that once these rooms had also fountains and statues.

The state of conservation of the archeological rests is not the best. Despite some previous restoration work, made on the wall top of the low masonry, there are still many conservative criticalities (Fig. 3-4). The archeological remains of Villa San Limato are very fragile and need an urgent maintenance work, for what concerns the environmental risks. The exposure to sea aerosol and the important presence of vegetation, both within the site that all around it, call for action to cyclic and fixed work of consolidation and protection, to preserve the life of the complex. It could be possible to design one or more coverings, that would protect the archeological remains, also reconfiguring the original volumes of the thermal and residential rooms of Villa San Limato. In particular, the mosaic floor shows many signs of degradation, even if it has been restored several times: lost pieces, weeds, surface deposit, crusts, and chromatic alteration.

In addition, the underground environments represent the worst criticality, as they show several signs of humidity, with important stagnation of water and proliferation of algae and mold.

It is clearly impossible to act every now and then on such complex and wide archeological remains. There is the need to put back together all the pieces, saving their authenticity and keeping in mind the actual role and the precise function of every element.

Fig. 3. State of conservation of the walls (Cappelli, 2021)

Fig. 4. Degradation of the cryptoporticus (Cappelli, 2021)

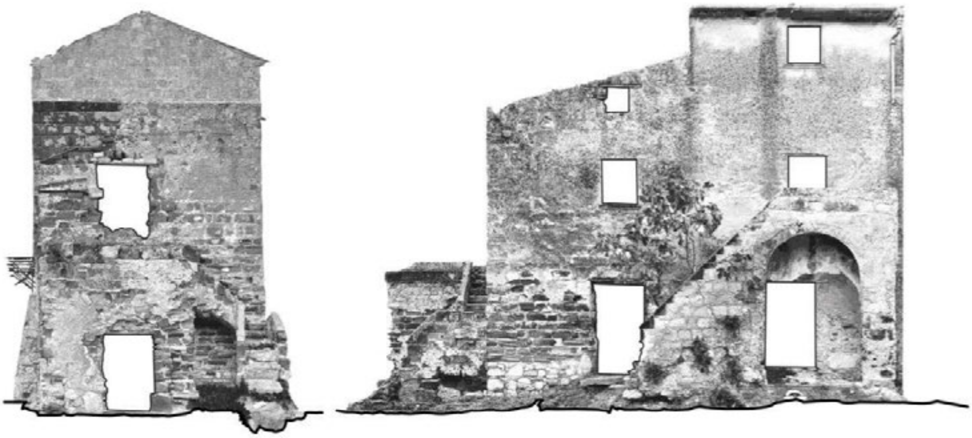

Fig. 5. The analysis of the materials and of the traditional techniques of the farmhouse (Cappelli, 2021)

3. The 18th century farmhouse. The restoration of a rural architecture on Roman remains

As already said, in the XVIII century the farmhouse was built on the cryptoporticus, that supported the rooms of the Roman villa. The building of the rural house on the rests of Villa San Limato went along with the potentiality of the surrounding natural environment.

On one hand, the Roman villa was built in this place for its view and with beauty-curative purposes, on the other the farmhouse reinterpreted the typological character of the Roman villa, answering to the rural needs. For example, the cryptoporticus was used as a cellar.

It is important to study and preserve the Roman rests of the Villa, as they testify the Roman way of living and local culture. The ruins of the farmhouse represent the last part of a building complex, which is made of another portion of private building, on which the vernacular structures of the 18th century were built. The farmhouse is basically developed on three buildings and on three levels, that rise on the cellar, converted from the Roman cryptoporticus.

The higher buildings, one covered with a gabled roof and the other with an orthogonal pitch, have a double entrance on the ground floor. These structures are what is left of the living center of the farmhouse, as there is the kitchen on the ground floor and two other rooms on the first floor, that were probably bedrooms. The two isolated rooms of the first floor are accessible through two external stairs, which rise above the north-east and south-east sides. The stair on the short side was built against an additional building, that had only one floor and only one entrance, intended for external use and equipped with a hob. This building has a flat covering, that functioned as the terrace of one of the rooms on the first floor.

The analysis of the materials of the farmhouse (Fig. 5) demonstrates the use of traditional techniques and materials. Starting from the materials, it may be interesting to understand the different steps during which the building was made and then modified as needed.

Due to lack of maintenance and to a long period of abandonment, the 18th century structures of the farmhouse and those of the Roman age (except the mosaic paving, recently restored) show different signs of instability and degradation. In particular, the constant exposition to the aerosol creates many conservative criticalities.

The study of the building techniques and the interpretation of the crack pattern of the farmhouse shows different kinds of instability: holes in the masonry shell (due to the absence of covering and to the collapse of the ceilings), signs of erosion on the walls, gaps in the masonry, due to collapses of the structure and old materials. What is left of the traditional wood ceiling are only a few chestnut wood beams with circular section, now rotted.

The architectonic surfaces show several signs of degradation, regarding the tuff, that is both yellow and grey, porous, and fragile. Due to years of exposure to atmospheric agents, the tuff developed different kind of erosion, surface deposits and efflorescence. The limestone blocks, that make up the foundation, show signs of erosion, chromatic alteration, and biological patina. There is an important presence of weeds, with shrubs of fig that cause the disintegration of some portion of the internal and external walls. It is important to face the structural problems and the degradation of the materials with carefully considered actions, that could satisfy the current needs of statical and functional adaptation but also respect the traditional techniques and the characteristics of vernacular architecture.

It is possible to use more modern techniques, materials and technologies or redesign some architectonic solutions, making the building more comfortable bot always ensuring the presence of the traditional peculiarities of the rural heritage. The roof with pitches, the traditional wood ceiling, the external stairs, the direct paths to the external court and the natural surrounding are fundamental values to preserve (Fig. 6-7-8). In addition, there are many criticalities regarding the fruition of the site. The archeological complex is rather peripherical in its municipal area, as it is built in the extreme south of Baia Felice, next to the beach. How to reach the site is one of the first problems to solve.

Currently, Villa San Limato is hidden by several buildings that do not allow to see the site and the archeological ruins from the road that leads to them.

Such urban disorder (Fig. 9) does not allow to see the archeological evidence, that are rather incomprehensible, although several attempts to communicate them through didactic signs (now old and ruined) and a tourist InfoPoint (always closed).

Fig. 6. The ancient kitchen of the farmhouse with holes for fire (Cappelli, 2021)

Fig. 7. The ancient access to the farmhouse below the staircase leading to the first floor (Cappelli, 2021)

Fig. 8. The wooden beams of the ancient floor of the farmhouse (Cappelli, 2021)

Fig. 9. The entrance of the archaeological site: urban disorder does not allow to see Villa San Limato (Cappelli, 2021)

The shape of the site does not allow an easy understanding, therefore there is the need of project interventions, able to differentiate the Roman rests and the structures of the farmhouse, but also to point out their direct connection.

The analysis of the building techniques and of the historical materials of the two houses is essential to elaborate a correct approach for the conservation of the ancient remains.

The environment surrounding the Roman villa and therefore the farmhouse makes this conservation very difficult. Apart from the fact that this area is abandoned most part of the year, the sight and recognition of the buildings has got worse, due to structural and cultural barriers.
Most of the people who live in this area do not know the archeological site or are not able to understand it.

The valorization of the site must consider the restoration of the farmhouse as a way to attract more people in this area. Recomposing the historical configuration of the farmhouse, thinking of new ways to revitalize the agricultural dimension of the villa and to enjoy beautiful sight, it is possible to increase the attractiveness of the site. The farmhouse could also become the background of cultural activities and events, through the addition of a working InfoPoint, a small museum with all the sculptures found during the excavation of the villa, service rooms with useful tools and equipment.

Lastly, the management of the site is an issue to consider, as the economy of Cellole depends primarily to the third sector and is mainly linked to the tourism on the coast. There is the need to identify a cultural association or a local company that could take care of the site and manage it, through the partnership of the Cultural Heritage and all the modalities required by law. The near accommodation facilities could be part of the promotion of the site, for example running activities ranging from food and wine appreciation to historical tours.

4. Conclusions

The complexity of the palimpsest that unites the archeological remains of the Roman villa of San Limato and the architectonic ruin of the rural building requires a conscious restoration project, that should consider both the rests at the same time, as testimonies of two different heritage but united by the same evolutional process and destiny (Fig. 10).

The restoration represents the main solution to reactivate the memory of this site and to transmit its values to the future generations. After the study of the building techniques and the historical materials and after the analysis of the traditional use of the different archeological and architectonic structures, it is possible to preserve and deliver them to the future generations. They will be able to understand their meaning only through well-thought architectonic interventions and an effective storytelling.

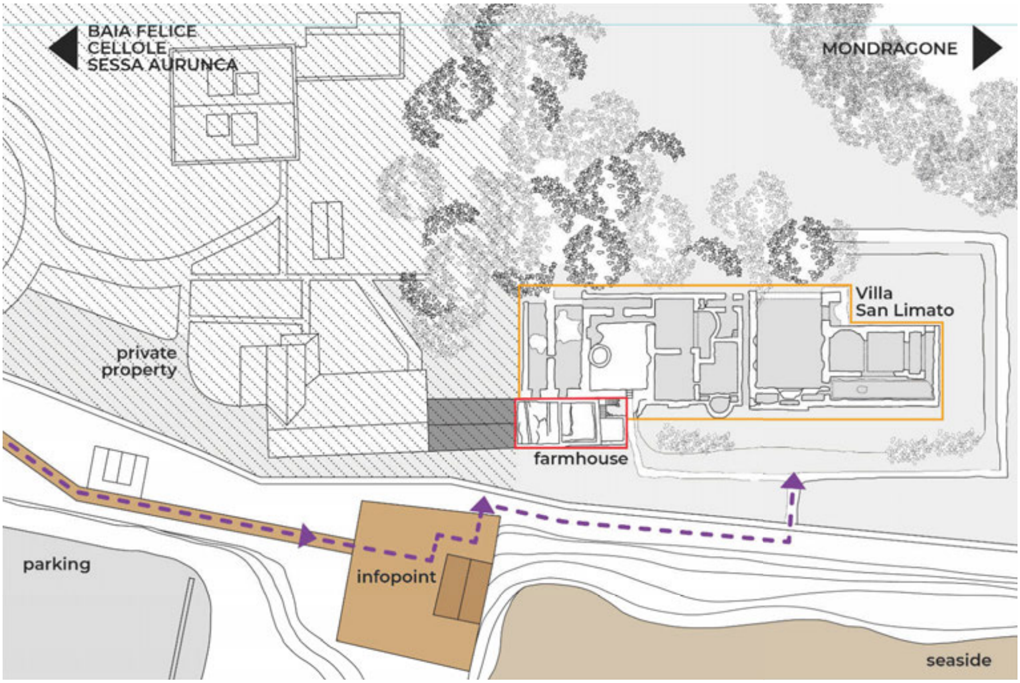

Fig. 10. The masterplan of archaeological site: a new access system and itineraries are needed to improve the use of the site (Cappelli, 2021)

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Conservation and restoration of timber architecture in the Czech Republic

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Topic: T4.2. Materials and intervention techniques for vernacular architecture

Abstract
This paper concerns the techniques and methods used for the construction, preservation, and intervention of timber structures in the Czech Republic, built of logs and hewn logs in particular. Against the overall European background, the paper endeavors to find a sustainable approach to preserving these structures out of consideration for their character, credibility, and information value.

Keywords: *timber heritage; deterioration; damage; intervention techniques.*

1. Introduction

Vernacular architecture has been built of fir and spruce wood in today´s Czech Republic for a long time. Round logs were used at first and squared throughout the country thereafter, even in regions completely transformed because of wood shortages as well as anti-fire measures. As an example, Slaný Region in central Bohemia can be mentioned. Local stones were used since the Middle Ages here. Another example is southern Bohemia, where entire villages were rebuilt with bricks during the 19th century. Log constructions have hardly been preserved in the territory of the Czech Republic, except for archaic building traditions in the case of some regions and building types as well as in combination with prevailing hewn logs.

1.1. Definition

Cyril M. Harris (1975) has differentiated a log cabin from a log house: *A **log cabin** is constructed of straight, round logs stripped of their bark and laid horizontally, one above the other, to form a structure. In contrast, a **log house** is constructed of logs that are hewn to form square timbers before they are assembled as a structure. The construction of these two types of buildings differs concerning tools, skill, and time. In both, the logs are notched or otherwise fastened together to prevent their spreading at the corners and to provide rigidity and strength, but in a log cabin, all the logs protrude beyond the joints.*

1.2. Terminology

Srub from ***roubený dům*** can be accordingly differentiated in the Czech language. In the first case, we can use “*das blockhaus*” or “*blockhütte*” in German, “*en bois massif empilé*” or “*cabane*” in French, “*capanna di tronchi*” en Italian, “*cabaña de troncos*“ in Spanish, and „*zrub*“ in Slovak. In the second case, there is also another English term, namely “*timbered house*”. But the “*log house*” is more often in use as well as the same in French "*en rondins*", in Italian "*di legno*" and Spanish "*de troncos*". In German, the general "*das Zimmerwerk*" is used. In Slovak, it is similar to Czech, i.e. „*zrubený*“. Because not only houses are included in the paper, the term „*log structure*“ or „*timber structure*“ will be used in the following text.

1.3. Method and scope

The classification below was carried out of consideration for log structures in today's Czech Republic; nevertheless, the European context was taken into account. The primary method used was field research in the course of the author's professional experience (https://lidova-architektura.cz).

2. General principles

There are several principal documents regarding interventions and preservations on heritage including timber architecture, not counting lots of general documents. At the international level, ICOMOS charters and other doctrinal texts (https://www.icomos.org/en/resources/charters-and-texts) can be mentioned in particular.[1] Except for these, there are many methodological manuals and practical guides as well as many papers at the national level. From the design, construction technology, and realization point of view, technical standards or building codes are particularly important as well as other specific recommendations. In this context, we cannot ignore the Eurocodes (EN) (https://eurocodes.jrc.ec.europa.eu/) which were developed by the European Committee for Standardization (CEN).[2] In the case of the Czech Republic, the national Czech technical standards (ČSN) were replaced by the EC (now ČSN EN). Out of consideration for the topic, it is naturally the most important section Eurocode 5: Design of timber structures (EN 1995)[3] except for Basis of structural design and Actions on structures. Equally important are technical standards relating to the wood and timber itself[4], and the others concerning diverse aspects of durability and wood preservatives.

3. Climate change and Green Deal

Although cultural heritage has always been exposed to the climate, its vulnerability increased due to the effect of climate variability and change apace. This also applies to timber heritage to a large extent. For that reason, the threat from either drought and fire or rainfall/snowfall and flood cannot be ignored. Flood hazard is likely to increase across much of Europe (Sabbioni et al., 2008). Creating a sustainable built environment must be also included, particularly for reducing whole life-cycle carbon emissions in the construction sector. Repair and reuse of existing timber buildings and components may be the optimal or even the best option in some cases. This is true in the case of the appraisal of the life-cycle including energy and resource consumption from a long-term point of view, not even counting the heritage values degradation themselves. (ICOMOS, 2019; Larsen & Marstein, 2000)

4. Damage, deterioration, and defects

Timber structures are very vulnerable to water in all states of matter as well as to fire for various reasons. Biocolonization by wood-destroying fungi or insects (Caneva et al., 1991; Goodell et al., 2020) is also a common cause, closely related to moisture. There are many damage manifestations, which can vary in extent and seriousness. Many technical terms correspond to these manifestations.

D	damage, dilapidated
DIS–(opposite)	disrepair, disrupt
DE–(remove, reduce)	decay, deformation, degradation, deterioration, defect, delamination, defibration, demolition, destruction, desolation, decrepit, deposit, decoloration

Table 1. General terminology concerning different types of damage manifestation (a selection illustrating the diversity of terms beginning with prefixes dis-, de-)

First of all, however, it is necessary to know their concrete causations. This knowledge is crucial for proper intervention in all respects. Among the common causes of wood deterioration (Gril, 2010;

[1] Charter on the Built Vernacular Heritage (1999), Principles for the Preservation of Historic Timber Structures (1999), Principles for the Analysis, Conservation, and Structural Restoration of Architectural Heritage (2003) etc.

[2] Two CEN (https://www.cencenelec.eu/about-cen/) technical committees are close to the subject, e. g. TC 124 Timber structures and TC 346 Conservation of Cultural Heritage.

[3] Part 1-1: General – Common rules and rules for building and Part 1-2: General - Structural fire design

[4] EN 335 Durability of wood and wood-based products – Use classes (incl. the biological agents' occurrence), EN 338 Structural timber – Strength classes

Uyielli, 2009; Rivery, 2014; Rosato, 2017) and timber structure damage fall:

- **climate and natural conditions**
  / water and temperature
  - dampness, moisture, humidity
  - dew point

  / biological colonization
  - fungi – Ascomycota, Basidiomycota
    (spore, hypha, sporocarp)
    (brown rot, white rot, soft rot)
    (Serpula lacrymans, Coniophora puteana, Gloeophyllum sepiarium, etc.)
  - insects – Anobiidae, Cerambycidae ...
    (larva, adult)
    (apertures, beetlesdust, joined cavity)
    (Hylotrupes bajulus, Ant, etc.)
- **construction conditions**
  / timber
  - hard or softwood, age, dressing
  - surface, previous treatment

  / oxygen
  - air access, i.e. construction detail
- **use conditions**
  / human being
  / building services engineering

Some of the often-repeated building defects are (Šimůnková, 2000):

- **damage, poor maintenance, neglect**
  / leaking from outside or inside
  / rainwater, surface water, bottom water
  / tap water, service water
- **air-tight closure**
  / facing, cladding, tiling, lining, panel-ling
  / wall in, line with (immure)
- **contact with cold elements**
  / plumbing
- **thermal bridge**
  / missing or poor thermal insulation
  / condensation of water vapour
- **construction waste**
  / unsuitable placement, e. g. in the loft
- **unsatisfactory ventilation**
  / natural, mechanical

5. Measures, intervention, and protection

Apart from the legislative and the enlightened administrator or owner, regular upkeep and opportune intervention are highly important. This is usually preceded or should be at least by an inspection within the condition survey and mycology survey. These surveys include measurement and gauging in situ as well as potential sampling for laboratory tests (Rosato, 2017). The personal experience and knowledge of building pathology (Watt, 2007; Freitas, 2013; Brito & Flores-Colen, 2021), which are imperative for the pre-intervention diagnosis, are equally important. There are many intervention techniques and methods as well as technical terms (Camino & Bustamante, 2012), complementary or overlapping in meaning.

CON– (together)	conservation, consolidation, construction, conversion
RE–CON	reconstruction
RE– (do again) +*ion, ment for process*	restoration, reparation, reintegration, renovation, replacement, reinforcement, revitalization, rehabilitation, rebuild, replication, remodeling

Table 2. General terminology concerning different types of building intervention (with prefixes con-, re-)

The subject and term relationship to medical terminology can not be unnoticed including other synonyms (convalescence, recovery, recuperation, remedy, etc.) as well as filling, prosthesis, and replacement hereinafter. In connection with the aforementioned terminology, many traditional and contemporary interventions can be found in situ. These can be categorized into (a) preventive measures; (b) emergency measures; (c) woodworking; (d) surface treatment; (e) structural strengthening; and (f) material improvement. The combination of several methods is often needed. It should be reminded that it depends on the specific cause of the damage or deterioration and its degree and extent. The intervention in compliance with cultural heritage values is taken for granted.

5.1. Preventive measures

This category covers the precautions against the risk or damage it precedes. It can concern the building itself as well as its vicinity to wood protection primarily. It can be differentiated:

- **physical protection**
  / dry, wet, design (structure, detail, etc.)
- **chemical protection**
  / surface, undersurface
- **installation**
  / climate control (ventilation, humidity, heating, operation, etc.)
  / anti-fire system (detector, water supply, sprinkler, water mist) (Karlsen, 2015)

Dry protection is the most appropriate preventive measure. This can include both wood preparation (logging, bark removing, storage, drying) and the suitable placement of timber members in the structure. This is aimed at moisture content rapid reduction in the first case and water long-term action prevention in the second case. This already refers to precipitation, capillary moisture, and surface or interstitial condensation. It is recommended to keep the moisture content in the wood below 20 % against fungus attacks. In the case of insects, around 12-18 % is sufficient. (VVÚD, 2005)

5.2. Emergency measures

This category includes the issue of securing the building itself as well as its vicinity, e. g. bank or hillside. In contrast to the preventive measures, it follows especially after the damage and a visible or at least detectable risk.

Fig. 1. Façade of the pub “Dřevěnka Inn” No. 92 (house formerly) supported by interim oblique back shores with balk and stone footing that is secured by iron anchor rods in the drilled opening, Úpice Village, Trutnov District, Hradec Králové Region © Martin Cernansky, 2008, NHI

The measures can be categorized into:

- **supporting** (Fig. 1.,2.)
  / prop, strut, stanchion, shore, etc.
- **wind bracing**
  / diagonal, cross, chevron brace, etc.
- **hanging**
  / webbing, strap, etc.
- **holding together**
  / collar, etc.
- **wedging**
  / joint wedge, etc.
- **covering**
  / canopy, tin hall, etc.

Fig. 2. Watermill No. 2 (82) and intervention requiring the support of the first floor with the aid of hydraulic bottle jack rest on a firm, level surface, Zubrnice Rural Reservation, Ústí nad Labem District, Ústí nad Labem Region © Martin Cernansky, 2015, NHI

5.3. Woodworking

Woodworking is related to the carpentry profession itself, alternatively joinery. Since mechanical properties reduction often precedes a visual disruption and complete decomposition of the timber, the lifetime of the member can be shortened despite its seemingly good appearance. Not just for this reason, a replacement of the members has been already common in the past. The usual example is the lower beam, made of hardwood because of capillary rise action and possible contact with the moisture-retentive soil. However, even when using hardwood, the replacement with the aid of a mechanical screw jack was necessary sometimes. Waterproofing (asphalt-impregnated felt etc.) was inserted into this bed joint later. In other cases, the lower part of the timbered building was underpinned as a stone or brick masonry socle was walled up.

The present interventions also consist of the replacement of the entire member or its part. Both handcrafted (Kloiber et al., 2020) and milled members are used. The appropriate choice should depend on the structure origin and import, not just the lower cost. For structural reasons, it is not possible without the use of steel elements sometimes. The use of the same or at least compatible wood is particularly important as well as the two-way joint secured by pins or even adhesive material. (Brentnall, 2008) For completeness, new methods are also mentioned in brief.

Renew
(Cernansky, 2015)

- **replica, reconstruction**
  / entire structure
- **replacement** (Fig. 3.)
  / just member, element, component
- **enlargement, cross-section**
  / cleat
- **„replenishment“**
  / instead of missing the original member

Fig. 3. Watermill No. 2 (82) and new members instead of damaged ones, the replacement requires additional supports and load securing, e. g. by carrying straps/webbing on the right, Zubrnice Rural Reservation, Ústí nad Labem District, Ústí nad Labem Region © Martin Cernansky, 2015, NHI

Repair and restoration
(Šimůnková, 2000; Makýš, 2004; Kim, 2012)

- **filling, carpenter´s method**
  / structure in the first place
  / hollow, large crack
  / chips or a piece of wood
  / solid foam
- **filling, restorer´s method**
  / furniture and works of art in particular
  / cavity, tiny crack
  / mastic (casein, wax, resin, nat. rubber)
- **prosthesis**
  / rotted end or head
  / wood, steel, laminate, carbon fibers

Reinforce

- **visible piece**
  / tension rod, anchor rod, heel strap
  / flat or rectangular bar
- **invisible reinforcement** (gouge, layer)
  / rolled-steel I, H, U
  / composite bar, i.e. glass or carbon fibre
  / fibre-reinforced composites

5.4. Surface treatment and impregnation

Surface treatment covers the dressing inclusive of different types of natural or man-made covering and coating. These were applied as protection against different agents:

- **biotic**
  / bacteria
  / wood-decaying insects
  / wood-destroying fungus
- **abiotic**
  / conflagration
  / weathering
  / moisture fluctuation
  / noxious substance, pollutants
- **anthropogenic**
  / chemicals, coatings

Surface treatment can be divided into traditional application methods:

- **daub**
  / thick clay coat, so call “fur” in Czech
- **rendering and plastering** (Fig. 4.)
  / mud plaster, lime plaster
- **cladding**
  / shingles and boards, slates, asbestos-cement slates, metal sheets
- **painting**
  / monochrome, polychrome paint

Fig. 4. House No. 14 and mud plaster application on reed mesh, the plaster is coarsened for easy topping coat adhesion as well as prevention of shrinkage cracks, Lhota Rural Reservation, Česká Lípa District, Liberec Region © Martin Cernansky, 2020, NHI

Erstwhile coats of paint were mainly used to finish the appearance, like chromaticity or gloss, (Šefců et al., 2000), although preservative effects can not be completely excluded:

- **limewash**, i.e. whitewash, most often
  \+ earth pigment of minerals
  / vermilion, ochre, ultramarine
- **oxblood** + whitewash
- **varnish**
  / boiled linseed oil, i.e. flaxseed oil
- **wax**
  / beeswax

A wide range of products used for carpenter´s and joiner´s work (wax, oil, or resin base) under various trademarks is currently on the market. Later, the wood protection itself is of equal or even capital importance to painting. The protection can be used not only as part of the above-mentioned preventive measures but also for later **chemical treatment** (Fierascu et al., 2020), i. e. biotic sterilization, and disinfection or abiotic protection:

- **wood preservatives**
  (biocide and/or fungicide)
  / inorganic compound
  / organic compound
  / polymers
  / disinfectants
  / nanoparticles
- **fire retardants**
  / inorganic compound solution
  / intumescent substance

Impregnation can be divided into modern application methods, namely (a) spraying and painting; (b) soaking; (c) immersion and pouring; and (d) full-cell process, i. e. vacuum, pressure, diffusion. However, a lot of wood preservatives and fire retardants are neither time-tested nor certified. Some of them are even unsuitable for the wood itself, as it is a porous and fibrous organic material. The coatings which are not air-permeable belong to a wide group of modern interventions that led to irreversible damage as they prevent water vapor diffusion. Other examples are chemical fire retardants based on inorganic compounds *(ammonium sulphate, ammonium phosphate)* (STOP, 2020) because their application resulted in the defibring of the wood grain. The water glass *(sodium silicate)* did not prove to be useful due to the wood mineralization itself. A lot of wood preservatives are harmful to any organism and thus also a human being. At the same time, there can be environmentally unsound as in the case of volatile organic compounds. Wood preservatives containing coal-tar distillates (*carbolineum and creosote*) or chemical elements (*copper, chromium, and arsenic*) are also dangerous, restricted, or banned by the European directive (EUR-Lex, 2005). Besides chemical preparations, there are also **physical methods** for short-lived sterilization listed below for completeness.

- **warming**
  / microwave, hot air, etc.
- **singeing**
  / flame
- **electromagnetic radiation**
  / gamma-ray, X-ray, ultraviolet
- **vacuuming**
- **acoustics waving**
  / ultrasound
- **fumigation**
  / hydrogen cyanide, methyl bromide,
  carbon dioxide, etc.

Application and use of these methods are also limited concerning both practicality (element size, metal fasteners, etc.) and harmlessness.

5.5. Structural strengthening

Structural strengthening covers supporting and bracing elements including the possible use of steel. The reason for their application is mostly to prevent deformations on account of the low compressive strength of wood in the direction orthogonal to the grain in particular.

Fig. 5. House No. 53 built of logs used for walls and ceiling. Apart from this profiled bracket, there are also simple shape brackets under the supporting beam. Rtyně v Podkrkonoší Village, Trutnov District, Hradec Králové Region © Martin Cernansky, 2008, NHI

In both cases, it is most often done by the permanent addition of wooden profiles (Fig. 5.) or steel rods. In the second case, only tension load is transferred. Except for the individual structural member (e. g. joist beam), the whole building can be strengthened with a system of support bearing, struts, and/or wind bracing. There are several historical as well as contemporary techniques. Among the historical ones, we can mention especially the ground floor frame of two-storey houses. Brackets supporting a beam placed at the wall are another example of additional and reversible intervention.

5.6. Material improvement

Material improvement consisting of consolidation is carried out by impregnation or micro-injection. Among the historically and recently documented conventional **consolidants** (Rivery, 2014; Walsh-Korb & Averous, 2018) for structural elements (and furniture) we can mention:

- **oils**, vegetal and mineral
  / linseed oil, Tung oil (in Czech later)
  / used motor oil (until recently, fence)
- **waxes**
  / beeswax
- **natural resins** (Fig. 6.)
  / rosin, i.e. colophony (wood, pine)
  / shellac (wood, lac bug)
- **bitumen**
  / tar (wood creosote)
  / asphalt (petroleum)

In addition to the abovementioned consolidant, there are chemical compounds (Fierascu et al., 2020) in use or research as well as contemporary substances like (a) alum; (b) sugars or sugar alcohols; (c) metallic (nano)particles; (d) polymers and polymeric resins; and (e) cellulose, chitosan, keratin, etc.

Fig. 6. Watermill No. 2 (82) and improving material properties using resin injection, Zubrnice Rural Reservation, Ústí nad Labem District, Ústí nad Labem Region © Martin Cernansky, 2015, NHI

6. Conclusion

Naturally, each of the methods or techniques is limited based on local conditions, resources, experience, craftsmanship, and funds. For this reason, there are a lot of options relating to the degree, suitability, efficacy, and economy of intervention. Present building codes and design standards play an important part in any case as well as the elimination of environmentally unsound material or even toxic chemical compounds. For that reason, it is increasingly difficult to find both suitable and effective coating against fungi and wood-destroying insects. Another problem is the elimination of modern interventions that have damaged historic buildings. In many cases, it is not only architecture from a heritage point of view but also the material substance itself. The great challenge is also manual woodworking, both from the point of view of conservation attitude and the demanding character of craftsmanship. Financial and time constraints are more difficult to overcome.

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Effects of the use of plant mucilage on the physico-mechanical properties of raw earth structures

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Topic: T4.2. Materials and intervention techniques for vernacular architecture

Abstract
Raw earth constructions, by their very nature, are particularly sensitive to variations in the surrounding climatic conditions. Consequently, the use of this material implies the incorporation of substances of various kinds that have a stabilising function and help to prolong the life of these structures. For this reason, the use of plant substances from succulent plants is proposed, which is also a sustainable and safe option, both for the environment and for cultural assets. In this sense, the aim of the present research is to study the effect of the incorporation of these substances in the chocototype of raw earth used from pre-Inca times to the present day in the Archaeological Park of Cochasquí, Ecuador. For this purpose, plant substances of the cactaceae family of the genus Opuntia; Austrocylindropuntia Subulata (MUHLPFRDT. Backbg) and Opuntia huajuapensis (Bravo), which can be found in the natural environment, have been evaluated. In this experimental investigation, the characteristics of these substances and the influence they can have on the stabilisation of this raw soil have been evaluated through a series of physical-mechanical tests, including: the comparison of the kinematic viscosity of the different plant substances used, as well as the evaluation of the water behaviour in soil samples stabilised with different concentrations of mucilage.

Keywords: *opuntia; raw earth; conservation-restoration.*

1. Introduction

In the area of heritage conservation and restoration, research has been carried out on the possibilities of integrating traditional construction methods as a sustainable alternative (Kita, 2015). For this reason, this research evaluates the efficiency of plant extracts from succulent plants on the soil called chocoto for use in the conservation-restoration of archaeological structures in the Archaeological Park of Cochasquí, Ecuador.

The historical data that have been preserved, as well as the archaeological evidence that has been collected over the years, together with folklore, point to the importance of the Cactaceae family and its influence on social, religious and economic life since ancient times in the Americas, where they originated (Alanís and Velazco, 2008). Specifically, in Andean countries such as Ecuador and Peru, their use dates back more than 11,000 years (Novoa, 2006 and De la Torre et al., 2008) and among their various uses in the construction sector, the remains belonging to pre-Inca cultures such as the Chavín (1200 BC - 400 BC) or Churajón (800 BC - 1450 AD), which left archaeological evidence of their use in the preparation of mortar for their walls, as thorns belonging to various opuntias were found (Álvarez and

Cáceres, 2003 and Zeballos, 2020), and their use in the sealing of pavements and the preparation of adobes for the construction of their temples (Benítez, 2017). However, due to their biodegradable nature, it is not always possible to detect these substances in ancient constructions. In these cases, some authors choose to rely on the traditions that vernacular architecture carries with it (Kita et al, 2013), since the latter acts as a means of transmitting the knowledge of the past.

In recent decades, experimentation with these substances has followed an upward trend, especially due to the guarantees of viability and compatibility that have been demonstrated over time. Most of the research published on plant gums from the Cactaceae family has been carried out especially in Mexico, and their application in Portland cement or cement-based materials stands out (Torres et al., 2010; Ramírez et al., 2012). They have also been incorporated in other materials such as gypsum, lime or concrete, obtaining slight physical and mechanical improvements (Martínez et al., 2008; Pérez, 2009; Durán et al., 2012; Ochoa et al., 2013). In raw soils, there are several laboratory studies and field applications with more or less promising results, including improvements in compressive strength, abrasion resistance, as well as a decrease in porosity (Martínez et al., 2008; Kita, 2013; Aranda and Suárez, 2013; Torres et al., 2015).

2. Objective

The main objective of this research is to evaluate the effects of the incorporation of plant extracts on the stability and resistance to deterioration of raw earth structures. For this purpose, and following previous studies carried out at the University Institute of Heritage Restoration of the Universitat Politècnica de València (Medina et al., 2015), two types of plants from the cactaceae family that are naturalised both in the archaeological area and in the Mediterranean Levant have been selected. These plants belong to the genus Opuntia spp.: Austrocylindropuntiasubulata (MUHLPFRDT. Backbg) and Opuntia huajuapensis (Bravo).

The results presented in this paper are part of a broader research project belonging to a doctoral thesis in progress, related in this case to the comparison of the kinematic viscosity of the plant substances under study, as well as the evaluation of the water behaviour in soil samples stabilised with different concentrations of mucilage.

3. Methodology

3.1. Extraction of the gums and preparation of the test tubes.

The fragments and adult cladodes of the plants were collected early in the morning, as recommended by some studies (Torres et al., 2015). After cleaning in running water and peeling, the fragments were cut into small portions. For each of the species, 3 subgroups were differentiated by temperature and maceration time, using the bain-marie technique for the hot macerations (Table 1).

Maceration methods evaluated		
Species	**Temperature**	**Time**
Opuntiahuajuapensis (Bravo)	18-22°C approx. 40ºC 80ºC	72 h. 5 min. 5 min.
Austrocylindropuntiasubulata MUHLPFRDT. Backbg	18-22°C approx. 40ºC 80ºC	72 h. 5 min. 5 min.

Table 1. Temperatures and times used to evaluate kinematic viscosity (η).

Once the maceration time had elapsed, the samples were filtered using a tulle cloth to prevent the smallest fragments from straining out. After stabilisation of the temperature, the kinematic viscosity evaluation test was started (Fig. 1).

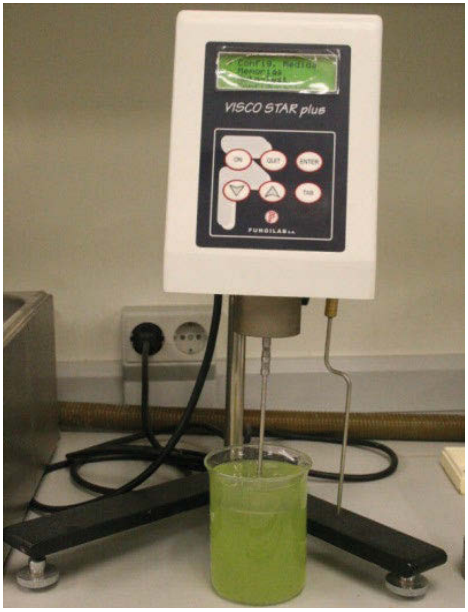

Fig. 1. Evaluation process of kinematic viscosity (η). (Source: Medina Lorente, 2022).

Subsequently, for the elaboration of the soil samples, the fragments and cladodes were collected and prepared with the same methodological approach as described above. In this case, the extraction method selected for the production of the soil samples was maceration at room temperature (approx. 18-22ºC). For this process, distilled water was also used in a mass ratio of 1:1 during 72 hours.

Once the indicated time had elapsed, the solid plant remains were strained and pressed to obtain a viscous substance. Three concentrations by weight were then established: 100% (substance obtained directly after maceration), 75% and 50%, the latter diluted in water. The solutions obtained are incorporated during the kneading of the raw materials in the manufacture of the raw soil samples. At the same time, reference samples are manufactured with the addition of water to evaluate the effect produced by the incorporation of the plant extracts.

The Chocoto soil was characterised by infrared spectroscopy (FT-IR). It is a clayey composition, with an absence of calcareous matter (data not shown in this publication). For this reason, clays of a similar siliceous nature were used as support for its reproduction, and an attempt was made to achieve a similar grain size to the soil by sieving.The specimens are divided into 3 groups: raw soil without gums (reference specimens, group 1) and stabilised with vegetable gum: Opuntia huajuapensis (Bravo) (HUA, group 2) and Austrocylindropuntiasubulata MUHLPFRDT. Backbg (AUS, group 3). Groups 2 and 3 are subdivided according to gum concentration: 50, 75 and 100% (Table 2).

Groups	Subgroups	Abbreviations
Group 1: REFERENCE	Raw earth mixed with water	REF-0
Group 2: HUA	Raw earth mixed with gum from Opuntia huajuapensis (Bravo) diluted 50% in water	HUA-50
	Raw earth mixed with gum from Opuntia huajuapensis (Bravo) diluted 75% in water	HUA-75
	Raw soil mixed with gum from Opuntia huajuapensis (Bravo) obtained directly from the 1:1 (water-plant) maceration.	HUA-100
Group 3: AUS	Raw soil mixed with gum from Austrocylindropuntiasubulata MUHLPFRDT. Backbg. Diluted 50% in water	AUS-50
	Raw soil mixed with	AUS-75

	gum from Austrocylindropuntias ubulata MUHLPFRDT. Backbg. Diluted 75% in water	
	Raw earth mixed with gum from Austrocylindropuntias ubulata MUHLPFRDT. Backbg. obtained directly from 1:1 maceration (water-plant).	AUS-100

Table 2. Groups comprising the specimens under study.

For the water vapour permeability tests, semi-plastic specimens of different sizes were manufactured, using manual compression, with the aid of a compression tester. Following the indications given in the regulations (Table 3). For the studies to determine the water vapour permeability and water vapour resistance, the following tests were performed.

Test	Size	Nº
Digital rotational viscometer: Visco Star Plus	500 ml	6
Determination of water vapour permeability. UNE-EN 15803-2010 (CEN©)	3Ø x1,5 cm	21
Determination of water absorption by capillary action. UNE-EN 15801: 2010 (CEN©)	3Ø x1,5 cm	21

Table 3. List of tests together with the characteristics of the specimens.

Rigid acetate and stainless aluminium moulds were used for the tests. The drying was carried out in an open air area but protected by a roof, periodically changing both the orientation and the faces of the blocks for a homogeneous drying. The drying time was 30 days.

3.2. Instrumentation and testing

3.2.1. Evaluation of kinematic viscosity (η)

The methodology consisted of using the Visco Star Plus digital rotational viscometer. Viscosities were recorded by SP: R3 at a speed of v=60 rpm. The data were recorded after 15 seconds of shaking. In this test, mucilages of the species of the genus Opuntia: *Opuntia huajuapensis* (Bravo) y *Austrocylindropuntia subulata*MUHLPFRDT. Backbg, obtained by three types of macerations (see Table 1) where temperature and time were varied.

3.2.2. Determination of water vapor flow density

- Test procedure:

The objective is to measure the water vapour flow through the test tubes. For this purpose, the wet cuvette method was used, which consisted of placing the test specimens on a cylindrical plastic container filled with Parafilm®, with a saturated solution of potassium nitrate ($KNO3$) inside, which provides a relative humidity in the container of 93%, leaving an air space between the specimens and the solution of 1.5cm in height. The water vapour flux is determined by varying the mass of the specimens. The weight of the specimens is recorded every 24 hours for 10 days. The specimens were kept in an extraction chamber during the whole process, without drastic changes in temperature and humidity

After the collection of the data obtained, a series of formulas were calculated until the water vapour permeability values were reached, according to the standards used:

The cumulative mass variation (Δmi):

$$|\Delta m_i| = m_i - m_0$$

Where m_i and m_0 are the mass at times t_i and t_0 in kg.
After obtaining these data, the flow density was calculated:

$$g = \frac{G}{A}$$

where G= $\Delta m/\Delta t$, in kg/s.

3.2.3. Determination of water absorption by capillarity

For this test, the procedure indicated in the Spanish standard: UNE-EN 15801: 2010 (CEN©) was followed. The purpose of the test was to determine the capillary water absorption of the test specimens, assessing the influence that these plant substances can have on the porosity of the raw soil specimens. The quantity of water absorbed by the specimen per unit area Qi (gr/ cm^2) in time ti (s) is calculated using the following formula:

$$Qi = \frac{mi - mo}{A}$$

Where Qi is the quantity of water absorbed per unit area in gr/cm^2, mi is the mass of the specimen at time t_i, in gr., mo is the mass of the specimen dry in gr. and A is the surface area of the specimen in contact with the water, in cm^2. The capillary water absorption coefficient (AC) is the slope of the linear part of the curve obtained, representing the variation of mass per unit area (Qi) as a function of the square root of time in seconds (ti ½) (Fig. 2).

Fig. 2. Sample of the capillary water absorption test (Source: Medina Lorente, 2020).

4. Results

4.1. Evaluation of kinematic viscosity (η)

The data obtained show that the viscosity of the extracts remains constant for most of the mucilages during the first 72 hours, irrespective of temperature and time in the three types of macerations. In contrast, the AUS-20 and AUS-80 extracts exhibited a more heterogeneous behaviour, showing large variations in viscosity depending on the type of maceration, however, viscosity did not undergo relevant changes for the extract with maceration at 40oC (AUS-40). It should also be noted that the extracts with the greatest changes in viscosity (AUS-20 and AUS-80) are also those with the highest viscosities (Fig. 3).

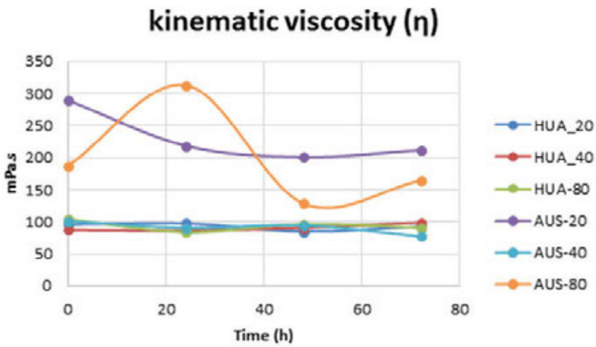

Fig. 3. Comparison of viscosities obtained at different maceration temperatures. Data obtained at v=60 r.p.m.

4.2. Determination of water water vapor flow density

TEST TUBE	WATER VAPOUR FLOW RATE $(kg/(m^2.s))$
REF	0,2579
HUA-50	0,2191
HUA-75	0,1941
HUA-100	0,1941
AUS-50	0,2285
AUS-75	0,2191
AUS-100	0,2191

Table 4. Results obtained.

As can be deduced from the previous results (Fig. 4), the addition of mucilage in the material produces in all cases a decrease in the flow rate of water vapour transmitted, with the lowest flow rates being recorded for specimens HUA-75 and HUA-100. On the other hand, the AUS-50 specimen is the one with the highest flow rate values, although lower than those of the reference specimen.

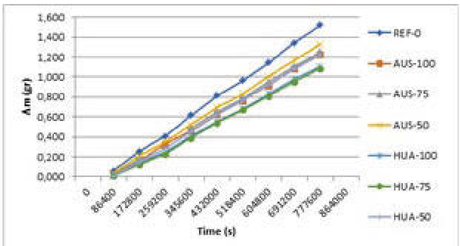

Fig. 4. The slope of each of the data series represented in the graph corresponds to the water vapour flow rate for each of the test specimens, which are shown in the following table (Table 4).

4.3. Determination of water absorption by capillarity

The results obtained show that the reference specimens (REF) disintegrate in shorter times compared to the specimens with mucilage, which seem to provide greater consistency to the material, which does not disintegrate so easily in contact with water. With respect to the HUA (Opuntia huajuapensis (Bravo)) specimens, a certain decrease in water absorption can be observed, with those made with a 100% mucilage concentration (HUA-100) standing out, followed by HUA-50 and HUA-75, respectively (Fig. 5).

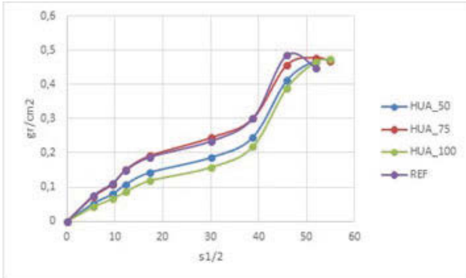

Fig. 5. Comparison of the results obtained in the test to determine the water absorption by capillarity of specimens made with *Opuntia huajuapensis* (Bravo) and reference specimens. Average curves obtained from three independent tests.

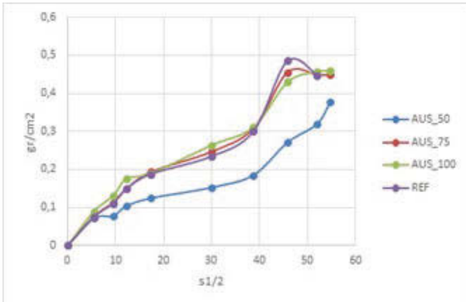

Fig. 6. Comparison of the results obtained in the test to determine the capillary water absorption of specimens made with *Austrocylindropuntia subulata* MUHLPFRDT and reference specimens.

In relation to the specimens made with Austrocylindropuntiasubulata MUHLPFRDT (AUS), the absorption results between the specimens with mucilage differ with respect to the specimens made with Opuntia huajuapensis (Bravo). In this case, there is a greater difference between the specimens made with 50% mucilage (AUS-50), being this group the one with the lowest water absorption compared to both species and the REF group. The remaining concentrations

(AUS-75 and AUS-100) show slightly lower absorption values compared to the reference samples (Fig. 6).

Among the species tested, Opuntia huajuapensis (Bravo) seems to slightly reduce the water absorption of the specimens when added undiluted (HUA-100). On the other hand, in the case of the species AustrocylindropuntiasubulataMUHLPFRDT, the 50% addition results in the greatest reduction of water in the material (Fig. 7).

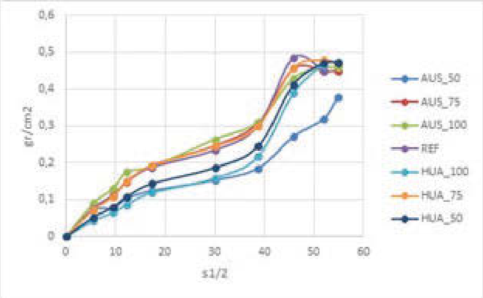

Fig. 7. Results obtained in the test to determine the water absorption by capillary action of the tested groups.

5. Conclusions

Overall, the results seem to show that different temperatures and maceration times do not significantly influence the viscosity values. This seems to be fully applicable to *Opuntia huajuapensis* (Bravo), however, for *Austrocylindropuntia subulata* MUHLPFRDT exceptions are recorded.

On the other hand, it should be noted that the values obtained (water vapour flow rate) allow all the materials to be classified as materials with high water vapour transmission according to the UNE EN 1062-1:1996 standard.

With regard to the capillary water absorption tests, in general, the incorporation of mucilage seems to produce a reduction in water absorption, as well as an increase in consistency compared to specimens without mucilage. However, there seem to be differences in behaviour between the species studied, as the addition of the 50% extract of the *Austrocylindropuntia subulata* MUHLPFRDT species is more effective in reducing capillary absorption, which may be related to its rheological characteristics (greater viscosity of the mucilage), compared to that obtained from *Opuntia huajuapensis* (Bravo), which gives the best results when incorporated undiluted. As for the different behaviour of test tubes with extracts of the same species, these differences may also be related to the heterogeneity and granulometry of the soil itself.

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Vernacular architecture and archaeological remains. Direct links in the Phlegraean Fields in Campania (Italy)

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Topic: T4.2. Materials and intervention techniques for vernacular architecture

Abstract
The paper analyses some vernacular architecture typologies in the Italian region of Campania which are intimately linked to the archaeological remains of the architectures that preceded them. These vernacular architectures have been poles for many centuries for the organization and management of the territory and have contributed to the definition of the historical landscape of the Phlegraean area. The economic and political importance of the Phlegraean territory in Roman times is amply evidenced not only by ancient literary sources, but also by the wide presence of archaeological remains. Alongside the major Roman monuments of Pozzuoli, Cuma and Baia, noble villas, cisterns and funeral buildings have been developed throughout the area of the Phlegraean fields, especially along the Via consularis Puteoli Capuam which connected the flourishing port of Pozzuoli to the city of Capua. It is on these remains that, starting from the sixteenth century, rural farms have been developed often by re-using the archeological remains as foundations for the new buildings or by employing archaeological materials inside the building. This heritage, which is in a state of disuse and abandonment, is not yet fully known and catalogued and constitutes an important example of the local built heritage for the values of the construction tradition, materials and techniques that they preserve. The study is characterized by an interdisciplinary approach and will address the close relationship with the landscape of these settlements, the continuity of use and bioclimatic characteristics and materials which make this heritage a valid reference for sustainability and an ecological way to build and live. The essay will address some emblematic case studies that illustrate the characteristic values of this vernacular architecture, and their state of conservation analysed with respect to their structural instability and degradation in order to identify guidelines for the conservation and enhancement of this rural heritage.

Keywords: *conservation; vernacular architecture; archaeology; Phlegraean Fields.*

1. Introduction

The economic and political importance of the Phlegraean territory in Roman times is amply evidenced not only by ancient literary sources, but also by the widespread presence of archaeological remains. Alongside the major Roman monuments of Pozzuoli, Cuma and Baia, noble villas, cisterns and funeral buildings have been developed throughout the area of the Phlegraean fields, especially along the Via Consularis Puteoli Capuam which connected the flourishing port of Pozzuoli to the city of Capua.

It is on these remains that, starting from the sixteenth century, rural farms have been developed often re-using the archaeological remains, as foundations for the new buildings or employing archaeological materials inside the building.

This heritage, which is in a state of disuse and abandonment, is not yet fully known and catalogued but constitutes an important example of the local built heritage for the values of the construction tradition, materials and techniques that they preserve. Rural dwellings, manor houses, agricultural and lookout towers, and rural farmhouses built on archaeological evidence are the main components of a full palimpsest strewn over the agricultural land of the Phlegrean Fields.

The close relationship with its landscape, the reuse of ancient and pre-existing constructions, the continuity of use, its typological and appropriately architectural technical-constructive specificities, are only some of the aspects that emerge from the analysis of such structures. In 2006, a research work conducted by a group of scholars of the University of Naples Federico II and funded by Regione Campania compiled an inventory of the farmhouses and rural dwellings located in the area of Pozzuoli, giving rise to a systematic process of knowledge dissemination and protection. This kind of activity was urgently needed because of the widespread conditions of degradation of this heritage, or, worse still, because of the unaware operations being conducted on it. Starting out from the results of that experience, this paper takes on the study of the rural architecture of the Phlegrean Fields, the area west of the city of Naples (Italy) characterised by its extraordinary geological and landscape characteristics, by thoroughly analysing all its connoting elements, in view of their conservation and protection. The Phlegrean Fields consist of many crater belts (Gauro, Astroni, Monte Nuovo, etc.), also transformed into lakes (Lucrino, Agnano, Fusaro, and Miseno) and residual strips of volcanic craters, such as Soccavo, Pianura, and Quarto, culminating on the spur of the Hermitage of Camaldoli. The localization of the largest Phlegrean rural dwellings follows the low-lying areas between the crater belts; these areas are best suited to extensive crops such as vines, which have been historically able to take advantage of the abundant presence of water, as well as of the presence of volcanic slag in the soil, an extraordinary element of fertilization throughout the entire *Campania Felix*. The heritage of rural architecture in the Phlegrean Fields has thus closely followed the structure of its agricultural territory: vine is the main crop, but the presence of but the presence of fruit trees and woods is historically documented, especially of chestnuts, which provided wood for vine piling. However, in the case of the Phlegrean area, during the classical age historical farmhouses were also built along the routes of the ancient roads of communication of the *ager puteolanus*, between Rome and Naples: ‘via Consolare Campana’, *Consularis Puteolim Capuam*, and ‘via Antiniana’, *Puteolis-Neapolim per colles*. In the vicinity of these routes—connecting the port of Pozzuoli to Naples and, through Capua and the Via Appia, to Rome—a widespread rural urbanization arose ranging from agricultural warehouses, to *cisternae*, *columbaria*, funeral mausoleums, and *villae rusticae*. The nuclei of modern hamlets have subsequently been grafted on to the Roman ruins of these architectures closely connected to the purely agricultural vocation of the *Ager Campanus*. Later, the first structures of the farmhouse complexes were built without formal, material, and functional interruptions.

1.1. *Casa dei comignoli* in Baia

Inside these farmhouses, it is common to find ruins of Roman nymphs in *opus reticulatum* reused as *cellai* (cellars) or ovens. However, the ancient *spolia* continued to be used for purposes similar to those for which they had been originally built, with a functional continuity that recalls the phenomenon defined in the 1960s by Emilio Sereni as “inertia of the agricultural landscape”.

This is the case of *Casa dei comignoli* in which we found a rural architecture founded on the preexistence of Roman structure. The area of Baia was the seat of Roman patricians and emperors for the healthiness of the place. Evidence of these constructions can still be seen today and the remains on which the chimney house stands can be traced back to these types. In fact, it incorporates on the ground floor parts of what could have been a cistern of the Augustan age, probably dating back to the first century A.D. Although the wall structure still visible is of scarce dimensions, we can clearly read the *opus reticulatum* which allows us to date the construction to the Roman phase.

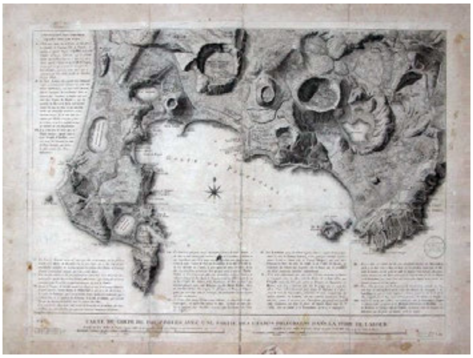

Fig. 1. F. La Vega, Map of the Gulf of Pozzuoli with part of the Phlegrean Fields , 1778-1780, Napoli, Biblioteca Nazionale

Fig. 2. Casa of Comignoli in Baia, Italy (Source: Angelino, 2002)

Fig. 3. Casa of Comignoli in Baia, Italy, the remains of a Roman structure in opus reticulatum (Source: Angelino, Bruno, Di Donato, Linguiti, Tomeo, 2018)

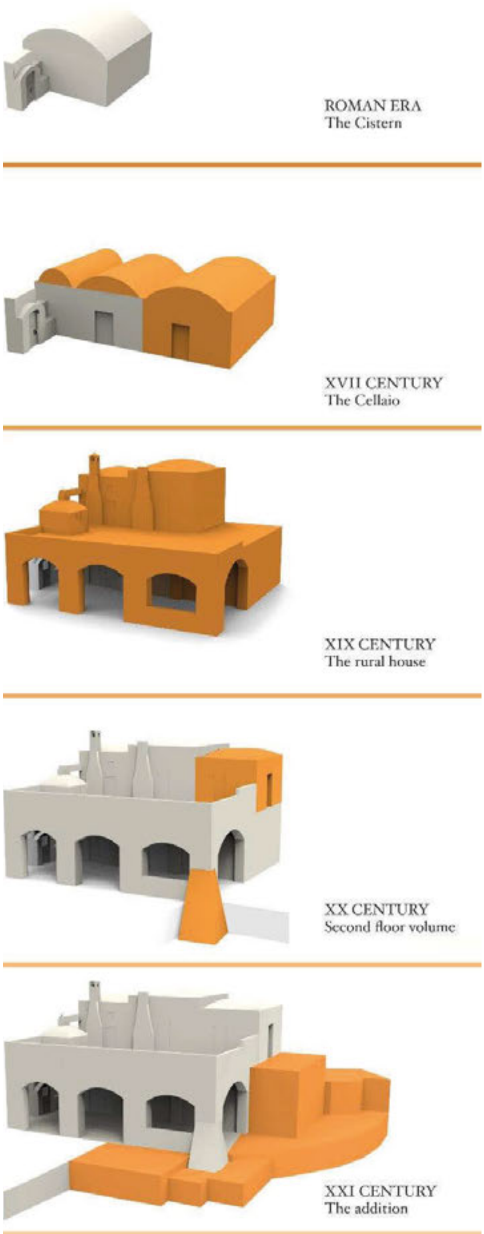

Fig. 4. Casa of Comignoli in Baia, Italy, historical constructive phase (Angelino, Bruno, Di Donato, Linguiti, Tomeo, 2018)

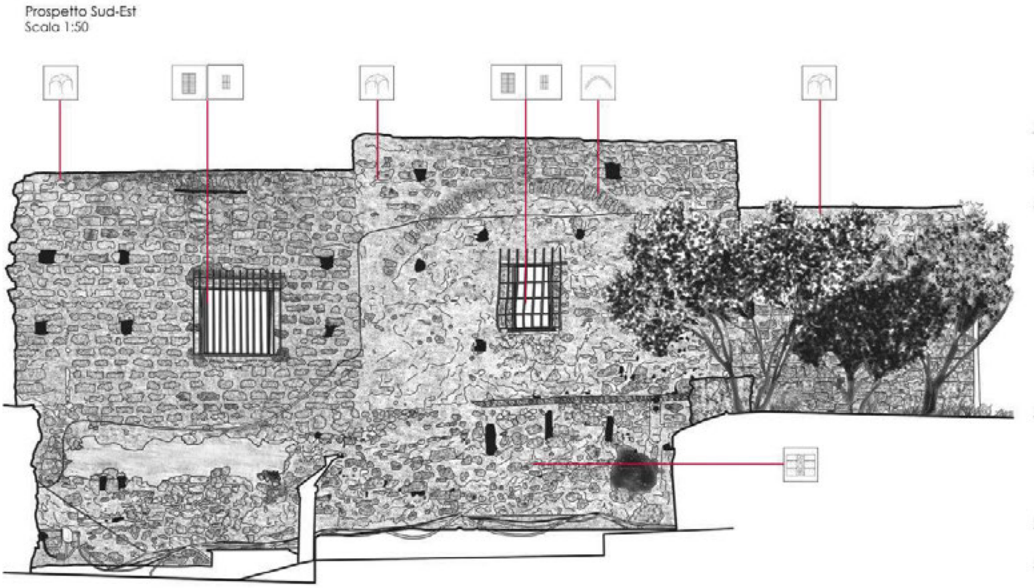

Fig. 5. Casa of Comignoli in Baia, Italy, Materic restitution of the state of conservation, north - east façade and section (Source: Angelino, Bruno, Di Donato, Linguiti, Tomeo, 2018)

After the eruption of 1538 the entire area of the Phlegraean fields was repopulated with an increase in the agricultural activity and the consequent development of a predominantly rural architecture. The house with the chimney pots can be traced back to this typology, which was built starting in 1670 with the construction of the two volumes on the ground floor with exposed barrel vaults, as is the case with the cellars in the area. In fact, from the maps of the time the presence of the building is clear, as well as in the *Map of Castiello de Baya* by Filippo Marinelli in 1734, representing the plan of the castle besieged by the Count de Marsillac. During the nineteenth century the building underwent further modifications to be used as a dwelling, as can be seen from the numerous views that portray the Castle of Baia. The terrace with the underlying arches was built and further volumes were added with vaulted roofs in wrought lapillus.

From an in-depth observation of the construction techniques through the material relief of the elevations and sections, it is clear that only two of the upper volumes can be dated to this period. With its acquisition by a noble family, the building takes the name of *Masseria Festinese* taking on, during the twentieth century, its current configuration with the addition of the third volume in the upper part. In the rural building, set of the film *Il Decamerone* by Pier Paolo Pasolini in the seventies of the twentieth century, there are still traces of coloured plaster, probably dating back to the nineteenth century. The building, abandoned in the second half of the twentieth century is in a serious state of neglect and decay that deeply undermine the preservation of the building's historical and architectural values.

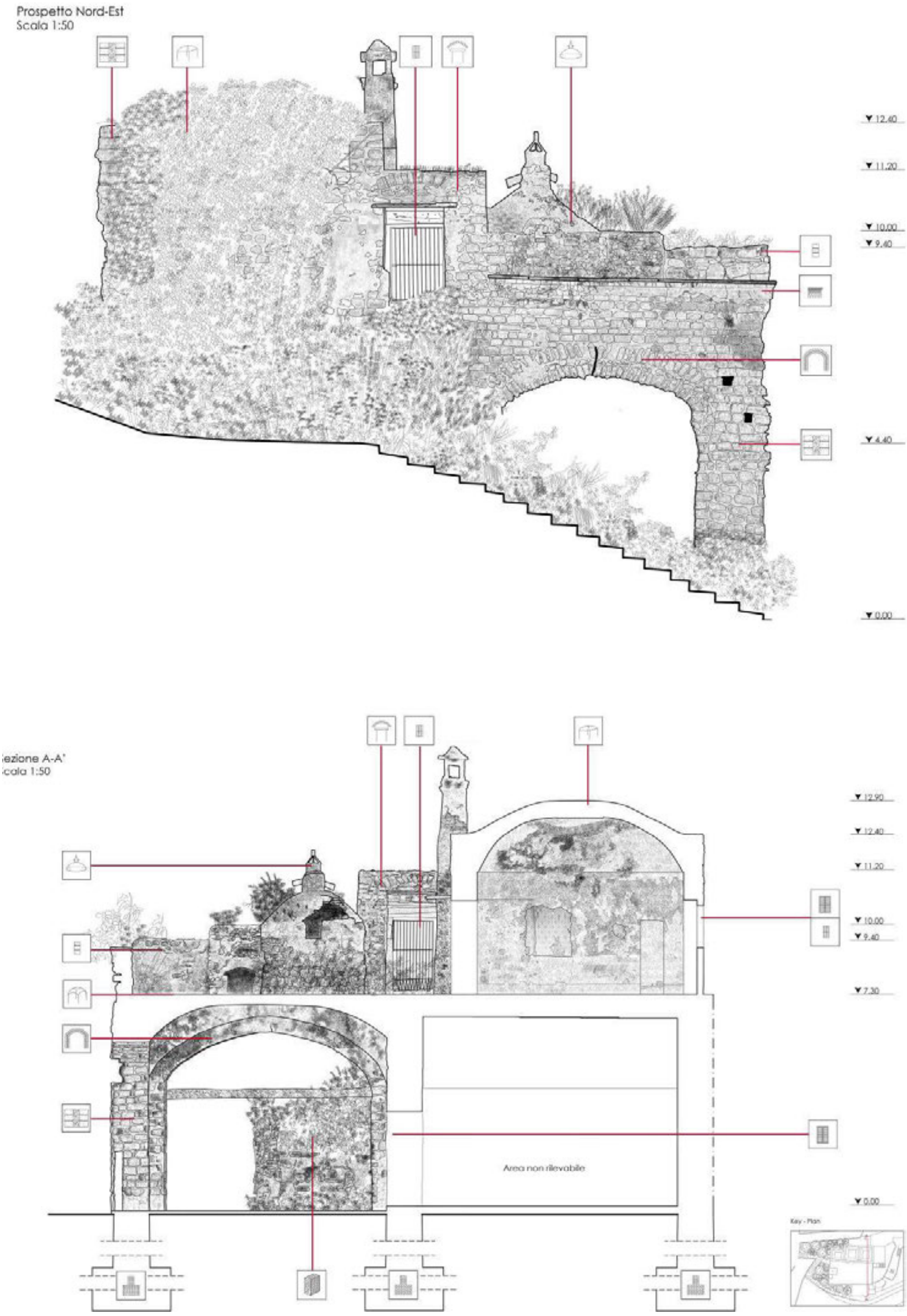

Fig. 6. Casa of Comignoli in Baia, Italy, Materic restitution of the state of conservation, south- east façade (Source: Angelino, Bruno, Di Donato, Linguiti, Tomeo, 2018)

1.2. Mirabella Farmhouse in Pozzuoli

The Mirabella farmhouse is located in the northern part of Pozzuoli, and relates to neighbouring rural context, in a radius of a couple of kilometers with other artefacts of the same type falling in a state of ruin of the same type ,namely *Masseria Costantino*, the two Masserie Negri and the *Masseria Tramontano* or the *Ricetto di Forte* of which the lack of the various collapsed roof slabs is visible from above. Most of the farms are currently used for residential purposes but this has led to the detriment of the possible interpretation of their original conformation. For example to make use of the building, numerous transformations and additions have been made that do not respect the typological, morphological and technological characteristics that are no longer visible or verifiable. Different from the old farms are the rural houses built in times closer to ours. Many are single-celled, some consisting of only a couple of rooms on the ground floor, and many with two floors.

The rustic edifice is reduced to just the cell or it does not exist where the property is small and practises horticulture; in this case the house - rectangular in plan - is made up of one or two rooms, an oven, a hut for storage, a chicken coop or pigsty. It is reduced only to the cell where the cultivation of the vine is widespread and where the breeding of livestock has no significance. Alongside the single-celled houses, consisting of a single room with a fireplace and beds, there are also several houses with a first floor and a horse or cow stable. These have a kitchen, an oven (or fireplace) and the rustic structure on the ground floor, the bedroom or bedrooms on the first floor, which is accessed via an external staircase. The hut with sloping roof (with a masonry base) accompanies almost every rural house in the crater basins (Pisani, Quarto). It serves as a cellar for wood and fruit storage or, more rarely as a barn. The *Mirabella* farmhouse retains all the materials and traditional construction techniques. The main load-bearing structure of the floors is made up of rough or squared beams, while the secondary one is made up of wooden panels (*chiancole* or *chiancarelle*) that rest on the beams, or squared rafters and a "boulder" or a plank of large boards nailed to the said rafters. The main beams are in raw chestnut, round and without squaring, resting on special recesses made in the load-bearing walls. These are arranged at a center distance of 80-90 cm, with the largest diameter alternately on one side and the other. The "*chiancarelle*" (90-100 cm) are placed in the normal direction to the beams and above them. A first layer of “*arriccio*” (ordinary mortar with pozzolana, common sand and slaked lime, mixed with various types of scrap) is prepared on the *chiancarelle*.The upper boulder is made up of a conglomerate of volcanic *lapilli*, lime and water. Typical of this type of rural farms are the vaults: The construction tradition handed down two types of vaults: the "*sopraterra*" one, built on shaped ground, and the "*sopralegnami*", made on wooden scaffolding. In the first case, the shaping of the vault is made with formwork positioned *ad hoc* in the environment surrounded by the perimeter walls so as to form, the supporting shape of the vault by beating. The stones – porous, light and suitably shaped are placed on this template with circular geometry. The second case consists of several ridges placed against the wall of their ends and supported by props. For the arched part there are other pieces such as *monachetti* and struts connected to each other which support the mantle of *chiancole* covered by rubble, so as to configure the boarding. The farm has a load-bearing wall structure in local yellow tuff, with irregular localized stone. From a volumetric point of view, as already mentioned, it has an ancient ground floor for purely agricultural and storage use (vaulted cellars side by side) and, in part, probably for breeding farm animals. According to the temporal aggregative hypothesis, the initial configuration provided, on the north side of the farm, an environment affected by the presence of open support arches that allowed (the) passage and acted as a threshing floor for the animals. The intervention saw the pairing of the first and third arches and an opening to ensure greater structural support. The kitchen with chimney and main entrance portal has seen over time a cut of a part of the inclined pitch and the subsequent construction of new portions of walls in yellow tuff and roof slab in reinforced concrete with iron joists. Wear and tear has caused the concrete cover to fall in some places, revealing the reinforcements above. Two buttresses have also been added in this room made up of trapezoidal tuff for structural containment purposes. The current situation sees, due to the complete abandonment, a state of advanced ruination of the building. Large portions of roofing slabs have collapsed due to the state of decay of the chestnut beams which, yielding in some points, have caused the various collapsings and the subsequent growth of weed vegetation. As for other invasive superfetations, these can already be appreciated in the elevation of the west front, with the volumetric addition of a bathroom on the first floor and another on the ground floor to the southwest (probably both being introduced around the middle of the last century).

Fig. 7. Mirabella Farmhouse in Pozzuoli (Angrisani, Bisceglia, 2018)

2. Conclusion

The increased farming complexity of the Neapolitan area in comparison with other Italian areas is generated by a greater land fractioning (95 % of the agricultural lands do not exceed five hectares. Thus Phlegrean rural houses present a great variety of types, even in very small areas. It must not be forgotten that the fragmentation of large rural dwellings was dictated by the reduction in land property attached to them and, therefore, also by the change in land use and the gradual substitution resulting in extensive cultivation with others requiring a smaller size property. The agrarian structure of the Phlegrean territory changes as crops change, with special adaptation to the climate, altitude, and to the land structure: the land fractionation and the fragmentation of the ancient nuclei increases, as well as the dispersion of rural architecture settlements, which continue to be isolated and to adapt their typology to the main crops, and hence to the agricultural processes that take place within them. Nowadays, the Phlegrean farms are in a general state of disuse and abandonment, due not so much to earthquakes or bradyseism as to their progressive abandonment, even by their owners. A heritage that has gradually lost its original function also due to wild urbanization and ecological conditions that make quality agriculture difficult is struggling to justify its conservation, although it still preserves its historical and constructive features and also in some cases its landscape value. Consisting of low and compacted buildings with no more than two floors, this heritage has withstood the earthquakes that have historically taken place throughout history in the area, but will not stand the lack of maintenance that today is gradually consuming the beaten elements, bringing down the wooden floors, pulverizing the masonry mortars subjected to crushing and deleting the traces of a building tradition that is disappearing on account of abandonment. In compliance with the Italian Law n. 378 of 2003 containing “Provisions for the Protection and Enhancement of Rural Architecture”, in 2006 the Campania Region issued a draft law “Regulations Regarding the Protection, Preservation and Enhancement of Traditional Rural Architecture”. In the absence of a full awareness of the values and elements necessary to safeguard this heritage, this law actually encouraged interventions that distorted the technical and anthropological specificities of these architectures, in the name of a misunderstood notion of ‘enhancement’. Studies like the present one aim to deepen and broaden our knowledge and dissemination of the values of these rural buildings to the Heritage Communities so that they can be preserved in their characteristic values. At the same time, the choices that follow the principles of architectural restoration make it possible to enhance this heritage, guaranteeing its transmission from archaeological times to the future.

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CONSERVATION, RESTORATION AND ENHANCEMENT OF VERNACULAR ARCHITECTURE

DIFFICULTIES AND POSSIBILITIES OF USING TRADITIONAL CRAFTS IN CONSERVATION

HERITAGE 2022 - International Conference on Vernacular Heritage: Culture, People and Sustainability
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Impediments to sustenance and revival of vernacular architecture in rural Madhya Pradesh, India

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Topic: T4.3. Difficulties and possibilities of using traditional crafts in conservation

Abstract

Over the past couple of decades, building typology in rural India has seen an unprecedented shift away from vernacular material and construction techniques. The substitute - replicable, mass-produced, concrete structures fail to respond to the climatic and cultural context. In addition to being carbon intensive, inadequate knowledge about form and function of new construction methods and materials have led to poor quality construction, that has a shorter life span. Compared to the existing vernacular buildings, such concrete structures are found to be uninhabitable by many end users. Studies done in the past on vernacular architecture of India focus on climate responsive design and execution, and traditional materials. However, there is insufficient research investigating the factors affecting the decline of vernacular practices. This paper assesses the reasons behind change in rural fabric of Madhya Pradesh, India, through primary focused group discussions, key informant interviews & field observations. The study identifies diverse factors, ranging from individual preferences to policies and laws governing access to resources. It also uncovers unexpected factors such as changing food habits leading to lack of traditional construction materials. These wide-ranging factors are classified under social, technical, financial, and legal categories. The study develops a framework to analyse patterns emerging across different agro-climatic and geographic regions Based on the findings, the paper also recommends potential interventions for reviving sustainable vernacular architecture in the region.

Keywords: *vernacular; architecture; rural; India.*

1. Introduction

India is a fast-developing economy with a rapidly growing population. Despite a high urban migration rate, more than half the country is still rural population. (Thakkar and Routh 2016) Given the geographic, climatic, and cultural diversity of India, there has been a variety of vernacular-buildings that have seen adaptation and transference through generations. Diverse materials, construction technologies and spatial arrangements are seen across the country. However, there is an increasing reluctance among rural population to use vernacular building practices and eagerness to replace them with global materials. (Thakkar and Routh 2016) This paper studies the decline in use of vernacular materials in villages in Madhya Pradesh. Formerly the largest state of India, Madhya Pradesh lies across 3 climatic zones, 4 cultural zones and has diverse geographical features. It also has one of the highest rural population percentages and the largest tribal population in India. (MHA 2021) Madhya Pradesh still retains a wide variety of vernacular architecture. However, as the state with the largest number of new *pucca* (permanent) houses constructed in the last 10 years (Ministry of Rural Development, India 2021), it is also

Fig. 1. Material based categorization of subregions.

understood that the state is seeing rapid transformation in rural areas. For the ongoing rapid development to be sustainable, it will have to be carried out with an adaptive management framework, backed by constant research.

2. Background study

A study of the existing literature reveals that beneficial aspects of vernacular architecture such as passive design features, spatial arrangement, disaster resilience (Sharma, et al. 2019), material footprint, characteristic elements, and skills involved are widely researched. (Nguyen, et al. 2019) Detailed studies document the features specific to different cultures, measure thermal comfort, (Singh, Mahapatra and S.K. 2010) analyse structural performance and disaster resilience of vernacular buildings across various states of India. Beyond the scope of academic research, the government has also commissioned studies to inform policies or schemes. Recognising the need for region specific response, studies have been undertaken to formulate and encourage appropriate regional construction.

A study conducted by UNDP in 18 states of India has helped in developing 130 zone-specific comfortable, affordable, green and multi-hazard safe design typologies aims to inform construction under government welfare scheme Pradhan Mantri Awas Yojana (Gramin) (Prime Minister Housing Scheme (Rural) (PMAYG). (MORD 2016). Despite of these efforts, the vernacular building practices continue to see a steep downward trend. Increasing trend in use of materials such as cement, steel in Indian villages, encouraged by government schemes (programs) and realized by aspirations of rural population is seen in new *pucca* (permanent) houses. However, many of these units are not used for the original purpose.

A typical design without consideration to its context, coupled with selection of poor-quality construction materials, renders some of these new buildings uninhabitable. Compared to the local materials with minimal processing, the newly introduced materials have significantly higher embodied energy and carbon footprint. Construction sector already contributes to 22% of total annual emissions of the Indian economy. With the change in typology of rural housing this could exacerbate further (GGGI 2022).

3. Aim & Objective

The paper aims to study various reasons for decline in the use of vernacular material in villages in Madhya Pradesh and to understand interlinkages between different factors affecting the decision making of users.

Fig. 2. Vernacular Architecture.

4. Scope of study

This paper is part of a larger action research undertaken by the Technical Support Organization of an ongoing rural tourism project with Madhya Pradesh Tourism Board. The study is conducted in villages of Morena, Bhind, Gwalior, Niwari, Chhatarpur, Panna, Rewa, Sidhi, Umaria, Balaghat & Chhindwara districts of Madhya Pradesh. This is a compilation of findings from over 3years of ground surveys. Thescope of this paper is limited to the materials and techniques aspect of vernacular architecture, aspects of spatial planning are not addressed in this study.

5. Methodology

The study is done along with the local, on-ground NGO partners. Initial qualitative data is collected through primary focused group discussions with large community (number of people, sex aggregation), key personal interviews and field observations through reconnaissance survey and transect walks. The secondary literature study conducted, informs the extent of available data and existing research on the region under study, as well as the trends in vernacular practices across the country. The study develops a framework to understand and present the interdependency of various challenges. Challenges are studied on parameters such as materials used, sub-regions, socio-economic groups to identify the root cause. Villages under study have been broadly categorised based on the prevalent vernacular materials and practices observed therein.

6. Observations

Vernacular structures across the studied villages are predominantly load-bearing. Walls are made of stone (with or without mud mortar), brick masonry with mud mortar, mud walls built using cob or in very few cases with wattle and daub technique. In Group 4, random rubble stone masonry walls are left exposed, while in Group 6, they are plastered with layer of soil mixed with husk. Cob walls in most regions have a core of straw or rice/wheat husk mixed with mud. Plaster made of mud, cow dung and Kodo millet is used in Group 6 & 7. Foundations, across most regions of the study have stone or brick masonry, while a few have mud walls with mix of hay and soil for foundations as well. Roof structures across most regions are made of various local wood and bamboo. For ancillary structures, use of thatch was also observed. The covering is made with kiln fired, country clay tiles. Broadly three variations of these can be seen across all regions - flattish tiles, partially overlapping each other in a sloping roof, alternating flat and half round tiles, and interlocking half round tiles. An additional roof layer creating attic space of wood joists, closely packed bamboo, packed with mud can be found in multiple regions. Stone slab flat roofs, supported by either stone beams or steel girders, with a top layer of mud terracotta pieces and mud are found in Group 1. Regional variation in materials is seen in Annexure1 gives an overview of the materials used for different components of the houses with the associated challenges across different regions. Several reasons identified through focused group discussions and key personnel interviews for the decline in interest to build using vernacular building materials and construction techniques were compiled and studied based on recurrence across the materials and regions. Some of these reasons are specific to a certain region or a technique but some reasons cut across all these regions, materials, and techniques.

7. Analysis

The findings have broadly been categorized as social, legal, material availability, technical issues and economic reasons **Table 1** shows challenges affecting the use of various materials across different regions.

Social

Vernacular building practices have been sustained by entire households participating in, not just the original construction, but the annual maintenance as well. Regular practices like cleaning and replacing of roof tiles, renewal of mud and cow dung plaster on floors and walls have been culturally embedded in rituals associated with festivals. With changing livelihoods, away from agriculture, sometimes in nearby cities, the time and involvement of the residents in the upkeep and maintenance has decreased significantly. And outsourcing the job to labour adds to the overall maintenance cost. Traditional building typologies with open and semi-open spaces, in the forms of courtyards and verandas, become multifunctional spaces used for living, dining, cooking, and sleeping during summers. With changing family structures and redefined needs of privacy, these spaces are becoming increasingly incompatible for some households.

In a particular instance, changing food habits have led to the loss of a crucial fibre in the composition of final layer of wall plaster.

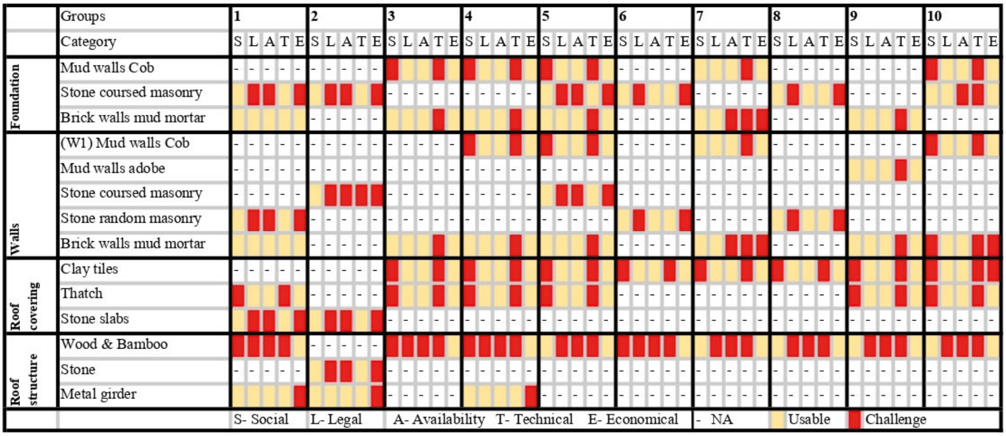

Table 1. Material based challenges.

Husk of Kodo (a variety of millet) used to be in the final layer of mud walls in Group 7. Over the years paddy and wheat have replaced millets, by reduced market demand of millets. Consequent lower prices and profits have discouraged the farmers from cultivating millets, leading to low or no availability of its husk.

A correlation can also be drawn between the proximity of a village to the nearest city and the extent of decline in vernacular practices, observed in the said village. Villages closer to a city have access to global materials, replacing the vernacular at a much faster pace. Acceptance of vernacular architecture in Group 2, 3 & 4 villages is low. Villages in remote locations of Group 7, 9, 10 have retained a lot of their vernacular practices. The tribal population and their own set of customs and outlooks are a point of further study.

Economic

Low-income groups predominantly are observed to have greater acceptance of vernacular materials due to their affordability, as opposed to financially well-off respondents with better purchasing power. However, it is also observed that both groups share the same aspiration to global materials.

Some of the construction techniques face the problem of widespread negative societal perception, especially the mud houses i.e., the cob houses. These are widely seen as the choice of the poor; therefore, the current residents' upward mobility also aspires to go for concrete, or even brick houses. In regions where stone is the predominant single vernacular material, the reason is reversed. Group 2 & 4 show that the prices of stone have gone up tremendously due to legal reasons and demand from cities. Here economic reasons deter low-income group even more from using the local stone.

Legal

Restrictive/Prohibitive Laws

Legislation induced unavailability of materials is found to be a commonly cited reason across regions under study. Restrictions/ complete ban on stone mining has caused Group 1 & 4 villages to deem stone as unavailable despite its abundant local availability. Restrictions/Prohibitions created for resource conservation are restrictions created through legal frameworks for mining. Mining is allowed only in the areas auctioned by the government and only the agency to which the blocks are allotted can mine and sell these resources. Profit-driven mining agencies maximize their earnings by selling to the highest bidding buyers from nearby cities, sometimes even across the country. Group 5 & 7 villages are located in a reserved forest core where the Forest Protection Act prohibits native tribals from collecting and harvesting timber for firewood and building materials. Forest department harvests and auctions wood in a structured manner. Even though the process is democratic, it does not consider the disparity in purchasing power of locals and city dwellers. This drives the prices of materials, essential to vernacular ways of building, higher, creating an artificial scarcity.

Low awareness and implementation on ground

Over the years, newer laws (The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006) have been introduced and provisions for marking village and forests in existing laws have been brought in to ensure the rights of communities. However, grassroots awareness of the same is low, leaving implementation at the discretion of local authorities, creating routine tensions among the forest officials and tribals.

Welfare Schemes - Incentives

Government housing schemes such as Awas Yojana (Housing schemes), which are focused on building houses for the rural poor, have seen maximum implementation in the state of Madhya Pradesh. However, due to lack of complete information of the scheme, use of outside material is not only encouraged, but communicated as the only alternative for receiving the financial incentives. An in-depth study conducted by UNDP in 18 states of

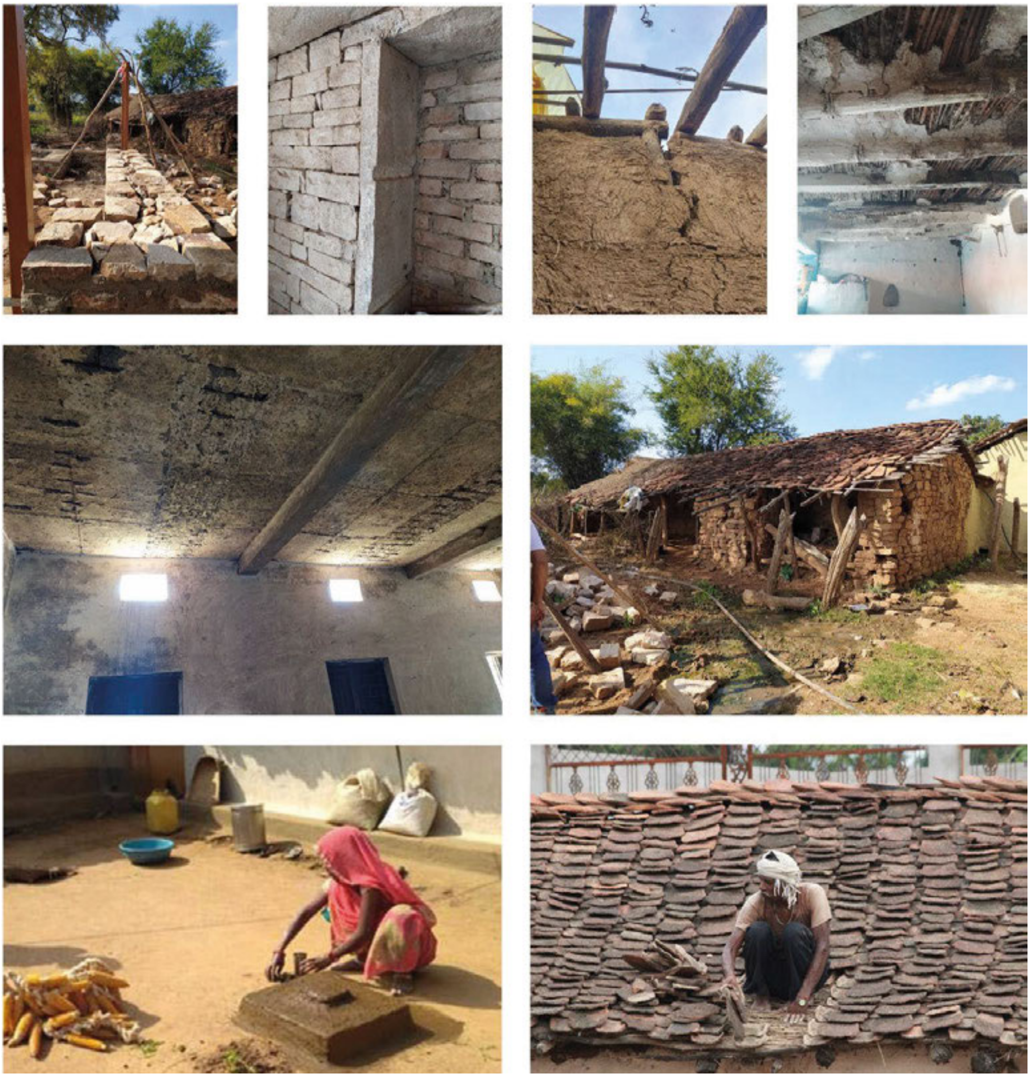

Fig. 3. Challenges in vernacular construction.

India has helped in developing 130 zone-specific comfortable, affordable, green, and multi-hazard safe design typologies to encourage appropriate regional construction. This was done to incentivize regional vernacular construction. Despite this, lack of awareness at the implementing bodies' level has resulted in only a single standard typology using concrete being used in all regions. Additionally, pressure on meeting large quantity targets pushes single modular designs for quick execution, monitoring, and assessment.

Technical

Across all regions, varying degrees of technical issues are observed for different materials some of the issues can be seen in Fig. 3 above. Lack of strong and higher plinth results in multiple issues across Groups 3,4,7. Damage caused by rain, particularly in low height cob plinths, leads to weakening of structure and requires annual maintenance. Gaps in random rubble masonry harbour critters such as scorpions, snakes. Roof structures constructed using untreated wood are found to be susceptible to termite. Irregular sizes of wooden logs, joined together create an undulated surface for the county roofing tiles leading to leakages. Country roof tiles are damaged by monkeys in areas closer to forests and unattended gaps permit entry of snakes and insects. These issues get exacerbated due to the changing lifestyles and reduced involvement in regular upkeep. Vernacular practices have evolved over generations of use and incremental technical innovation. Rapidly changing lifestyle and availability of standard materials are providing an easy quick-fix. With lack of material and demand for vernacular techniques, traditional embedded knowledge systems are fast disappearing, creating a vicious cycle of decline in vernacular practices.

8. Conclusion

Decline in vernacular architecture is caused by multi-dimensional reasons, the decision making is influenced by factors ranging from social acceptance, challenges faced in the upkeep, increasing costs, government policies and depleting resources.

Efforts in order to revive or conserve have to be multi sectoral and multi-agency. Awareness about the benefits of using local materials is necessary to change the perception of local materials. This will need the involvement of local agencies, government, and technical organizations. Policies need to be more equitable to bridge the social and financial disparity, giving an easy access of materials to the locals. Incentivizing use of local resources is needed. Vernacular technique and materials need to be evolved through further research by technical institutes, research outputs can play an important role in appropriating these for the contemporary needs to conserve vernacular ways of building.

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CONSERVATION, RESTORATION AND ENHANCEMENT OF VERNACULAR ARCHITECTURE

MANAGEMENT AND MAINTENANCE OF VERNACULAR ARCHITECTURE

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Ghadames, Libya. A traditional earthen settlement, resilient to crises and environmental challenges

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
Ghadames, a World Heritage property, is an outstanding example of a traditional human settlement, representative of a traditional culture and human interaction with its environment. The old town has a symbiotic relationship with its surrounding oasis. Its earthen housing design is extremely original and climatically adapted. Serious human and environmental challenges increased recently. The community of Ghadames has however always been, responsible for the exceptional qualities of this site, from its inception to its conservation. An active local convenient authority was purposefully set up for conservation. Fortunately, the present crisis in Libya only caused indirect damage. . Our paper aims at better inform about Ghadames little known heritage features, encountered challenges and conservation achievements. Through this particular case study, our multi-faceted paper aims to demonstrate how a comprehensive approach, in construction, architecture, urbanism, landscaping, irrigation, climate, law and institutions, is important for understanding and planning conservation issues.

Keywords: *earthen architecture; oasis settlement; climate challenge; comprehensive planning; world heritage.*

1. Introduction

Ghadames used to be a gateway for a major route to the great Sahara Desert and its Southern areas for commercial caravans and Sufi religious circles. Its oasis in a desert region is located about 430 km from the capital city of Tripoli at the present junction of Libyan borders with Algeria and Tunisia. It is very hot in summer, as temperature can reach or exceed 45 °C (113 °F). Few rains occur in winter.
The city was in the past the seat of a Roman garrison and an Episcopal city later. During the first part of the 20th century, it was successively occupied by Ottoman, Italian and French powers but didn't suffer from fighting, not even recently, with the exception of a US limited bombing during WW2. An old airport doesn't seem much frequented.
According to local traditions, the town emerged and developed beside Ain al Faras water spring. Beautiful fortified granaries are to be found on the road to Tripoli, like in Nalut and Qasr al Haj. Some of its features, like covered streets, are somewhat similar to those of Temacine and Tamelhat in the South of Algeria. This vernacular settlement is consistent, outstanding, authentic and rather undamaged. No other similar settlement was so well safeguarded in Libya and the North of Africa. Its specific features are however still rather ignored not completely described.

Fig. 1. Closer aerial view with roof terraces.

In 1986 an ICOMOS mission went to Ghadames and produced a report that served as a basis for the inscription of the city on the World Heritage List on the same year. This inscription probably contributed to raise the local, national and international attention. A conservation *modus operandi* was however apparently long to be found.

Our own first mission to the site dates back to 1998 and somehow continued until recently, with long interruptions. It implied visits and meetings with community leaders and authorities in charge, as well as access to original documents. Based on this experience, this paper will comprise three sections: Architectural and environmental features, Challenges and opportunities, as a World Heritage in Danger.

2. Ghadames Architectural and Environmental Features

A somewhat circular, high earthen wall surrounds the old city (12 ha) and its oasis (225 ha together). This is probably why some western early visitors mentioned a "round city". A sort of symbiotic relationship developed between the city and its oasis. One would not have developed without the other one and the growth of both was probably related. Moreover, palm groves and residential districts are interpenetrated. In the oasis water channels from Ain al Faras major spring connected earlier, central irregularly shaped agricultural parcels. On the periphery, orthogonal parcels are linked to more recent artificial wells, Ain Talian and Ain Francis, provided during the Italian and then the French occupation. The total length of channels is of about 13 km and caretakers do attend them.

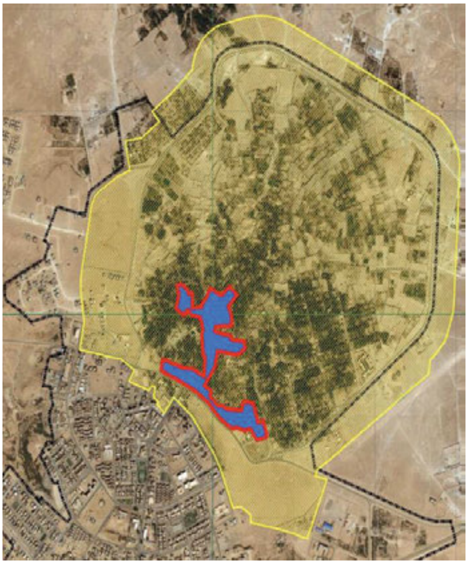
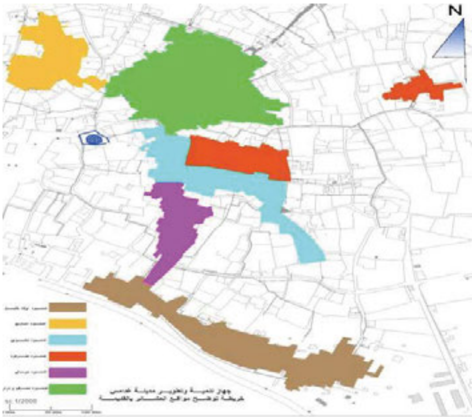


Fig. 2. Aerial view. The World Heritage site is in blue and its present boundary in is in red.



تقسيم مدينة غدامس بين عشائرها

Fig. 3. Social Map. Each tribe has a different color.

The Old Town of Ghadames included more than 1250 houses, 23 mosques, Sufi centres and some shops and more interestingly 7 physically attached but distinct and gated residential districts. A different tribe or coherent social group dwelt in each one. Most were Berbers with a presence of Touaregs to the West. A late Ottoman administrative district faces south, along a major road. There, is also located the main access gate. As the street pattern is ramified, similarly to a tree, it would be possible to access any house from the main entrance. There is something organic in this social and physical distribution. The built area is not compact but consist of thinly connected compact blocks.

At close level, the internal streets are designed for pedestrian and animal traffic. Benches along the houses walls allow elderly people to sit and chat. Arches across streets support rooms above. Occasionally, an absence of roofing provides lighting and air. No water distribution pipes are provided below for fear of an accidental burst that may provoke a flood that would result in the melting down of adjacent structures. Some writers often repeat that men's traffic would be located at the street level, while women's traffic was located at rooftop level. This would be a powerful feature, but realistically the feminine specific upside walks would probably be limited to a few close houses rooftops.

At the urban level, climate protection was provided thanks to an exceptional density and narrow covered streets. Each house is protected as much as possible from sunrays by the walls of adjacent buildings. When a house has a side located along a palm grove, it has no doors and its windows are small on that facade. Anyway palm trees provide shade and a cooler air gets inside from inside the house from the street and from the plantation. Warm air rises naturally and is evacuated through the roof shaft. The roofs are flat and regularly whitewashed with lime for waterproofing.

Fig. 4. Traditional Ceiling, ith palm trunks, palm stems and a shaft.

Houses are low rise, with between 3 to 4 levels usually. Their walls are made of earth on stone foundations. They are constructed with mud bricks and externally plastered and whitewashed. Roofs were supported by palm wood and palm stems. Doors and openings were based on an elaborate carpentry. Contrarily to other Mediterranean or Oriental traditional settlements, Ghadames houses do not include courtyards. They are however arranged around a central covered room with a shaft in its ceiling, for lighting and air renewal. The periphery of this central space is somehow sculpted with stairs, cupboards and openings unto low peripheral rooms. Its white walls are painted with red decorative patterns. For esthetical purposes, some sets of domestic traditional utensils are permanently displayed on shelves.

People sit below on benches and rugs. The kitchen is located upstairs and directly connected to the rooftop, perhaps to avoid smells. One niche is covered by a red fabric and is called *Kuba*. This is where the bride waits for the groom, where the mother is congratulated for her newborn baby and where the widow receive condolences if her husband dies

Fig. 5. A road in the oasis.

3. Ghadames challenges and opportunities

The population estimate of the city was of 4,000 persons in 1850, of 1,700 in 1952 and 12,700 presently. The Government started supplying apartment blocks housing in a new adjacent district outside the oasis since 1969. Around 1983 the old city was practically empty of inhabitants. Many former dwellers do however maintain their previous homes and even return during the summer hottest days. An informal watch is provided to prevent looting and degradation. As traditional houses have normally few external openings, the old city doesn't look like a ghost town and before 2011, a modest stream of tourists appreciated its visit.

Cultivating palm groves became difficult at the end of last century, because of technical problems at Ain al Faras. Cultivated land shrank. Libya nearby borders were definitely closed because of security and political issues. This accumulation of problems raised serious concerns about the future of Ghadames as a whole.

In 1986 fortunately, the "Old town of Ghadames" was inscribed on the World Heritage List according to criterion V with an acknowledgement of the Integrity and Authenticity of its Heritage.

« **Criterion (v):** Ghadames is an outstanding settlement in the Saharan pre-desert renowned for its exceptional built heritage, erected thanks to long-lasting traditional practices resulting from the particular demands of the harsh climate. For at least 2,000 years, the city has played an important role in the trans-Saharan trade network. It has been a crossroads for the major cultures of the African continent and the Mediterranean basin, while also developing its own unique architecture and traditions related to its historic origins and subsequent interactions. (…). The balance between the inhabitants and the environment has been fundamental to the development of the city's unique urban character, but is also an important factor in its vulnerability to human and climatic change.»

Fig. 6. Inside the oasis.

As Ghadames is located in a remote area with a rather difficult access, external scientific missions remained few and without being exhaustive, we may mention:

- A University of TsingHua architectural survey, undated, probably in the 1980's
- A UNESCO inter-sectorial mission, 1983
- An ICOMOS (as advisory body) field mission to evaluate the nomination of Ghadames, 1985
- A UNCHS (now UN Habitat) feasibility study for a conservation project, 1987 and 1990
- A UNDP/WTO Master Plan for Tourism in Libya, 1997-1998

- A UNDP-UNESCO mission for a Rehabilitation of the Old City of Ghadames, 1998 and 1999
- A CRAterre assistance to the improvement and use of traditional materials and the training of local craftsmen, 2008-2010

The UNDP-UNESCO was based on a comprehensive and strategic approach, proposing a sustainable future for Ghadames based on its cultural, environmental and human resources, including:

- Development of Tourism (particularly small scale guest houses in traditional homes)
- Revitalisation of economic, social and cultural activities: Housing and community facilities, Traditional Construction, Traditional Crafts, Irrigation and Agriculture)
- Comprehensive Physical Planning (GIS, Rehabilitation and Conservation Plan, Comprehensive Master Plan, etc.)
- Accompanying measures (Developing know-how and awareness, improving capacities)
- Institutional Framework
- Working Agenda

The Ghadames community has long been dedicated to the conservation of its old town. An appropriate administrative, financial, technical and legitimate tool was needed to undertake its projects Existing tools were not sufficiently adequate. A dedicated authority able to engage with all local, national and international stakeholders was necessary. The Service for the Planning and Management of the Old City of Ghadames (SPMOCG) created by law n° of 1994 and the he General People's Congress executive Decree n°63 of 1995.

This agency was continued by the Ghadames City Promotion ad Development Authority (GCPDA, or the Authority for short) created by State Decree n°401 of 2007. To our knowledge, in Libya, such authorities were set up only in Ghadames and Tripoli. Effective protection is guaranteed through the collaboration between the local Authority, the development partners and the Department of Antiquities, the Urban Planning Department, local City Council, civil society associations, the Tourist Police, and the Committee for Management, Implementation of the Conservation and preservation strategy of the five Libyan World Heritage properties. Maintenance and salaries are usually locally provided, but Conservation Projects are normally nationally budgeted through "capital funding". Abdulkader Omar, Head of the Authority is a knowledgeable, dedicated and efficient member of the community.

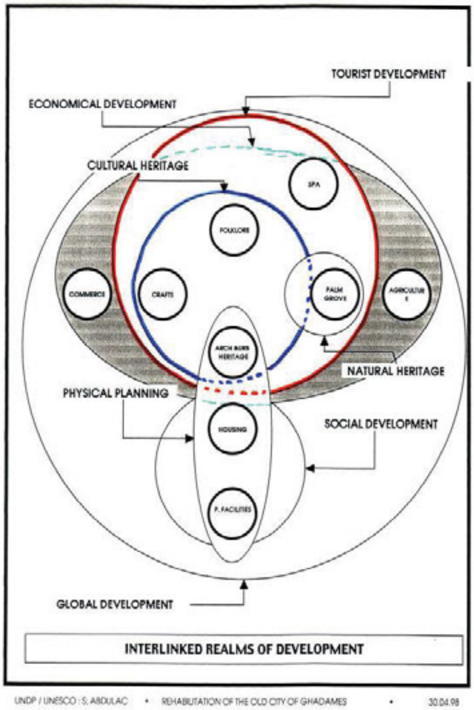


Fig. 7. A proposed strategy combining the Conservation of Cultural Heritage with Comprehensive Development (1999).

The Authority had to face several difficult challenges: a decaying built fabric, a deserted town and a worsening economic situation. One of the first initiatives was to organize an annual festival of folk arts that attracts crowds of visitors from Ghadames and the rest of the country. The local community participated massively as actors and participants and became even more proud of its identity as well as of their tangible and intangible heritage. However, 191 buildings collapsed over time on a total of 1205. Hopes based on tourism momentarily expired ten years ago and cultivated land substantially decreased in the 1990's and 2000's. Ghadames had to face new environmental concerns. As mentioned, the whole oasis shrunk about twenty years ago. In 2003 the cultivated area dropped to a proportion of 49,25 % of the oasis surface. It rose again to 80% in 2020 thanks to the repair works undertaken at Ain al Faras, the digging of 5 new wells to a depth of 450m and the repairing of 18 km of water channels, and of 36 km of farms external wall. The Authority also subsidizes the replanting of palm trees in a proportion of 75%.

Fig. 8. A meeting at Ghadames City Council.

The GCPDA passed 250 working contracts with small contractors between 2007 and 2013. Climate change was expected to increase drought, but extremely unusual heavy rains occurred in December 2017 (15 buildings collapsed) and then again in March 2019 (6 houses collapsed). These disasters were due to the lack of provision for exceptional rainwater evacuation. A limited fire also occurred in the oasis in July 2019. About 50 to 100% of 2017 damage was already repaired in 2020. Maintenance and large-scale waterproofing campaign had also to be undertaken everywhere to prevent this earthen settlement from melting. Aerial photographs seem suggesting a rise in the number of detached buildings in the oasis. An assessment is still not easy to provide, but if these constructions were intended for housing and not for farming activities, this would mean that a creeping urbanisation is underway, which would be a rather regrettable development.

4. Ghadames as a World Heritage in Danger

As a World Heritage property, Ghadames should take into account the rules included in present Operational Guidelines, even if some of them were not yet formalized at the time of its inscription on the List. The property boundaries were originally restricted to those of the old town itself, although the article 100 of the Guidelines mentions that: "*For properties nominated under criteria (i) - (vi), boundaries should be drawn to include all those areas and attributes which are a direct tangible expression of the Outstanding Universal Value of the property, as well as those areas which, in the light of future research possibilities, offer potential to contribute to and enhance such understanding* ».

Fig. 9. Disaster due to excessive rainfall.

The ICOMOS report of 1986 also stressed the importance of the oasis, concluding that the « management of *the oasis, whose survival is necessary for an understanding of the history of the site and for the ecological equilibrium of the city, special attention should be paid to traditional systems for the irrigation of the palm tree grove.* ». It is hoped that a future Retrospective Statement of OUV and a Minor Boundary Modification would give justice to the global interest of this property. The State Party is also progressing in the development of a Management Plan including Regulations and a Building Code to be used in the Property and its Buffer Zone.

Fig. 10. Reconstruction after disaster.

The World Heritage Committee inscribed the Old Town of Ghadames on the List of World Heritage in Danger in 2016, mainly because of the potential threats and destruction consequent to the armed conflict in Libya that began in 2011. Ghadames has fortunately remained far from any combat activity and its OUV was not jeopardized. Indirect threats were however considered because of the reduction of capital funding and some maintenance issues. A joint Reactive Monitoring Mission (UNESCO/ICOMOS) has still to be postponed, but a set of corrective measures and a timeframe for their implementation is already decided. The World Heritage Committee has accepted in July 2021 a "Desired State of Conservation for the Removal from the List of World Heritage in Danger" (DSOCR), elaborated with the World Heritage Centre, ICOMOS and the State Party. The Government in Tripoli has pledged a consistent financial support.

5. Conclusions

Given the diversity and specific features of the site, as well as all the met challenges, its conservation is facing, a comprehensive, original and adapted strategy has been needed. This strategy seems now to be found and already at work since about 15 years. Anyway, the main driver for its exceptional qualities, from its inception, its development to its present conservation is no doubt essentially the local community. One would certainly wish that living in the new town would not gradually severe the links of the new generations with the old one and that Ghadames would always remain secure and climatically adapted, benefitting from a sustainable development allowing the conservation of its outstanding cultural heritage, together with international assistance.

Fig 11. A central room with traditional decoration.

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Architectural Heritage and seismic vulnerability: mapping the available knowledge to reduce damage during an emergency

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
Vernacular architecture has become a full part of our cultural heritage, since it constitutes evidence of our material culture and is tied to specific historical/geographical contexts. This type of 'lesser' heritage has withstood various transformations over time, whether negative transformations due to abandonment, or positive transformations due to expansion and renovation work on historical buildings or their simple adaptation to new living conditions. Thus, vernacular architecture often presents intrinsic vulnerabilities resulting from all the transformations it has undergone. The presence of this type of vulnerability within the vernacular built heritage also constitutes an even greater risk for buildings located in seismic areas, as this could lead to an increase in the level of damage due to an earthquake, often with irreversible losses. Achieving a good level of knowledge about the vulnerability of historical buildings in seismic areas is therefore important for their adequate preservation. This not only allows preventive maintenance to be planned, but also because when an earthquake occurs, this type of knowledge would allow decisions to be made with greater awareness regarding where to intervene first, and to more quickly identify where safety interventions for the most vulnerable buildings must be realised. As is well demonstrated by the collapses caused by the earthquakes that hit Central Italy in 2016, the possibility of promptly securing damaged historical buildings is of fundamental importance for conserving the built heritage damaged by an earthquake. To this end, the contribution describes some of the main instruments available in Italy for technicians and functionaries that intervene during a seismic emergency to secure the architectural heritage, with suggestions as to how these tools can be strengthened.

Keywords: *seismic risk and seismic vulnerability; emergency management; interoperability.*

1. Introduction

Architectural heritage is an important element of the cultural heritage: it bears witness to traditional architectural techniques and to artistic values and crafts specific to certain ages and places. Local populations have always ascribed a major value not only to the great monuments but also to the vernacular heritage, which often still has a social, historical and cultural pre-eminence for them.
In every region of Italy there are many examples of 'vernacular' architectural heritage, of which churches are undoubtedly a particularly significant cultural testimony. In many cases, these buildings seem modest on the outside, but they keep a considerable artistic heritage – i.e. paintings, frescoes, sacred furnishings – on the inside. These churches, even small ones, still play a social role for the local population as a landmark of the local identity.
Churches also represent a building typology that is particularly vulnerable to seismic actions due to the large size of the *aula*, often lacking

of suitable reinforcing elements. Frequently, these buildings are also poorly maintained since they're rarely attended during the year. For these reasons, when an earthquake occurs, churches regularly suffer major damage. The most common causes of their vulnerability are, for instance, the lack of effective seismic protection elements (*presidi antisismici*), the inadequate connection between the walls, the poor quality of the materials, as well as the lack of retrofitting intervention and an inadequate level of general maintenance.

Provisional works, if promptly executed during the first phase of a seismic emergency, may prove to be an effective temporary solution. They could successfully limit the damage caused by seismic aftershocks, especially those of strong intensity, as recent earthquakes that hit Central Italy in 2016-17 have shown.

The ability to promptly install the necessary countermeasures to stop the progression of seismic damage is not a simple process. In order to reach a positive effect, it is necessary to know the characteristics of the building, such as which and where the most vulnerable elements are. Moreover, all the entities that are involved in the emergency should rapidly activate a series of operations in a coordinated manner. Concerning the architectural heritage, the public authorities that intervene to safeguard it are: the Ministry of Culture (MiC), which is responsible for the protection of the heritage; the National Fire Brigade (NFB) and the Civil Protection Department (CPD), which are charged with implementing the interventions. Aiming to promptly manage the emergency, the involved operators should know in advance which are the listed buildings that are located in seismic areas so that they can efficiently organise all the securing activities, from the damage surveys to the realisation of appropriate countermeasures.

1.1 Architectural heritage and emergency

When an earthquake occurs, emergency operators are immediately activated. In Italy, the management of a seismic emergency is entrusted to the National System of Civil Protection, which is designated to manage both the first relief operations and the assistance to affected populations. During the early stages of an emergency, search and rescue activities and measures to assist the displaced population are carried out, together with first surveys to assess the damage that has occurred in the most relevant buildings – i.e. hospitals, administrative centres/public buildings, schools, etc. During this time, an evaluation of where public access should be prohibited is also carried out – i.e. in those areas that show the greatest risk of suffering further damage and collapses. These latter activities are performed by the National Fire Brigade, a component of the Civil Protection Department with specialist teams trained to carry out emergency operations, such as rescuing people, evaluating the stability of structures and implementing technical countermeasures.

In the case of a severe emergency, such as when an earthquake of high intensity causes significant damage, the CPD requires the collaboration of other public security authorities, such as the Italian Army, starting from the corp of *Carabinieri*.

Regarding the architectural heritage, the emergency activities mainly concern:

- for the immovable heritage, the assessment of the occurred damage, the design/execution of securing countermeasures to contain the damage/progression of the activated collapse mechanisms;
- for the movable heritage, the recovery and transfer to temporary warehouses in order to restore the damaged items and to protect them from possible further damage or theft.

When a natural/anthropic emergency occurs, the MiC activates specific crisis units called '*Unità di Crisi per il coordinamento Nazionale – UCCN*' (Crisis Unit for the National Coordination) and '*Unità di Crisi per il coordinamento Regionale – UCCR*' (Crisis Unit for the Regional Coordination). The UCCN does coordination tasks for the activities carried out by the UCCR, and it supports communication with other public authorities that intervene during the emergency. The UCCR instead deals with giving specific indications for the emergency activities that are conducted locally by the officers of the MiC. Each UCCR is organized into different operational units: the 'O.U. for the damage surveys', the 'O.U. for the realisation of the provisional countermeasures systems' and the 'O.U. for the displacement and restoration of the movable heritage'. During an emergency, the officers of the MiC collaborate directly with both the CPD / NFB and the teams of qualified researchers/professionals.

The officers of the National Fire Brigade play an important role in securing the damaged architectural heritage: they have to evaluate, design and implement technical countermeasures. Starting in 2015, the NFB has defined a specific operating protocol for the realisation of the provisional systems, called 'Short-Term Countermeasures System – STCS'. It regulates the reconnaissance of damage scenarios, the supply of necessary means/materials and the execution of technical countermeasures.
The NFB has a special operative unit named '*Nucleo Interventi Speciali* – NIS' (Team for special intervention), which is trained to design the technical countermeasures. In order to define an intervention, the officers of this unit participate in special surveys called 'GTS surveys'[1]. When the evaluation concerns the architectural heritage, surveys are performed jointly by the NFB, the Civil Protection Department, the local administration and the MiC.

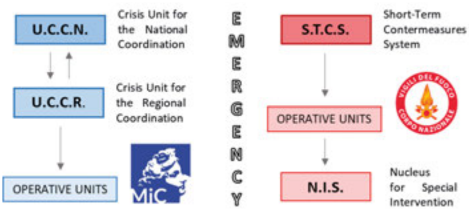

Fig. 1. Emergency Operative Units activated by MiC and NFB.

Moreover, in order to properly design the countermeasures for damaged buildings, the NFB has prepared a specific manual with some technical sheets[2].These documents have been developed based on the experience from the L'Aquila seismic emergency in 2009. They allow the NFB to design and implement the technical countermeasures according to some codified intervention schemes, which define the most appropriate solution starting from the constructive characteristics of a building, also considering the typology/extent of damage and the risk conditions which may exist in the context and/or in adjacent dwellings.

1.2 Tools for finding the preliminary level of vulnerability

It is therefore clear that, at the time of an emergency, the NFB need to know which are the main constructive characteristics of a damaged building, thus being able to define in a correct and a timely way the most appropriate technical countermeasures. The most important data are those related to the structure, including external/internal dimensions, materials and changes occurred over time. Unfortunately, these data are not always available in public/ministerial archives or they are not easily/immediately accessible. Thus, even when these data exist, they are not readily usable at the time of an emergency.
Otherwise, knowing this information before starting to design the countermeasures could be a valuable resource for the NFB since it would make it easier for technicians to understand the effective vulnerability of buildings and, consequently, to design appropriate, urgent technical countermeasures for those parts that might be subject to a greater risk of collapse.

It was several years ago that, aware of the connection existing between the vulnerability of a building and its expected seismic damage, the Italian '*Istituto Centrale per il Restauro* – ICR' (Central Institute for Restoration) started a study to survey the constructive vulnerability of national built heritage. This study is part of a larger project called '*Carta del Rischio*' (CdR), aimed at identifying those natural/environmental or anthropic risks that might threaten the Italian architectural heritage [3]. *'CdR'* is a geographic

[1] The acronym 'GTS' means: '*Gruppi Tecnici di Sostegno*' (Technical Support Groups). These teams include both specialised officers and technicians from different public agencies.

[2] '*Manuale opere provvisionali*' and 'Schede tecniche STOP'.

[3] Nevertheless, this is not the first analysis carried out to define the causes of degradation of the cultural heritage that stands in a territory: a first important project, aimed at mapping this link by identifying methods, professionalisms and experts able to carry out preventive interventions of 'planned conservation', was already proposed in 1975 by G.Urbani, who was the director of the ICR. That project was called

information system developed to map, on a cartographic basis, what are the assessed risk conditions for the architectural and archaeological immovable heritage. The system evaluates the risk of each item by assessing its vulnerability and the hazard of the area. These parameters allow for the evaluation of the level of danger from environmental, hydrogeological or seismic risk.

Fig. 2. An example from the Italian '*CdR'*. The map shows the areas where the seismic risk has already been assessed.

Concerning the seismic risk assessment, the evaluation is determined both through filling in specific forms which catalogue the vulnerability level of buildings[4] and through the seismic hazard level, which is determined by the '*Istituto Nazionale di Geofisica e Vulcanologia* – INGV'(National Institute of Geophysics and Vulcanology) depending on the seismo-geological properties of the region. Some analyses of this type have been carried out in Southern Italy, especially in Calabria and in Sicily. Nonetheless, they have not yet been completed everywhere, nor in those areas that are characterised by high seismic activity.

Therefore, it is not yet possible to have a complete map of seismic vulnerability and risk for the architectural heritage.

2. The earthquake of Central Italy

The earthquake that hit Central Italy on 24th August 2016 was the first in a long sequence, which saw more than 3,000 tremors during the whole year. The earthquake affected an area that stands along the two sides of the Apennines, between the Sibillini and the Laga Mountains, in the inner part of the valley of the River Tronto, among the regions of Lazio, Marche, Umbria and Abruzzo. The seismic sequence, known as the '*Amatrice-Visso-Norcia seismic sequence'*, was characterised by 7 events with a *magnitude* of $M_W \geq 5.5$. Among these events, two occurred on 24th August 2016, whose epicentres were registered near Accumoli (RI) in Lazio and near Norcia (PG) in Umbria. Strong aftershocks occurred again on 26th and 30th October 2016[5], worsening the damage that had already been induced by the events in August.

Indeed, many buildings which had been damaged by the earthquake of 24th August had not yet been secured. Thus, at the end of October, they suffered further irreversible damage. This was also the case for the architectural heritage, where the most serious damage happened in the churches. Two examples of churches belonging to the vernacular heritage that collapsed almost completely due to the aftershocks at the end of October 2016, after already being damaged by the earthquake of 24th August 2016, will be briefly presented below. These examples are particularly significant as in both the churches, some securing interventions had been started by the NFB, even if they had not been completed by the end of October.

'*Piano Pilota per la conservazione programmata dei beni culturali dell'Umbria'* (Pilot plan for the planned conservation of the Umbria cultural heritage).

[4] There are specific forms that catalogue the 'architectural vulnerability' and the 'seismic vulnerability' of buildings. They differentiated one from other depending on building typologies.

[5] On 2016.10.26, two aftershocks with a *magnitude of* M_W=5.5 and 6.1 occurred, followed, on 2016.10.31, by a further one with a *magnitude of* M_W=6.6. The epicentres of these events were registered in Castelsantangelo sul Nera (PG), and in Norcia (PG) in Umbria. Two strong tremors with a *magnitude* of M_W=5.7 and 5.6 happened on 2017.01.18 in Montereale (AQ).

2.1 S. Antonio Abate church in Frascaro (PG)

Sant'Antonio Abate is a small church in the countryside near Norcia, whose construction started in the 15th century. The church had great artistic and cultural interest with frescoes and polychrome wooden statues from the 16th and 17th centuries inside and a scarved stone portal on the façade, which dated back to the middle of the 16th century. After the earthquake of 24th August , the most evident damage occurred in the carved stone portal, where part of both the lintel and the upper masonry collapsed partially. Cracks had also opened at the impost blocks of the cross vaults inside the church, and the collapse of the portal made the building inaccessible.

After that event, both the damage surveys and the assessment of the technical countermeasures were promptly defined by the functionaries of the MiC, who started the first intervention less than two weeks after 24th August. In September, the NFB also carried out the initial countermeasures, which involved the securing of the collapsed portion of the façade. It was also planned to construct shoring systems on the external walls, hooping them with steel cables and wooden beams in order to prevent the façade from overturning. These countermeasures were not started at the same time or promptly, probably due to some logistical problems, such as the lack of availability of the NFB specialised teams, who were entirely engaged in other securing work. On 26th and 30th October, when the main aftershocks occurred, the church had not yet been completely secured: only the countermeasures that were designed to strengthen the collapsed part of the façade had been finished. Thus, the church of Sant'Antonio Abate suffered an irreversible worsening of the previous damage:it collapsed almost entirely, with only part of the apse wall surviving thanks to the presence of the sacristy dwelling that stood behind it.

The study carried out on archival sources that are kept in the Diocese of Spoleto and Norcia has highlighted that the church had already suffered previous damage as a consequence of the earthquake that hit Valnerina in 1979.

That earthquake had caused damage on the cross vaults and the opening of some deep cracks, both in the external walls and below the belfry. After that event, the church had been restored by consolidating the extrados of the cross vaults with a reinforced concrete layer and by inserting cement mortar and armed perforations, both in the perimeter walls and in the portal of the façade[6].

Fig. 3. The church of *S Antonio Abate* after the earthquake of 24th August 2016 (left) and in 2017, after its collapse (right) (Source: https://frascarodinorcia-noprofit.webnode.it/galleria-immagini/ (a); https://www.iluoghidelsilenzio.it/frascaro-norcia-pg/ (b)).

2.2 S. Maria Assunta in Castelluccio (PG)

The church of Santa Maria Assunta was in Castelluccio di Norcia, a hamlet situated at the top of a mountain, 1,452-metres above the sea level, in the plateau called '*Piano Grande'* within the *Sibillini* Mountains. The church had a square plan and it was possibly built in the 16th century inside the fortified village, partly in adherence to other buildings. This church also had a carved stone portal with a considerable value. It was sculpted in 1528 and it was very similar to the one of Frascaro. Inside the church, which had been repainted in 1862, there were fragments of some frescoes dating back to the 16th century and wooden statues from the same period, albeit restored on several occasions. After the earthquake of 24th August , the worst damage to the church was in the 18th century bell tower, where

[6] Technical reports and drawings are stored in the technical office of the Diocese of Spoleto-Norcia, to whom the church belonged. This was also the case for the second example.

some angular masonry blocks had been inserted. There had also been local collapses of some wall blocks inside the church.

The ministerial officers reacted promptly in this case as well, carrying out the damage surveys at the beginning of September and arranging the recovery of movable heritage to the temporary warehouses that had been set up for restoration – thanks also to the help received from the NFB. The functionaries of the superintendence, coordinated by the UCCR Umbria, defined the necessary countermeasures for the bell tower, aiming to consolidate the ruined portion of the masonry and to hoop steel tie-rods all around the belfry. The first part of the intervention was carried out by the NFB in mid-September, but there is no evidence of other countermeasures being realised to contain the damage inside the church, nor other provisional works outside. After the earthquakes of October, both the bell tower and the church have unfortunately completely collapsed, as well as many other buildings of the hamlet, which had already suffered a great deal of damage on 24th August. It was, however, possible to save the wooden polychrome altar that was inside the large wall niche used as an apse, which had remained intact even after the collapse in October.

Fig. 4. The church of *S.Maria Assunta* before the earthquake of 2016 (Source: http://www.sabap-umbria.beniculturali.it/index.php?it/257/norcia-fraz-castelluccio).

The research has once more highlighted the existence of archival sources, which are stored in the technical archive of the Diocese of Spoleto-Norcia. The archival documents concern the restoration that was carried out during the 80's to repair the damage produced by the 1979 earthquake. That earthquake caused the opening of cracks in the interior walls of the church and also the presence of some vertical bending phenomena in the walls. The restoration was provided by strengthening the internal walls with reinforced plaster and by waterproofing both the roof and the external walls of the church. It also appeared that the roof of the church had been restored a few years earlier, with the external coverage built in concrete.

3. Discussion

The analysis of the 2016 seismic emergency has shown some critical issues related to the realisation of the technical countermeasures for the damaged architectural heritage. These issues have contributed to a reduction in the number of interventions completed in a timely manner. Therefore, most historical buildings that had not yet been secured before the end of October then suffered further damage and collapses. In most cases, precise information regarding materials, structures, the constructive history or previous damage due to past earthquakes weren't available for the built heritage. Moreover, vulnerability analyses provided by the system *'CdR'* hadn't yet been completed for the area affected by earthquake. On the contrary, if these investigations had been carried out in the past, they were not readily accessible at that moment. Thus, they weren't used for the first emergency surveys. In addition to this, the damage provoked by the earthquake meant it wasn't possible to enter the buildings, since it wasn't considered safe. Therefore, this limitation contributed to making the damage surveys incomplete and partial, often only detecting cracks that were visible from the outside. For this reason, the extent of the damage may have been underestimated in some cases, as well as the urgency assessed for the implementation of the technical countermeasures.

Moreover, in many cases it wasn't possible to proceed promptly to secure the architectural heritage due to the insufficient number of NFB, who were already really busy carrying out other public safety interventions. Thus, the finalisation of technical countermeasures for cultural heritage were executed only after having completed other public interventions assumed more urgent.

Therefore, when the aftershocks at the end of October occurred:

- not all the damage assessments for the buildings belonging to the architectural heritage had been carried out;
- some surveys were carried out only externally, giving an incomplete assessment of the real extent of damage;
- many of the necessary technical countermeasures for the architectural heritage had not yet been completely realized.

4. Conclusions

During the seismic sequence of 2016, the recurrence of severe aftershocks two months after the first event demonstrated for the built heritage the importance of prompt technical countermeasures to reduce possible further damage and/or collapses. During the emergency, the employment of a large number of specialised units was required, due to both the extension of the affected area and the need to carry out damage surveys in order to understand where countermeasures were urgently required. This was true not only for the functionaries of the MiC but also for those of other public agencies that intervene during emergencies. Thus, the earthquake of Central Italy has shown that it would be desirable to increase the number of firefighters specialised in the 'STCS' procedure, as they are also able to realise the technical countermeasures for the architectural heritage.

The problem related to an insufficient availability of specialised operators in the affected area also concerns the number of qualified restorers who, already knowing the damaged heritage, would be able to promptly intervene – i.e. protecting the movable pieces at the very least.

In fact, this problem did not come to light only recently: indeed, it had already been highlighted after the seismic emergency that hit the Umbria Region in 1997. Some negative issues were also identified in that period. They were not only the lack of knowledge on buildings and churches – also those belonging to the 'vernacular' heritage – or the absence of preventive maintenance intervention but also an insufficient number of both qualified professionals and means/materials needed to promptly install the countermeasures or to safely remove the sacred furnishings and artworks from churches. Conversely, in 1997 some qualified restorers who had previously completed specific training courses organised by the Umbria Region and the ICR were present in the affected territory. The availability of these specialised professionals, who had the specific knowledge of both the damaged heritage and the operating procedures that were useful to realise the protection/transport of movable artworks, in some cases enabled the prompt securing of cultural heritage [7].

Fig. 5. The provisional intervention on the bell tower of *Santa Maria Assunta*, realized by the MiC and the NFB (© *Vigili del Fuoco*) (Source: https.//www.vigilfuoco.tv/umbria/perugia/ norcia/ messa-sicurezza-chiesa-smaria-assunata).

Finally, the difficulties encountered during the surveys, especially regarding the availability of detailed information on both the constructive history and the level of vulnerability of built heritage, highlighted the importance of carrying out the analysis in advance, before the occurrence of an earthquake. Indeed, knowing these data at the time of an emergency would be an advantage for both technicians and public functionaries. On the one hand, knowing the existent vulnerability of the architectural heritage would allow damage surveys to be carried out primarily in those buildings that are exposed to a greater risk. On the other hand, the firefighters who

[7] Some meaningful examples are the safety intervention that has been realised by some trained restorers to protect the paintings of Benozzo Gozzoli in the apse of San Francesco in Montefalco (PG) or the one achieved in the homonymous church in Nocera Umbra (PG). On the contrary, the same result hasn't been achieved in Sellano (PG), due to the lack of both means and materials.

are entrusted with designing the technical countermeasures could better understand where the most vulnerable elements of a building are, therefore also predicting the evolution of damage and defining the most appropriate intervention more easily.It is thus clear that it is desirable to continue enforcing the collaboration between the MiC and the NFB.

A further advantage in the management of the emergency operations for the architectural heritage could be given by:

- increasing the number of NFB units that are specialised in architectural heritage;
- extending the number of the surveys aimed at deepening the knowledge of the Italian architectural heritage in order to understand the level of vulnerability and other important parameters, such as materials, structure and constructive history of buildings.

  The systematic organisation of this knowledge could be implemented by exploiting the already existing databases / information systems, such as the *'CdR'* project.

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Analysis and regeneration strategies for the abandoned villages of the Santerno valley in Tuscany

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
The historical settlement system of the Mugello mountains in Tuscany is characterised by scattered rural stone villages and houses. In the past these villages housed communities mainly dedicated to the centuries-old cultivation of chestnut. The process of abandonment can be traced back to the 50s and 60s, when the inhabitants left these isolated places to head towards the cities in search of better economic and living conditions. This paper illustrates the research carried out on three abandoned settlements in the municipality of Firenzuola, with particular reference to the Santerno valley. Pratalecchia, Brento Sanico and Castiglioncello were taken as case studies to carry out a typological and constructive analysis, comprising state of conservation and vulnerability maps of their vernacular heritage. The first part of the investigation analyses the context and the environmental resources; identifies the characteristics of the recurring architectural types; and carries out a classification of the building techniques. The main classes of stone-masonry types were recorded and mechanical parameters of the masonry types were determined through the application of the masonry quality index (IQM) method . In the second part of the research, the state of conservation of the buildings was assessed. According to a risk-based approach, a vulnerability level was determined for each building, considering the quality of the construction elements, the degree of damage and the relation with adjacent buildings. The research made it possible to outline a first methodological approach in order to plan future intervention priorities and to identify strategies for the sustainable conservation, enhancement and rehabilitation of this architectural heritage.

Keywords: *abandoned villages; stone architecture; vulnerability assessment; sustainable regeneration.*

1. Introduction

The territory of Upper Mugello is characterised by small towns located along the main roads, while the inland areas of the mountain are dotted with isolated houses and small villages that today, in some cases, are completely abandoned. The phenomenon of depopulation and consequent abandonment is a process common to many areas of the hinterland, marked by peripheral position, lack of essential resources and services, and deep changes on traditional economic and social balances. The settlement structure and the evolutionary dynamics of the villages of the Santerno Valley in the municipality of Firenzuola were deeply linked to the cultivation of chestnuts, in a strong relationship of balance with the environmental context. Over time, the territories of the villages have undergone a process of marginalisation that has slowly led to their depopulation and later abandonment. These villages are still the expression of a vernacular heritage that has developed thanks to a strong knowledge of the environment and the adaptability to a context with few resources. They are part of a cultural landscape which includes a plurality of values, meanings and potentials. Today, considering the pandemic crisis and the climate emergency, it is necessary to reconsidering the capacity of these marginal contexts to trigger territorial, economic and cultural enhancement processes, generating new centralities (Fenu, 2020; Dipartimento per le politiche di coesione, 2020) both for quality and eco-friendly tourism, and for the development of new production chains based on local resources.

1.1. Research aims and methodologies

This study has the main objective of enhancing the knowledge concerning the system of values (architectural, formal, spatial, functional values, technical culture and construction systems, etc.) of the vernacular architectural heritage of the Santerno valley villages to be safeguarded. The interdisciplinary analysis we carried out is aimed at identifying strategies and guidelines for an appropriate regeneration according to a sustainable development of the area. In fact, the absence of shared guidelines and protocols for the regeneration – which has in part already begun –, risks compromising the technological and cultural authenticity of these architectures (Coppola & Dipasquale, 2022) and the balanced relationship between anthropogenic activities and landscape maintenance with a minimum environmental impact, which has characterised the existence of these settlements.

This study is based on multiscalar analysis, in order to understand the implicit rules that generated these architectures. The analysis of the documentary sources was supplemented by in-situ data collection, which allowed direct survey operations and the reading of the remains (Mannucci, 2021). The analysis have led to the identification of the urban and morphological characteristics of the settlements, the features of the recurring architectural types (Coppola, 2018), the traditional building systems, the state of conservation, and the main processes of decay and failure. An evaluation of the mechanical performance of the masonry structures was carried out and a vulnerability assessment model was developed to prioritize conservation actions. Finally, specific strategies and actions were identified to trigger a sustainable regeneration process of the settlements.

2. Local building culture

2.1 The Santerno valley: environmental and socio-economic characteristics

The Upper valley of the Santerno river constitutes one of the historic natural links between the regions of Tuscany and Emilia Romagna. The landscape of the valley, narrow and rocky, is deeply influenced by the presence of the river, which has created small and narrow bends. The slopes are wooded, with coppice and chestnut forests up to 800m a.s.l., while higher altitudes are covered in coppices of beech trees. The hilly areas, mainly those near water courses and along the sunniest slopes, are intended for self-consumption agricultural production. The phenomenon of depopulation that has characterised the mountain area for decades has caused a progressive abandonment of pastures, crops and agro-forestry pastoral practices which are inevitably followed by the processes of "re-naturalisation" of agricultural environments by the forest, with the loss of landscape and ecological diversification.

The centuries-old chestnut groves of the area were an important source of income for the local populations, who for decades cultivated and maintained plants and undergrowth, shaping a cultural landscape of considerable value. Starting from the 1950s, the abandonment of inhabited centers did not correspond to a systematic abandonment of the chestnut groves. In many cases the villages have been (and still are) inhabited (and limited to some intact buildings) only during seasonal work in the chestnut groves.

Another important resource that has played a central role over the centuries, becoming one of the most representative activities of the local culture and economy is sandstone. There are about 40 quarries in the municipality of Firenzuola, 25 of which are in operation. The stone, easily workable, gray-blue in color, has historically found various uses in architecture, from monumental to vernacular architecture, and even in recent years it has been widely used in the form of cladding or flooring.

2.2 Villages morphological features

The villages are located in the strip between the valley floor and 700 m asl, all in a position well exposed to solar radiation, protected from northern winds, and generally close to a water source. The trend of the slopes has imposed strong constraints on the location of the settlements which are often divided into several buildings located in different areas to better adapt to the contour lines, exploiting the variations in elevation to create access points to different floors of the same complex.

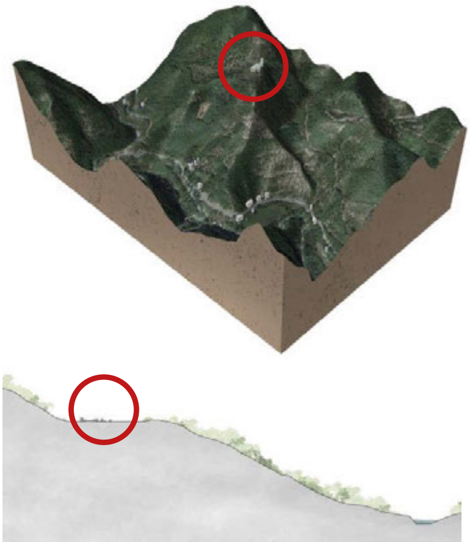

Fig. 1. Territorial model and environmental section of Pratalecchia.

The three analysed villages, Pratalecchia, Brento Sanico and Castiglioncello, have similar morphological characteristics: they all rise on mountain ridge (Fig.1) and have a linear distribution of the buildings along a main central axis, oriented in the north south direction. Pratalecchia (590 m a.s.l.) and Brento Sanico (625m a.s.l.) are located in the Monte Coloreta mountain, not far from the city of Firenzuola; Castiglioncello (340 m s.l.m.) is located further north, at the current borders between Tuscany and Emilia Romagna. Their strategic position has played since medieval times an important role in the control of trade between Florence and Bologna (Balducci, 1993). From the 18th century onward the construction of new roads axes led to a progressive exclusion of these rural areas from the main roads, which culminated in the abandonment of villages between the '50s and' 60s (Fig. 2), following the urban development processes after Second World War.

The organisation of these historic towns is strongly related to the management of pastures, chestnut groves, groves and other agricultural activities. The vegetable gardens were located in areas with a lower slope, taking advantage of the difference in height to naturally convey rainwater. The number of production buildings equal or exceed those for residential use and every house always has a space for production or storage activities (Guccini, 2011).

Fig. 2. Castiglioncello village.

2.3 Main building types

The traditional buildings of the villages examined have elementary volumes, with a rectangular plan and two or three floors above ground. The roof has usually two inclined and slightly protruding pitches covered with stone slabs. The dwelling, in its simplest form, consist of a base unit on two levels, connected by an internal staircase: the kitchen is located on the ground floor, while the first floor is reserved for the bedroom. In cases where the building is located on sloping ground, an additional room accessible from an independent entrance, serving as a cellar, barn or stable, can be located below the kitchen. The kitchen is the place of social life of the family. It houses the fireplace and is always located in a central position and in direct contact with the outside. Over time, and depending on the needs, the basic cell of the house has undergone transformations through lateral or posterior doubling of the main volume, leading to a redistribution of spaces, but always keeps the living area separated from the sleeping area on overlapping floors.

The spaces for productive activities are the barn, the stable, the dryer and the furnace. The barn and the stable are often included in a single building on two levels. It is generally located in the steepest areas of the settlement, in order to take advantage of the slope to obtain two overlapping rooms that are accessible from separate entrances.

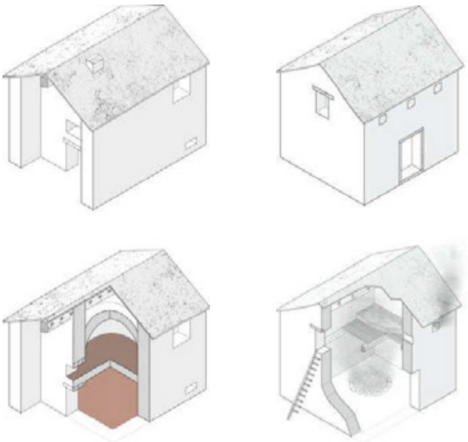

Fig. 3. Scheme of a oven (left) and a dryer (right) in Pratalecchia village.

A typical building of this area is the chestnut dryer (Fig. 3). The structure is single-celled on two floors divided by a horizontal trellis made of chestnut wood shafts: in the lower room a weak fire is lit; in the upper compartment, through a window accessible with an external staircase (or through the natural unevenness of the ground), chestnuts were placed to be dried. The drying operation, which required constant surveillance to prevent the fire from developing a flame (thus burning the chestnuts), lasted about forty days, then the wooden boards of the attic were removed and the chestnuts fell into the lower compartment.

The oven also plays a fundamental role in these settlements and can be external or integrated into the house. When separated, it often includes a small room below the oven, which, taking advantage of the heat of the fire, was used as chicken coop, pigsty, dovecote, but also as a well or woodshed (Guccini, 2011).

2.4 Construction techniques

The building materials are closely linked to the resources available in the area: the masonry is always made of sandstone blocks walled with earthen mortar. The stone blocks are generally hewn, while square blocks are used where a better performance of the masonry was needed, such as the corners of buildings. Three main classes of stone-masonry types have been recorded, using a set of parameters (Dipasquale et al., 2020): general dimensions, laying criteria, type of blocks, use and nature of mortars, etc. The openings are generally characterised by stone lintels and cornices, sometimes decorated with simple engravings. The openings of the service annexes are made with simple chestnut wood architraves placed side by side to cover the entire thickness of the masonry.

Floors have single or double framed timber structure. The elements are obtained from simply debarked and roughly hewn chestnut trunks with a maximum diameter of 30 cm. The floors with a simple frame consist of wooden beams embedded in the load-bearing masonry, a wooden plank placed in an orthogonal direction to the underlying beams, an infill layer in earth and crushed stone of variable thickness and a finishing layer in stone slabs. The beams generally cover lengths ranging from 3 to 5 meters and they are placed directly on the masonry using stone scales that ensure the interlocking between stone and wood.

Double frame floors are often used for agricultural buildings. The main structure consisting of beams is superimposed with square joists placed at a distance of 60 cm from each other and by a final layer of stone slabs. A second variant, found only in the residential buildings of the village of Castiglioncello, is more complex because, while following the main structure of beams and joists, brick tiles and a thin filling soil are interposed between the joists and the stone slabs.

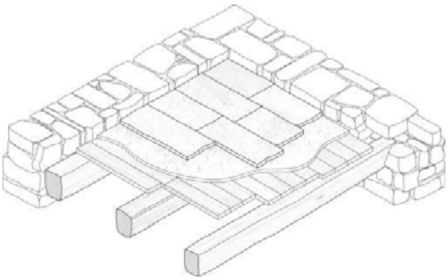

Fig. 4. Axonometric view of a single-joisted floor.

The gable consists of a double warp of beams and joists and a covering of stone slabs. The slabs are laid without any anchoring: the installation starts from the bottom where the heaviest slabs were laid, and then proceeds towards the ridge line following horizontal rows and making sure to sufficiently overlap the upper and lower slabs, thus avoiding infiltration of rainwater. The roof required a careful execution in order to find a balance between the overlapping of the slabs and the economy in the use of the material: a greater overlapping of the stone slabs, in fact, ensures greater resistance to infiltration by water, but at the same time causes increased weight and material consumption.

3. Analysis and assessment of the quality and vulnerability of traditional buildings

3.1. Analysis of the masonry quality of the main masonry types

With the aim of evaluating the mechanical quality of the identified masonry types, the Masonry Quality Index, MQI, method (Borri & De Maria, 2019; Rovero et al., 2016) was applied to three walls (M1, M2 and M3) which were identified as representative of the masonry types. The MQI method describes the capacity of walls in contrasting different actions, evaluating the presence, partial presence, or absence of constructive features linked to the so-called “rule of the art”. The MQI method allows a robust estimation of Young’s modulus, compression strength and shear strength, using correlation diagrams obtai-ned through wide experimental analysis.

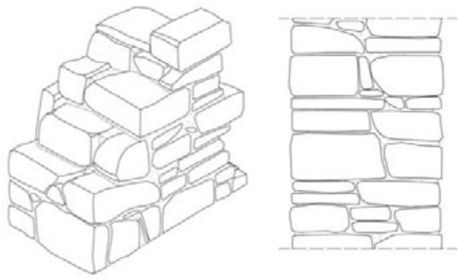

Fig. 5. Axonometric view and section of a M1 type masonry.

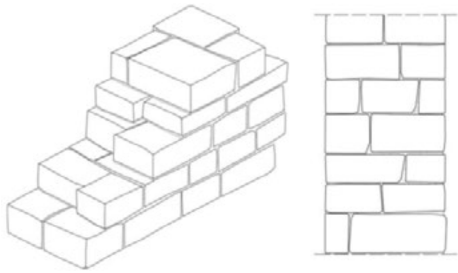

Fig. 6. Axonometric view and section of a M3 type masonry.

M1 masonry (Fig. 5) presents rough-hewn ashlars, of various shapes and sizes. The mortar is powdery, the bed joints are wide and the use of stone scales is not adequate to ensure sufficient adhesion between the elements. The horizontal nature of bed joints is partially respected, but the absence of headers and the insufficient staggering of vertical joints make the masonry uneven and susceptible to instability and disintegration. According to the MQI method, M1 masonry belongs to category C, that means inadequate behaviuor of the masonry, with 754-1082N/mm^2 Young’s modulus, 1.38-2.34N/mm^2 compression strength and 0.029-0.064N/mm^2 shear strength. M2 masonry belongs to a barn that has been well preserved over time and has no particular critical issues. The blocks are mostly squared in shape; the earth-based mortar is powdery and eroded in some areas but this critical issue is compensated by an efficient use of scales. The connection between the two faces of the wall is ensured by the presence of headers and the head joints are properly staggered. M2 masonry is classified as category B, that means an average quality behaviour of the masonry, with 1095-1559N/mm^2 Young's modulus, 2.20-3.57N/mm^2 compressive strength and 0.127-0.241N/mm^2 shear strength.

M3 masonry (Fig. 6) belongs to the church of Brento Sanico's village and is characterized by large square ashlars, with vertical joints properly staggered and continuous horizontal bed joints. he only parameter that is not perfectly respected concerns the mortar that, also in this case, retains its characteristic powdery consistency. The analysis leads to classifying this masonry in category A, with 2269-3184N/mm^2 Young's modulus, 5.49-8.15N/mm^2 compressive strength and 0.22-0.40N/mm^2 shear strength.

3.2. Analyses of the state of conservation of the buildings

In order to define a framework for the assessment of the state of conservation of the existent buildings, a series of parameters have been defined. Factors relating to the masonry (collapses, cracks, material degradation and weeds) and factors relating to floors and roofing floors (collapses and material degradation) have been evaluated. Through this process, five levels of damage have been defined and reported in form of a map: intact building; slightly damaged building; damaged building, severely damaged building and building in a state of ruin. The worst conditions, observed above all in Castiglioncello, are affected by the high degree of degradation and damage of the floor and roof structures: the horizontal structures, in fact, play a leading role in the box-like behaviour of the building. If these horizontal structures are missing or are compromised, the masonry 'box' tends to open and disintegrate.

3.3 Analysis of the main degradation phenomena and collapse mechanisms

The Apennine territory in which the three villages are located is a highly seismic area. For this reason, after the observation of the instabilities and the survey of construction features, the main mechanisms that may have been activated in buildings due to the seismic action have been hypothesized.

The most frequent collapse mechanisms are "first mode mechanisms" These are kinematic systems triggered in wall panels affected by orthogonal seismic actions which tend to produce the overturning (Fig. 7) (Avorio et al., 1999). These kinematic systems may occur in buildings where the lack of stable connections between walls and floors and between the wall panels themselves does not guarantee the establishment of an overall behaviour of the structure.

Fig. 7. Vertical bending and overturning mechanisms.

The buildings which present masonry with insufficient wall leaf connections primarily record instability and collapses linked to phenomena of simple overturning or horizontal bending, which manifests itself with the expulsion of material from the summit area of the wall and the detachment of cuneiform objects accompanied by the formation of oblique and vertical cylindrical hinges (Beolchini et al., 2005). Complex overturning mechanisms, generally affect, buildings that have vulnerable corners made with small stone elements: in these cases it is common that deep cracks are created at the edge of the building that are precursors to an upcoming overturning and disaggregation of the masonry.

Finally, the vertical bending mechanism has been detected at the level of doors and windows, which represent weak points in the masonry, appearing in the form of a horizontal cylindrical hinge that divides the wall into two blocks and is described by the reciprocal rotation of the same around this axis (Beolchini et al., 2005). The signals that reveal the activation of this mechanism are the bending and the out of plumb of the wall, the presence of horizontal and vertical cracks and the slippage of the floor beams.

3.4 Vulnerability Assessment

The analyses carried out on the state of conservation, on the structural system and the construction defects led to the assessment of the state of vulnerability of the buildings in the three villages. Vulnerability is obviously not only a function of seismic phenomena but is also strongly influenced by the action of atmospheric agents (wind, rain, snow, water infiltration,ect.), which, due to the state of abandonment and advanced degradation of many buildings, are decisive factors in the risk of collapse of buildings. The vulnerability assessment (Fig.8) was conducted on the basis of the following parameters: factors related to masonry (portions of non-connected walls, crack pattern, roof and floor belts, corners, presence of "waiting stones" at the edge of the building); factors related to floors and roofs (portions of non-connected floors, absence of floors and roofs) and factors related to the location of the architectural structure (proximity to buildings with high-risk levels); state of conservation of the building. The assignment of different values establishes a matrix through which it is possible to determine vulnerability levels, divided into four groups: low, average, high and very high. Low vulnerability characterised those buildings that do not present elements at risk of collapse; buildings that belong to the second category do not present serious deficiencies yet present a risk of collapse related in particular to their proximity to very vulnerable buildings; high vulnerability characterises buildings with parts in a heavy state of deterioration and structural weakness that can lead to a consequent instability of the entire wall box; finally, very high vulnerability concerns buildings presenting conditions where a strong instability of the masonry may lead to sudden collapses as a result of any external action.

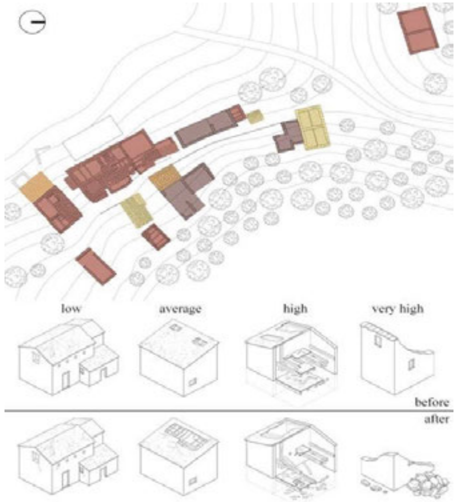

Fig. 8. Map of the vulnerability of buildings in Pratalecchia. Yellow: low vulnerability; orange: medium; red: high; brown: very high.

4. Identification of strategies for a sustainable regeneration

The identification of critical issues and the assessment of the quality of the construction elements was an essential step for determining intervention criteria for the rehabilitation of buildings, in ways that are as compatible as possible with the existing heritage. Based on the type of critical issue involved, intervention actions were determined, aimed at restoring the structural behaviour of the building and improving the anti-seismic and energy performances, by acting on the envelope without modifying the authenticity of the building. The proposed interventions involve the use of local materials or materials similar in terms of physical, mechanical and hygrometric characteristics to those already used.

In addition to the determination of intervention proposals, the authors conducted a reflection on a larger scale to define a plan of strategies to be used as the basis of guidelines for the sustainable regeneration of the cultural and environmental heritage of these places, that can be replicated to similar cases. The strategies aim at ensuring sustainable development based on culture and nature and have been identified starting from the three axes of sustainability: environmental, socio-cultural and socio-economic. Beginning from these strategies, some concrete proposals have been identified. A first proposal concerns the enhancement and strengthening of the network of paths to create new cultural itineraries, which connect these abandoned and mostly unknown contexts to the main places of interest and the most relevant hiking trails, so as to trigger processes of enhancement and knowledge of these territories. Another proposal concerns the activation of training activities, aimed at learning construction techniques and the recovery of stone masonry buildings, taking advantage of the possibility of having a site as an experimental training field, where workshops and internships for students, professionals, technicians, and owners, can be carried out.

5. Conclusions

The complex interdisciplinary analysis conducted on the three villages provides quite a clear picture of the characteristics, risks and potential of the built heritage of the villages of the upper Santerno valley. Considering the critical conditions that have emerged, with a state of advanced widespread degradation, the importance of intervening urgently is underlined, first of all by sharing guidelines for appropriate rehabilitation interventions and more broadly for a sustainable regeneration capable of respecting the delicate balance between environmental resources, built heritage and thesocio-economic and cultural context. Starting from the intervention criteria and the strategies identified, a series of specific actions could act as a driving force to trigger a process capable of increasing the attractiveness of places, in a perspective of sustainable development based on the cultural identity of the places, in full respect of the environmental context in which they are located.

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Learning from the past. The loss of vernacular heritage in the interest of hydropower development in Spain

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
The fact that water stored in reservoirs may be used for diverse purposes - hydroelectricity, irrigation or industrial use, human consumption, recreation, etc. - explains the widely spread policy of building these structures all over the world during the 20th century. However, dams and reservoirs building policies at those times in Spain led to the disappearance of many villages in rural regions due to the flooding of large areas and, as a result, the loss of vernacular architecture and local traditions was unavoidable. In this research, it is aimed to analyse the building of Ricobayo reservoir by the company Saltos del Duero together with its consequences for the affected communities and their heritage through the case of a particular village: La Pueblica, located in the province of Zamora in Castile and León, Spain. La Pueblica was a little and humble village, isolated from modern times, with 'unhygienic and meagre' facilities. During the land and housing expropriation process in La Pueblica, Fernando Lopez Heptener recorded some images of the village before its final devastation for the docu-mentary called Por Tierras de España (1933). Due to the subsequent interest in spreading the film, nowadays it is possible for us to recover the lost image of La Pueblica, the vernacular ar-chitecture within as well as the traditions which were carried out in those spaces. If the future of dams is linked to sustainable energy resources and developing countries as thought nowadays, previous positive – but also negative – experiences must be considered, since, despite all the prior benefits linked to water utilisation, building these engineering structures undoubtedly implies a direct social effect on the communities and heritage elements connected to them, which could be decisive to manage our cultural heritage nowadays.

Keywords: *flooded heritage; reservoir building; Ricobayo; Zamora.*

1. Introduction

Spain is a country rich in water resources, since there is a significant amount of water in its rivers compared to the countries around it (Fernández Rodríguez, 2021) and this fact explains that water utilisation in Spain dates back to the Romanization of Hispania (Molina Sánchez, 2015). However, fossil fuels were the most used supplies to produce electric energy in thermal power stations, from where energy was conveyed using direct current (Cayón García, 2002) until 1884. This year meant a change since it was when a new method to generate and transfer vast quantities of electricity to further distances (Espejo Marín, 2010) due to the use of hydroelectric plants, which could make the most of waterfalls and transfer the obtained energy through alternating current (Cayón García, 2002).

In addition, in terms of emerging state intervention, the 19th century was also a relevant period, especially due to the publication of two Water Laws in 1866 and 1879, where it was specified that the flowing waters in the country, except from the maritime, were under state control (Fernández Rodríguez, 2021). During the 1880s, particularly in 1883, another law that complemented the above mentioned was approved: the Irrigation Law, which meant a step forward for the government to control the building of diverse hydraulic works (Fernández Rodríguez, 2021).

Fig. 1. Caricature of Rafael Gasset published in the satirical magazine 'Gedeón' (Source: Joaquín Moya, 1900, Wikimedia Commons).

From this moment onwards, hydropower development in Spain was enabled and remarkably fostered by diverse state policies, being the most relevant: the National Plan of Hydraulic Exploitation or Gasset Plan (1902), the Law on hydraulic buildings for irrigation (1911) (Fernández Rodríguez, 2021), the creation of the Hydrographic Union Confederations (1926-1931) and the National Plan of Hydraulic Works (1933) (Mateu González, 2002).

Although all these points have already been studied, for instancem from the Engineering or the Economic History perspectives, in this paper – related to the R+I National Project 'Nuevos paisajes olvidados. Agua, patrimo-nio y territorio cultural' (Ref. PID2019-108932GBB-100) and funded by the Spanish Ministry of Science and Innovation, 2020-2024 –, it is aimed to delve into how the building of Esla dam and Ricobayo reservoir affected the cultural heritage linked to the flooded rural areas and the displaced communities.

To this end, it is intended to present the contrast between the actions carried out to preserve monuments in the area, such as San Pedro de la Nave, and the deliberate devastation of vernacular architecture, as happened in La Pueblica, on the assumption that the forced expropriation and consequent displacement to a new village was going to mean an improvement for its inhabitants. Ìn addition, it is possible for us to 'recover' the vernacular architecture in La Pueblica and the traditional crafts connected to it due to the documentary '*Por tierras de Zamora'*, recorded by Fernando López Heptener, which preserves somehow the memory of the lost community and the lost village.

2. Saltos del Duero and the building of Esla Dam and Ricobayo reservoir in Zamora, Spain

River Duero is one of the mightiest rivers in Spain, and this fact together with the land slants, turned it into a key resource for hydropower development, and the first person who became aware of this potential was Ferderico Cantero Villamil (Fernández Rodríguez, 2021).

Cantero Villamil was the first engineer that contemplated the possibility of taking advantage of the water resources of the Duero and presented a project for building a dam in order to provide different cities and villages in Castile and León with electricity already in 1898 (Redondo Quintela et al., 2011). This project was finally carried out and led to the building of San Román de los Infantes Dam, which started to work in 1902 (Redondo Quintela et al., 2011). A few years later, specifically in 1918, Cantero Villamil signed an agreement with Horacio Echevarrieta after which the company Saltos del Duero owned all the licenses for dam building granted to Cantero, except from the one regarding to San Román de los Infantes (Redondo Quintela et al., 2011).

On its part, Saltos del Duero was a hydroelectric company founded, precisely in 1918, by Eugenio Grasset and José Orbegazo, both engineers like Cantero Villamil, in collaboration with the entrepreneur Horacio Echevarrieta and the financial support of Bilbao Bank in 1918 (Díaz Morlán, 1998).

However, this company could not start its dam building works until 1929, when the first dam on river Esla, tributary of river Duero, and Ricobayo reservoir were promoted. The importance of this project is corroborated by the investments made between 1929 – with an investment of eight million *pesetas* (48.080,97€)–, and 1930, when the estimate was increased until reaching twenty-seven million *pesetas* (162.273,27€) (Díaz Morlán, 1998).

However, the expenses funded by Saltos del Duero were set aside not only for building works but also to compensate people whose properties were expropriated in order to be flooded. In fact, due to the company report for 1932, it is possible to know that a significant 75% of the owners accepted the compensations offered by the company and more than the 50% of required expropriations had been carried out by the same year (Saltos del Duero, 1933).

Fig. 2. Building works in Esla Dam, 1932 (Source: Saltos del Duero, 1933).

3. Monument vs. vernacular heritage preservation in the building of Ricobayo reservoir

The building of Ricobayo reservoir implied the complete flooding of three villages – Nave, La Pueblica and Palacios del Pan – and also affected other settlements, such as Losacino, Vide, Montamarta, San Vicente del Barco, Ricobayo, Muelas del Pan, Almendra and Carbajales partially (Fernández Rodríguez, 2021).

As it is widely known, at first, Heritage Theory was narrowly connected to monuments and ancient remains, but not to vernacular heritage (García Cuetos, 2011). In fact, it was not until 1989 that the 'Recommendation on the Safeguarding of Traditional Culture and Folklore' was confirmed in Paris (García Cuetos, 2011). Regarding vernacular architecture in particular, it was in 1999 when an specific document on this matter was devised, including its definition as well as its significance for humanity (García Cuetos, 2011).

This situation explains how, as described below, the the value attached to monuments and vernacular heritage was so different in the 1930s that, on the one hand, a new method of dismantling and remounting buildings was developed in order to preserve a monument, while rural villages and their vernacular architecture were completely devasted.

Fig. 3. The village of Nave prior to the flooding (Source: IPCE, Ministry of Culture and Sport of Spain. Archive Ruiz Vernacci. Signature: VN-38433).

3.1. A new method for safeguarding *San Pedro de la Nave*

The Visigoth church San Pedro de la Nave, considered National Monument since 1912, was located in a village called Nave, one of the villages that disappeared after the building of Ricobayo. Before the works started, a debate was established between those who argued that the church should be relocated – for instance, José Ramón Mélida and the Spanish Royal Academy of History – and those who thought that the reservoir should prevail (García Cuetos, 2019).

Finally, in the concession agreement for the works it was stipulated that San Pedro de la Nave had to be relocated in order to avoid the flooding and be preserved (Fernández Rodríguez, 2021).

The dismantling, relocation and remounting of this temple in El Campillo were managed by the architect Alejandro Ferrant, Manuel Gómez-Moreno, who was the Directorate of Fine Arts, and the archeologist Emilio Camps (Esteban and García, 2007) and meant one of the most relevant preservation highlights in Spain at the beginning of the 20th century. In addition, this situation was also considered a magnificent opportunity to study the building in depth – its constructive phases were analysed, and a proposal of its historical stratification and possible original layout was established (García Cuetos, 2019). – and also to restore it (Esteban & García).

To fulfil this complex and unprecedented endeavour a systematic method was developed. It consisted of elaborating preliminary studies in which every stone block was drawn and also numbered, so that it was possible to know their exact location depending on the building area, course and orientation variables (García Cuetos, 2019). Then, the dismantling, stone by stone, was carried out in two different stages from August 1930 to April 1931 (Esteban & García, 2007) and, after the relocation of the blocks in El Campillo, it was finally remounted and restored.

As aboved mentioned, this achievement was so remarkable that it was included in a documentary sponsored by Saltos del Duero, as the company was highly interested in documenting and registering the progress of the dam and the reservoir building and the actions related to it.

Fernando López Heptener, in charge of recording the images for the documentary *Por tierras de Zamora*, worked for Saltos del Duero while the company was building the reservoir. In fact, he had been hired in 1929 as draughtsman and topographer (Casquero, 2014) and he even oversaw expropriations of lands and housing located in areas to be flooded for the company (Cebrián, 1994).

However, *Por tierras de Zamora* does not only include images of the works in the dam and the reservoir, or pictures of noteworthy engineering structures, such as the bridge near Manzanal del Barco. López Heptener was also able to record how people lived in La Pueblica, one of the flooded villages before its disappearance.

4. *Por tierras de Zamora*: recovering la Pueblica

The above mentioned documentary together with the comparison between the filmed buildings and the already studied features of traditional architecture in Zamora can provide us with some information for recovering la Pueblica in some way. Of course, this method is not original. It has already been used for similar purposes, for instance, in the dissertation by Ana María Villanueva about the lost heritage after the building of Luna reservoir, also in Castile and León (Villanueva, 2013).

The already mentioned *Por tierras de Zamora,* which was publicly released in 1933, constitutes a source that provides us with visual information regarding la Pueblica, but it also contains narrated statements that turn it into a rather biased document. In this sense, it is impossible to forget that, at first, *Por tierras de Zamora* was conceived to be presented to investors, and that is the reason why every activity carried out by the company was praised in order to supposedly improve Spain and Spaniards lives.

In fact, it is interesting to compare the opposing statements regarding the safeguarding of San Pedro de la Nave and the description of La Pueblica. Although the venture to dismantle and remount the church built in the 7th century was praised – and maybe that is the reason why some images of the temple, already remounted and restored, are shown –, the images of la Pueblica are presented while the village is defined by the narrator as a settlement which was 'isolated from modern times', since it is said that it had not evolved with the times and technological advances. The houses and their rooms were defined as 'unhygienic' and 'meagre', while the lives of their inhabitants were described as 'miserable' and 'pitiful' (Fernández García, 2021).

In this way, and without being aware of the values of vernacular architecture, the subsequent devastation of the town after the flooding and the forced move of its inhabitants to a new village built by the company in Campeán meadow was justified in the film. This new settlement was named after the lost village and the new location, trying to preserve, in a certain way and through the toponymy, the identity of the neighbours who had agreed to move to the new and modern village.

Again on the question referred to the vernacular architecture registered in the documentary, the images taken before the flooding partially show a village where the architecture followed the traditional features in the area, the region of Aliste.

In the first place, it is possible to identify different buildings fitted in with those characteristics: two-floor houses, that maybe combined livestock and agriculture tasks (Morán & Rodríguez, 1992), as well as one-floor houses, which could be identified as the most humble (Jiménez Arqués, 1980). According to the characteristics of the popular housing in the region, we could venture that, next to the room for people and separated by a partition wall, there could have been another one, which would have had the function of stable (Jiménez Arqués, 1980).

Fig. 4. Vernacular architecture built in La Pueblica (Source: Caption from *Por tierras de Zamora* by Fernando López Heptener, min. 7:27. Restored version uploaded to YouTube platform).

Regarding the building materials, it is also possible to appreciate the use of wood, stone – possibly quartzite which is common in the area– and adobe in some cases (Morán and Rodríguez, 1992).

To roof the spaces, we are able to to identify slate slabs and tiles for housing as well as vegetable roofs, which could let us identify auxiliary buildings, such as the stables, since this kind of roof is still used currently (González et al., 2012).

Fig. 5. One-floor masonry buildings in la Pueblica (Source: Caption from *Por tierras de Zamora* by Fernando López Heptener, min. 7:51. Restored version uploaded to YouTube platform).

Furthermore, it is also feasible to recover the use of outer spaces, such as courtyards, or facilities like the well, which were narrowly linked to the community, their way of life, and the traditional trades and crafts in the village.

For instance, some of the pictures in the documentary portray the inhabitants, especially women, in their daily lives. In this sense, it is interesting to get to know how women used to gather in courtyards, spaces that were also connected to intangible heritage, such as the relevance of wool and linen culture in Castile and León (Fernández García, 2021).

Fig. 6. Women gathering in the courtyard preceding the house (Source: Caption from *Por tierras de Zamora* by Fernando López Heptener, min. 8:07. Restored version uploaded to YouTube platform).

5. Conclusions

The building of Esla dam and Ricobayo res-ervoir is one of the first and most interesting experiencies in Spain regarding the impact caused by hydropower policies on our cultur-al heritage in the 20th century.

Nevertheless, except from the outstanding case of San Pedro de la Nave and the development of a pioneer and also rigurous methodology, the devastation caused by the flooding meant the loss of many villages and the vernacular archictures built in them, since the relevance of these cultural manifestations and their values had not been established by those times.

Currently, the context we live in is not the same, as the importance of traditional and popular heritage in general, as well as vernacular architecture – together with the trades and techniques connected to it – have been taken into account since the 1980s and the 1990s, when this matter was especifically included in international recommendations and, consequently, affected the way this heritage is understood.

Nevertheless, in the 21st century, we are facing diverse challenges regarding, for example, the use of sustainable energy resources, and hydropower industry could be considered an appropiate way of obtaining that green energy.

That is the reason why getting to know previous experiences is important for future projects, no matter the country or area they are designed for. Dams and reservoirs do not only impact on the physical environmet. Their building also implies a direct and strong social effect on cultural heritage and, as a result, on the communities that may lose their memory and identity, materialised in their cultural heritage and traditions, that should be preserved as far as possible.

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Post seismic intervention strategies over the last fifty years in Italy (1968 – 2016). Initial observations about the vernacular architecture's conservation

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Topic: T4.4 Management and maintenance of vernacular architecture

Abstract

The numerous reconstruction experiences after the great earthquakes occurred in Italy during the last fifty years (Sicily, 1968 – central Italy, 2016) have given way to a great improvement of the Italian post-seismic emergency management and differ from each other by their results in terms of degree of conservation of the pre-existent buildings. Through the summary analysis of the legislation adopted for the reconstruction process after the Belice (1968) and Friuli (1976) earthquakes, this contribution aims at investigating the peculiarities of the different intervention strategies adopted for the conservation of the traditional masonry buildings and the historical built landscape – to which they belong – recognised as the essential component of the Italian cultural heritage. Specifically, the 1968 and 1976 earthquakes provided an opportunity to enhance the cultural debate on the approach to the towns destroyed by seismic events and initiated an ongoing process which progressively moved towards an increasing recognition of the vernacular architecture's value.

Keywords: *post-seismic reconstruction; italian earthquakes; masonry; vernacular architecture.*

1. Introduction

Over the course of the last fifty years the earthquakes that struck Italy – starting with the 1968 earthquake in the Belice Valley, the first major seismic event after the two world conflicts, which launched a debate and an experimentation process still in place today – have produced a remarkable evolution in practices for the seismic emergency's management and the structural reinforcement of the damaged heritage.

This essay focuses on some of the early results of a major research[1] aimed at deepening the reconstruction models of nine earthquakes occurred in those fifty years; specifically, it addresses the post-seismic reconstruction strategies adopted after the events of 1968 (Belice valley) and 1976 (Friuli – Venezia Giulia), for which the current state of the research allows us to formulate some preliminary reflections. In this respect, the study of the reference regulations here proposed is functional to underline how these seismic events – although they occurred a few years away from each other – were distinguished by very different reconstruction programs, at least as regards the existent-built heritage's conservation. For these reasons, both the analysis of the reconstruction experiences and the specific actions aimed at the physical rebuilding of the damaged heritage allow us to highlight a wide range of intervention strategies within which it is possible to recognise the stages of an evolutionary process, related to the way of facing the conservation of the vernacular architecture.

1 Current PhD research project of the author, "Conservation of the historical built heritage and post-seismic reconstruction activities in Italy (1968-2016)", Department of Civil Engineering and Architecture, University of Catania.

2. Post-seismic reconstruction experiences and the traditional residential architecture's conservation. Research methodology

The earthquakes studied in the main research have been selected on the basis of some characteristics recognised as especially significant: earthquake intensity, consequences on the affected areas (in terms of impact on both population and existent built heritage), social and institutional response and incentives for the evolution of scientific and cultural debate over the built heritage conservation (and the related intervention methodologies).

After examining the data – presented in table 1 – related to the seismic effects on the anthropic system, the research has been addressed to define a method for analyzing the results of the concurrent reconstruction intervention[2].
Just as the occurrence of an earthquake produces widespread effects concerning both the architectural heritage and the social and economical life of entire communities – thus requiring a multidisciplinary approach – the study of the post-seismic reconstruction processes needs to take into account the influence of the territorial, economic, social and cultural-historical context. In order to face this complexity from the point of view of the built heritage conservation, three areas of study – described below – have been identified to define a basic cognitive framework.

The first field concerns the norms issued to guide the emergency management and to define the intervention strategies for the damaged architectural heritage. This kind of analysis clarifies the reconstruction program's general orientation as well as further essential factors for the definitions of its outcomes, such as the organisation of administrative competences and economic intervention for the reconstruction of private homes.

	Magnitude (Me/Mw)	Macrosei-smic inten-sity (MCS)	Affected area (kmq)	Population affected	Number of victims	Displaced people	Depopulation phenomenons	Damaged buildings
Valle del Belice, **1968**	6,5	10	1,100 (most affected area)	96,951 *	231	70,000*	12,000	20,600 (in 14 most affected
Friuli – Venezia Giulia, **1976**	6,4	9-10	900 (most affected area)	255,950 *	978	66,000 (52,454) *	-	
Valnerina, **1979**	5,9	7			5		-	5,000 (most affected area)
Irpinia, **1980**	6,9	10	2,300 (estimated)	870,000 *	2,735	394,000 (219,726) *	32,000	832,578 (whole reconstruction
Sicilia Orientale, **1990**	5,4	7-8			18	10,000	-	7,104 (inagibili)
Umbria – Marche, **1997**	5,8	8-9	350 (estimated)		11	32,000		80,000
Abruzzo, **2009**	5,9	9-10	600 (estimated)		309	60,000		15,000
Emilia – Romagna, **2012**	5,9	7-8			27	19,000		16,000
Centro Italia, **2016**	6,6	10-11			333	40,000		200,000 (whole reconstruction

Table 1. First earthquakes' characterization. The light-blue cells contain data derived directly from the CFTI5Med (online catalogue of strong earthquakes in Italy and in the Mediterranean area). The asterisk states data descending from the same bibliographical reference.

2 It is worth clarifying that the generic expression "post-seismic reconstruction" refers, in this context, to the heterogeneous series of strategies and intervention practices realised to overcome the emergency state and relaunch the affected communities' life; therefore it includes, as far as the specific aims of this contribution are concerned, both the reconstruction of the destroyed structures and the repairing of the damaged ones.

The simultaneous study of the coeval technical standards – with special reference to the intervention techniques on historic masonry buildings – allows us to understand if the operating practices describe an improving process concerning the historical masonry buildings' conservation.

The second field of study refers to an in-depth analysis of the instruments adopted in the aftermath of the seismic event for the description and evaluation of the damage.

The use of survey forms provides a useful general framework for defining the architectural heritage's level of damage and can be considered the basis of the reconstruction program itself, identifying the actions' priority orders. Survey forms were first used in a systematic way during the 1976 earthquake and from that moment on were progressively implemented in their composition and purposes. The analysis of their evolution, with special reference to the sections dedicated to the masonry buildings, can be considered as a mean to read, from another point of view, the different stages which marked out the progression of studies on the traditional buildings' seismic vulnerability.

The last area of study examines the scientific and cultural background within which both the themes addressed in the previous fields were developed.

3. Towns' relocation practices: the earthquake of Belice valley (1968)

The framework of actions taken after the 1968 earthquake showed, since the very beginning of the emergency management, a strategy based on the abandonment of the damaged built heritage: three weeks after the mainshock (on January 14), Law no.79/68[3] provided for the instructions to identify the damaged centres which had to be transferred. The immediacy that distinguished the choices on the delocalisation of the most damaged towns clarified the cultural opinion of a country which, in full building development, identified the new building as the best strategy for the reconstruction needs in a territorial reality, the one of Western Sicily, affected by long years of economic recession[4]. In this sense, the earthquake is supposed to encourage intervention coherent with the building renovation taking place in that period.

Based on this context was the belief of a necessary abandonment – regardless of the level of seismic damage – of the entire Belice Valley's rural towns, made up of traditional buildings believed unhealthy and, after the earthquake, unsafe too. In the year following the seismic event all fourteen towns mostly damaged were subjected to partial or total transfer.

The relocation of towns represents, among the emergency management's strategies, the most extreme action since every possibility of conservation of the existent identity is denied. In this sense, it is quite surprising the Belice Valley's reconstruction appeared to take no account of the cultural orientation defined by the post-war reconstruction programs (RP) which, in fact, represented the legislative basis for the post-seismic ones[5]. As a matter of fact, the RP proposed the recovery and the conservation of the architectural environment as some of the reconstruction's main goals, recognising their role in rebuilding the communities' identity compromised by the devastation of war.

Poggioreale was one of the Belice valley's town to be subjected to total relocation. This case is very representative of practices which were

3 Law no. 79 of 27 February 1968, *Further measures for reconstruction and economic recovery of cities affected by the earthquake in January 1968*.

4 Law no. 717 of 26 June 1965, *Regulation on the development measures for the south of Italy*. This regulation aimed at encouraging and facilitating the location and the expansion of social and productive activities in the southern regions of Italy.

5 Law no. 1402 of 27 October 1951, *Amendment to the legislative decree no. 154 of 1 March 1945 on reconstruction plans for towns damaged by the war*" is considered the major post-war reconstruction law.

Fig. 1. The old town of Poggioreale (Source: Macca, 2022).

leaded by precise development ideas rather than by the actual level of damage; even today, the ancient town of Poggiorale shows a quality of preservation that little corresponds to the description which was provided for the town in the aftermath of the seismic event. If the expression "total destruction"[6] was indeed exact with reference to other centres subjected to total relocation, it could be hardly considered acceptable for Poggioreale[7].

As shown in the pictures (Fig. 1) the old town – almost entirely made up of masonry buildings – shows very limited cases of total collapse and although partial collapses on the top of the masonry walls are very widespread, floors are quite often still in place. From the observation of the walls' sections, it is possible to recognise the good quality of the masonry assembly; the presence of a relevant local building expertise is also underlined by a high-level aesthetic value in many architectural elements. So, it might be stated that the good quality of Poggioreale's local building traditions would have played a role – even a partial one – in the minor level of damage with respect to the other towns of the seismic crater. Representing a place in which time seems to stand still, the old town of Poggioreale represents an absolutely charming location; nevertheless, in the absence of valorisation's perspectives, the historical settlement is destined to progressively disappear. The attempt of repair a bond traumatically interrupted after the relocation practice could ultimately benefit the new Poggioreale too, built three kilometres from the ancient city and today largely uninhabited[8] and characterised by a poor urban quality.

4. In-place reconstruction and repair of damaged architectural heritage. The Friuli's experience.

Few days after the first major quake on the 6th May, an appeal[9] by a group of local intellectuals

6 This expression belongs to the report realised by the regional Civile Engineering Office which was assigned of surveys' operations in the damaged town after the earthquake, in M. De Panfilis, L. Marcelli, Il periodo sismico della Sicilia occidentale iniziato il 14 gennaio 1968, "Annali di Geofisica", 1968, pp. 375-378.

7 Poggioreale, Montevago, Gibellina and Salaparuta were the four towns subjected to total relocation, according to the Decree of the President of the Republic of 30 May 1968, *Total relocation of the town of Montevago, Gibellina, Poggioreale and Salaparuta and partial relocation of S. Margherita di Belice, Partanna, Salemi, S. Ninfa and Vita in reliance on the earthquakes of Jenuray 1968*.

8 This also descended both from the abandonment caused by the earthquake and some subsequent debatable strategies for the displaced people' temporary accommodation.

9 *Our Manifest*, published on 12 May 1976 on the regional journal "Corriere del Friuli". The appeal was expressly published so that the "[…] experiences of Belice were not repeated, ceding to trends and interventions unrelated to the identity of places affected by the earthquake […] and so that architects, engineers […] contributed with the population to

expressed the common feeling of the local population who, perceiving the reconstruction experience in the Belice valley dangerously close, plainly opposed the relocation practices and proposed, instead, the recovery and the conservation of the existent architectural heritage. To this scope, the subsequent choice of the Italian government to proceed to the reconstruction process through a framework of subsidiarity[10] – thanks to the delegation of most of the administrative procedures to the region – was decisive and promoted a reconstruction model focused on the local realities' will and the popular participation. The reconstruction model in Friuli – Venezia Giulia was outlined as a process based on the faithful reconstruction of what had collapsed and on the anti-seismic restoration of what was damaged: the basic law of reconstruction stated that "the housing requirement [had to be] satisfied through the functional and static recovery of the existing buildings as a matter of priority" and that these intervention had to be implemented "ensuring the valorisation of the remaining historical built heritage to the great extent possible"[11].

Buildings belonging to the local masonry construction tradition suffered the greatest damage; in this regard, the technical standards (both the national ones, in force at the time, and those specifically formulated by the Region after the earthquake) on the regulation for repair practices on masonry buildings become even more significant to analyse the reconstruction process.

The national technical standard of reference for the reconstruction in Friuli[12] (Law no. 76/1974) contained some relevant guidelines for the historical built-heritage: actions provided by the previous standards[13] for the mitigation of seismic vulnerability in masonry buildings aimed at the removal of those architectural elements recognised – according to the acquired knowledge – as adversely affecting the masonry buildings' structural safety (cantilevered stone stairs, deteriorated wooden ceilings and load-bearing vaults). Thanks to a cultural process which gradually recognised the architectural value that often characterises these elements, Law no. 76/74 provided for a possible derogation on their demolition when it was required by "significant architectural instances"[14]. The law rather suggested some technical measures aimed at the removal of the elements' criticalities, such as the use of metal tie-rods to counteract the horizontal thrusts of vaults.

Even more interesting are the technical standards enacted by the region Friuli – Venezia Giulia and formulated by the specially formed Central Interdisciplinary Group (CIG)[15]. Among the others, two specific technical documents deserve to be deepened. The technical document no.2 (DT2, Recommendations for masonry buildings' structural repair) was the result of a thorough literature search on repair works carried out up to that point – in Italy and abroad – for masonry buildings; it represented the first collection of technical addresses for structural strengthening of masonry buildings. The technical document no.8 (DT8, Suggestions concerning repair works of buildings with environmental, historical, cultural and ethnic value and related to local architecture) gave a new attention to the safeguard of vernacular architecture, already expressed in the general reconstruction legislation: it underlined that the reconstruction process of Friuli intended to pur-

give Friuli its identity back, respecting the particular urban and architectural fabric that characterized it".

10 Law no. 546 of 8 August 1977, *Reconstruction of the areas belonging to Friuli-Venezia Giulia and Veneto regions affected by the 1976 earthquake*.

11 Article 1, Regional Law no. 30 of 20 June 1977, *Urgent measures to provide for housing needs of people affected by the earthquakes in May 1976.*

12 Law no. 76 of 2 February 1974, *Construction measures with particular provisions for seismic areas.*

13 Law no. 1684 of 25 November 1962, *Construction measures with particular provisions for seismic areas.*

14 Article 12, law no. 76 of 2 February 1974.

15 The publication of these technical documents was required by the article 8 of the Regional Law no. 30 of 20 June 1977.

Fig. 2. Venzone in the aftermath of the earthquake. The Town Hall and the view of ruins from the medieval walls (Source: http://www.impegnociviopervenzone.blogspot.com, accessed on 23 January 2022).

sue the aims of "[…] economic and social development […] defending the ethnic and cultural heritage of the population". This interest in conservation's themes was even more clear from the presentation – in the premises of the document itself – of the Venice Charter of 1964, identified as a valuable contribution to the statement of universally valid principles for the restoration of traditional masonry architecture.

Some general peculiarities of the technical interventions proposed by the CIG will be described in the following paragraph; what it is now useful to underline is the care given to the realisation, according to state-of-the-art methodologies and techniques, of legislations that tried to align themselves with a clear aim of safeguarding the damaged historic fabrics through the recovery of identity characteristics. The old town of Venzone represented one of the most relevant application's examples of the Friuli reconstruction model. Declared "National monument of great historical interest" in 1965, it was completely destroyed after the quake of the 6th May (Fig. 2). The historical-critical search which was launched to define the intervention criteria established a design method based on numerous intervention's strategies: the entirety of roads and public spaces was rebuilt following the exact configuration of the pre-earthquake state while the main monuments and the medieval walls were rebuilt by anastylosis.

With reference to the ordinary buildings, a more complicated intervention method was applied[16], strictly linked to the different features of the local traditional architecture. Thanks to a detailed buildings census, a deepen study of the building types and the analysis of the masonry's assembly, it was defined a reconstruction process based on the re-building under a regulated scheme (referred to building types and maximum height) and by means of modern building technologies.

5. The cultural debate of the 1980s: new perspectives for the approach to existent buildings

Although the features of technical measures proposed by the CIG can not be specifically addressed in this context, the reference to them is quite significant to introduce the terms of the scientific and cultural debate which took place over the intervention practices for masonry buildings in the eighties and which can be certainly considered at the basis of the actual cultural and technical awareness on the cultural heritage's seismic protection.

In July 1986 a circular of the Ministry of cultural and environmental heritage, titled "Interventions on monumental buildings in seismic area: recommendations" was published. Although it was specifically conceived for specialised buildings, the

16 This study was conducted by a working group guided by the architects F. Sartogo and G. Caniggia.

document – expressing overall concepts on the interaction of modern materials and techniques with masonry buildings – was a reference point for considerations on traditional residential buildings, too. The document, known as Ballardini's circular, was the result of the National Committee for Prevention of Cultural Heritage from the Seismic Risk's work; the research group was formed in 1984 when it became increasingly manifest how the technical knowledge available in the aftermath of the Friuli earthquake had been inadequate in facing the conservation's themes within the reconstruction process.

The circular made explicit reference to the practices suggested by the technical documents of CIG – and to the reconstrucion's legislation used after the 1980 earthquake, in Irpinia region, too – underlining a cultural, normative and technical lack of clarity with regard to the use of modern materials for masonry buildings' repair. The document suggested, instead, the use of "mainly traditional" methods.

The circular was the expression of a cultural background within which the traditional construction techniques were rediscovered and recognised as the starting point for the formulation of interventions consistent with the pre-existence, both from the technical and philological point of view.

The research activities carried out by the National Committee and by particularly sensitive scholars (Edoardo Benvenuto, Salvatore Di Pasquale, Antonino Giuffrè) were addressed to the use of a new study approach on the ancient fabrics' structural behaviour, "characterised by the complexity proper of masonry buildings, built with materials and methods which change across regions and historical periods"[17]. This approach can be recognised at the basis of the realisation of subsequent codes of practice for the historic building fabrics' conservation, thought in the nineties, which laid a foundation for technical aids most recently employed to repair buildings damaged by the earthquake.

6. Conclusions

The discreet presence of the state, the transferring of responsibility to Regions, popular participation and the main objective of repair and in-site reconstruction were the features of an organizational model, that of Friuli, to which was made reference in the subsequent reconstruction experiences: the earthquake of 1980 in Irpinia – Basilicata, the one occurred in 1997 in Umbria e Marche regions and the recent earthquake in 2012, in Emilia – Romagna. What we can ultimately underline is how, despite common basic criteria, the diverse reconstruction programs may differ substantially from each other; as an example, the reconstruction model used after the 1980 earthquake, which directly descended from the Friuli's one, had very poor results in terms of historical fabrics' conservation. This seems to be strictly linked to the complexity and variety of factors involved in the seismic events and the subsequent reconstruction: it has been underlined the importance assumed by population and intellectuals' standpoint after the 1976 earthquake. This also means that the modification process to which the different reconstruction models are progressively subjected is not defined by a proper "evolutionary" course; it may show, instead, setbacks and even backward steps from the point of view of the damaged heritage's conservation. However, it clearly appears that the conservation of cultural heritage, intended as the activity which aims at granting the fruition of future generations, acquires in the post-seismic experiences even more relevant value for the present ones, for its role in the possibility of recovering the sense of identification suspended by the earthquake traumatic experience.

17 G. Carbonara, introduction to *Linee guida per la valutazione e riduzione del rischio sismico del patrimonio culturale*, coord. Laura Moro. Gangemi Ed., Roma (2006).

In a similar way, the parallel upgrade path of technical standards and cultural standing represents a process still in place.

The post seismic reconstruction of Friuli represents, as well, a turning point for a cultural and technical approach, the actual one, which aims at considering together the history of building construction and the technical expertise.

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Close to the volcan. Knowledge, conservation and enhancement of a Vesuvian vernacular heritage

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
In the area surrounding the slopes of the volcano, a historical network of rural architecture created by the known fertility of the Vesuvian soil can be identified. The terrain, rich in minerals due to the pyroclastic nature of the site, has since Roman times favoured the construction of agricultural structures, more or less concentrated in areas where the impervious nature of the soil allowed a profitable settlement for cultivation. The network of such examples of vernacular architecture, located within the boundaries of the Vesuvius National Park, is still visible today, albeit fragmented and in a state of abandonment. An ongoing research has made it possible to carry out an initial rigorous survey. These buildings are expression of distribution criteria in line with their function and represent the close relationship between settlement typology and territory. This peculiarity is strongly reflected in the constructive techniques and also represents the material evidence of a particular building savoir-faire passed down through the centuries. Materials taken from the site (e.g. lavas, lava foam, lapilli, pumice, etc.) are used and although there is no accurate quarrying of the stone, there is the technique 'a cantieri' with a strong mortar as a binder. The typology is diversified: from the small presidio to the building arranged on two levels, sometimes turreted, depending on the production and cultivation commitment. Unlike the traditional farms (masserie) located further down the valley, which have already been the subject of a considerable historiography, these cases of rural architecture located further up the slope have never been the subject of systematic survey. The contribution aims to focus on this almost unpublished heritage and to illustrate a methodology of integrated knowledge linked to the peculiarities of the volcanic site. The conservation of these vernacular architectures, in fact, plays a central role in the reading and understanding of the multidimensional values of the Vesuvius-Bay of Naples cultural landscape.

Keywords: *Vesuvian vernacular architecture; rural landscape; constructive rural techniques; Vesuvius National Park.*

1. Introduction: identifying the investigation area

The dispersed historical fabric of rural architecture, still visible today in the landscape of the Bay of Naples, represents the tangible relationship between the complex natural volcanic context and the anthropic action that has stratified over the centuries. The coastal area, with the islands of the Gulf, together with the volcanic systems of the Campi Flegrei and Somma-Vesuvio, compose a geo-historical territory in which the vernacular heritage, despite the strong conurbation of the areas, is still recognisable, albeit with some variations and in association with the particular contexts in which the rural settlements themselves developed. It is therefore a heritage that lets us read in the urban and natural fabric, a sort of patrimonial 'framework' that expresses the historical relationship between productive activities and the territory with strong volcanic connotation[1]. These areas are universally known, even before the Roman colonization, to be fertile, as evidenced by the presence of pseudo-urban villas in the suburban parts of archaeological Pompeii and surrounding areas[2], indicating an important development of profitable agricultural activities. The repeated eruptions[3] and the mantle of pyroclastic material stratified over the centuries have determined the peculiar Vesuvian agricultural fertility, which is at the origin of the socio-economic events of the foothills surrounding Somma-Vesuvius. These testimonies of material culture present some variations in typology and sometimes in construction, so that their morphology and the materials used fully reflect the geological nature of the site where they are located. Several studies, which have become the main reference in this field, have deepened the knowledge of the rural heritage of Campania and have focused over the years on some specific areas, investigating certain topics in depth[4]. The present contribution, the result of a research in progress, focuses instead on a scarcely investigated area in which there is a network of buildings, in some ways unprecedented, with precise peculiarities given the impervious articulation of the soil and the state of abandonment of the single architecture. The aim of the research is to identify them precisely, to examine the specific features of their construction and their current criticalities, as part of a broader comparative study of the traditional rural constructions that have already been studied and fall within the same macro-area.

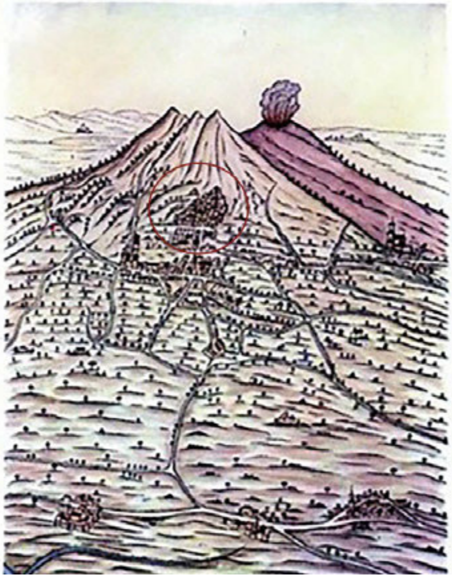

Fig. 1. *Somma e contorni* (XVII century, Archivio di Stato di Napoli). This view shows the Northern part of the volcanic site and the Monte Somma ridge with the scattering of buildings in the agricultural context. Study area circled in red.

The residual rural heritage of the Somma-Vesuvius volcanic system consists of a series of scattered buildings that have resisted both repeated eruptions and abandonment as a result of frequently unauthorised urbanisation processes, which since the 1950s have de facto decimated the cultivated areas. With respect to this area,

[1] See the cartographic documentation of the Piano Paesaggistico Regionale, with particular reference to cartography GD22_l; for the many aspects of the Bay of Naples cultural landscape, see the text edited by A. Aveta, B. G. Marino e R. Amore*, La Baia di Napoli. Strategie integrate per la conservazione e la fruizione del paesaggio culturale*, artstudio paparo, Napoli 2017, voll. I-II.

[2] Marino B.G., *La Villa di Diomede: restauri e ritrovamenti tra le muraglie di una casa pseudourbana*, in Greco G., Osanna M., Picone R. (a cura di), *Pompei: insula occidentali. Conoscenza, scavo, restauro e valorizzazione*, L'Erma di Bretschneider, Roma 2020, pp. 415-420.

[3] Among the eruptions of the 20th century, the most incisive for the northern Vesuvian area was that of 1906. See Siniscalco C., *Istoria del Vesuvio e del Monte Somma con la descrizione delle principali eruzioni vesuviane dall'anno 79 e.v. fino alle recenti*, Tip. della R. Accademia delle scienze, Napoli 1890.

[4] See: Cennamo M. *et al.*, *Le masserie circumvesuviane. Tradizione e innovazione nell'Architettura Rurale*, Fiorentino Art & Book, Benevento 2006; Gravagnuolo B., *Architettura rurale e casali in Campania*, Clean, Napoli 1994; Fondi M., Franciosa L. et al., *La Casa rurale della Campania*, Olschki, Firenze 1984; Pane R., *Campania. La casa e l'albero*, Montanino, Napoli 1961; Pane R., *Architettura rurale campana: con 53 disegni dell'autore*, Rinascimento del libro, Firenze 1936.

which concerns the area closest to the slopes of the volcano, the survey focuses on the settlements on the Monte Somma ridge (Fig. 1), the oldest volcano that gave rise to the best known, Vesuvius. In fact, it is precisely in this area that we find specific features that are of great importance for the typology of constructive technique, for the interconnection with the agro-agricultural aspects and, not least, for the characterisation of a landscape that is the object of potential enhancement processes.

2. Specificity of a singular heritage: settlement aspects

The buildings examined are located within the administrative boundaries of the municipality of Somma Vesuviana[5], as well as in an area included in the Vesuvius National Park[6]. More precisely, our investigation area is located between the general oriented reserve (zone B) and the protection area (zone C), occupying the northern sector[7]. The territory here is characterised by significant transformations and alterations, but also by the presence of cultivated areas interspersed with long natural riverbeds (*alvei*) created by the outflow of volcanic lava which descending from the summit of the mountain with a steep slope reach the plain below, causing hydrogeological problems[8]. Numerous disused rural buildings are scattered along the furrow of the riverbeds, which are connected by inter-country paths (Fig. 2). In addition to the consistent slope of the mountainside, there is dense vegetation in some places - which differentiates this area significantly from the southern area on the slopes of Vesuvius - to which is added a repeated lack of maintenance of the paths, making it difficult to reach the rural presidia, which in many cases are unknown even to the inhabitants of the area.

This circumstance also makes it difficult to georeference the buildings, and the plans of the authorities responsible for governing the territory (Vesuvius National Park and some municipal urban plans) do not indicate their presence. This lacuna is being remedied by integrating historical plans, georeferenced maps and localisation by means of drone surveys which, as can easily be deduced, provide data to be interpolated and verified due to the dense vegetation present.

Fig. 2. *Carta Topografica e Idrografica dei contorni di Napoli* (1817-1819). In this detail are indicated the fortified houses Fasano, Franci/Casillo and Scozio (Source: Nucleo Bibliotecario di Geografia, Università degli Studi di Napoli Federico II; graphic elaboration by Ragosta, 2022).

However, the presence of rural buildings is reported in some historical maps: in the *Carta Topografica e Idrografica dei contorni di Napoli* (1818-1819)[9] and in those of the Military

[5] For some historical information on Somma Vesuviana, see: Angrisani A., *Brevi notizie storiche e demo-grafiche intorno alla città di Somma Vesuviana con la bibliografia, cronologia, documenti, tavole geografiche ed illustrazioni*, Barca Ed., Napoli 1928.

[6] The Vesuvius National Park has been instituted with D.P.R. of June 5th 1995. Besides Somma Vesuviana's territory it includes areas of twelve other municipalities: Ercolano, Torre del Greco, Trecase, Boscoreale, Boscotrecase, Terzigno, San Giuseppe Vesuviano, Sant'Anastasia, Ottaviano, Pollena Trocchia, Massa di Somma, San Sebastiano al Vesuvio.

[7] Cfr.https://www.mite.gov.it/sites/default/files/archivio/normativa/piano_parco_nazionale_vesuvio2010.pdf Vesuvius National Park Plan – NTA

[8] Simonetti R., *La bonifica e la sistemazione idraulica dei torrenti di Somma e Vesuvio*, Stabilimento Tipo-Litografico del Genio Civile, Roma 1912, p. 4; Cocozza G., *I torrenti del Somma*, in «Summana», n°16, Marigliano, settembre 1989.

[9] *Carta topografica ed idrografica dei contorni di Napoli*, raised by order of HM Ferdinand I, King of the Kingdom of the Two Sicilies, by the Officers of the General Staff and by the Topographical

Geographical Institute dating back to the beginning of the last century, we can identify edifices and toponyms such as "masserie", "torrette" or more simply "case".

The studies conducted on historical rural architecture, as mentioned above - apart from the fundamental work of Benedetto Gravagnuolo, which has opened up the field to very interesting homogeneous geographical groupings[10] - concern only certain geographical areas, and are generally oriented towards emphasising the typological aspect. In our case, therefore, the difficulty resides precisely in the absence of previous studies and specific bibliographical references: the limited research carried out at local level, of considerable usefulness, is therefore being supplemented with the collection of oral sources, to be cross-referenced with anthropological data and data relating to human geography and, in parallel, with those relating to building techniques and local materials, in order to obtain an adequate basis for comparative analysis, in order to achieve a greater degree of knowledge. In other words, from the point of view of method, we are aware that we are carrying out one of the «limitati “sondaggi” in un terreno ancora in larga parte da esplorare»[11], we are mapping data that could be considered homogeneous.

An early characterisation is that of the altitude of these 'mountain' rural settlements: shapes, dimensions and chromatic aspects are direct expressions of this particular landscape and its geology, distinguishing these buildings substantially from the large farms located on the lowlands. In fact, the latter, situated in the area further down the valley, are developed according to wider and more complex architectural solutions: the rooms were used not only for the residence and preservation of the products, but also for their processing, with a planimetric layout generally in the form of a courtyard, occupying with the different rooms a rather large surface area, sometimes distinct between the production area and the living area[12] (Fig. 3).

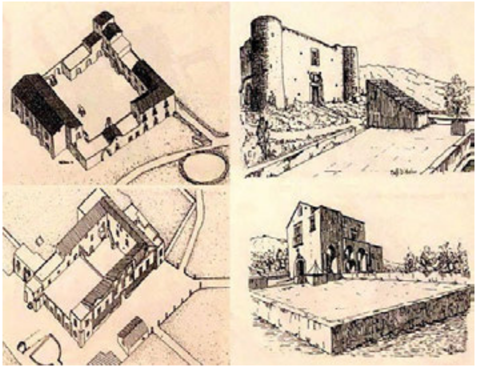

Fig. 3. Compositional schemas of two examples of masseria in the valley area and of the Scozio and Casillo fortified houses located in the upper area (Source: D'Avino, «Summana», n°64, p. 7).

The common feature of the rural buildings on the ridge of Monte Somma is a more compact and simplified shape, with a prevalent vertical development and exclusive use of lava material[13]. Moreover, the corners are often characterized by turreted elements, sometimes used for the insertion of the staircase[14].

The function of these garrisons was generally that of the momentary conservation of the products collected, without prejudice to the residential function, more or less continuous[15].

Engineers in the years 1817, 1818, 1819, drawn and engraved in the Topographical Office of Naples. Tavv. n 15. scale: 1: 25,000.

[10] See Gravagnuolo B., *op. cit.*

[11] Gravagnuolo B., *op. cit.*, p. 9.

[12] D’Avino R., *Le masserie di Somma. Parte I: l’area orientale*, in «Quaderni Vesuviani», n°23, San Giorgio a Cremano, 1994.

[13] This is what emerges from direct observation. For the classification of these types of rural buildings cfr. Gravagnuolo B., *op. cit*., p. 15.

[14] D’Avino R., *Le “torrette” sulla dorsale del monte nel comune di Somma Vesuviana*, in «Summana», n°46, Somma Vesuviana, settembre 1999, p. 2.

[15] *Ibidem*.

3. «Masserie», «torrette» and «case»

Leaving aside a series of tower-houses and small constructions, reference will now be made to three buildings near the Ammendolara alveo. Visible also in the above-mentioned *Carta topografica e idrografica dei contorni di Napoli*, they correspond to the farms Fasano, Casillo and Scozio. These are located at different quotas and are concentrated in a more easily accessible area[16]. All of them are articulated on two levels to which is added the attic, a ventilated space with the function of drying the products of the earth[17]. The interior spaces of the levels below are small and essential, obviously aimed at a shelter for products, livestock and accommodation of settlers in a temporary manner. On the ground floor are developed functional spaces for agricultural activity, upstairs residences. Outside, in the areas of relevance, are still preserved several attached farm buildings - small in size - and other small structures, including spaces dedicated to the oven and the threshing floor, sometimes fenced. The first farmhouse that one encounters near the Ammendolara alveo is the Fasano (Fig. 4); it is a building of considerable dimensions, still close to the Sommese inhabited area. Its planimetric configuration is rectangular, with two levels and an attic with a single-pitch roof. In the corner between the north and east facades there is a slightly scarped turreted element, currently in precarious conditions. The main entrance (Fig. 5) is visible on the western façade, in which there are two access passages, to which correspond three openings on the upper levels: two on the first level and one in the attic. The masseria Casillo (Fig. 6) has an almost similar planimetric development, to which a rectangular body is attached; here the main front still preserves one of the two angular towers, which symmetrically defined the prospectus, at the center of which there is the main access, a rectangular space in correspondence of which, at the upper level a window opens up. Above the access room there is a frame in which an epigraph[18] attested the importance of these buildings in the framework of the productive organization of the nobility settled in the surroundings of Naples since the 17th century, with an increase of their presence in the Vesuvian area after the realization of the Royal Palace of Portici.

Fig. 4. Fortified house Fasano. View of the Western front with the two entries and the three windows (Source: Ragosta, 2022).

The Casillo fortified house, which visibly respects from a distributive point of view the differentiation of functions between the ground floor and the upper floor, is still surrounded by a series of smaller rural buildings.

Fig. 5. Fortified house Fasano, detail of the access to ground floor: note the masonry construction ‘a cantieri’ and the flattening surface of the masonry section using brick elements (Source: Ragosta, 2022).

[16] In the territory of Somma Vesuviana there are also other turreted buildings, among which are mentioned the Di Lorenzo turret, the Raia turret, the Cassano turret and the D'Avino turret. Ivi, pp. 4-8.

[17] Ivi, p. 2.

[18] D'Avino refers to what was written in the epigraphic engraving, also denouncing its theft. Cfr. ivi, p. 4.

A peculiarity is represented by the perimeter of the farmyard, which follows the shapes and sizes of pre-existing underground spaces, which some hypotheses date back to Roman times: these are barrel-vaulted cellars, reused with the same function[19].

Finally, the fortified masseria Scozio (fig. 6), also with a rectangular plan, presents the entrance to the lower spaces on one of the two short sides, while the staircase, which leads to the upper floor with a large terrace, is grafted onto the northern facade. This is also surrounded by some small structures, among which one presents an interesting case of barrel-vaulted extrados coverage, hardly found along this side of Somma-Vesuvius. From the point of view of building techniques, the first remark that can be made is that in these three buildings there is almost no tuff, a stone which is widely used for the walls of the farms in the valley. The tuff is in fact used exclusively in the piers, in the setting of the windows and the arches of the vaulted rooms. The ribbed vaults are made of concretionary structure with small lava stone and mortar (Fig. 7).

Fig. 6. View of the fortified house Scozio; we can note here the presence of a terrace facing cultivated fields (Source: Ragosta, 2022)

The availability of volcanic material on site and the evident difference between the buildings in the valley and those in the mountains, the former reserved for a more comfortable stay, the latter almost as a support to the former in the agricultural and productive process, in line with a more sober morphology, is reflected in the wall fabric.

Fig. 7. Fortified house Fasano. Particular detail of the vaulting ceiling with mortar and small lava stone and arches in tuff (‘spaccatelle’) (Source: Ragosta, 2022).

“Scardoni” and “scheggioni”[20] (Fig. 8) alternated with lavas and “ferrugine”, irregular and of different sizes, bound by a tenacious mortar, characterize the masonry texture, which is built in the form *'a cantieri'* of which it is possible to recognize, in some places, the levelling surface with brick or stone elements of small thickness. Even if in the masonry structure there aren't visible any crossing stones, it is possible to catch a glimpse of a good graft between the stone elements. In some parts the covering plaster is still present, composed of lime and inerts of various naturally volcanic grain, while the floors, made of chestnut wood - essence still present in the area in the highest part of Monte Somma - reflect the traditional building composition with main non squared beams and secondary

[19] In these hypogeal environments is testified the presence of mosaic flooring made of white limestone tiles. Cfr. *ibidem*.

[20] The stone masonry masters used to differentiate the two stones, using the term "scardone" to indicate the spheroidal stone components and the term "scheggione" to indicate those with the thinner and sharper end. Cfr: Califano L., *Poche riflessioni interessanti circa l'uso delle pomici vulcaniche nelle fabbriche*, Tip. all'Insegna del Diogene, Napoli 1851; Ragucci L., *Principj di pratica di architettura : ne' quali si espongono un'idea di descrizione di fabbricati, otto esemplari di misure per altrettante arti diverse e un dizionario de' vocaboli tecnici piu in uso presso i nostri artefici*, Stamperia del cattolico di Francesco e Gennaro De Angelis, Napoli 1859; Di Stefano R., *Edilizia: elementi costruttivi e norme tecniche*, L'Arte tipografica editrice, Napoli 1967; Aveta A., *Materiali e tecniche tradizionali nel napoletano. Note per il restauro architettonico*, L’Arte Tipografica editrice, Napoli 1987; Cennamo M. et al., *op. cit.*

planking with the "panconcelli" or "chiancarelle"[21] with lime and volcanic inerts (Fig. 9). The covering structures, as we can see, have a double pitch, supported by wooden trusses of simple palladian type and with a mantle of brick tiles. Rare are the cases of vaulted roofs extrados in beaten lapillus[22].

Fig. 8. Fortified house Casillo. Detail of the tower on the southern side. The wall structure is also visible here, with irregular stone elements of different shapes and the use of abundant mortar (Source: Ragosta, 2022).

Fig. 9. Fortified house Casillo. Wooden ceiling with chestnut beams and second-arybeams ('chiancarelle') and flooring stratigraphy (Source: Ragosta, 2022).

3. Conclusions

The state of preservation of these buildings is quite critical for both structures and finishes. The roofs are affected by partial or in some cases total collapses, following the eruptions of Vesuvius and the earthquake of 1980. The intermediate floors present almost total collapsing, except for the case of the masseria Casillo, and the turrets of the masserie Fasano and Scozio, as mentioned, present important crashes. Some buildings have been abandoned for years, others are still used as storage of agricultural tools for cultivation. The lack of awareness of the presence and the value of the rural heritage of the Somma's mountain is gradually leading to the disappearance of a significant and unique heritage of the material culture of Campania. The first steps of the research document the importance of a rich rural building heritage of particular historical-architectural but also anthropological significance. In its remainingness, it constitutes a material trace of that micro-history, resulting from social, political and productive dynamics, which have occurred over the centuries in the shadow of Vesuvius.

The international guidelines that define rural landscapes as dynamic systems, repositories of methods, techniques and traditional knowledge emphasize the need to link the criteria for action to the understanding, protection, sustainable management and transmission of rural landscapes and values related to them, in a perspective of conservation and dissemination of material and immaterial heritage.

The Vesuvius National Park, active as authority for almost thirty years, recognizes in the system of farms a fundamental repertoire of historical anthropization processes, proposing, as part of a strategic project, the redevelopment for forestry, agricultural, naturalistic and scientific research activities.With regard to this prospect is

[21] Cfr: Aveta A., *op. cit.*, pp. 164-170.

[22] This type is less frequent in inland areas and is typical of rural coastal architecture, particularly on the islands of Campania, where wood for the construction of pitches was more difficult to find. For further information cfr. B. Gravagnuolo, *op. cit.*; Pane R., *Architettura rurale campana: con 53 disegni dell'autore,* cit. pp. 5-6.

necessary a thorough interdisciplinary knowledge of these artifacts part of a piece of the built historical vernacular Vesuvian. It is essential, through a broad interpretation of the value system and the material authenticity still recognizable and following a methodology in line with the most recent reflections in the field of rural heritage[23], to configure guidelines for their restoration in the framework of an optimization of the planned tourist routes but above all recovering the multidimensional perceptual values of the landscape and the micro-history that the stones of these manufatti still keep alive.

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[23] See for example: Mileto, C.; Lidón de Miguel, M.; García-Soriano, L.; Trizio, F., *Balancing Tradition and Development? Early Trials of a Methodology for Studying Vernacular Architecture and its Transformations*, in «International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences» (Online), XLIV (1), pp. 781 – 788.

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Heritage and community centre in Matta Sur, Chile

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract

The Matta Sur neighbourhood in Santiago acquired official protection for its heritage value in 2016. It is the largest protected area in the city and one of the few in which vernacular architecture, local lifestyles and community networks withstand the city's rapid urban development. It has a regular urban structure of wide streets framed by continuous facades, which predominantly belong to one-storey homes, organised around a central courtyard. They are built combining burnt or raw masonry and wood and earth traditional building systems, which are now discontinued and often misunderstood, leading to poor interventions which deteriorate the quality of buildings and liveable spaces. The Heritage and Community Centre Project attends the need for comprehensive interventions to approach appropriate conservation of Matta Sur under these circumstances. This project aims, on one hand, to provide a suitable community space within the neighbourhood and, on the other, to set an example for appropriate intervention, management and maintenance of the vernacular constructions in the neighbourhood. All of the process is developed through community-based design and intervention, attending to the role of community organisations in Chile, which have been traditionally responsible for filling the gap between public policies and community wellbeing, particularly in urban contexts, through strong solidarity networks. Through a process of co-design and co-management, the project aims to refurbish a traditional house of the neighbourhood into a community centre in which various community initiatives converge and which allows for these solidarity networks to keep functioning in a contemporary context.

Keywords: *community; co-design; urban vernacular.*

1. Introduction[1]

The Matta Sur neighbourhood is a 189 hectare heritage area within the centre of Santiago de Chile. This extension makes it the largest protected area within the city, which lodges more than 10.000 people in a city of seven million inhabitants. This area was first populated in the early 19th century with spontaneous settlements (Jorquera, 2018) from the west consolidating the east part of Matta Sur between 1898 and 1929 (Flisfisch, 2014), which where regularised from 1875 up to the beginning of the 20th Century; after the creation of the *Ley de Habitaciones Obreras* in 1906 (Pérez, 2017). This law aimed to set habitational standards for low income homes, in a context of rapid growth of urban population within the city.

During this period, plots towards the west of the city, which were closer to the historical city centre, were preferred by wealthier inhabitants, while the current emplacement of Matta Sur was

[1] This work makes part of the project "Arquitectura, patrimonio e infraestructura comunitaria. Trabajo con la JJJVV Plaza Bogotá ZT Barrio Matta Sur" or "Patrimonio Comunitario" (2021) funded by the VIME program from the Vicerrectoría de Vinculación con el Medio of the University of Santiago. Responsable: Amanda Rivera Vidal.

populated by workers. The urban area of Matta Sur was divided into regular plots which were 6 to 12 metres wide and several housing ensembles were built through private, cooperative or public developments, with standards which included access to water, sewage and electric energy within homes (Hidalgo, 2002). This development led to the consolidation of a regular urban structure of wide streets framed by continuous facades, which predominantly belong to one-storey homes, organised around a central courtyard. They are built with raw and burnt masonry and wood and earth traditional building systems, combining vernacular construction knowledge with urban and architectural planning.

Fig. 1. JJVV Plaza Bogotá headquarters, within Matta Sur (Source: Cristian Muñoz, 2021).

This development progressed into a neighbourhood populated by "small scale merchants, officials and artisans" (Laboratorio Patrimonio Activo in Jorquera, 2018) which during the 20th Century developed its own character and livelihood (Lawner, 2018), in which community networks where an important part of the day-to-day construction of a local identity. The sense of community living, diversity of different social groups and social mobility were characteristic of the area (Laborde, 2015 in Espinoza, 2017).

These community bonds have been the key to different initiatives which seek to preserve the identity of the neighbourhood and the wellbeing of its inhabitants also during the recent history of the neighbourhood: from the initiative of declaring Matta Sur as a typical zone[2] in 2016 and community organisation after the 2019 social arisements and during the COVID-19 pandemic. The first succeeded in protecting the area from liberal inmobiliary projects linked to rapid urban growth within the city, while the later strongly contributed to supply basic goods to families who struggled maintaining their already precarious jobs during a period of mobilizations within the country and the latter confinement due to COVID-19. The latter was conducted through solidary supply chains and *ollas comunes*[3], which in Chile have a long history of helping families through periods of scarcity ever since the saltpetre crisis in the 1930s. These practises are not only a way of providing mutual care, but also a space in which popular cultural practises such as music and dance can be recognised, appreciated and widespread; while community bonds are strengthened.

Fig. 2. Cooking for *ollas comunes* within JJVV Plaza Bogotá in Matta Sur (Source: Cristian Muñoz, 2021).

All these activities are deemed to be relevant both for the wellbeing of local communities and for the preservation of heritage ensembles and social tissues, which are interlinked with these cultural practises. In spite of this and however efficient these networks are in providing mutual support, interventions within the physical space of the neighbourhood do not meet the same standards, due to the discontinuation of traditional building methods, lack of appropriate technical support and the absence of centralised policies which are able to provide actualized infrastructure to sustain these activities under changing circumstances. Because of this, the quality of building and liveable spaces has

2 Local denomination of a heritage protected area.

3 Community kitchens in which neighbours share and cook food.

deteriorated, introducing a breach between the quality of tangible spaces and that of the activities which are developed within them.

The heritage and community centre in Matta Sur project aims to confront the challenge of conciliating new needs of use of heritage spaces with the valorisation of an architectural and building typology which results from the encounter of urban and architectural planning of Santiago with vernacular building knowledge, through a process of co-design which recognizes the diversity of initiatives supported by neighbours while enhancing previously existing community networks.

2. Junta de vecinos Plaza Bogotá

The heritage and community centre in Matta Sur project originated at the request of the neighbours association (Junta de Vecinos or JJVV) of Plaza Bogotá, a sector within the area of Matta Sur. The headquarter of the JJVV is located in a former home, which is representative of the heritage trades of the area's architecture. This building, which is one storey high and is organised around a courtyard, has functioned as a community meeting place with minimal transformations up to 2019. Events in Chile up to this point, such as the social uprising of 2019 and the COVID-19 pandemic made the need for actualization of this space urgent, in order to meet new needs of encounter and discussion.

The original request of improving existing infrastructure and transforming the former house into a heritage and community centre, together with the previously existing close social tissue, was deemed as an opportunity to develop a process of co-design, as defined by King (1983), in which main stakeholders are neighbours with no previous knowledge on architectural design and a team of technical advisors of the project "Patrimonio Comunitario". The main role of the technical team being the register and analysis of technical information (architectural plans, diagnosis of damage within the building, legal frame, etc.), design of participatory activities (Arnstein, 1969) that foster deliberative forums (Carson, 2003 in Sannoff, 2006) during the process, as well as the elaboration of deliverable products required to access further funding for construction.

The aims of the design project and specific requests throughout its development were made by the neighbours. These requests exceeded the design of the JJVV headquarters and included the need for educational talks on cultural heritage and management of cultural assets, as well as the request for practical workshops which taught how to intervene in damaged heritage buildings throughout the neighbourhood.

Fig. 3. Design exercise to express needs of the communitary space (Source: Patrimonio Comunitario Project, 2021).

While the early stages of the project - namely, framing its goals and defining its methodology - were developed with a small group of active neighbours, a general invitation to participate was extended. Invitations were distributed through existing communication channels of the JJVV, through door to door invitations and digital social networks, promoting a snowball sampling strategy. During the first invitation processed, neighbours were also surveyed in order to define topics of interest and help adjust the methodology of following activities. Other neighbourhood associations which used the infrastructure of the JJVV were targeted. This included groups of diverse interests: cooperativa La Minga, Patrimonio Matta Sur, Centro Cultural y Patrimonio Matta Sur, Escuela de Permacultura among others. Most activities were held online, through zoom platforms, due to the pandemics.

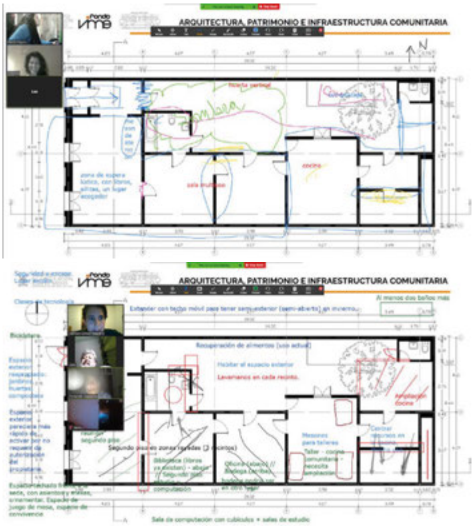

Fig. 4. Design exercise through which neighbours express their ideas of renewal of the JJVV headquarters (Source: Patrimonio Comunitario Project, 2021).

2.1. Design process

Co-design was conducted through eight biweekly meetings in which different stages of the design process were approached:

- Identification of general needs of the community
- Research for references
- First ideas of distribution
- Plan brainstorming
- Exposition of synthesized ideas
- Demonstration of construction techniques and the possibilities of intervention

During each meeting, participating neighbours were divided in smaller groups of three to four people for discussion of specific aspects. Results of each group were exposed to all assistants. Feedback of main results of the previous meeting was given by neighbours before commencing a new meeting, or by the technical team whenever advice on legal or technical aspects was required. This includes, for example, length required by the norm for universally accessible ramps or materials required for structural retrofitting.

While the idea of heritage stood strongly behind the neighbours' discourse, the focus of conservation needs lay on the recovery of aesthetical elements, such as hydraulic tiles and wooden doors and windows. Initially, little explicit mention was made to architectural spaces or distribution, as well as the relevance of the central courtyard within its distribution. In addition to this, expectations regarding the possibilities of transformation of the building were limited at the beginning, showing an underlying idea that the existing building could not be sufficiently transformed to meet demands of use.

During these early stages of the process, the conversation focused on the need for accessibility, green spaces and generation of new spaces to lodge activities with young people (including spaces for study), to expand activities related with cooking and food supply, but without a clear idea of where these new spaces should be. During these first discussions, makig smaller the courtyard and eliminating existing vegetation was seen as the only option for enlargement, even if these actions were not desired by the community, who agreed that these actions would diminish the quality of livable spaces.

During the first stages of the design, neighbours typically focused their first proposals in interventions within the street area immediately next to the JJVV, since intervening outer space seemed to them simpler than intervening the construction itself, due to the permits which are required to do so. This street gardens called “Platabandas” are also the first approaches from the neighbours to public space intervention for the benefit of the community (Nuñez & Alvarado, 2020)

To approach these limitations, the technical team developed icebreaker activities focused on the opening of creative processes and the revision of examples of other interventions or new community spaces. These were complemented with explanations of processes to obtain permits and other projects carried out in the neighbourhood which had managed to value different aspects related with the JJVV. In this context, leaders of the Jardines del Barrio Matta Sur and other projects were invited to expose their experiences. This information helped designs to become more ambitious and flexible.

During this process, the courtyard acquired a central role, as the largest available space to hold meetings and also a space which and a new consensus was reached to maintain existing vegetation. The solution for providing larger spaces for new activities was the flexibilization of inner spaces. For this, movable panels were designed to substitute existing walls, enhancing the relationship between inner spaces and with the central courtyard.

Fig. 5. Axonometric of the final proposal (Source: Patrimonio Comunitario Project, 2022).

Fig. 6. Plan of the final proposal (Source: Patrimonio Comunitario Project, 2022).

2.2 Intervention prototype

The development of the design process and complementary activities provided a favouring context for the development of an exemplary intervention within a *tabique de adobe en pandereta* (Guzmán, 1980) wall in the JJVV headquarters.

This system is found in inner walls throughout Matta Sur and consists in 2 x 4 "to 4 x 4" structural wooden frames infilled with adobe blocks of 10x30x48cm to 10x30x60cm set vertically and held in place by iron wires, diagonally nailed to the wooden structure. Damages in this wall are also typical to the whole neighbourhood and are often overlooked or poorly approached in interventions within homes, leading to a deterioration of their bearing and isolation capacity. Wooden elements were infested by xylophagous insects, particularly in lower and higher areas of walls, in which humidity levels were high due to water infiltration from the roof and capillarity from the ground, linked to alterations of floor levels and materials. Metal wires were corroded and some adobes of the infill were missing, making the wall vulnerable to seismic activity.

Students from DUOC UC[4] diagnosed these elements and intervened a 5 metre long wall as a prototype for for their own learning process and to show neighbours appropriate intervention techniques which could be used in their own homes: fumigation, substitution of damaged elements, retrofitting of humidity barriers and reposition and reinforcement of earthen infills. These interventions took place two days a week during a four month period, in which neighbours could follow the process and participate. Two meetings were held to transmit the technical principles of the intervention among neighbours.

[4] Students enrolled in the Restoration of mixed system course of the Restoration of Heritage Assets Degree.

Fig. 7.a. Stone foundations and damage in bearing wooden elements in original walls (Source: Authors, 2021).

Fig. 7.b. New foundations and retrofitting process in sample (Source: Authors, 2021).

2.3. Funding and management

Broadcasting of the project's activities through social networks, even if intended for neighbours, also called for participation of institutional stakeholders who spontaneously approached the JJVV and the responsible of the "Patrimonino Comunitario" Project. Where previous institutional links were based on the funding of day-to-day costs within the headquarters, new opportunities of collaboration were detected among municipal offices: gardens, environment, and the recently created city and heritage department, as well as the semi public CORDESAN (Corporation for the Development of Santiago). These units usually carry out parallel work in each of their areas of expertise and rarely converge or are informed of each other's activities.

In parallel, funding for the first stage of building works was awarded from the Ministry of Culture and Arts. The request was conducted through neighbourhood organization Centro Cultural Patrimonio Matta Sur, using the products which resulted from the co-design process.

3. Conclusions

The participative design process allowed for common thought of neighbours regarding the needs and potentialities of the JJVV headquarters. Design decisions which modified the space achieved better consensus even if they not alway met individual requirements or expectations, which is deemed to ease sustainability of the project in the future. At the same time, the process allowed for neighbours to gain a wider perspective of the possibilities of their own homes.

Even though participation was relatively high considering that all design activities were developed online due to the COVID-19 pandemic, the participation of elderly people who didn't have the support of younger relatives to access digital platforms for participation felt excluded from the process. The development of offline activities and the continuous presence of students within the headquarters after the end of quarantines allowed for the better integration of these members of the community, who finally accessed information regarding the project, even if they could not participate in the design process itself.

The virtuous collaboration between neighbours and students of different expertise and the recognition of handcraft work by students of DUOC UC was particularly valuable in a national context in which technical studies require visibilization and there is still little expertise regarding maintenance and restoration of traditional wood-earth constructions. Not only is there a will to establish a more permanent link with the institution, but neighbours and students established direct contact, leading to the possibility of mutually beneficial collaboration in the future, as well as job opportunities for recently graduated technicians, who may approach lower cost interventions within the neighbourhood. Even if neighbours do not consider themselves fit to approach restoration of their homes, they declared better understanding of technical requirements for intervention and enlarged their available networks to approach this issue.

As for the prospective continuation of the project, funding for a first building stage has been recently granted (January 2022) and construction works should commence at the end of this year. Funding was granted directly to a neighbourhood association, which will be accompanied by the technical team. During this process, community participation meetings will continue and the development of better and more specific management capacities are expected.

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Local materials and traditions in the conservation of vernacular buildings

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
What were the traditional techniques and materials employed to maintain and conserve vernacular buildings? If we study carefully, we could find the answers in analyzing existing vernacular constructions, related traditional building cultures, and the inhabitants' lifestyle practices. My research, particularly my Master's in Architectural Conservation dissertation, aimed to explore the tangible and intangible aspects of traditional living that contributed to the conservation of vernacular buildings. My research affirmed that people in the olden times had a deep understanding of their surrounding environment and microclimate. They effectively used local land resources to develop building techniques that preserved their buildings for several generations. E.g., In India, fruit resin was added to mud-plasters to strengthen them. The study also provided insights into traditions and social norms that contributed to the upkeep and longevity of vernacular buildings. E.g., In Portugal, every year, people lime-washed their walls before the village feast. Though it was a cleaning act, the whitewash served as a protective layer to the walls. The former practices were conscious efforts to preserve buildings. However, the latter often laid hidden in daily life routines and hence remained unrecognized as conservation efforts. This research paper highlights some traditional building and maintenance strategies native to different parts of the world that – consciously or not – contributed to the conservation and maintenance of vernacular constructions. It is intended to bring to notice traditional conservation methods, which could be integrated into modern conservation strategies by heritage professionals today.

Keywords: *tangible and intangible heritage; conservation.*

1. Introduction

Though some traditional buildings have stood the test of time and centuries-old buildings continue to exist today, the science of built heritage conservation of the olden times does not feature – at least boldly in heritage literature. Heritage conservation has today, of course, evolved into a formal practice and involves planned interventions. So what was it that ensured the health and survival of buildings in the olden days and has passed them to the current generation?

If observed intentionally, the conservation of traditional times can be read between the layers of traditional building cultures, life practices, and beliefs. They subliminally supported conservation, thus making it a way of life rather than a separate and disconnected activity reserved for professionals. It is thus little wonder that conservation in olden times necessitated no formal recognition. This paper explores tangible and intangible aspects of traditional living that – consciously or subconsciously – contributed to built-heritage conservation, and more so, almost eliminated the need for deliberate intervention.

2. Local buildings cultures

Back in the day, inhabitants in different regions of the world, with their profound understanding of their micro-environments and climates, effectively used local land resources to develop building techniques and structural designs that protected their buildings for generations.

Following are some examples of local building methods that ensured the durability and sustainability of vernacular buildings.

2.1. Additives in preparation of building materials: earth and/or lime plasters

In many parts of the world, people added local produce and naturally available materials while preparing earth and/or lime plasters for construction. It was done to improve the workability, strength, water resistance, etc. of the building material/building.

In *India*, eggs and resins from local fruits acted as binders. In some regions, builders added lentils too. For example, in the state of Goa, cooked rice water (*kanji water*) was used. In the recent restoration of the Convent and Church of Santa Monica, neem water, belfruit juice, and jaggery water were mixed into the plaster mix.

Fig. 1. Belfruit, neem water (green), belfruit juice (orange), and jaggery water (brown), Goa – India [Source: Fernandes (Architect, Goa)].

While preparing lime plasters in *Poland*, bones, eggs, cheese, meat, etc. have been used since ancient times. In the making of clay plasters, cow dung was often used. Among others, a liquid substance is produced by burning pieces of birch tree bark. (As communicated and demonstrate by Jarema Dubiel from "Earth, Hands and Houses" – Poland).

Fig. 2. [a, b, c, d, e & f]. Preparing a waterproofing additive for plasters from the bark of birch trees – Poland (2015).

2.2. Roof structure and materials

Roofs of traditional buildings were detailed to stand steady and protect and secure the structure.

In *Scotland*, some roofs comprised cruck frames – which upheld the roof, thatch – which covered the roof and provided natural insulation, and cow sharn i.e. dung without the fiber – which was applied on thatched roofs as a waterproof membrane.[1]

Fig. 3. Cruck framed roofs ensured the stability of roofs, Dumfriesshire – Scotland (Source: Walker, McGregor, Conservation of Vernacular Buildings).

[1] Walker, *Earth Structures and Construction in Scotland*, p.86

In Goa – *India* and Normandy – *France*, sloping roofs and large overhangs protected wall surfaces from rainwater and winds. Local materials such as coconut palms (Goa) and thatch or slate (Normandy) were used to cover the roofs.


Fig. 4. Large overhangs built with local materials: [a] Goa – India (2019) [b] Normandy – France (Source: Patte, *Architectures En Terre*).

In Normandy – *France*, plants like Iris were grown along the ridges of traditional roofs as their roots absorbed rainwater and protected the buildings from water damage. This feature can be seen on the "Association Pierre et Masse" and "Maison des Marais" buildings.

Fig. 5. Plants on roof ridge protected buildings from water damage, Maison des Marais in Normandy – France (2015).

3. Traditional lifestyles and systems

Traditional lifestyle practices and beliefs also seemed to have had a significant bearing on the care and longevity of traditional buildings. However, as most traditions and beliefs lay embedded and hidden in the routines of everyday life and often included daily activities and rituals that bore no intention of conservation, they remained unnoticed, unrecognized, and unnecessary of mention. This lack of transparency led to the lack of acknowledgment and worth attached to the role traditional lifestyles are likely to have played in conservation. This continues to be the case today.

Even more so, now that traditional lifestyles have disintegrated to give way to modern living, it is even more difficult to trace and fragment aspects of traditional life that integrated building conservation and maintenance culture.

3.1. Planting trees that would provide for the upkeep of homes

In Goa – *India*, house owners grew local varieties of trees at the time of building their houses. These were mainly coconut, bamboo, mango, and jackfruit trees. The owners envisioned that the trees would grow with them and provide for them in their old age. The coconut tree trunk, for example, is used to repair and replace traditional pan-tile roof frames, which after decades, often need attention. Bamboo serve as raw material for weaving mats and baskets used in farming. Bamboo baskets were also useful in cob earth building to carry mud. Mango and Jackfruit are popular for their wood as well as fruits.

3.2. Burning fire, fuel, and incense in houses keep dampness and insects away

Various traditions and rituals in *India* involve burning fuel and incense on a regular daily or occasional basis. The smoke and essence they give out help keep dampness and insect infestation on walls at bay. In some regions, daily cooking is done on traditional wood-burning stoves inside the house.

Incense sticks are often left burning for religious reasons or for fragrance. In Goa, frankincense is burnt on religious occasions, at wedding rituals, after bathing infants, etc. The reasons may vary from beliefs like warding off evil, inviting good omen, or just keeping mosquitoes and other insects away and sanitizing the space.

The blackhouses of *Scotland* left fireplaces burning constantly. Combined with the thermal properties of clay used in the construction (peat, mortar, etc.), it kept the house lit and warm. The building had hardly any window and door openings. It thus retained much of the rising smoke and helped keep insects away from walls. It aided in preserving the roof material as well.

In some houses of *France*, smoke from fireplaces contributed to guarding floor beams against insect attacks. This has been particularly observed at the manor house at Saint-André-de-Bohon in Normandy. (As communicated by François Streiff, Architect, Normandy).

Fig. 6. Traditional cooking inside the house gave out smoke that kept insects and dampness away from walls – India (Image source: http://www.projectsurya.org/, accessed in 2015).

3.3. Burying lime at the birth of a male child served as a building material for his future house

According to tradition in Poland, a family buries lime at the birth of a male child. This is done so that the lime ages to quality and provides a durable plastering material for their heir when he grows to be 25 – 30 years old and is ready to repair his ancestral house or build a new one. (As communicated by Jarema Dubiel, "Earth, Hands and Houses" – Poland)

3.4. Lime disinfected animal sheds

Farmers in *France* periodically painted animal sheds with lime to disinfect the space. (As communicated by François Streiff, Architect, Normandy). The lime paint, in turn, served as a protective layer and protected the walls from everyday wear and tear.

3.5. Annual lime washing of walls

In some parts of *Portugal*, it is a custom to whitewash houses annually, usually before the village feast. As Paulina Faria (Architect, Lisbon) and others explained, this action was more of a cultural norm rather than an activity with technical implications. Those who did not whitewash their walls were considered to be less clean. Some people also mixed a product called 'cloro' with water and applied it to the walls before whitewashing them. This was primarily meant to disinfect walls, kill any fungal growth, etc. It probably also helped with the adhesion of the new layer of whitewash.

Traditionally, lime was made from limestone ('*cal*' in Portuguese), and walls were whitewashed every 1-2 years. This created several paint layers and thickened the walls.

Today, people prefer paints ('*tinta*') bought from the market, and repaint the walls rarely.

Fig. 7. Wall in Moura, Alentejo – Portugal (2018).

Fig. 8. White washing with modern paints, Mourão in Alentejo – Portugal (2018).

3. Conclusions

This paper tried to unearth some local building cultures and traditional lifestyle practices from different parts of the world that – conscious or not in the mind of inhabitants – largely contributed to the upkeep and longevity of vernacular buildings.

If approached effectively and feasibly imbibed with modern and technical conservation practices, they could add a new dimension to modern conservation. They could also enlarge the scope of rendering built-heritage conservation more affordable and simple. For example, in the repair of masonry bee damage, burning frankincense can be used to ward away the bees.

Traditional and modern approaches clubbed together for the care and protection of vernacular buildings can thus enhance the conservation approach. In imbibing traditional methods in conserving traditional buildings, we are conserving not only the tangible built heritage but also the intangible aspects that are allied with the building. It thus allows for a holistic approach to architectural conservation.

Note

This paper contains excerpts my master's in Architectural Conservation dissertation titled, "Regional Distinctiveness of Earthen Structures: Construction Techniques and Conservation Approaches. A Comparison of Mudwall/Cob Buildings in Perthshire – Scotland and Normandy – France" (University of Edinburgh – UK, 2015) and my post-master's DSA-Earthen Architecture and Heritage dissertation, "Comparison of the vernacular earthen architecture in Goa (past Portuguese colony in India) and Alentejo (Portugal): Local building cultures and conservation approaches" (CRAterre, École Nationale Supérieure d'Architecture de Grenoble – France).

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Vernacular earthen architectures. Institutionalisation and management models for its conservation in northern Argentina

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
The conservation of vernacular earthen architecture presents specific technical and social challenges, which implies particular reflections in relation to concrete actions for their restoration, but also to the management models implemented in the interventions. The heritagisation of many of these architectures implies an institutionalization of actions, with approaches on vernacular techniques with procedures that are often foreign to the logics of local constructive cultures. This paper is oriented to the analysis of two vernacular earthen architectures in northern Argentina: Casa del Marques -in the town of Yavi- and the Church of Uquía, both in the province of Jujuy. These analysis involve a recognition of the different trajectories around the institutionalization of conservation, both historical and contemporary. In this sense, the paper will focus on three issues: (a) the action of state institutions in the conservation of these architectures; (b) the problems associated with these actions in technical terms; (c) the possibilities of participatory approaches from vernacular practices.In methodological terms, this presentation will be based on the fieldwork carried out for the registration, diagnosis and support in the execution of the works, in dialogue with other approaches from archive documentation. In the particular case of Casa de Marques, the fieldwork implied the realization of different workshops with local communities, from participatory approaches.

Keywords: *Earthen heritage, Local communities, Participatory approaches*

1. Introduction

The processes of institutionalisation of heritage, consolidated fundamentally around the 19th century, were inseparable from the formation of modern national states, especially in Europe, and involved the construction of a set of imaginaries, narratives and representations of heritage. In many cases, this institutionalisation implied the creation of various state bodies that began to establish certain ways of managing these heritages, including the criteria for their conservation, based on the centralisation of decisions and actions, within networks that involved various actors. In a way, this centralisation was constituted as a form of regulation of the relationships between social subjects and architectural objects, which implies thinking of it in terms of a regulation of materiality, understood, in Miller's (2005) terms, precisely as that relationship. These regulations, in turn, implied an invisibilisation of other possible relationships between social groups and their emblematic architectures, a significant issue for vernacular productions. Institutionalisation, and the adoption of certain management models, has not been unrelated to the technical choices that have been made in many cases for the conservation of these architectures, within the framework of theoretical constructions on conservation, which is of particular interest when looking at earthen architecture.

In the case of Argentina, these processes of institutionalisation began in the first half of the 20th century, replicating European structures, with the creation of the National Monuments Commission, which was also characterised by a centralisation in the selection of the properties to be valued and the criteria for their conservation. These criteria implied technical decisions that generated important transformations in the properties, and have historically been in tension with vernacular perspectives on durability and authenticity.

This paper will analyse these relationships between institutionalisation, management models and technical actions from two case studies in northwestern Argentina, the Church of the Santa Cruz and San Francisco de Paula in the town of Uquía, Quebrada de Humahuaca, and the Casa del Marqués, in the town of Yavi, in the Puna de Jujuy, both of colonial origin, built using earth construction techniques. In the first part, from their diverse trajectories to the present, these cases will allow us to analyse the common aspects and heterogeneities in the processes of institutionalisation, considering the technical implications they had; the second part will be oriented towards a review of the vernacular approaches to conservation, and the critical analysis of the interventions undertaken in recent years from different types of participatory approaches.

The material to be presented arises from the work carried out by the authors for the development of projects and interventions in these recent conservation actions, through the relationship of an academic space with the competent state bodies, particularly the Secretariat of Culture of the province of Jujuy, and with the various local organisations involved in the different communities. In this sense, the proposed approach to the institutionalisation of heritage and its conservation is based on participation in institutional relations.

1.1. Case studies

The highlands of the province of Jujuy have historically been characterised by a construction culture based centrally on the use of earth as a material, with an outstanding place for adobe masonry. Within this framework, earthen construction plays a very important role in the whole of vernacular architecture, both historical and contemporary, with a centrality of colonial times, between the 16th and 19th centuries, both for institutional and ecclesiastical buildings as well as domestic ones. The Church of the Santa Cruz and San Francisco de Paula, and the Casa del Marqués are two very relevant examples of this colonial production in the current province of Jujuy.

The first is located in the town of Uquía, in the Quebrada de Humahuaca, and was built in 1691, as part of the processes of evangelisation and reduction of the indigenous population (Sica, 2016). It is a chapel that responds to the general features of ecclesiastical architecture in the Andean area (Gisbert, De Mesa, 1997), with a single nave, an adjoining sacristy, and a flat façade with a triangular frontispiece. The atrium is enclosed by a perimeter wall and has a single, free-standing tower located on one of the corners. In constructive terms, the chapel has adobe walls up to 1 m thick, and a roof finished with torta de barro (literally, mud cake) on a wooden structure with a collar beam. Although the urban environment in which it is located has undergone important transformations over time, the chapel continues to play a structural role in this area, with a central role in local devotions, as well as having become a very important tourist attraction in recent years.

The Casa del Marqués, on the other hand, is located in the town of Yavi, in the extreme north of the Puna of the province of Jujuy, and is a domestic architecture that was built in the 17th century, as a space for the residence and administration of a colonial hacienda, within a complex that also includes the Church of San Francisco (Barada, Tomasi, 2020). The house has a square floor plan, with a large central courtyard from which the different rooms are accessed. In terms of construction, it was also built with adobe masonry and a mud-cake roof over a wooden structure. Apart from its domestic use in colonial times, it was later put to different institutional uses, including the administration of a sugar ingenio and different functions for the public administration, and is currently used as a historical museum.

Both architectures, which are part of the universe of vernacular productions, have undergone processes of institutionalisation based on their heritage status, with different characteristics, which are relevant for the purposes of this paper.

Fig. 1. The church of Uquia, Quebrada de Humahuaca, Jujuy © Walter Reniaga

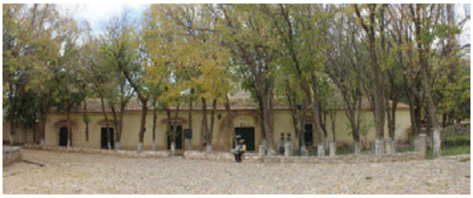

Fig. 2. Casa del Marqués, Yavi, Jujuy © Authors

2. The institutionalisation of historic vernacular architectures

Beyond some previous studies, the institutionalisation of the approach to heritage in Argentina began in the first half of the 20th century with the creation in 1938 of the former National Commission of Museums and Historical Places (currently the National Commission of Monuments, Sites and Historical Properties, CNMLyBH). This institution would be responsible for unifying the registration, cataloguing and conservation of certain properties defined as relevant in the construction of a national history and identity, through their declaration as National Historic Monuments or Places (Viñuales, 2011; Herr, Rolón, 2018). From that moment on, the valuation and conservation actions were centralised in this institution, a role that is maintained to the present day, being the ultimate authority responsible for establishing the criteria and authorisation of any type of intervention, although in general it does not undertake the projects directly but rather they are developed through institutions.

2.1. Institutional trajectories

The Church of Uquía was declared a National Historic Monument in 1941, within the first set of declarations after the creation of the CNMLyBH in 1938, which included 122 properties until 1946. As Herr and Rolón (2018) have studied, in this period there was a strong emphasis on ecclesiastical architecture corresponding to colonial times, so that in the province of Jujuy 10 chapels from both the Quebrada de Humahuaca and the Puna were included. At the same time, in association with this bias towards colonial history, earthen construction had a very important incidence, with a presence in 45% of the NMM, which is paradoxical considering the prejudice towards these technologies that had been growing since the end of the 19th century. In any case, the valuation of these buildings was not based on their construction technology, as will be seen below, but on historical recognition of their belonging to a period that was claimed as the foundation of a "national identity", in opposition to the transformations produced by European immigration at the end of the 19th century.

The trajectory of the Casa del Marqués was so different that it was not declared a MHN until 2001. Around the 1930s the house was associated with the administration of the San Martín del Tabacal ingenio until its expropriation in 1949 (Barada, Tomasi, 2020). At that time, a prolonged interchange between the state agency in charge of the expropriation and the CNMLyBH began, as the latter was expected to take over the management of the historic building, something that did not happen for many decades. This is relevant in order to observe the bias in institutional interests over heritage, since the Church of San Francisco, which formed part of the same complex and is contemporary to the Casa del Marqués, was declared an MHN in 1941, together with that of Uquía, and even the town of Yavi itself was declared a National Historical Place in 1975.On the other hand, it is interesting to note the different levels of institutionalisation of the historic buildings, in that the Casa del Marqués was subject to institutional patrimonialisation at a very late stage, but at the same time it had institutional meanings, particularly in local terms, throughout the 20th century, having been the seat of the local government of Yavi, among other bodies, as well as being a space used intensively by the communities for different celebrations, such as the patron saint festivals.

2.2. Management models and conservation

The declarations as MHN have effectively implied an institutionalisation of these vernacular architectures, entering into networks of relations between different state agents linked to the valuation and conservation of heritage, reconfiguring the interactions with other social actors, particularly local ones. The CNMLyBH begins to be ultimately responsible for establishing the criteria for intervention and supervision of concrete works, although it is not directly in charge. That is to say, since the declaration as a MHN, local actors who used to be responsible for the conservation of these architectures, within their historically modelled relationships, begin to have a relation that is mediated by an institution that centralises the decisions and, moreover, the conceptions of architectural conservation.

In the case of the Church of Uquía, actions for its conservation began rapidly after its declaration, with a very significant intervention in the early 1940s, which covered both morphological aspects and the constructive technologies that define this property. This first institutional intervention was followed by others in the 1960s and 1980s, until the most recent ones between 2012 and 2018, which focused on the mud-cake roof. The Casa del Marqués, in relation to its more recent patrimonialisation, underwent a different process, with interventions that began later. In any case, the actions for its conservation from the 1950s to the 1970s were also carried out by different public bodies, although in a more dispersed manner, with the active participation of the General Directorate of Architecture of the province of Jujuy. These interventions also involved profound transformations and general reconstructions, which would be completed with other works in the following decades. In a certain sense, in the Casa del Marques, institutional conservation began before its formal recognition by a body such as the CNMLyBH, emerging from the networks of relations between state agents.

Fig. 3. Church of Uquia in 1939, before its declaration as National Historic Monument © Hans Mann

The analysis of the limited documentary material available on the interventions shows how the conservation actions in both buildings were conceived and executed through the interaction between various public bodies, with the approval of the CNMLyBH, but without the direct or indirect participation of local communities and organisations. In this sense, the institutional reconfiguration of the relationships between people and these architectures can be observed, with the mediation of new actors who, over time, regulated the links between subjects and objects, with direct implications at the technical level.

2.3. Technical approaches

These models centred on the role of heterogeneous public bodies, alien to the participation of local actors, which has certainly been sustained over time, have not only had implications for the management of conservation actions and articulation in social terms, but also had direct impacts in technical terms, with the understanding that the technical is a social fact (Lemonnier, 1992). The interventions developed over time tended towards the technological transformation of the buildings, based on a set of prejudices associated with earthen construction techniques, particularly adobe (Viñuales, 2011). In this sense, the work carried out was oriented, on the one hand, towards structural reinforcement and, on the other, increasing the durability of the materials, in both cases through the incorporation of a set of materials alien to local construction cultures.

Both the Church of Uquía and the Casa del Marqués are marked by the incorporation of structural elements of reinforced concrete. In the first case, in the intervention of the 1940s, a structure of beams and columns was built into the adobe walls, and a pyramid-shaped crowning on the tower, while in the Casa del Marqués, between 1950 and 1970, an upper chain beam was incorporated into the walls, also made of reinforced concrete. These technical strategies are crossed by an institutional logic based on the idea of the weakness of adobe and the overestimation of the capacities of concrete (Healey, 2009), together with the ignorance of the technical deficiencies emerging from the articulation between these materials. These reinforcements, hidden in the walls, were executed in order to sustain an aesthetic imaginary of the buildings, while altering the values of their construction systems.

The roofs were the second area where the greatest institutional interventions were made, in order to increase the durability of the mud cake which, due to their characteristics, require periodic renovation. To this end, in both buildings different solutions were implemented to reduce, or completely avoid, this periodic maintenance. While in the Church of Uquía this included the use of layers of cement mortar and plastic membranes, in the Casa del Marques during part of the 20th century, the mud cake was replaced by an integral tile roof. In both cases, the solutions not only failed to improve the performance of the roofs, but also generated diverse pathologies, particularly in Uquía (Tomasi, Barada, 2021).

Fig. 4. Diagram of the reinforced concrete structure, in red, incorporated into the adobe walls in Uquia © Authors

Fig. 5. Detail of the reinforced concrete beam incorporated into the adobe walls in Casa del Marques © Authors

Fig. 6. Detail of the roof in Uquia © Authors

In this framework, the institutionalisation of the conservation of these heritages, with their associated management models, implied the incorporation of materials and techniques that are also integrated in the institutional technical valuations. While earthen building cultures have been alien to the value systems and social representations of public and private organisations, other building systems have been institutionally endorsed, and have even managed to permeate the technical senses of local communities.

3. Towards participatory management

In recent decades, debates within conservation theory have focused on the need to incorporate other voices, particularly those of local actors (Johnston and Myers, 2009; Alonso González, 2015; Watkins, 2019), emerging from in-depth discussions in critical studies on the very concept of heritage (Llorenç Prats, 2000). These searches, crossed by anthropological approaches to heritage, refer to the need to recognise the existence of other ontologies around the valuation and intervention of these architectures. These ontologies imply particular views on the temporality of heritage, on the greater or lesser duration of buildings, or on their becoming in time from the changing relationships with social subjects, which ultimately put institutional conceptions of the conservation and authenticity of the properties in tension. In any case, the meanings of participation remain a field in dispute regarding its real scope. In other words, it is a question of whether this participation enables the recognition of other materialities, of other possible relations between subjects and objects, or only the incorporation of other voices that provide nuances within the hegemonic interactions within the institutionally established hegemonic interactions. It is necessary to observe that institutional views and local perspectives, beyond their differences within asymmetrical power relations, are not constituted as totally antagonistic and independent fields, but are mutually permeated.

Ethnographic studies have made a significant contribution to observing the way in which societies develop different practices related to the duration of their emblematic architectures, whether for their maintenance over time, their transformation or their destruction in the course of relations in the flows of life. These practices are indivisible from the links established with architectural objects and their conditions of existence. In this framework, social relations are not simply prior to the development of actions on the buildings, but emerge or are strengthened in the very interaction with architectures. In the Andean context, different works have shown how the renovation of church roofs creates and consolidates relationships within societies (Sendón, 2004), which leads us to a perspective that transcends the idea of "management models" as an a priori structure. The institutionalisation of conservation, in this framework, implies the establishment of formal links through certain agents that regulate the way in which relations between subjects unfold through architectural objects.

3.1. Intersections between diverse actors and conceptions of vernacular practices

Starting in 2018, conservation projects began to be developed in the Casa del Marqués, first, and then in the Church of Uquía, aimed at the remediation of existing damage, much of it caused by previous interventions, and the recovery of the material characteristics of the buildings, based on vernacular techniques. These projects were undertaken through a collaboration between a national science and technology organisation and the Secretariat of Culture of the Province of Jujuy, in a consensual search to explore alternative forms of joint construction of the process with the local communities and organisations. This search is framed within institutional relations, which implies recovering the question formulated above regarding the scope of participation within these institutional margins that ultimately regulate the universe of possible relations.

Both projects had different trajectories and dynamics in terms of the construction of interactions between the different actors involved, the scope of participation and the methodologies employed. The work carried out in the Casa del Marqués was based on the joint work with the ten communities that make up Yavi, in addition to the Municipal Commission, the local government body, and the role of the CNMLyBH. This allowed the whole process of survey, diagnosis and project, but also the development of the entire works, which are in progress, to be done from the community work. Participatory workshops were developed to address the different themes, seeking to recognise local perspectives from their heterogeneity, observing other social and constructive histories, beyond those valued in institutional terms (Barada, Tomasi, 2020).

Fig. 7. Participative workshops for the restoration projet for Casa del Marques © Authors

Fig. 8. Eaves with plant fibre fabrics in Casa del Marques © Authors

This working methodology favoured the development of exchanges that highlighted the significance of this architecture, but also the technical possibilities within the earthen constructive cultures for the remediation of damage, together with the dialogue with other solutions developed in academic spaces. Given the incidence of previous interventions, the roof became a particularly relevant field where vernacular technical solutions were combined, including the use of plant fibre fabrics for the eaves, with the incorporation of reinforcements such as a wooden collar beam (Barada, Tomasi, 2020). Participative work allowed to rethink the characteristics of each technique involved, recognising their vulnerabilities and achieving reinforcement systems technically and historically coherent.

The process of the Church of Uquía, although based on similar objectives, took place in a different institutional context, in relation to the sources of financing available and also due to the high exposure of this building, which limited the margins of action, favouring the reproduction of the existing management models. While in Casa del Marqués the intervention was undertaken by the communities themselves, in Uquía the work was carried out by a construction company, with the involvement of different public bodies at provincial and national level. In this context, participatory logics were more limited than in Yavi, concentrating on the generation of different instances of consultation and validation of proposals generated mainly by the technical team, based on the academic research carried out on vernacular architecture in the region. These decisions, in turn, had to be mediated by the various organisations involved, in addition to the opinion of the construction company. In this sense, the network of relations between actors had a greater institutional centrality than in the case of Yavi, particularly in terms of the influence of local organisations. Even though technical decisions adopted were consistent with the construction system, mainly regarding the reinforcement of walls through the use of ropes and the restoration of the original materiality of the roof. These were based on research, so they did not emerge with the same intensity as in the Casa del Marqués from the joint work, which led to the need to develop expositive activities in which the community could observe and be aware of the decisions and progress made. This was not exempt from discussions and discrepancies which, although they could be exposed, in some cases were not entirely settled. In this case, institutionality also implied limits to effective participation and, therefore, to the technical decisions adopted, and in particular regarding construction times.

4. Conclusions

The processes of institutionalisation of heritage in Argentina began in the first half of the 20th century, with the creation of a state structure linked to its valuation, registration, protection and conservation, through the declaration of certain properties as National Historic Monuments, recreating the forms and logics applied contemporaneously in various European countries. This institutionalisation has implied the establishment of certain relationships between subjects and objects, materialities, through centralised and vertical mechanisms, even within the heterogeneity and contradictions in the interests and policies involved in the functioning of the state. In any case, these processes of institutionalisation imply a relocation of the relations of social collectives with their significant architectures, including new conceptions of the durability and permanence of buildings and their authenticity and integrity.

The cases analysed of the Church of Uquía and the Casa del Marqués allow an approach to the processes of institutionalisation of what is defined as heritage, recognising the implications that this has had on the "management models" for its conservation. While these architectures have historically been sustained by diverse local actors, within the framework of their own tensions and consensuses, the action of hegemonic state and private institutions has implied a significant shift in the networks of relationships involved in conservation. This has not been alien to the technical actions in interventions on buildings, even up to the present day, insofar as the institutionalisation of architectural heritage has implied the use of materials and techniques that are also institutionalised and alien to vernacular logics.

The development of participatory processes, from the institutional spheres implies a challenge in relation to the recognition of the margins of action available in order to achieve articulations that are not limited to incorporating new voices within the already established dialogues, but to generate new and different ones.

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Protection and reuse of a forgotten heritage: the Parmesan cheese buildings. Notes for a widespread museum in the lower Reggio Emilia plain

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Topic: T4.4. Management and maintenance of vernacular architecture

Abstract
The content of this proposal is a reflection on the landscape of the low Reggio Emilia plain and on the material traces still present in the area linked to the artisanal production of Parmigiano Reggiano (Parmesan) cheese dating back to the 1700s and 1800s. We refer, in particular, to the agricultural system related to the production of forage and high quality grass to obtain the so-called "white gold", i.e., milk—the raw material for making cheese—and to the architectural buildings used for artisanal dairy production. These structures, called caselli*, are much more numerous in the province of Reggio Emilia (the "Dairy Register" of 1911 lists 711* caselli*), compared to Parma and Modena, despite the fact that Parmigiano Reggiano has always characterized the economy of all of these areas. This kind of architecture is characterized by buildings of reduced proportions with a central, square or polygonal plan, structurally set on a central pillar around which the processing phases of the cheese production were organized. With perimeters of the buildings defined by brick walls, which bear weight on the edges, and characterized by a light and ventilation system, known as* gelosie *or "jalousies" paneling on the sides, they are an embodiment of valuable constructive knowledge. The brick-grid infills, or "jalousies", designed to calibrate air and light, become essential components for the production of cheese. Starting from the idea of a widespread museum in the area, related to H. de Varine's thought on the ecomuseum, some design guidelines are established for the enhancement of this production tradition and its agricultural landscape. The rapid evolution of dairy technology on the one hand, and the changes in the territory on the other, have compromised the interpretation of a system that in the tradition of knowledge, techniques and materials had characterized a territory for at least two centuries.*

Keywords: *agricultural landscape of the plain; Parmesan cheese building architecture; widespread museum.*

1. Premise: circumscribing the Parmesan area and the *caselli* territory

The starting point of a clear understanding of a territory is fundamental for framing how the production of Parmesan is a constitutive part of the Emilian agricultural design. What is left of a heritage of material culture linked to the artisanal way of producing Parmesan is presented not only in the cheese production buildings, but in the whole agricultural system that supported the craftsmanship of Parmesan: the fields cultivated for fodder, their extension and size (proportional to the capacity of the companies for milk production), the collection of milk and its transport, the art of making cheese, and the traditions associated with it. Knowing these interconnected networks makes it possible to enhance a heritage that affects the material and immaterial history of two centuries of a vast territory and which finds its character of physical recognition in the *caselli*.

The geographical area of Parmesan production corresponds to an area between the Po and the Tuscan-Emilian ridge, in the provinces of Parma, Reggio Emilia, Modena and Bologna. The territory of Parmigiano Reggiano, which extends from the plain to the hills to the Apennine Mountains, was (and still is, in part) recognizable for its landscape with its unique and characteristic morphology, a mosaic: various soil types with multiple crops growing and coexisting next to woods and strips of uncultivated land. These are the places where particular environmental and climatic conditions proved to be optimal for the production of Parmesan cheese.

This paper focuses attention on the structures of the cheese buildings as highly developed architectural elements and characterizing an articulated production system capable of drawing that physical link between the family, the community and the land that was worked, between the rural residence and the agricultural context. In the Po Valley, there has been a gradual upheaval suffered by the ways of life that were an integral part of that structure of the territory and its economic and social organization. The new landscape of industrialized agriculture is almost continous with the growing urban development that branches off a widespread city and is distributed along the farm roads, which in the meantime have been paved, widened, and lined with warehouses.

It is a landscape that has undergone major and rapid transformation since the post-war period, including road infrastructures, new railway lines, such as high-speed railways, the consequent abandonment of the more marginal ones, the reclamation works, the implementation and the redesign of the irrigation system, and the spread of intensive agriculture and its mechanization. All these have entailed structural changes to the agricultural landscape of which the production of Parmesan has been an integral part for centuries.

The abandonment of the dairy structures of the cheese buildings is, together with the design of the fields, the most visible part of the transformation that has taken place. Pazzagli points out that ‘abandonment is not all the same’, but all its gradations have in common the lack of models of life and relationships that he summarizes with the term ‘disorientation’ and which have led to an ungoverned modification of the landscape, much to its detriment.

The *caselli* are small buildings, dedicated to the artisanal manufacture of Parmesan cheese that spread from the end of the 18th century to the beginning of the 19th century, in the limited territory of Reggio Emilia, Parma and Modena. These buildings had several specific recognizable characteristics: reduced proportions; a square or polygonal plan, set on a large central pillar around which the cheese processing phases were organized; a weight-bearing structure of brick pillars; and grid infill patterns, called *gelosie* or “jalousies”. These “jalousies” allowed the air to circulate and mediate the extreme heat of the cheese production, creating a filtered environment, while modulating the light that flowed inside. However, it was only in the province of Reggio Emilia that the *caselli* with these specific recognizable characteristics were present in large numbers.

In the high and low plains, where the production of Parmesan is greater, there is a high concentration of these cheese buildings. The “Dairy Register” of 1911 lists over 700 *caselli* in the province of Reggio Emilia.

2. The *caselli*

The first *caselli* of the mid-18th century were simple constructions with a wooden structure. When in the second half of the 19th century, the production of Parmesan increases, the producers begin to need specific architectures that are functionally related to the processing: brick boxes are introduced, offering adequate ventilation and the possibility of lighting a fire inside. These structures were built in a rural environment and were closely linked to the farm for the produc-

tion of milk and the reuse of the waste derived from cheese production in pig breeding. The distribution of these buildings throughout the territory was dictated by the need for milkmen, who transported milk on their shoulders or on hand-pushed carts, to make their trips as short as possible. The place where they chose to build the constructions met specific requirements: it had to be easily accessible, near a crossroads or at the convergence of several roads.
The *caselli* became nodal points of the territory. They faced the road to be more visible and had a front space that could be used as a loading zone. They were as important for economic organization as they were for social life. The *casello* was configured as a place of meeting and information sharing for the population, so much so that the civil and ecclesiastical authorities used it to post their notices.

It was part of the building system that made up the dairy; the *casello* was used for the storage and processing of milk, the *salatoio* was where the cheese was salted, and the *casera* was used for the first seasoning or aging of the cheese. The cheese building could be isolated or merged with the residence and have an adjoining or separate salting room.

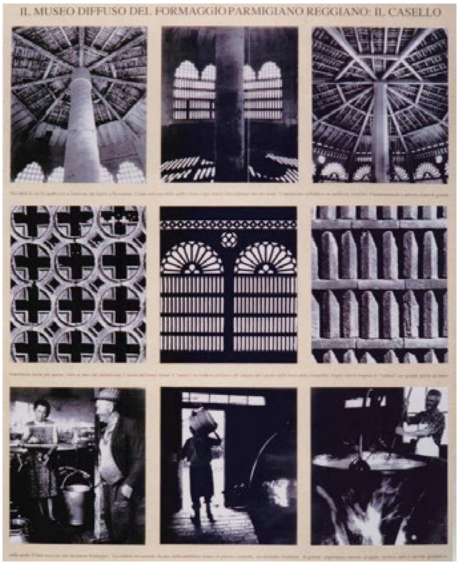

Fig. 1. The structure, the "jalousie" grid and the work of the *caselli* interior. (Stanislao Farri, 1979)

Before the arrival of a stable architecture suitable for its production, the cheese was cooked on a temporary hearth, set up outdoors, with a central support to hang the boiler. This was sheltered by perimeter screens and a roofing system, both supported by wooden poles. This pattern takes on a stable form in the brick building. They mainly have a central plan: polygonal (hexagonal or octagonal) or square. The square one is more archaic than the polygonal one, which in addition to ensuring a more immediate recognition of the dairy, improved its functionality in the distribution of work spaces and increased the ventilation capacity, making the direction of the wind less decisive.

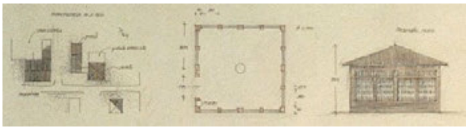

Fig. 2. Location of *casell*o in the system of rural buildings: square type. (drawing made by the author of this paper)

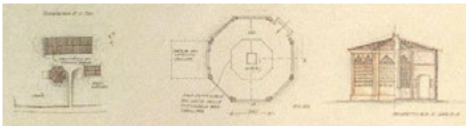

Fig. 3. Location of *casell*o in the system of rural buildings: polygonal type. (drawing made by the author of this paper)

In most cases, the increased productivity involved the construction of additional spaces to the original volume of the building, progressively marking the decline of artisanal production and the introduction of an industrialized process.

Analyzing the dimensions of the plans and the elevations of the remaining *caselli*, it can be seen how, in those built from the second half of the 19th century, the measurements are often linked by proportional relationships. "Osteria Vecchia" in Casalgrande, "Margone" in Scandiano, and "Giardiniera" in Roncadella, are octagonal blocks in which the internal divisions of each elevation are based on geometries articulated on the figure of the square, on its decomposition through diagonals and medians, and on the size of a single brick, taken as a modular unit of measurement.

In the quadrangular Roncina building, the height and width dimensions are linked by the geometric ratio 1:2, the elevation being equal to half of the plan.

In all the cheese buildings, the materials are local ones linked to traditions widely used throughout the Po Valley: terracotta, wood and stone. The brick used for both the structural and finishing parts prevails, providing a porous and transpiring material very suitable for the needs of this architecture. The ductility of the clay allows intervention on the finished element by cutting or smoothing, and allows a great variety of shapes even in the grids and in the pieces that compose them.

In the *caselli* structure, a very important element is the central pillar. It has a circular or square section, and large dimensions as the beams of the roof converge on it from the corner pillars. A metal bracket was inserted into the pillar, which allowed the *caldera* to be suspended over the fire.

The *caldera* is the copper boiler in which the milk was cooked. The *fornacella* is the hole dug next to the central pillar where the fire was lit, circumscribed by a wall about 90 centimeters high that protected the dairyman from the fire. The cover is made in such a way as to facilitate the dispersion of fumes.

The rafters, arranged radially, support the tiled roof. All the elements of the roof structure were generally made of oak. In order to increase the ventilation of the room, tiles were not always placed between the cover system and the wooden structure.

Sometimes, to prevent dust and debris from falling on the milk containers placed on the shelves close to the walls, the tiles were interposed only in the peripheral part of the roof. Another architectural element functional to the aeration of the cheese building is the turret that takes up the shapes and proportions of the building on which it stands and repeats the perforated holes with the “jalousies”. Dictated by the need for functionality, the turret became a decorative element. The owners of the cheese buildings used this opportunity to further characterize their company. Pinnacles, chimneys and small terracotta figures placed at the top of the roof fulfulled the same purpose. Even the windbreak grills, derived from the strictly functional need to make the environment as permeable to air as possible, became decorative and characterizing elements. One of the purposes of the “jalousies” was to break the wind gusts that could have altered the climatic equilibrium of the environment. Ventilation was necessary for the nocturnal decantation of the milk and during the cooking phase it helped to keep the fire lively and also helped to eliminate smoke.

There were no particular heating requirements because the cheese building wasn’t used in the winter months. Due to the chemical composition of the milk, linked to the feeding of the animals that varied according to the seasons, production went from April to November. Even though the “jalousies” contributed to making the environment airier and, therefore, cooler in the summer months, during the day, the temperatures inside the *casello* became very high. Thus, rows of trees were planted at the right distance to shield the sun during the hottest hours of the day.

The windbreak elements of the “jalousies” could be oriented so as to favor the rapid exchange of air and the rotation of the fumes inside. The grids also responded to the purpose of regulating the light appropriately; harsh lighting would have been harmful to the processed products and the dim light helped to keep away the insects that would have been attracted by the light. The “jalousies” were in terracotta, with the most archaic ones in wood. Only in S. Michele della Fossa is there still an example of grates of the latter type.

As far as the grids are concerned, each building has a different formal solution. In addition to the modular elements used being quite varied, the way of composing them also changes. The great variety of combinations is their characteristic.

The elements that made up the grids of the *casello* were often purposely manufactured either by modifying the bricks currently produced, or by using molded pieces. The shapes are the most varied: from the small columns spread in the middle and lower plain in the northeast, to the "crosses and circles" motif, from the four-leaf clover framed by a lozenge to the "S" arranged alternately in straight and inverted form.

At the end of the 19th century, dairy production changes and, progressively, it passes to an industrial type of production. Several factors will lead to the development of the most modern social dairies and to the abandonment of the cheese buildings. These factors include the need for greater hygiene during all stages of processing, and the impossibility of containing more modern machinery due to the scarcity of space. As a result of these factors, the transition is made from an artisanal production model to an industrial one, which becomes more scientifically and technically adequate, profitable and competitive. With the industrialization of the Parmesan cheese production process, the larger and more modern steam stations replaced the wood-fired ones which, abandoned or destined for often incompatible uses, began to undergo a process of decay. Then what Andrea Emiliani called, 'the drama of the transition towards the cultural model of industrial civilization' took place, which as he affirms, saw the steep decline and death of a particular way of relating to, and caring for, the things of daily life. Unfortunately, the generational passing-down of know-how also ceased then. There was a rupture in the profound transmission of artisan knowledge, which is not a subordinate and secondary science, but the "other culture", the practical one, never written and, as such, inherited from generation to generation from the hands and from the pragmatic intelligence of humankind. Among the more than 700 cheese buildings listed in the "Dairy Register" of 1911, only about 85 remain.

3. An enhancement proposal. The Caselli Park: itineraries in the museum of the Reggio Emilia plain

The *casello*, as an open architecture, in continuous osmosis with the outside, is a characteristic element of the landscape and a fundamental stage in a dense network of connections linked to the places where milk and, therefore, cheese are produced. An enhancement project must consider not so much the *casello* as architecture in itself, which will need a specific conservative restoration, but the *casello* as architecture in the territory. A widespread museum project is proposed, capable of speaking for the agricultural-productive history of a territory. The perimeter and extension of the area of interest can be understood through a continuous process of updating; however, initially the choice falls on the Reggio Emilia area where the concentration of cheese buildings is greatest: the area between the Po and the municipalities of Novellara, Correggio, Bagnolo in Piano and Reggio Emilia.

Factors of primary interest for the constitution of the Caselli Park include the attractive role of the provincial capital, and the existence of significant natural resources and valuable architectural assets that are in complete abandonment. Furthermore, the condition of environmental degradation due to the presence of the industrial and exhibition areas of Mancasale, and the environmental-ecological directives of the Bagnolo Master planning, constitute important factors in terms of potentiality and criticality. On the one hand, the aim is to restore functionality and its own recognizability to each cheese building; and on the other hand, articulated plots are woven to recover the readability and understanding of the whole territory. By consulting the regional landscape plan and the territorial government plans of the municipalities mentioned previously, the proposal is a park system that revolves around Bagnolo in Piano, in which the *caselli*, through the widespread museum of Parmesan cheese, become a guiding and unifying thread.

The intent is to build a network of paths that interpret the territory and its development, while recovering a potentially strategic area since it is located at the center of a series of points of architectural and naturalistic environmental interest. Bagnolo in Piano is located in a central position with respect to significant points of the territory: Reggio Emilia to the south, Correggio to the west, Novellara to the northeast, and the Po to the northwest. Paths are designed that follow guidelines already specific to the area and make them useful again through the creation of three countryside parks: the Canalazzo Tassone-Crostolo countryside park, which flows into the Po; the Strada Vecchia countryside park that connects Bagnolo to Novellara; and the old Campagna park.

The Caselli Park becomes an opportunity to solve existing criticalities and put into a planned system the projects already in place: the recovery of the Reggio-Guastalla railway line, the involvement of the Sun Cycle Route (Verona-Bologna-Florence), the Correggio cycle paths, the high-speed bypass, the environmental recovery areas of the brick-production furnace of Fosdondo, the project for the enhancement of the Po and the project of a naturalistic cultural interpretation path of the Reggio Emilia canal. The numerous studies concerning the Park area involve different portions of the territory and have been formulated at different times and by different bodies with the result of a lack of communication with each other. The Caselli Park has, among its objectives, enhancing continuity by synergistically linking the different aims.

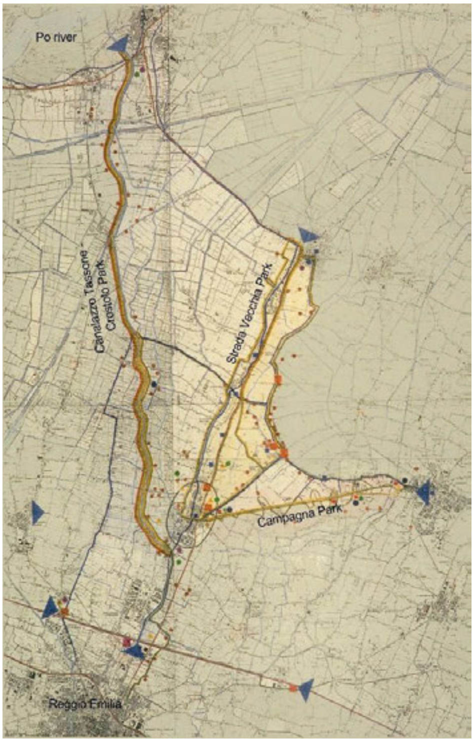

Fig. 4 Caselli Park Map: a territorial museum experience.

First level: the three lines along which the three different parks develop are established. This includes the Canalazzo Tassone, with an environmental and naturalistic character; the park along the Reggio-Guastalla state road, with a historical and architectural character; and the one along the Bagnolo-Carpi railway, with a playful character.

Second level: the intersection of the three theme parks in Bagnolo in Piano becomes the hinge of the system.

Third level: the access points to the Caselli Park are chosen. These are as follows: to the south from Reggio Emilia, through the cycle paths of the city; to the east and west, the accesses from the motorway rest areas of Sesso and Dinazzano, where two *caselli* become stages of the widespread museum of Parmesan cheese; and to the north, the preferential access is from the Po, through the pedestrian and cycle paths along the Crostolo-Tassone stream. In this way, the Caselli Park is connected to the Po cycle path and to the Po Project.

Fourth level: the two horizontal connections are established: to the north, the Guastalla-Correggio state road; and to the south, the cycle path that leads from Sesso to Dinazzano.

The superimposition of these four levels on the territory creates the backbone of the Caselli Park. The widespread museum of Parmesan cheese is developed across the three countryside parks, constituting a unifying element for them, interpreting the environmental and cultural context in which the *caselli* themselves were first built and then evolved.

The cheese buildings inside the Caselli Park represent the stopping points of the widespread museum of Parmesan cheese; there are seven in all (the transformed ones) and they constitute a privileged observatory.

The museum, in fact, is not intended as a fenced reserve, but as a reality open to the whole territory affected by the presence of the cheese buildings. Those who visit the widespread museum receive the tools to recognize and understand the other 78 *caselli* present in the Reggio area. The seven recovered cheese buildings become a bike rental, a small museum, an audiovisual space, an educational laboratory, two refreshment places and an information space.

The Caselli Park offers a a form of enhancement and protection of the agricultural landscape and its architecture, together with a model of local development through a responsible experience of a territory. It is a journey through the knowledge of ancient traditions linked to one of the most profitable and consistent forms of the economy of the Emilia-Romagna region currently present, a sort of bridge between past and future. It ranks as a possible ecomuseum of Parmesan cheese consistent with the principles of the strategic Manifesto of the Italian Ecomuseums. This ecomuseum could stand together with other experiences such as the Cervia Salt Mines, Terre Salentine, Argenta, Parabiabo, Gemona Water Ecomusuems, etc., as museums that unite the places of production to the constructed landscape in which they are located.

4. Conclusion

The territory is no longer conceived as a container of isolated ineffable monuments, rather it is seen as a system of goods and objects connected to each other, and only in this way understandable.

The cheese museum is an open-air museum of material culture. Visiting this museum, one learns about the fabric of works and forms that can be read as signs of the history of a culture.

Going through the widespread museum of Parmesan cheese implies discovering the material culture linked to the *caselli*: the artifact, its history and its territory. In so doing, the visitor regains possession of the testimonies of the past, made alive and current again.

Fredi Drugman, architect and professor at the Politecnico di Milano, one of the first theorists of the widespread museum concept, said "(...) I think that museums, some museums serve precisely this: to strengthen, as far as their limited sphere of action allows, the sense of belonging (...)". These are words that underline the profound value given to the history of work, of communities, to all those events that can constitute an experience of knowledge.

It means being able to know a landscape as a visible manifestation of current uses and of those that have followed over time by reading that palimpsest of signs that make up the wealth of the territory.

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HERITAGE 2022 INTERNATIONAL CONFERENCE

VERNACULAR HERITAGE: CULTURE, PEOPLE AND SUSTAINABILITY

Eds. C. Mileto, F. Vegas, V. Cristini, L. García-Soriano

Vernacular architecture, tangible and intangible heritage of great importance to European and global culture, represents the response of a society culturally linked to its territory, in terms of climate and landscape. Its construction features are born from the practical experience of the inhabitants, making use of local materials, taking into consideration geographical conditions and cultural, social and constructive traditions, based on the conditions of the surrounding nature and habitat. Above all, it plays an essential role in contemporary society as it is able to teach us important principles and lessons for a respectful sustainable architecture.

Vernacular Heritage: Culture, People and Sustainability will be a valuable source of information for academics and professionals in the fields of Environmental Science, Civil Engineering, Construction and Building Engi-neering and Architecture.

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