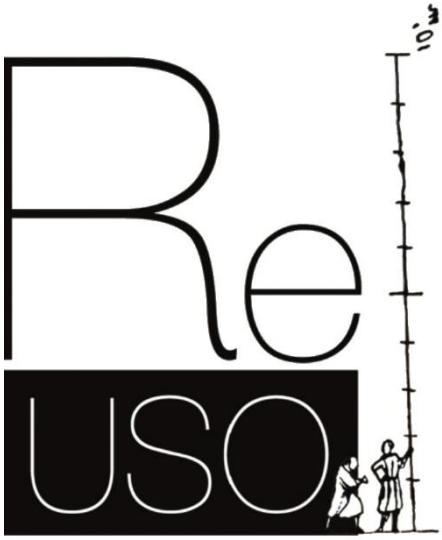
Documentation, Restoration and Reuse of Heritage

2-4 November 2022
Porto, Portugal

BOOK OF EXTENDED ABSTRACTS

INSTITUTO DA CONSTRUÇÃO
U.PORTO FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO
CONSTRUCT



Documentation, Restoration and Reuse of Heritage

Book of Extended Abstracts

2-4 November 2022
Porto, Portugal

www.fe.up.pt/reuso

Extended Abstracts of the

Xth edition of the ReUSO - Documentation, Restoration and Reuse of Heritage

Format: Ebook (pdf)

ISBN: 978-972-752-297-2

Porto, Portugal, 2-4 November 2022

H. Varum, A. Furtado & J. Melo (eds.)

Chair

Humberto Varum
U.Porto / FEUP, Conference Chair

Honorary Committee

António Sousa Pereira (Rector) | UP | Portugal
Rui Artur Bártolo Calçada (Director) | FEUP | Portugal
João Pedro Xavier (Director) | FAUP | Portugal
Ignazio Marcello Mancini (Dean) | U. Basilicata | Italy
Giuseppe De Luca (Director) | U. Firenze | Italy
Aldo Corcella (Director) | DiCEM/U. Basilicata | Italy
Susanna Caccia Gherardini (Professor) | U. Firenze | Italy

ReUSO Founding Committee

Stefano Bertocci | U. Firenze | Italy
Giovanni Minutoli | U. Firenze | Italy
Fauzia Farneti | U. Firenze | Italy
Susana Mora | U.P. Madrid | Spain
Silvio Van Riel | U. Firenze | Italy

Organising Committee

Humberto Varum, Portugal
Alexandre Costa, Portugal
André Furtado, Portugal
Aníbal Costa, Portugal
António Arêde, Portugal
Bruno Marques, Portugal
Bruno Quelhas, Portugal
Cilísia Ornelas, Portugal
Clara Vale, Portugal
Esmeralda Paupério, Portugal
Hipólito Sousa, Portugal
Hugo Rodrigues, Portugal
João Miranda Guedes, Portugal
José Melo, Portugal
José Miguel Rodrigues, Portugal
Marco Faggella, Italy
Miguel Malheiro, Portugal
Nelson Vila Pouca, Portugal
Patrício Rocha, Portugal
Pedro Delgado, Portugal
Rui Póvoas, Portugal
Rui Silva, Portugal
Teresa Ferreira, Portugal
Vasco Freitas, Portugal
Xavier Romão, Portugal

Scientific Committee

Humberto Varum, Portugal
Agostino Catalano, Italy
Alexandre Costa, Portugal
Alice Tavares, Portugal
Ana Tostões, Portugal
Ana Velosa, Portugal
André Furtado, Portugal
Andrea Nanetti, Singapore
Angelo Lucchini, Italy
Aníbal Costa, Portugal
Antonella Guida, Italy
Antonello Pagliuca, Italy
Antoni Moreno-Navarro, Spain
António Arêde, Portugal
Antonio Conte, Italy
Calogero Bellanca, Italy
Camilla Mileto, Spain
Caterina Palestini, Italy
Clara Vale, Portugal
Damiano Lacobone, Italy
Juan A. García Esparza, Spain
Juan B. Aznar Mollá, Spain
Lorenzo Jurina, Italy
Luis Miguel Correia, Portugal
Luis Palmero Iglesias, Spain
Manlio Montuori, Italy
Manuela Grecchi, Italy
Marcello Balzani, Italy
Marco D'Orazio, Italy
Marco Faggella, Italy
Marco Morandotti, Italy
Marco Pretelli, Italy
Marco Tanganelli, Italy
Marcos Tognon, Brazil
Maria Fernandes, Portugal
María Paz Sáez Pérez, Spain
Mariana Correira, Portugal
Marianna Calia, Italy
Mariella De Fino, Italy
Marina Fumo, Italy

CONTENTS

Plenary Keynote Lectures

Participants communications

Methodology for minimum intervention in sustainable Earthen architecture

Aníbal Costa – Risco, University of Aveiro, Portugal, agc@ua.pt

Alice Tavares – CICECO, DEMAC, University of Aveiro, tavares.c.alice@ua.pt

Abstract: The old buildings that are vacant, many of them with cultural, social and historical values, are part of the identity of a region and are an opportunity to revitalize it, through its reuse. It is urgent to use environmental and cultural sustainability criteria in this process, in counter-cycle with the increase in construction waste production, that between 2015-2018 reached values of 48% (dangerous) and 38.7% (non-hazardous), resulting from the current practice of demolitions.

Earthen architecture is one of these heritage legacies at risk, disseminated in the Central region of Portugal, and the present study inventoried representative buildings - the Patio Houses Gandaresas (1164 buildings) and the Brazilian type Houses (462 buildings) - in 10 municipalities . Based on this survey, the most significant typologies and their constructive system characterization were studied, serving as a basis for the structuring of a methodology for minimum conservation intervention, for which the current anomalies were previously identified: deformation of facades, lack of cohesion of the structural system (walls/floors/roofing), incorrect functioning of the rainwater drainage system and ventilation at the base of the walls, the action of salts on the coatings, among others.

The exhaustive knowledge of materials, construction systems, risks of degradation due to use or environmental conditions impacts, as well as interventions from the past to be reversed, support the options of real case studies of minimum intervention, of which two examples are presented: the Cestinhos House at Ílhavo and Gandaresa House at Seixo in Mira.

Keywords: Conservation, sustainability, authenticity, earthen architecture, adobe.

1. Introduction

Earthen architecture in the central region of Portugal is one of the most outstanding expression of integration in the landscape intrinsically linked to the lives of past populations, due to their way of using natural resources. For this reason, it represents a valuable cultural heritage associated to its effective values of sustainability, in accordance with the current concepts of continuous reuse of this construction material.

It is usually recognized that the new use of buildings, through rehabilitation or conservation interventions, must be compatible with the preservation of the authenticity of the built heritage. It is essential that a criteria framework is defined before the architectural design plan, for that purpose. This will enable to integrate the preservation of materials and traditional construction systems of the old building avoiding the disseminated use of demolitions. As Pritzker Prize winner Anne Lacaton says, “demolition is a waste in every way—a waste of energy, materials and also our collective memory”.

In this regard the use of a model for an architectural heritage conservation strategy based in the minimum level should be established and serves as a guidance to support the decision-making process [1].

The first step in this process is the inventory of buildings typologies where it is possible to define a coherent set of common characteristics which distinguish them from other types of buildings. The knowledge about the percentage of buildings with high level of authenticity is crucial for the definition of levels of protection and acceptable transformation levels. In this sense, sustainability criteria and preservation criteria are combined in the minimum intervention.

The present study inventoried representative buildings of Earthen Architecture, such as the Gandaresas Courtyard Houses (1164 buildings) and the Brazilian-style Houses (462 buildings) in 10 municipalities in the Central region of Portugal [2]. The survey carried out georeference them, as a starting point of this knowledge. For Gandaresa houses were considered the following regions: Ílhavo, Vagos, Mira, Cantanhede, Oliveira do Bairro, Mealhada, corresponding to an area of 887 km2 with 151,221 inhabitants. In this region were identified 1164 Gandaresa houses. The same procedure was followed for the study of Brazilian type houses in Cantanhede, Mealhada, Anadia, Tondela, Santa Comba Dão, Oliveira do Bairro, Águeda, corresponding to an area of 1560 km2 with 161,339 inhabitants and 462 Brazilian type houses were identified [2].

In Portugal, the buildings built before 1919 represent most of the vernacular architecture, regardless of the traditional construction system used. According to the 2011 censuses, those buildings represented only 5.8% of the total number of buildings which have declined in the last ten years, reaching 4.8% (2021). This critical value indicates the onset of an irreversible loss of vernacular architectural heritage. Within ten years (2001 to 2011), Portugal lost 18.9% of its buildings built before 1919, and the central region of the country stood out with a 31.8% loss. For some of the municipalities where adobe was the most representative building material these buildings represent less than 3% of total building stock [2]. An analysis of the situation of earthen architecture in the Central region of Portugal reveals a sharp decrease in recent years, with special emphasis on municipalities where adobe architecture represents practically all of the built heritage, such as Anadia with a decrease of 43%, Ílhavo with a 35% decrease or Mealhada with a 46% decrease.

Therefore, urgent measures are necessary to safeguard this valuable heritage. The central region of Portugal is rich in Earthen architecture (with adobe and *tabique* partition walls), and ordinary stone earthen masonry is still present, [3].

In the recent rehabilitation interventions in existing buildings, it is recognized that the activities carried out by the building sector generate an increased construction waste, reaching between 2015-2018 values of 48% (dangerous) and 38.7% (non-hazardous). This is due to the common practice that carry out extensive demolitions, most of the time preserving only the facades or just the main facade. This situation gives rise to a lot of waste on which a whole theory of recycling is then developed, but with scarce effectiveness. However, this situation can be avoided through a sustainable rehabilitation operation that seeks to maintain the existing materials and construction systems, and the intervention may or may not be accompanied by new uses. Within this concept, Reuse can also be seen as a sustainable strategy as long as it is well framed and accompanied by a program that is compatible with the characteristics of the existing building.

Yang Zhang [1] states that “it is critical to identify the minimum intervention for preservation needed, as well as the levels of interventions. Only by clarifying the total number of intervention levels can we find the minimum level of intervention for an architectural heritage, which is the relationship between them”. This research presents a methodology for minimum intervention to be applied for the case study buildings and presents its application to two representative Earthen architectural heritage.

2. The structure of a methodology for minimum intervention

The main objective is to combine the preservation of the cultural values of the building, reducing the production of construction waste and provide the necessary conditions of habitability. A previous work was carried out to assess the changes ocorred in built heritage in the last years, in a case study region involving [4]. The analysis of this results were used for the proposal of the methodology for minimum intervention structured in four main sectors:

- preservation of cultural values;
- minimum actions for efficient repair;
- programmatic and regulatory compatibility;
- anomaly prevention and increased durability.

Each of these sectors complies a set of criteria to help in the decision-making of possibilities. The Table 1 summarizes the structure of a methodology for minimum intervention for which research, *in situ* assessment and dialogue with future users or stakeholders should provide the necessary information to establish the framework of the intervention.

Table 1 - Structure of a methodology for minimum intervention (previous architectural design)

Minimum intervention			
Preservation of cultural values	**Minimuml actions for efficient repair**	**Programmatic and regulatory compatibility**	**Anomaly prevention and increased durability**
Assess level of authenticity and integrity of cultural values	Data from *in situ* assessment (inspection)	Definition of steps for progress improvement, sustainability and acceptable impact of legislation/regulations	Choice of materials compatible (chemical & physics) with the old ones
Asses level of uniqueness in the region	Results of laboratory analysis and monitoring	Identification of uses compatible with pre existence	Choice of construction components compatible with the old structure
Reversibility of solution	Knowledge about the evolution of the building and past repairs	Previous definition of non-changeable areas (building) due to cultural values	Choice of durable materials
Identification of original features and components	Identification of causes of anomalies	Previous definition of acceptable impacts of new infrastructure (ventilation and others)	Ensure peripheral rainwater drainage system
Assess level of integration in the landscape (rural / urban)	Informed definition of necessary repairs	Previous definition of acceptable changes due to acessibilities	Ensure natural ventilation at the base of walls and ceiling
Low intrusiveness (architecture and construction level)	Strategy to improve comfort, use and safe energy compatible with pre existence	Previous definition of acceptable changes in the surroundings	Provide accessible openings in the building for inspection

3. Earthen architecture case studies

In the selected case studies this methodology was applied, a survey about the number of these types of buildings in the region was carried out. The assessment of changes and percentage of buildings with original elements was also pursued. Most municipalities allowed more than 35% of demolition of old buildings in the last 10 years (2011-2021), in the most of the cases, buildings prior to 1919 represent less than 5% of total building stock.

For this reason the case study buildings represent a relevant cultural heritage and a landmark in extinction. One of them (Brazilian type house) the use was maintained and the intervention was inline with conservation intervention. Maintaining the same use (housing) made it easier the application of minimum intervention model and the preservation of cultural heritage. On the other hand, in the Gandaresa house the use was changed, for recreative purposes of a cultural association, but the defined program was careful evaluated prior to any change or recovery and compatibility levels were defined to all intervention. This allowed the reduction of production of debris and the preservation of the authenticity as much as possible in both cases. In this sense, the following case studies show that sustainable rehabilitation can give new life to abandoned buildings and when well framed in an urban rehabilitation policy, can be a lever for cultural tourism or comply the needs of housing in a region.

3.1. Cestinhos house (Brazilian type house)

Cestinhos house, the only Earthen architecture building classified in Ílhavo, Figures 1 to 3 (in intervention), located on the side of the EN 109 street, in the municipality of Ílhavo, is part of the group of Brazilian type houses of the 19th century in Portugal, presenting an Eclectic architecture with good characteristics of constructive and material quality, with well-executed traditional techniques. In the past, this sometimes involved looking for the construction workers in regions other than the location of the building, which justifies similar shapes in different traditional materials and the replication of design models of decoration and volumetric shapes.

Figure 1 – Cestinhos house, Ílhavo (credits: Aníbal Costa)

Figure 2 – Room, interior, Cestinhos house (credits: A. Tavares)

Figure 3 – Balcony Cestinhos house (credits: A. Tavares)

Cestinhos house stands out in the urban landscape due to its singularity, Figure 1, use of high roofs, color, decorative elements on the facade and interior, decorative and functional individualization of spaces (funcion dependent) over partition or adobe walls , Figure 2, stairs as a sculptural element at the main entrance with a balcony, Figure 3, the use of turrets

or other elements such as porches. The internal organization follows the traditional symmetry solution with a central corridor to which changes with foreign influences were added, following international models. From a constructive point of view, the main feature is the choice of good quality materials, with good construction techniques and durability criteria. In this region the materials used were adobe masonry and formed masonry (close to rammed earth but with stones, bricks in a mixture with earth), the wooden structures (local or imported from Brazil, USA and Northern Europe) for the roof and floors. In this sense, the use of durable materials in the original places were maintained, according with the good results of preliminary building assessment which gave confidence to preserve them.

This house had been abandoned for several years, having progressively been deteriorated, until it was bought by the new owners, who wanted to recover it for their housing. They intended a minimum intervention, in order to preserve the original building as much as possible, not only for cultural heritage values but also for economic reasons.

As is usual in interventions in existing buildings, a building assessment Report [5] was carried out, in which *in situ* analysis and laboratory tests were a fundamental data to characterize materials, the construction systems, structural and non-structural anomalies. Based in this preliminary analysis of the building a series of minimum intervention measures were defined, namely the reduction of structural changes and the judicious use of wooden prostheses with metal devices or the type of retrofit of connections between walls and wooden beams (structure of the floors), in order to make sustainable conservation as much as possible.

In all constructions, it is essential to avoid the ingress of water, either above (roof) or below (rising damp) to avoid future problems in the durability of materials and structures. In this case, there were several problems associated mostly to leaks through the roof in singular volumetric intersections and through rising damp due to absence of drainage water system, Figures 4 to 6.

Figure 4 – Leaks through the roof, chimney, kitchen (credits: Aníbal Costa)

Figure 5 –Leaks through the roof close to the turret

(credits: Aníbal Costa)

Figure 6 – Humidade ascensional (créditos: Aníbal Costa)

As mentioned, the intervention in this case sought to eliminate the causes of the detected anomalies using minimum solutions to resolve them, Figure 7 to 9.

Figure 7 – Jointing the wooden beams and locking the masonry walls out of plane by connecting to the floor structure (credits: Aníbal Costa)

Figure 8 – Repair of connections between roof structure with floor beams

(credits: Aníbal Costa)

Figure 9 – Splice of wooden beams (credits: Aníbal Costa)

Figure 10 – Cestinhos house at the end of minimum intervention (credits: A. Tavares)

3.2. Gandaresa House, Seixo, Mira

Gandaresa House is located at Moliceiros street in the parish of Seixo, in Mira. The aim of the promoters of the initiative (a non-profit association) was rehabilitate the House which was vacant, to create a cultural center for the dissemination of Gandaresa Culture. Not being reduced to just a museum, but being a center of life experiences deeply rooted in the local population, showing their old rural tools, promoting dynamic community actions, their singular gastronomy, among other aspects.

Gandaresa House is part of the group of one-story courtyard houses of vernacular architecture in the coastal region of Central Portugal, with existing buildings mainly from the end of the 19th century to the mid-20th century. It presents an implantation in “L” predominant (50%), or in “U” (30%) or even in “O” (20%). Possibly with parts, to the back, built in different moments, denoting its organic evolution following the growth of the household family and the its economic capacity. Gandaresa House is deeply associated to the rurality of these regions, in locals with deep constructive traditions linked with solidarity communities in all moments of the construction of the house for the new family. (Figure 11).

Figure 11 – Front facade and interior view of the courtyard of Gandaresa House, Seixo, Mira (credits: Aníbal Costa)

Gandaresa House at Seixo is made of adobe (sundried blocks with earth, air lime and water) which is a singular and sustainable construction product, very rooted in the local culture and with great qualities (thermal, humidity control and acoustics) and simplicity. Its use or reuse, as well as the preservation of the adobe blocks can easily contribute to strategies for the circular economy, reducing waste and to achieve goals in terms of reducing the carbon footprint. In this particular case, sustainable rehabilitation involved solving the causes of structural and non-structural anomalies using solutions in which the preservation of existing materials and construction systems was privileged, following the recommendations of the preliminary building assessment report. The judicious replacement of degraded wooden elements, the types of connections between walls through nailing with stainless steel rods with injection of compatible liquid mortar were decided priorizing compatibility criteria.
It was considered essential to reactivate the ventilation of the void of ventilation of ground floors, crucial to improve the durability of the base of the adobe walls and timber beams of the floors. correcting the level of the ridge, placing it at level, was essential to avoid singular points of infiltration. The final result of the intervention can be seen in Figure 12.

Figura 12 – Front façade and the courtyard of the Gandaresa House, Seixo, Mira (credits: Aníbal Costa)

4. Conclusions

The present challenges of preservation of cultural heritage buildings and reduction of demolitions (which increase the production of construction waste) compromising the committing to the European goals to be achieved, impel the urgent dissemination of minimum intervention. In fact just less than 5% of the building stock are buildings prior to 1919 which is a demonstration of this complex problem. This research study two significant types of Earthen Architecture heritage – Brazilian type House and Gandaresa House – belonging to the central region of Portugal. A survey in 10 municipalities of this region provided the necessary information to built the structure of the methodology of minimum intervention, divided in four sectors of evaluation & decision: preservation of cultural values; minimum actions for efficient repair; programmatic and regulatory compatibility; anomaly prevention and increased durability. The minimum intervention was applied in two different case studies: Cestinhos house (Brazilian type house) at Ílhavo and Gandaresa house at Seixo, Mira. The definition of criteria of compatibility at all levels is crucial when the preservation of cultural heritage values as well as sustainability are targets to achieve. The minimum intervention applied to the two case studies were presented.

Acknowledgements

Alice Tavares thanks to FCT – Fundação para a Ciência e Tecnologia due to postdoc research support (2021.03830.CEECIND), and her work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC).

References

[1] Yang Zhang, Wei Dong. Determining minimum intervention in the preservation of heritage buildings. International Journal of Architectural Heritage 2021; 15:698-712, http://doi.org/10.1080/15583058.2019.1645237.

[2] Alice Tavares, Aníbal Costa. Rehabilitation of earthen architecture, from courtyard houses to Brazilian houses in the center of Portugal. REHABEND 2022 – Congress on Construction Pathology, Rehabilitation Technology and Heritage Management, 13 a 15 de setembro, Granada, 2022.

[3] Alice Tavares, Aníbal Costa. A Investigação para a Conservação do Património da Arquitetura de Terra (Adobe) na Região Centro de Portugal. 7º FIPA - 7º Fórum Internacional Património Arquitéctónico – Portugal Brasil. ISBN 978-65-00-055466-7 e ISBN 978-989-54851-0-9, pp. 85-96. Editores Rita Amoroso, Ceça Guimarães, Diego Dias, Aníbal Costa, Alice Tavares. 7º FIPA 2020.

[4] Alice Tavares, Maria Rita Amoroso e Aníbal Costa. Contributos para o conhecimento do Património Arquitetónico Português-Brasileiro e medidas para a sua salvaguarda por análises multicritéio. CONREA21. O Congresso da Reabilitação. Livro de Atas. Editores: Aníbal Costa, Alice Tavares, Hugo Rodrigues, José Lapa. Editora: UA Editora. ISBN 978-972-789-699-8; DOI: https://doi.org/10.48528/gy68-y843.1ª Edition – june 2021.

[5] Aníbal Costa, Alice Tavares,, Cláudia Escaleira.– Technical Assessment Report . Casa dos Cestinhos, Rua do Cabecinho nº 1, EN109, Ílhavo. Owners: Drº Viriato Rodrigues e Drª Marina Rodrigues. October 2017.

Gran Canaria: patrimonio diverso

Juan Sebastián López García, Universidad de Las Palmas de Gran Canaria, Gran Canaria, Spain, email: juansebastian.lopez@ulpgc.es

Como las restantes islas de Canarias, Gran Canaria ofrece un patrimonio diverso que se corresponde con su posición geográfica tricontinental. El poblamiento inicial se produjo con gente procedente del norte de África, lo que se evidencia en el patrimonio arqueológico, con manifestaciones tan destacadas y variadas como Risco Caído y las montañas sagradas de la cumbre de la isla (Patrimonio Mundial, 2019), La Guancha (Bien de Interés Cultural [BIC], 1949) y la Cueva Pintada (BIC 1972) en Gáldar o Cuatro Puertas en Telde (BIC 1972), contando con el Museo Canario como museo arqueológico insular concertado, en las Palmas de Gran Canaria. Con la conquista (1478-1483) se produce la hispanización y en la construcción histórica del territorio continuaron ciudades antiguas y se crean de nueva fundación, que hoy son conjuntos históricos de distintas características (Las Palmas, Telde, Gáldar, Arucas, Teror, Guía, Barranco Hondo y Santa Brígida). Los lenguajes artísticos aparecen en la arquitectura desde los elementos del gótico y las carpinterías de tradición mudéjar, con la continuidad en la arquitectura popular de la casacueva prehispánica con otras manifestaciones tradicionales. Los bienes muebles cuentan con el aporte de Flandes, distintas regiones españolas y otras zonas europeas, mientras desde América llegaron pinturas, esculturas y piezas artísticas, continente que además fue la puerta de Oriente para obras procedentes de Filipinas y Japón. En paralelo los propios artistas canarios destacan en el panorama de las distintas artes del archipiélago, destacando el pintor Juan de Miranda y Luján Pérez entre los nacidos en el siglo XVIII. Gran Canaria cuenta con más de un centenar de bienes de interés cultural, en las categorías de monumentos, zonas arqueológicas, conjuntos históricos, sitios etnológicos, sitios históricos, bienes muebles y bienes inmateriales, a los que se sumarán otros de paisaje cultural y sitio industrial.

The rehabilitation of Bolhão Market, Porto.

Project, process and the future of historical central markets

Nuno Valentim – Faculdade de Arquitectura da Universidade do Porto, Porto, Portugal, nvalentim1@gmail.com

Abstract: The difficult condition of most central fresh markets in consolidated or historical cities can be handled with policies based on architectural research and knowledge.

With knowledge we can fight the "temptation of efficiency" and the current logic of superimposing ideas or ideologies to reality – in the last 30 years Bolhão market has accumulated four political visions and architectural solutions, very different from each other.

But not only the historical and architectural knowledge - also the human and productive knowledge (of the sellers and their context, the origins of their production and contemporary forms of distribution and commerce). No form of data (material and immaterial) can be ignored from this "reality reading" if we aspire to good and environmentally conscious design practices – we have called it critical and adaptive reintegration of existing material.

In the rehabilitation of the Bolhão market, the project is a tool for discernment, a decision process on the physical values and relationship values - its transformation and continuity.

There is no film without images, there is no radio without sound, there is no future without project.

Process to optimize the life cycle of used timber elements.

De Gregorio Stefania – DICEAA, University of L'Aquila, L'Aquila, Italy, e-mail: stefania.degregorio@univaq.it

Extended Abstract

The reuse of building materials from selective demolition makes it possible to reduce the environmental impact resulting from the use of raw materials, to safeguard the soil by limiting the amount of material sent to landfill and to avoid the emissions that would occur in the production from scratch of a material/component that has to perform the same functions as the decommissioned material/component. Currently, timber elements resulting from selective demolition are often destined to be recycled into chipboard, wood fiber or fiber-cement blocks. This practice, when a timber element fulfilled a structural function during the first life cycle, devalues and deems almost worthless the residual performances of the elements destined for recycling without a proper assessment of their potential for reuse. This happens due to the lack of specific regulations for the reuse of timber elements for structural purposes. To define the structural characteristics of a timber element, whether new or used, the same standard is used. The standards for the visual grading do not specify if the analyzed timber is new or used, but define only the range within the defects have to comply. The visual grading used to define the structural characteristics of wood does not evaluate information deriving from the previous life cycles of the component.

In this way a paradox occurs: the elements that would be discarded today were used in the past; we are witnessing an increase in the level of performance required by the elements. Just think that many of the elements analyzed in this research, according to current visual grading, would not be appropriate to structural use because they do not meet the minimum requirements, while from their installation (1920) until their demolition (2016) they have performed structural functions.

The proposed research is directed to timber elements deriving from selective demolition, with the purpose to individuate the real mechanical properties to promote an immediate process of reuse, reducing the waste destined for recycling or thermal valorization. Specifically in the paper, taking samples of rectangular timber elements from selective demolitions made in the Valencian Community, the structural values that are assigned by visual strength grading legislation were compared with the real resistance values identified by experimental analysis in order to verify their compliance.

The method of the research is based on these steps:

1. to find timber beams from selective demolition, the beams must be intact i.e. they must not be subject to biological degradation and must not have problems of structural failure;
2. identification of the species of beams by microscopic analysis and selection in homogeneous groups of the same species;
3. visual grading of the beams according to the standards in force, identification of the unsuitability/suitability for use and the possible resistance class;

4. experimental analysis (even destructive) carried out in a laboratory to identify the real strength and stiffness properties and density;
5. comparison between the worst defect identified in the visual classification that conditioned the unfitness/suitability for use and the assumed strength class, and the real strength and stiffness properties and the worst defect that conditioned the failure;
6. assessment of the approximation of the current standards in defining the strength values of an element that has already undergone one or more life cycles;
7. identification of additional steps in the current visual grading, which includes a consideration of the effective modalities of reuse evaluated according to the worst defects and information arising from previous life cycles.

The verification showed that the visual grading is not able to optimize the performance of the timber element in its reuse. The analysis carried out in these tests shows the limits of visual grading and the need to introduce additional phases in the current visual grading, taking into account the added value of knowledge derived for the first life cycle. In this way it is possible to increase the level of safety and at the same time maximize reuse.

For the reuse of a timber element for structural purposes, the research propose to act in two ways. In the first mode, the aim is to put the element back on the market as a "new element", i.e. without knowing how it will be used (scheme and loading conditions). The visual classification is carried out and, if it is no longer suitable for structural use due to localized defects (as knots, wanes, ring shakes, cracks or biological degradation) it is possible to increase the resistant class by making appropriate cuts targeted cuts of the timber element are made. In fact, the analysis shows that in some cases the cutting of part of the element causes an increase of the visual class and consequently of the strength class.

In the second mode the aim is to put the item back on the market as "used". At the time of demolition, the technician should note the structural information as mode of use (beam, pillar), span or height, position of the element (e.g. for a beam: compressed part and tensioned part), load diagram, load bearing capacity and environmental information as place of use (longitude and latitude), risk class (EN 335:1995), humidity measured on site.

Using this information can be prepared a specific label for the material that describes the conditions of use in the first life cycle and identifies different classes of resistance: one in case the second life cycle takes place in the same way as the first life cycle and one in case the conditions are different. This label becomes a tool to guide the technician to find the best mode to reuse the timber element optimizing its residual performances.

In conclusion, the paper illustrates a process in which the integration of information derived from the first life cycle in the visual classification optimizes the life cycle of used timber elements.

Keywords: timber life cycle, structural reuse, historical beams, visual grading, experimental analysis, sustainability

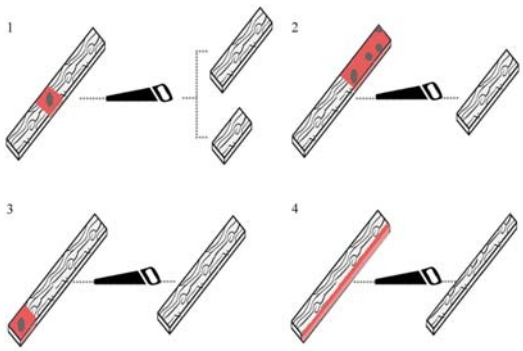


Figure 1. Examples of the elimination of worst defects aimed at increasing mechanical performance.
1-elimination of knot centrally located,
2-elimination of group of knots,
3- elimination of knot head
4- elimination of the wane.

Las Nuevas Poblaciones de Sierra Morena

The New Towns of Sierra Morena

Lomoschitz Mora-Figueroa, Emma - Etsam, Madrid, España, emma.lomoschitz@upm.es,

González Almansa, José Luis - Etsam, Madrid, España, joseluis.gonzalez.almansa@alumnos.upm.es

Abstract:

This paper studies the founding of the Nuevas Poblaciones de Sierra Morena, established in 1767 under the reign of Carlos III. It is an interior colonization that develops a complex project of territorial organization, guided by physiocratic principles and for which we have an ideological corpus, the manuscript on Sinapia that appeared in 1975 after having been hidden for more than two hundred years. It is a classical utopia developed in accordance with the Enlightenment thought.
In this colonization, six thousand settlers were brought from Central Europe, mostly Germans and Swiss. They were promised a paradise, in contrast to the world of misery and disease in which they were immersed after the Seven Years' War.
First, the New Towns of Sierra Morena are studied, and later on, three parishes are analyzed graphically: Las Navas de Tolosa, Carboneros and La Carolina. Initially, the scope of the study is introduced and the methodology carried out is explained. Then, the raised plans are interpreted to explain this interior colonization guided by the enlightened ideal presented by Sinapia, a successful example that served as a model transferred to all of Hispanic America.

Keywords: Nuevas Poblaciones, colonization, Enlightenment, Olavide, 18th century, Sierra Morena

1. Introduction

The current technological advances in the world of communication, information, the distribution of products and merchandise, etc., allow the quality of urban life to be accessible also in the countryside. University studies, the latest technological gadgets, even instant communication between like-minded people from all over the world are now accessible to anyone via the Internet. In this sense, Koolhaas' vision in his latest lectures and exhibitions1 speaks of a possible future of architecture that is different from that of the city.

It was with this idea in mind, that of how to approach settlement in the countryside, that this research was initiated. Since the ancient Roman colonies, there have been different types of settlement in Spain (Figure 1, timeline): the different forms of repopulation in the Middle Ages, the modern period with the reign of the Habsburgs, then the Enlightenment with the Bourbons. In contemporary times, in the 20th century, more than three hundred villages were settled by the INC (Instituto Nacional de Colonización), and lastly the new technological colonization, almost dehumanised, already reported in "Countryside, A Report "[3].

Through the historical evolution of colonizations, a singular point stands out, bringing about a change in the way populations were conceived. Throughout the eighteenth century

there was a proliferation of New Populations, as they are called, created after a detailed and thoughtful planning. They are towns designed and conceived to fulfill strictly their function as a shipyard, factory or port.

However, a group of these New Populations was developed with multiple functions and not in an isolated manner but together. This colonization had never existed before. It is planned the occupation and exploitation of an entire territory, previously almost deserted, with a complex lattice of towns, villages, cities, roads and plots. Under the protection of a new administrative model, the Intendancy, these New Populations of Sierra Morena have the same status as the old historical kingdoms of Andalusia: Jaén, Granada, Seville, Córdoba. This fifth kingdom, the Superintendencies of Sierra Morena and Nueva Andalucía, break with tradition and point to the future.

This interior colonization can be considered as the first Land Management Plan in the modern sense of the term. It is almost a century ahead of the birth of hygienist urban planning. Yet it is not only focused on the population nucleus, as said urbanism will do, or as was already done in the Baroque period in the search for the beautiful city. Here the territory, countryside and population centers are considered jointly and on a large scale.

This model was soon expanded to the entire American continent through the Intendances in the Indies. Being Olavide, along with Campomanes, Múzquiz and Aranda the architects of that interior colonization in the peninsula; José de Gálvez, first Visitor to the Viceroyalty of New Spain and then Minister of the Indies, was the great promoter, along with Floridablanca, of this new administrative scheme that introduced modernity to the entire American continent, structuring it from the border of the nascent United States to the River Plate (Rio de la Plata).

When studying the New Populations of Sierra Morena, Sinapia was discovered. An anonymous manuscript found among the papers of the Count of Campomanes, after remaining hidden for almost two hundred years. It described a country in the geographical and ideological antipodes of Hispania, which represented the aspiration of Enlightenment thought. A Spanish utopia that offers us the ideological body of the colonization on which this work focuses.

This research aims to dive into and analyze that unique moment in which an organization of the territory is put into action in search of a utopia or a realistic ideal. From this understanding, conclusions can be drawn on how to approach the possible return to the countryside as the future of architecture, or what relationship there is between the ideas, or the models that we want to make a reality, and their implementation. We are facing a utopia that has been realized, from which we can learn and draw consequences. We can speak of a "new built territory" with the aim of building a "New Society"

The Monastery of Sant Miquel d'Escornalbou (Tarragona, Spain): multidisciplinary research for the understanding of the relation between the religious complex, the territory and the European Franciscan network

Soler Maria - University of Barcelona, Barcelona, Spain, mariasoler@ub.edu

Ferretti Roberta - University of Florence, Florence, Italy, roberta.ferretti@unifi.it

Cioli Federico - University of Florence, Florence, Italy, federico.cioli@unifi.it

Keywords: Religious architecture; GIS; digital survey; cultural heritage; F-ATLAS Franciscan Landscapes

This work is part of the wide-ranging European project "Franciscan Landscapes. The Observance between Italy, Portugal and Spain", known as F-ATLAS (https://www.f-atlas.eu/). The project, coordinated by the University of Florence, with the co-participation of the University of Barcelona, the Portuguese Catholic University and the University of Lisbon (ISCTE-IUL), aims to significantly contribute to the promotion and study of the rich legacy of the Franciscan Observance in Europe, paying particular attention to its architectural heritage. With this purpose, the University of Barcelona team has catalogued and geo-referenced with GIS a total of 640 Observant convents documented in the territory of current Spain. This work has allowed mapping the implementation process of the Observance from the first foundations - of the end of the XIV century - until the exclaustration of the middle XIX century. The study of this large number of geo-referenced data allowed discerning the existence of several models of monastic implantation. Between the convents whose origin is not related to the Observant order, stands out for its monumentality and rich history the case of Sant Miquel d'Escornalbou (Baix Camp, Tarragona). The historical, architectural and patrimonial study of this last and interesting centre of medieval spirituality has been developed jointly by the Italian and Spanish teams of the project. Nowadays, from the original monastic building, only a few structures have been well preserved: the Romanesque church of Sant Miquel and a part of the cloister, as well as the al chapter house, located in the east wing of the cloister and the sacristy, adjacent to the apse of the church [2]. The monastic complex also has a set of caves and hermitages, which offered the monks both a physical and spiritual path, whose transit allowed them to develop an inner search, meditative and individual. This double spacial configuration - the main buildings and the caves or hermitages - is analogous to other Observant monasteries of medieval and modern times. The current appearance of the monastery of Sant Miquel d'Escornalbou is due to the diplomat and egyptologist Eduard Toda (1855-1941), who invested a part of his fortune in buying this place. The monastery was, in fact, restored and transformed into a residence, gathering inside a rich library, furniture and other collections that are still partially preserved. Nowadays is not easy to distinguish between medieval and modern stages and the events of the last contemporary centuries, including Toda's reconstruction. In November 2021, was carried out a digital survey campaign to obtain complete documentation of the monastery. The campaign included the integration of

different methodologies such as the laser-scanner survey, with the use of Lidar devices (Light Detection and Ranging) as terrestrial laser scanners, and the SfM (Structure from Motion) photogrammetric survey, which involved the use of photographic devices such as digital cameras and drones. The digital survey aims to understand the evolutionary phases, the state of conservation of the buildings, the interpretation of the parts to be preserved and the development of intervention guidelines [3]. The accuracy of the drawings in describing the walls and vaulted structures is essential to check the walls' axiality and the presence of deformations and to interpret and understand the state of conservation of the complex [1]. The final objective of the F-ATLAS project is to develop, starting from the data acquired during the digital survey campaign, the archival research and the existing routes, new cultural itineraries exploiting cultural and sustainable tourism systems. These itineraries exploit the advantages of digital technologies to create a network between Italy, Spain and Portugal, which connects the places of the Franciscan Observance from a cultural, historical and landscape point of view. Based on the in-depth analysis, the Monastery of San Miguel d'Escornalbou shows three possible levels of redevelopment. First, the complete restoration of the caves and the museumisation of the route, characterised by the agricultural system, the water sources, and the surrounding boundary walls. The second intervention strategy focuses on the church of San Miquel, which, adequately consolidated, can be re-functionalized and become an auditorium or a space dedicated to exhibitions. The third level is that of the manor house, heavily altered by the restorations and reconstructions during the twentieth century, which can host a museum system to rediscover the history of the settlement and its link with the territory and the surroundings.

Figure 1: The Monastery of Sant Miquel d'Escornalbou (Baix Camp, Tarragona).

References

[1] Bertocci, S., Minutoli, G., Pancani, G. (2015). *Rilievo tridimensionale e analisi dei dissesti della Pieve di Romena*. Disegnare con. 8-14 gennaio

[2] Bolòs J., Puigferrat C., Gort E., Adell J., López D. (1995). "Sant Miquel d'Escornalbou", *Catalunya Romànica, vol. XXI. El Baix Camp*. Barcelona, Enciclopèdia Catalana, p. 245.

[3] Minutoli G. (2017). *Percorsi di conoscenza per la salvaguardia della città storica,* Firenze: DIDApress.

The abandoned mining complexes in Sardinia. Potential approaches to recover their value

Dessì Maria, Laboratorio di Analisi e Conservazione del Patrimonio Culturale (LACHE) - Dipartimento di Architettura, Design e Urbanistica di Alghero - Università degli Studi di Sassari; Palazzo del Pou Salit, Piazza Duomo, 6 - 07041 Alghero (SS), Italia, mdessi@uniss.it

Abstract: Through the analysis of some emblematic cases of abandoned mining sites in Sardinia, which are poorly preserved nowadays, we want to examinate how the decay process advances along the time and the various dynamics that induce constantly, with various stages, the loss of the Sardinian historical and architectural heritage. We want to investigate how the current politics, managed the control of the loss of this type of heritage as well as the positive aspects and/or the issues of the solutions accomplished until now. Finally, we will try to understand if guidelines can be defined to reverse this trend, protect and add value to the heritage, intended as an *unicum* consisting of singularities. If so, we shall explore future potential actions to prevent the inevitable loss of a part of these architectures is left to chance. To demonstrate the relevance to storage the existing heritage, several data will be reported, at least through a field survey, to maintain awareness on the structures that are bound to disappear in the coming decades if there will not create utilization opportunities based on an economic self-sufficiency.

Keywords: mining complexes, heritage, value, vulnerability

Extended abstracts This paper presents the results of research concerning the vulnerability of historical mining buildings in Sardinia; it examines how the slow and continuous loss of part of this historical architectural heritage occurs, from different points of view.

There are several buildings that have been restored, used as museum in almost all cases. The functionality of these museum structures, whether or not maintained along time, is linked to various factors, first of all their position on "tourist" routes. However, a large part of the heritage is excluded from protection dynamics and, sometimes, any attempt of requalification has often been unsatisfactory.

Through the examination of some emblematic cases of architectural complexes observed at the architectural and urban scale, the aim was to investigate how the damage to the structures evolves; starting from their dismission, relating to the architectural characteristics of the structures we estimate how the loss of parts of architectural elements has happened.

A general historical and geographical synthesis shows the impact that these architectures have on the landscapes of Sardinia, in terms of number and variety.

The actual cases are various:

- high-value architectural complexes, in terms of the construction techniques and finishes adopted;

- medium quality complexes, with architectures perfectly made, but with rare solutions to reduce their vulnerability or with minimal fine finishes;

- complexes built as the local "minor" architecture, with low quality construction techniques and without valuable finishes.

The vulnerability of the architectures is different according to:

- some aspects related to environmental conditions,
- inner nature of the buildings examined,
- the constructive and geometric-dimensional characteristics,
- the use / not use along time that involved the transformations of building and have altered the original structural behaviour, etc.

The quality of the architecture is undoubtedly the principal factor that define the resistance of the structures, if there are no others factors, such as rockfalls and landslides, architectures resist the passage of time and natural disintegration due to exposure to atmospheric agents.

The problems and the potentiality of buildings are examined for individual situations and the summary of them, for an overall protection, on a regional scale, of this heritage.

Thus, in the different case studies examined, different ways of damaging the structures can be observed.

Starting from the knowledge of the architectural consistency and the current state of conservation, as well as the dynamics with which the damage has evolved, it can be observed how the overall protection of the heritage in question can be achieved.

In particular, some emblematic cases were examined in detail:

- the Asproni Village, where the damage appears more slowly and less dependent on the configuration of the single building;

- the Malacalzetta and Monte Narba villages, with architectures of medium quality, where the dynamics of damage are varied and not always related to their geometric characteristics;

- the example of Acquaresi, with lower quality construction techniques, where the damage is very quick and it depends no of geometries, but can be related only to the disuse.

The heritage can be managed only through in-depth knowledge, and the planning of interventions can be actuated in the buildings with different degrees of works:

- grade 0: survey of the current state and acceptance of the loss of the property

- grade 1: securing with shoring works before obtaining spaces request by local inhabitants and resources for restoration

- grade 2: all works aimed to reuse the site.

Therefore, the structures must be analyzed again according to their consistency and quality, as well as identifying, from time to time, new properly functions, according to the historical and architectural prestige (with different limits of transformability and protection, with critical evaluations).

It cannot be thought that museums that are difficult to reach can endure over time; if there are not available resources to make a properly reuse, it is necessary to keep at least the memory of what has been, through knowledge achieved by punctual surveys.

Problems of Intervention in Non-Monumental Architectures in Brazilian Historic Centers: a case study of the Tiradentes Town Hall

Dangelo, André Guilherme Dornelles – Universidade Federal de Minas Gerais, Belo Horizonte, Brasil, e-mail: adangelo@ufmg.br
Brasileiro, Vanessa Borges – Universidade Federal de Minas Gerais, Belo Horizonte, Brasil, e-mail: vbbrasileiro@ufmg.br
França, Valéria Sávia Tomé – Universidade Federal de Minas Gerais, Belo Horizonte, Brasil, e-mail: valeriastf@gmail.com
Machado, David Prado – Universidade Federal de Minas Gerais, Belo Horizonte, Brasil, e-mail: dpmarq@hotmail.com
Araújo, Luiza Salles – Universidade Federal de Minas Gerais, Belo Horizonte, Brasil, e-mail: luizasallesaraujo@gmail.com

Since 1937, when the public policy for the preservation of cultural assets in Brazil was created, little changes can be perceived, keeping intact the prevalence of the preservation of great monuments. Smaller assets did not have better luck: not being characterized either by their monumentality, nor constituting their value from the urban sets, as happens with the common houses, such buildings were at the mercy of indiscriminate uses and of little attention paid to them by the organs of preservation.

Added to this is the scarce or non-existent precise documentary source and the lack of tradition in documents conservation and archival research in the country. In terms of interventions, these are guided by an effort to collect from the building itself the information necessary to support design decisions; it is from its typological and technical-constructive characteristics, and through the direct observation of pathological manifestations, that decisions are made. An immediate consequence of this simplistic and careless attitude is the elaboration of incomplete intervention projects, which, during the construction phase, become a requirement for revisions, promoting delays and demanding resources not previously foreseen.

Paradoxically, it is in the most representative 18th century historic centers of Minas Gerais, currently the target of intense tourist speculation, that these smaller assets receive the greatest transformations. In the case of public buildings, adaptations to modernization to contemporary activities and other small interventions, carried out with few resources and almost no technical guidance, have often promoted the acceleration of the processes of degradation of buildings that, although they cannot be considered monumental, are public heritage in the broad sense of the expression, demanding even greater zeal.

This is the case of Tiradentes Town Hall, object of analysis of this article. The objective, when presenting the case study, is to indicate how much careless interventions, added to the intense variation (and modernization) of the use of the cultural property, can be harmful to its conservation.

The former Town Hall of São José del Rei was built, or was adapted in a pre-existing building, during the 18th century, not before 1718, the year the town was erected. The lack

of documentary records does not allow us to accurately state any of this information. It is known, also by stylistic analogy, that a balcony was added to the building in the 19th century. Certain are the records that indicate the various functional activities housed by the building: Town Hall until 1889, Tiradentes Court Chamber until 1918, again Town Hall until 1970. On this date, the property was donated to the Rodrigo Melo Franco de Andrade Foundation (FRMFA) by the Government of the State of Minas Gerais. Many other functions were carried out – seminary, kindergarten, cultural center – until, in 1985, a loan agreement was signed and the building again passed to the legislative function, which it houses until today.

The Town Hall building is located next to Largo da Câmara, which is formed by the confluence of Jogo da Bola and Câmara streets. The urban situation is quite particular, as it is located in disarray in relation to the neighbouring buildings on the main road, motivated by the construction of a terrace in the 19th century.

Little is known about the 18th century building, given the scarcity of documents. Its characteristics attest to its affiliation to the typology and construction systems typical of the period: a simple quadrangular volume, approximately 400m2 in area, covered by a hipped gable ceramic roof, which extends towards the back. The plan corroborates this hypothesis, as a perimeter of robust walls built in moledo – a porous stone common in the region – and taipa follows a sequence of rooms that configure a differentiated body. Internally, wattle-and-daub walls divide the rooms.

The external walls are whitewashed and the openings, on the facades to the public roads, follow greater care in the composition; unlike the other views, which have less elaborate openings, where curved lintels and elaborate cushions and frames are no longer present.

The wide terrace, which gives elegant appearance to the building, reveals the stylistic refinement used with the presence of columns, sometimes in stone, sometimes in wood, with capitals in the same material, supporting lowered arches. In the central span, there is a shield where today the design of the Arms of the Republic is identified. Such elements denote greater sophistication in finishes and details, in order to ennoble the building.

The pathological manifestations are characterized by a little advanced degree of deterioration, but by a variety of situations, largely the result of deficient conservation processes or even functional adaptations that pay little attention to the fragility of materials, elements and construction systems. It is noticed that the state of conservation of the building is good, but the sum of the indicated situations can generate bigger problems of consolidation and recovery. The building only needs some occasional interventions, such as the exchange of some deteriorated materials and maintenance of some elements, such as floors, ceilings, doors, frames, railings. These procedures will guarantee the property a conservative and relatively low-cost intervention, for a restoration work. Thus, the necessary preventive conservation is evidenced, an action often neglected by public entities.

Currently, the building houses the Tiradentes Town Council and in its main room there is the Chamber plenary. In the adjacent rooms there are secretariat, public service, archive, in addition to the administrative functions of the House. It is clear, supported by the demand for a better use of the environments, the necessity to rethink the building complex in several aspects, in line with the principles of minimal intervention and conservative restoration, which guided the intervention guidelines.

The musealization of modern residential architecture

Casale Teresa – Galleria Casale, Rionero in Vulture, Italia, tc.teresacasale@gmail.com

Garda Emilia – Politecnico di Torino - DISEG, Torino, Italia, emilia.garda@polito.it

Today, some fragments of the massive residential heritage of the Modern Movement are converted into house-museums. In these places-originally defined by a comprehensive design of interior, exterior, and furniture elements-time has been interrupted and space has been frozen to give more space to emotions.

The design approach initially aimed at the concretization of the '*Gesamtkunstwerk*' in which, all parts, from the context, to the structure, to the smallest details, reflect the same spirit.

Modern works, are the result of the freedom of expression that has been granted to architects and that has declined in different ways because it has been influenced by the author's architectural idea and by the uniqueness of his thinking about man and world. In this context, globalization has played a leading role in the meeting and exchange of ideas.

This heritage, which is complex, is accomunated by key elements that, from the definition of the new futurist architecture, refer to an important principle: essentiality that aims to answer to the needs of man. Often, the original characteristics have been lost with time therefore, protection of this architecture, legitimizes a substantial restoration work aimed to rediscovering its essence. In this view, the space of modern living, is reborn thanks to the careful work of the restorer who returns the primal order. But, before opening the doors to the public, the restorer decides the future of a house museum because, first of all, he must understand the spirit that guided the author, and then proceed with the restoration.

All over the world there are many examples while in Italy, the prevalence of house-museums is still in an embryonic state but, thanks to the experts of the modern restoration, it is possible to enter in a dimension far any established tradition of restoration. The restoration of modern residences is the cause of the break with the concepts on which Italian restoration theory is based. But is not the break with tradition the basis of modern thinking?

Evaluating the impact of infrastructures on urban ecosystems: application of the Envision Protocol to the "Sopraelevata" of Genoa

Vite Clara - University of Genoa, DAD - Architecture and Design Department, Stradone S. Agostino 37, 16123 Genova, Italy, clara.vite@unige.it

Gaggero Marta – University of Genova, Genova, Italy

Abstract: Technological progress and the increasing growth of industrial sectors mean that today's infrastructure needs to be updated. Therefore, while such engineering development is essential, control systems must be in place to mitigate the adverse effects on the environment. However, threats from the environment and climate change require a high level of response from infrastructures, which will have to anticipate and resolve any technical problems created by future uncertainties. The importance of infrastructures is recognised, but it is necessary to approach the problem with a broader vision, intercepting what could even be future problems, not just current ones. The Envision protocol is a fundamental tool used by public administrations and private investors to identify specific crucial points of certain infrastructures. The construction of new infrastructures requires a new design for old ones, which are now uncomfortable in specific urban contexts. This paper, therefore, explores the application of the protocol to the case study of the Sopraelevata of Genoa and tries to highlight its potential and identify a model strategy that can be a starting point for the local administration to improve the sustainability of an infrastructure that no longer seems to be in step with the times.

Keywords: Sustainable Infrastructure, Envision Protocol, Rating System, Digitalisation

1. Extended Abstract

The urban scale and the infrastructure have only recently become part of the collective imagination. With the term infrastructure, we mean the connection of significant works that helps the connection with different portions of territories, national and international. The network of infrastructures is what allows our economy to develop globally. However, infrastructure is much more than that.

Infrastructure plays a huge role in the city's development and cannot be considered separately. Indeed it is, in most cases, old and dilapidated infrastructures with significant structural problems dating back to the 50s and 60s. Decades of neglect mean that massive infrastructure investments are now needed worldwide. Demolishing and rebuilding a new infrastructure is not always the best solution. Sometimes the best choice does not involve demolition because it could be a historical figure and part of society's collective memory. Finding a balance between historical memory, technological innovation, and progress is undoubtedly one of the most critical challenges for the future society.

In order to accomplish this, it is essential to use the technologies available to us, which not only include the use of the most advanced software on the market but also identify a process that can be applied to every engineering area.

Given the long lifetimes of infrastructure, it is crucial to take early action to integrate adaptation into decision-making and ensure flexibility or robustness to address future uncertainty. Willing to analyze the best course of action to approach this issue, the presented research is focused on an existing infrastructure that is the focal point of one of the most important port cities for

European trade. In Italy, there are several of these examples scattered throughout the national territory. One of these is the Sopraelevata of Genoa. It was chosen as the case study mainly because of its uniqueness. It is a unique infrastructure of its kind in Italy and Europe, a pioneer of a new way of experiencing the city's mobility since the 60s.

The Sopraelevata of Genoa is an infrastructure developed due to the General Regulatory Plan (PRG) provision, approved in 1959. The City Council approved the final project in March 1962, and the work was officially transferred to the company CMF (Società Costruzioni Metalliche FINSIDER). The engineer Francesco De Miranda designed the work, and was finished and inaugurated in 1965. Numerous interventions have been carried out over the years below the Sopraelevata, re-establishing a direct connection between the city and the port. Starting from the 90s, discussion on the future of the Sopraelevata began. Citizens and administration recognize its great usefulness. Despite this, the visual and environmental impact of the infrastructure is considered harmful, and the structure appears obsolete.

The presented research aims to assess the sustainable performance of this infrastructure. The results of the implementation of the Envision protocol to the case study of Genoa's Sopraelevata are presented, attempting to highlight its potential, and outlining a strategy that could be taken as a starting point by the local administration; all aimed to improve the sustainability of an infrastructure that, now more than ever, seems to be behind the times.

Different methods are introduced to assess the sustainability aspects of the entire life cycle, and a sustainable rating system can be adopted for this purpose. There are more than 600 rating tools and 170 evaluation criteria in the building industry. Indicators for assessing infrastructure's environmental, social, and economic performance are vague, and transport-specific sustainability metrics are more difficult to define than building metrics. Moreover, building a sustainability rating system could not only be transferred to the infrastructure sector, but it needs to develop a sustainability rating system specific to the infrastructure sector. Envision Protocol is the first rating system to assess a sustainable infrastructure through an analysis grid, adaptable to any infrastructure development project. Envision was developed in a collaboration between ISI (Institute for Sustainable Infrastructure), a non-profit organization based in Washington, created specifically to develop sustainability rating systems for civil infrastructure. The envision protocol has been applied to the case study of the "Sopraelevata" of Genoa, although there are mainly examples of application and certification of new infrastructure.

The final result obtained is 85 out of 864, and specifically, the results are distributed in the Quality of Life, Climate and Resilience and Natural World categories. The results obtained in the certification are as expected, and the analysis shows that the infrastructure is unsustainable in many aspects. Despite being a futuristic work for its time, the Sopraelevata is still an infrastructure that is more than 50 years old. It was built to last, but more importantly, it was built because it served the population and the entire city. Although about 60 years have passed since its construction, the Sopraelevata still performs its tasks, avoiding the collapse of city traffic. It is noted that the Sopraelevata remains a project that will have new life for the strong will of the public administration and the citizens.

The Envision protocol is a very useful tool to highlight those categories with gaps and develop strategies to improve the sustainability of the infrastructure. The project actions have been elaborated in such a way as to highlight what the next steps could be and what can be a good modus operandi for the future, which can be undertaken not only by private companies but also by public administrations.

Valorisation and Reuse of Catholic Heritage in the Balkan Peninsula

Trematerra Adriana - University of Campania "Luigi Vanvitelli", Department of Architecture and Industrial Design, Aversa (CE), Italy, e-mail: Adriana.trematerra@unicampania.it

Gennaro Pio Lento - University of Campania "Luigi Vanvitelli", Department of Architecture and Industrial Design, Aversa (CE), Italy, e-mail: gennaropio.lento@unicampania.it

Luigi Corniello - University of Campania "Luigi Vanvitelli", Department of Architecture and Industrial Design, Aversa (CE), Italy, e-mail: luigi.corniello@unicampania.it

Abstract: The research is part of a broader ongoing study focusing on the analysis of places of cult in the Balkans by means of documentary operations aimed at the reuse and conservation of religious heritage. Case study of the investigation is the Dominican Monastery of the Holy Cross in Croatia, a Catholic religious complex built in 1432. The contribution presents the results of the phases of the knowledge process used: a philological analysis of the construction phases through the preliminary study of archive documents; a survey for the identification of the current configuration, materials and construction techniques used; the analysis of degradation using the forms and graphic conventions inherent to the pathologies of stone materials in the UNI 11182/2006 standard and the ICOMOS illustrated glossary; and the elaboration of some guidelines for the reuse of the disused interior spaces and for the use of the monastery for tourism purposes. The results obtained with this survey are to be understood as a database on a cognitive basis to be used and implemented over time for the valorisation and fruition of the same architectural exempla located in the Balkan territory, constituting a rich cultural heritage that is often forgotten and abandoned.

Keywords: Catholic Architecture, Knowledge, Documentation, Reuse, Valorisation.

1. Introduction

The Art. 6 of the Cultural Heritage and Landscape Code (2004) defines a connection between operations aimed at knowledge, protection, enhancement and enjoyment of cultural heritage. These provisions were complemented and consolidated by the Faro Convention adopted by the Committee of Ministers of the Council of Europe in 2005 to emphasise the importance of the relationship between heritage, society and communities [1]. Architectural artefacts and their landscape contexts become important depending on the value that individuals attribute to them and the ways in which they can be understood and passed on to future generations [2]. In this context, the issue of reuse aimed at the rehabilitation and use of disused spaces assumes a role of primary importance. Starting from this premise, the research proposes the analysis of the Dominican monastery of the Holy Cross in Croatia (fig.1), which is currently without function.

2. The method for the knowledge and valorisation of religious heritage

For centuries, the Monastery of the Holy Cross played a significant role for the Dominican province of Dalmatia not only from a spiritual point of view, but also in terms of teaching, as it was chosen as the main site for the religious and intellectual education of young monks. However, as a result of political clashes with Enlightenment ideologies, thousands of monks were forced to leave their monasteries. This phenomenon also occurred within the Monastery of the Holy Cross, which was gradually abandoned. Within the framework of the knowledge of the Monastery, the research envisaged the carrying out of survey

campaigns, which can be considered as a tool for critical observation and investigation useful for representing reality while serving as a fundamental cognitive basis for the choices of the valorisation and reuse project [3]. The data acquired through the survey campaigns were used as the basis for the diagnostic analysis aimed at material knowledge and mapping the pathologies suffered by the Monastery studied.

3. Conclusions

The research conducted on the Monastery of the Holy Cross in Croatia can be considered as a possible knowledge methodological approach aimed at valorisation and reuse to be applied to similar architectural exempla located in the Balkan territory. Field analysis by means of material survey and degradation diagnostics revealed the potential and criticality of the site: a high architectural, material and landscape value; precarious conservation conditions and the absence of function. In this context, the research envisaged the elaboration of guidelines aimed at a reuse of the monastery in order to restore its original function for the education and teaching of different disciplines. This methodological approach was aimed at restoring an identity to the Balkan religious heritage in order to create cultural spaces for social gathering, compatible with the original use. Valorisation and reuse become concrete possibilities for the reintegration of religious complexes of the past, often forgotten, to be considered as added social value in the contemporary era

Figure 1. Il monastero della Santa Croce: documentazione fotografica

Acknowledgements

The contribution was realised thanks to 'Valere2019' funding from the University of Campania 'Luigi Vanvitelli'.

References

[1] Council of Europe (2005) Framework Convention on the Value of Cultural Heritage for Society, Faro.

[2] Council of Europe (2020) La Convenzione di Faro: la via da seguire per il patrimonio culturale, Comune di Fontecchio.

[3] C. F. Carocci, C. Circo (2015) Il rilievo per il restauro. La loggia di palazzo Ardinghelli a L'Aquila. In: AID Monuments. Materials techniques restoration for architectural heritage reusing, vol. I, Ariccia: Ermes, 134-142.

Le ville Palladiane: paesaggio e architettura. Tutela di un sistema ambientale
The Palladian villas: landscape and architecture. Protection of an environmental system

Giovanni Minutoli – Università degli Studi di Firenze, Dipartimento di Architettura, Firenze, Italia, giovanni.minutoli@unifi.it

Keywords: protection, environment, cooling, ventilation, restoration

The importance of architecture is applied to design the environmental aspects of buildings by virtue of the places in which they are located. Palladio, in one of the four architectural books he wrote, often speaks of the orientation and consequent exposure to the sun of the buildings and their individual rooms. In fact, he takes for example the villas of costozza, in which the flues are considered by him to be a "marvelous" example of the freshness of his rooms. Everything is based on the thermal differential and on "chimney" suction systems based on both orientation and technology. Palladio successfully applied these ventilation-cooling systems in many buildings he built. The contribution reports the analysis of some of its main achievements, emphasizing the aspects inherent to environmental comfort and the peculiarities of individual buildings.
Andrea Palladio, trained at the school of Giangiorgio Trissino, approaches the study of Greek-Roman antiquities thanks to the teacher and in particular the work of Vitruvius. In 1570 he published his treatise The Four Books of Architecture; work that will be a point of reference for generations of future architects. In the second book of the treatise (On the compartment of the rooms and other places) Palladio describes how to arrange the rooms of the house based on orientation and use, but also describes how to divide the interiors according to the winter and summer seasons. In addition, in the De 'Camini paragraph of the first book, Palladio gives the example of the villas in costozza as an example of naturally cooled rooms.
In Palladio's architecture we find some aspects present in the Costzza Villas. Villa Godi Malinverni with a severe appearance, has a symmetrical structure; central facade set back and opened by a loggia with three arches. The symmetry also continues in the plan of the main floor, in fact the building is set along a central axis consisting of the loggia and the hall, flanked by two apartments of four rooms each.
The building to the east faces a semi-circular garden connected to a wood. There is a formal garden to the west. Inside the main hall, at the top on the west side, there is a stone grid. According to Luca Trevisan: "Tra le varie funzioni si rammenta che l'ambiente del salone era adibito a fungere da sala da ballo: un piccolo vano ricavato sopra la loggia permetteva di accogliere i musici, che rimanevano nascosti agli occhi dei nobili, mentre a garantire la diffusione del suono stava la grata lapidea visibile nella controfacciata del salone".
This hypothesis loses its meaning if both with the dimensions of the grid, too small to transmit music, and with the attic environment, not functional for this purpose. On the other hand, it is much more evident that it is a ventilation grille. It can be assumed that the cooler air coming from the east and cooled by the lush vegetation of the forest, enters the living room thanks to the large windows. The quantity of air contained in the upper part of the hall, through the existence of this decorated grille, could have flowed into the attic, and then be expelled outside through the windows on the west side. This system uses the contrast between the cold front, located to the east, and the warm front, located to the west; the attic, low and warm, functioned as a heat accumulator and had the purpose of sucking the air from the main hall.
In 1542 Marcantonio and Adriano Thiene began the renovation of the fifteenth-century family palace located in the historic center of Vicenza, the grandiose project envisages that the building occupy the block. Scholars attribute the palace project to Giulio Romano and tend to attribute the executive design of the building to the young Palladio. In the basement of the latter building, a perforated grid is located on the top of a brick vault of a corner compartment. This environment has similarities with the prison of the winds of Villa Eolia in costozza. Many of the internal and external doors of the building facing the four-sided portico had overhead openings; it cannot be excluded that they were designed to facilitate ventilation and the exit of hot air to the outside. Around 1548 Palladio was commissioned by Biagio Saraceno to build a large villa on the site of the pre-existing agricultural court. As in other cases, Palladio designs a noble floor raised from the ground and placed on a podium. To the south, a large loggia is built with a mediating function between the inside and the outside. The main room is in the shape of a "T", consisting of two side cellars intended to accommodate the stairs. In these

rooms, at the base and at the top there are grids that overlook the living room. It is thought that these grids allow the expulsion of hot air thanks to the "chimney" effect generated by the stairwell. While the cold air enters from the north side where a door and two large windows open. Around 1549 Villa Pojana was commissioned to Palladio by Bonifacio Poiana from Vicenza.
This villa remains away from the road and surrounded by gardens. The main floor, placed on a base intended for the service areas, is composed of a barrel vaulted hall, on the sides of which the smaller rooms are distributed in a symmetrical manner, with always different vaults. In the central hall, in front of the entrance, there is a stone grid on the floor, which connects the main floor with the ground floor. A similar solution was also applied in the Thiene palace, the fresh air is sucked from the basement thanks to the grille. The openings on the doors favor the escape of hot air. The loggia, located to the west, serves to prevent sunlight from entering the building.
Villa "la Rotonda", the best known name by which Villa Almerico-Capra is known, located just outside the historic center of Vicenza, was commissioned to Palladio in 1566 by the clergyman Paolo Almerico and subsequently sold to Odorico Capra. In 1580, after Palladio's death, the architect Vincenzo Scamozzi took over and completed the project without excessively modifying the initial project. The villa consists of four floors above ground, in addition to the ground floor with service functions, a first representative floor, a mezzanine and an attic floor. The ground floor is accessed directly from the garden, through a vaulted path under the external terraces. The upper floors are accessed via spiral staircases, obtained in the corners of the square in which the central circular hall is inscribed. These allow to reach all the levels of which the Villa is composed. Access to the main floor is guaranteed by four symmetrical stairways open to the pronaos. Around the central hall on the main floor there are four rectangular corner rooms and four small bedrooms. All these rooms were decorated around the seventeenth century. The central room, with a circular plan, is covered by a dome, closed by a lantern. Palladio in the initial project had planned to leave the oculus in the center of the dome open as in the Pantheon. However, the architect designed a lantern, which was only built after a hundred years. The Villa has four angles oriented according to the cardinal points: During the summer the sun's rays have a rather vertical inclination, so the interior of the building, thanks to the four porches, remains more shaded and, therefore, cool. Instead of winter, the light manages to penetrate inside the structure, heating it. The south-west side overlooks a large wooded area, the south-east side overlooks the countryside. The north-west front is that of the current main entrance, while the north-west front was once the main entrance.
On the ground floor, the two south-east and south-west fronts present, under the terraces, two connecting tunnels leading to the wood and the agricultural area. The decision to leave the wooded area on the southwest side is probably always linked to the search for greater thermal comfort in the summer months. Furthermore, it is likely that the functionality of the rooms varied according to the season as well as that of the furnishings. Also in this Villa, in the center of the main hall there is a mask, which connects the ground and noble floor; fundamental element for ventilation. The different air temperature between the two floors, ground and first, generated convective motions, which pushed the hot air out of the building, through the circular opening on the dome. In the same way, the tunnels that connected the woods and fields brought fresh air to the ground floor, helping to lower the temperature of these environments. On the north-east and south-west sides, below the pronaos, there are grilles for the hot air to escape. It is desirable that the stairwells also participate in the escape of hot air and consequent ventilation of the connected rooms. Unfortunately, this cooling system was partially lost with the construction of the laterna and the closure of the stairs. In all these buildings we find the princes that Palladio had seen in the villas of costozza; the convective motions, which are generated thanks to the introduction of cooler air into the hypogeum environment, allow the cold air to be sucked in thanks to the warmer air placed at the top and then expelled thanks to the openings placed in the parts high halls. All this happens thanks to the connecting grates between the basement and the ground floor or between the ground floor and the upper rooms.

Recovery and reuse in the walkway architecture: looking to the future for dismissed rural buildings in Italy and France

Garda Emilia – Politecnico di Torino, Torino, Italia, emilia.garda@polito.it

Renzulli Alessandra – Sapienza Università di Roma, Roma, Italia, alessandra.renzulli@uniroma1.it

Abstract: The walkway architecture represents the interconnection between past, present and future. Proposing the networking of dismissed rural heritage, the walkway architecture would provide a glimpse of what is currently out of everyone's sight, an insight into the vernacular structures that are forgotten and left in their rudimentary state. As a result of the fact that they have lost their function and are no longer helpful to the production chain, these buildings cease to be considered part of the territory and, therefore, adequately valued. The paper proposes a change of perspective of these elements of the Italian and French vineyard cultural landscape as spaces capable of supporting slow tourism. The case of Piedmontese casòt and Burgundian cabotes will be analysed, given their position within the UNESCO heritage nomination of their respective landscapes. The recovery of some of these types of rural architecture, historically used as warehouses for storing tools or as stables, has made it possible in Burgundy to propose models of reuse for reinsertion within the landscapes system, in contrast to what happens in Italy, where the historical memory of the building is slowly disappearing.

Keywords: walkway architecture, networking, rural architecture, vineyard landscapes, UNESCO world heritage

Rural architecture defines vernacular construction that expresses the relationship between the land and the man who cultivates it. Pure, astylistic, and functional, an example of constructive integrity, results from an effort realised with minimum energy dissipation. These architectures are contained in the farming landscape, which becomes part of its network. In other words, of that layered system built over time that proves to exist and to be authentic in its relationship with the society that forged it, that lives it and takes care of it, and continues to exist as long as it is rooted in its culture. The patrimonial value that these signs of the territory take on and the way they interact with the landscape system mean that they are charged with significance to the point of becoming potential for the future development of the landscapes.

It was around 1800 that architects became interested in this architectural type after looking for inspiration in the organic relationships between land and local materials, climate and customs found in the structures of rural houses and other country architecture. The first systematic investigations of the rural world were recorded in Italy and France simultaneously. The main objective is to learn about rural populations' habits, beliefs and living conditions. As far as the French world is concerned, many investigations were carried out during Napoleonic domination (1805) under the initiative of the Académie Celtique in Paris, for the Italian world during the period of the Regno Italico (1811) under the industry of the Ministero dell'Interno. In the 1920s, architects such as Le Corbusier also approached the subject of traditional rural architecture. From 1930, in France and Italy, although with different approaches, the attention of architects focused instead on the relationship between rural architecture and modernity.

Over time, a collaboration bedifferentdiffer professionals such as landscape architects, geographers, ethnographers, economists, architects, etc. have led to the increased edge and

a broader conception of the heritage value of rural assets. The analysis is increasingly taking place with greater openness to the surrounding territory, conceived as a socially constructed geographical space, including all the tangible or intangible elements of the community that has shaped it. Recognition of this treasure chest of natural and cultural evidence combined into a single inimitable system was conducted by UNESCO in 1992 in the Convention on the Protection of the World Heritage with the definition of the cultural landscape. In this category, wine-growing landscapes are also included.

Two of the eighteen wine-growing landscapes nominated by the international body were investigated in the case study of the paper: the Italian Langhe Roero and Monferrato and the French Climats of Burgundy. The examination of the two territories highlighted which rural architectures have been valorised and which still need to be valorised. Those buildings that are still recoverable in their forms, although significantly deteriorated and with a high risk of static collapse, were considered. Those buildings, subject to evolution over time, are in the process of sudden ageing due to a lack of attention and loss of cultural identity on the part of the people who built them. As far as Italy is concerned, the architectural typology referred to is that of the casòt: small rural buildings with a maximum volume of 30 square metres and supporting the production chain such as drying rooms, cellars, warehouses, stables and temporary residences. With time, the loss of function concerning current needs has led to a process of sudden degradation and a state of total decay, in contrast to what happens in France with the Burgundian cabotes, a building typology similar in size and function to the Piedmontese one, where the latent potential of these structures is better exploited. The Association des Climats du vignoble de Bourgogne, the governing institution of the UNESCO site, has launched Mission Climats, a project to restore disused rural heritage for non-residential use (murgets, clos, murets, cabotes). Through awareness-raising campaigns and concrete actions aimed at protecting and valorising these minor assets, it has promoted the encouragement of restoration to favour the preservation of the existing heritage in its relationship with the past. Today, cabotes are often used as landmarks of the territory to promote the company’s brand to which they refer or reinserted within excursion routes for mise en scene touristique.

The walkway architecture project aims to restore the casòt according to tradition, reinserting them within the Piedmontese hiking and stratified landscape systems through re-functionalisation and re-functionalisation of their successive networking. The casòt network design is also intended as a continuum of maintenance, conservation and innovation. The intention is to combine aspects related to tourism with a strategic activity that adequately operates on the market by grasping its continuous evolutions: taking up the building tradition of the past and going beyond the French concept of the mise en scene touristique. If the mise en scene touristique proposes restoring the asset to make it an object of attention for the tourist, the architecture of the walk takes into account, making it usable by the hiker. The types of use could differ: from the possibility of resting to making a pit stop, from a hotel room to pitching one's tent undercover. The experiential tourism of living in the territory and the beauty of the countryside also experienced at night would make it possible to enhance this diffuse constellation of historical memories and building systems so that this heritage could become an actual vehicle of cultural identity. The walkway architecture of the path still proposes understanding the landscape as an open experience. This work can be continuously modified in space and time concerning the history and future challenges.

Natural hydraulic mortars for rehabilitation of historic buildings: review of the state of the art

Fernanda Calado Mendonça – FPB/UNIFACISA, João Pessoa, Brazil | CONSTRUCT-LABEST, Faculty of Engineering (FEUP), University of Porto, Porto, Portugal, fernanda_mendonca5@hotmail.com

Lino Maia - CONSTRUCT-LABEST, Faculty of Engineering (FEUP), University of Porto, Porto, Portugal | Faculty of Exact Sciences and Engineering, University of Madeira, Funchal, Portugal, linomaia@fe.up.pt

Abstract: The growing concern with environmental issues has enabled the insertion of new solutions for waste management in various fields of knowledge, including civil construction. The evolution of construction techniques and the option for materials with less impact on the environment have been increasingly topics of study in this regard. Among the most significant residues, we can mention the ceramic residues that come both from the production of this material and from the demolition and execution of new construction sites. Inserting ceramics in the mixture of natural binder mortars has been a construction technique used for centuries to obtain a material with hydraulic properties. Many of the historical buildings were built with this type of mortar, since Portland cement is a binder considered recent, having started its commercialization only at the end of the 19th century. To assist in the research of new compositions, this paper proposes a review of the state of the art on the use of natural mortars in historic buildings and the insertion of ceramic waste in these mixtures.

Keywords: Mortars, Natural hydraulic binder, Ceramic residues, Rehabilitation

1. Introduction

Developing the rehabilitation of historic buildings with the insertion of materials that would potentially be waste sent to landfill sites, is an effective way to bring together the already known use and function of mortars produced with natural binders. This paper aims to review the available literature on the production of this type of natural mortar with hydraulic properties, cataloguing information about the ceramic waste, the properties of the mixture, and possible uses in on-site case studies.

2. Materials and methods

The main purpose of this study is to gather information that can support the development of mortars with natural binders, with hydraulic behaviour, that have good performance for the rehabilitation of facades of historic buildings. The method used to reach this goal is based on three important research topics: ceramic residues and their processing, production of natural mortars, and rehabilitation of historic buildings. Through the catalogued information, it will be possible to seek answers to the following questions: Is there technical and environmental feasibility for the development of these mortar mixtures? What are the benefits of using natural mortars in this context? Are ceramic residues materials with pozzolanic potential to favour the function of the proposed mortars?

In order to conduct scientific research on the development of material mixtures and application of mortars in situ and in laboratory tests, a typical systematic review of the literature was conducted in major databases such as Scopus, Web of Science, and Springer. In this study, the search was programmed to find the keywords in the titles and abstracts of

the articles. The keywords "ceramic waste" and "mortar" were restricted by the following filters: (i) type of article (research, reviews, and book chapters); (ii) publication between the years 2012 to 2022; (iii) text written in English. All results were reviewed and selected with support from the "Mendeley" literature review software. Duplicate sources were removed, as well as those that did not contain in the title, abstract or keywords the list of words: mortar, natural mortar, lime mortar, alkali-activated mortar, ceramic waste, historic building. The final selection was made by analysing the title and the abstract. This search methodology led to the enumeration of the latest publications related to the development of natural mortars with insertion of ceramic material in their composition.

4. Final remarks

The presented review aimed to demonstrate the available investigations about the production of natural binder mortars with addition of waste for the rehabilitation of historic buildings. As observed in several studies, the properties of ancient mortars have similarities with this type of mixture.

The results obtained from the research point to an amount of studies of ceramic waste as a substitute for natural aggregates and binders in mortars, most of which refer to investigations related to Portland cement products. However, for the use intended here, this material should be avoided, for not generally presenting a behaviour compatible with historic buildings.

In order to better research the proposed theme, it is recommended that the years of publications searched be extended. One can also alter the keywords searched, so as to possibly include more articles that study the type of mixture that obligatorily includes a natural binder (lime) and ceramic residues of various types. Another limitation imposed was the language in which the article was published, with only English being used, which despite being the language of most publications, there were still some exceptions in other original languages.

Acknowledgements

This work is financially supported by: Base Funding – UIDB/04708/2020 of the CONSTRUCT – Instituto de I&D em Estruturas e Construções – funded by national funds through the FCT/MCTES (PIDDAC). This work is funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the Scientific Employment Stimulus – Institutional Call – CEECINST/00049/2018.

References

[1] Barrios AM, Vega DF, Martínez PS, et al (2021) Study of the properties of lime and cement mortars made from recycled ceramic aggregate and reinforced with fibers. J Build Eng 35:. https://doi.org/10.1016/j.jobe.2020.102097

[2] Bayer Öztürk Z, Atabey İİ (2022) Mechanical and microstructural characteristics of geopolymer mortars at high temperatures produced with ceramic sanitaryware waste. Ceram Int 48:12932–12944. https://doi.org/10.1016/j.ceramint.2022.01.166

[3] Bianchini, G., Marrocchino, E., & Vaccaro, C. (2004). Chemical and mineralogical characterisation of historic mortars in Ferrara (northeast Italy). Cement and Concrete Research, 34(8), 1471–1475. https://doi.org/10.1016/j.cemconres.2003.12.030

[4] Böke, H., & Akkurt, S. (2003). Ettringite formation in historic bath brick-lime plasters. Cement and Concrete Research, 33(9), 1457–1464. https://doi.org/10.1016/S0008-8846(03)00094-2

[5] Böke, H., Akkurt, S., Ipekoğlu, B., & Uğurlu, E. (2006). Characteristics of brick used as aggregate in historic brick-lime mortars and plasters. Cement and Concrete Research, 36(6), 1115–1122. https://doi.org/10.1016/j.cemconres.2006.03.011

Place and identity.
Conceiving the *Genius Loci*

Di Mari Giuliana – Politecnico di Torino, Torino, Italia, giuliana.dimari@polito.it

Garda Emilia Maria - Politecnico di Torino, Torino, Italia, emilia.garda@polito.it

Renzulli Alessandra – Università della Sapienza di Roma, Roma, Italia, alessandra.renzulli@uniroma1.it

Vitale Denise - Politecnico di Torino, Torino, Italia, vitaledenise.vd@gmail.com

The human existence is deeply anchored by the relationship with its current location. The consequence of this association is the origin of the *Genius Loci*, but where does its original meaning come from?
According to ancient mythologies and religions, some places were emotionally abundant because they were also home of a deity or a demon who interfered, acted and intervened in human life. In fact, Servius Marius Honoratus, in his work '*Commentaries to the Aeneid*', wrote in the fourth century A.D. "*Nullus locus sine genio*" ("*no place is without Genius*") affirming the importance and the presence of this entity. What is the genesis of this articulate expression? Clearly, this expression was coined during the Romans era, however, it is also necessary to refer to the Hellenistic age, as the *Genius* was often compared with the Greek *Daimon* ("*Δαίμων*" in ancient Greek).
The discussion about this topic is very extensive and complex: in fact, there are numerous authors, poets and philosophers who have analysed this mystic figure; there are also many interpretations and some of them are even antithetical. Another challenging element is that translated texts often do not fit the primary sources. In some writings it is evident how not even the Romans were able to fully understand the characteristics of this entity. Through the Book V of the '*Aeneid*', it is possible to know that Virgil is uncertain about the attribution of this spirit to either family or space, that correspond to the *Genius* of the father or the *Genius* of the place.
Greeks, like Romans, also recognized the importance of the *Daimon*, a divinity who controlled, guarded and protected the place where they used to live.
The *Genius Loci* is like a spirit that instills places with a certain identity and recognizability. The presence of this divine spirit generates emotions that create wonder, terror and even shock. These ever-changing feelings are triggered by the characteristics of each place; some of these features are culture, landform and inhabitants.
Nowadays, after overcoming the classical concept of the *Genius Loci* as a divine entity, the expression refers to the essence, the uniqueness and the nature of the place. In particular, this expression is adopted especially in architecture to refer to the two-way relationship between man and the environment.
Romans were used to pay respect to the place in order to avoid divine hostility. Today understanding the *Genius* helps to act respectfully towards a specific area. Probably, it is in this particular act that the pre-existing heritage protection is realized.

The Garden of Remembrance on the ruins of the Marburg synagogue in Germany: memory, identity and reuse

Rossella Leone - SapienzaUniversità di Roma, Roma, Italia, rosleone@hotmail.it

Roberto Ragione - SapienzaUniversità di Roma, Roma, Italia, rob.ragione@gmail.com

Nicola Santopuoli - Dipartimento di Storia Culture Civiltà, Alma Mater Studiorum – Università di Bologna, Bologna, Italia, nicola.santopuoli@unibo.it

Abstract: This contribution proposes a part of the results of the research, in progress, on the "Garden of Remembrance" (Garten des Gedenkes) in Marburg, Germany. The garden is built on the ruins of synagogue that was razed during the Nazism. The garden is the consequence of actions that, in about 150 years, have transformed the area several times.
This article will illustrate – therefore – the chronological sequence of trasformation and use of the place: the build of the synagogue in 1897 by Wilhelm Spahr; the destruction during the "Crystal Night" in 1938; the use as a parking by the adjacent University (Landgrafenhaus); the construction of the little garden in 1963 with a memorial by Dieter Waldemar Paffrath; the excavations conducted in 2008 by "Freie Institut für Bauforschung und Dokumentation"; the competion to make of a memory garden in 2009 and, finally, build the "Garden of Remembrance" in 2012 by Rainer Sachse with the collaboration of the artist Oliver Gatherand Christian Ahlborn

Keywords: Marburg, Germany, synagogue, memorial garden, identity

Nel 2012 è stato inaugurato nella città di Marburg in Germania il Giardino della Rimembranza, realizzato dallo studio Landschaftsarchitekten GmbH di Düsseldorf dell'architetto paesaggista Rainer Sachse con la collaborazione degli artisti Oliver Gather e Christian Ahlborn. Il progetto si basava sulla volontà di erigere un memoriale sul luogo dove sorgeva una sinagoga, centro religioso, sociale e culturale della comunità ebraica cittadina tra la fine del XIX secolo e la prima metà del secolo successivo.

L'edificio di culto era stato realizzato, in stile ecclettico, tra il 1895-1897 su progetto dell'architetto Wilhelm Spahr (1867-1945). Si distingueva in modo particolare per la sua cupola, unica nella città di Marburg alla fine dell'Ottocento. La sinagoga, sia per la sua imponenza sia per la sua posizione (l'edificio era stato costruito in un'area strategica in forte espansione), rappresentava l'emblema e il centro della comunità ebraica a Marburg.

Durante la repentina presa di potere del governo nazionalsocialista, nei giorni precedenti e immediatamente successive alla cosiddetta "Notte dei Cristalli" (9 novembre 1938), si scatenarono in tutta la Germania una serie di pogrom contro i cittadini di religione ebraica. Proprio in quei giorni la sinagoga venne incendiata e successivamente rasa al suolo, le macerie vennero rimosse e il terreno livellato tutto a spese della comunità ebraica che fu anche costretta infine a vendere la proprietà, al di sotto dell'effettivo valore di mercato, alla vicina Università che da tempo progettava una espansione della sua sede proprio nel lotto contiguo dove insisteva la sinagoga. L'intero sito divenne, quindi, di proprietà dell'Università di Marburg, ma l'avvento della Seconda guerra mondiale fermò i progetti di ampliamento della sede universitaria.

Nel Secondo dopoguerra l'area venne destinata alla realizzazione di un parcheggio ad uso esclusivo dell'Università, ma l'Unione Socialista Tedesca degli Studenti si mobilitò al fine di erigere un memoriale della sinagoga distrutta. Il 10 novembre 1963 – 25 anni dopo l'incendio dell'edificio di culto – venne inaugurato un piccolo giardino con un monumento opera dello scultore Dieter Waldemar Paffrath (1936-2002). Sul monumento un'epigrafe ricordava la sinagoga sacrilegamente incendiata e tutti gli ebrei della comunità di Marburg assassinati durante il regime nazista. Una porzione del sito venne comunque destinata a parcheggio per l'Università.

Dagli anni '80 del Novecento, durante una nuova crescita della comunità ebraica a Marburg, si sviluppò l'idea di ricostruire la sinagoga nell'antica sede, ma la discussione a causa di problemi di carattere finanziario e architettonico non arrivò mai a un vero e proprio progetto. Contemporaneamente, però, si concretizzò il desiderio di restituire l'area alla comunità ebraica. Iniziarono, quindi, le trattative tra lo Stato dell'Assia e la comunità locale che si conclusero il primo settembre 2002 quando venne trasferita la proprietà alla comunità ebraica (venne lasciata di pertinenza dell'Università solo la necessaria strada d accesso per i vigili del fuoco).

Nel 2005 la comunità ebraica decise di fondare una nuova sinagoga sulla Liebigstraße, abbandonando definitivamente l'idea di ricostruire il vecchio edificio di culto. Nel 2008 è stata condotta una campagna di scavo dal Freie Institut für Bauforschung und Dokumentation (Istituto Pubblico per la Ricerca e la Documentazione storica), commissionata dalla città di Marburg, che ha permesso di rintracciare le strutture di fondazione della sinagoga e mettere in luce la planimetria degli ambienti più importanti dell'edificio come l'aula magna e la sala del'mikveh', bagno rituale di purificazione. Sulla documentazione restituita dalla ricerca storica e dalle indagini archeologiche, nel 2009 è stato bandito dal Dipartimento di Pianificazione, Edilizia, Ambiente della Città di Marburg un concorso per la realizzazione di un nuovo giardino pubblico con la funzione di memoriale.

Nel 2012 è stato inaugurato un Giardino della Rimembranza: lo spazio realizzato esprime la volontà di fornire informazioni su un brano di città scomparso che comprendeva l'antico edificio di culto, essere evocative per la comunità ebraica e la sua cultura fortemente osteggiata in passato, e allo stesso tempo costituire un'area pubblica per la vita quotidiana e per l'interazione della cittadinanza. La preesistenza si lega e rivela grazie alla nuova architettura, lo spazio centrale quadrato lasciato a prato ricalca il perimetro dell'aula magna della sinagoga, qui è stato collocato il monumento del 1963, nel prato è presente anche un tiglio rimasto dalla configurazione post distruzione del 1938; inoltre, sul prato sono distribuite le teche dello 'Zettelkasten' (caselle di nota) del progetto artistico curato da Oliver Gather e Christian Ahlborn. Le teche raccolgono citazioni degli ebrei di Marburg sopravvissuti all'Olocausto, in un continuo dialogo tra passato e presente. Nello stesso momento il giardino si apre al pubblico su una delle vie più importanti della città come un'attraente area urbana.

Maintaining and reusing in tourism accommodation construction in Baixo Tâmega Valley

Pinto Jorge – UTAD / CMADE, Vila Real, Portugal, tiago@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Bentes Isabel – UTAD / CMADE, Vila Real, Portugal, ibentes@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Cristina Reis - UTAD, Vila Real, Portugal, crisreis@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Paula Luísa - UTAD, Vila Real, Portugal, plsilva@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Pereira Sandra - UTAD, Vila Real, Portugal, spereira@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Zięba Zofia - Wrocław University of Environmental and Life Sciences, Wrocław, Poland, zofia.zieba@upwr.edu.pl: (pl. Grunwaldzki 24, 50-363 Wrocław)

Paiva Anabela - UTAD / CMADE, Vila Real, Portugal, apaiva@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Abstract: Several rehabilitation processes have already taken place in rural and low population density areas. The Baixo Tâmega Valley region is one example. Some examples of this region's traditional rural dwellings are recent examples of rehabilitation processes. This paper's main objective is to highlight the possibility of rehabilitating traditional rural dwellings sustainably by maintaining and reusing building materials. It is also intended to share the building trends in this region for tourism purposes. Some options for maintaining and reusing materials and building elements are presented and described. It is noticed that maintaining and reusing seems to be a wise decision because there may be an economic gain and also a valorisation of the heritage. The solutions introduced in this work may be extended to other worldwide rehabilitation processes and contribute to valorising traditional building techniques.

Keywords: Reusing, Maintaining, Rehabilitation, Tourism Accommodation, Baixo Tâmega Valley

1. Introduction

Fortunately, the rehabilitation of the Portuguese city centres is already a reality [1]. It is also reaching the rural areas. In fact, interesting rehabilitation processes have been occurring in these areas. The Baixo Tâmega Valley is one of these areas. Nowadays, this region is getting more attention in terms of tourism. Thus, it has triggered an attractive real estate situation based on acquiring farms and rehabilitating the rural building in tourism accommodation.

On the other hand, in a rehabilitation process, it is a good building practice to keep, as possible, the traditional materials, the traditional elements, the traditional technics, the traditional colours and finishing types, among other practices.

Some examples of the rehabilitated building are presented in this paper. They are examples of maintaining and reusing practices during their rehabilitation process.

At the same time, in this region, they are already different suppliers of used building materials that can be applied in this type of rehabilitation process, Figure 1.

Key: Tourism accommodation Company Area concerning the above figure

Figure 1. Location of some companies

Maintaining and reusing in a rehabilitation building process is possible. Old and new may work together. It is also a sustainable solution [2].

4. Conclusions

The trend of rehabilitation has already arrived in rural and low-density population areas. Dwellings are some of the buildings under this type of building process. Some of them have been transformed into tourism accommodations. It has been occurring an increasing interest in rural tourism. In these rehabilitation processes, there has been careful in maintaining the traditional building. Fortunately, respect in terms of heritage has been occurring.

In some cases, a part of maintaining and reusing building materials or components has also been noticed. This building practice main be economically advantageous and may contribute to a more sustainable building behaviour. Several companies are already operating in the used materials market, and a wide range of options is also available.

Acknowledgements

This work was supported by the FCT (Portuguese Foundation for Science and Technology) through the project UIDB/04082/2020 (CMADE)

References

[1] Padrão, J., Arêde, A., Guedes, J. M., Pinto, J. (2019). Experimental Characterisation of Mechanical Behaviour of Existing Tabique Walls Under Compressive and Shear Loading. Structural Analysis of Historical Constructions. Springer, Cham. 568-576. https://doi.org/10.1007/978-3-319-99441-3_61. Print ISBN 978-3-319-99440-6. Online ISBN 978-3-319-99441-3

[2] Zięba, Z., Dąbrowska, J., Marschalko, M., Pinto, J., Mrówczyńska, M., Leśniak, A., Petrovski, A. & Kazak, J. (2020). Built Environment Challenges Due to Climate Change. IOP Conference Series: Earth and Environmental Science, Volume 609, 6th World Multidisciplinary Earth Sciences. IOP Publishing Ltd.

Survey of the Leiria Castle Tower

Carina Carmo – Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, cmcarmo@ua.pt

Ana Silva– Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, ana.seoane@ua.pt

Tamiris Dourado – Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, tamirisviesser@ua.pt

Francisca Antunes– Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, franciscamariapa@ua.pt

Francisca Pinto – Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, franciscamsmp@ua.pt

Fábio Mota – Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, fabiomota@ua.pt

Catarina Freitas – Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, c.freitas@ua.pt

David Pereira– Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, davidmp27@ua.pt

Vitor Antunes – Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, vitorantunes18@ua.pt

Dener Silva– RISCO, Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, dener.silveira@ua.pt

Inês Bourgeois– RISCO, Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, inescbourgeois@ua.pt

Ana Alves – RISCO, Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, anadalves@ua.pt

Hugo Rodrigues – RISCO, Civil Engineering Dep., University of Aveiro, Aveiro, Portugal, hrodrigues@ua.pt

Abstract: This paper intends to study the conservation state of the Leiria Castle Tower, as well as assess its structural safety, through an extensive survey and characterization campaign. When performing this type of study in Cultural Heritage, there is a need to use non-destructive techniques, so that no damage is done that can affect its authenticity. This work starts by doing a geometrical survey of the Tower, by using laser scanning technology that enabled to generate a BIM model of the Tower. Then, a survey and mapping of the anomalies present in the Defense Wall and in the Tower. To characterize the masonry structure of the wall, several sonic tests were performed, which allowed to characterize the tower masonry as very regular, with a low percentage of voids. To finalize this phase of the study, environmental vibrations tests were done in the floors and roof of the Tower, to do the dynamic identification. This work manages to gather several structural properties that will be used in a second phase to do the numerical model of the Tower and perform simulations.

Keywords: Cultural Heritage, Laser scanning, BIM, Sonic tests, Dynamic identification

1. Introduction

The present work shows the characterization work carried out in the Leiria Castle Tower for the development of a BIM model that allows the integration of all the geometric characterization and other types of information related to the materials, recent interventions, and pathologies. Throughout the inspection campaign, several non-destructive techniques were applied to perform the geometrical survey of the Tower and to characterize its structural materials, to conclude about its state of conservation and structural safety [1],[2].

2. Building survey and Non-destructive Tests

The geometric survey was based on the point cloud resulting from the laser scanner survey, allowing the preparation of a three-dimensional modelling of the Tower.
A visual inspection and photographic record were made, what enabled to do the survey of pathologies and to assess and understand their evolution patterns [3]. The on-site experimental campaign carried out in the Tower included sonic tests of six masonry walls. Through this test was possible to estimate the mechanical properties of the walls [4]-[7].

For this structure under investigation, experimental tests have been performed by applying Environmental vibrations test, what allowed to obtain correlations between natural frequencies and vibration modes of direct measurement [8],[9].

In this first phase of this study the information on the geometry, mechanical properties of the materials and construction details, was collected. In the second stage it will be developed a numerical model, to be calibrated with the results obtained from the non-destructive tests and results from the dynamic identification to assess the seismic safety of the tower.

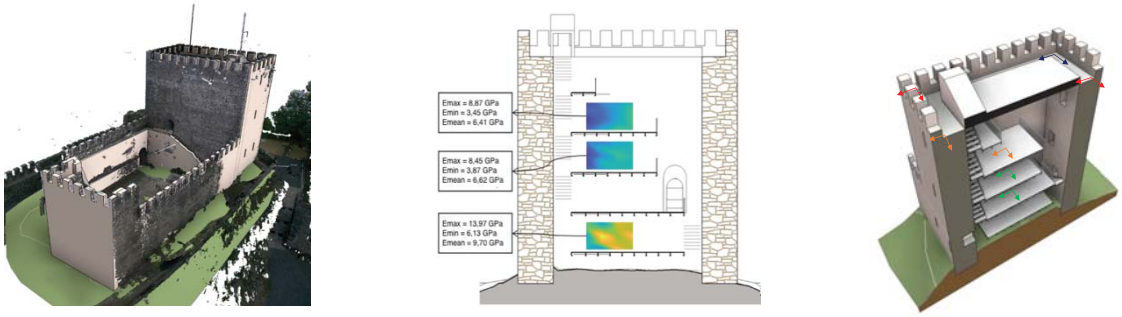


Figure 1. a) Overlap of BIM model and point cloud b) Sonic tests results c) Sensor layout of vibration testing

References

[1] L. M. Correia and J. Aguiar, *Castelos em Portugal: retrato do seu perfil arquitectónico [1509-1949]*. Imprensa da Universidade de Coimbra, 2011. doi: 10.14195/978-989-26-0220-2.

[2] A. Ginja, "The last stronghold of the Castle of Leiria and its constructive evidences: when Romanesque encloses Gothic," *Arqueología de la Arquitectura*, no. 14, p. 063, Dec. 2017, doi: 10.3989/arq.arqt.2017.020.

[3] A. L. Vieira and C. S. Oliveira, "Impacte do sismo de 28 de fevereiro de 1969 em algumas cidades. Comparações," *Territorium*, no. 28(II), pp. 93–114, Jul. 2021, doi: 10.14195/1647-7723_28-2_8.

[4] T. M. Ferreira, J. Ortega, and H. Rodrigues, "Geometrical, constructive, and mechanical characterization of the traditional masonry buildings in the historic city center of Leiria, Portugal," in *Masonry Construction in Active Seismic Regions*, Elsevier, 2021, pp. 147–174. doi: 10.1016/B978-0-12-821087-1.00004-1.

[5] L. F. Miranda, J. Rio, J. Miranda Guedes, and A. Costa, "Sonic Impact Method – A new technique for characterization of stone masonry walls," *Constr Build Mater*, vol. 36, pp. 27–35, Nov. 2012, doi: 10.1016/j.conbuildmat.2012.04.018.

[6] L. Binda, A. Saisi, and C. Tiraboschi, "Investigation procedures for the diagnosis of historic masonries," *Constr Build Mater*, vol. 14, no. 4, pp. 199–233, Jun. 2000, doi: 10.1016/S0950-0618(00)00018-0.

[7] P. B. Lourenço, A. Trujillo, N. Mendes, and L. F. Ramos, "Seismic performance of the St. George of the Latins church: Lessons learned from studying masonry ruins," *Eng Struct*, vol. 40, pp. 501–518, Jul. 2012, doi: 10.1016/j.engstruct.2012.03.003.

[8] A. Saisi and C. Gentile, "Post-earthquake diagnostic investigation of a historic masonry tower," *J Cult Herit*, vol. 16, no. 4, pp. 602–609, Jul. 2015, doi: 10.1016/j.culher.2014.09.002.

[9] A. Vuoto, J. Ortega, P. B. Lourenço, F. Javier Suárez, and A. Claudia Núñez, "Safety assessment of the Torre de la Vela in la Alhambra, Granada, Spain: The role of on site works," *Eng Struct*, vol. 264, p. 114443, Aug. 2022, doi: 10.1016/j.engstruct.2022.114443.

Understanding, interpreting, and shaping a dialogue between drawing and digital modelling. The case study of Donatello's Pulpit.

Sandro Parrinello - University of Pavia, Pavia, Italy, sandro.parrinello@unipv.it

Francesca Picchio - University of Pavia, Pavia, Italy, francesca.picchio@unipv.it

Silvia La Placa - University of Pavia, Pavia, Italy, silvia.laplaca@unipv.it

Abstract: Donatello's pulpit is a sophisticated architectural work that represents an important historical and religious symbol for the city of Prato, as a stage in the Ostension of the Sacra Cintola ceremony. The original parapet is in the Museum of the Opera del Duomo, while a copy is placed on the main facade of Santo Stefano Church. On the occasion of the exhibition 'Donatello, the Renaissance', two of the original pulpit tiles have been removed for display in other museums. Documentation actions were therefore planned to digitally reproduce the artwork and create virtual and 3D-printed products to replace the temporarily missing tiles. This process was an opportunity to evaluate the relationship between the artwork and its reproductions, as well as to understand the value of the digital model as a critical reinterpretation of the complexity of the real artwork. In this sense, the article aims to describe the dialogue between different databases and 3D models obtained with reality-based and image-based tools applied to Donatello's pulpit.

Keywords: 3D survey, digital twin, 3D printing, Donatello's Pulpit.

1. The digital form and the symbolic reinterpretation of the pulpit

This paper aims to describe some drawing activities conducted on an extremely refined artwork explaining, in addition to the methodological components that defined the actions and activities conducted, the relationship between the artwork, its copy, and its digital copy. This is a path of knowledge based on drawing, in which an approach to material and physical knowledge of the artwork is developed through an analysis of forms and through processes of measurement [1].

Donatello's pulpit in Prato constitutes an allegorical system in relation with Santo Stefano's Cathedral. It communicates the events connected to the city and its relic, the *Sacra Cintola* (or Sacred Belt), placed by the apostles around the Virgin's waist before her Assumption [2]. Donatello's pulpit, placed at the intersection of the south and west elevations of the Cathedral, is the last stage of the Ostension ritual, and it consists of decorative tiles housing a theme of festive sprites assuming a variety of poses, in a composition marked by rhythm and harmony. In 1776, the pulpit underwent numerous restorations, until it was replaced in 1972 by a copy made of resin and marble dust, which can currently be seen on the exterior façade of the Cathedral [3]. The original parapet, together with the bronze capital below, is now preserved in the Museo dell'Opera del Duomo.

To constitute a digital memory of Donatello's pulpit has been developed a digital duplicate to increase knowledge and communication through a dialogue between physical and digital models. For this reason, a research project has been developed to document the original pulpit and its outdoor copy [4]. To define a new dialogue between the artwork and its

reproductions different methodologies and tools have been tested. From a discretised database can be produced numerous interpretative models of the original artwork. Thanks to these models and through the digital, the dialogue between the work and its duplicates can be enriched, as well as the relationship between the values of the original work and the new meanings of its reproductions [5].

2. Conclusions

The considerations addressed in this contribution underline the importance of integrated digital survey and documentation for a dual purpose: to develop a database that can support the conservation of the artwork, and to create a product that can enrich the cognitive and communicative value of Cultural Heritage. The models obtained from the different databases cannot give an exhaustive and complete overview of the original artwork. Each model represents a simplified version of the original but at the same time goes deeper into a specific descriptive aspect. From different products comes a plurality of different narratives. These offer multiple points of view: each model is simplified from the original but related to the other models. This connection provides maximum personalisation of the user's knowledge experience.
The models and the relationships between them also become "other" than the artwork itself. Comparative processes are thus promoted to foster the development of knowledge and the many forms of knowledge, giving rise to models of models.

Aknowledgements

The documentation and graphic restitution activities described in this contribution are part of a research project scientifically coordinated by the University of Florence and the University of Pavia. The project, financed by the *Fondazione Cassa di Risparmio di Prato* and promoted by the *Musei Diocesani di Prato*, was conducted by researchers from the joint laboratory LS3D_Landscape, Survey and Design of the University of Florence and the University of Pavia and the DAda-LAB laboratory of the Department of Civil Engineering and Architecture of the University of Pavia.

References

[1] Parrinello, S., Picchio, F., Database and complexity. Remote use of data in the virtual space of reliable 3D models, “Architecture and Engineering”, 2017, 2(2); 27-36.
[2] Dello Russo, M., Storia della Sacra Cintola di Prato. Stamperia Ferrante, Napoli, 1858.
[3] Giusti, A., Biliotti, C., “… sì belli e sì mirabili”: recuperi e limiti nel restauro dei rilievi donatelliani, [in:] Giusti, A. (edited by), Donatello restaurato. I marmi del pulpito di Prato, Maschietto editore, Florence 2000; 61-72.
[4] Rivellino, C., Ricciarini, M., *Testing the reliability of mini-UAVs acquisition campaign on detailed bas-reliefs. The case study of sculpturing elements of Donatello’s Pulpit*, [in:] Barba, S., Parrinello, S., di Filippo, A., Dell’Amico, A., (edited by), “D-SITE Drones - Systems of Information on culTural hEritage”, 2022, 2(2); 518-527.
[5] Parrinello, S., Dell’Amico, A., Experience of documentation for the accessibility of widespread cultural heritage, “Heritage”, 2019, 2(1); 1032-1044.

Earth-based mortars at the Wupatki Pueblo: a preliminary assessment through non-destructive testing

Gambilongo Laura – Department of Civil Engineering, University of Minho, ISISE, 4800-058 Guimarães, Portugal, e-mail: laura.gambilongo@gmail.com

Barontini Alberto - Department of Civil Engineering, University of Minho, ISISE, 4800-058 Guimarães, Portugal, e-mail: albe.barontini@gmail.com

Lourenço Paulo B. - Department of Civil Engineering, University of Minho, ISISE, 4800-058 Guimarães, Portugal, e-mail: pbl@civil.uminho.pt

Abstract: This paper deals with the inspection and diagnosis of the Wupatki Pueblo archaeological site (Arizona), mainly built of sandstone units and earthen mortar joints. The investigation aimed at assessing the state of conservation of the site, affected by accelerated degradation phenomena due to aggressive environmental conditions. To that end, the evaluation of the mechanical properties and the durability of the earth-based mortars was deemed necessary. Four non-destructive tests (i.e. penetrometer, Schmidt hammer, pendulum hammer, and scratch tests) were therefore carried out on six different types of earth-based mortars identified on-site by visual inspection. Both the penetrometer and the Schmidt hammer tests allowed a quantitative estimation of the compressive strength, while the pendulum hammer and the scratch tests provided a qualitative assessment of the hardness and durability, respectively. Main limitations of the equipment and best practices were identified during the experimental campaign on-site. In conclusion, the earthen mortars showed an average compressive strength of 0.8 MPa and an acceptable durability.

Keywords: earth-based mortar, on-site diagnostic investigation, non-destructive testing, durability assessment, strength assessment.

1. Introduction

Earth-based mortar performance is extremely variable, mainly due to the intrinsic heterogeneity of the raw material, mixture constituents, and water content, as well as the construction technique and environmental conditions. Therefore, an exhaustive characterisation of the material properties for each specific case is required. To that end, several on-site non-destructive tests (NDTs) exist. However, they have been developed for mortars other than earth-based, and sometimes the devices have technical specifications which are not compatible with low-strength materials such as earthen mortars [1]. Indeed, a shortage of research on the use of NDTs on earth-based mortars has been noted in the literature. This work aims, therefore, to address this gap by using well-established NDTs to characterise earth-based mortars at the Wupatki Pueblo archaeological site (Arizona).

2. *In-situ* non-destructive testing at the Wupatki Pueblo

A diagnostic investigation is carried out at the Wupatki Pueblo, the largest open-air archaeological site within the Wupatki National Monument (Arizona) in order to assess its state of conservation under aggressive environmental conditions. Due to their sensitive nature, earth-based mortars are investigated in terms of strength and durability performance. In particular, six earth-based mortars, defined as amended because stabilised with an acrylic-emulsion polymer, are selected through visual inspection for testing. Four NDTs are

combined to evaluate the strength and durability of earth-based mortars: penetrometer, Schmidt hammer, pendulum rebound hammer, and scratch tests. By applying different procedures, it is possible to maximise the reliability of the results. Both the penetrometer and Schmidt hammer tests provide the compressive strength of the material by correlating it to the penetration of a needle and the rebound of a spring-controlled mass, respectively. On the other hand, the pendulum rebound hammer allows a qualitative estimation of the mechanical properties through the measurement of the pendulum-mass rebound. While the durability performance of the mortar is qualitatively estimated through the scratch test, by measuring the indentation of a probe into the mortar surface.

3. Conclusions and recommendations

In general, the tests proved to be suitable for widespread use, since, if appropriately conducted, cause minor or no damage. According to the preliminary assessment, the earthen mortars showed an average compressive strength of 0.8 MPa and an acceptable estimated durability. This on-site experimental campaign allowed to identify the main limitations of the equipment and best practices. As a future goal, these procedures should certainly be improved and adapted to the peculiarities of earthen materials, mainly by developing, through destructive testing on laboratory specimens, curves tailored to earth-based mortars.

Acknowledgments

This publication is made possible with support from the J. Paulo Getty Trust. The study has also been funded by the “Archaeological Site Conservation and Management, Wupatki National Monument” project through the Getty Foundation. The project was undertaken in collaboration with the Architectural Conservation Laboratory/Weitzman School of Design at the University of Pennsylvania. This work was also partly financed by FCT / MCTES through national funds (PIDDAC) under the R&D Unit Institute for Sustainability and Innovation in Structural Engineering (ISISE), under reference UIDB / 04029/2020.

References

[1] Mammoliti E., Ferretti A., Malavolta M., Teloni R., Ruggeri R., and Roselli G., “Defining a non-destructive in situ approach for the determination of historical mortar strength using the equotip hardness tester” *Appl. Sci.*, vol. 11, no. 11, 2021.

WoodBox modules: a flexible and re-usable emergency solution for temporary retail activities

Lucchini Angelo – Politecnico di Milano, Milano, Italy, angelo.lucchini@polimi.it

Mazzucchelli Enrico Sergio – Politecnico di Milano, Milano, Italy, enrico.mazzucchelli@polimi.it

Scrinzi Giacomo – Politecnico di Milano, Milano, Italy, giacomo.scrinzi@polimi.it

Pastori Sofia – Politecnico di Milano, Milano, Italy, sofia.pastori@polimi.it

Stefanazzi Alberto – Politecnico di Milano, Milano, Italy, alberto.stefanazzi@polimi.it

Silva Stefania – Politecnico di Milano, Milano, Italy, stefania.silva@mail.polimi.it

Severgnini Mario – Politecnico di Milano, Milano, Italy, mario.severgnini@mail.polimi.it

Abstract: Ongoing climate change effects can bring to extremely negative consequences in the coming decades. In this context, the development of housing prototypes suitable to provisionally host people affected by emergency situations (to which the emergency related to war events has recently been added) is nowadays an issue of primary importance. However, recent seismic events in Italy have highlighted how the problems of post-emergency and reconstruction are not only related to the rapid housing construction, but also derive from other serious and prolonged inconvenience for the people involved. In fact, the priority of emergency procedures mainly concerns the realization of temporary residential housing, without considering the people need to continue their activities, that means aggregation and social life. The need to create a place where people can start again their work and social activities, has guided the research here presented. The paper describes the development of an innovative construction system based on prefabricated modules that can be used in the early post-emergency phase, but also during the reconstruction of the damaged buildings or during neighbourhood redevelopment interventions. The paper analyses different layout configurations, with an in-depth study of the methods of installation and connection, considering building services integration as well.

Keywords: risk mitigation, climate change, modular unit, emergency housing, flexibility

1. Introduction

Reduction in water resources, soil instability, forest fires, soil consumption, desertification and severe weather events are some of the numerous risk factors that characterize the Mediterranean Basin. In addition, there are other pressures caused by ongoing climate change that act as 'amplifiers' with the potential for extremely negative consequences in the coming decades if a new model of sustainable development aimed to reduce impacts and strengthen resilience is not pursued. Climate change may in fact influence the frequency and intensity of hazardous events, with inevitable widespread impacts, also on architectural heritage and building stock [1]. In this context, the development of housing prototypes suitable to provisionally host people affected by natural disasters or emergency conditions is nowadays an issue of primary importance [2]. Mainly as a result of the several earthquakes occurred in Italy in the last decades, many researches have been carried out to define alternative design approaches different in typology, construction methodology and materials [3]. However, recent seismic events have highlighted how the problems of post-emergency reconstruction are not only related to the rapid housing construction for the affected populations, but also derive from other serious and prolonged inconvenience. In fact, the

emergency camp is not just a temporal discontinuity, but also a spatial one in the refugees' lives. It is not a place, but a transit space where the lack of social relations and the anonymity can become the rule [4]. The paper presents the design of an emergency construction system based on prefabricated timber modules that can be used to host commercial retail activities and to create more complex buildings and common areas where people can meet and spend their time even over several weeks after the emergency.

2. The standard WoodBox design

Considering many aspects, among which flexibility, speed of production, ease of assembly and disassembly, transport, reuse, etc., the research has led to the definition of a prefabricated standard module (WoodBox) that can be easily adapted according to the different climatic conditions of the Italian territory. The modules are characterised by a timber frame construction system, particularly suitable to manufacture housing units after catastrophic events, guarantees a fast production, lightness (and therefore a good behaviour in seismic areas), ease of transport, installation and commissioning. These module types, aggregated in different configurations, can generate buildings of more complex and articulated geometry. The concept of modular standardisation and coordination, together with the flexibility criteria, are essential to minimise the production and construction times, and they allow to realise a buildings system able to respond to the functional spatial needs reaching standards, comfort and performance comparable to the last generation of sustainable buildings. Since the layout of the modules is linear and essential, it was decided to create more articulated buildings assembling and overlaying the modules in different ways. This was possible using some additional elements, such as staircases, balconies, banisters, etc.

3. Conclusions

The paper highlights how the problems of an emergency reconstruction are not only related to the rapid housing construction, but also to the availability, as soon as possible, of areas where people can start again their work and social activities, in order to avoid the lack of social relations and the anonymity of the place. In particular, it is noted that housing prototypes suitable to provisionally host people affected by natural disasters is a primary importance issue, but places for commercial and social activities are fundamental too. The results show how flexibility, fast production, ease of assembly and disassembly, transport, reuse, etc. considered to define the prefabricated standard WoodBox module, are fundamental for an emergency reconstruction.

References

[1] E. Sesana, A.S. Gagnon, C. Ciantelli, J.A. Cassar, J.J. Hughes (2021) Climate change impacts on cultural heritage: A literature review. WIREs Clim Change. 12:e710. https://doi.org/10.1002/wcc.710

[2] S.M. Cascone, N. Tomasello, V. Zaccaria (2017) Box-Housing: impianto di cargotecture per gestire tempestivamente le situazioni di emergenza, in Proceedings of Colloqui.AT.e 2017 Conference – Demolition or Reconstruction?, Ancona, Italy, 28-29 September 2017.

[3] C. Sicignano, P. Fiore, G. Di Ruocco (2017) Case alloggio post sisma: prefabbricazione leggera e/o pesante, approccio conoscitivo per una riqualificazione consapevole, in Proceedings of Colloqui.AT.e 2017 Conference – Demolition or Reconstruction?, Ancona, Italy, 28-29 September 2017.

[4] F. Primicerio, E. Sicignano, G. Di Ruocco (2017) L'architettura dell'emergenza. Gli aspetti qualitativi di un insediamento temporaneo, in Proceedings of Colloqui.AT.e 2017 Conference – Demolition or Reconstruction?, Ancona, Italy, 28-29 September 2017.

The factory and its doom. Considerations about the non-application of the different knowledge for the restoration and use of industrial heritage in the case of Olivetti Brasil

Di Mari Giuliana - Politecnico di Torino, Torino, Italia, giuliana.dimari@polito.it

Garda Emilia - Politecnico di Torino, Torino, Italia, emilia.garda@polito.it

Abstract: The contribution aims to analyse the events surrounding the Olivetti factory in Brazil. The purpose is to reflect on the work from a broader panorama that sees it as deeply connected to its era - the second half of the 20th century -, to its ownership - Olivetti - and to the architect who designed it - Marco Zanuso. The factory is considered among the references of modern architecture produced in São Paulo during the 1950s, a pioneering case of globalised architecture produced by that group of European architects who influenced Brazilian architecture. In the 1990s, the factory underwent a reconversion that distorted its original composition, a fate from which it has not been possible to escape despite the efforts made to ensure its preservation. The occasion promotes a discussion related to the themes of the preservation of the industrial architectural heritage, still too fragile and too often subjected to building speculation that replaces historical-cultural values with political-economic ones. The factory and its doom are thus aimed at underlining the lack that played a role in the reuse of the factory. Lack of awareness, knowledge, methodology, and adherence to restoration principles, finally results in the lack of historical memory.

Keywords: Olivetti, Zanuso, Brazilian modern architecture, industrial heritage, reuse

The 20th century more than any other, experienced turmoil and ferment that resulted in the search for a culture common to all peoples, in clear opposition to the nationalist fervour that the politics of the beginning of the century imposed on all art. With the end of the Second World War, Italy was the scene of the formation of art groups linked to the resistance against fascism, and initially, Italian art was generated by all kinds of artistic manifestations, which were based on the recovery of elements linked to post-cubism, geometric abstraction, new realism and metaphysical painting. Across the ocean, in Latin America, European cultural avant-gardes had an impact, mainly in literature, music and painting. These influences undoubtedly stemmed from the political, economic, and social contradictions that defined a different way of assimilating rationalist codes at that time, on the one hand, identified with the most progressive political positions, and on the other a need for stylistic renewal in line with contemporary trends. However, the assimilation of the Modern Movement in Latin America cannot be analysed as a simple translation of stylistic features as it was conditioned in each case by the specific historical circumstances of each country (Guitiérrez, 1996).
During the 1940s, there were two important exhibitions at MoMA for the dissemination of Brazilian culture abroad: one on the Italian-Brazilian artist Cândido Portinari, and the other on Brazilian colonial and modern architecture. In the second case, Philip L. Goodwin, the curator of the catalogue, offered a vision of Brazilian architecture capable of experimenting and proposing solutions for Europe, thanks to a young, strong, and prosperous architecture. After Goodwin's 1943 book Brazil Builds, Brazil gained visibility with international publications and articles published in the magazines Studio and Architectural Review - both English - and the French magazine L'Architecture d'Aujourd'hui.
Latin America thus became a privileged territory for economic expansion, and it was no coincidence that Olivetti - which was already present with several subsidiaries and sales

offices distributing imported products - chose Argentina and Brazil to establish its industrial presence.

«Olivetti in Brazil, as a productive entity, besides contributing to industrial and economic progress in an undoubtedly beneficial way, represents a decisive step in the updating, in this country, of industrial design still too much left aside or reproduced by anyone. [...]» (Bardi, 1958)

Olivetti's industrial architecture integrated the factory's functionality with the beauty of the surrounding landscape (Olmo, 2018). Workplaces are designed on a human scale and at the same time are compatible with economic and production needs. In addition, industrial areas are placed in territories where human life is not sacrificed for production: through urban plans, workers' quarters, libraries, social services, canteens, and kindergartens, the needs of the individual and society are placed in the foreground. Tangible signs of Olivetti's architecture can also be found abroad, and this remains a field that has been investigated to a limited extent (Astarita, 2000).
Adriano Olivetti commissioned Marco Zanuso to design the South American factories who was, at the time, still a young architect. Guiducci stated in issue 216 of Casabella in 1957 that «[...] quite a few technicians from the client company, Olivetti, asked how many factories the architect had already built, what experience he had in industrial matters. [...] On the other hand, it had to be made clear that the specific technical experience for the type of factory that was to be built could only come from technicians specialised in that particular sector, and not from the architect, no matter how many other factories he had built or knew from old experience. [...] Therefore, the problem was finding formulas for the passage of industrial technical experience into industrial architectural experience» (Guiducci, 1957).

The desire for development and progress in the conviction that modern industry reflects the problems of modern society was Zanuso's design mission in Latin America. Zanuso's *modus operandi* finds full manifestation in the industrial architecture of the Olivetti commission. In these projects, one can see the search for structural logic capable of optimising the relationship between form and function. The workspaces are conceived as a continuum in which production can and must change to adapt to new requirements. By experimenting with the potential of reinforced concrete, Zanuso seeks the rationalisation of components to create an immediately recognisable structure. There is the search for a perfect balance between technique and language and this is realised in the use of a generating principle, which in Argentina is identified in the beam-pillar system and Brazil in the triangular module defined by vault and pillars.
This generating element is infinitely repeatable and thus responds to the principles of applicability, and flexibility. reproducibility. Through the elaboration of the project, and even more so between one project and the next, the architect gives back a global dimension of architecture through his design outcomes. The two South American projects highlight the progressive refinement of elements and distribution schemes and constitute the place of experimentation for those technological and morphological solutions that will eventually be implemented in Italy.
The reconstruction of the specific architectural event intervenes in analysing the constituent elements of Zanuso's design and the variations of the theoretical matrix applied to the specificities of the factories built for Olivetti. During the 1990s, Olivetti sold the Brazilian factory to a company that converted it into a shopping centre in 2007. From here began the process that led to the oblivion of the history of the factory, an icon of modern architecture in São Paulo and a rare work by Zanuso outside Italy.

The Rehabilitation Impact of Historic Houses on Cultural Heritage
Sustainable Actions for the Historic Centre of Oporto, World Heritage Site

Rosa, Inês - Universidade Católica Portuguesa, School of Arts, Master in Conservation and Restoration of Cultural Heritage, Porto, Portugal, inesmmrosa@hotmail.com

Moreira, Patrícia - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, prmoreira@ucp.pt

Guedes, João Miranda - Faculdade de Engenharia, Universidade do Porto, CONSTRUCT, Porto, Portugal jguedes@fe.up.pt

Vieira, Eduarda - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, evieira@ucp.pt

Abstract: This paper focuses on the rehabilitation practices of Porto centenary buildings from 2015 to the present, with an emphasis on touristic and common housing projects, chiefly those with great cultural significance. The study evaluates the impact of the interventions conducted on those buildings, with consequent potential for gentrification and loss of identity. Tourism is a relevant element of the equation (low-cost flights/mass tourism/rehabilitation boost - economic growth) due to the deep alterations it allowed and brought to the built historic heritage and traditions. Foremost, this research incorporates historical and cultural preservations grounded in the pillars of sustainability, highlighting procedures adaptable to similar projects in the city, by reviewing defensible projects and regional solutions taking place in other parts of the world.

Keywords: Climate Change; Sustainability; Built Heritage Conservation; Circular Economy; Energy Efficiency

1 Introduction

The work presented is part of the project ***HAC4CG - Heritage, Art, Creation for Climate change. Living the city: catalysing spaces for learning, creation and action towards climate change***. The project takes the city of Porto as a case study for global changes and analyses, among other topics, the research line RL1 - ***Engaging Citizens through Heritage Protection*** focused on Cultural Heritage preservation and contemplates a ***Heritage Observatory*** (WP3), in which this paper is included within a master thesis as a project's output. The underlying principle of this study is to highlight the shape of a community's identity into its built heritage, its collective memories expressed in the urban mesh, the architectonic designs, technical construction values as well historic decorative materials and techniques, all relevant questions arising within rehabilitation/alteration practices. The aim is to analyse the alterations in the city centre (considering the ICOMOS report on Monuments and Sites in Danger [1]) with a review of selected projects weighing the sustainable trinomial: Conservation and Restoration, Circular Economy and Energy Efficiency[2].

2 Alterations to the Praxis

The tourism impact on the urban tissue can be directly linked to a variety of rehabilitation projects undertaken, and understanding the causes and drives of the touristic market allows

us to have a clear view of the construction industry's behaviours to serve touristic purposes both on tangible and intangible aspects [3]. The Historic Centre of Porto as a World Heritage Site sets the mote for this investigation on Historic Houses Rehabilitation by comprising the definitions and guidelines on the topic stated by UNESCO and other crucial charters, conventions, principles and declarations on historical integrity and sustainable future, alongside its role in the community´s identity, thus providing a framework for a better understanding and systematization of the information regarding the main objectives.

3 The Pillars of Sustainability

The analysis of casual-comparative research regarding transformations outside Porto (both National and International case studies) provides an outline of rehabilitation trends that might be adopted in the *Invicta* city and may result in methods to shift or overcome certain practices towards to the considered Sustainability Pillars [4]. The three pillars are addressed by proximity and, although correlatable, here, **Conservation and Restoration** procedures are measured in Social sustainability, **Circular Economy** practices in Economy sustainability and **Energy-efficient** measures in Environmental sustainability.

4 Final considerations

The categorization of the sustainability pillars will lead the way to the gaps in the field [5], that range from mismanagement in the project (e.g., facadism); in the planning (e.g., waste management), in the construction site (recyclability and compatibility) and the direct linkage in ill practices following touristic demand, its consequences on the environment and the community.

Acknowledgements

This study is being conducted under the project NORTE-01-0145-FEDER-000067 co-funded by the European Regional Development Fund (ERDF) through the Northern Regional Operational Program, under the terms of the Notice of Application No. NORTE-45-2020-75 - Scientific and Technological Research Support System - "Projetos Estruturados De I&D&I "- Horizon Europe.

References

[1] ICOMOS Portugal (2020) Portugal: Threats to the World Heritage. Machat C, Ziesemer J, eds. Herit. Risk. World Rep. 2016-2019 Monum. Sites Danger. ICOMOS, Berlin: hendrik Bäßler verlag, p. 107–9.

[2] Climate Change and Cultural Heritage Working Group. International Council on Monuments and Sites - ICOMOS (2019) The Future of our Pasts: Engaging cultural heritage in climate action. Paris: International Council on Monuments and Sites - ICOMOS; World Universities Network; Center for Heritage and Society, University of Massachusetts, Amherst, USA.

[3] Fernandes, J.A.R. Tenreiro, J.P. Figueiredo, P.M. de. Pinto, J.R.. Chamusca, P. (2021) A Baixa do Porto - Arquitetura e Geografia Urbana 2010-2020. Porto: BKC. Book Cover Editora, lda.

[4] Potts, A. (2021) European Cultural Heritage Green Paper. Europa Nostra, The Hague & Brussels, ICOMOS.

[5] Aguiar, J. Pernão, J.. Ferreira, T.C. (2020) Preservação do Património. Júlio ES, ed. Guia Fundo Nac. Reabil. do Edif., Lisboa: FUNDIESTAMO, SA., p. 143–60.

Shen Joan Vladimirit Orthodox Monastery: reuse and conservation

Trematerra Adriana - University of Campania "Luigi Vanvitelli, DADI, Aversa (CE), Italy, e-mail: adriana.trematerra@unicampania.it

Abstract: The contribution, part of a broader investigation focused on the analysis of Orthodox places of cult in the Balkan Peninsula, proposes the study of the Albanian religious heritage with cognitive operations aimed at the restoration and reuse of disused sacred spaces. The object of the research is the Monastery of Shen Joan Vladimirit in Albania, built in the 10th century at the behest of the Prince of Dioclea and Durazzo, Charles Thopia, in order to preserve the relics of Saint Joan Vladimirit after whom it is named. The current configuration, the result of a reconstruction in 1381 following an earthquake that destroyed much of the original layout, consists not only of medieval structures such as the surrounding wall and the church, but also of more recently built structures such as the buildings used as cells and refectory for the monastic community. The research envisaged the analysis of this place of cult through the discipline of restoration, making use of a preliminary historical research, aimed at the knowledge of past transformations, and a subsequent survey campaign to document the current state of conservation. The aim is to draw up guidelines for the conservation and reuse of degraded and functionless spaces.

Keywords: Orthodox architecture, Knowledge, Documentation, Conservation, Reuse.

1. Introduction

The issues of reuse and conservation, as is well known, should not be considered in opposition to each other but, on the contrary, as a single discipline aimed at community self-recognition and social enhancement. At the same time, these subjects are able to ensure educational objectives for communities, which recognise themselves in the cultural heritage of their own geographical areas. In this context, the 2005 Faro Convention sanctioned the importance of the use of historical artefacts by the community, which is given a primary role in the preservation and enhancement of the cultural heritage inherited from the past. This is the context of the proposed case study, the Shen Joan Vladimirit Orthodox Monastery (Fig. 1), whose interior is composed of architectural structures that are currently devoid of function and, in some cases, degraded. The research, carried out in different phases, aims to analyse the artefact through the discipline of restoration in order to devise some guidelines for the valorisation and reuse while respecting the sacred characteristics of the site.

2. Architectural survey and diagnostic analysis for restoration

The investigation included a cognitive phase aimed at acquiring a series of information on the material, and therefore tangible, aspect of the current configuration of the Shen Joan Vladimirit Monastery. This phase is of considerable importance in the field of historical artefacts, as it allows us to identify the presence of a series of stratifications in the architectural fabric, bearing witness to all those processes of transformation undergone over the centuries [1]. The main objective of this phase is to highlight the presence of materials and construction techniques to be preserved and enhanced over time as evidence of cultures inherited from the past. Only

through this cognitive process is it possible to identify the most suitable intervention strategies for the conservation and valorisation of the architectural artefact analysed [2]. Following the material analysis, the cognitive process involved the diagnosis of the pathologies affecting the external masonry of the various buildings, mapped out using the symbols and definitions contained in the 2006 UNI 11182 standard and in the Illustrated Glossary produced by ICOMOS, in order to identify surfaces affected by manifestations of degradation and the state of conservation of a historical masonry [3].

3. Conclusion

The methodological process adopted made it possible to assess the close link between the survey, diagnostics and intervention on degraded architectural structures and the importance of this process for the formulation of hypotheses for the conservation and reuse of historic. The proposed investigation can be considered as a possible methodological approach aimed at the knowledge of the Balkan religious heritage in order to enhance and preserve it through the practice of restoration and reuse. In this perspective, a critical analysis aimed at understanding the tangible aspect of the analysed heritage was necessary in order to highlight strengths to be preserved and critical points to be overcome. Through the proposed studies, the intention is to offer interpretative and operational tools capable of counteracting the problems encountered in the reuse of sacred buildings that have been deprived of their function, in whole or in part, in order to strengthen and spread collective knowledge of the Balkan religious heritage, which is poorly known on a global scale and often not adequately valued.

Figure 1. The Shen Joan Vladimirit Monastery in a 1940s historical photo. Source: Arkivi Digjital Elbasan.

References

[2] Boato, A. (2008) L'archeologia in architettura. Stratigrafie, Misurazioni, Restauro. Venezia: Marsilio Editori.

[3] Carocci, C.F., Circo, C. (2015) Il rilievo per il restauro. La loggia di palazzo Ardinghelli a L'Aquila. In: AID Monuments. Materials techniques restoration for architectural heritage reusing, I, Ariccia: Ermes, 134-142.

[4] Franceschini, F., Gaiani, L. (2010) Manuale operativo per il restauro architettonico. Metodologie di intervento per il restauro e la conservazione del patrimonio storico. Roma: Tipografia del Genio Civile.

The Fort of SS. Salvatore in Messina. Relief, stratifications and degradation of a fortification between the Middle Ages and the Modern Age.

Altadonna Alessio, Università degli Studi di Messina - Dipartimento di Ingegneria, Messina, Italy, aaltadonna@unime.it

Martello Giuseppe, Università degli Studi di Messina - Dipartimento di Ingegneria, Messina, Italy, gmartello@unime.it

Nastasi Antonino, Università degli Studi di Messina - Dipartimento di Ingegneria, Messina, Italy, antonino.nastasi@unime.it

Todesco Fabio, Università degli Studi di Messina - Dipartimento di Ingegneria, Messina, Italy, ftodesco@unime.it :

ABSTRACT

The restoration of monuments is inevitably translated throughout the modification of the state of things, which means. the modification of the only certain "document" that makes it possible in understanding the history of the artefact, attributing chronologies to the different parts of which such architectures are composed of and in preparing calibrated projects for specific environmental requirements.

The knowledge phase, therefore, is of primary importance in order to avoid the dispersion of information, which allows to recompose a mosaic made up of historical events that had involved the territory with their existing artefacts. The acquaintance of these events can only be inferred from the observation of the living structures, which constitutes tangible proof of the events that occurred in the past.

Therefore, the documentation prior to the intervention is a necessity that in recent decades has had positive impulses throughout the use of laser scanning techniques making it possible to acquire a great deal of information that constitutes accurate apparatus for the project elaboration. The fort of SS. Salvatore is located at the end of the neck of land facing the city of Messina, a curved shape similar to a sickle, which suggested to the Chalcidian Greeks the city name attribution of Zancle.

The site has always revealed its strategic importance both for the presence, since ancient times, of a signaling lighthouse for sailors, and for its the neck of land that encloses the port, in controlling the traffic.

The fortress was built in later epochs and incorporates also a tower built by the great Count Ruggero d'Altavilla, who was the first to understand its war potentiality both for defense from external enemies and for the control of the city of Messina. The Normans built a tower equipped with a cistern which in the Aragonese period was further fortified by encircling it with a building called Forte Campana, characterized by a curvilinear masonry wall with gun openings oriented in all directions, also facing the city of Messina. During the Norman reorganization of the island's government, a Greek rite monastery was allocated near the fortification on which almost all the so-called "Basilian" monasteries in the Valdemone region depended, corresponding roughly with the current Province of Messina.

Starting from the Aragonese period, but above all in the context of the reorganization of the strongholds wanted by Charles V, other fortification works were combined with the original artifact by the military engineer Ferramolino da Bergamo, who enlarged the defensive walls connecting them to the masonry of the Fort Campana, enclosing the entire final part of the neck of land and also incorporating the remains of the church of the Holy Savior in the phari language.

The earliest sources that allow us to gather knowledge of the fort layout date back to the late 16th century when it is reproduced graphically by Ferramolino, who also describes the other existing fortified structures defending the city. Observation of the early graphic documentation allows us to understand the importance highlighted by the designer on the defensive needs of the artifact

Thus in fact the existing fortification enlarged according to Ferramolino's indications stood in front of the city in a privileged position, capable of controlling the wide stretch of sea to the north and the entrance to the city's port.

The comparison between the drawings of the period and the current survey allows for the development of significant reflections regarding the defensive capabilities of the artifact, thus sheding light on the thorough knowledge developed on the battlefield by Ferramolino on the warfare techniques of his age.

The survey of the fortress, which has undergone various tampering and transformations over the centuries, was carried out using photogrammetry and laser scanning techniques making it possible to identify and document important vestiges, recognizing certain historical events that affected the multi- layered site, as well as providing useful support for the design and control of the intervention.

Such comparison between ancient cartography and the present survey has confirmed, through the stratigraphic analysis, the transformations of the artifact and its surroundings occurred in successive periods through the numerous constructions that have been built against it over the centuries. This is the case of a huge reservoir intended for the collection of water that insists at the highest point of the northeastern bastion, called "Prince's Castle." It was also possible to verify, in the case of other buildings existing today, the correspondence of the perimeter of the ancient construction with the recent one, thus being able to hypothesize the reuse and transformation of part of the ancient structures.

The research carried out to date portends significant results that we aim to obtain in its continuation through the comparison of the elements acquired with those detectable in other fortifications located along the Sicilian coasts in order to acquire useful knowledge for the development of a project of planned maintenance of one of the most significant interventions that have characterized the history of the Mediterranean.

Strategies for rural settlements and marginal areas regeneration: multiscale and multidisciplinary approach for a systemic process

Fernanda Speciale - Politecnico di Milano, Milan, Italy, fernanda.speciale@polimi.it

Manuela Grecchi - Politecnico di Milano, Milan, Italy, manuela.grecchi@polimi.it

Laura Elisabetta Malighetti - Politecnico di Milano, Milan, Italy, laura.malighetti@polimi.it

Keywords: minor historic town centres, reuse, energy retrofit

Extended Abstract

The scenario that Europe presents up to now shows a strong tendency towards the centralization of the population in urban areas, causing depopulation of smaller towns, the aging, and the abandonment of the tangible and intangible heritage of marginal areas, where 30% of the total EU population lives. Lots of international policies encourage local building heritage refurbishment and cultural regeneration projects of minor historic villages, to rebalance and strengthen economic, social, and environmental connections and ties between urban, peri-urban, and rural areas. For those reasons, it is necessary to offset the current macro-trend and promote a sustainable development where new emerging post-pandemic challenges become the drivers for implementing regenerative actions beneficial for residents and marginalized social groups, as well as for the protection and safeguarding of the cultural and natural heritage and the development of small and medium-sized businesses through creativity and innovation, hinging on culture and local knowledge.

The research highlight approaches to characterize marginal areas and identify strategies for renovation, starting with a multiscale deep investigation process, a strong collaboration with local communities and stakeholders, and finding out a Vision to be translated in objectives and actions. Reuse and refurbishment of historical minor villages are investigated for improving the resilience and adaptation of the building stock, preserving cultural heritage while making it more adaptive to climate change, through the activation of cross-sector sustainable synergies, in a multiscale and multidisciplinary approach, having as reference the case study of Spluga Valley regeneration project (Italy). The paper describes methods to recognize the values of pre-existence through the knowledge phase and the indicators, originated from analysis and diagnosis process, to hypothesize new functions compatible with the existing and capable to link the physical renovation to the relaunch of the territory and therefore of its local community.

The methodological approach presented in the paper is the result of research and experimentation: from the end of 2017 an innovative research and co-design path was promoted by the Lecco Campus of Politecnico di Milano in collaborations with The Chamber of Commerce of Lecco, Lecco Municipality, REsilienceLAB Association and other no-profit bodies promoting research, communication and experts training in environmental policies focused on adaptation and resilience strategies for Lombardy

mountain territories. Over time, several courses of the MSc in Building Engineering-Architecture have been involved in an innovative “in field teaching” with the development of over 30 Master theses, allowing to develop an organic path towards the identification of shared project scenarios through common reflection aspects. The objective of the co-designed path was to start a discussion on the adaptation to climate change and on the resilience of mountain areas, aimed at identifying their innovative development potentials.
The different strategies are illustrated through an emblematic case study object of a master's thesis of the Politecnico di Milano, based on the actuation of multiple synergies:

- the integration between the different scales of the project that, starting from the comprehension of the context and its resources, leads to the development of territorial regeneration strategies and the identification of the best re-uses;
- the classification and involvement of the different stakeholders in activating co-production and co-design processes of project options but also in the management of the new functions and areas, to guarantee the success of the transformation with long-term strategic visions;
- the discovery of the best refurbishment techniques starting from a deep investigation of local and rural architecture, functions established and the application of passive strategies to lower the project impact.

The Spluga Valley is an alpine territory which constitutes the extreme northern offshoot of Lombardy towards Switzerland. As a mountain territory, it has related orographic, morphological, and hydrological problems, but the fact of being a frontier territory, straddling the two economic and commercial polarities in Switzerland and Lombardy, favors the potential for each intervention proposal to be developed also in a perspective of international and multicultural collaboration, which further consolidates the relationship and exchange between the various European communities that overlook it and confront each other.
Analysis of this territory, carried out through fact-finding surveys, questionnaires, field meetings, GIS data mappings, etc., led to the development of a vision and a renovation strategy that involved the different municipalities, tying them together through sustainable mobility implementation strategies, educational centers and the enhancement of the existing heritage. In the paper, the strategies developed on Spluga Valley are described, neither in a general nor generalizing way, but in a way through which, starting from the specifics of the territory, its inhabitants, and its peculiarities, can give life to all the potential of resources and heritage.

To validate the strategy, we practiced it on a case study of refurbishment, the most emblematic and the one with the best prerequisites for activating the territorial strategy. So, the process went down to the urban and building scale, reiterating the process of analysis, diagnosis and design choices already implemented on territorial scale, to develop a refurbishment project in a holistic view that would act as a pole of attraction for the launch of the Valley strategy. Starting from the survey path, we highlighted some key project points such as the enhancement of the strong relationship with the natural context, the application of passive strategies to low the project impact, the implementation of residual performance of the buildings through natural local materials, the energy self-sufficiency of the area exploiting renewable sources, and design choices ensuring spatial and temporal flexibility of the intervention. In the third and last phase, the conclusions of this experimentation were expressed in guidelines designed to allow the repetition of this process. The research path thus returned to the territorial scale, strengthened by local experience, to start again by triggering the design of the subsequent interventions hypothesized.

Spazi, società, università: per una rinnovata didattica del restauro. Il caso studio dell'Amideria Chiozza

Spaces, society, university: for a renewed teaching of restoration. The case study of Amideria Chiozza

Marin Alessandra – University of Trieste-Department of Engineering and Architecture, Trieste, Italy, e-mail: amarin@units.it

Pratali Maffei Sergio - University of Trieste-Department of Engineering and Architecture, Trieste, Italy, e-mail: pratali@units.it

Abstract: This essay describes the innovative aspects of the didactic activities promoted by the Master Course in Architecture of the University of Trieste in the teaching of restoration and enhancement of the regional historical-architectural and territorial heritage, focusing attention on a case study of absolute importance: the former Amideria Chiozza factory in Ruda, in the Friulian lowlands, Italy. A case study of reuse and restoration of an important industrial archeology complex, founded in 1865 and active for over a century, the only starch factory in Europe still in possession of the original production system and machinery. Here it is demonstrated that an integrated design approach (from a disciplinary point of view) and an inclusive attitude (in the intervention choices) can promote virtuous and successful processes. This type of processes can be differentiated from many cases of restoration that we can find today in our cities and territories, unable both to protect the complex system of values that are present in a patrimonial object, and to avoid forms of banal relocation on the real estate market.

Keywords: industrial heritage, integrated design of the restoration, ecomuseum, public-private partnership, territorial sustainable redevelopment

Extended abstract

In keeping with its status as a 'special' region - i.e. endowed, like many Italian border regions, with a statute that differentiates it from regions with ordinary statutes - Friuli Venezia Giulia has developed overtime innovative tools for intervening on its cultural heritage, often anticipating trends that later developed in other regions or on a national scale. In particular, there is a clear interest in the historical, cultural and territorial heritage that has marked the profound transformations underwent in the 19th and 20th centuries by the region, as well as an interest in industrial heritage. This heritage – as has been recognised for several decades by geographers, historians architects and town planners – is not only made up of places of doing, factories and production infrastructures, but of a set of assets, both tangible and intangible, that have given life to industrial (and industrious) landscapes of great interest, nowadays possible driving forces towards new paths of local development (Dansero, Emanuel, Governa 2003).

It is in 1997 that Friuli Venezia Giulia became one of the first Italian regions to approve a special law for the protection and enhancement of industrial archaeology –Regional Law 24/1997, *Norme per il recupero, la tutela e la valorizzazione del patrimonio archeologico-industriale della Regione Friuli-Venezia Giulia* (Rules for the recovery, protection and enhancement of the industrial archaeological heritage of the Friuli-Venezia Giulia Region)

– which ensured a coherent framework for years regarding the knowledge, protection and enhancement of the regional industrial heritage.

By virtue of this law, various cataloguing projects were developed (merged into the regional information systems); later, forms of financing were activated using European structural funds, leading to the renovation of some of the most relevant realities of the regional industrial heritage: several buildings of Trieste's Porto Vecchio, the hydroelectric power station of Malnisio, the industrial founding town of Torviscosa and the workers' village of Panzano in Monfalcone. This was a linear process of valorisation, based on the classic three-step distinction (know, understand, intervene). Nevertheless, it proved to be inadequate: not only it involved only a small part of the overall heritage – certainly on account of its size and complexity – but it also often lacked in developing some relevant aspects of the protection project, restoration and reuse of the aforementioned cultural asset. First and foremost, it lacked the ability to investigate (and reactivate) relations with the local community and the ability to adopt methods of design and intervention able to highlight the different stratifications and shades of meaning of a cultural asset as such.

The role of the university training of architects called upon to carry out restoration and enhancement operations, as well as the relationship between the university and the territory, are fundamental to give the necessary prominence to the proposed forms of intervention. For this reason, a noteworthy path has been pursued for over a decade in the Architectural and Urban Planning Laboratories of the Degree Course in Architecture at the University of Trieste, which deal with the existing built and territorial heritage. In these Laboratories, and even more so in the different Restoration courses, students were proposed with themes identified on the basis of requests from local authorities and, more generally, from local communities and associations.

This commitment, going beyond the sphere of training courses, has often turned into institutional collaborations between the University (or the Department) and several local authorities. This has frequently led both to the allocation of financial resources and to subsequent and effective restoration and enhancement measures, also thanks to our scientific contribution; at the same time, the activity of university lecturers and students has provided a stimulus to attention for citizens, who have rediscovered architectural heritage of their history and culture.

The aim of this contribution is to highlight the innovative aspects of the training activities promoted by the Degree Course in Architecture in Trieste, in the field of the didactics of restoration and of the valorisation of the regional historical-architectural and territorial heritage (Caltabiano, Marin, Pratali Maffei, 2017). This will be achieved by focusing on a case study of absolute importance: the Amideria Chiozza in Ruda, in the Friulian lowlands. This case can prove well that an interdisciplinary approach, which is also inclusive in terms of the construction of intervention choices, can promote virtuous and successful processes. These processes distinguish themselves from many cases of restoration in our cities and territories, often incapable either of protecting the complex system of values that is stratified in a heritage object, or of giving it new life regardless of forms of trivial relocation on the real estate market. Rather, they will unravel in the respect of the heritage itself and of its multiple identities, as well as of the right of local communities to enjoy assets that have now become their symbol and common heritage (Trisciuoglio, Barosio, Ramello, 2014).

References

R. Caltabiano, A. Marin, S. Pratali Maffei (2017), a cura di, *Memoria ed emozione: conservazione, valorizzazione e rigenerazione del patrimonio industriale. Studi e progetti per l'Amideria Chiozza a Ruda (UD)*, RES edizioni, Gorizia.

E. Dansero, C. Emanuel, F. Governa (2003), a cura di, *I patrimoni industriali. Una geografia per lo sviluppo locale*, Franco Angeli, Milano.

M. Trisciuoglio, M. Barosio, M. Ramello (2014), a cura di, *Architecture and places. Progetto culturale e memoria dei luoghi*, Celid, Torino.

Improving Cultural Heritage conservation: LSTM neural networks to effectively processing end-user's maintenance requests

D'Orazio Marco – Università Politecnica delle Marche, Ancona, Italy, m.dorazio@univpm.it

Bernardini Gabriele – Università Politecnica delle Marche, Ancona, Italy, g.bernardini@univpm.it

Di Giuseppe Elisa – Università Politecnica delle Marche, Ancona, Italy, e.digiuseppe@univpm.it

Abstract: Preventive conservation of cultural heritage can avoid or minimize future damage, deterioration, loss and consequently, any invasive intervention. Recently, ML methods were proposed to support preventive conservation and maintenance plans. Several data sources were used, such as structural data and images depicting the evolution of the deterioration state, but till now textual information, exchanged by people living or working in historical buildings to require maintenance interventions, was not used to support conservation programmes. This work proposes a method to support preventive conservation programs based on the analysis of data collected into CMMS (computer maintenance management software).

Keywords: Preventive conservation; Maintenance; NLP; Neural Network

1. Introduction

To reduce the need for major and invasive interventions on the built heritage, preventive conservation approaches were proposed [1]. It has been underlined that maintenance, as the process of "taking care of", is an important element, though not exclusive, of a preventive conservation strategy. Maintenance evolved and from a set of corrective actions performed to solve emerging issues, it become a planned approach, based on preventive actions (pre-determined, condition-based, predictive) to avoid failure during operation, to reduce the possibility of service interruptions and, also, to reduce cost. Both in corrective or preventive maintenance approaches, monitoring actions should be regularly performed and data collected. Maintenance actions are usually managed through a CMMS (Computerized Maintenance Management System) [2], which collect the end-user's maintenance requests and the related relevant information to generate a corresponding Work Order (WO). Then, when existing, CMMS data could be a relevant source of information, not only to act in a "corrective" manner but also to support "preventive" conservation approaches, based on data collected over longer periods. This paper provides a contribution, by analysing a CMMS dataset referred to a listed Italian building and developing an LSTM Neural Network able to predict the appropriate workforce with required skills to perform a specific maintenance task, thus reducing service interruptions and improving the general maintenance activity of the building. The proposed approach could also be useful to quickly adapt the maintenance program to emerging issues.

2. Methodology

The study refers to the CMMS data collected on a historical building, named "Villarey Barrack", hosting a University Economics Campus, located in Ancona, Italy. The

maintenance of the building is managed through a CMMS, containing the end-user's maintenance request and labels: codes and short texts expressing the place, the fault typology and other relevant information useful to assign the proper priority and the required skilled staff to the intervention. The dataset was analysed through data mining routines to extract information about the statistical distribution of the interventions and to find specific correlations. Then the end-users' maintenance requests were processed through text mining tools and an LSTM neural network has been trained and tested to predict the appropriate workforce with required skills to perform the maintenance tasks. Results were compared through the following indicators: "Accuracy", "Precision", "Recall", "F1-score". All the processes has been performed through MATLAB 2021a writing specific code scripts.

3. Results

The ability of the LSTM neural network trained for each category has been checked through « Precision », « Recall » and « F1-score » values. The precision score obtained (ratio of the number of elements correctly classified to the total predicted in each class), is very high, reaching values near the unity. Almost all the sentences are correctly predicted by the trained LSTM neural network. Consequently also Recall (ratio of the number of elements correctly classified to the number of known elements in each class) is very high. The lowest value is 0.949. F1-score (harmonic mean between both precision and recall) shows the optimal agreement obtained in each class. The lowest value is 0.993, meaning that almost all the sentences are correctly recognized.

4. Conclusion

This work proposes a method to support preventive conservation programs based on data collected in a CMMS (computer maintenance management software). Data about end-user's maintenance requests collected for 34 months and stored into a CMMS in a heritage building hosting a University Campus in Italy were analysed. In particular, a LSTM neural networks was trained to predict the category of each maintenance request, thus reducing the intervention time. The proposed model can predict, with high accuracy levels (96%), the technical category of each new end-user's maintenance request and automatically select the correct staff. In this way, the CMMS become able to dynamically adapt the maintenance program to the emerging issues, thus improving the management process of the built cultural heritage. Future research should further investigate proper analysis methods of maintenance intervention trends (e.g. the concentration of interventions belonging to certain categories during certain periods) in order to further develop preventive approaches.

References

1. K. Van Balen, Preventive Conservation of Historic Buildings, Restor. Build. Monum. 21 (2015) 99–104. https://doi.org/doi:10.1515/rbm-2015-0008.
2. P. Pishdad-Bozorgi, X. Gao, C. Eastman, A.P. Self, Planning and developing facility management-enabled building information model (FM-enabled BIM), Autom. Constr. 87 (2018) 22–38. https://doi.org/10.1016/j.autcon.2017.12.004.

CityGML-based models for the qualification of cultural built environment: the 3D Semantical City Model of the historic district of Carovigno (BR), Italy

Lasorella Margherita - Department of Civil, Environmental, Building Engineering and Chemistry (DICATECh) - Polytechnic University of Bari, Bari, Italy, margherita.lasorella@poliba.it

Cantatore Elena - Department of Civil, Environmental, Building Engineering and Chemistry (DICATECh) - Polytechnic University of Bari, Bari, Italy, elena.cantatore@poliba.it

Fatiguso Fabio - Department of Civil, Environmental, Building Engineering and Chemistry (DICATECh) - Polytechnic University of Bari, Bari, Italy, fabio.fatiguso@poliba.it

Abstract

The recovery and the rehabilitation of architectures in historic districts are concrete emergencies, even now. In fact, it is not a recent issue. During the time, technical and administrative process of recovery required complex activities degree and the prolonged time, heightening the critical levels of decay and the high percentage of disuse, that already affected such buildings. These, as a natural process or their long physical presence in cities. Differently from the Cultural Heritage as single representative architectures, historic districts have a landscape significance in the urban environment that reflects multi-level and multi-scale points of relevance. Due to this, the recovery process of historic districts results from the multi-disciplinary, multi-scale analysis and assessment, involving several expertise and users. In fact, the process requires several operative, conceptual and instrumental activities, allowing the identification of inherent (morpho-typologies, material and constructive techniques, architectural relevance) and extrinsic factors (transformations, social, cultural and economic values), their assessment in term of performances and normative consistency, as well as the relevance in term of local identity. Moreover, the complexity is mostly related to the correct identification of heterogeneous characters, features and values of such heritage, from the component scale to the district one, along with the identification of relations among them. In that sense, the technical knowledge of such environment is the key to solve their multi-scale and multi-dimension relevance, concerning the scale of building components and the aggregates, as well as focusing on the original nature of the fabric, the transformations carried out and state of decay.

Overcoming the traditional tools and strategies, the digitalization of the built environment by means of Digital Models allows the collection and the management of characters and features as systems of well-determined properties (standard codes), organized according to specific relations (ontologies) useful to support the objective compiling of structured databases, their unambiguous reading by several users and, specifically, their semantic interoperability. Where, the main ontology at thematic/semantic and geometric/topological levels, as well as through specific taxonomies and aggregations, in order to qualify the built environment is CityGML standard. This allows the digitalization of extended part of cities including specific thematic modules such as buildings, infrastructures, geography, land uses, vegetation. Nevertheless, the present study discusses how technical knowledge,

in term of data and information about existing building heritage can be systematised according to the CityGML standard. To this end, starting from an accurate analysis of the theoretical notions, practical experiences, previous scientific studies and regulations about the recovery of cultural heritage, the work identifies the system of simple and complex parameters, useful for the built environment qualification and assessment. In detail, all the collected classes of data are categorised in three types: i) Descriptors (Ds) that can be directly obtained by means of direct in-situ inspection or documental acquisition (period of construction, buildings permission, uses, state of maintenance of walls, roofs); ii) Primary Factors (PFs), the first level of derived data, that offer a higher and technical level of knowledge about the descriptors as combination of derived factors (nD); iii) Secondary factors (SFs), the most complex level of derived data, as the combination among primary ones (nPF) and primary and descriptors (nPF + nD). Moreover, descriptors and factors are also categorized according to the thematic relations with urban and building elements and components, by means of defined logical-relational scheme and according to the CityGML standard. On the other hand, they allow the semantic-thematic enrichment of the digital model and the in-depth technical analysis.

Finally, the system of descriptors according to CityGML standard has been applied and validated for the qualification of the ancient core of Carovigno, a city in the south of the Apulia Region (Italy). The relevance of this case study is related to intrinsic criticalities in term of physical and normative obsolescence of buildings, such as the number and size of rooms, the deficiency of services and urbanisation systems, the uncontrolled transformations of the built-up area, the lack of maintenance activities and/or recovery interventions. In addition, these factors generated extrinsic challenges for local administration in managing abandoned buildings and families with high unemployment rate. The creation of its Digital Model with the CityGML standard offers the opportunity to undergo the gap. In particular, the technical cognitive process of the Historic Centre of Carovigno has focused specifically on the ancient area. Where, staring from the studies carried out by Municipal Authority, main characters have been identified. In detail, at morfo-typological level, there are four main building type: T1) Terraced House, T2) In-line House, T3) Palace and T4) Corner or End Houses. Moreover, as prevalent constructive and material features, masonry and vault in “Leccese” tuff represent the main technological characters. Finally, the state of conservation of the place has a particular relevance for the case. Following the technical knowledge of the historical core of Carovigno, the digital model has been developed. For this, the collected data were preliminarily systematised in GIS. Consequently, the semantic and geometric model has been carried out within the Safe FME visual programming platform. Here, the specific structure developed has allowed: i) the creation of the three-dimensional geometric model at a LOD 1, ii) the implementation of logic-mathematical functions for automatic processing of primary and derived factors, and iii) the translation of semantic and geometric data according to the CityGML standard. Thus, the architectural entities populated the “Building” class and urban elements the Transportation one. To this end, the development of the semantic digital model also helps users involved in the conservation process, as well as during the analysis of the historic built environment. The organization of technical knowledge in coordinated parameters and factors in a structured database and relations also support i) the elaboration of subsequent conservation strategies and ii) the suitable reuse of buildings, the improvement of actual functions or the introduction of new social functions (cultural, managerial, commercial activities). As results, digital 3D models and CityGML ontology allow applications in several level of detail for Cultural Heritage. This, aiming at a higher level of knowledge both at physical and historical levels as well as the higher relevance for the resolution of interdisciplinarity and interoperability during all the recovery phases.

Recupero del campanile a vela della Chiesa di San Domenico a Bari

de Marco Marina, Serra Alessandro - Marco Studio Tecnico Associato, Bari, Italia, studiodemarcoassociati@gmail.com

Abstract: The structural rehabilitation of the bell tower of the church of San Domenico in Bari was necessary due to some lesions that occurred on the wall facing for the stability of the structure. After the first phase of investigations and assessment of the extent of the damage suffered by the masonry, we moved on to the determination of the inter-ventions necessary for safety first and then to restore the integrity of the masonry.After shoring up the entire part of the masonry and the bells, we intervened with punctual “scuci-cuci” operations to restore the curtain wall in the parts where the ashlars were fractured and to eliminate the concrete inserts that emerged after the plastering partial. For the remaining plastered surface of the facing, only recoiling, deep grooving of the joints and cracks were carried out with a mortar similar in granulometry and chemical components to the existing one, after scarifying and cleaning the cracks. The intervention ended with the restoration of the missing plaster parts and the painting of the surfaces with a lime-based paint finish cycle, whose colors and shades were agreed in compliance with the original colors of the facade and all the decorative elements that compose it.

Keywords: structural rehabilitation, lesion, scuci-cuci, concrete masonry.

1. Introduzione

L'intervento di risanamento strutturale del campanile a vela della chiesa di San Domenico si è reso necessario a causa di alcune lesioni che si erano manifestate sul paramento murari.

Pertanto, è stato redatto un progetto di recupero strutturale, realizzato con tecniche tradizionali, del manufatto architettonico.

2. Avvio dell’intervento

La Chiesa di San Domenico, si presentava, nel complesso, in un buono stato di conservazione.

A seguito del sopralluogo effettuato sulle coperture della chiesa e dall'analisi dello stato fessurativo presente sulla struttura muraria del campanile, è risultato evidente che il motivo delle lesioni era dovuto alle vibrazioni causate dalle campane che, con il loro movimento, sollecitavano la muratura che tendeva a fessurarsi soprattutto nei punti di inserimento di alcune barre metalliche utilizzate per collegare le vecchie campane al nuovo sistema meccanico installato per farle suonare automaticamente.

Quindi, esaminata la situazione del campanile, si è ritenuto:

- effettuare dei saggi, eliminando l'intonaco nelle zone interessate dalle lesioni,
- valutare meglio l'entità dei danni provocati alla muratura
- verificare la struttura muraria anche in parte del suo spessore

Dall'esito dei saggi è parso evidente che soltanto alcuni conci erano fortemente danneggiati pertanto, previo puntellamento della muratura e delle campane, con delle operazioni di scuci – cuci puntuali per ripristinare l'integrità della muratura nelle parti dove i conci murari risultavano fratturati. Per la restante parte di superficie sono state effettuate soltanto delle rincocciature.

3. Conclusione

L'intervento si è concluso con il ripristino delle parti di intonaco mancanti attraverso l'utilizzo delle "tecniche antiche", che fanno riferimento ai magisteri tradizionali delle costruzioni in pietra e muratura portante quali tecniche di sostruzione dello scuci - cuci. escludendo l'intervento attraverso le tecniche contemporanee per non alterarne le peculiarità originarie.

Veiled Head. Restoration and extension of the town hall of Capo d'Orlando.

Pier Paolo Lagani – Università degli Studi di Firenze, Firenze, Italia, e-mail: pierpaolo.lagani@stud.unifi.it

Abstract: Italy's immense historical heritage is dotted with buildings that struggle to make their mark on history. Many factors play a role: difficult commissioning, poor design choices, or unfortunate geographical and environmental locations. These causes often converge in borderline buildings, now considered historic in their context but of low historical value within the historic heritage. These artifacts, often ignored, are left to their own devices even if still in use.

Such is the case with the municipal building in Capo d'Orlando, which began in the 1930s and, due to the municipality's financial straits, completed only in the first half of the 1950s. The building that at the time was meant to represent the city's laboriously acquired autonomy has now completely lost its strength, both symbolically and architecturally.

The purpose of the research is to understand how the restoration project can restore a new vital impetus to this type of building while maintaining and reinforcing their historical and symbolic value within their communities, acquiring a new value within the historical heritage.

Keywords: Restoration project, Extension project, Historical relevance, Reuse

Extended abstract

The history of the Capo d'Orlando area has its roots in ancient Greek times. The place name Capo d'Orlando, on the other hand, dates back to the early Middle Ages; in fact, the town was renamed in honor of an alleged stopover the paladin Orlando made during a crusade to the Holy Land. Throughout the centuries, several descriptions of the town can be found that focus on describing the morphological aspect of the territory and the defensive system on the promontory. The aggregate is often mentioned as the "navy of Naso" or at any rate always linked to its name Capo d'Orlando will be a hamlet of the city until 1925. Thanks to the important economic growth of the city in 1922 a town assembly was called to request independence from Naso, which would be officialized in 1925. In those years the city did not yet have a suitable building to accommodate the political life of the new municipality and represent its much-desired autonomy.

Construction of Capo d'Orlando's municipal villa began in the 1930s only to stop in 1933 due to the municipality's financial straits. It was not until the 1950s, with the need to expand space and municipal offices that funds were found for the expansion and restoration of the town hall. The construction of the three bays, planned in the new project, is carried out by imitating the style of the existing building, retaining the main features of the decorative apparatus, but making significant simplifications. In this way, the extension operation is not immediately recognizable but still individual. In particular, two signs, like caesuras, are added to both side facades to mark and emphasize the boundary between the old and the new.

The building to date is not suffering from any form of critical or pathological deterioration, let alone irreversible structural disruption or problems. The main degradation afflicting the municipal building is that the building is no longer able to fulfill its function, neither from a

practical point of view, as a place of management of the city's political life, nor from a "symbolic" point of view as a reference building of Capo d'Orlando. As the city expanded, the city hall inside continued to become saturated, and spaces were fragmented and readjusted to new needs. On the outside, however, the city's urban and building growth has gradually encompassed the municipal villa, causing the city's main building to lose its role as a symbol and architectural emergency.

It is, therefore, necessary, due to the historical and environmental conditions explained so far, to think of a restoration project capable of going beyond the mere preservation of the material. It is essential to take note of the *historical relevance* of the building within its environment and historical context to understand its limitations and potential, to be able to identify in addition to its form, its original intent, and why it has been lost over time.

Precisely to restore the building to its original image and purpose, the 1950s expansion - along with the subsequent ones - is recognized as a superfetation, a concretion that depresses the existing architecture, an expression among other things of a decorative language that emulates the previous one, itself the result of an architectural style based on the imitation of ancient architecture. Therefore, demolition of the superfetations becomes necessary, and to accommodate the new functions, a new expansion is placed side by side with the 1930s building, the bearer of a language completely different from the original.

The *Veiled Head* is thus first and foremost a fifth, towering over and watching over the ancient architecture, without ever negating it; on the contrary, it gives it new strength and prominence within the urban and built fabric of the city, returning the building to its original purpose, to represent Capo d'Orlando.

As the viewpoint approaches, the quinta, from a megalithic and monumental block, dematerializes, revealing completely different places and spaces within it. As with modern art, the outer surface is only a projection of the idea that generates the work; one must tear open the veil to aspire to discover the truth.

Under the veiled head, the first contact with the city is a huge void. A place of shadow, open and public. A covered square, devoid of any street furniture except for a seat that, like a modern sossello, offers refreshment and welcome to the inhabitants of the city. The square is thus a place that can bend to the needs of daily living by transforming itself as needed.

From this interstitial space, which is formed by the brutal act of tearing, the project reveals its organism: paths, openings, and staggered planes show themselves as limbs and parts of a living and pulsating system. The project continually invites to be observed and discovered, offering ever-changing views that vary depending on the point of view and the observer. Thus the project continually invites to be observed and discovered, offering views that are always different, varying according to the point of view and the observer.

Inside, the large spaces are designed to accommodate the municipality's collection of modern art. The silence of the void is broken by the painted colors and shapes, making the unique works take center stage within the exhibition rooms.

Like Karamazov, the *Veiled Head* contains two abysses. Deep darkness and moments of intense light collide and meet in a continuous succession of pressures and decompressions, continually contrasting and contrasting each other. This continuous succession of pressures and decompressions tells of the two faces of the human soul and of Sicily, a land as fertile as it is harsh, as happy as it is painful.

Towards zero plastic waste: reuse and recycling of PolyEthylene Terephthalate (PET) sand

Beibei Xiong - Politecnico di Torino. Dipartimento di Ingegneria Strutturale, Edile e Geotecnica. Corso Duca degli Abruzzi, 24, 10129, Torino, Italy; beibei.xiong@polito.it

Cristoforo Demartino - Zhejiang University - University of Illinois at Urbana Champaign Institute, Zhejiang University, Haining 314400, Zhejiang, China; cristoforodemartino@intl.zju.edu.cn

Devid Falliano - Politecnico di Torino. Dipartimento di Ingegneria Strutturale, Edile e Geotecnica. Corso Duca degli Abruzzi, 24, 10129, Torino, Italy; devid.falliano@polito.it

Giuseppe Carlo Marano - Politecnico di Torino. Dipartimento di Ingegneria Strutturale, Edile e Geotecnica. Corso Duca degli Abruzzi, 24, 10129, Torino, Italy; giuseppe.marano@polito.it

Abstract: This paper presents a novel study on the characterization of the mechanical properties of concrete substituted by recycled PolyEthylene Terephthalate (PET) aggregate. Four replacement levels, namely 5%, 10%, 20%, and 30% by volume of fine aggregate are considered. Compressive and flexural behavior are detailedly investigated. An explanation of the results of this study by comparing them with the previous studies and the results indicates that the novel green concrete substituted by PET aggregate shows a good performance on physical and mechanical properties. Under a low substitution level, only a slight reduction can be observed in compressive strength while regarding flexural strength, it even is slightly improved until the substitution level reaches 20%. Relatively low substitution levels by PET sand can fill up the micropores and enhance the interfacial bonding between the plastic aggregates and cement paste which enhances the mechanical performance of green concrete.

Keywords: Recycled plastic; PET flaky sand; compressive strength; flexural strength

1. Contents and main results

Plastics are one of the widest used materials in human daily life since their first synthesis in the early 20th century [1]. The characteristic of lightweight, excellent thermal properties electrical insulation, flexibility, and ease of production make plastics popular in the field of industry and construction. In 2017, according to statistics, more than 190 million tons of plastics are produced all over the world every year and the number is continually growing [2]. The most common thermoplastics include PolyEthylene (PE), PolyPropylene (PP), PolyStyrene (PS), PolyVinyl Chloride (PVC), PolyEthylene Terephthalate (PET), and PolyCarbonate (PC). Considering the elastic modulus and tensile strength, PET and PVC show superior properties than other types of plastic.

Rather than the convenience of the application of plastics, more attention should be paid to the disposal of plastics, explosive production and low level of disposal, and elongating of their life cycle, the existing huge amount of plastic waste make it a big challenge to solve it. It is estimated that more than 12 million tons of plastic waste are generated every year [3]. More than half of them are entering the marine environment directly. Nowadays, the major disposed methods of plastic waste are landfill, combustion (incineration), and recycling including mechanical recycling and feed-stock recycling. However, the former two methods are still considered not environmental-friendly and even contrary to the requirement of carbon neutrality. So recycling is an ideal method for the disposal of plastic waste [4].

The method of recycling takes a rethink about the solid plastic waste in the constructional field. A recycling method was applied in Civil Engineering consisting in using recycled plastic material in the mix design of cementitious materials, such as mortar and concrete mixtures [5]. The most common approach is to substitute some of the main components of the concrete with recycled plastic trying to obtain a new mix with the same granulometric characteristics. PET is the fourth-most produced synthetic plastic which urgently needs a proper way to dispose. A lot of existing research has conducted many experiments on the PET fibers, however, few studies investigated the application of PET flaky sand. The availability of this data is crucial for the reuse of PET flaky sand.

This study focused on the characterization of the physical and mechanical properties of concrete substituted with recycled PET flaky sand. Recycled PET flaky sand was adopted to substitute fine aggregate by volume with substitution levels (r) of 5%, 10%, 20%, and 30%. The experiment determined compressive and flexural behavior. Under a low substitution level, only a slight reduction can be observed in compressive strength (Figure 1) while regarding flexural strength, it even is slightly improved until the substitution level reaches 20%.

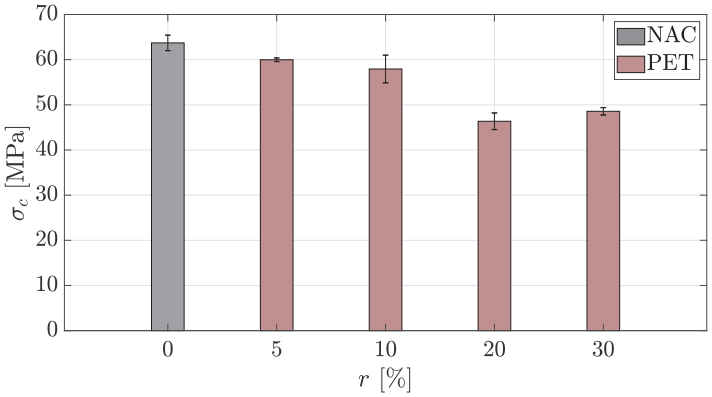


Figure 1. Variation of the compressive strength for different substitution levels

References

[1] F. Pinto, P. Costa, I. Gulyurtlu, I. Cabrita, Pyrolysis of plastic wastes. 1. effect of plastic waste composition on product yield, Journal of Analytical and Applied Pyrolysis 51 (1999) 39–55.
[2] E. Yaghoubi, A. Arulrajah, Y. C. Wong, S. Horpibulsuk, Stiffness properties of recycled concrete aggregate with polyethylene plastic granules in unbound pavement applications, Journal of Materials in Civil Engineering 29 (2017) 04016271.
[3] S. Hohn, E. Acevedo-Trejos, J. F. Abrams, J. F. de Moura, R. Spranz, A. Merico, The long-term legacy of plastic mass production, Science of the Total Environment 746 (2020) 141115.
[4] D. Lazarevic, E. Aoustin, N. Buclet, N. Brandt, Plastic waste management in the context of a european recycling society: Comparing results and uncertainties in a life cycle perspective, Resources, Conservation and Recycling 55 (2010) 246–259.
[5] X. Li, T.-C. Ling, K. H. Mo, Functions and impacts of plastic/rubber wastes as eco-friendly aggregate in concrete–a review, Construction and Building Materials 240 (2020) 117869.

Bloco da Carvalhosa, The South Terraces Reinterpretation

Ferreira, Henrique – EAAD, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal, emais: a80776@alunos.uminho.pt

Maia, Carlos - EAAD, Lab2PT, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal, e-mail: cmaia@eaad.uminho.pt

Mendonça, Paulo - EAAD, Lab2PT, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal, e-mail: mendonca@eaad.uminho.pt

Abstract: In this paper is presented the analysis of the Bloco da Carvalhosa building in order to develop an intervention proposal for one of the spaces that highlights the innovative aspect of the building, the South terraces. This space was created in order to provide a private outside space, specially developed for the kids, and that allowed to bring natural light and ventilation for the inner divisions of the apartment. However, during construction the architects were forced to enclose the terraces with windows, restraining it from its original functions and, consequently, generating a space without a specific use, which lead the inhabitants to adapt it according to their needs. In order to help develop the intervention proposal, an analysis to the thermal comfort of the terrace was carried out by measuring the temperature and humidity, in order to validate simulations of the space and to establish a base for the proposal. Therefore, it was possible to design a solution, that was a reinterpretation of an original system designed by the architects for the same building, that was flexible and allowed to create different environments in the space according to the needs of each inhabitant and allowed to give the space its original character and functions.

Keywords: Modern Movement, Bloco Carvalhosa, Thermal Comfort, Reinterpretation

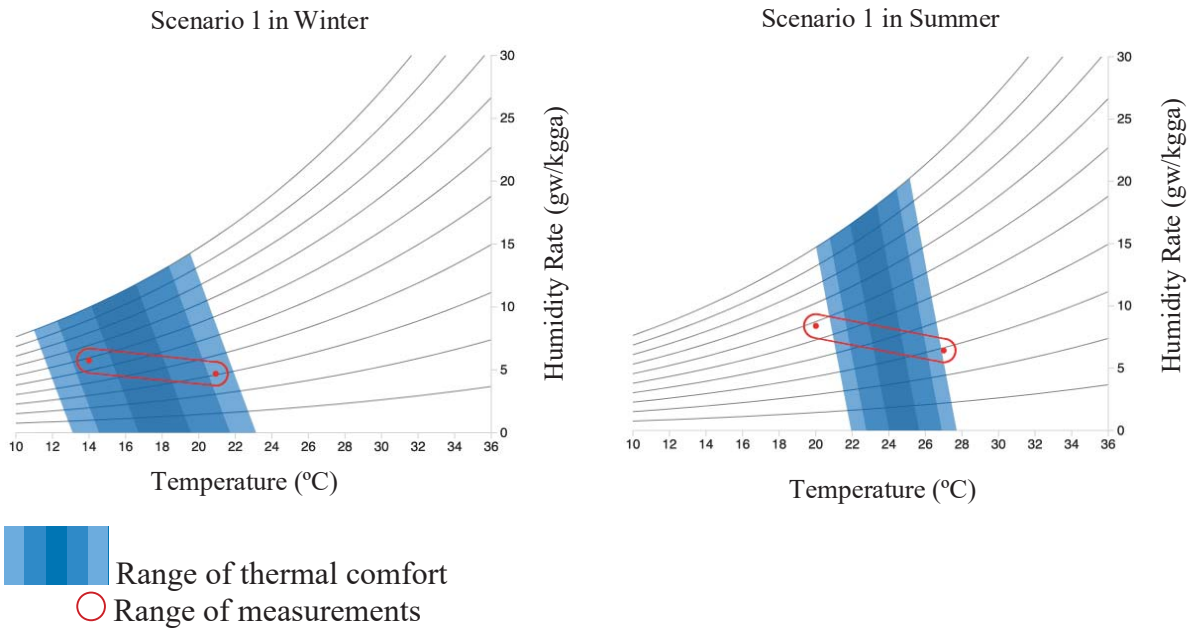
1. Introduction

The Bloco da Carvalhosa building was designed in 1945 by Arménio Losa and Cassiano Barbosa, and it's one of the first collective housing buildings in Porto with an experimental and timeless character that keeps it up to date. For this reason, in 2017 the Cultural Heritage Department of Portugal classified it as a Monument of Public Interest.

2.Intervention

The South terrace was introduced by the architects as a private exterior space, that was located inside of each apartment, and that was developed specially for the children to have a space to play. This place was also important for the function of the apartments because it brought light to the inner parts of the apartment and helped ventilate the building. During the construction of the building, the terraces had to be closed with windows because it was not approved by the municipality entities [1].

To better understand the space, a portable datalogger that measured the temperature and the relative humidity of the space was used. For the measurements, two different scenarios were created for each extreme seasons (one in the winter and one in the summer). In the first scenario the windows in the terraces were left open during the measurements in order to understand the levels of comfort of the space and to mimic the original use of the space, while in the second scenario the windows were kept closed.



3. Conclusions

With the analysis of the results presented in figure 1, it's possible to conclude that during most part of the day, even in the extreme seasons, it achieved comfort inside of the terraces with the windows opened (the range of thermal confort was achieved using the typical summer clothes for summer and typical winter clothes for winter). Therefore, these results justify the original idea of the architects of keeping the terraces opened.

As the terraces are being used in different ways by each person, the solution for the terraces needed to be flexible to be able to adapt to each case, despite the results obtained. Thus, the new solution for the terraces, allow the space to be used as intended by the original idea of the architects and allows the inhabitants to adapt the space to their need, while keeping it integrated in the architectural context of the building.

Acknowledgements

This work has support of Project Lab2PT - Landscapes, Heritage and Territory laboratory - UIDB/04509/2020 through FCT - Fundação para a Ciência e a Tecnologia.

References

[1] Neves, António, (2016) "Arménio Losa e Cassiano Barbosa, Arquitectura no segundo Pós-Guerra Arquitectura Moderna, Nacionalismo e Nacionalização", Doctoral Thesis in Architecture on the University of Porto, Porto 2016;

[2] Rosa, Edite, "ODAM: Os valores Modernos e a Confrontação com a Realidade Produtiva", Tese Doutoramento em arquitetura na Escola Tècnica Superior d'Arquitectura de Barcelona (ETSAB-UPC), Barcelona 2005.

Adaptive reuse as a strategy for overcoming obsolescence: the "Mercato dei Fiori" in Pescia

De Vita Maurizio – Università degli Studi di Firenze, Firenze, Italia, e-mail: maurizio.devita@unifi.it

Marchionne Laura - Università degli Studi di Firenze, Pisa, Italia, e-mail: laura.marchionne@unifi.it

Parrini Elisa - Empoli, Italia, e-mail: elisa.parrini@alice.it

Keywords: adaptive reuse, functional conversion, sustainable renovation, overcoming obsolescence, historical document

Extended abstract

This study debates the theme of the adaptive reuse strategy for heritage belonging to disused modern architecture, focusing on the case study of the “Mercato dei Fiori” of Pescia as an example. Numerous markets have been built throughout Italy since the early years of the Twentieth Century, often characterized by large vaults in iron and reinforced concrete. They represent a significant part of the Italian building heritage, but almost all of these majestic structures are united by a common destiny: from vibrant and colorful places, they often fell into disuse becoming urban voids.

However, these abandoned buildings generally have good potential for recovery and reuse. Adapting them to new functions can guarantee a process of physical redevelopment and conservation, thanks to the maintenance of their use.

It has been repeatedly demonstrated how economic and working issues in many cities, whether large or small, have significant repercussions in cultural, social and environmental spheres. Through architectural and urban reuse, it is possible to generate not only a process of physical redevelopment, but also the regeneration of the community and the resources dedicated to it. The city heritage is therefore a catalyst for the complexity of the values characterizing the landscape.

The adaptive reuse strategy, for an architectural artifact that has become obsolete, is a valid solution as it can guarantee its conservation and future vitality. Nevertheless, the design process requires accurate preliminary considerations on numerous aspects. The first phase of this study is therefore a solid documentation and knowledge acquisition regarding this important construction of the Italian architectural heritage. It is essential to analyze the building from different point of view, not only historical or morphological, but also with reference to the structure, the design, the state of conservation.

It is also important to study both the building itself and the environment, as well as the connection between them. Interpreting the relationship between an architectural monument and the urban contest is essential for the correct reconstruction of the serial events that led to a state of abandon, as the intention is to avoid the perseveration of this state.

Based on this information, it is possible to understand what this building means and could mean for the city, local authorities, and citizens. This is an essential step for the adaptive reuse project to be successful.

Starting from the collected sources, a project proposal was studied. The goal is to be as much as possible respectful to the perception that citizens have regarding the spaces of the former market, considering it as a resource for new functional possibilities. The proposal also takes into consideration the point of view of the public administration, which is interested in having no longer an additional growing cost but a new space for public-commercial use generated by a sustainable choice of enhancement of the cultural heritage. Therefore, the strategy involves the inclusion of offices and commercial establishments that are currently found with difficulty in the surrounding area, aiming to the promotion of small trades and crafts.

The design takes its cue from the precise and particular geometricity of the building. A modular spatial scanning is identified, and the new functions are included in this geometric matrix, both for the covered areas under the iconic vault and outdoor spaces of the in front Piazza dei Fiori.

A multifunctional promenade connects all of these functions and spaces, from the market to the river, ending with a discreet panoramic view of the riparian ecosystem. Specific floral, shrub and tree species are included, in order to bear witness of the original function of the market, as well as to improve the environment both from an esthetical and ecological point of view.

The aim of this project solution is to be integrated, in a balanced and unobtrusive way, within the consolidated urban fabric and the difficulties of city mobility.

This reuse proposal brings new life to the area thanks to an approach that takes in consideration two phases: the first in the short-term, given by the immediate uses of the spaces, and the second in the long-term, for the creation of a new identity of the market thanks to its spatial and functional flexibility.

The reuse strategy is a valid solution to the excessive consumption of land problem. Moreover, it appears to be an effective approach to the “Ex Mercato dei Fiori”: it was once a cornerstone of social and economic life in the city, and can now once again become an attractive pole and an important landmark destination with a high social value.

The passage of time and the constant modifying action carried out by men, leave signs on the urban fabric. Understanding these elements in an architectural reading key, today represents the basis for a planning design adequate to the built environment, in an ecological and cyclical view of the space that deserves to be reborn every time starting from its nature, its technology, through a contemporary filter, towards a future reuse.

The recognition of cultural value as an element of the recovery project for the XX Century Heritage. Application of the ICOMOS Methodology to the ex S.M.O.M. of Pozzuoli.

Vitiello Veronica - University of Naples Federico II, Naples, Italy, e-mail: veronica.vitiello@unina.it

Castelluccio Roberto - University of Naples Federico II, Naples, Italy, e-mail: roberto.castelluccio@unina.it

Trampetti Silvia – University of Naples Federico II, Naples, Italy, e-mail: silvia_trampetti@libero.it

Abstract: The building recovery action must work on the identity and specificity of the places, paying the utmost attention to the context relationships. The analysis of these elements is fundamental for the recognition of the intrinsic "value" of the building, of cultural, architectural and landscape type and of the "value relations" that the building tightens with the surrounding context, of social and economic, but above all cultural and identity type. The Methodology defined by the ICOMOS Document of Madrid - New Delhi recognizes in the identification of the cultural value of the object of intervention the fundamental passage for the promotion of the Heritage of the XX century. The contribution analyzes the design process developed by applying the ICOMOS Methodology to a building complex built in Pozzuoli in the first decades of the twentieth century. The evolutionary history of the different volumes and the configuration of "modern ruins" give rise to prospective relationships with the local reality that today assume a stronger identity value than that connected to the original project. The different construction techniques used and the state of conservation of the buildings lead to identifying different elements of value and, consequently, to elaborate different design choices.

Keywords: XX century Built heritage, materials and construction techniques, reinforced concrete, cultural value, ICOMOS

1. Introduction: the concept of value as the basis of the recovery project

Building rehabilitation intervention, when it also includes the re-functionalization, must work on the identity and specificity of places, paying the utmost attention to contextual relationships (Cecchini, 2004). Recognition of "value" is the focal point of any rehabilitation intervention identified, in the Methodology defined by the ICOMOS Madrid-New Delhi Document, as a fundamental step in the promotion of 20th-century Heritage (ICOMOS, 2017). The documentary value of this Heritage consists in the testimony of a period of social and cultural transformation, of evolution and experimentation with materials and construction techniques futuristic for the time, to be preserved and promoted even at the expense of reconfiguring the original volumetry. In this sense, the ICOMOS Methodology identifies the criteria for the determination of value, which is placed at the basis of any transformation intervention to be carried out even on buildings that are not specifically constrained. The paper analyzes the design process developed by applying the ICOMOS Methodology to a building complex realized in Pozzuoli in the first decades of the 20th century. The evolutionary history of the volumes, in relation to the succession of the phases of construction, the different functions to which they were destined over time, but above all the transformations they underwent and the configuration of "modern ruin" that was consolidated, gave rise to complex perspective relations with the local reality that assume today an identity value stronger than that connected to the original project.

2. ICOMOS methodology applied to the case study of the Former S.M.O.M. of Pozzuoli

The approaches specifically identified for built heritage by the ICOMOS Document consist of: identification of cultural significance, application of appropriate planning and management methodology for conservation, analysis of technical and design aspects of 20th century cultural heritage and management of change with sensitivity in order to preserve cultural significance. The choice of case study is motivated by the heterogeneity of materials used, construction techniques and technological solutions. Applying the ICOMOS Methodology leads to the development of different design proposals in relation to the specific values recognized for the artifacts.

The knowledge phases showed that the value elements to be placed at the basis of the design are different for each of the pavilions and include: the landscape value of the complex in its altered configuration and the documentary value understood as evidence of the experimentation of materials and construction techniques. In order to simultaneously comply with the needs of enhancement and structural safety verifications required by current regulations, the project identifies different technical solutions for each body, consistent with the urban planning requirements for the area.

The recovery project finds "the honorable compromise" between the aims of recovery, reuse and conservation, in the definition of a use that is compatible and, above all, capable of strengthening the contextual relationships aimed at the cultural, social and economic promotion of the area (Romoli, 2004).

3. Conclusions

The analyses carried out show that the quality of the recovery project disregards the concept of “constraint” when it is affixed with rigid logics of freezing certain building or urban arrangements. Instead, the recognition of cultural value must follow accurate and characterized methodological processes for each specific case, in order to deliver to those responsible for transformation a complete and complex knowledge framework to support the definition of the design strategies to be deployed. Such an approach is even more crucial when intervening on the typical building typologies of 20th-century Heritage, which are connoted by a great heterogeneity of meanings and signifiers for the transmission of cultural values of the modern building tradition.

References

Cecchini D. Cinque principi per il progetto urbano. Intersezioni, Annali del DAU 2004, 1.

ICOMOS. Approaches for the conservation of twentieth-century cultural heritage. Madrid – New Delhi Document; 2017.

Romoli E. Beni e attività culturali: vecchi e nuovi compiti di tutela e valorizzazione, in: Tutela del patrimonio architettonico, Bollettino 2002 / 2003, SABAP Bergamo e Brescia; 2004.

A methodology for the comfort upgrading and the microclimate management: a case study

De Vita Mariangela - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy; 67100, Italy, e-mail: mariangela.devita@guest.univaq.it

Marchionni Chiara – Freelance Engineer, Giulianova, Italy, ing.chiaramarchionni@gmail.com

Rotilio Marianna* - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: marianna.rotilio@univaq.it (corresponding)

Di Cresce Giovannna - Freelance Engineer, Roma, Italy, giovanna.dicresce92@gmail.com

De Berardinis Pierluigi - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: pierluigi.deberardinis@univaq.it

Abstract: The Architectural Heritage performance upgrade is a an extremely interesting topic, due to the impact on the energy saving and the comfort management of the historical buildings. The ways of using the built heritage are paramount, in order to contain both the fuel consumption and the CO_2 emissions of valuable artefact on the occasion of their rehabilitation. As the way of using of the historical environment changes over time, a compatible performance upgrade is more often than not required. In particular in religious buildings, the change of intended use through the installation of new heating system has a greater impact on the conservation and on the original microclimate of the indoor environment. This work illustrates the case-study of the S. Vito Church in L'Aquila (Italy) for which, due to reuse needs, an energy performance update has been hypothesized, following the restoration interventions that took place in Abruzzo after the 2009 earthquake. This paper shows a design methodology for the restored Architectural Heritage that has to adapt the comfort management according to the changes in the structure method of use. In this project, the technological solutions, compatible with the restoration interventions recently applied, are hypothesized and a plant-based update is introduced with the aim of achieving a more comfortable and flexible use of the liturgical hall.

Keywords: Architectural Heritage, Conservation, Non-Destructive Diagnostic Techniques, Energy simulations, Indoor Comfort

1. Introduction

In the last decades, thanks also to the attention paid to monitoring the state of conservation of historical buildings in relation to the changes in the intended use of the rooms, it has been possible to experiment with the application of modern heating systems, such as the radiant floor panels, also in places of worship. This has been quite successful in terms of impact on the conservation of historical and artistic values, considering the low operating temperatures of the heat transfer fluids used.

On the other hand, in the artifacts where recent restorations and renovations have not been made, there is a widespread use of inefficient or invasive systems to counteract discomfort, such as electric splits or infrared lamps which, while guaranteeing extreme flexibility, reversibility, low installation and management costs, have many side-effects linked to the questionable aesthetical impact, the release of gases into the environment, the fire risk and the impairment of the surfaces hit by the heat source.

From what has been argued, it is evident that the research concerning the improvement of comfort conditions in liturgical environments is not concluded, since there are many methodological gaps to be filled, in-depth studies to be carried out and results to be achieved. This paper intends to contribute to overcome the critical issues identified, through the development of a methodology aimed at optimizing the management of environmental comfort and the internal microclimate of churches, following restoration, reuse and refurbishment interventions. This methodology was validated through the application on a case study: the church of S. Vito in L'Aquila, Italy.

2. The methodology

In this work, the phases of the performance optimization project involve the analysis of the state-of-the-art and, in particular, an in-depth energy diagnosis carried out by means of a monitoring campaign. This latter was developed through the use of non-destructive analysis methods, such as the technique thermographic and the one based on the use of a thermal fluxmeter.

The steps of the design process may be summarized as follows:

- Step 1. Analysis of archive sources and non-destructive investigations in situ.
- Step 2. Critical analysis of the collected data.
- Step 3. Identification of compliant solutions.
- Step 4. Verification of results through application on the case study with dynamic simulations.

3. Results and conclusions

This paper is intended to contribute to the identification of a methodology in order to overcome some of the critical issues related to user comfort and energy consumption, that are highlighted in relation to changes in the way churches are used after reuse and restoration interventions. This methodology was validated through the application to the case study of the church of San Vito in L'Aquila. The verification was carried out through the comparison of the Fanger indices: the outputs show an increase in comfort for the project status that may be found throughout the selected simulation period. By means of the same simulations, a saving in terms of CO2 produced was also estimated equal to 61.8%. The results show how the ways of use of the environments are crucial to allow a correct identification of the performance improvement interventions to be applied, enabling the definition of specific and optimized solutions for the intervention context.

Methodological proposal for the analysis of the heritage values of buildings for intervention decisions.

BENCHENNI Fatima - Abdelhamid Ibn Badis University of Mostaganem, Algeria, fatima.benchenni@univ-mosta.dz

MONJO-CARRIÓ Juan - Polytechnic University of Madrid, Spain, juan.monjo@upm.es

Abstract: To know how to intervene in existing buildings to ensure their authenticity, integrity, and use, we have developed a decision sheet based on the evaluation of heritage values as a criterion for intervention decisions. The objective was to propose a "value sheet" model for decision support based on an analysis of values and interventions that allow maximum recovery of each parameterized, weighted, and normalized value. This scientific research enabled us to identify the main values and sub-values in question, follow the process of estimating the values identified, and find each intervention action adapted to the recovery of each sub-value. Values and sub-values are grouped into four categories: historical-artistic values, technical values, use values, and contextual values. We have confirmed the hypothesis that it's possible to estimate qualitatively and then quantitatively the heritage values and sub-values of any existing building, which made it possible to know whether and how to intervene by prioritizing possible actions. The decision-making reports the result of quantified values. The proposed method constitutes a new scientific tool to help in the decision-making process of architectural intervention which can be applied to real cases.

Keywords: Heritage Values, Parameterization, Decision Making Process, Recovery of the Built Heritage, Architectural Intervention.

L'infrastruttura ospedaliera per l'emergenza Covid-19: strategie costruttive sostenibili

Healthcare setting enhancements for Covid-19 emergency: sustainability and seismic management

Marchionni Chiara - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, ing.chiaramarchionni@gmail.com

Sciomenta Martina - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: martina.sciomenta@univaq.it

D'Alessandro Giulio - Freelance Engineer, Roma, Italy, giulio.dalessandro92@gmail.com

Carozza Francesco - Freelance Engineer, Roma, Italy, carozzafrancesco@yahoo.it

Fragiacomo Massimo - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: massimo.fragiacomo@univaq.it

Abstract: The Covid-19 pandemic has really test the national health system and has brought out the problem of the lack of beds in intensive care units, the narrow timeframe to increase their number and the related equipment, and the need to identify quick solutions that may allow assistance to the infected and the safe work of healthcare staff.
This paper is part of this research area, which sees the concept of resilience of places dedicated to hospital emergencies as protagonist, the redesign of functional spaces and the implementation speed of additional environments, through the design experimentation concerning the expansion of the San Salvatore Hospital in L'Aquila and the design of an intensive care unit for Covid-19 patients, with spaces adapted to new needs. For this reason, it was decided to design the structure taking advantage of the qualities of dry modular construction: the protagonist of the construction system is the application of sustainable solutions, first of all the construction technique in XLAM wood panels.

Keywords: Covid-19, intensive care unit, dry construction, XLAM, sustainability

1. Introduction

The Covid-19 pandemic has changed the most common habits related to everyday life, causing heavy economic and social consequences and imposing drastic changes in world lifestyles. The space around us must be settle to have an active role in the prevention, mitigation and control of contagious diseases. To accomplish this purpose, is essential to act both on the retrofit of existing buildings as well on an oriented design of new ones.

One of the infrastructures that mainly needs a deep rearrangement and effective solutions to limit the virus diffusion is healthcare. The complexity of these structures requires the development of new design approaches, able to integrate the different levels involved in the project, such as urban planning, land use, architecture and construction process, as well as the site maintenance.

In this paper, the above-mentioned integrated approach is applied to an existing hospital, chosen as study case: the San Salvatore, located in L'Aquila (Italy). In particular, the design proposal concerns the realization of a new pavilion having as intended use the treatment of highly contagious patients such as those from Covid-19.

2. Methodology

This research aims to provide a possible solution to the huge demand for beds and intensive care units, due to the Covid-19 health emergency. The proposal concerns the expansion of the existing hospital structure, through the construction of a new permanent unit. This latter is design to be both flexible and adaptable to possible new future scenarios as well seismically safe and sustainable.

The steps of the design process can be summarized as follows:

• Step 1. Analysis and knowledge of the existing context: involves the analysis of the existing structure and its vulnerabilities; concurrently, the context and the location is investigated.

• Step 2. Meta-design phase: consists on analyzing the requirements to be respected and on the formulation, based on them, of different design scenarios. As final result, the most suitabl architectural configuration of the building was defined.

• Step 3. Design phase: it is characterized by the choice of the construction system and materials.

3. Results and Conclusions

In this work, a proposal for the addition of a new hospital pavilion for the management of contagious disease, such Covid-19, was developed. The integrated design process was carried on based on the above described methodologic phases. These latter are articulated in step of subsequent in-depth analysis.

In order to optimally place the new structure, the hospital context was analyzed. At last, a functional integration, which takes into account the existing spaces, was achieved and proposed. The connection paths were identified and the entire complex was divided into functional units to be created in successive parts. The main focused was on the structure defined as "Block A", containing the Intensive Care Department; a structural, functional and architectural analysis was carried out. Timber was chosen as a sustainable construction material. The X-Lam panel construction system was exploit its speed of installation, high seismic performance and outstanding sustainability characteristics.

The research aims to be a support, to the local institutions as well as to designers and sector workers for the resolution of the logistical and functional problems that are currently causing the evolution of the pandemic from Covid-19. This proposal aims to give a design and constructive response to address the current shortcomings of the health service, in particular of the intensive care units.

Circular approach for deep renovation of historic building heritage. The case of a manor villa in Argelato, Bologna

Cecilia Mazzoli – DA - Department of Architecture, Alma Mater Studiorum – University of Bologna, Bologna, Italy, cecilia.mazzoli@unibo.it

Lorna Dragonetti – DA - Department of Architecture, Alma Mater Studiorum – University of Bologna, Bologna, Italy, lorna.dragonetti2@unibo.it

Rachele Corticelli – DA - Department of Architecture, Alma Mater Studiorum – University of Bologna, Bologna, Italy, rachele.corticelli2@unibo.it

Annarita Ferrante – DA - Department of Architecture, Alma Mater Studiorum – University of Bologna, Bologna, Italy, annarita.ferrante@unibo.it

Keywords: Circularity, historic buildings, deep renovation, environmental impact, circularity indicators

Extended abstract

Buildings are responsible for about 40% of the European energy consumption and 36% of greenhouse gas emissions from energy. As stated by the European Renovation Wave, effective actions - both at the policy-legislative and academic and corporate research level – are crucial to making Europe climate-neutral by 2050. In this framework, the Horizon 2020 European project "DRIVE 0 - Driving decarbonisation of the EU building stock by enhancing a consumer centred and locally based circular renovation process" (G.A. no. 841850) deals with the promotion of **decarbonisation strategies** of the existing building stock through the implementation of deep renovation interventions. The project intends to encourage the adoption of a circular approach within the renovation processes that is based on the use of energy from renewable sources and the use of materials from biological or technical cycles, in which waste production is minimised and end-of-life strategies with a positive impact on the environment (*Cradle to Cradle*) are envisaged. The project, in which the Department of Architecture of the University of Bologna (UNIBO) is involved to carry out the present research, identified several case studies located in the home countries of the partners involved, in which to implement the circular strategies. Among these cases, UNIBO contributed with a demo case located in Argelato (Bologna, Italy), owned by a private foundation.

The Italian demo case consists of a building complex constructed in the early 1900s and partially demolished and rebuilt over the decades, composed of a manor villa, a hayloft/stables, and a small animal shelter. In 2021, when the private foundation decided to intervene in the building complex, it was compromised and damaged in terms of seismic safety, architectural and conservative quality, and energy and mechanical performances. At the end of the renovation process, the Municipality of Argelato will dispose of the renovated "Corte Palazzo" complex: while the manor villa will be transformed into a multi-user social residence for disadvantaged families and disabled people, the former barn-stable will host social services for residents and citizens, surrounded by a park of great landscape value. The buildings are subjected to a historical-documentary constraint, and the regulations in force do not allow

for deeply intervene in façades but just on the roof (*"Restoration and conservative renovation"*). This paper is focused on the **manor villa**, constituted of load-bearing masonry in solid bricks, which represents a typical rural residential commonly widespread in different rural territories of Southern Europe and Italy. The intervention foresees the reuse of original materials, the use of new local materials, and the implementation of new sustainable and circular prefabricated components, which is completely innovative in the field of protected heritage.

The construction works began in July 2021, and the end of the works is scheduled for the mid of 2023. This deep renovation demonstrator is based on **several circular actions**: i) the reuse of existing materials, such as the 90% of the original roof ceramic tiles on the new roof and the reuse of crushed original solid bricks for paving substrates; ii) the installation of Photovoltaics panels integrated into the South oriented portion of the roof; ii) the energy refurbishment of the façades through two different systems: the first one is a traditional External Thermal Insulation Composite System (ETICS) in EPS, and the other one is an innovative prefab plug&play system designed by the Italian factory ALIVA, filled in with an internal glass wool layer and an external sandwich panel in rock wool; iv) the installation of new high-performance windows integrated within thermal insulated prefabricated monoblock frames, which also include the related window shading systems.

The analyses are focused on the **two different envelope solutions**, which are applied to the building in order to compare their circularity. The results of the analyses, which consider not only the Embodied Energy (EE) and Embodied Carbon (EC), but also parameters linked to the Design for Disassembly (DfD), Materials Origin (MO), and Re-Usability (RU) of materials and components, bring out some important reflections on the actual lack of application of a circular approach to historic buildings. By considering the EE and EC values through a Life Cycle Assessment (LCA) analysis, the prefabricated solution is more impactful than the traditional ETICS solution. However, by analysing also the other above-mentioned aspects of circularity, as defined by DRIVE 0 project, the plug&play ALIVA solution is less impactful. Furthermore, a comparison between two different plug&play ALIVA solutions is made, in order to assess the influence that the type of façade finishing has on the degree of circularity. The solution including a cladding in recyclable ceramic tiles and metallic structure and anchors is more circular than the one imposed by the historic-documentary constraint, with its non-recyclable original lime-based plaster finish. Furthermore, the assessment of the circularity of the solutions in terms of DfD, MO, and RU is related to the production of waste. When comparing the two systems, the dry-assembled cladding system produces half as much waste as the partially wet system imposed by regulations. So, in terms of waste, the prefab plug&play ALIVA system has less impact on the environment.

Based on the results obtained, it can therefore be said that a comprehensive analysis of all circularity parameters is crucial to raising awareness and understanding how to enhance decarbonisation in the building sector. It is important that this awareness is spread at all levels, from the customer who must make the final decisions to the designer who develops the project and the regulatory institutions that define the laws and authorise the projects. This specific case of the historic villa in Argelato, which represents a large part of the highly consolidated built context in Italy, shows that the regulatory framework is often a major obstacle to the diffusion of highly circular innovative technological solutions that could contribute to decarbonisation. Definitely, the legislative constraints attributed to the existing buildings, especially those with architectural and historic-documentary interest, represent a significant **barrier to the adoption of a circular approach** to deep renovation interventions.

THE USE AND THE CONSERVATION OF HISTORIC BUILDINGS CASE STUDIES IN THE ALENTEJO REGION, PORTUGAL

Fernandes, Maria - CEAACP and DGPC (Centre for the Archaeological Studies, Arts and Heritage Sciences, General Directorate of Cultural Heritage), Coimbra and Lisboa, Portugal, arqmariafernandes@gmail.com: Architect/Researcher, https://ceaacp.uc.pt/, http://www.patrimoniocultural.gov.pt/

Costa, Maria João – DRCALEN and CCDR (Regional Directorate of Culture of Alentejo, Alentejo Regional Coordination and Development Commission), Évora, Portugal, mjoao.costa@cultura-alentejo.gov.pt: Civil Engineer, https://www.cultura-alentejo.pt/, https://www.ccdr-a.gov.pt/

Abstract: The conservation of historic buildings is directly related to their use, maintenance and management. The continuity and permanence of historic buildings depend on this cycle - use, maintenance, management. In Portugal, in the last twenty years there have been numerous institutional and political changes that have directly affected the way in which historic buildings had been managed and maintained, especially during the 20th century. It took years, for those responsible for the management of historic buildings to adapt to the new rules and funding. The paper aims to present some examples of intervention in historic buildings since 2017-2022, which reflect these changes. The paper falls under the topic of the conference – Reuse and restoration concepts, current orientations and future trends.

Keywords: Historic buildings, conservation, reuse, continuity, Alentejo.

1. Introduction

In 2006, the Government Institutes that since the mid-twentieth century were responsible for the conservation and management of Portuguese Historic Buildings (Monuments) were extinguished – The General Directorate of National Buildings and Monuments (DGEMN) and the Portuguese Institute of Architectural and Archaeological Heritage (IPPAR). Since then, the management and conservation of mainly historic buildings, owned by the Portuguese State, were handed over to the Municipalities, associations and private organizations that occupied them, without there being a historical and local tradition dedicated to this effect [1]. Only a small list of Monuments was left to the Government through the Ministry of Culture - DGPC and DRCs (General Directorate of Cultural Heritage and Regional Directorate of Culture).

This change had very negative repercussions. It took years before the Municipalities and the other associations managed to organize themselves to recover and guarantee the maintenance of historic buildings. The transfer of Monuments to Municipal management was not peaceful, as well, the decision of who would be the associations responsible for the maintenance of several historic buildings. The direct consequences of these political decisions were the closure of numerous historic buildings, the abandonment of others, and only a few continued to be used without any maintenance, or with the management and funding guaranteed by the Ministry of Culture.

The solution found for the problem, in the Alentejo region, were public partnerships established between the Government (Ministry of Culture - DRCALEN), the Municipalities and other organizations, for the elaboration of projects, execution of interventions and financing through European Union funds. The DRCALEN was

responsible for the projects and technical support, while the other organizations, Municipalities included, were responsible for the financing and implementing the interventions.

The case studies to be presented are located in the Alentejo region and resulted from projects developed by DRCALEN and the management of Municipalities and private organizations responsible for the use: *Igreja de Santo Antão* and *Ermida de São Brás* (Évora), *Capela da Boa Nova* (Alandroal) and *Convento de São Bento de Cástris* (Évora).

.

References

[1] CUSTÓDIO, Jorge (2010). 100 Anos de Património: Memória e identidade. Portugal 1910-2010. .2ª edição, Lisboa: IGESPAR, ISBN 978-989-8052-20-9.

[2] DRCALEN (2017-2018). Igreja de Santo Antão, Évora – Obras de Conservação. Projeto.

[3] SIPA (2006). Igreja Paroquial de Santo Antão de Évora/ Igreja de Santo Antão. [on line], available WWW: <URL: http://www.monumentos.gov.pt/Site/APP_PagesUser/SIPASearch.aspx?id=0c69a68c-2a18-4788-9300-11ff2619a4d2.

[4] SIPA (1993). Ermida de S. Brás. [on line], available WWW: <URL: http://www.monumentos.gov.pt/Site/APP_PagesUser/SIPA.aspx?id=3854

[5] FERNANDES, Maria da C. Lopes Aleixo (1998). Os “restauros” e memória da cidade de Évora (1836 – 1986). Dissertação de mestrado em Recuperação do Património Arquitetónico e paisagístico. Universidade e Évora. Texto policopiado.

[6] DRCALEN (2019-2021). Ermida de S. Brás, Évora – Obras de Conservação. Projeto.

[7] SIPA (1999). Santuário de Nossa Senhora da Assunção/ Capela da Boa Nova [on line], available WWW: <URL: http://www.monumentos.gov.pt/site/app_pagesuser/SIPA.aspx?id=4442

[8] DRCALEN (2019-2020). Capela da Boa Nova de Terena, - Obras de conservação. Projeto.

[9] SIPA (1998). Convento de S. Bento de Cástris [on line], available WWW: <URL: http://www.monumentos.gov.pt/site/app_pagesuser/SIPA.aspx?id=6511

[10] SPHERA CASTRIS Southwest Park for Heritage and Arts. Centre for arts, science and technology – research, innovation and sustainability. MAGALLANES – MAGALHÃES ICC, Espanha-Portugal. Centro Magalhães para o empreendimento de indústrias culturais e criativas. Available WWW: <URL: http://www.poctep.eu/pt-pt/2014-2020/centro-magallanes-para-el-emprendimiento-de-industrias-culturales-y-creativas

[11] DRCALEN (2017-2022). Convento de S. Bento de Cástris, Évora. Pano geral e Processo de empreitadas.

Place and identity.
Conceiving the *Genius Loci*

Di Mari Giuliana – Politecnico di Torino, Torino, Italia, giuliana.dimari@polito.it

Garda Emilia Maria - Politecnico di Torino, Torino, Italia, emilia.garda@polito.it

Renzulli Alessandra – Università della Sapienza di Roma, Roma, Italia, alessandra.renzulli@uniroma1.it

Vitale Denise - Politecnico di Torino, Torino, Italia, vitaledenise.vd@gmail.com

The human existence is deeply anchored by the relationship with its current location. The consequence of this association is the origin of the *Genius Loci*, but where does its original meaning come from?
According to ancient mythologies and religions, some places were emotionally abundant because they were also home of a deity or a demon who interfered, acted and intervened in human life. In fact, Servius Marius Honoratus, in his work '*Commentaries to the Aeneid*', wrote in the fourth century A.D. "*Nullus locus sine genio*" ("*no place is without Genius*") affirming the importance and the presence of this entity. What is the genesis of this articulate expression? Clearly, this expression was coined during the Romans era, however, it is also necessary to refer to the Hellenistic age, as the *Genius* was often compared with the Greek *Daimon* ("*Δαίμων*" in ancient Greek).
The discussion about this topic is very extensive and complex: in fact, there are numerous authors, poets and philosophers who have analysed this mystic figure; there are also many interpretations and some of them are even antithetical. Another challenging element is that translated texts often do not fit the primary sources. In some writings it is evident how not even the Romans were able to fully understand the characteristics of this entity. Through the Book V of the '*Aeneid*', it is possible to know that Virgil is uncertain about the attribution of this spirit to either family or space, that correspond to the *Genius* of the father or the *Genius* of the place.
Greeks, like Romans, also recognized the importance of the *Daimon*, a divinity who controlled, guarded and protected the place where they used to live.
The *Genius Loci* is like a spirit that instills places with a certain identity and recognizability. The presence of this divine spirit generates emotions that create wonder, terror and even shock. These ever-changing feelings are triggered by the characteristics of each place; some of these features are culture, landform and inhabitants.
Nowadays, after overcoming the classical concept of the *Genius Loci* as a divine entity, the expression refers to the essence, the uniqueness and the nature of the place. In particular, this expression is adopted especially in architecture to refer to the two-way relationship between man and the environment.
Romans were used to pay respect to the place in order to avoid divine hostility. Today understanding the *Genius* helps to act respectfully towards a specific area. Probably, it is in this particular act that the pre-existing heritage protection is realized.

The Preservation of Built Heritage Typical Characteristics in through the Codes of Practice. An Operational Tool for the Renovation of San Giovanni Lipioni's Heritage

Costantino Carlo - Department of Architecture, University of Bologna, Bologna, Italy, carlo.costantino2@unibo.it

Benedetti Anna Chiara - Department of Architecture, University of Bologna, Bologna, Italy, annac.benedetti@unibo.it

Mantini Nicola - Department of Architecture, University of Bologna, Bologna, Italy, nicola.mantini@studio.unibo.it

Bartolomei Cristiana - Department of Architecture, University of Bologna, Bologna, Italy, cristiana.bartolomei@unibo.it

Predari Giorgia - Department of Architecture, University of Bologna, Bologna, Italy, giorgia.predari@unibo.it

Keywords: Restoration Manual; Built Heritage; San Giovanni Lipioni; Preservation; Inner areas

Abstract: In order to preserve the typical characteristics of the heterogeneous Italian built heritage, a vast production of manuals has developed over the past century, providing designers with a solid knowledge base and relevant guidelines. The main purpose of this paper is to outline the role of restoration manuals as an operational tool for built heritage preservation, describing the methodology from data collection to drafting. The case study of San Giovanni Lipioni has met a progressive depopulation over the last decades, causing the abandonment of many constructions and placing some of them at risk of disappearing. Fifty-one building units have been surveyed, analysed and mapped using summary factsheets to reveal the construction characteristics and weaknesses, which become the knowledge core of the Restoration Manual. Thereby, twelve categories of construction elements were classified, and each component is described through both graphical and textual book-plates aimed at comprehending how they were built, offering a detailed description in terms of materials, geometry, work stages, structural, energy and conservation weaknesses to find the most proper intervention. The Restoration Manual is a significant theoretical and practical reference for local administrations and technicians for vernacular architecture preservation and is an essential part of the village's cultural legacy.

Extended Abstract

Italy has an extremely rich, ancient and heterogeneous built heritage, whose characteristics are directly related to history and natural resources available in various territories (wood, clay, stone, etc.). Consequently, the regional construction techniques that evolved over the centuries are profoundly different in each region. Therefore, in order to preserve the typical characteristics of this invaluable heritage, a vast production of manuals (Città di Castello, Roma, Abruzzo, etc.) has developed over the past century, providing engineers and architects with a solid knowledge base and proper guidelines in the development of interventions on the local built heritage. These manuals follow a longstanding analysis methodology that starts from a virtual dismantling of buildings into individual construction elements, examining them down to detail in order to arrive at a full awareness of the materials used and work stages. This deep solid knowledge aims to identify the best practices for the conservation and restoration of each building element in terms of seismic improvement, increase in energy efficiency and preservation of finishes. Furthermore,

recognising uniform building characteristics allows for defining intervention guidelines that preserve the original characters of the built heritage.

The main purpose of this paper is to outline the role of restoration manuals as an operational tool for the proper preservation of the built heritage, describing the methodology from data collection to drafting. The case study has been identified in the historic village of San Giovanni Lipioni, a small municipality with less than 200 inhabitants in the province of Chieti, Abruzzo (Italy), where social changes of the last decades favoured the abandonment of a large number of constructions. Thereby, fifty-one building units have been surveyed using UAV photogrammetry, a vast photographic repertoire, and traditional tools to identify the construction and architectural characteristics of the local built heritage. Subsequently, the drawings and outcomes of the analysis of these units have been collected in summary factsheets to reveal specific data regarding localisation, current use, typology, number of floors, construction period, and the surface of rooms. In particular, detailed information on construction techniques, weaknesses, local materials and the conservation state both of vertical and horizontal structures have been collected to identify the vulnerabilities and the presence of damages. As a result, this database becomes the knowledge core of the Restoration Manual, designed as an illustrated guideline that binds building elements and good intervention practices to support the technicians for a proper renovation project.

The first section studies the building units from a typological point of view, identifying the conformation and the connection type between one floor and another. Subsequently, all data have been clustered into three summary schedules and a total of twelve categories were classified in the Manual: four types of structural components (vertical, horizontal, roof and stair structures), four finishes (openings, external and internal finishing, flooring) and four decorative elements (ornaments of portals, eaves, balconies, oven/fireplace). In this way, it was possible to map, identify and analyse the frequency of recurring building characters inside the village: in terms of structural elements, there is a significant prevalence of irregular stone masonry (73.1%) with steel floors, made with NP steel beams and brick vault or tavelloni (67.2%), roofs in wooden beams (67.9 %) and brick-vaulted stairs (48,2%). The facades present few iconic decorative elements: in the first place, the ornaments of portals and windows in brick or stone blocks (24.6% and 14.8%); secondly, the traditional construction techniques of “Romanella” in which two rows of “Pianella” bricks and one of imbrices (35.7%) are used to make the roof eaves. Similarly, also the finishes employ simple and poor materials: there is a comparable frequency of plastered or unplastered brick facades, both on the outside (55.3% and 44.7%) and inside (57.9% and 42.1%), wooden windows are prevalent (63.4%), while the 25.3% of floors finishing is made with traditional terracotta tiles. Each category contains a certain number of elements depending on the characters identified in the building sample and the Manual study each classified element in two ways: (i) through the use of graphical book-plates useful to give full awareness of local materials employed and their installation; (ii) using textual book-plates that give a detailed description of local materials required, geometry, work stages, and vulnerabilities (both in terms of structural behaviour, energy consumption, and maintenance of finishes) in order to provide several alternatives among the most proper intervention types. This mapping and analysis method thus allows the development of a broad and solid knowledge of building characteristics toward a more comprehensive regeneration programme through awareness, representation, and dissemination. Furthermore, it aims to represent a significant theoretical and practical reference for local administrations and technicians in order to preserve this vernacular architectural heritage which constitutes an indissoluble part of the cultural legacy of the village.

Influence of calcium chloride on the properties of lime pastes with pozzolanic additions

Sales, Leane Priscilla Bonfim – Universidade Federal da Paraíba, João Pessoa, Brazil, leanepriscillab@gmail.com: (Conj. Pres. Castelo Branco III, João Pessoa, Paraíba 58033- 455, Brazil)

Nóbrega, Aline Figueiredo da – Universidade Federal da Paraíba, João Pessoa, Brazil, alinefnobrega@gmail.com: (Conj. Pres. Castelo Branco III, João Pessoa, Paraíba 58033- 455, Brazil)

Abstract: The hardening time observed in lime and lime and pozzolan mortars is still longer than that found for conventional Portland cement mortars, and this can be seen as a limitation for the dissemination of its application in restoration services. Thus, this research aimed to evaluate the performance in hardened state of hydrated lime pastes and two different metakaolins, one commercial metakaolin (MK) and the other from kaolin calcination in laboratory (CK), associated with the use of 5% and 10% of calcium chloride (CaCl2), in order to reduce the hardening time. For this, the X-ray Diffraction (XRD) was carried out in pastes at ages of 3 and 7 days and Scanning Electron Microscope (SEM) tests in lime-CK pastes at 7 days. From the results obtained, it was observed that the main hydration product observed in all pastes diffractograms was monocarboaluminate. The CaCl2 increased monocarboaluminate formation in lime-MK pastes and apparently delayed microstructure development in lime-CK pastes.

Keywords: Calcined kaolin; Hardening time; Lime paste; Admixture; Calcium Chloride.

1. Introduction

Lower mechanical strength and very long hardening time can be seen as disadvantages between lime mortars and those produced with Portland cement [1]. Studies indicate that the inclusion of pozzolans in mixtures with lime reduces the hardening time and improves durability [2]. However, this reduction in time is still far short when compared to the hardening time of Portland cement mortars and can be seen as a limiting aspect for its use today. According to Veiga [3], historical mortars have limited and infrequent use.

Although studies involving the setting and hardening mechanisms of lime-based mortars are vast, having even been compiled in Alvarez et. Al [4], the authors themselves point out the difference in terms of setting time between the pozzolanic reaction and hydration from hydraulic binders. Studies with setting accelerating additives in lime-based materials were not found.

Thus, the focus of this work was evaluating the microstructure development of lime pastes and two metakaolins against action of calcium chloride, whose accelerating effect is recognized in Portland cement-based materials.

2. Methodology

The materials used were type I Hydrated Lime – CHI, commercial metakaolin (MK), metakaolin produced from kaolin (below 45μm mesh sieve) calcination in laboratory (CK) and water supplied by the local distribution network. Calcium chloride ($CaCl_2.2H_2O$) in powder for analysis was used as hardening accelerator agent.

After materials characterization, pastes with ratio of 1:1 (lime:MK/CK) and water/binder content fixed at 1.0 by mass were prepared. The percentage of $CaCl_2$ used was 5% and 10% in relation to dry materials. Wet curing was adopted. XRD tests at 3 and 7 days of curing and SEM at 7 days were performed to evaluate the products formed in the pastes.

3. Results

In XRD of lime-MK, the following phases were found: portlandite, monocarboaluminate, quartz, kaulinite, illite, calcite and hydrated calcium aluminate (Ca2Al(OH)73H2O). In lime-CK pastes, same phases were found except for quartz, kaulinite and calcite. At 7 days, the reference lime-CK paste showed small peaks of stratlingite. Comparing the ages analyzed, it was observed portlandite peaks tend to decrease, while monocarboaluminate peaks also decrease.

The influence of calcium chloride in accelerating the microstructure formation time varied according to metakaolin used. In SEM images, the phases identified were stratlingite (S), in the form of fine shales [5,6] and monocarboaluminate (M), seen as thin hexagonal plates [7].

4. Conclusions

The main compound resulting from the pozzolanic reaction was monocarboaluminate, whose XRD peaks decrease with advancing age while the formation of small peaks of strantligite starts. In lime-MK pastes, calcium chloride increased the formation of monocarboaluminate peaks and in lime-CK pastes, the additive delayed microstructure development, and evidence of this is the formation of stratlingite only in the reference paste. The microscopy images showed that less dense distribution of compounds were seen in the pastes with less developed microstructure, which for the lime-CK pastes were those with calcium chloride.

References

[1] Nežerka, V. et al. (2014) Comprehensive study on mechanical properties of lime-based pastes with additions of metakaolin and brick dust, Cement and Concrete Research, 64, pp. 17–29. doi: 10.1016/j.cemconres.2014.06.006.

[2] Gameiro, A. et al. (2014) Physical and chemical assessment of lime-metakaolin mortars: Influence of binder:aggregate ratio, Cement and Concrete Composites. Elsevier Ltd, 45, pp. 264–271. doi: 10.1016/j.cemconcomp.2013.06.010.

[3] Veiga, R. (2017) Air lime mortars: What else do we need to know to apply them in conservation and rehabilitation interventions? A review, Construction and Building Materials, 157, pp. 132–140. doi: 10.1016/j.conbuildmat.2017.09.080.

[4] Alvarez, J. I. et al. (2021) RILEM TC 277-LHS report: a review on the mechanisms of setting and hardening of lime-based binding systems, Materials and Structures/Materiaux et Constructions, 54(2). doi: 10.1617/s11527-021-01648-3.

[5] Frías, M. et al. (2012) Evolution of mineralogical phases produced during the pozzolanic reaction of different metakaolinite by-products: Influence of the activation process, Applied Clay Science. Elsevier B.V., 56, pp. 48–52. doi: 10.1016/j.clay.2011.11.022.

[6] Kwan, S., Larosa, J., & Grutzeck, M. W. (1995). Si and AI MASNMR Study of Stratlingite. Journal of the American Ceramic Society, 3(7), 1921–1926.

[7] Banfill, P. F. G. (1991) Rheological measurements with cement pastes in viscosimeters: a comprehensive approach, in Rheology of Fresh Cement and Concrete: Proceedings of the International Conference organized by the British Society of Rheology. London: Taylor & Francis, pp. 13–22.

The building of the Gioventù Italiana del Littorio in Forlì converts into a Museum of Gymnastics and an Auditorium. Restoration and reuse of dissonant architecture.

Atrium, Cultural route of the Council of Europe, Forlì, Italia, info@atriumroute.it, Andrea Savorelli.

Comune di Forlì, Forlì, Italia, chiara.atanasibrilli@comune.forli.fc.it , Chiara Atanasi Brilli.

Keywords: Dissonance, totalitarian regimes, restoration, modern.

1. Introduction

This paper addresses the restoration and reuse of the G.I.L. *(*Gioventù Italiana del Littorio*,* English: Italian Youth of the Lictor) building constructed in Forlì in 1933-35 on a project by the engineer Cesare Valle. The building is part of a common European architectural and urban heritage - which can be defined as "dissonant" or "inconvenient" - erected by totalitarian and authoritarian regimes in the mid-20th century. The international association ATRIUM, Cultural Route of the Council of Europe, aimed at studying and researching these architectures beyond their architectural aspects by framing them also in their cultural and social environments of origin, has dictated its own operational guidelines for restoration with *the "*Manual of wise management, preservation, reuse and economic valorisation of architecture of totalitarian regimes of the 20th century*" (2013) and the "*Guideline for the restoration of modern architecture*" (2015).* This research presents the intervention of the restoration of the "modern" in its implications related to the "dissonant" characteristics that distinguish the former G.I.L. building. It will introduce the criteria used in the design and the project results. This work is a case study of particular interest and complexity for its guiding principles, design, and technical choices, all of which can potentially be future trends for interventions on the dissonant architectural heritage.

2. Historical notes

In 1926, the O.N.B. (Opera Nazionale Balilla*,* purposedly a cultural institution for the physical and moral education of youth) was founded with the aim of training, from an early age, politically and physically, the "citizen-soldier". In 1937, due to the need for greater militarization, the O.N.B. merged into the G.I.L. (Gioventù Italiana del Littorio). The very delicate task of erecting the O.N.B. building in Forlì, Benito Mussolini's city, was entrusted to engineer Cesare Valle (Rome 1902-Rome 2000).

3. Main features of the building

The building consisted of three main blocks: a gymnasium, swimming pool and cinema theatre. A fourth block, attached, was intended for a library, offices, and after-school facilities. A 30-meter-high tower, visible from afar, symbolized the power behind the entire complex. On two of its sides (the West side on Viale Benito Mussolini and the East side, bearing on the sports fields), large white litho-cement letters spelled the violent Balilla oath.

4. Degradation in the post-war period

After the fall of fascism, many public buildings erected during the regime were conflated with its ideology and left to decay and degradation, sometimes even destroyed. The G.I.L. building is a clear example of such an evolution. In the eyes of the post-war society, it was juxtaposed with the very identity of the Fascist regime, leading to questioning its architectural worthiness as a building deserving to be handed down to future generations.

5. The first phase of the restoration and reuse project: The Museum of Gymnastics

The building was purchased by the Municipality of Forlì in 1999. In 2008, the project "Restoration and conservative rehabilitation of the former G.I.L. building for the construction of sports facilities and a Gymnastics Museum" were carried out. The first phase aimed primarily at recovering the original characteristic of functional and distributive unity between sports and cultural zones, particularly for the most significant places (Theatre Hall entrance, Sports Zone entrance, atriums of the Helicoidal Staircase; internal staircase to the Sports Zone).

6. The second phase of the restoration and reuse project: The Forlì Auditorium

The second phase was carried out in 2021, involving the construction of the City Auditorium in the rooms of the cinema theatre designed by Valle and the adjacent functional spaces. The project involves the functional and distributive reorganization of a sector of the building to create an Auditorium that can also serve as a conference hall.

7. Conclusions

The restoration of "dissonant" modern architecture entails additional complexities in what Roberto Masiero (2005) calls "the impossible discipline of restoration...a discipline in which history and art, history and values, history and design are continually at stake" . Almost eighty years after the fall of fascism, there is sometimes today still an ill-concealed fear of restoring and redeveloping the architecture built then, as these building are often identified exclusively with the regime that ordered their construction. The projects and results achieved with the restoration and reuse of the important and valuable G.I.L. building are presented here believing that the philosophy, method, technologies and restoration techniques employed can potentially be proposed as trends that can be used in the future for interventions on the restoration of the modern and in particular on the dissonant architectural heritage.

Historical rural architecture of North Portugal and Spanish Galicia – analysis of vernacular forms and concept of adaptation for cultural tourism needs, case study of Porreiras in Portugal

Orszt, Marta – University of Lisbon, Lisbon School of Architecture, Portugal, martao@edu.ulisboa.pt

Raszeja, Elżbieta – University of the Arts in Poznań, Faculty of Architecture and Design, Poland, elzbieta.raszeja@uap.edu.pl

Introduction: IntroductionForms which can be found in North Portugal and Galicia (region of Western Spain) can be traced down up until times, when this geographical area was bound together through Celtic influences. Vernacular architecture connects regions of countries overstepping existing borders, as can be seen in the researched area, still reminding of the Celtic influences and time when it was a Roman province Gallaecia (Díaz & Menéndez-Bueyes. 2018). Wood, stone, and clay, used for local constructions, appear in many forms which are until now well preserved around the area. Non-monumental architecture constitutes 3/4 of the buildings in which people live, die, profess their faith or work (Oliver, P. 1997). Current research on non-monumental architecture focuses on the use of building materials which was justified by knowledge passed on and tested from generation to generation (Correia, M.R & Lourenco, P.B. & Varum, H. 2015). The rural vernacular architecture is in threat because of modern development processes and the change of lifestyle in rural areas (decline of the farming). The contemporary method of saving historical buildings is the village renewal theory, which is based on building economic independence of rural areas, strengthening cultural identity through emphasizing local traditions, integrating communities and the environment, and respecting the historical landscape while improving the living conditions of the inhabitants (Niedźwiecka-Filipiak 2009, Raszeja, 2013). The aim of the research was the study of vernacular forms, focused on granaries, commonly found in analysed area, and creating the proposal of their reuse. Development and roots of those buildings is researched, showing their historical origin, locally sourced materials used in the region, as well as the state of the buildings nowadays and legal ways of their protection in Spain and Portugal, with the focus on a case study of Porrerias in Portugal.

Keywords: Vernacular architecture, Galicia, North Portugal, granaries, cultural tourism.

Results

Study explores rural architectural forms of North Portugal and Spanish Galicia through their characteristics, state and connections; proposing future reuse solutions to safeguard granaries; developing a conceptual revitalisation strategy of rural settlements based on an example of Porreias in North Portugal. Actions as surveying, sketching, 3D modelling and literature review were executed before prototyping the concept. Granaries, commonly found in the region, are a specific form, and this study emphasizes their unique value. Built with granite, wood, and clay tiles, they are an essence of local craftsmanship, showing its wealth through vast variety of details. Called espigueiros in Portugal, and hórreos in Galicia, they are vernacular agricultural objects, which have possibilities of being maintained if their function is changed and updated to demands of today. Evolved with the passage of time and change of needs, they are witnesses of local culture, which this proposal tries to revive through boosting local activities, growing cousciousness of cultural heritage and proposing new economical models compatible with village renewal objectives. The base of the project is a village renewal concept which aims to adapt the ruins of unused agricultural settlements located in Porreiras for cultural tourism needs, with a proposal of reusing granaries as pilgrim units. Concept of safeguarding granaries through giving them new function is proposed to be implemented on Camino de Santiago trail, since the granaries are commonly found in rural landscape of North Portugal and Spanish Galicia.

Conclusions

The research draws attention to the multidimensional potential resulting from the preservation of former habitats on the Santiago de Compostela trail and in its vicinity, visible in cultural, social, historical, economic, and ecological aspects. The result of the analysis is the village renewal plan and the proposition of incorporation of granaries commonly present on the Camino de Santiago route into a system of pilgrim units.

References

Arquitectura Popular em Portugal. Lisbon: Sindicato Nacional dos Arquitectos, (1961). Correia, M., Lourenço, P. B. & Varum, H. (eds.) (2015). Seismic Retrofitting: Learning from Vernacular Architecture. London (UK): CRC Press / Balkema / Taylor & Francis

Group. Díaz, P. C., & Menéndez-Bueyes, L. R. (2018). Culture and Society in Medieval Galicia. A Cultural Crossroads at the Edge of Europe. In J. D'Emilio (Ed.), La corónica: A Journal of Medieval Hispanic Languages, Literatures, and Cultures (Vol. 47, Issue 1). https://doi.org/10.1353/cor.2018.0018

Niedźwiecka-Filipiak, I. (2009). Wyróżniki krajobrazu i architektury wsi Polski Południowo-Zachodniej. Wydawnictwo Uniwersytetu Przyrodniczego we Wrocławiu,

Wrocław. Oliver, P. (1997). Encyclopedia of Vernacular Architecture of the World. Cambridge: Cambridge University Press.

Prista, P. Terra Palha Cal / Earth Straw Lime; anthropological essays on vernacular building

materials in Portugal. Lisbon: Argumentum, 2014. Raszeja E. (2013). Ochrona krajobrazu w procesie przekształceń obszarów wiejskich.

Wydawnictwo Uniwersytetu Przyrodniczego Teixeira, M. C. (2013). Arquitecturas do granito, arquitectura popular. Arcos de Valdevez:

Municipio Arcos de Valdevez. Vernacular Architecture Towards a Sustainable Future. London: edited by. C. Mileto, F. Vegas, I. Garcia, V. Cristini, Taylor & Francis, 2015.

Glocalization design strategies of multinational enterprises in the context of revitalizing historic districts: Case studies in China and Europe

WEI Xi – The University of Hong Kong, Hong Kong SAR, China, e-mail: weixi@connect.hku.hk

WU Xin* - Fuzhou University, Fuzhou, China, wuxin@fzu.edu.cn, *Corresponding author

XU Qiang - Fuzhou University, Fuzhou, China, e-mail: 253868888@qq.com

LI Jiajun - Fuzhou University, Fuzhou, China, e-mail: 2388123407@qq.com

CALIA Marianna – University of Basilicata, Matera, Italy, email: marianna.calia@unibas.it

EXTENDED ABSTRACT:

The rapid economic growth caused by globalization has also led to the conflicts between economy and culture. Historic buildings reused by multinational corporations (MNCs) or multinational enterprises (MNEs) in cultural districts could well spur urban revitalization with their economic capital and business expertise. Nevertheless, with large scales and standardized business models, MNCs/MNEs normally maintain a high degree of consistency in their standardized architectural and interior design around the world. Historic districts are thus often caught in the dilemma of the diversity of cultural heritage conservation and the homogeneity of international enterprises' business models, which would inevitably cause the tension surrounding the conflicting identities between those MNCs/MNEs global presence and the local sensitivity attached to the cultural heritage. In historic districts, from the point of cultural conservation of heritages, it seems worthy to know how urban planning/design restrictions on the building utilization and decoration style are enforced in the context of commercial revitalization. Therefore, in the game of economic capital verses culture and social capital, the localized adjustments had to be made in architectural design.

Compared with the considerable number of studies on urban redevelopment highlighting the downside of wholesale redevelopment in breaking up communities, only limited reports exist on successful prevention of demolition of lived spaces in place-specific communities with strong social capital. In recent decades the call for accountability of the societal and environmental impacts of MNCs/MNEs financial decision makers has given rise to an increasingly rich and diversified branch of finance, i.e. impact investing, while the public sector, especially city and regional local authorities, are struggled to develop efficient ways of financing to safeguard and promote cultural heritage infrastructures and sites, and to develop urban economies targeting heritage preservation, as set out by the 2016 UN New Urban Agenda (later reiterate in the Sustainable Development Goals). The role of innovative financial mechanisms can therefore be seen as a robust way to minimise volatility during economic crises, increase accountability and transparency, and be a source of alternative funding under different methods of implementation. This emerging field is well-suited to respond to the needs of cultural heritage projects since these investments represent an asset class targeted by new types of investors, and because they have both tangible and intangible feature. Nevertheless, with large scales and standardized business models, MNCs/MNEs normally maintain a high degree of consistency in their standardized architectural and interior design around the world. Historic districts are thus often caught in the dilemma of the diversity of cultural heritage conservation and the homogeneity of international enterprises' business models, which would inevitably cause the tension surrounding the conflicting identities between those MNCs/MNEs global presence and the local sensitivity attached to the cultural heritage.

In Neocapitalism studies, Bourdieu and his followers has discussed the interchangeability in between the four types of capital (economic, cultural/symbolic, social and human), this paper looks at another aspect of the relationship between the capital types, that is, the possibility of mutual restrictions in urban regeneration processes, and in this respect, how culture can be considered a determinant to the accumulation of economic and social capital. It examines the transformation of the historical districts located in metropolitan Fuzhou, Foshan, Tianjin, Milan and Budapest, where the past three decades have witness a radical global change, especially in China cities, in social, economic and environmental profile. Due to its transition from the industrial-led development model to the post-industrial model in which investments in cultural and creative activities/industries, which are supplying new opportunities for the local area in a metropolitan dimension. Historic districts are often caught in the dilemma of the diversity of cultural heritage conservation and the homogeneity of international enterprises' business models. Therefore, in the game of economic capital verses culture and social capital, the localized adjustments had to be made in architectural design. It seems worthy to know what impacts does such planning and design regulations or restrictions have on the building utilization and decoration style are enforced in the context of commercial revitalization.

In this paper takes two common MNCs/MNEs were chosen with three Starbucks and McDonalds respectively as cases to investigate their localization strategies in terms of façade, layout, spatial and decorative elements in Chinese and European historic districts by comparing them to their standard stores nearby. This article also evaluates the rationality of the reuse and design strategies of heritage architecture by considering their built environment.

Cases: Tianjin Heping Road Starbucks, Fuzhou Sanfangqixiang Starbucks, Fuzhou Sanfangqixiang McDonald's, Foshan Mandarin McDonald's, Milan Starbucks Milan Selection Store, Hungary Budapest West Railway Station McDonald's

Keywords: localization, historic districts, multinational enterprises, building reuse, revitalizing design

Indoor air quality and ventilation: two fundamentals to define Healthy Buildings

Savoca Ludovica Maria Sofia – University of Messina, Messina, Italy, e-mail: ludsavoca@unime.it

Abstract: The purpose of a home is to satisfy the needs of its users; therefore, the functional properties of the building should satisfy all the needs deriving from its biological, psychological, and social structure. The Covid-19 emergency has significantly accentuated the attention both to the hygienic-sanitary conditions of the environments and the symptoms attributable to the Sick Building Syndrome – SBS. The SBS recognized by the World Health Organization in 1986.
The syndrome groups together a series of disorders related to those aspects of the microclimate. It related to their people who spend most of their time in "confined". In this case, the environments are exposed regularly. It is starting from the 9 foundations for a healthy building, up to the selection and analysis of two of them: air quality and ventilation, so that they can be subsequently developed in relation to a building. The purpose of this research will lead to the analysis of the various factors that determine the foundations chosen above, to summarize and have a complete picture of all the aspects that characterize what was examined, in view of a future application to the case study.

Keywords: Healthy Buildings, Sick Building Syndrome, Indoor Air Quality, Ventilation, Modern Architecture.

1. INTRODUCTION

The attention to the issues of sustainability and health pushes building professionals to seek increasingly innovative solutions for the construction of *green buildings Green buildings* (designed, built and managed in a sustainable and efficient way), smart buildings *Smart buildings* (with technological sub-systems able to manage and optimally monitor various characteristics of the construction, analyze data and generate insights on patterns and trends of use, important to optimize the environment and the operations carried out by the building) and finally also of healthy buildings, the *Healthy buildings* (able to ensure a better quality of life for the user, supporting the physical, psychological and social health and well-being of people in the built environment). [1]

As part of the public health programme, the *Healthy Building* movement addressed the issue of *the safety and security* of buildings and analysed all the factors of the built environment which influence human health, well-being and productivity of the inhabitants. To this end, the *Harvard T.H. School of Public Health* conducted a study on *Healthy buildings*, drawing up the key points that determine health in a building. The following nine "fundamentals" are the result of many interactions between real estate technicians, university researchers, apartment owners, building owners and hospital administrators. [2]

For years, issues related to indoor air quality and ventilation have been studied, we have learned that closed environments are not necessarily healthier than outdoor spaces, on the contrary, the risk of virus propagation increases without a good exchange of air, as the recent lockdown period, due to Covid-19, has shown.

It was therefore decided to deepen two of the nine "fundamentals", air quality and ventilation, and hypothesizing a case of intervention on a type of residential building belonging to modern architecture. The choice to think about a "dated" building derives from the high probability that the parameters and design inputs referring to air quality and ventilation are partly lacking (certainly also together with others among the "fundamentals" mentioned but not analyzed in the present work) in existing buildings, especially if with a few decades of age. [3]

The aim of this study includes, as a next step, the detection of the *status quo* and the diagnosis on indoor air quality and ventilation of the starting situation, the preparation of various improvement scenarios and the comparison of options from both a qualitative and economic point of view.

To deepen the two foundations, air quality and ventilation, a residential building of modern architecture was analyzed, located in the Harar-Dessiè district of Milan, the popular district on the western outskirts of the city near the San Siro Stadium, which can be considered one of the most successful outcomes of the INA Casa program. [4]

REFERENCES

[1] EPA, United States Environmental Protection Agency, *Indoor Air Facts* No. 4(revised) Sick Building Syndrome, February 1991, pp. 1-4.

[2] Allen Joseph G. and Macomber John D. *Healthy Buildings: How Indoor Spaces Drive Performance and Productivity.* Cambridge, Massachusetts, London, England, 2020.

[3] Savoca, L. M.S., Healthy Buildings: cambiare il concetto di salute per un ambiente costruito sano, in Atti del colloquio. Conferenza AT.e 2022 – Memoria e Innovazione, 2022.

[4] INA Casa, Piano per aumentare l'occupazione dei lavoratori. Case per lavoratori. Consigli norme e schemi per l'elaborazione e la selezione dei progetti – Bandi di Concorso (fascicolo I), Roma, 1949.

Projection mapping for the enhancement of Estense wall paintings: a workflow for complex surfaces and the man-agement of colors

Manuela Incerti - Dipartimento di Architettura, Università di Ferrara, Italy, icm@unife.it

Stefano Giannetti - Dipartimento di Architettura, Università di Ferrara, Italy, stefano.giannetti@unife.it

Abstract: The present paper constitutes the development of research work carried out in 2018 as part of a project to enhance and promote the Estense architecture. Through the projection mapping technique, we wanted to compensate for the partially compromised decorations of the facades of some Estense dwellings, by building a permanent system capable of periodically projecting their re-construction directly onto the existing surfaces. The critical issues analyzed during the process carried out in the past year of-fered the basis for the development of a new methodology, attentive to the result from the outset and more consistent with the objectives of enhancing the architecture itself.

Keywords: projection mapping; architectural survey; historic reconstruction

1. Introduction

In recent years, *projection mapping* events have reached such diffusion as to characterize a real artistic and show genre. Although widely used in the field of cultural heritage, the projection mapping technique has rarely been used to enhance the overall object of the projection. The events in which the architecture was dismantled, elaborated, distorted through the projection of videos and those in which the facades were used as large urban screens, the mapping rarely offered new contents concerning the cultural heritage on the architecture that hosted the show [1-2].

With the SOGNO O SON DESTE project, Through the use of projection mapping, we aimed to reconstruct the wall decorations of some Estense dwellings based on the few remaining fragments. On some external portions of the Rocca di Vignola and on the walls of the cloister of Casa Romei it was possible to hypothesise the development of the decorations and, through mapping, reproduce them in their entirety (July and October 2018). The process identified to carry out the mapping involved numerous actors with different skills and, throughout its course, took on characteristics that diverge from classic projection mapping. In particular, the use of static images (instead of dynamic images), the periodicity of the event, the goal of integrating with existing architecture and decorations, approximated the enhancement project to a light design rather than real mapping.

As described in other studies of the same research group [3], the mapping presents intrinsically limiting characteristics to achieve the goal of integrating the decorations: the synthesis of additive type colors typical of light sources (different from the subtractive one of painting) and the discontinuities of the surface (walls with brick portions and plastered portions) significantly affect the color rendering of the reconstructions. Furthermore, the static nature of

the projected images also highlights possible small misalignments between the projection and the support, which would be usually masked by the typical animations of projection mapping.

This paper illustrates the following aspects of the work.

- The project and the new workflow (phases 0, 1, 2, 3, 4).
- Managing the geometry: the barrel vault of Vignola.
- Reconstruction of the lacunars of the barrel vault made on the basis of the texture obtained through the cylindrical projection (UV mapping) (fig. 1).
- Managing colour: Vignola and Casa Romei [4].
- Conclusion.

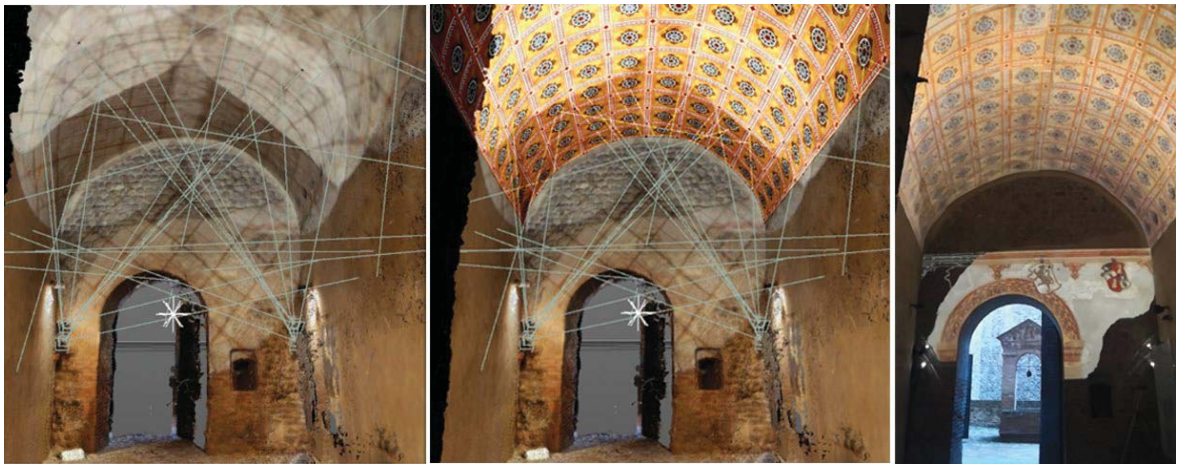


Figure 6. Reconstruction of the lacunars of the barrel vault made on the basis of the texture obtained through the cylindrical projection (UV mapping). Reconstruction of geometries and decorations Stefano Giannetti; Artistic and pictorial reconstruction Natalia Gurgone, Laura Vignoli.

References

[1] Lo Turco M. Teatri urbani e affreschi di luce. Raccontare il territorio con le tecnologie digitali. Luigini A, Panciroli C, editors. Ambienti digitali per l'educazione all'arte e al patrimonio. Milano: Franco Angeli; 2018, p. 151–171.

[2] Maniello D. Augmented Heritage per la per la valorizzazione dei beni culturali. Suoni e luci per il Königorgel di Nijmegen. DISEGNARECON 2016; 9(17): 8.1-8.10.

[3] Giannetti S, Lodovisi A, Sardo A, Grassivaro M, Incerti M. Esperienze di projection mapping per la valorizzazione delle facciate dipinte nei territori estensi. Experiences in projection mapping. Enhancing the painted facades of the Estes. In P. Belardi, editor. UID 2019 - Riflessioni: l'arte del disegno/il disegno dell'arte / Reflections: the art of drawing/the drawing of art. Roma: Gangemi; 2019, p. 1621–1628.

[4] Incerti M, Giannetti S, Lodovisi A, Sardo A. Dal rilievo al projection mapping. La ricomposizione degli affreschi della chiesa di Santa Caterina Martire in Ferrara / From the Survey to Projection Mapping. The Recomposition of the Frescoes of the Church of Santa Caterina Martire in Ferrara. Connettere. Un disegno per annodare e tessere. Atti del 42° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione/Connecting. Drawing for weaving relationships. Proceedings of the 42th International Conference of Representation Discipline. Milano: Franco Angeli, 2020, p. 3365–3382.

Integrated investigation methodologies for architectural Heritage conservation and promotion: La Romita di Cesi (TR), Umbria, Italy.

Cottini Anastasia - DIDA Dipartimento di Architettura - Università degli Studi di Firenze, Florence, Italy, anastasia.cottini@unifi.it

Becherini Pietro - DIDA Dipartimento di Architettura - Università degli Studi di Firenze, Florence, Italy, pietro.becherini@unifi.it

Abstract: This article is part of the research conducted as part of the European project F-ATLAS,. It follows the preliminary phases of the study of the La Romita di Cesi monastery complex, by means of integrated digital survey campaigns with TLS and photographic instruments.

Keywords: Observant Architecture, Franciscan Observance, Integrated digital survey, TLS, SfM photogrammetry

1. Introduction

This article is part of the research carried out within the European Project F-ATLAS, one of the winning projects of the JPI-CH 2019 call. F-ATLAS aims to study the conventual complexes of the Franciscan Observance and their landscape context between Italy, Spain, and Portugal. The research uses historical and archival sources and integrated digital survey methodologies to document and study the network of Observant convents and the paths that connect them for their conservation, protection, and enhancement. The project is a collaboration between the University of Florence, the Instituto Universitario de Lisboa, the Universitat de Barcelona and the Universidade Catolica Portuguesa and is a three-year project launched in 2020. In particular, the text illustrates the preliminary phases of the study of the convent complex La Romita in Cesi (TR), Umbria, Italy

2. La Romita di Cesi

La Romita is located on a slope of Monte Torre Maggiore, along the route that connects the archaeological site of Carsulae to Spoleto, near Terni. There are traces of settlements in the territory of Terni already in prehistoric times, witnessed by finds of a necropolis, while from the third century B.C., the area became a Roman colony.

2.1. Historical background

The archivist Rossi has reconstructed the historical events of the convent complex, in which it is said that St. Francis lived several times, starting from 1213. It is attested the presence of a Benedictine hermitage built around the VII-IX centuries in honour of the SS. Volusiano and Procolo, next to which St. Francis had made a shelter with wood and clay. The intervention of the friar, as is also witnessed in the volume in which he gathered his own experience of life at La Romita, presupposes a deep knowledge of the local history and the characteristics of the architecture of the Franciscan convents. The volume mentions the presence of a cave of prehistoric origin near the convent, consecrated to the cult of fertility

and still visitable, as well as a sacred path that connected Carsulae to the first Umbrian temple (VI sec. a.c.) and then Roman (IV sec. a.c.) located on top of Monte Torre Maggiore. Thanks to the reconstruction operations since 1991, the Benedictine chapel, the church of SS. Annunziata of the fourteenth century, the cloister, the cells and the novitiate of the fifteenth century, the refectory of the eighteenth century, the system of cisterns and the surrounding gardens were restored

3. Metodologie

The digital survey of the Romita di Cesi complex provided for the development of an acquisition methodology that would guarantee its accuracy and reliability on an architectural scale: the need to investigate the sections of the area for documentation purposes determined the scale of territorial representation with centimetre reliability, regarding its spatial location in the horizontal plane and for the elevation, the interesting different height differences to which the site is subjected. Two integrated digital survey campaigns were carried out in parallel with studying historical and archival sources. During the first, in August 2021, a laser scanner was used to detect the external spaces of La Romita, defining a closed polygonal around the convent's buildings. A digital camera and a drone were also used to make photogrammetric and documentation acquisitions. During the second campaign, in March 2022, a laser scanner was used to detect the interior spaces of the convent.

4. Conclusions

Integrating digital surveying techniques and studying bibliographic and archival sources constitutes reliable support for the architectural analysis of historical buildings. The data collected in La Romita convent have been entered into the database of information relating to the research project F-ATLAS. They will constitute a database that can be consulted and updated over time. The data of this database are different and significant in digital space; it is, therefore, essential to establish *a priori* the purpose of use and discretise the data accordingly. The collection of data with methodologies of digital survey, therefore, assumes a crucial role in the documentation of the state of the convent complex: the data can be updated in the future and used as support for architectural and diagnostic investigations or the promotion of Heritage. The project's objectives are to preserve the Observant Cultural Heritage, promote it, and make it known to the public, considering the cultural contributions and historical-artistic-architectural characteristics. In this specific case, the aspects related to the conservation of assets are of particular interest also for the future management of La Romita, having recently passed away Friar Bernardino, the leading proponent of the correct management of the conventual complex.

Acknowledgements

The project F-ATLAS is funded by JPI Cultural Heritage, which received funding from the European Union's Horizon 2020 research and innovation programme (www.f-atlas.eu). The consortium is composed of 4 principal investigators: University of Florence (PL Stefano Bertocci), University Institute of Lisboa (PI Soraya Genin), University of Barcelona (PI Maria Soler Sala), Portuguese Catholic University of Lisbon (PI Maria Filomena Andrade).

Bridging tradition and modernism in the reuse of built heritage. Fernando Távora's design approach at the Porto University Club

Ordoñez-Castañon, David - Centre for Studies in Architecture and Urbanism Faculty of Architecture of the University of Porto, Portugal, e-mail: dcastanon@arq.up.pt

Ferreira, Teresa Cunha - Centre for Studies in Architecture and Urbanism - Faculty of Architecture of the University of Porto, Portugal, e-mail: tferreira@arq.up.pt

Abstract: This paper focuses on the concepts, methods and design principles of the Portuguese architect and professor Fernando Távora (1923-2005) in the reuse of built heritage through an in-depth analysis of the renovation and conversion of the so-called *Primo Madeira House* into the *Porto University Club* (1986-1990). The architect's different performance on the two buildings of the pre-existing complex reflects his case-by-case approach. The intervention in the main house consisted in occasional and delicate repairs that demanded skilled labour in traditional techniques, aimed at restoring the original bourgeois character. By contrast, the annexes show a more affirmative contemporaneity in the introduction of a modern staircase and the renewal and update of the bedrooms. This representative case took place at a stage of full maturity in the architect's career, reflecting the main features of his personal *modus operandi*: careful prior analysis of the pre-existence, respect for the previous character of spaces, atmospheres and construction systems, as well as sensitive introduction of new elements with subtle modern expression in continuity with the architectural identity of the building.

Keywords: Adaptive reuse, conservation and repair, design principles and strategies, Fernando Távora, modern architecture

1. Introduction and methodology

The professional career of the Portuguese architect and professor Fernando Távora (the mentor of Álvaro Siza and Eduardo Souto Moura, among other architects of the so-called School of Porto) has given consistent contributions in the field of restoration and conservation of built heritage. His renovation works show a sensible adaptation of heritage buildings to new requirements (functional, spatial, technological, comfort, accessibility, etc.) while preserving the memory of the pre-existence, its constructive systems and architectural character. One of his most valued works in this regard was the conservation of the Primo Madeira House and its conversion into the Porto University Club (1986-1990).

This work dates from his professional maturity, also coinciding with a series of other exemplary cases of reuse of built heritage. Thus, Távora put into practice a method that was fully consolidated after decades of experience. Furthermore, the different responses given to the two buildings that make up the Porto University Club complex illustrate different nuances in his approach to the renovation of heritage buildings. That being said, this project has been insufficiently studied and disseminated, so this paper aims to study the concepts, strategies and design principles underlying this specific case, which, nevertheless, allows to draw more general conclusions about the architect's *modus operandi*.

The research methodology is based on the cross-referenced analysis of different resources, combining literature review, archival research, semi-structured interviews, onsite observation and drawing analysis and interpretation.The study of archival documentation was further complemented by field research, involving direct observation of the building (systematic photographic survey, drawings and notes), as well as by interviews with Távora's collaborators who were directly involved in the intervention (those testimonies provide valuable unpublished and revealing information about the design and construction processes). Furthermore, drawing has been a fundamental tool for comprehending the transformations, including plans of the previous state, the final state and the alterations (using the graphic code of reds and yellows to better understand the extent of demolitions and additions). Thus, each stage of the entire intervention process has been analysed in depth, establishing a sequence that allows documenting both the state prior to the intervention, the design of the operation, the execution of the works as well as the impact of this project in the context of the School of Porto and in architectural criticism.

2. Results and conclusions

The project for the Porto University Club involved the recovery of the main house, the annex building and the surrounding garden. Regarding the main house, the architect succeeded in adapting the nineteenth-century mansion for different functions from the original ones (lounge areas, restaurant, meeting rooms, library…), while preserving its previous identity. No significant changes were made to the layout thanks to the amplitude and functional flexibility of the spaces. Also, because the building was in an acceptable state of repair despite having been abandoned. Thus, the purpose was to recover and perpetuate the original bourgeois atmospheres by means of delicate repairs that required skilled labour in almost forgotten traditional techniques. The effort to recover the splendour of the ornamental repertoire (based on stuccoes, gilding, marble, marquetry, woodwork, etc.), required slow and expensive work, carried out in an on-site workshop where reproductions of the irrecoverable pieces were produced. In addition, Távora recovered original furniture, while other pieces were bought from antique dealers. The architect also designed some pieces from scratch, following classic but updated models, perfectly integrated into the traditional space. The colour palette of the walls was also slightly revised, using neutral shades of grey, blue and cream. The project was thus conceived as a comprehensive work.

On the other hand, the lesser heritage value of the annexes and the need to mark another stage of the transformation process led to a more affirmatively contemporary intervention, although with maximum respect for the pre-existence. The most obvious gesture of innovation is the new metallic spiral staircase in the atrium, assuming a sculptural condition. Other characteristics such as transparency, luminosity, chromatic uniformity (white), the formal simplicity of the new elements (such as the metallic profiles of the parapets), or the greater feeling of lightness (the curtains) show a clear expression of modernism.

In a context of global vulnerability in which the conservation and reuse of buildings are fundamental issues of the work of architects, this paper presents the valuable contribution of Fernando Tavora in the adaptive reuse of built heritage. Indeed, this particular case shows some of the main features of the architect's *modus operandi*, based on a careful analysis of the pre-existence, supporting sensitive introduction of new elements with subtle modern expression in continuity with the identity of the old building. Tradition and modernism are thus combined in a balanced, natural and coherent way, confirming Távora's conception of built heritage, not only as something received from our ancestors that must be embalmed, but as "a permanent and collective creation" to be transmitted to the future generations.

Review on the application of ceramic residues in mortars

Fernanda Calado Mendonça – FPB/UNIFACISA, João Pessoa, Brazil | CONSTRUCT-LABEST, Faculty of Engineering (FEUP), University of Porto, Porto, Portugal, fernanda_mendonca5@hotmail.com

Lino Maia - CONSTRUCT-LABEST, Faculty of Engineering (FEUP), University of Porto, Porto, Portugal | Faculty of Exact Sciences and Engineering, University of Madeira, Funchal, Portugal, linomaia@fe.up.pt

Abstract: Concern with the destination of the residues generated in several sectors has caused an increase in the amount of research related to the reuse of these materials for the creation of new products. In this context, the present work aims to present the most updated information about the use of ceramic waste for mortar production. A literature review was conducted using the collection published on the online platform Science Direct of works carried out since 2019, which bring knowledge related to the keywords: ceramic wastes and mortar (in Portuguese, ceramic wastes, and mortar, respectively). The results found in the research confirm the technical feasibility of using waste in mortars, because some characteristics obtained in the mixture indicate the possibility of applying this product in various activities in civil construction. Among the main problems still observed when reviewing the contents, one notices the small amount of work that directly addresses the positive environmental impact generated by this type of reuse of ceramic waste.

Keywords: review, waste, ceramic residues, mortars

1. Introduction

The objective of this work is to provide the most updated information about the use of ceramic waste for mortar production. In this context, there was a focus on the publications provided by the "Science Direct" platform and the main information and conclusions obtained by previous research, including other bibliographic reviews, experimental research and case studies, were observed.

2. Materials and methods

The literature review allows for an overview of existing sources (or part of it) on a specific topic to be provided, including the analysis and presentation of the material in an organized manner, obtaining important considerations about previous research (Wee and Banister 2016). In this case, the steps for the development of the proposed review, are described below.

The Science Direct Platform was used in its advanced search function. The subjects and keywords used in the search were "ceramic waste" and "mortar" (both singular and plural). There was a temporal delimitation of articles published in the last five years, that is, since 2019.

The results, with the filter applied, were 58 articles in the English language. Some of the papers were rejected due to the following reasons:

I. They did not deal with the study of mortars as a central focus.
II. They only observed ceramic residues generated during the polishing process in the production of ceramics.
III. Study other types of non-ceramic materials.

After applying the exclusion criteria, 42 articles were reviewed. Among these, there are review materials, case studies, and especially, technical test reports that report on the behaviour of mortars with the addition of ceramic waste (including, in some cases, other types of waste, fibers, and/or aggregates) for application in the most diverse functions of civil construction.

4. Final remarks

Ceramic residues can be applied in the mortar matrix in various functions (aggregates, cement substitutes, fillers) and associated with other types of materials and/or waste. There is also the possibility of reinforcing the mortars with the use of fibers, composed of different materials, which can improve the performance regarding cracking and shrinkage.

In most cases, it is necessary to process the waste before it is used in mortars, because the sources of collection are varied: ceramic and tile production companies, construction and demolition companies, or incinerated rejects in the form of ashes. The ceramic materials can be separated, ground, crushed and screened so that the appropriate granulometry can be reached and inserted into the mortar or cement mixtures.

The use of aggregates reduces the use of natural materials, such as sand. Despite some results attesting to a poor mechanical behaviour, when compared to natural aggregate, mortars can still be applied in finishing functions and there are other gains associated with durability and resistance to polishing that can be advantageous in specific situations.

In the partial replacement of Portland cement, the main gain is the reduction in cost and environmental impact caused by the industrial production of this binder. Ceramic waste has a different composition from cement, and thus, changes are promoted in the chemical processes related to hydration and hardening of the mortar.

The reviewed works demonstrate that the trend to substitute "traditional" materials in mortar production is a reality. And this solution can be widely employed when it comes to the production of mortars and cement with the insertion of ceramic waste (and other types). The studied properties of this material, besides the reduction of environmental impact that it promotes, attest that it is possible to use this type of mortar in several applications in constructions.

Examining the literature available since 2018 in the researched repository, it is possible to notice fields where there is more need for deepening to better understand mortars with ceramic waste addition. Notably, one can list: studies on the environmental and financial consequences of these mortars, analyses of possible real situations where there was the application (as an example, of case studies of constructions), and appreciations on the financial cost involved in this production process of mortars and concretes considered more sustainable.

Acknowledgements

This work is financially supported by: Base Funding – UIDB/04708/2020 of the CONSTRUCT – Instituto de I&D em Estruturas e Construções – funded by national funds through the FCT/MCTES (PIDDAC). This work is funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the Scientific Employment Stimulus – Institutional Call – CEECINST/00049/2018.

The reuse of the architectural heritage in a state of ruin as a strategy for the conservation. The “Canto di Stampace” in Pisa

Marchionne Laura - Università degli Studi di Firenze, Pisa, Italia, e-mail: laura.marchionne@unifi.it

Parrini Elisa - Empoli, Italia, e-mail: elisa.parrini@alice.it

Keywords: Fortification, Valorisation, Re-Use, Integration, Ruins

Extended abstract

Historical ruins provide a tangible link with our past as they embrace several testimonies over time. The analysis of these testimonies illustrates the identity collective memory of the place where the ruin is located.

The valorisation of Cultural Heritage is fundamental for the purpose of guarantee the protection and conservation of both the architecture and the values it represents, for their transmission to the future. A sustainable and correct approach to their management is a crucial issue. It seems important to analyse their role within the life of the local community in order to preserve their ability to serve as historical document.

The reuse strategy appears to be an effective instrument to ensure the conservation of an historical building, preventing the persistence of ruination and decay processes.

The conservation and valorisation of Cultural Heritage is a cross-cutting issue that requires a multidisciplinary approach. It is therefore a starting point for a reflection on the complexity of the Restoration field, and its connections with Composition, Archaeology, Landscape and Technology areas, concerning the re-use of a cultural asset for the benefit of the community.

The re-use, and therefore the "adaptation", of ancient structures in a state of ruin alludes the inclusion of new functions other than the exquisitely contemplative one, providing a role within the life of the local community. This operation requires an in-depth analysis regarding the connection between any new additions and the historical architecture. Any intervention must comply with the typological, material, structural characteristics of the monument-document.

Designing a correct and respectful restoration intervention needs to take into account several issues and it is necessary to analyse the interaction between place, ruin, and memory when intervening on the preexistences.

Thus, the extensive study of a particular case, such as the “Canto di Stampace”, the south-west section of the medieval city walls of Pisa, can serve as a valuable reference in order to define an eligible practice and elaborate a strategy to sustainably manage and reuse of historical ruins in an urban context.

The first phase of the study includes solid detailed territorial analysis, as well as an accurate historic, bibliographic and archival survey. Within this study, the ability to understand, analyse, synthesise the information will aid in the organization of the planning process.

The historical stratification represents an important document. From the construction of the medieval fortification, every addiction or subtraction serves as an historical testimonial of a phase the city of Pisa and its community went through. In particular, the Sixteenth Century bastion Stampace underwent large modifications during the contemporary era: between the end of the Nineteenth and the beginning of the Twentieth Century, both additions and subtractions were made in order to allow the passage of the railway line, and the area was also largely affected by the bombings in 1943 in Pisa.

The restoration proposal takes into consideration all the historical phases and events that characterized the Canto di Stampace and its architectural artefacts, chasing the criteria of reversibility and compatibility. The addition of technological features employs a contemporary language. These new additions are meant to not be excessive or invasive and the design uses light materials and solutions in order to be respectful to the identity of the location.

This restoration proposal aims to integrate the area inside the city life through the realization of new social spaces. The definition of the project is based on its strengths and weaknesses in order to increase the value of the firsts and rectify the seconds.

The outdoor spaces are redesigned as a new urban park. This space will include multi-functional areas for several activities that will involve the University and the museums of Pisa. The design of the street furniture consists of elements that strive to be versatile, adaptable and integrated within the context. The design also includes the choice of specific plant species, in order to improve the environment both from an esthetical and ecological point of view.

The historical buildings are restored and connected to the cultural activities of the area through their integration inside of the cultural itinerary dedicated to the history of the fortification of Pisa and in particular Canto di Stampace.

In conclusion, the area known as Canto di Stampace shall be converted from a neglected unsafe area to an important landmark destination with a high cultural and social value. With new vitality and dynamism to the neighbourhood, it will immensely improve the environmental qualities, adding new social catalysts and attractions.

Start over from the fragment. Some notes on old Gibellina and new Gibellina

Esposito Daniela - 'Sapienza' Università di Roma, Facoltà di Architettura, DSDRA, Roma, Italia, e-mail: daniela.esposito@uniroma1.it

Concas Daniela - 'Sapienza' Università di Roma, Facoltà di Architettura, DSDRA, Roma, Italia, e-mail: daniela.concas@uniroma1.it

Abstract: The theme of the value of the fragment, its perception in contemporary culture, in today's scientific language and the related works of arrangement, reassembly by anastylosis, reintegration, within the limits of the recoverability of the architectural text, and reconstruction assumes substantial importance. What is meant by fragment? Consequently, what is the methodology of approaching a source like this? So, and under what conditions, can the unity be recomposed starting from the fragment or is it destined to remain alone forever, in its 'anachronism'? These are some questions that we will try to answer by analyzing two significant cases made in old Gibellina and in new Gibellina following the earthquake that struck the Belìce Valley in 1968: the Grande Cretto by Alberto Burri and the Palazzo di Lorenzo by Francesco Venezia.

Keywords: Fragment, conservation, Grande Cretto, Palazzo di Lorenzo, Gibellina

The theme of the value of the fragment, of its perception in contemporary culture, in today's scientific language and of the related works of arrangement, recomposition by anastylosis, of reintegration, within the limits of the collectability of the architectural text, and of reconstruction assumes substantial importance today in the face of the huge devastation and in cases of destruction following calamitous events, such as earthquakes or other natural phenomena. In all these contexts the problem arises either of maintaining the *status quo* after the disastrous event or of how and how much to recompose and reinstate. The proposed reflection, concentrated in the preliminary phase on the concrete case of old Gibellina and new Gibellina, is induced by the necessary questioning of the conception and operational results on the fragments and the remains of ancient architectural structures, in the light of the most recent developments in the field of aesthetics, techniques and virtual representation of objects, works or parts of lost works. The notes presented are aimed at allowing an expansion of the knowledge of contemporary thought, including philosophical and aesthetic, on the theme of the fragment and the "potential unity" of the work, even if mutilated. A reflection that starts from the recognition of the value of the architectural fragment as part of a whole, above all with the intention of competing with History in a shared way and with the different disciplines in the various fields of knowledge, in the field of its materiality, as truth. precarious, and in relation to the whole of which it is a part. The definition of fragment offered by some dictionaries of the Italian language includes two meanings: the fragment as a product of separation following a fracture with consequent loss of the testimonial value of something that has been lost and the fragment as something separate from the whole, valid as a reference to an absentee, of whom one possesses something but only in part. Therefore it seems that the character of a fragment is defined in relation to the absence of the whole, of which it forms a part. A whole from which it has been involuntarily separated and with which it is generally not directly comparable and is lost and becomes known only through the fragment itself.

To pass on the old city to memory, Alberto Burri creates the Great Cretto by incorporating the ruins of old Gibellina into his work of art and thus giving physical form to the tragedy. The idea, which came to the artist, is to evoke the blocks delimited by the streets as a labyrinth of memory and a reinterpretation of the interpretation of places, of the original relationships between full and empty spaces and the recovery of relationships with the landscape. The ruins of the town's architecture, household objects, agricultural tools and everything in the vicinity are stacked and bordered with deformed metal sheets used as formwork for the castings of the reinforced concrete to amplify the final effect of movement of the surfaces of the walls that were to reproduce the blocks of the old city. Finally these large blocks are covered with a metal mesh and a pour of concrete. The only signs are the wavy surfaces and the vertical traces left by the deformed metal sheets, which create ripples in their nakedness in memory of the drama of the seismic event with plays of light and shadows. In addition, the surface treatment of the concrete of the individual blocks in contrast between the smooth and glossy walls and the puffy and opaque roofing is illuminated differently at different times of the day, accentuating their liveliness. The Great Cretto is a direct intervention by Burri on the "matter" of the destroyed city and is simultaneously an artistic, architectural, urban and landscape work.

Instead, Francesco Venezia designs a building in Gibellina Nuova to evoke the material testimony of the large fragment of the Palazzo di Lorenzo, recovered during the demolition of the old Gibellina. The façade is located in the center of an elevation overlooking a rectangular "walled" courtyard. Here we find the concept of immobile and changing time in the transition from ruin to an integral part of the building with an act of anastylosis on the one hand and the use of local construction techniques and local workers on the other. To the north-west, the head of the courtyard is doubled by a C-shaped volume, called the "rest", detached from the perimeter wall. In this new architecture of walls we notice a careful reflection not only on the architectural fragment, but on the "matter" in its entirety. The treatment of the walls is different depending on the partition and depending on the position towards the courtyard or towards the external space. It also appears an architecture closed in on itself with few openings to the outside. The main façade of the new building is framed by three terraces, where there is a decentralized walkway, which faces the only window, which in turn allows the view of the landscape towards the countryside through the central balcony of the Palazzo di Lorenzo and its correspondent on the opposite wall. The building is accessed via a path to the far right of the garden, which follows the orography of the land and is flanked by high walls. Arriving at the court, continue with a ramp, next to the counter-façade, which leads to the first floor, offering the opportunity to appreciate the different orders of the Palazzo di Lorenzo. Then through the semicircular passage you enter the long room of the parallelepiped volume. At the end we reach the "rest" which with a ramp leads to the garden and then starts the journey again. The circular time returns, linked to the ascensional path, in a continuous exchange between inside and outside. Finally, the light, coming from the few openings and from the technical joints, plays a fundamental role.

In the creations of Alberto Burri and Francesco Venezia, past time and present time tend towards the same end which is the present. On the one hand, a series of physical and temporal relationships between the whole and the parts find their courtly expression of great empathy, reminiscent of the old city, and on the other hand the great stone fragment, not devoid of melancholy beauty, is the center around which the new architecture is realized which still evokes the drama of the uprooting experienced by the inhabitants: in both graft and bud.

La riqualificazione energetica di un complesso di edilizia popolare d'autore Le case INCIS di Ridolfi: una sfida per i rivestimenti termoriflettenti

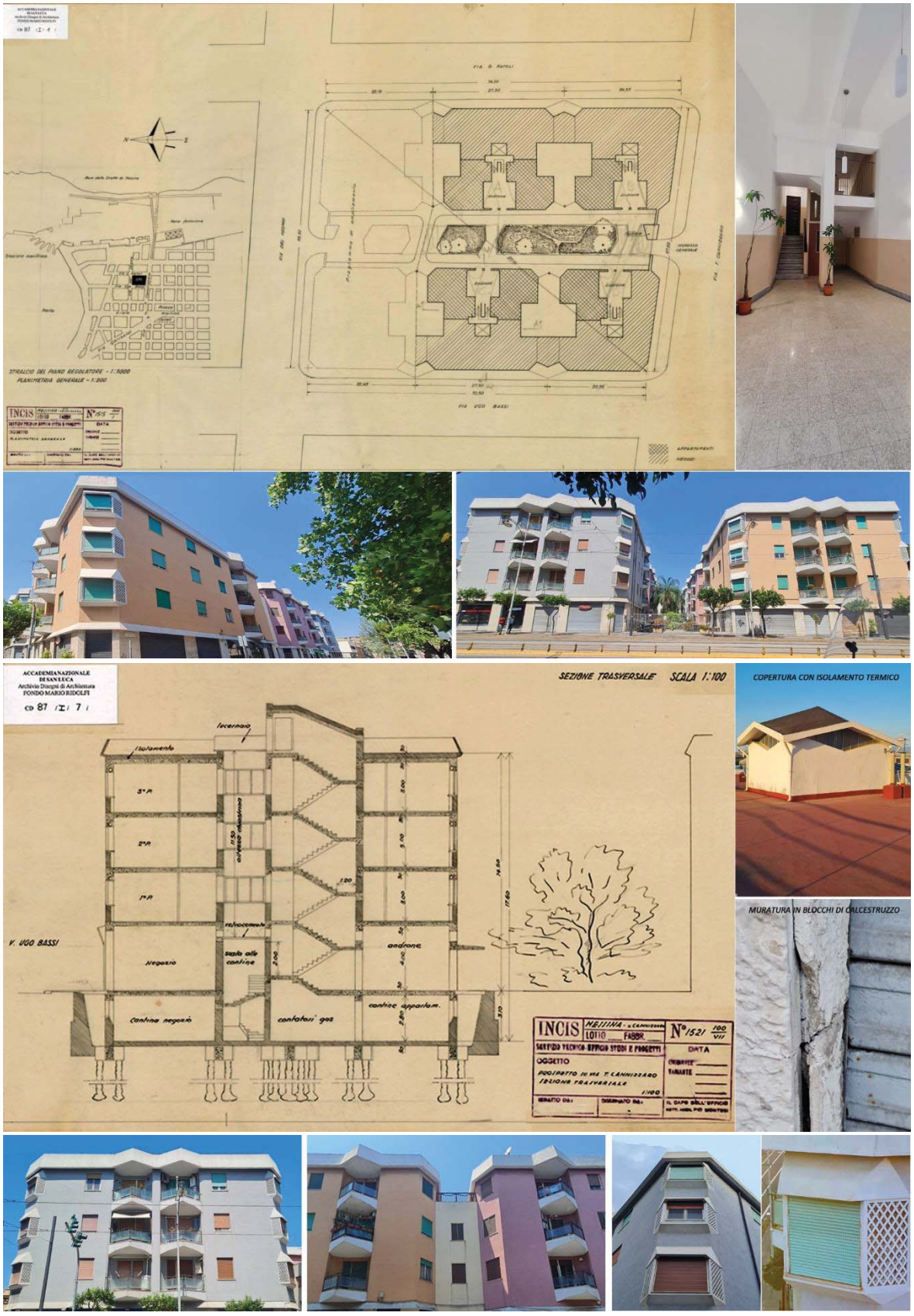
The energy requalification of an author's social housing complex Ridolfi's INCIS houses: a challenge for heat-reflective coatings

Currò Giuseppina - Università degli Studi di Messina, Messina, Italia, giuseppina.curro@studenti.unime.it

Fiandaca Ornella - Università degli Studi di Messina, Messina, Italia, ornella.findaca@unime.it

Russo Giovanni F. - Università degli Studi di Messina, Messina, Italia, giovanni.russo6@studenti.unime.it

Abstract: After more than half a century since their construction, many buildings, complexes, and districts of affordable social housing require technical and performance enhancements to adapt to altered housing needs, also arisen from current environmental policy.
The approach to their redevelopment must account for a multitude of factors: ranging from the creator's value to the social, cultural and technological testimony of a construction system which characterised the post-war period; from the adoption of specific intervention methods to innovative materials aimed at preserving the expressive and material value of the structure; from the technical inadequacies in responding strategically to current regulations and assessing residents' actual needs.
In this paper, bearing in mind the historical and architectural value of Mario Ridolfi's INCIS housing complex in Messina, adopted as a model for methodological experimentation, innovative products were analysed and compared to put forward an unconventional energetic refurbishment solution, according to current legislation, taking into account the fiscal incentive system favouring individual interventions combined with public financial support. The challenge concerns conciliating the prerogative of conserving the Modern, also when not conditional, and the pressing needs of performance adjustment imposed by energetic requirements, yet in practice implemented by the residents piecemeal.



The INCIS Houses complex by Mario Ridolfi in Messina: formal quality to be protected and technical construction aspects to be considered during an energy requalification.

Waterfront Renaissance in Bagnoli (Italy)

Rocco Angelica - Department of Architecture University of Naples Federico II, Naples, Italy, angelica.rocco@unina.it

Francese Dora - Department of Architecture University of Naples Federico II, Naples, Italy, dora.francese@unina.it

Abstract: Multiplication of initiatives on the waterfront represents an high potential for radically transforming the city and its symbolic places, by means of implementing policies and practices whose impact has spread throughout the city, and has involved a large portion of local and global targets with different roles. The main methodology adopted for the design action goes through the interpretation of the urban space as border of the waterfront, as well as of the waterfront itself as edge of a city. This methodology characterizes the design options for the case study and has been outlined by means of the analysis of the different social dimensions and by implementation of the dialogue between potential of changes and critical issues, so as finally attempting to enhance the resources of the place and to recognize inhabitants as element of a participatory, shared and sustainable urban regeneration process.

Keywords: Waterfront renaissance; neglected areas, disused industrial sites; sustainable soft solutions.

1. Introduction

Disused industrial areas represent a widespread phenomenon both in Italy and in the rest of Europe. The industrial decommissioning represents, as is known, a process of total or partial arrest of industrial activities that affects the external areas such as the individual buildings, where the recovery or the destination to a new function show problems of various kinds related, first and foremost , to the loss of the function for which they were designed. The proposed theme does not only touch the metropolitan city of Naples but, indirectly, all those cities that, in the past, had seen state industrialization as a response to the economies of Southern Italy without focusing on the vocations of the territory.

The consolidated urban space, once released from industrial activities, becomes the subject of a profound reorganization of functions, in particular by defining phenomena of productive dynamism that ultimately identifies the places themselves.

2. The case study

The proposed area falls within the Gulf of Pozzuoli, a territorial area characterized by emergencies of significant landscape value: the Campi Flegrei, the Posillipo Hill and the volcanic islet of Nisida.

The former Ilva of Bagnoli area, originally a place of spa activities and bathing establishments, was transformed into an industrial center between the mid-nineteenth century and the first decade of the twentieth century, as it was identified as a suitable place for production due to its proximity to the sea and to the railway line and for the presence of a large flat land easily accessible. Unfortunately, these premises converge in the sole purpose of creating a sort of small tourist city, which, although benefiting from the sea and greenery and usable open spaces, nevertheless lacks, once again, a strategic vision.

The objective is therefore configured in the definition of new renaissance perspectives through the unveiling of innovative intentions with respect to the current role of modern industry in a southern city, and the strategies to be put in place to restart sustainable local economies.

Figura 1 Views of the area

3. The proposal

The survey, driven by the objective of providing strategic lines of intervention on the disused industrial site of Bagnoli, develops a reflection on the contribution offered by the technological-environmental design for the identification of a repeatable methodology that allows to read and interpret in a systemic key the area through an interpretative synthesis of the technological requirements required in relation to the main territorial and environmental matrices. The area is also recognized as a landslide and volcanic risk area, as well as a site of national and community interest. Within the area, there is a strong criticality linked to the presence of some buildings scattered in almost abandoned places but with a high naturalistic potential.

The orographic study of the position of the area has enabled the natural belt to be activated for a morpho-functional reconnection of the components of natural biodiversity to the urban and former industrial landscape, while optimizing the needs of use of the different types of users, through the integration of the project structures with the territory itself. For the anthropic component, the design solutions contribute to the reactivation of the paths inside the park area and the connection between the park itself and the external urban system. The presence of vegetation assumes the fundamental role of attracting element of the area itself and therefore particular attention is shown in the choice of native species to be preserved.

4. Conclusions

The new approach of the urban renaissance passes through an urban regeneration, which is more aimed at social objectives, which develops according to a poetic approach and which offers a vision of promotion of the territory not only linked to mass tourism, but animated by a single file rouge that links the different characteristics and potentials. Many seaports have undergone a complete process of urban regeneration elevated to take on the meaning of access to the city from the sea with great opportunities for the development of tourism.

Sostenibilidad en centros históricos. Análisis de diferentes variables del entorno construido.

Sustainability in historic centres. Analysis of different variables of the built environment.

Buenaño, Cristina – Universitat Jaume I, Castellón de la Plana, Spain, buenano@uji.es

García-Esparza, Juan A. Universitat Jaume I, Castellón de la Plana, Spain, juan.garcia@uji.es

Altaba, Pablo – Universitat Jaume I, Castellón de la Plana, Spain, paltaba@uji.es

Keywords: sustainability, urban, biodiversity, historic centres.

1. Abstract

Historical centres are cultural environments with unique particularities and characteristics depending on their management and protection. The values projected by these cultural assets focus on traditional and monumental architecture and social and economic matters. In addition, recent studies speak of the environmental value of historic centres as containers of biodiversity. In the current context of climate emergency, preserving this biodiversity, green areas and the elements that make historic centres more resilient to change is fundamental.

In this context, it is essential to know the main characteristics of the building stock and thus be able to relate building morphology to the environmental values projected by the cities. To carry out this analysis, a mixed methodology has been used based on previous studies in cities in central Spain, work in depopulated historic centres, fieldwork based on the inventory and cataloguing of assets and the use of cartographic tools. The main objective is to understand the urban context to be able to apply biodiversity indicators to it and conclude with the current environmental status of a specific city.

To carry out this analysis, the city of Castellón de la Plana has been chosen, dividing it into two areas of action: the historic centre and the maritime district. In addition to the fieldwork and the inventory of buildings and constructive elements, cartographic data from open sources (Cadastre, Google Maps, National Institute of Statistics) and a QGIS 1.16 software plugin for downloading cadastral data are used to generate thematic plans that serve to carry out the analysis of building typologies, green areas and zoning.

The previous analysis of the historic centres of central Spain allowed the development of a methodology using QGIS as a working tool that led to the discovery of socio-economic patterns that could not be seen with an analysis in tables or lists. In addition, this type of analysis allows the preparation of thematic cartography where indicators could be reflected.

The analysis shows how the multiple spaces generated in housing construction (balconies, eaves, roofs) are spaces where a great variety of biodiversity can be found. In the same way,

green areas are the lungs of the city and, at the same time, a refuge for multiple species. According to the cartography obtained, in the case of the historic centre of Castellón de la Plana, the building analysis showed that the buildings vary in height from 1 to 18 storeys, the most repeated size being two levels. The most repetitive elements are balconies and overhangs in the historic centre and maritime district. It should also be noted that eaves are rare in both areas.

On the other hand, the type of buildings that predominate near the sea is more recent in the historic centre. Slopes are also frequent in the residential part because their modern design incorporates slopes in the façade and roof. A reduced number of eaves can be seen, which are concentrated in the old quarter of the maritime area. There are fewer balconies because most of the buildings have flush balconies.

Finally, it should be added that the inventory of buildings and the analysis carried out can serve as a tool to detect constructive characteristics that encourage biodiversity to promote their implementation in urban development or urban regeneration processes. It can also identify obstacles or deficiencies as an experience that should not be transferred to other cities. The last noteworthy fact that can be seen both in the historic centres analysed above and in Castellón de la Plana is that there are few green spaces. The areas identified as green zones have bushes far from being consolidated to promote biodiversity.

The reuse of Lisbon convent typologies into collective housing

Silva, José Miguel - CIAUD, Research Centre for Architecture, Urbanism and Design, Lisbon School of Architecture, Universidade de Lisboa, Portugal, josemiguelsilva@edu.ulisboa.pt

Abstract: The present proposal is about the reuse of the built heritage, considering in this embryonic phase the old convents in Lisbon, with the aim of understanding their resilience to be reuse as collective houses, oriented to a social network and healthy environments.

The paper integrates the contributions of two ongoing research projects, one on building typology [1] focusing in the construction of a systematic inventory of buildings, common and singular; other on Rehabit Convents in Lisbon[2], seeking to understand the reuse and resilience of old convents to became new housing spaces.

This is an important moment to deepen the theme in the context of the city of Lisbon. Some hospitals facilities, for example, installed in old convents buildings in the city centre, are being rethink to receive new uses. In this sense, in opposition to the proliferation of hotels, museums or "companies' nests", the study proposes their reuse to housing, to become "nests of [social] houses". Thru the adapted reuse of convents into housing, it is possible to conserve a past memory with an idea of social integration in the present. It is said, that it is not a process of returning to any past condition, but the defending the continuity of the building with a "new-old" use.

Simultaneously, the relation between the meaning of each Religious Order and its repercussions in the organization of the convent typology, is adaptation to the urban context, topography, urban plot, and infrastructure are considered. That it is, a work process intended to identify the relations between the symbology, locus and program, how they are aggregated and related to each other in the definition of the convent typology and specially the importance of the cells as living spaces.

Methodologically, the study seeks to establish a reconstructive and morphological analysis of old convents, documenting its successive composition stages until our days, especially its resilience to the introduction of a new houses. The result is the construction of a database possible to be used as a support in the adaptive reuse of convents today.

As a study universe 114 old convents, monasteries, seminaries and colleges, are being analysed in the city of Lisbon, of which 20 were already demolished or fragmented in the current built fabric and 94 remain built with the most varied uses. Most of them result from a progressive occupation since the 19 Century, with uses such as infrastructure, military, school, assistance, cultural, hotels and 4 were adapted to collective housing.

The study aspires to conceived an instrument that elects the existing city as a historical and model reference to professionals and academics. But, the consensus on the value of the built city implies that its metamorphosis is processed in the understanding and the respect for healthy, inclusive, sustainable and collective housing. And it's from this, from its re-utilization and re-interpretation that the cities of the future will be built.

Keywords: Built Heritage, Building Typologies, Convents, Adaptive Reuse, Collective Housing.

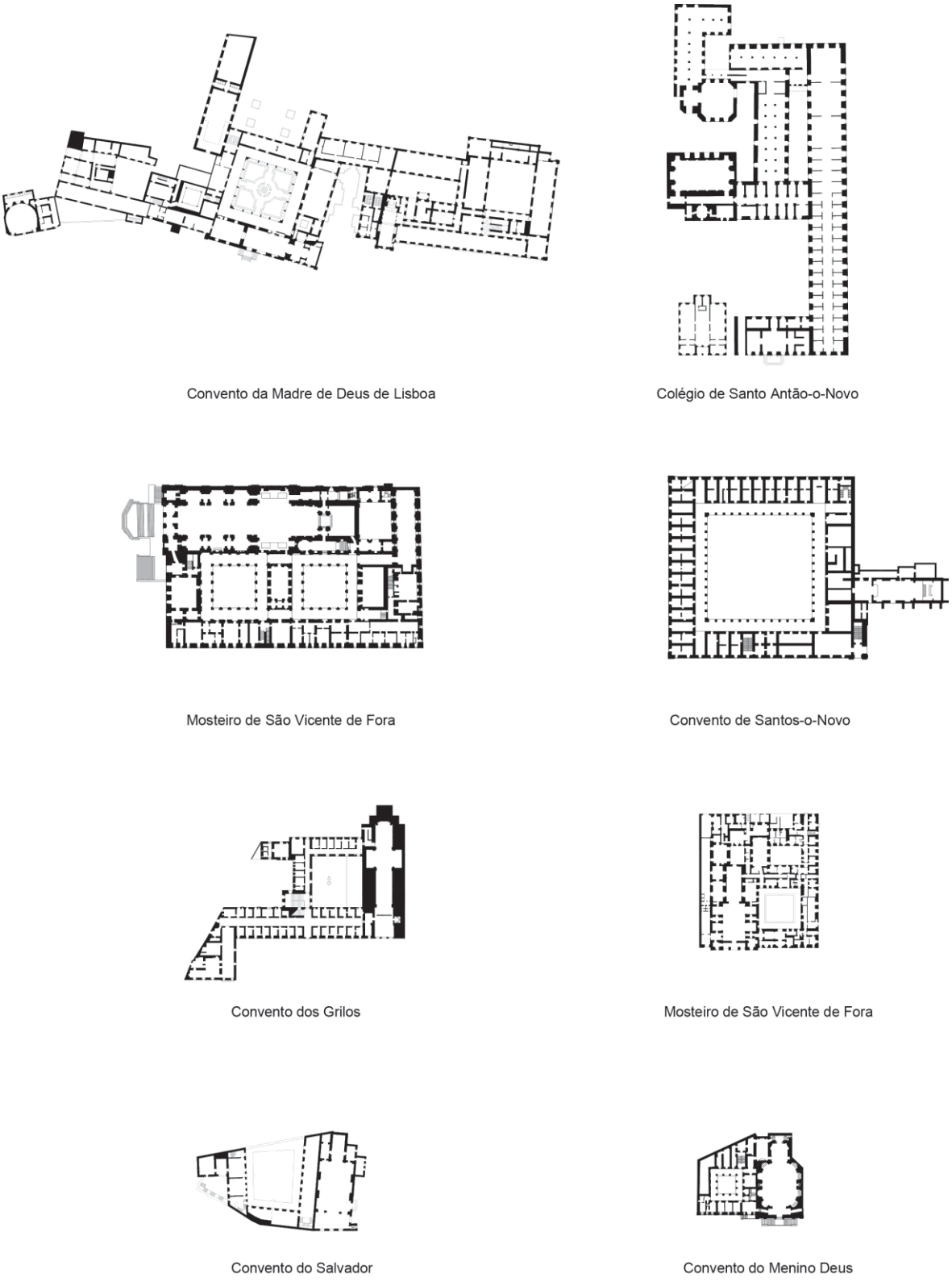


Figure 1. Comparative table: vitiations of Lisbon convent types

References

[1] Dias Coelho, C. (coord.) (2017-), Building Typology. Morphological Inventory of the Portuguese City, funded by FCT Ref: PTDC/ARTDAQ/30110/2017.

[2] Silva, J.M, (coord.) (2021-), Rehabit Convents in Lisbon. Built heritage, adaptive reuse and urban form transformation, funded by CIAUD Ref: UIDP/04008/2020.

TECHNICAL ANALYSIS OF THE USE OF THE WASTE FROM ORNAMENTAL ROCK IN COATING MORTAR

Ivnna Alves de Lima - Instituto Federal de Educação, Ciência e Tecnologia do Ceará, Fortaleza, Brasil, ivnna.alves@gmail.com

Helaine Silva Nascimento - Instituto Federal de Educação, Ciência e Tecnologia do Ceará, Fortaleza, Brasil, helaine.silva.nascimento06@aluno.ifce.edu.br

Perboyre Barbosa Alcântara - Instituto Federal de Educação, Ciência e Tecnologia do Ceará, Fortaleza, Brasil, perboyre@ifce.edu.br

Abstract: The objective of this research is to verify the pozzolanic activity of the material originated from the cut of the rock block, as well as the physical and mechanical performance of rendering mortar produced with this material in the replacement of the cement and of the aggregate. For this, chemical and physical tests were carried out in accordance with the ABNT NBR 12653 - Pozolanic Materials - Requirements, in order to prove the existence of pozolanicity of the material collected at Asa Branca Quarry (Santa Quitéria, CE). Allied to this, characterization tests of the rendering mortar with a trace consisting of cement, sand and water (conventional trace) and two other traces (alternative traces) were prepared: one with partial replacement of the cement by the reject of the granite block and the other replacing the sand by the reject, both using as a reference the trace of 1: 4 (cement, sand - by volume), so that this mortar attend the properties in the fresh and hardened state. Finally, the quality of the alternative mortars was evaluated in comparison to the conventional mortar, based on the normative parameters and the classes of wall and ceiling mortars.

Keywords: Pozzolanic activity, Coating mortar, Ornamental rock waste

1. Introduction

Ornamental rocks are a natural stone material used in coatings, structures, elements of architectural composition, decoration and furniture (ABNT, 2013). Among the active mining fronts, there is the White Granite Ceará, located in Santa Quitéria, CE, which according to GRANISTONE (2019) has a reserve measured at 100 million cubic meters. However, the extraction of ornamental rock blocks through diamond wire cutting, sheet sawing and polishing generates a high volume of tailings in the form of very fine powder.

Its important to reduce the environmental impact caused by the construction and mining industries relationed to the large volume of mortar that is used in constructions and renovations and the need to recycle this mining waste and the research proposal is to partially replace the fine aggregate and the cement in the mortars from the albite granite tailings.

The objective of the study is to verify the pozzolanic activity of the albite granite tailings, based on the standards required by ABNT and to evaluate the physical and the mechanical characteristics of mortars containing proportions of 5%, 10%, 15%, 20% and 25% of this

reject by cement and sand, in order to prove that its used in mortars for coating walls and ceilings meet the normative parameters and the referring classes.

2. METHODOLOGY/RESULTS

For this article, a 1:4 mix was adopted (cement, medium sand - in volume), a reference mixture was prepared (conventional mortar - T0) using cement, water and natural aggregate and other mixtures containing the cutting waste of rock (granite albite) at levels of 5, 10, 15, 20 and 25 % as a partial substitute in relation to the volumes of the binder (TC) and the fine aggregate (TA). Table 1 are showing the released tests and the respective standards for the characterization of the tailings, fine and binder aggregate and the characterization of the mortars in the fresh and hardened state.

Table 1 – Tests for technical analysis.

Stage	Test	Source
Aggregate characterization	Unit mass in the loose state (g/cm³)	NBR NM 45 (ABNT, 2006)
Cement characterization	Unit mass in the loose state (g/cm³)	NBR 12127 (ABNT, 2017)
Tailings characterization	Unit mass in the loose state (g/cm³)	NBR 12127 (ABNT, 2017)
	Material retained on the 45 µm sieve	NBR 15894-3 (ABNT, 2010)
	Especific mass (g/cm³)	NBR NM 23 (ABNT, 2000)
	Pozzolanic activity with lime at 7 days	NBR 5751 (ABNT, 2015)
	Moisture content	NBR NM 24 (ABNT, 2002)
	Fire loss	NBR NM 18 (ABNT, 2012)
	Shape and angularity of aggregates	AASHTO TP 81:2012
Mortar in the fresh state	Mass density	NBR 13278 (ABNT, 2005)
	Built-in air content	
Mortar in the hardened state	Apparent mass density	NBR 13280 (ABNT, 2005)
	Water absorption by capillarity	NBR 15259 (ABNT, 2005)
	Capillarity coefficient	
	Flexural tensile strength	NBR 13279 (ABNT, 2005)
	Compressive strength	

Table 2 – Grade average of mortar results.

Test	TA	TC
Mortar in the fresh state - Mass density	D5	D5
Mortar in the hardened state - Apparent mass density	M6	M6
Capillarity coefficient	C5	C5
Flexural tensile strength	R6	R5
Compressive strength	P6	P6

Ancient Monastery of S. Spirito in Bergamo: the rebirth

Beatrice Bolandrini - Fondazione Istituti Educativi Bergamo (FIEB), Bergamo, Italia, conservatore@istitutieducativi.it

Roberta Grazioli - Direttore restauri; Bergamo, Italia

Simone Tribbia - Direttore tecnico Ars Restauri, Bergamo, Italia

Abstract: The restoration of the ancient monastery of S. Spirito, which overlooks via Tasso, one of Bergamo's main road axes, has made it possible to rediscover cycles of intact sixteenth-century frescoes in three of the rooms on the ground floor overlooking the two spectacular cloisters. Unfortunately over the centuries the improper use of the complex, including a hotel up to a few decades ago, has distorted the original vocation of the double monastery, founded in 1311 and first entrusted to the Celestines who were replaced by the Augustinians in 1476. The recovery intervention proved to be particularly challenging given the precarious conditions of the entire structure, which began in 2021 and is still underway. It also provided for the recovery of the paintings placed in the original refectory and of an entire cycle of frescoes dedicated to St. Augustine, torn in 1928 to be placed on canvas, as well as its relocation to its original location on the vault and along the walls of the main hall of the building, thanks to the use of particularly innovative techniques that are intended to be shared in this prestigious Xth ReUSO Edition.

Keywords: Bergamo, S. Spirito, torn fresco, relocation

Extended abstracts

The restoration of the former monastery of Santo Spirito in Bergamo, approved and authorized by the Archaeological Superintendence of Fine Arts and Landscape for the provinces of Bergamo and Brescia, had as a basis the verification of the sources and an in-depth analysis of the state of conservation. The future intended use, hotel, was conceived in respect of the building, with the aim of enhancing the pictorial findings.

Unfortunately, over the centuries, the improper use of the complex has distorted the original vocation of the double monastery, founded in 1311 and first entrusted to the Celestines who were replaced by the Augustinians in 1476. The restoration work proved to be particularly demanding given the precarious conditions of the entire structure, which began in 2021, is still ongoing.

As far as the bibliographic sources are concerned, only scant information published in N. Gritti is available, *Il ciclo di affreschi dell'ex convento di Santo Spirito*, in F. Noris, N. Gritti (a cura di), *Ars et Caritas. La collezione d'arte degli Istituti Educativi di Bergamo*, Bolis Edizioni, Azzano San Paolo (Bg) 2007, pp. 121-138, while unfortunately the archive sources are rather incomplete and fragmentary.

This research is absolutely unprecedented, and involved different professionals: Roberta Grazioli, director of the construction site for the restorations, Simone Tribbia, technical director of Ars Restauri who carried out the accurate interventions on the wall paintings, Beatrice Bolandrini, curator of the historical and artistic heritage of the Bergamo Educational Institutes Foundation (FIEB), which was responsible for archival,

iconographic and stylistic research. The multidisciplinary approach has made it possible to work in synergy, dealing daily with the problems inherent in the interventions and the age-old question relating to the relocation of an entire cycle of frescoes torn by Franco Steffanoni in 1928 on the vault and on the walls of the main hall.
It should be noted that since the works are currently underway at a fast pace, in September, in compliance with the schedule, the following report will be updated taking into account the activities carried out in this temporary period. This research is divided into two parts, a technique, entrusted to restorers who present the technological innovations used on site, and one focused on the iconographic and stylistic aspects.
The main hall is the most evocative, but also the most demanding, requiring months of studies, investigations and in-depth analyzes to perfect the rearrangement of the frescoes of the early sixteenth century torn in 1928. Undoubtedly this type of intervention has created many problems and the optimal solution for the planting was identified in the reversible magnetic system, after carrying over to a volumetric structural support.
For several decades, the torn paintings have undergone conditions of total abandonment, so much so that serious damage has been identified due to corrosion from leaching and mechanical abrasion as a result of tearing operations, detachment and exfoliation phenomena, the presence of deposits of particles and incoherent carbon black. This kind of conservation following the tear exposed the works to microbiological aggressions, as well as to the formation of whitish patinas. The decision to undertake a substantial restoration and relocation to their original location meant devising an undoubtedly ambitious and equally demanding restoration project.
In this tenth edition of ReUSO we intend to present the particular choice of supports recently experimented in Naples in the Church of San Filippo Neri, a choice mainly dictated by the complex surface on which the tears must be relocated, the type of restoration interventions and the historical-artistic research, dedicated to paintings of particular value, forgotten for centuries and today, finally, not only rediscovered but made available (by spring 2023). Three large tears will soon be relocated on the ceiling: a central round with the Blessing Christ with a diameter of 3.5 meters and two lateral completions with Angels accompanied by the symbols of the Passion for a total of over 5 meters of painted surface. The tears are currently being restored and the original colors are emerging with surprise and satisfaction. On the vault of the hall in fourteen sails there were instead as many stories dedicated to the life of St. Augustine, while the decoration was completed by candelabra pilasters and some phytomorphic monochrome friezes, which will be relocated with a slight recess to offer a unitary and harmonious reading to the whole.
Among the most interesting discoveries from a pictorial point of view is the Gallery, a narrow and long room which is accessed from the main hall and which overlooks the other two frescoed rooms recovered in recent months. The space culminates in a vaulted ceiling that marks a series of lunettes on all four sides, under which a terracotta frame runs, similar to the others. The intervention in this environment proved to be particularly laborious, above all due to the adaptation in the past to a kitchen: it was possible to observe the pipes inserted in the masonry demolishing entire portions of plaster and frame, piling on the walls, cables. Furthermore, in correspondence with the lower sections and around the openings, the lime plaster was roughly replaced with cementitious plasters.
Therefore, due to the numerous damages perpetrated, the pictorial surfaces appeared to be seriously compromised, but nevertheless with meticulousness it was possible an almost total recovery of the frieze and the lunettes, which are reported here for the first time.
The main intent of this research is therefore to make known two cycles of frescoes whose traces had essentially been lost and which have never been exhibited to the public after the 1920s, also proposing some reflections in the stylistic and iconographic field.

The discovery of the date 1526 on a lunette in the Gallery, the harmonious stylistic code that pervades all the frescoes discovered during this restoration and which extends to those torn in 1928 and recovered, also allowed to shed new light on the presence of artists in Bergamo. in the third decade of the sixteenth century, at the same time as Lorenzo Lotto's fervent activity in the city and in the province.

Fragility and recovery of colonial architecture: toward sustainable rehabilitation in Morocco

Santi Giovanni - Department of Energy, Systems, Territory, and Constructions Engineering. University of Pisa, Pisa, Italy, e-mail: giovanni.santi@unipi.it

Abida Majda - Ecole Nationale d'Architecture de Marrakech, Marrakech, Morocco, e-mail: abida@enamarrakech.ac.ma

Abstract: In many ex-colonial countries, the built heritage from foreign domination is still undervalued and at risk of preservation. Some countries, such as Morocco, where the research presented is still ongoing, have recently begun to take initiatives by launching inventories to classify buildings from that period, with the aim of preventing their demolition. The paper focuses on some specialized building types (industrial buildings, commercial, etc.) that are briefly mentioned in these technical inventories, as opposed to other types (residential, administrative, school buildings, etc.). Through the analysis of a case study of a now-abandoned covered market in the city of Casablanca, with a comparison of the original and current state, the evolution of both the building and the urban situation is shown. By means a graphic-semantic analysis, thanks to archival research and site surveys, a type-technological framing, and a parametric reconstruction using H.B.I.M., recovery design reflections are outlined that show how many parameters are required for a hypothetical redevelopment, from respecting the original history of the building to meeting changing human needs.

Keywords: Architecture Reconversion, Sustainable reconversion, Moroccan colonial heritage, Casablanca modern architecture.

1. Introduction

Many post-colonial countries, which gained independence between the end of World War II and the early 1960s and 1970s, during foreign domination become a field of architectural experimentation for new forms of habitat through which to reconnect with local identities and traditions of life.
In the Maghreb, North Africa, in little more than a decade, during which the critical relationship between occupying countries and colonies dissolves, we witness on the one hand reparative operations by which France seeks a ground for confrontation with the occupied countries, and on the other hand operations that, although begun under French control, end after independence is achieved and represent opportunities for redemption and the construction of a new identity for the former colonies. In the case of Morocco many buildings have been demolished as a result of their failure to be protected because they are in doubt as to whether they deserve to be preserved as part of the national building heritage. About it industrial or commercial architecture, which is easily abandoned due to the rapid development of the city and the movement of activities in need of new building models that represent the country's progress and not that particular past. Several investigations and studies showed that these architectures, as well as in other geographical environments, e.g Europe, have long been protected as evidence of values that go beyond architecture [1,2]. Working spaces, and also industrial archaeology, show important examples of buildings with bold constructive and technological solutions. Within this framework, places of commerce, and specifically the market building, in its various forms and declinations, have always played a central role in the layout of cities. As a result, these buildings, structured on particularly significant typological systems, appear with different declinations in the various western and eastern contexts, showing, however, permanent features in the different settlement and architectural typologies. Beginning in the 1920s, research in

the field of thin reinforced concrete shells led pioneering French and German engineers to experiment with the shape resistance of various geometries, including surfaces of revolution, such as domes, translation, such as cylindrical vaults, and ridged, such as the hyperbolic paraboloid [3]. Concrete Shells first appeared on the architectural - engineering scene in the 20th century, used for the construction of various buildings such as warehouses, industrial buildings, and as in the case study in Casablanca analysed covered markets. Casablanca is one of the witnesses of modernity and architectural innovative technologies «*The first thin reinforced concrete vaults were built in Casablanca for example, by the Perret brothers in 1917. In addition, the buildings benefit from a level of comfort, at the time still rare in Europe: bathroom, WC, storage room. junk, elevators, underground parking. Finally, the Casablanca urban plan and regulations have served as a model for the development of many European cities for fifty years*» [4].

2. Materials and methods

The fragmentation of the available information, and very often the lack of documentation, have pushed research to rely on direct knowledge methods both traditional (on-site surveys) and innovative (photoscan and application of HBIM). This has allowed us to reconstruct the modern heritage thanks to the information collected, with hypothesis, on the original state, supported also by a deep research of similar cases. For the initial phase of knowledge of such an articulated building heritage, it has been necessary to draw up special evaluation sheets of the elements: Territorial (urban location), Formal (planimetric/volumetric aspects), Distributive (typological aspects), Constructive (constructive aspects), Technological (main technology nodes).

3. Case study

Developing the cognitive method specifically for this type of building, the “Crio Market” in the ex-industrial zone of “Roches Noires” in Casablanca, was possible to proceed with by a reconstruction of the 3d model of the building, elaborated by elements (H.B.I.M.) coinciding with the original real one.

4. Conclusions

The first results of the research show the importance of the cognitive phase especially with the use of new tools like HBIM. The choice of new use for buildings similar to the case study is influenced by many factors from architectural and constructional to short and long term economic sustainability of the project, so it is important to examine the financial opportunities of public-private partnerships). Furthermore, new uses should be linked to the needs of the territorial and local context, involving all stakeholders from the planning stage. Finally, the best re-use strategy cannot be defined without considering the needs of conservation and preservation of the architectural identity of the building.

References

[1] Cossons, N. Why preserve the industrial heritage? In Douet, J. (Ed.), Industrial Heritage Retooled. The TICCIH guide to Industrial Heritage Conservation. London: Routledge; 2015, pp. 6-16,

[2] Poretti, S., Casciato M., Mornati, S. (Eds). Architettura Moderna in Italia. Documentazione e conservazione. Atti del Primo Convegno Nazionale Docomomo Italia; Roma: Edilstampa, 1999.

[3] Joedicke, J. Shell Architecture. New York: Reinhold publishing corporation, 1963.

[4] Casablanca, Ville du XXème siècle, carrefour d’influences
https://whc.unesco.org/fr/listesindicatives/5848/ (access on 12/08/2022)

Il valore dell'uso e della manutenzione programmata per gli immobili storici di pregio architettonico: il caso del Castello di Quaglietta in Campania (Italia)

The value of use and scheduled maintenance of historical buildings with architectural interest: the case study of the Quaglietta Castle in Campania (Italy)

Basile Eliana – Università degli studi di Napoli "Federico II", Napoli, Italia, elianabasile@live.it

D'Angelo Gigliola – Università degli studi di Napoli "Federico II", Napoli, Italia, gigliola.dangelo@unina.it

Extended Abstract:

The work presented is part of a Master's thesis in Construction Engineering in Building Recovery and Planned Maintenance at the Federico II University of Naples, supervised by prof. arch. Marina Fumo and prof. ing. Maurizio Nicolella with the tutor ing. arch. Gigliola D'Angelo, and aims to emphasise the importance of maintaining the heritage. The interest in the analysis of this case study stems from the sense of belonging to the village of one of the authors, now a graduate, Eliana Basile, and the need to bring to light the beauty of a forgotten territory by focusing on the rediscovery of the awareness of intangible values and the recovery of the historical heritage that the research group has been pursuing for many years.

The village of Quaglietta, stands within the Campania Region, in Irpina situated in the Alta Valle del Sele (Upper Sele Valley). After the 23 November 1980 earthquake, the rush to reinforced concrete began, as a quick solution for trying to fill the sense of impotence and emptiness brought by the seism. This, on the other hand, led to the abandonment of the "old" villages, the loss of local building tradition and historical identity of the village [1]. Thanks to the project "The Villages of Tradition", aimed at recovering the four castles with the purpose of reusing the existing rooms in accommodation for rural tourism, workshops for the promotion of typical products and in small museums for the documentation of local emergencies, the village of Quaglietta [2], has been restored and re-functionalised, restoration work carried out can be considered "light" and aimed at seismically upgrading buildings with non-invasive structural techniques.[3]; however, only twelve years after completion of the work, the signs of decay and neglect are evident. Starting from this issue, the actual state of degradation of the village was analysed and, in accordance with the Municipal Council's approval, a new function was set for it. Moreover, this work is intended to serve as a warning for future interventions on the historical and cultural heritage, at the same time acting as a warning case and a best practice project. The restoration work on the village and the castle was completed in 2010. However, as of 2011 the vast majority of the buildings show signs of decay, neglect and there has been no lack of vandalism. The castle has not been exempt from this mismanagement: the rooms intended for cultural activities are unusable and even access to the area has become

difficult. The Cultural Heritage and Landscape Code defines maintenance as "the complex of activities and interventions aimed at controlling the condition of the Cultural Heritage and maintaining the integrity, functional efficiency and identity of the Heritage and its parts". Therefore, maintenance is a discipline characterised by a dual task: the analytical one, aimed at defining descriptive diagnostic frameworks of the state of functioning or of the deterioration or risk conditions of a Cultural Heritage; and the planning one, whose objective is to define implementation strategies and identify, in technical and executive terms, the specific actions to be carried out to contain the actions of the agents of deterioration and to control risk situations. Thus, Planned Maintenance is maintenance organised and conducted according to a pre-established plan such as the "Maintenance Plan"[4-5]. Actions aimed at preserving the hamlet and castle of Quaglietta cannot disregard the project of reutilising the areas. Abandonment by the population was the real cause of the current state of the area, and in order to give it the necessary care and maintenance, it is important to recreate the link that the population had with the village before the 1980 earthquake. This area, following the earthquake, was declared unfit for use and subsequently became state property. Creating a new intended use is necessary so that the area, devoid of attractiveness, does not return to its initial state of neglect. In order to actually understand what the area should become for the population, they were asked to answer a short questionnaire [6]; the answers revealed the need to give new value to the area, allocating it to cultural activities and recreational activities. After a SWOT analysis was carried out for the entire area. From the analysis of the meta-project and through the use of the available state funding, investment 2.1 "Attractiveness of Villages" for the cultural, social and economic regeneration of villages at risk of abandonment and neglect, it was decided to create a food and wine route within the village, taking into account the provisions established at the time of the approval of the Municipal Council. It should be noted that the area currently offers the possibility of overnight accommodation thanks to the presence of the Albergo Diffuso. Once past the village area through the first castle entrance gate, there’s an ancient cave, in this environment, the idea was to create a wine cellar and tasting area for locally produced wines. A mobile stage will be built on the viewing terrace; binoculars and tables will be placed too.

The project proposal that has been drawn up does not stop only at the re-functioning of the hamlet and castle area but aims to create valorisation strategies that encourage what could be defined as “itinerant tourism”, an example of which is the Val D'Orcia. By creating a network of “beauties”, it is possible to focus on the entire Irpinian territory and ensure that it is not abandoned. The ultimate goal is the desire to revive in people the knowledge of forgotten tangible and intangible heritage, because only through knowledge is it possible to instil in people the passion and care necessary for such precious assets to continue to exist.

References

[1] Verderosa, A “Il recupero dell’architettura e del paesaggio in Irpinia” De Angelis Editore, Avellino;
[2] Ficetola, G. “Quaglietta ieri e oggi” Rotostampa SRL, Nusco, 2015;
[3] Fumo, M., Formisano, A., Sibilio, G., Violano, A. Energy and Seismic Recovering of Ancient Hamlets: the Case of Baia e Latina, Sustainability, 9 agosto 2018;
[4] Cecchi, R., Gasparoli, P. “Prevenzione e manutenzione per i beni culturali edificati” Alinea Editrice, Firenze 2010;
[5] Nicolella, M. Manutenzione programmata degli edifici, Luciano Editore, 2021;
[6] D’Angelo, G.; Gugg G. Riscoprire la memoria dei luoghi attraverso le indagini preliminari per la qualità dell’intervento, La qualità dell'intervento sui beni culturali attualità, problemi e prospettive, XXXVII° Convegno Internazionale, Scienza e Beni Culturali, Bressanone, 5 - 8 luglio 2022

The reuse and reliving of space in architectural heritage. Proposal for intervention in Tabacalera, Valencia.

Graziella Bernardo _ Universitat degli Studi della Basilicata, Matera, Italy, graziella.bernardo@unibas.it, (via Lanera, 20, 75100 Matera).

Luis Manuel Palmero Iglesias_Universitat Politècnica de València, Valencia, Spain, lpalmero@csa.upv.es, (Camino de Vera, s/n 46022 Valencia)

Abstract: Architectural heritage, especially built heritage in use, presents us with a series of very interesting readings in terms of future interventions that can be effective alternatives to different uses that have not been thought of in their original state. Interventions are always a possible alteration to a space, monument or construction that must be considered from the side of conservation, synthesis and the critical state of the current state, all raised with an order that responds to many considerations, whether these are spatial, social, functional, constructive and practical. This article proposes the closure of a space in order to be able to carry out activities related to the functioning of the building itself. This proposal to cover one or both courtyards of the modernist building known as Tabacalera gives the opportunity to inhabit an area that is currently a mere passageway. The compatibility of materials between new materials and those of origin gives at least an interesting idea as to possible solutions.

Keywords: spatial reuse, courtyards, architecture, modernism, tobacco factory

1. Introducción

Superada la convulsa primera mitad del siglo XIX, y con Gran Bretaña como principal impulsora, se generó en su metrópolis un entorno de estabilidad que permitió la creación de una Oficina Internacional de Exposiciones (BIE por sus siglas en inglés), que organizó la celebración en todo el mundo de eventos de gran envergadura. Estas ferias o acontecimientos recibieron el nombre genérico de exposiciones universales, mundiales o internacionales y tenían el fin primordial de promocionar la ciudad en que se celebraban con el objetivo de mostrar sobre todo los grandes avances tecnológicos y "las últimas expresiones aceptadas por la Academia del Arte". Las exposiciones se clasificaban en dos categorías (Registradas y Reconocidas) y no pasaban de ser mega-ferias que también podían ser organizadas por una ciudad o país sin el patronazgo del BIE. La flexibilidad en su organización y desarrollo también alcanzaba a su duración, que podía extenderse desde tres semanas hasta seis meses.[1]
La ejecución de edificios aislados solucionaba el problema que generaba el darle un uso posterior para otros fines a las grandes e importantes estructuras de la feria. La ejecución de edificios aislados derivó en el aprovechamiento de la arquitectura de los pabellones para representar a la nación, servicio o producto concreto expuesto, lo que acabó provocando que la arquitectura de los pabellones se convirtiera poco a poco en la verdadera protagonista de las exposiciones.

8. Conclusiones

La conservación del patrimonio arquitectónico no consiste solamente en que el monumento perdure a lo largo del tiempo, sino que es un conjunto de acciones que tienen como finalidad impedir el deterioro patrimonial y cultural del inmueble tanto por su importancia física y material como su significado histórico y simbólico.
Por ello, a la hora de intervenir en una obra de esta condición, hay que considerar el grado de autenticidad y realizar un previo análisis teórico del edificio para poder concebir sus valores y la historia que ha vivido para posteriormente poder actuar con criterio. Acorde con la metodología mencionada, el desarrollo de la actuación comprende una fase previa de búsqueda e investigación, tanto gráfica como de análisis del edificio, y una segunda fase de ideación de proyecto y ejecución. Así pues, previamente a cualquier tipo de intervención o actuación patrimonial, se tienen que saber identificar todos estos valores que otorgan la esencia del edificio. Esta noción de la conservación y la forma de actuar en el patrimonio nos traslada irremediablemente a tres grandes postulados que nos han precedido a lo largo del tiempo en la arquitectura y en la restauración.
En la propuesta de actuación en el edificio de la Tabacalera se ha combinado en todo momento el respeto hacia el grado de autenticidad del propio edificio -para así mantener sus valores históricos y culturales- con la búsqueda de una propuesta de intervención que sea respetuosa con el principio de mínima intervención, lo que se pone de manifiesto, en primer lugar, en la sobrecarga ejercida con el muro existente de ladrillo, en segundo lugar en la integridad de la cubierta en su conjunto y, por último, la reversibilidad del proyecto siendo sencillo el proceso de montaje y desmontaje sin dañar el edificio.

Intervention Methodology in the Porto Bourgeois House - Conservation of heritage values as an environmentally sustainable action

Joaquim Teixeira – Centro de Estudos de Arquitectura e Urbanismo da Faculdade de Arquitectura da Universidade do Porto, Portugal, e-mail: jteixeira@arq.up.pt

Rui Fernandes Póvoas - Centro de Estudos de Arquitectura e Urbanismo da Faculdade de Arquitectura da Universidade do Porto, Portugal, e-mail: rpovoas@arq.up.pt

Extended abstract

Nowadays, it is very clear that it is no longer possible to maintain a position, be it political, ideological or of any other nature, defending infinite growth, when it is obvious that the planet doesn't grow, that the emission of pollutants keeps reaching historic highs and that natural resources are being exhausted. The increasing awareness of the non-sustainability of our society model, not only environmental, but also economic, social and political (because it has been unable to solve people's problems), calls for an urgent change of paradigm.

Having buildings and the construction industry major responsibilities in the emission of pollutants and the consumption of resources, they will certainly be targeted in the expected and necessary changes leading to a new paradigm of society in the near future, which should include paying more attention to existing buildings, making them more energy efficient and improving their performance, in order to reduce their environmental footprint. Nevertheless, for rehabilitation activity to be environmentally sustainable, it should be based on the concept of minimal intervention, avoiding profound transformations, so as to reduce as much as possible the actuation and focusing on the essential, thus seeking to maintain, as far as possible, the existing, promoting its reuse.

The bourgeois houses of Porto represent an inestimable heritage of the city, inseparable from its monuments and public spaces, currently at serious risk of disappearing, not only due to the neglect of several decades, but also to the current actions of speculative intervention. These are single-family houses, narrow, tall and very deep, with granite elevations of an austere appearance, which contain interiors that may present real surprises in the arts of stucco, falsework or woodwork and carpentry. This edification reflects centuries of cultural, historical, social and architectural values, which have been gradually disappearing, with the demolition of its interiors and the indiscriminate association of the parcels, erasing forever an important part of our identity.

The knowledge about the constructive system of these houses, deepened throughout hundreds of academic works, as well as the perception of the several attacks to its safeguard, motivated the development of a doctoral study [1] with the main goal of conceiving a methodology of intervention in this edification. In general terms, the methodology is composed of the following stages: decision to intervene; knowledge of the existing; intervention project; execution; and time of useful life, forming a circular sequence.

The evidence of a great systematisation of procedures, not only regarding the materials used, but also the construction techniques, enabled the conception of a constructive model of the houses, which constitutes the basis of the intervention methodology.

The constructive model becomes very useful in the stage of knowledge of the existing building, enabling the establishment of analogies with each case of intervention, either for the geometric and constructive surveys, or for the identification of elements of value, of changes introduced, or for the assessment of damages and anomalies. In the methodology, the knowledge of the existing is of the utmost importance for the development of the subsequent stages, as well as for the qualification of the interventions.

The recommended interventions contemplate five actions: selective demolition; structural reinforcement; repair of anomalies; performance improvement; and addition of new elements. Except for the demolition and the addition of new elements, the remaining actions propose intervention solutions in three degrees of intrusiveness: slightly, moderately and highly intrusive. As regards performance improvement, to each of the degrees of intrusiveness a level of performance is associated, i.e., the less intrusive interventions are those with the lowest level of performance, while the most intrusive come close to the standards established by the typified reference solutions.

Soon after the end of a rehabilitation a new cycle of useful life of the building starts, marked by a progressive and complex process of degradation, which should be mitigated by adequate maintenance operations, until it is necessary to carry out a more profound intervention. For this truly sustainable practice to work, it is important to adopt a Use and Maintenance Manual, complemented by the Identity Booklet of the building. In both documents, the adoption of the constructive model proved to be of the utmost importance in the detailed description of the basic rules of use and care of the building and its components, in the indication of the maintenance needs and in the register of the occurrences and interventions carried out, be they of maintenance, recuperation or replacement.

In short, the desirable and necessary change towards a truly sustainable architecture - environmentally, economically and socially - should be fundamentally directed towards intervention in the existing building, following principles of minimal intervention, based on maintenance and conservation, which preserve the identity and authenticity of the existing heritage values.

References

[1] Teixeira J. Salvaguarda e Valorização do Edificado Habitacional da Cidade Histórica. Metodologia de Intervenção no Sistema Construtivo da Casa Burguesa do Porto. Tese de doutoramento. Porto: FAUP; 2014.

The cloister of Santa Marta in Bergamo: from the restoration by Luigi Angelini to the current context of the new Piacentiniano Centre

Antonella Versaci - Kore University of Enna, Enna, Italy, e-mail: antonella.versaci@unikore.it

Alessio Cardaci - University of Bergamo, Dalmine, Italy, e-mail: alessio.cardaci@unibg.it

Abstract: During the first half of the 20th century, the town of Bergamo was concerned with significant planning interventions. The engineer and architect Luigi Angelini prepares a recovery plan for the Upper Town, which will become a point of reference for many later activities in historic urban settings. In the Lower Town, the Piacentiniano Centre, a new administrative, financial, and cultural heart, is built on the old town layout, but without completely cancelling its memory and characteristics. The restoration of the cloister of Santa Marta fits into the latter context. While being a child of its time, it expresses an idea of architectural conservation as a tool to read and understand the past, placing it at the service of a contemporary enhancement of the territory. Based on the idea of fluidity and sharing, it promotes a very modern approach, which is today confronted with the new major redevelopment project of the Piacentiniano Centre that the municipal administration is carrying out.

Keywords: Conservation, Reuse, Luigi Angelini, Bergamo.

Bergamo has one of the best preserved and most valuable historic centres of the Italian peninsula. Urban interventions conducted in the Upper Town from the beginning of the 20th century to 1963 have positively marked its destiny, routing the old village towards a harmonious and respectful future. The recovery plan designed by the engineer and architect Luigi Angelini is certainly significant in the history of the city [1]. It still stands for a major step in the evolution of the culture of the protection of monuments and historic centres, and even in the construction of today's theoretical-operational apparatus of the discipline of architectural conservation. A work that solved the problems dictated by the tragic sanitary conditions and the serious state of decay of the buildings that, from the very first years of the 20th affected the old *Bergomum* [2].

In the same period, a decision to rethink the Lower Town is made to impress a decisive turning point in the area hitherto occupied by the *Fiera di Sant'Alessandro* - a vast masonry quadrilateral, which housed 540 shops arranged in several rows - and to connect the two villages that grew up along the ancient roads to Venice and Milan. The will to create a new centre for Bergamo, for the benefit of its citizens [3] leads to the launch of a national competition in 1906. Despite the high turnout of participants, any of the projects is awarded due to both a too academic approach focused on neoclassical symmetry and virtuosity and a scarce attention to the morphology of the city and its architectural and environmental characteristics [4]. Therefore, a new competition takes place in 1907 and graduates the 'Panorama project' developed by the engineer Giuseppe Quaroni and the architect Marcello Piacentini.

The so-called Piacentiniano Centre in the Lower Town, built between 1912 and 1926, with the help of other experts working in Bergamo such as Luigi Angelini, Ernesto Suardo and Giovanni Muzio, will allow reflecting on the future of the city as a whole, thus imagining for the acropolis a redevelopment free from the constraints of an - otherwise necessary -

adaptation to the functional and logistical needs of modernity that will, however, be assigned to the Lower City.

The case study of the cloister of Santa Marta fits in this context: a precious place, which has survived destruction and demolition and that will be included in the new political, administrative, financial, and cultural new heart of Bergamo. Its conservation and reintegration into city life are due to Luigi Angelini who, as already mentioned, was for a long time the operative arm of Piacentini in Bergamo, after having completed the post-graduate internship from 1909 to 1911 in his Roman studio [5]. A period that will certainly contribute to his training, allowing him to arrive at that personal reading of the lesson taken by Gustavo Giovannoni that we can find imprinted in the various projects conducted during his professional life.

The work of Luigi Angelini as restorer only recently highlighted through specific studies on its theoretical and operational activities [6], shows a meticulous and rigorous work of 'active conservation' of historical architecture, to protect it from the pitfalls dictated by economic processes and speculation, for the benefit of harmony and beauty. Architectural restoration is for Angelini the ideal solution to remove the spectre of demolition; it also may prove to be the engine of an overall revitalization of the role of the historic city within the entire urban context and the improvement of the life of its inhabitants. The so 'rediscovered beauty' must then be able to be enjoyed and become an active participant in a symbiotic process of a cultural, logical, and psychological nature entertained with the population.

In this sense, the case study of the restoration of the cloister of Santa Marta appears emblematic. Although 'a product of its time', it expresses a conception of architectural conservation seen as a tool to read and understand history, placing it at the service of an enhancement in a contemporary key of the territory. A goal that Angelini tries to achieve setting his projects on the assumptions of fluidity, sharing, and permeability. An approach of great modernity, which is today confronted with the large new redevelopment program of the Piacentiniano Centre that the administration municipal of Bergamo is carrying out.

References

[1] Barbero W, Gambirasio G, Zanella W, editors. Luigi Angelini. Ingegnere architetto. Milano: Electa; 1984.

[2] Casini S, Fortunati M, editors. Bergomum: un colle che divenne città. Bergamo: Lubrina Editore; 2019.

[3] Angelini L. Il volto di Bergamo nei secoli. Bergamo: Poligrafiche Bolis; 1951.

[4] Ojetti U. Relazione sul concorso per la sistemazione della fiera di Bergamo. Bergamo: Istituto d'arti grafiche; 1907.

[5] Angelini L. L'architetto Marcello Piacentini. La rivista di Bergamo 1924: 35, 1851-1860.

[6] Versaci A. Luigi Angelini. Restauratore e innovatore. Bergamo: Lubrina Bramani Editore; 2021

Adaptive reuse of built heritage in Portugal: Alcino Cardoso House (1971-1991) by Álvaro Siza as a reference case study

Ferreira, Teresa Cunha - Centre for Studies in Architecture and Urbanism - Faculty of Architecture of the University of Porto, Portugal, e-mail: tferreira@arq.up.pt

Fantini, Eleonora –University of Bologna, Bologna, Italy, e-mail: eleonora.fantini4@unibo.it

Ordóñez-Castañón, David - Centre for Studies in Architecture and Urbanism Faculty of Architecture of the University of Porto, Portugal, e-mail: dcastanon@arq.up.pt

Coutinho, Miguel Frias - Faculty of Architecture of the University of Porto, Porto, Portugal, e-mail: up201505932@up.pt

Cruz, Tiago – Faculty of Architecture of the University of Porto, Porto, Portugal, e-mail: tcruz@arq.up.pt

Abstract: The Alcino Cardoso House (first phase: 1971-1973; second phase: 1988-1991), located in northern Portugal, was one of the first interventions in pre-existing buildings undertaken by architect Álvaro Siza (1933-) to receive national and international acclaim. The design consisted of the conservation of vernacular farm buildings and their transformation into a holiday home and tourist accommodation. It echoes the concerns of the critical revision of modern architecture in the Portuguese context (the so-called 'third way' as coined by Fernando Távora) marked by an innovative reinterpretation of tradition: modern principles are introduced while alluding to vernacular construction techniques and materials. This early Álvaro Siza intervention in a rural context has become a reference case-study for the School of Porto architects and provides us with lessons on contemporary reuse of built heritage.

Keywords: Adaptive Reuse, Vernacular Architecture, Built Heritage, School of Porto, Architectural Conservation, Álvaro Siza.

The Alcino Cardoso House, in Moledo do Minho (north of Portugal), was one of Álvaro Siza's first renovation projects to achieve national and international acclaim. The design project started in 1971 in a cultural climate determined by the critical revision of the Modern Movement aiming at the reconciliation of contemporary architecture with concepts such as tradition, place and context. At the same time, guidelines for the recovery and reuse of historic buildings were changing, moving from stylistic restoration (which had prevailed during the Salazar dictatorship) towards practices more open towards the international debate including the Venice Charter (1964).

This building complex is also a good example of the School of Porto's approach to interventions in pre-existing buildings, renouncing to any separation between design and conservation. Its methodological approach consisted of using history as a design tool, preserving the values of the ancient artefact, while adding new features in a contemporary aesthetic capable of establishing a relationship of continuity between the old and the new. The Alcino Cardoso House is therefore an exemplary case of adaptive reuse, showcasing a remarkable balance between the conservation of the pre-existing rural complex and the introduction of contemporary architecture to meet the new requirements.

The research methodology is thus based on the cross-referenced analysis of different sources, raging both from literature review and archive research, as well as interviews with different actors (Álvaro Siza, collaborator, owner, among others) whose testimonies provided

precious information on the conception, design and construction processes. Adopting drawing as a research tool, this paper includes the production of graphic contents, such as demolition-addition drawings, interpretative schemes of the construction phases and of the compositional and geometric principles, as well as an analysis of constructive details.

The first phase of the renovation of the Alcino Cardoso House expresses a clear difference between the new and the old, even though they merge and create relations of dialogue and continuity. The housing programme was incorporated into a triangular annex whose strange geometry, the integration of industrial materials (the flat zinc roof), and its condition as a modern curtain wall in the landscape identify it as a contemporary artefact. At the same time, the use of stone and wood, as well as the reinterpretation of the traditional carpentries, refer to the vernacular constructive solutions of north-western Portugal. Siza thus manages to critically revise modern axioms, such as the glass curtain wall, integrating international compositional grammars into the Portuguese context, but he also succeeds in establishing a dialectic relationship between the new and the old, softening the formal contrast and endowing unity on the whole. On the other hand, in the second phase, even though the programmatic needs and the area available differ, Siza was able to preserve the main features of the house without new volumetric additions. However, localized interventions seek to improve currents standards of comfort and use (new bathroom excavated in the basement, new window for improved lightening in the interior spaces) while including delicate modernity in the details.

Indeed, the Alcino Cardoso House echoes the ambitions pursued by the so-called “third way” (bridging modernism and tradition), which emerged in the heat of the “Survey on Regional Architecture in Portugal”, as well as reflecting the search for continuity in the intervention in pre-existing buildings. Rather than directly copying traditional solutions, architects such as Fernando Távora and Álvaro Siza proposed a reinterpretation of vernacular architecture. This formula allowed harmonious insertions of contemporary concepts and aesthetics within the pre-existing buildings and spaces. Nevertheless, it is in the second phase of the Alcino Cardoso House (1988-1991) where more evident similarities with Távora's methods emerge, not only through the adoption of the garnet red colour for the carpentry and woodwork, but also due to the morpho-typological and constructive preservation (in line with projects by Fernando Távora, such as the Casa da Cavada in Briteiros, 1989-1991). This respect for the old matter, however, did not prevent the implementation of important interior modifications to adapt these spaces to their new purpose as tourist accommodation. Regarding Eduardo Souto de Moura, although he led his career along an autonomous path, the false ruin of Alcino Cardoso's swimming pool is somehow aligned with the romantic vision of ruins that characterises some of Souto Moura's first projects.

The current situation of vulnerability at a global scale has determined a recent increase in the search for new sustainable design practices. However, since the 1970’s, Álvaro Siza’s approach in the Alcino Cardoso House was able to reconcile the legacy of the past with the contemporary needs. It has become a reference case-study in the way architects can reshape pre-existences while preserving its ambience, and its influence is notorious in other works by architects of the School of Porto (Fernando Távora, Alcino Soutinho, Eduardo Souto Moura and many others). By understanding the place before intervening, articulating its traditions, and integrating pre-existences and natural resources we find in Álvaro Siza an important lesson in the reuse of vernacular built heritage.

The Rehabilitation Impact of Historic Houses on Cultural Heritage
Sustainable Actions for the Historic Centre of Oporto, World Heritage Site

Rosa, Inês - Universidade Católica Portuguesa, School of Arts, Master in Conservation and Restoration of Cultural Heritage, Porto, Portugal, inesmmrosa@hotmail.com

Moreira, Patrícia - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, prmoreira@ucp.pt

Guedes, João Miranda - Faculdade de Engenharia, Universidade do Porto, CONSTRUCT, Porto, Portugal jguedes@fe.up.pt

Vieira, Eduarda - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, evieira@ucp.pt

Abstract: This paper focuses on the rehabilitation practices of Porto centenary buildings from 2015 to the present, with an emphasis on touristic and common housing projects, chiefly those with great cultural significance. The study evaluates the impact of the interventions conducted on those buildings, with consequent potential for gentrification and loss of identity. Tourism is a relevant element of the equation (low-cost flights/mass tourism/rehabilitation boost - economic growth) due to the deep alterations it allowed and brought to the built historic heritage and traditions. Foremost, this research incorporates historical and cultural preservations grounded in the pillars of sustainability, highlighting procedures adaptable to similar projects in the city, by reviewing defensible projects and regional solutions taking place in other parts of the world.

Keywords: Climate Change; Sustainability; Built Heritage Conservation; Circular Economy; Energy Efficiency

1 Introduction

The work presented is part of the project ***HAC4CG - Heritage, Art, Creation for Climate change. Living the city: catalysing spaces for learning, creation and action towards climate change***. The project takes the city of Porto as a case study for global changes and analyses, among other topics, the research line RL1 - ***Engaging Citizens through Heritage Protection*** focused on Cultural Heritage preservation and contemplates a ***Heritage Observatory*** (WP3), in which this paper is included within a master thesis as a project's output. The underlying principle of this study is to highlight the shape of a community's identity into its built heritage, its collective memories expressed in the urban mesh, the architectonic designs, technical construction values as well historic decorative materials and techniques, all relevant questions arising within rehabilitation/alteration practices. The aim is to analyse the alterations in the city centre (considering the ICOMOS report on Monuments and Sites in Danger [1]) with a review of selected projects weighing the sustainable trinomial: Conservation and Restoration, Circular Economy and Energy Efficiency[2].

2 Alterations to the Praxis

The tourism impact on the urban tissue can be directly linked to a variety of rehabilitation projects undertaken, and understanding the causes and drives of the touristic market allows

us to have a clear view of the construction industry's behaviours to serve touristic purposes both on tangible and intangible aspects [3]. The Historic Centre of Porto as a World Heritage Site sets the mote for this investigation on Historic Houses Rehabilitation by comprising the definitions and guidelines on the topic stated by UNESCO and other crucial charters, conventions, principles and declarations on historical integrity and sustainable future, alongside its role in the community´s identity, thus providing a framework for a better understanding and systematization of the information regarding the main objectives.

3 The Pillars of Sustainability

The analysis of casual-comparative research regarding transformations outside Porto (both National and International case studies) provides an outline of rehabilitation trends that might be adopted in the *Invicta* city and may result in methods to shift or overcome certain practices towards to the considered Sustainability Pillars [4]. The three pillars are addressed by proximity and, although correlatable, here, **Conservation and Restoration** procedures are measured in Social sustainability, **Circular Economy** practices in Economy sustainability and **Energy-efficient** measures in Environmental sustainability.

4 Final considerations

The categorization of the sustainability pillars will lead the way to the gaps in the field [5], that range from mismanagement in the project (e.g., facadism); in the planning (e.g., waste management), in the construction site (recyclability and compatibility) and the direct linkage in ill practices following touristic demand, its consequences on the environment and the community.

Acknowledgements

This study is being conducted under the project NORTE-01-0145-FEDER-000067 co-funded by the European Regional Development Fund (ERDF) through the Northern Regional Operational Program, under the terms of the Notice of Application No. NORTE-45-2020-75 - Scientific and Technological Research Support System - "Projetos Estruturados De I&D&I "- Horizon Europe.

References

[1] ICOMOS Portugal (2020) Portugal: Threats to the World Heritage. Machat C, Ziesemer J, eds. Herit. Risk. World Rep. 2016-2019 Monum. Sites Danger. ICOMOS, Berlin: hendrik Bäßler verlag, p. 107–9.

[2] Climate Change and Cultural Heritage Working Group. International Council on Monuments and Sites - ICOMOS (2019) The Future of our Pasts: Engaging cultural heritage in climate action. Paris: International Council on Monuments and Sites - ICOMOS; World Universities Network; Center for Heritage and Society, University of Massachusetts, Amherst, USA.

[3] Fernandes, J.A.R. Tenreiro, J.P. Figueiredo, P.M. de. Pinto, J.R.. Chamusca, P. (2021) A Baixa do Porto - Arquitetura e Geografia Urbana 2010-2020. Porto: BKC. Book Cover Editora, lda.

[4] Potts, A. (2021) European Cultural Heritage Green Paper. Europa Nostra, The Hague & Brussels, ICOMOS.

[5] Aguiar, J. Pernão, J.. Ferreira, T.C. (2020) Preservação do Património. Júlio ES, ed. Guia Fundo Nac. Reabil. do Edif., Lisboa: FUNDIESTAMO, SA., p. 143–60.

Sustainable assessment for ancient timber structures with multi criteria decision analysis: the Cloister of Michelangelo in the Diocletian Baths

Santini Silvia – Architecture Dept, Roma Tre University, Rome, Italy, silvia.santini@uniroma3.it

Borghese Vittoria – Architecture Dept, Roma Tre University, Rome, Italy, vittoria.borghese@uniroma3.it

Baggio Carlo – Architecture Dept, Roma Tre University, Rome, Italy, carlo.baggio@uniroma3.it

Keywords: Heritage, Timber, Sustainability, HBIM, AHP, MIVES

Extended abstracts

Wooden roofs, and especially the chestnut trussed ones connected with masonry structures, with their complexity and magnificence are part of the architectural heritage all over the world. Despite their relevance, they are often poorly monitored, with devastating effects caused by poor maintenance, by fire or by earthquakes [1, 2]. In Italy, few are the original roofs that have survived to the present day. Too often, it tends to partial or full replacement of old timber structures that are perceived as damaged and with insufficient mechanical strength, rather than preserving them with localized interventions.

In general, the structural assessment of historical constructions involves the authenticity criteria and the principles of minimum intervention and reversibility. This would require accurate diagnostic activities with investigation of in-place historic timber performance by means of visual inspections and non-destructive tests NDT (hygrometric tests, ultrasonic investigations, penetrometric tests and drilling resistance).

In order to promote conservation of cultural heritage, a study has been done to evaluate (from the environmental, economic, social and structural points of view) some of the interventions carried out on the chestnut roof of the Michelangelo Cloister in the Diocletian Baths in Rome (Italy), emphasizing that the substitution of the elements must take place according to conscience and after in-depth diagnostic investigations. The Michelangelo Cloister, has 100 bays divided in 4 wings of 84 m each mono-pitched roofs with supporting rafters and purlins of chestnut wood. In the past twenty years, some of the bays undertook substitution of the roof structure with newtimber elements of chestnut wood, but in most of the roof a number of different interventions were carried out: steel cross bracing, steel L beam to strengthen main timber beams, or nothing at all [3].

In the paper, an investigation has been carried out by comparing different intervention alternatives, modeled with HBIM and evaluated through a multicriteria analysis [4]. The proposed methodology combines the AHP (Analytical Hierarchy Process), developed by Thomas Saaty in 70's, implemented through the MIVES methodology (Modelo Integrado de Valor para Evaluaciòn Sostenible) to quantify the sustainability value of the considered alternatives [5, 6].

An exaustive state of the art with mapping of the case studies regarding sustainability of wooden roofing has been presented. Then, with the aim of providing an integrated

methodology involving diagnosis, four alternatives have been evaluated: i. complete replacement of the wooden elements with the insertion of braces; ii. non destructive testing and steel cladding with L-shaped retaining profiles welded in situ; iii. non destructive testing and the insertion of two support beams below bolted with braces; iv. non destructive testing with the insertion of simple braces.

The contribution of this research is the application of a methodology for the assessment of sustainability, aiming at the conservation of the historical value of original timber roofs, and avoiding technical and economical efforts due to a full substitution intervention.

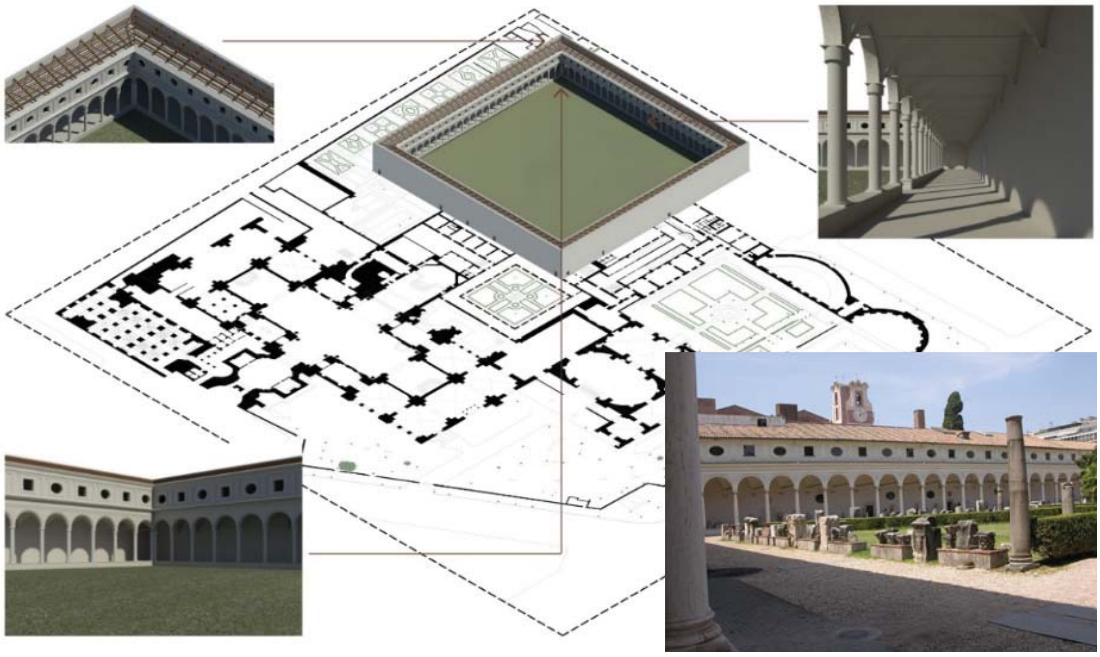


Figure 1. Model of the entire Cloister of Michelangelo realized with Autodesk Revit in HBIM technology.

References

[1] Tampone G. Il restauro delle strutture di legno. Il legname da costruzione - le strutture lignee e il loro studio – il restauro – tecniche di esecuzione del restauro. Hoepli BTH. Milano, Italia; 1996.

[2] Bertolini Cestari C, Marzi T. Conservation of historic timber roof structures of Italian architectural heritage: diagnosis, assessment, and intervention. International Journal of Architectural Heritage 2018; 12 (4): 632 - 665.

[3] Santini S, Baggio C, Sguerri L. Sustainable Interventions: Conservation of Old Timber Roof of Michelangelo's Cloister in Diocletian's Baths. International Journal of Architectural Heritage 2021.

[4] Thakkar JJ. Multi-Criteria Decision Making. Studies in Systems, Decision and Control, 336. 1st ed. Springer Singapore; 2021.

[5] Saaty RW. The analytic hierarchy process - what it is and how it is used. Mathematical Modelling 1987; 9: 161-176.

[6] Viñolas Prat B, Aguado de Cea A, Josa Garcia-Tornel A. Com mesurar la sostenibilitat de les nostres estructures?. A: II Congrés UPC Sostenible 2015. Barcelona 2009 ; 1-10.

Presentation of a methodology for the analysis of old industrial chimneys

Vila Pouca, Nelson – CONSTRUCT-LESE, Faculty of Engineering, University of Porto, Porto, Portugal, nelsonvp@fe.up.pt

Silva, Rui – CONSTRUCT-LESE, Faculty of Engineering, University of Porto, Porto, Portugal, ruis@fe.up.pt

Rocha, Patrício – proMetheus, Polytechnic Institute of Viana do Castelo, Viana do Castelo, Portugal, parocha@fe.up.pt

Paupério, Esmeralda – CONSTRUCT-LESE, Faculty of Engineering, University of Porto, Porto, Portugal, pauperio@fe.up.pt

Arêde, António – CONSTRUCT-LESE, Faculty of Engineering, University of Porto, Porto, Portugal, aarede@fe.up.pt

Abstract: This article discusses a methodology for the inspection and structural analysis of old industrial chimneys. In this type of structure, it is relatively common to observe damages related to material deterioration, essentially caused by the action of atmospheric agents. It is also common for the chimney to present a considerable horizontal displacement at its crown, which must be considered in the structural analysis. This article also discusses the calibration of the structure's modulus of elasticity, by carrying out environmental vibration tests. Vibration tests are currently one of the most effective and complete types of tests, for the *in-situ* identification of the structure´s vibration modes and its elasticity modulus. The structural analysis of the chimney is also addressed, discussing the approach followed and the main results obtained, namely, the assessment of displacements at the top of the structure and the vertical tensions generated by the action of the wind and earthquake.

Keywords: Old industrial brick chimneys, Structural inspection, *In-situ* tests, Structural analysis

1. Introduction

The present paper describes the strategy used in the inspection and structural analysis of an old industrial brick chimney, located in Vila Nova de Gaia. The importance of this paper is justified by the number of chimneys spread across the country that, currently, present an advanced state of deterioration. For this reason, it is of greater importance to carry out assertive rehabilitation procedures, which can analyse the chimney´s current state of conservation and prescribe the most appropriate rehabilitation measures. Thus, the present paper aims to justify the importance that a visual inspection, geometric survey, *in-situ* testing campaign, and numerical analysis may have in the chimney's structural assessment.

2. Geometric characterization and visual inspection

Considering that an accurate knowledge of the chimney´s geometry is essential, a geometric survey was carried out using laser scanning. To document and record the chimney´s current state of conservation, a visual inspection was done throughout its height. The help of a vehicle with a lifting arm offered access to almost the entire height of the chimney, allowing a closer observation. During the procedure, the chimney´s external surface was inspected, aiming to identify damages that may affect its stability and integrity, namely, cracking, fractures or areas

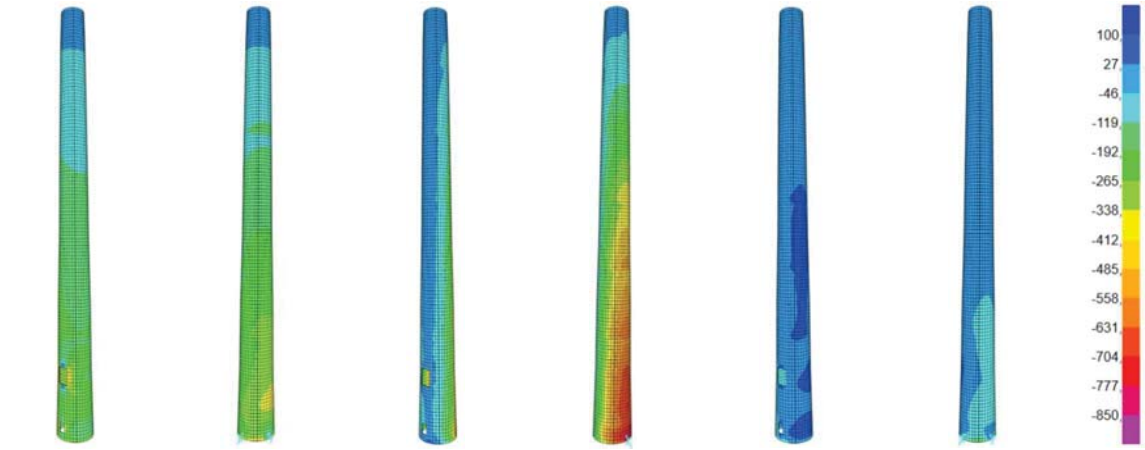
with loss of constituent material, or problems in block existent in the chimney´s base. Complementing this visual inspection, a photographic survey was carried out using a drone, allowing the identification of the main damages and the definition of the *in-situ* test to perform.

3. Dynamic environmental vibration tests

Dynamic environmental vibration tests are currently one of the most effective types of tests, for the *in-situ* identification of the structure´s vibration modes and its elasticity modulus. In the present case, accelerometers were used, recording the accelerations to which the structure was subject during a defined period. Afterward, it was possible to relate the readings taken at different points of the structure, determining its frequencies and vibration modes. The structure´s elasticity modulus, E, was estimated through a modal analysis evaluation, performed with a numerical model in an iterative process in which a good approximation of the eigenfrequencies and numerical vibration modes with those determined experimentally is sought.

4. Structural assessment

The analysis of the results involved the assessment of the maximum horizontal displacement obtained at the chimney´s top, and the maximum vertical stresses obtained considering only the chimney´s self-weight and its combination with the wind or seismic loads. The horizontal displacement at the chimney´s top corresponded to about 1/1121 of the chimney height, being perfectly accommodated by the structure Also the maximum values of the compressive and tensile stresses calculated in the control sections were inferior to the design strength values.



a) West view b) East view

Figure 10. Self-weight

a) West view b) East view

Figure 11. Wind combination

a) West view b) East view

Figure 12. Seismic combination

5. Final considerations

The present article focused on the description of an inspection and structural analysis methodology, for the assessment of old industrial chimneys. Across the country, it is possible to observe the presence of a vast quantity of this type of structure, some of each, requiring immediate intervention. Thus, it is relevant to understand the importance of an accurate visual inspection and geometric survey, capable of characterizing the structure. Also, through the environmental vibration test performed, the structure´s modulus of elasticity was satisfactorily estimated, recurring to modal analysis. Finally, it is important to emphasize that the considerations obtained through the *in-situ* inspection, tests, and analysis, constitute a valuable support in the definition of an integrated rehabilitation project.

Understanding to maintain the INA-CASA experimentation. Minnucci and public housing in Brindisi

Chiarantoni Carla – Polytechnic university of Bari, Bari, Italy, e-mail: (carla.chiarantoni@poliba.it)

Abstract: The paper stems from a wider research study which involves the economic and popular building quarters of the Apulian region. In particular, it focuses on the case of an Ina-Casa building located in Brindisi and created by Gaetano Minnucci, an architect of the post-war reconstruction period. The importance of this complex lays in the testimony of the experiment on the theme of the economic and popular housing since it almost completely reuses the design criteria indicated in the national guidelines provided by the INA-Casa institute. The buildings and the dwellings in question are from the 50s, second 7-year term of the Italian INA-Casa period. They are no longer occupied by the original tenants and are often subjected to drastic transformations, in addition to a technical and technological decay. The research has proposed a valorisation of the performances of the quarters in typological-functional and energetic terms and has also paved the way for a functional rehabilitation of the urban district aimed at the achievement of a better quality of life for its inhabitants.

Keywords: Functional regeneration; social housing; domestic space; INA-Casa heritage building

1. Introduction

The debate regarding the wide residential public building heritage, constructed in the immediate post-war until the early 80s, is mainly focusing on the strategies of energetic retrieval of the housing heritage and on the regeneration of the related urban spaces for social purposes. A great part of this building quotient responded to a social demand of “house” [1]. Such period was especially rich in reflections, debates and the realisation of large building complexes by important architects of the time, who focused on the importance of the house and the constructed space. In Italy, the models of formal and social building were mediated by the large cultural debate at European level [2], from which the functional model of the house was codified, while the technical and technological models continued to be those of the Italian tradition. These choices allowed the use of labour already shaped to work in the building sector and well-known materials, whose processes of production and use had already been tested [3]. The heritage created, although cutting-edge in its intentions, was not accompanied by the complete realisation of the various expansion plans. In fact, few years after its realisation, it proved to be already obsolete and with great deficiencies from the technical point of view and in terms of performance. Therefore, it clearly emerges how the requalification of the residential buildings of this historical phase imposes a global and integral reflection on the technical and technological adjustment of the constructions to the new normative and energetic-performance parameters, as well as on the distributional and functional reorganisation of the living places in relation to the numerous social aspects (work, relationships, family) which characterise life and the contemporary demand of domestic space.

2. Methodology

The study presented in this paper has the objective of illustrating the building features of this important INA-CASA experiment in Brindisi. The research was conducted through a multi-scalar cognitive analysis, performed through bibliographic investigations (at the State archive) and archive materials of the A.R.C.A. North Salento and Brindisi Council. The collected material has been systemised and converted to digital format. The study has been conducted analysing the equalities and deformities of the original projects in order to analyse the conformation of the building complexes in terms of form and structure.

3. The building nucleus in Via Duca degli Abbruzzi

The residential complex of Viale Duca degli Abruzzi represents a fundamental element of the popular buildings in Brindisi. The complex, located in the quarter Casale of the city of Brindisi, is inserted within an already existing urban arrangement set on the great transversal axes of the coast, and divided into six quadrants of building expansion. The road axis became one of the centres of the new urban policy for the sustainment of the rural class. In this view, Viale Duca degli Abruzzi, with its 400 m of length and almost 20 m of width, was chosen as central element of the whole quarter and the National Monument to the Italian Sailor was inserted to close the axis, an important symbol for the city of Brindisi. The importance of this urban/building axis can be found in the strong alignment with the design and technical guidelines included in the "Plan for increment of worker occupation. Houses for workers", realised by the architects Gaetano Minnucci and Costantino Forleo [4]. Minnucci opened the construction of the whole block in 1950, with the realisation of the first corner block (block H) adjacent to piazza Duca degli Abruzzi and to close the whole operation, he will realise 8 years later in 1958 the construction of the whole western side of the road (with the blocks D and I), completing in this way the entire urban axis. The other three buildings which compose the road axis (blocks E, F and G) can be reconducted to the architect Forleo and the 1950s.

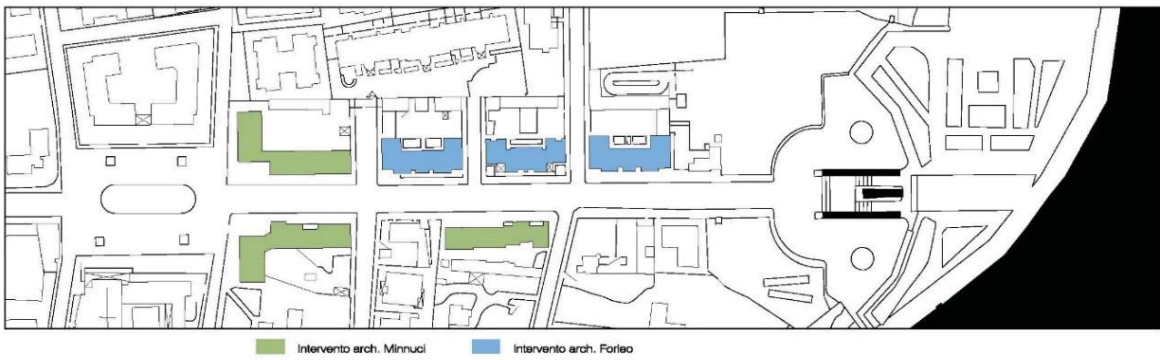


Figure 1. Urban plan of Viale Duca degli Abruzzi

References

[1] Di Biagi, P. (2001) *La grande ricostruzione. Il piano INA-Casa e l'Italia degli anni Cinquanta*. Roma: Donzelli.

[2] Baffa Rivolta, M., Rossari, A. (1975) *Alexander Klein: Lo studio delle piante e la progettazione degli spazi negli alloggi minimi / scritti e progetti dal 1906 al 1957*. Milano: Gabriele Mazzotta

[3] Melis, P. (2010) *La valutazione della qualità globale degli edifici residenziali nella programmazione degli interventi di riqualificazione alla scala del patrimonio edilizio*. Tesi di Dottorato, Università degli studi di Cagliari.

[4] Minnucci, G. *L'abitazione moderna popolare nell'architettura contemporanea olandese: esame delle leggi, sviluppo, tecnica ed estetica delle abitazioni economiche in Olanda*, Libreria di scienze e lettere, Roma 1926

Fortresses in Portugal. Conservation and basis for new uses

Paupério, Esmeralda – CONSTRUCT-LESE, Faculty of Engineering, University of Porto, Porto, Portugal, pauperio@fe.up.pt

Arêde, António – CONSTRUCT-LESE, Faculty of Engineering, University of Porto, Porto, Portugal, aarede@fe.up.pt

Silva, Rui – CONSTRUCT-LESE, Faculty of Engineering, University of Porto, Porto, Portugal, ruis@fe.up.pt

Abstract: This paper focuses on the experience of the Rehabilitation Nucleus of the Construction Institute (NR-IC), integrated in the Faculty of Engineering of the University of Porto (FEUP) in the analysis, inspection and diagnosis of structures with ancient defensive walls existing in Portugal. Aiming at promoting careful and heritage-respecting rehabilitation interventions, in line with the recommendations of ICOMOS (International Council on Monuments and Sites), the NR-IC has participated in several conservation and requalification projects. The development and implementation of a consolidated and holistic methodology of inspection and diagnosis aims to intervene in these historic structures by respecting their authenticity and integrity. In this context, this paper addresses two cases studies in different contexts and state of conservation: the Penedono Castle, in the countryside, and the Peniche Fortress in the seashore.

Keywords: Structural inspection, Structures, Defensive walls, Fortress, Rehabilitation

1. Introduction

The fortified remains of Portuguese national defence such as the Penedono Castle (in the centre-north countryside close to Spain) or the Peniche Fortress (in the centre-south seashore) are part of the landscape and the daily life of the populations with the tranquillity of centuries of existence. Culturally, these elements constitute the materialization of the basis of the Portuguese nation. Nowadays, however, due to time and history vicissitudes, castles, towers, fortifications, strongholds and fortress no longer play the same central role in everyday life as they did in other eras. Even so, they often continue to be the object of multiple and different looks, whether these are distracted, indifferent or, on the contrary, admiring, curious and worried. Therefore, this heritage preservation is essential to ensure that these cultural identity testimonies can be seen by the next generations. Thus, this work presents the methodology used in the inspection and structural diagnosis of the Penedono Castle and the Peniche Fortress, as part of their rehabilitation and preservation interventions.

2. Methodologies for structural survey and interventions

The inspection methodology used by NR-IC, for safety assessment of stone masonry structures, is based on the ICOMOS charter recommendations for "Analysis, Conservation and Structural Restoration of Architectural Heritage". It has been used in numerous conservation and rehabilitation projects, as well as technical inspections on different construction types in order to contribute for a sustained intervention on built heritage, comprising the phases of Analysis and Diagnosis of historical constructions, Fig. 1. A

particular focus is given to the Analysis phase, with the goal of assessing the construction's overall condition. The Diagnosis phase, that helps on defining both the technologies and the materials better suiting the characteristics of the construction, is essential for a correct intervention and it will be addressed. In fact, when proceeding to a sustainable rehabilitation of a heritage construction, the development of a careful diagnosis is paramount.

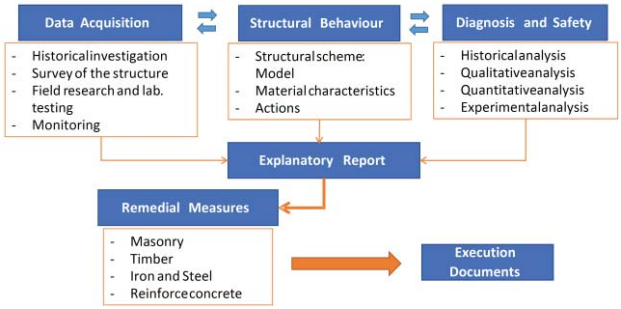


Fig. 1. The NR-IC inspection methodology

3. Case studies

The Penedono Castle and the Peniche fortified complex are examples of a larger studied set of fortified military structures in which the conducted surveys allowed identifying, beyond other important damages, the cutting and sliding of the slopes and fortresses' foundations and the cutting or degradation of the rock outcrops supporting the structures (Fig.2-a), further affected by the effect of climate change, as one of the most widespread damages and responsible for the stability loss of these kind of structures. In the case of coastal fortresses, the rise of sea waters associated with climate change can be problematic (Fig.2-b). Also, it is crucial to pay attention to the good maintenance of the rock masses and slopes, which support these structures. Although they are treated not as part of the supporting structure, they proved to be fundamental for their stability, therefore being their integral part.


a)


b)

Figure 2. Studied fortified military structures: a) Penedono Castle and b) Peniche fortified complex

4. Final considerations

In this work, some of the procedures used in the inspection and diagnosis of fortified military structures were presented, highlighting the importance of a good organization and systematization of the information for the accomplishment of appropriate diagnosis and interpretation of the structural situation of the monuments. Thus, decision-makers can decide in a sustained way about the need for an intervention. It should also be noted that multidisciplinary teams and their interaction in this work results in added value for the final results.

Terra cruda e processi circolari dell'Industria 4.0
Raw earth and 'circular' application methodologies 4.0

Bernardo Graziella - Unibas, Matera, Italy, graziella.bernardo@unibas.it
Guida Antonella - Unibas, Matera, Italy, antonella.guida@unibas.it
Palmero Iglesias Luis Manuel - Upv, Valencia, Spain, lpalmero@csa.upv.es
Pacente Giulio - Unibas, Matera, Italy, giulio.pacente@unibas.it

Extended abstract

The climate and environmental crisis of planetary dimensions is taking on ever greater resonance due to a critical situation that is constantly worsening. Eco-sustainable design is taking on a key and decisive role in our daily building and living choices as they will profoundly influence and determine the future. Specifically, demographic growth, intensification of industrialisation activities, increasing waste production, increasing polluting emissions, excessive land consumption, uncontrolled urbanisation, the health crisis and many more, become elements we are forced to deal with every day. The epochal turning point occurred during the first industrial revolution and the resulting mechanised work, with an exponential increase in production, expenditure of energy and raw materials, and emissions of harmful substances over time.
Today, both the European Community and the UN, as well as other organisations, are setting goals for safeguarding the planet and finding answers to the climate and environmental crisis. Among the changes to be implemented is the need to move from linear production systems to dynamic models that use natural resources and also focus on disposal or reuse processes of discarded materials: from a linear economy to a circular economy model. Before industrial progress, architectures were, by nature, sustainable as they were strongly influenced by the place they belonged to, in fact an indissoluble harmonious bond, lasting over time, was generated between territory and artefact. Each project was in order with respect to a context or reasoning, which was often irreproducible elsewhere.
The identity of each place made it easy to recognise the geographical position, the climatic conditions or the morphology of a territory with which one was confronted. In the contemporary condition, architecture, urban settlements, possess a uniform compositional language. The phenomenon of standardisation and mass production produce new architectural construction principles: greater living space obtained from reduced and prefabricated structural elements; use of the free plan; and the rejection of all decoration.

In this work, an attempt is made to adopt an innovative approach to design that links innovative techniques with eco-sustainable materials in order to imagine a future that respects environmental rights. In particular, the focus has fallen on eco-friendly materials capable of creating zero-impact architecture such as raw earth and wood. In view of the considerations expressed regarding the environmental issue, we have set ourselves the task of imagining a sustainable envelope that is able to satisfy technical, bureaucratic and, at the same time, aesthetic regulations. Making design choices on local materials is one of the most effective

solutions both for the low energy charge in the production phase and for the reduction of harmful emissions from transport, but above all for the high energy performance in the management phase. Unfired earth is one of the first materials used by human beings due to its ease of processing; in fact, earthen artefacts are an integral part of the world's architectural heritage and are powerful expressions of the human ability to create shelter through the resources available on site. According to recent studies, earth as a building material has been used for over eleven millennia, and even today, one third of humanity lives in earthen buildings. We generally define earth as a composite material consisting of a combination of sand, silt and clay. Depending on their respective percentages, compounds with different characteristics and different uses are obtained. This versatility makes clear the use of this material since ancient times by man, huts, small urban settlements, tools, etc. Raw earth is an example of resilience and adaptability in that it has preserved its traditionality over time to such an extent that it has become a contemporary material akin to current environmental issues.

The technique takes on a different role in each territory, sometimes rising to a cultural matrix that expresses social, political, religious and economic meanings. Through knowledge of the material and its application, research has focused on the architecture and large artefacts that testify to its strength. In fact, earthen constructions represent an effective means of responding to today's housing needs through low-cost solutions with zero environmental impact.
A number of projects have been identified that use or can be applied to the use of earth in the smart manufactory in Industry 4.0 and 5.0. There are several experiences, including Italian ones, that combine the use of this material with automated systems, such as 3D material moulding.
As the final stage of the research project, a prototyping of a fast and effective construction solution was attempted, in line with the needs of emergency architecture, with installation techniques, easily replicable, dry. The prototype was created in collaboration with the company Wood Design srl, and is characterised by wooden elements filled with portions of raw earth, applied using the torchis method, with a minimum thickness to ensure hygrometric and thermal comfort between the interior and exterior. The choice of materials was marked by the study of the resources available in the area and the study of their respective life cycles: paulownia for the frame, bamboo for the internal laths. The earth adheres to the bamboo structure, giving greater solidity to the panel with high thermal and acoustic insulation performance of the structure. The objective of the research aims at a radical paradigm shift capable of creating a social rather than personal use of building systems, a turning point around which new types of future city settlement revolve. Through open source dissemination methodologies, it is possible to imagine scenarios of recovery and repopulation of the inland areas of the Basilicata region through the use of traditional techniques for the creation of new structures and the recovery of the existing heritage to safeguard the historical memory of the architectural landscape of these places.

Keywords: Raw earth; bamboo; circular economy; prototyping; climate change.

H-BET Historic Built Environment Typologies. Open spaces and SUOD events in the compact historic town

Edoardo Currà – Sapienza University of Rome, Italy, edoardo.curra@uniroma1.it

Alessandro D'Amico – Sapienza University of Rome, Italy, alessandro.damico@uniroma1.it

Martina Russo – Sapienza University of Rome, Italy, martina.russo@uniroma1.it

Marco Angelosanti – Sapienza University of Rome, Italy, marco.angelosanti@uniroma1.it

Enrico Quagliarini – Università Politecnica delle Marche, Italy, e.quagliarini@univpm.it

Cassia De Lian Cui – Sapienza University of Rome, Italy, cassiadelian.cui@uniroma1.it

Abstract: The relationships between the Built Environment (BE) and SUdden-Onset Disasters (SUOD) are increasingly the focus of hazard mitigation investigation. Specifically, in the Historic Built Environment (HBE) defined as the network of buildings, infrastructure, and open spaces of the compact historic city, recent and past events have shown the need for an elevation of the resilience of the resident community. Previous studies by the authors's research team have objectified the characterization of HBEs prone to SUODs. What emerged was the primary importance of open spaces in the Built Environment, as elements to be characterized with respect to possible emergency phases and BE user behaviour. Specifically, the Historic Built Environment Typologies (H-BETs) can help to evaluate user behaviour during and after the event. Focusing on the role of the classification of the open spaces, the paper presents the H-BETs and their potential role in the multi-risk assessment of the compact historic town. The specific risk conditions of the urban areas (e.g., crowding, the complexity of the overall form of BEs, characteristics of built elements, uses of BEs), and the physical characteristics of historic urban BE are considered together in order to propose a classification of different type of open spaces, starting from morphological classes towards the definition of a more complete typological categorization, representative of the urban system's variables that interact with the identified SUOD hazards.

Keywords: built environment; multi-risk; cluster analysis, historic town, urban fabric.

1. Introduction and aims

In the context of SUdden-Onset Disasters (SUOD), the morphological characteristics of the Built Environment (BE) have a great influence on people's safety. In particular, it is a priority to be concerned with the features of Open Space (OS) and building-infrastructure-open space interfaces, as they can be affected by significant conditions of increased risk. In addition, one can act on the boundaries in a way that affects the BE and its users. Specifically, in the Historic Built Environment (HBE), defined as the network of buildings, infrastructure, and open spaces of the compact historic city, recent and past events have shown the need for an elevation of the resilience of the resident community [1]. In particular, we were concerned with defining the morphological characteristics of the built environment of the compact historic city and investigating the distribution in Italian cities of such configurations. To do this, a reconnaissance of the criteria currently adopted for morphological classification and for the determination of risk factors was used. At present, 1111 open spaces have been investigated. Such typologies of the built environment, informed by the many factors involved, are termed BET. The survey has resulted in the identification of BETs, which for the compact city can thus be considered H-BETs (Heritage-BETs). This work aims to define typical scenarios, referring to areal spaces (i.e., squares) as significant open spaces in the BE [2] and considering the Italian context as a reference. The characterization of these scenarios

represents a significant step from BEs to historic built environment typologies (H-BETs), where H-BETs represent the idealization of common features of Italian open spaces in historic BEs.

2. Morphological Systems of Open Spaces in the HBE compact fabric

In current literature, it is possible to find many approaches to defining types of open space in the historical urban context that could play a role in disaster resilience. Among those, the analysis of urban morphology and systems of the OSs within them is decisive for risk assessment in the historical BE. The preliminary morphological classification of the open space in historical BE proposed by the authors was mainly influenced by the relationship between users and urban open spaces, especially in relation to SUOD events. According to the classification elaborated by Koren and Rus [3], two main morphological systems could be identified in the historical urban town: the areal spaces (AS) and the linear spaces (LS).

3. Methodology

Following the BE S2ECURe research project outcomes [4] the analysis for the definition of BETs started from the parameters described in Table 1.

Table 1. Parameters used to define BETs, according to the BE S²ECURe research project [4].

Parameter		Definition
P1	**Morphology**	Prevalent shape of the OS, in terms of compactness and regularity of the shape
P2	**Height**	Comparison between maximum height (Hmax) of the built fronts that define the OS perimeter and OS minimum width (d_2)
P3	Structural type	Related to the presence of a built frontier along the OS perimeter
P4	**Accesses**	In terms of number compared to the perimeter of the OS
P5	**Special building**	Numbers of buildings with a special function. Four categories: places of worship, public buildings, education, cultural and tourism attractions
P6	Construction technique	In terms of homogeneity of the construction technique, considering masonry as the prevalent type
P7	Porches	Presence of porches along the perimeter of the OS (%)
P8	**Slope**	Presence of sloped ground, in terms of maximum difference in height
P9	**Green**	Presence of green space, in terms of percentage of green areas on the overall OS area

Selected parameters for fast analysis are highlighted in bold.

4. Conclusions

The specific characteristics of BEs in Italian cities are all recognizable in the historic city, with specific factors affecting SUOD (e.g., earthquake and terrorist attack) and SLOD (e.g., heat waves and air pollution) risks. The identification of potential scenarios characterized by features common to Italian H-BEs provides an opportunity to plan further analysis and simulations for the description of risk levels. The multi-hazard scenarios identified thus lay the foundation for future BE risk assessments of compact urban fabrics in Italian cities. The process by which the BETs were defined is again being applied as the open GIS of the historic city is updated, allowing for an increasing definition of the most typical and recurring H BETs, as well as providing a comparative assessment of the influence of individual features on overall risk.

References

[1] F. Fatiguso, M. De Fino, E. Cantatore, e V. Caponio, «Resilience of Historic Built Environments: Inherent Qualities and Potential Strategies», *Procedia Eng.*, vol. 180, pagg. 1024–1033, 2017, doi: 10.1016/j.proeng.2017.04.262.

[2] M. Russo *et al.*, «Morphological systems of open spaces in built environment prone to Sudden-onset disasters», in *International Conference on Sustainability in Energy and Buildings SEB 2020*, pagg. 1–10.

[3] D. Koren e K. Rus, «The potential of open space for enhancing urban seismic resilience: A literature review», *Sustain.*, vol. 11, n. 21, 2019, doi: 10.3390/su11215942.

[4] F. Rosso *et al.*, «Urban morphology parameters towards multi-risk scenarios for squares in the historical centers: analyses and definition of square typologies and application to the Italian context», *J. Cult. Herit.*, vol. under revi, pagg. 167–182, 2022, doi: 10.1016/j.culher.2022.06.012.

[5] E. Mandolesi e A. Ferrero, *Piazze del Piceno*. Roma: Gangemi, 2001.

[6] C. Moughtin, «The European city street, part 1: paths and places», *Town Plan. Rev.*, vol. 62, n. 1, pagg. 51–77, 1991, doi: 10.3828/tpr.62.1.j0v4j745161766r6.

[7] G. Forbes, «Urban Roadway Classification», *Urban Str. Symp. Dallas, Texas*, n. April, 1999.

[8] C. Cecere e E. Currà, «Performances of the existing building organism at the urban fabric scale. The morphological indicators research», *U+D urbanform Des.*, n. 7/8, 2017.

[9] E. Cantatore e F. Fatiguso, «An energy-resilient retrofit methodology to climate change for historic districts. Application in the mediterranean area», *Sustain.*, vol. 13, n. 3, pagg. 1–33, 2021, doi: 10.3390/su13031422.

[10] F. Fatiguso, M. De Fino, E. Cantatore, A. Scioti, e G. De Tommasi, «Energy models towards the retrofitting of the historic built heritage», *Struct. Stud. Repairs Maint. Herit. Archit. XIV*, vol. 1, pagg. 159–170, 2015, doi: 10.2495/str150141.

[11] G. Zuccaro, M. Dolce, D. De Gregorio, E. Speranza, e C. Moroni, «La Scheda Cartis Per La Caratterizzazione Tipologico- Strutturale Dei Comparti Urbani Costituiti Da Edifici Ordinari. Valutazione dell'esposizione in analisi di rischio sismico», *Gngts 2015*, n. May 2019, pagg. 281–287, 2016.

[12] M. Dolce *et al.*, *Seismic risk assessment of residential buildings in Italy*, vol. 19, n. 8. Springer Netherlands, 2021. doi: 10.1007/s10518-020-01009-5.

[13] M. Morganti, A. Salvati, H. Coch, e C. Cecere, «Urban morphology indicators for solar energy analysis», in *9th International Conference on Sustainability in Energy and Buildings, SEB-17, 5-7 July 2017, Chania, Crete, Greece*, 2017, pagg. 1–8.

[14] M. Morganti, «Spatial Metrics to Investigate the Impact of Urban Form on Microclimate and Building Energy Performance: An Essential Overview», in *Urban Microclimate Modelling for Comfort and Energy Studies*, M. Palme e A. Salvati, A c. di Cham: Springer, 2021, pagg. 385–402. doi: 10.1007/978-3-030-65421-4_18.

[15] E. Currà, C. Cecere, H. Coch, M. Morganti, e A. Salvati, «Energy behavior of compact urban fabric», in *Handbook of Energy Efficiency in Buildings. A Life Cycle Approach*, F. Asdrubali e U. Desideri, A c. di Elsevier, 2019, pagg. 714–740. doi: 10.1016/C2016-0-02638-4.

The reuse of an aristocratic palace in inland Cilento (Salerno, Italy)

Polverino Francesco - Department of Civil, Architectural and Environmental Engineering of the University of Naples Federico II, 80125 Naples, Italy; polverin@unina.it

Sicignano Claudia - Department of Structures for Engineering and Architecture of the University of Naples Federico II, 80125 Naples, Italy; claudia.sicignano@unina.it

Abstract: In the present contribution, conservative restoration interventions are envisaged that will ensure the conservative state by recognizing the typological and structural relevance of an aristocratic palace in the inner Cilento (Salerno) so as to allow its complete recovery. The interventions to be carried out will be restoration and rehabilitation of the main and secondary fronts with partial modifications that will not alter the composition of the elevation and will take care to safeguard the elements of particular stylistic value; static consolidation works with possible replacement of the non-recoverable parts, without changing the position of the structural elements. The interventions are aimed at preserving the building organism and ensuring its functionality through a systematic set of works that, while respecting the typological,formal and structural elements of the organism itself, allow its uses compatible with it such as consolidation; restoration and renovation of the building's constituent elements and the elimination of elements extraneous to the building organism. This study has offered considerable insights into the rehabilitation of both facades and interiors with respect to deterioration, to be understood both as structural deterioration and as deterioration due to alterations caused by the passage of time due to total or partial absence of maintenance.

Keywords: reuse, restoration, degradation, conservation and cultural heritage

Ipotesi di recupero della Dogana al Ponte della Maddalena

hypothesis of “Dogana” recovery at the Magdalena Bridge

Iovino Renato - Università Telematica Pegaso, Napoli (Italia), renato.iovino@unipegaso.it

Mecca Ippolita - Università Telematica Pegaso, Napoli (Italia), ippolita.mecca@unipegaso.it

La Mantia Emanuele - Università Telematica Pegaso, Napoli (Italia), emanuele.lamantia@unipegaso.it

Fascia Flavia - Università Federico II, Napoli (Italia), flavia.fascia@unina.it

Abstract: The goal that the authors have set themselves is to create a structure that, together with other buildings already present in the Neapolitan territory, form a "welcome network and hospitality” for the many tourists who, by sea, by air and by land, arrive in Naples. They studied the recovery of the Dogana at Ponte della Maddalena, a historic building in total abandonment. Each of these structures will be aimed at promoting the historical and artistic heritage of the city of Naples as well as the cultural initiatives present in the area.
It will thus be possible to pass from the ancient "city walls" to the entrance doors, controlled by soldiers, to the "finance wall" of the nineteenth century with the "Customs" buildings inhabited by financial officers to a modern and telematic "welcome and reception network" which could become the modern gateway to the city of Naples.
The historic building of the Customs House, located in the San Giovanni district, will be the modern gateway to the city of Naples, for travelers and tourists coming, by land, from the south of Italy.
The choice of the "Dogana" is a consequence of the circumstance that San Giovanni a Teduccio, in addition to being for centuries an urban sector characterized by a consolidated historical building and a strong relationship with the sea, is today also one of the most involved in major development projects: from the construction of the tourist port of Marina di Vigliena, which will host up to 850 berths, to that of the Faculty of Engineering and Law of the University of Naples Federico II.
San Giovanni a Teduccio experienced a period of particular splendor during the eighteenth century, when, following the construction of the Royal Villa of Portici, the entire area that leads from the city of Naples to Torre Annunziata was a favorite destination for the Neapolitan aristocracy who there he built a large number of villas of considerable artistic and architectural value, which form the so-called "Golden Mile".
San Giovanni a Teduccio has two important elements that if exploited can set in motion a driving force for economic development as well as a strong urban recovery, these are the history and the sea resource.
Indeed, the district experienced a period of particular splendor during the eighteenth century, when, following the construction of the Royal Villa of Portici, the entire area that leads from the city of Naples to Torre Annunziata was a favourite destination for the Neapolitan aristocracy who there he built a large number of villas of considerable artistic and architectural value (the Golden Mile).
The strong impulse to the building increase that took place along this stretch of coast between 1840 and 1880, was favoured by the construction in 1839 of the Naples - Portici railway, glory of Ferdinand II, which however broke the continuity of the territory with the sea. In those years, the San Giovanni area was the subject of intense urbanization which, on the one hand, made the neighborhood one of

the main industrial centres of the city of Naples, on the other, it compromised its delicate urban balance.
Along the strip between Vigliena and Pietrarsa, thanks above all to the presence of the railway and following the establishment of the Real Opificio, wanted by Ferdinand I of Bourbon, many new factories were built between the seventies and eighties of the nineteenth century, mostly occupying existing productive buildings; all the examples of the Corradini metallurgical industries (founded in 1872 and liquidated in 1949), the renamed Cirio canning industry founded in 1875, the Pietrarsa plant now transformed into the National Railway Museum, the Pattison shipyards are valid.
The industrial development of the Neapolitan area, which sees its strong point in San Giovanni a Teduccio, takes on more marked connotations in the early years of the twentieth century following the enactment of the Special Law for Naples in 1904 (L. 351 of 8 July 1904 for the "Economic Risorgimento of the city of Naples") which foresees, in fact, the construction of two industrial areas located one in the eastern area and one in the western area of the city of Naples and connected by a road axis. The construction of the new road layout and a series of workers' districts determines the bond between the city and the neighboring municipalities. In those years, in fact, the idea of a "Great Naples", proposed by Francesco Saverio Nitti, began to make its way into the debate on initiatives for the development of the city. The union was sanctioned a few decades later, in 1925 with Royal Decree no. 2183 of 15 November, which establishes the definitive annexation to the municipal territory of Naples of the districts of Barra, Ponticelli and San Giovanni a Teduccio, and again with the subsequent Royal Decree of 7 February 1926 n. 359, which extends the municipal territory to the districts of Secondigliano, Chiaiano, Pianura and Soccavo.
With these two decrees, the eastern outskirts of Naples and at the same time the industrial area, assumed a new geographical dimension partly similar to that predicted by Francesco Saverio Nitti in the elaboration of the "Great Naples". In fact, with the aggregation to the city, a process of urban transformation of the farmhouses began which would have undergone a rapid evolution after World War II.

Keywords: Knowledge; Recovery; Enhancement; Reuse

Garden as Architectural Heritage of the Bastion Castle Ensemble

Tikhonova Olha - Tadeusz Manteuffel Institute of History of the Polish Academy of Sciences, Warsaw, Poland, e-mail: otikhonova@ihpan.edu.pl

Abstract: Historic gardens are often seen as a botanical heritage, considering their aesthetic and botanical value. Yet, their architectural importance as an integral part of the architectural heritage of the bastion castle ensemble is ignored. The attempt to find the relation between the castle and the garden nowadays is complicated because of considerable changes in the townscape since the 17th century and the lack of details on gardens depiction on maps. The paper demonstrates how historical maps, especially military ones, combined with an on-site analysis of the current situation, can reveal the main architectural types of the gardens in the bastion castle ensemble and show their most important architectural features that must be preserved. The results showed three scenarios of the relationship between the garden and the palace component of bastion castle, their main features, and the challenges faced in front of them. The definition of the main features can help to create conservation and valorization plans for the gardens in such ensembles.

Keywords: Historic Garden, bastion castle, military maps, architectural heritage, typology

1. Introduction

In most cases, the changes in ownership and function of the bastion castle ensembles caused the loss of the architectural design of the gardens and the original landscape features. In many cases, two of which will be presented here, the gardens of bastion castles became used as public green areas. In others, they were sold as land for private properties, as in Brody's ensemble. Adaptation of the outline of the gardens to the needs of new functional green spaces was usually made without consideration of the primary design. When preserved, the new garden designs are characterized by spontaneous openings of new routes due to the guidance of visitors to specific locations. In other cases, they are destroyed and covered by new structures, as in the Brody bastion castle ensemble.

The first depiction of gardens as a part of bastion castles in the military treatises can be found in the engravings of treatises done by Jacques Androuet Du Cerceau “Les Plus Excellents Bastiments de France” (1576) and Jacques Perret “Des Fortifications Et Artifices. Architecture Et Perspective” (1601).

This work shows the analysis and importance of the gardens in the modern bastion castle ensembles in the 17th-18th centuries and the challenges selected examples face nowadays.

2. Method

To approach the research topic, historical maps and on-site inspection analysis were used in three selected case studies. Namely, the bastion castle ensemble in Pidhirtsi, Brody (Ukraine), and Lodygovice (Poland) were chosen for the examination.

The method presented by G. Smienk and J. Niemeijer [1] was used in this research to understand the significance of the gardens in bastion castle and their place in the

landscape. The method is based on the sightlines' connection network of the main elements in the ensemble.

As the materials in the historic gardens' documentation in bastion castles are limited, it was decided to collect everything that could help to analyze the gardens. The information used in the research comes from different sources. However, it became evident after analysis that military maps and on-site analysis were the most helpful in such research.

3. Results and conclusions

The analysis of the gardens in bastion castle complexes revealed their importance as an integral architectural part of the ensembles' design. Although the interaction between the bastion castles and the gardens is performed in different ways in different examples, it is dictated to a great extent by the spatial organization type of the bastion castle. The most robust relation of gardens with spatial organization of the inner spaces of the bastion castle is seen in Pidhirtsi and Lodygovice bastion castles. In contrast, the bastion castle in Brody has a minor connection with the garden.

None of the analyzed historical gardens are currently preserved in their initial state. Only the general outline of the gardens in the bastion castle ensembles in Pidhirtsi and Lodygovice is visible nowadays and has greater potential to be restored. The garden's territory in Brody is currently under private sector ownership.

Acknowledgments

These are the first results from the project: "Jacques Perret Influence on Defensive Polish Architecture in the 17th Century". This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 847639.

References

[1] G. Smienk and J. Niemeijer, *Palladio, the villa and the landscape*. Basel: Birkhauser, 2011.

RECOVERING THE MODERN. A “fragile” work of Ignazio Gardella.

Dameri Annalisa – Politecnico di Torino – Dep. Architecture and Design, Torino, Italy, e-mail: annalisa.dameri@polito.it

Mellano Paolo – Politecnico di Torino – Dep. Architecture and Design, Torino, Italy, e-mail: paolo.mellano@polito.it

Abstract: At the beginning of the 20th century the Borsalino family, owners of the well-known hat factory, in an effort to build a modern and efficient city, entrusted several construction sites to Arnaldo Gardella and his partner Luigi Martini. The entanglement between Alessandria, the Borsalinos, and the Gardellas grew closer over the years. The intense activity of the Gardella Martini firm was interrupted by Arnaldo's sudden death in 1928. The construction site of the sanatorium, in the Orti district, was the setting for the forced passing of the torch between the father and his son Ignazio Gardella who, even though he had not yet graduated, was called upon to replace him abruptly. This opened a season that brought Alessandria to the center of twentieth-century architectural history. Some masterpieces, later recognized by international critics, would be built here.
Within the construction site of the sanatorium, yet to be completed, the young Ignazio took charge of the design of the small church, a manifesto of one of the future protagonists of the Italian twentieth century. The chapel possesses, in essence, the elements that characterize the modern movement (bell tower, blades of light to illuminate the apse, the anomalous floor plan separated by the thick septum wall wanted by the iron rules imposed for tuberculosis patients and excavated to house the confessionals) but unfortunately today it demonstrates it's fragility.

Keywords: Gardella, Modern movement, restoration, Borsalino, sanatorium

1. Introduction

The "short century" also proved over time to be the "fragile century" of Architectural History. The large quantity of buildings produced in that limited time span has, as the years have gone by, suffered an undoubted decline in architectural quality. The materials with which this heritage has been built, despite a relatively young age, have now revealed a number of problems of physical deterioration and decay, certainly also due to exogenous factors such as air pollution, rising average temperatures, neglect of environmental problems, etc.

The fragility increases if the heritage of the modern is located in a context not so studied or outside established cultural paths. This is the case in Alessandria, located in the north of the Italian peninsula, where today it would be possible to build and enhance a pathway through twentieth-century architecture, which is the result of the joint efforts of a family of entrepreneurs and three generations of engineers and architects.

2. Gardella for the Borsalino

The Borsalino family, owners of the well-known hat factory in Alessandria since the mid-19th century, entrusted several construction sites to Arnaldo Gardella and his partner Luigi Martini in the early 20th century in an effort to build a modern and efficient city. After World War I, the financial contribution that Teresio Borsalino directed to the modernization of the city became increasingly more substantial. He took on the task of equipping Alessandria with basic infrastructure without neglecting social-welfare initiatives, culminating in the expansion of the retirement home and the construction of the Hospice of Divine Providence

whose design was entrusted to engineers Arnaldo Gardella and Luigi Martini. A close collaboration between the Borsalino and Gardella families (father Arnaldo and son Ignazio, and much later grandson Jacopo) was thus inaugurated. Designers were called upon on several occasions (and over several decades) to respond to needs expressed on several fronts. In the private sector they built villas, studios, the family cemetery chapel for the Borsalino family. On the commercial side they built stores, booths, lodging for the factory employees, and managed the extension and reconstruction of the factory. They also did work in the field with strong social welfare implications (Institute of the Sisters of Divine Providence, Vittorio Emanuele III sanatorium, children's hospital).

However, the intense activity of the Milanese Gardella Martini firm was interrupted by Arnaldo's sudden death in 1928. The construction site of the sanatorium, in the Orti district, was the setting for the forced passing of the torch between the father and his son Ignazio Gardella who, even though he had not yet graduated, was called upon to replace him abruptly. Ignazio would work more and more in Alessandria for the Borsalino family. The factory, offices, employee houses, the store but also schools, extensions to the children's hospital and the asylum, and the anti-tubercular dispensary are just some of the works Gardella designed in the city. These works opened a season that brought Alessandria to the center of the history of twentieth-century architecture: some excellences would be built here, later recognized by international critics.

Within the construction site of the sanatorium, yet to be completed, the young Ignazio took charge of the design of the small church, a manifesto of one of the future protagonists of the Italian twentieth century. The chapel possesses, in essence, the elements that characterize the modern movement (bell tower, blades of light to illuminate the apse, the anomalous floor plan separated by the thick septum wall wanted by the iron rules imposed for tuberculosis patients and excavated to house the confessionals) but unfortunately today it demonstrates it's fragility.

Figure 1. The chapel of the sanatorium of Alessandria, designed by I. Gardella (photo by P. Mellano)

THE DIFFICULT "REUSE" OF HISTORICAL HERITAGE: THE CASE OF THE SCARDAVILLA DI SOPRA MONASTERY IN MELDOLA

Farneti Fauzia - Dipartimento di Architettura, Firenze, fauzia.farneti@unifi.it

Van Riel Silvio - Dipartimento di Architettura, Firenze, silvio.vanriel@unifi.it

Abstract: The monastery of SS. Crocifisso di Scardavilla di Sopra, built by the Camaldolese monks of the older monastery of S. Maria between the end of the seventeenth century and the first half of the following century, indelibly marked the territory of Meldola for centuries, exercising a central function in religious and cultural activities. With the Napoleonic suppression and the changed conditions of life, the monastery, albeit with difficulty, continued to play its role in the territory until the 1940s, when the structures of the monastery and the church began an irreversible process of degradation and architectural disrepair that led the cultic building to its current condition of ruins, with the loss of the roof while the front building still retains its features, despite the maintenance debt. The ruins of undoubted architectural value are combined with a territorial system of environmental value due to the presence of a forest that has taken on value over the centuries and has become a Regional Nature Reserve since 1991; the remaining free-cropping land is kept as a vineyard of typical local grape varieties. Given the changed interest that has characterized agricultural activity over the past two decades, directing it toward increasingly selected and qualitative productions, the recovery, restoration and enhancement of the two artifacts to their new representative business functions will make it possible to heal the serious wound that these ruins now mark the territory. At this stage of the study, historical research has been conducted that will support the design lines in order to organically recover, restore and enhance the existing artifacts and the productive redevelopment of the farm in accordance with current trends in the food and wine.

Keywords: Scardavilla di Sopra, Church of the Most Holy Crucifix, Consolata Missionary Fathers of Turin in Scardavilla, Scardavilla farm

The Monastery of the Holy Crucifix of Scardavilla di Sopra, together with the older monastery below of St. Mary's, has indelibly marked the territory of Meldola for centuries, exercising a central function in religious and cultural activities**.**

After several requests to the prior of Camaldoli, in 1645[1] the monks of the more ancient monastery of S. Maria di Scardavilla di Sotto decided to build a new mixed complex, hermitage and coenoby, on "Monte Lippone de Medulae," at the distance of about a quarter of a mile; in the Annales Camaldulenses it is reported that construction began in 1684. The latter also show that the monastery was completed in 1733, when a family of twelve hermits were sent from the mother house of Camaldoli. The church at Scardavilla di Sopra, dedicated to the Most Holy Crucifix and consecrated on July 12, 1750, was surrounded by twelve cells for the hermits, with gabled roofs, each of which was perfectly autonomous with respect to the general organizational system.

Like the monasteries founded by the Camaldolese, the small religious complex was separated from the civil world, in a large, unspoiled territory with forests, protected by walls that encircled it and hid within it the wealth of water and vegetable gardens with fruit trees. The forests of Scardavilla have been preserved for centuries thanks to the application of the

Camaldolese rule, according to which the order settled within monasteries and hermitages among woods and forests, had an obligation to care for and protect the surrounding natural environment. S. Maria di Scardavilla di Sotto took up by simplifying it the model of Camaldoli, which is even more typologically translated in the new mixed monastery, dedicated to the Most Holy Crucifix, which took up the model proposed by Romualdo of Ravenna at the beginning of the 11th century.

The church, dedicated to the Most Holy Crucifix, with a Greek-cross plan preceded by a rectangular atrium, although it is currently reduced to the state of ruins with nature having taken possession of the structures, it preserves intact the architectural lines of the time even though in the last century it has undergone more or less obvious renovations and additions on the short side at the main chapel and the adjacent bell tower that has been incorporated into the new spaces. The cultic building still shows the richness of the stuccoes that invested the walls, the pillars, and the polygonal tiburium set on four pillars; unfortunately, the original roof that dominated the surrounding landscape, detectable from the photographic documentation of the 1980s, has been lost

The plan that opens diagonally to the sides embracing the viewer, the twisted columns on high stylobate, the entablature, the splendid broken tympanum with cherubs above it that decorated the altar, and the medallions highlight the Baroque drafting of the interior.

The church overlooks an open space and is located in the vicinity of the so-called "palace," presumably built in the 19th century on an earlier structure, currently located abutting the road municipal. The Scardavilla di Sopra complex reveals an architectural and decorative quality that suggests the intervention of skilled workers, starting from the planning stage.

With the Napoleonic suppression and the changed conditions of life, the monastery, albeit with difficulties, continued to play its role in the area until the 1940s, when the monastery and church structures began an irreversible process of decay and architectural disrepair that brought the cultic building to its current ruined condition, with the loss of the roof while the front building still retains its features, despite the maintenance debt.

The ruins of undoubted architectural value are combined with a territorial system of environmental value due to the presence of a forest that over the centuries has taken on value and since 1991 has become a Regional Nature Reserve; the remaining free-cropping land is kept in vineyards of typical local grape varieties. Given the changed interest that has characterized agricultural activity over the past two decades, directing it toward increasingly selected and qualitative productions, the recovery, restoration and enhancement of the two artifacts to their new representative business functions will make it possible to heal this serious wound in the territory.

At this stage of the study, the historical documentary research has been drafted, which will support the design lines in order to organically recover, restore and enhance the existing artifacts and the productive redevelopment of the farm according to current trends in food and wine.

References

[1] *Annales Camaldulenses*, VIII, pp. 247-248

Traditional Dwellings as Wildlife Habitat – Baixo Tâmega Valley Case

Pinto Jorge – UTAD / CMADE, Vila Real, Portugal, ibentes@utad.pt: (5000-801 Vila Real)

Bentes Isabel - UTAD / CMADE, Vila Real, Portugal, tiago@utad.pt: (5000-801 Vila Real)

Zięba Zofia - Wrocław University of Environmental and Life Sciences, Wrocław, Poland, zofia.zieba@upwr.edu.pl: (50-363 Wrocław)

Cristina Reis - UTAD, Vila Real, Portugal, crisreis@utad.pt: (5000-801 Vila Real)

Pereira Sandra - UTAD / CMADE, Vila Real, Portugal, spereira@utad.pt: (5000-801 Vila Real)

Abstract: The main purpose of this research is to give a contribution on the study the traditional dwellings of the Baixo Tâmega Valley region, Portugal. This is an interior rural area. The traditional construction of this region uses local and natural building materials such as stone, earth and timber. It ends up being well integrated in the landscape. Fortunately, in general, it has a good level of conservation. At the same time, it is also home of a big range of wildlife such as plants, insects, birds, among other. Some examples of this fact is provided in this paper. In particular, boars, foxes and European genets caught by camera using the gardens of this type of traditional dwellings are also included in this document. As a main conclusion, it is highlighted that this traditional dwelling may be wildlife friendly because of their materials, of their building details and of their surroundings. There is a proper symbiosis between natural and built elements.

Keywords: Traditional dwelling; Rural construction; Wildlife habitat; Baixo Tâmega Valley

1. Introduction

Baixo Tâmega Valley is a region located in between Oporto and Douro Valley, Portugal. It is a rural area. Its landscape is characterized by the Tâmega river and the vineyards. Considering that exists a vast area of agricultural and forest which is complemented by a lot of water sources, this region is a proper habitat for wildlife.

At the same time, in this region, there is also a rich traditional dwelling heritage which is mostly rural orientated. Fortunately, most of this construction presents a good state of conservation. This type of constructions uses local and natural building materials such as stone, earth and timber. Thus, this solution proves to work in this area. This traditional dwellings tend to have a garden. This heritage is part of the existing ecosystem and, with time, they start to interact. Thus, the traditional dwellings start to be also the home of plants, insects, birds, reptiles and other animals, Figure 1.a.

In fact, wildlife are relevant for this ecosystem. For instance, during summer 2022, in UK, beavers helped prevent drought [1].

In contrast, the existence of wildlife in construction may be consider as a pathology problem [2].

In addition, green roofs and façades are very trendy sustainable building options. It consists on bring wildlife to urban areas and transforming them in more environmental friendly places to live.

Thus, the main objective of this paper is to understand the benefit of traditional dwelling of the Baixo Tâmega Valley in terms of habitat of wildlife.

It was concluded that the traditional dwellings of Baixo Tâmega Valley may be wildlife friendly, Figure 1.b.

a) Traditional dwelling with mosses b) Boars in the garden

Figure 1. Traditional dwellings of Baixo Tâmega Valley as wildlife habitat

2. Conclusions

Taking into account that the Baixo Tâmega Valley region is rural, has forest and water sources, it offers the surviving conditions to allow the existence of a rich wildlife. The traditional dwellings of this region are built with natural and local materials such as granite stone, earth and timber. Thus, they are well integrated in the landscape and in the ecosystem. Certain plants, mosses, birds and insects may grow in this type of traditional dwellings. In fact, we may say that the traditional dwelling of this region may be wildlife friendly. On the other hand, improving the knowledge about this type of wildlife may give guidance for new green construction design.

References

[1] https://www.timeout.com/uk/news/why-bringing-back-beavers-could-help-prevent-drought-080822

[2] Teresa Pinto; Sandra Pereira; Ana Briga Sá; Anabela Paiva; Jorge Pinto. Biodegradation of tabique walls. Session 29 -: Traditional Building – Their contribution for a better Sustainable World 1. ICEUBI2015. International Conference on Engineering. Engineering for Society. University of Beira Interior. Faculty of Engineering. Covilhã. Portugal. December 2, 3 and 4, 2015.

The palace of the Forest and Grove of Heras: intervention of Manuel del Olmo in a property of the duke of Infantado

Carlos González Duque – Sapienza Università di Roma, Italia, e-mail: carlos.gonzalezduque@uniroma1.it

Abstract: Manuel del Olmo was one of the main master masons of the Baroque period in Madrid, due to the protection of the Duke of Pastrana and Infantado. In 1678, he visited and wrote several unpublished technical reports of works on buildings, allowing local master masons to present their offers. Throughout this report we will analyze the rural palace in the Forest and Grove of Heras. This is a unique source of information to understand how these places, nowadays destroyed, were. The detailed technical description of the works to be done and the materials to be used, enables us to discover what the most common pathologies were, and perhaps the most significant point: how the interventions were carried out. It is unusual to find in similar documents an explanation of the aims of the intervention. However, the motivation for the work is deliberately pointed out: to recover the integrity and symbolic legibility of a palatine architecture.

Keywords: restoration, palatine architecture, history of construction, Manuel del Olmo, Guadalajara

1. The conservation of the legacy of the dukes of Infantado in Guadalajara

After sixty two years from the designation of the capital, the VII Duke of Infantado decided to move to Madrid in 1633. Since then, the patronage of the dukes in Guadalajara (their former residence from centuries) was reduced to a minimum. Naturally, their buildings lost a clear practical interest. Hence, those palaces that had previously been thier symbol of prestige and power of an antique lineage started to fall gradually into ruin.

With the death of the consort Duke, the VIII Duchess of Infantado urgently intervened in her own inherited legacy, as we know thaks to the unpublished *Memorias de Reparos* that were drafted between June 1676 and 1678. They were done by the *maestro de obras* Manuel del Olmo, architect of royal works, of the *Buen Retiro* and master builder of fountains in Madrid. He would not intervene directly because of the distance between the Court and Guadalajara, but maybe he was chosen to do this work as an architect given his skills in the intervention of pre-existing buildings. These interventions were focused on several palaces, such as the main palace of the Infantado, the palace of the Armoury, the suburban palace of Heras and as well as the farmsteads of Maluque and Fresno, near to Guadalajara.

2. The *memories of repairs* as a project

Manuel del Olmo uses a precise and detailed language for the operations that he considers the most sensitive, with instructions of good execution and use of materials, as well as concise descriptions of the buildings before the interventions. In some cases he justifies the purpose of the work, allowing us to understand the architect's criteria and therefore the actual nature of the work. The works suggested by del Olmo, in general terms, affected the vertical and horizontal structure, roofs, carpentry and finishes, depending on the needs of each

building. Regarding the structure, the aim was often to ensure the stability of the walls, through the construction of brick pillars and arches embedded in the earth walls, the execution of underpinning, or the replacement of some specific structures, such as galleries without disassembling the roofs, that would be supported by shores.

Given the representative quality of palaces, or perhaps simply its material qualities, we find a significative care. It is possible to find a better material quality, a greater accuracy, but it is also possible to find a certain attempt in preserving and recomposing the most significant architectural elements and the supports of the ornamentation, such as the wooden roofs or the stone structures. The texts portray an early approach for material conservation together with an attempt to repristinate certain architectural elements. In any case, the *memorias de reparos* are not specifying clearly whether there was a differential valuation in their material aspect (as costly pieces), cultural (as the work of the lineage) or of any other category.

3. The palace of the Forest and Grove of Heras

This building and its territory was bought by Íñigo López de Mendoza in 1422, when it was strictly regulated by the Dukes for its conservation and enjoyment as a hunting area. Many historical descriptions emphasized the surroundings and the palace, which completely disappeared just four decades ago. The palace, bounded by geometrical orchards, auxiliar facilities, chapels and enclosed private gardens, had a traditional U-shaped plan with two narrow and parallel wings. They enclosed the main courtyard together with the main structure of the palace (to the south) which had a rectangular plan and a gallery in each side. Thanks to the *memoria* drafted by Manuel del Olmo and a sketch we can understand its spaces and appearance, that is similar to other palaces of the nobility and the monarchy.

It is impossible to entirely justify his work on simple functional and utilitarian purposes since, at that time, it was going to lack its former function. In addition to consolidate the building, he tried to achieve a certain uniformity, avoiding the recognition of the works, but and conserving pre-existent materials. There are complex shoring works aimed at preserving the wooden roofs. The *maestro de obras* demonstrates his great knowledge of construction, materials and structural issues. He evidences that he intended to mantain (or create) autonomous perceptual uniformities (separated by spaces), even thougth sometimes he intentionally did not totally carries out. Together with the memoirs in the palace of Cardinal Mendoza, Manuel del Olmo acts in a peculiar way, counting with conservative approaches of the materiality with indications using a significant lexical such as keeping out of the rest (*que no desdiga de lo demás*), that must be done again imitating the context (*ymitando*), or ordering that paths (*remiendos*) that must be coloured as the stone so they may not seem to be a patch (*teñidos con un color que diga con la piedra vieja y no parezca ser remiendo*).

4. Conclusions

This *memorias* shows us a specific management aimed at preserving the personal legacy of the nobility and the memory of their antique lineage and legitimacy, throuth conserving a material that was able to remind their ideological messages. The collapse of the Ancien Régime also wrecked the management and conservation of their legacy. As a consecuence, all the buildings of these memoirs have not remained to the present day. Although the interventions could be prefiguring certains restoration criteria, there was actually a retrospective orientation towards the *concinnitas* and also the legibility of the symbols of a noble legacy. In this respect, the most conservative actions were carried out on the usual supports for the celebration of the lineage as stoneworks and carpentry.

PRO-MOBILITY: ANALYSIS, STUDY AND RESEARCH OF THE MOST INACCESSIBLE ARCHAEOLOGICAL HERITAGE

Márquez de la Plata, Adela Rueda – University of Extremadura, Cáceres, Spain, e-mail: adelarm@unex.es

Cruz Franco, Pablo A.– University of Extremadura, Cáceres, Spain, e-mail: pablocruzfranco@unex.es

Ramos Sánchez, Jorge A. – University of Extremadura, Cáceres, Spain, e-mail: jramossanchez@unex.es.

Abstract: Heritage is under constant pressure to be adapted for tourism use and is the economic lifeline of many cities. The aim of this research project is to propose a sustainable, new and inclusive tourist response thanks to virtual models that offer a new tourist experience. The project, led by the University of Extremadura (UEX) as a precursor of the digitisation of heritage, has the collaboration of the Consorcio de Mérida, which ensures access to the documentation and monuments for their digitisation and 6D survey. The methodology will use non-invasive tools such as GPR, UAVs and VR and AR technologies. The case study is the city of Merida, a World Heritage Site, where tourism is an economic engine and the tourist use of monuments is very polarised, some with high impact, while others are highly unknown, losing interest in society. The expected results are twofold: an effective interdisciplinary working methodology for heritage management, and the creation of new tourist attractions such as inclusive physical prototypes, virtual tours of the most inaccessible places, new digital tourist routes and gamification to attract new audiences.

Keywords: Virtual Twins, Heritage, HBIM Protocols, Digital Surveying, Prototyping.

1. Introduction

This paper presents the research project "Application of VR technologies and 6D surveys for the implementation of universal accessibility in the archaeological heritage of Roman public buildings", led by the University of Extremadura in collaboration with the Consorcio de Mérida. In the development of this project, virtual twins are being generated from the use of non-invasive tools as a sustainable alternative for the tourist management of heritage assets that suffer every day the wear and tear of use and abuse of their most tangible values, incorporating areas that are currently not accessible to the public into the visit.

This research project is being developed thanks to the financing of the Junta de Extremadura with the European Regional Development Funds (FEDER), allocating 149,078.60 € for this research. This project is based on a series of previous works carried out both in Mérida and in the city of Cáceres, so that this previous experience has contributed to the fact that some of the works proposed in the research have already been tested and proven.

Architectural and archaeological cultural heritage is constantly threatened by deterioration, which is why the Charter of Venice (ICOMOS, 1964), stated the need to document heritage, this being fundamental to manage, conserve or restore the historical legacy.

Nowadays, the use of 3D technologies for the generation of virtual twins is becoming more and more widespread, which led the London Charter (2006) to draw up recommendations that were subsequently developed in the Seville Principles (2011). Interdisciplinarity, complementarity, authenticity, historical accuracy and training are the principles that should govern the generation of virtual reconstructions.

2. Approach and Methodology

The work of the research project has been structured in three stages (Figure 1) in order to achieve the objectives, set out, each of the stages being composed of tasks that are assigned to each of the members of the research team.

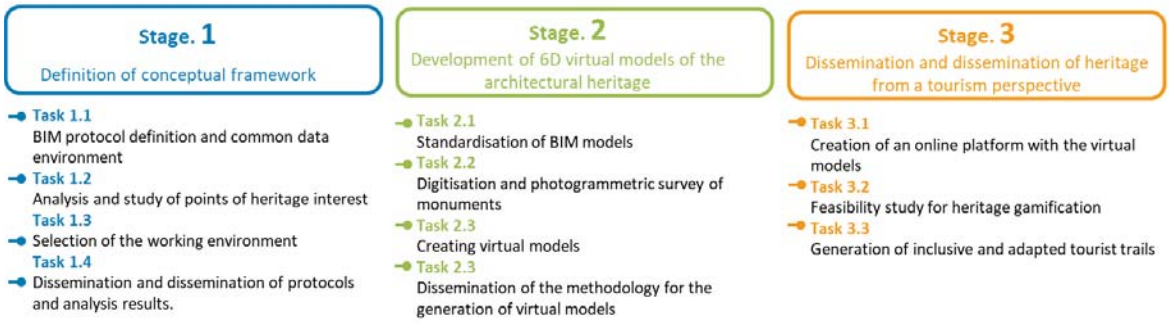


Figure 1. Stages and tasks for the development of the Project.

3. Results

The results obtained have been, on the one hand, a workflow that has been tested with the development of the pilot project for the generation of the virtual HBIM model of the Columbariums of Mérida, where not only has precision been obtained from the geometric point of view but also information of a semantic nature: characterisation of materials, construction systems, archaeological information... In short, a BIM model has been obtained that serves as a support tool for the daily work of professionals in different fields.

This method has been extrapolated to the Forum of the Colony of Emerita Augusta (Mérida). The aim is to digitise all the archaeological remains (museumised and non-museumised) in order to combine them in a single digital model, so that we can contextualise each of the excavations within the foral complex of Roman Merida. With this survey, we are able to facilitate the understanding of the archaeological remains for the non-specialist public. The digitisation work has been divided into several phases, starting with the so-called "Pórtico del Foro", which is a northern corner of the eastern platform of the foral complex. These remains are currently at street level and visible to the public. For this work, a colour scale has been created to indicate which elements are original, which are reconstructed and which are interpretations, following the principle of authenticity established in international heritage charters, where the virtual visitor will be able to differentiate between original elements and those that are not. (Figure 2)

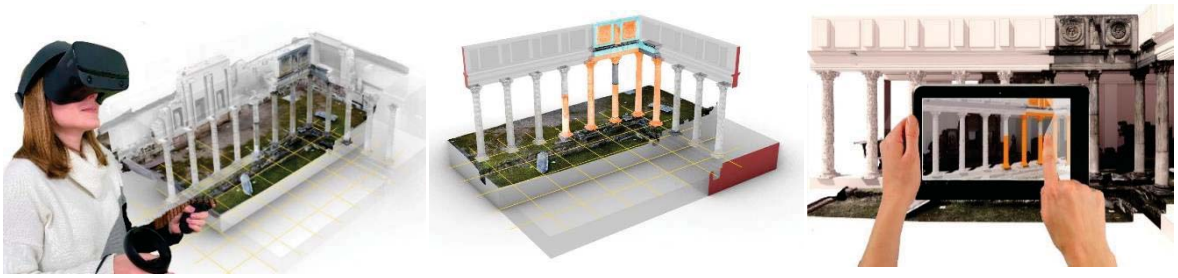


Figure 1. Virtualisation of the Portico of the Forum of Merida.

As a future development, work is being carried out on the photogrammetric survey of the Los Milagros aqueduct in Mérida. As a contribution to the research, an analysis of the graphic documentation of the aqueduct is being carried out in accordance with the existing techniques at the time, from the engravings made by Laborde at the beginning of the 19th century to the photogrammetric survey carried out at the present time.

Polychrome majolica of Apulian domes: history, technique, pathology and conservation

Mariella De Fino – Dept. DICATECh Polytechnic of Bari, Bari, Italy, mariella.defino@poliba.it

Vito Domenico Porcari – Dept. DICEM University of Basilicata, Matera, Italy, vitodomenico.porcari@unibas.it

Albina Scioti – Dept. DICATECh Polytechnic of Bari, Bari, Italy, albina.scioti@poliba.it

Stefano Sica – Dept. DICATECh Polytechnic of Bari, Bari, Italy, s.sica@studenti.poliba.it

Antonella Guida – Dept. DICEM University of Basilicata, Matera, Italy, antonella.guida@unibas.it

Fabio Fatiguso - Department DICATECh Polytechnic of Bari, Bari, Italy, fabio.fatiguso@poliba.it

Abstract: The paper is focused on the historical-architectural evolution and material-technical qualification of polychrome majolica domes that were built between the 17th and 19th centuries in Apulian religious buildings. In particular, the cultural context in which this solution spread throughout the Mediterranean area and the case history of construction and decorative techniques are. The study is then detailed on the Church of Santa Maria della Vetrana in Castellana Grotte (BA), for which the morpho-typological survey and mapping of the decay state are presented, based on the use of terrestrial and aerial photogrammetry. Finally, based on the identification of the main pathologies from both direct and indirect alteration factors, the most appropriate conservation and maintenance interventions are outlined, with specific focus on repair and integration of the majolica tiles, according to principles of high compatibility and low intrusiveness for a solution meeting artisan tradition and technical practice.

Keywords: majolica domes; aerial photogrammetry; 3D modelling; non-destructive techniques; restoration treatments

Introduction

The scientific literature on polychrome majolica domes generally follows two separate lines: (i) the analysis and modelling of the "dome construction system" as structural and envelope component of religious monumental buildings; (ii) and, the characterization of the "ceramic material manufactured as majolica". This work aims to fill the gap, by developing some previous studies [1, 2, 3] and proposing some methodological guidelines and operational procedures toward an integrated approach for assessment and intervention, by defining general principles for decay diagnosis and treatment of the whole support-tile-coating system.

Methods and tools

The proposed workflow (Fig.1), applied to a representative case study in South Italy, the Church of Santa Maria della Vetrana, is composed of four tasks: T1. Digital Survey of the morpho-typological and material-constructive characteristics of the dome, the supporting structures and the envelope system of the internal space below, by means of digital terrestrial and aerial photogrammetry; T2. 3D Modelling for photorealistic representation, by processing the photographic images with SfM (Structure from Motion) and MVR (Multiview Stereo Reconstruction) procedures, in order to obtain coloured point clouds and textured polygonal meshes and, thus, extract 2D CAD drawings and orthoimages; T3. Decay Mapping, related to crack/deformation patterns, humidity stains and the surface alterations, including some

peculiar deterioration patterns, namely leaching and corrosion; T4. Diagnosis of the state of conservation, taking into account some typical defects and failures for this type of system, namely dome buckling, infiltration and/or condensation humidity on the indoor surfaces and physical obsolescence of the mantle due to exposure to environmental agents.

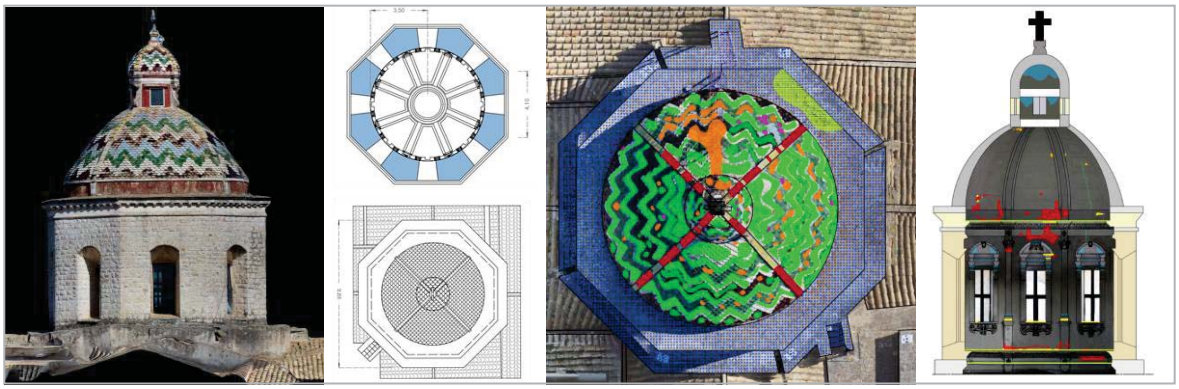


Figure 1. 3D model, 2D drawings and decay maps on orthoimages from digital photogrammetry survey,

Results

From the results of the methodical workflow on the case study, it was found that the deterioration of the majolica shingles is caused by: (i) direct alteration factors, namely the interaction with the surrounding environment, resulting in missing and fractured elements, detachment of the vitreous coating, chromatic alteration and leaching of the polychrome mantle; (ii) and, indirect alteration factors, structural buckling and infiltration humidity, detectable from the crack patterns along the dome meridians and the efflorescence stains at the dome/drum connection. Particularly, beyond reinforcement and dehumidification works, specific attention should be paid to recover the physical integrity and performance reliability of the polychrome mantle, by a series of treatments, that should two main approaches: planning the restoration onsite to avoid laborious anastylosis procedures and delicate works to remove the elements, with risk of fracture; applying different methods and techniques, depending on the specific alterations and the most trustworthy laboratory treatments for repair, consolidation and cleaning of mobile ceramic artefacts, following artisanal procedures.

Conclusions

The attention to this remarkable architectural solution rises from the acknowledgment of its distinctive role as landmark of the built heritage and its landscape across the Mediterranean area. Nevertheless, it is elicited by the increasing tendency, within contemporary restoration works, to replace the original damaged elements with industrial ones, showing high durability, excellent mechanical resistance, reduced thickness and low cost. Such a practice might neglect those imperfections, colour shades and changing shine, that should be kept by methods and procedures of preventive and conservative maintenance against degradation phenomena.

References

[1] Zerlenga O., Cirillo V., Cennamo C., Cusano C. (2021). The majolica dome of Santa Maria della Sanità in Naples. Geometric configuration analysis and stability studies. Informes de la construcción, 73 (562), 1-11

[2] Dell'Aquila C., Favia C. Primo inventario delle cupole maiolicate in Puglia, (1979), In: Atti XII convegno internazionale della ceramica, Albisola (SV), 31 May – 3 June 1979

[3] de Cadilhac R., Catella M. A., (2018). Cupole maiolicate in Puglia. Criteri e metodi nel percorso della conoscenza finalizzata alla conservazione. In: La conservazione del patrimonio artistico, architettonico, archeologico e paesaggistico, Luciano Editore, Napoli, ISBN: 978-88-6026-245-5

PROGETTAZIONE SALUTOGENICA E RIGENERAZIONE PER IL PATRIMONIO COSTRUITO

REGENERATION AND SALUTOGENIC DESIGN AND REGENERATION FOR BUILDING HERITAGE

Name - Rosa Maria Vitrano, University of Palermo, Italy, e-mail: rosamaria.vitrano@unipa.it

Abstract: A The design approach used and intended to be described is the 'Salutogenic Park City Immersive' which focuses on the renaturation of urban living environments. A strategic role is played by the use of greening and landscaping design systems that are able to absorb a significant share of the country's climate-changing gas emissions, as already partly highlighted by the European Green Deal. In particular, the key factors and methodologies of intervention are based on the interaction between Green City Adaptive and Resilient Design, in terms of physical redevelopment, environmental remediation and energy improvement, integrated with the enhancement of existing heritage. With the SPCI we intend to experiment with interventions that can act on associated life and social inclusion at all scales, operating an environmental reconversion that puts the inhabitant and his health at the centre of its interests, also with bottom-up procedures. Today, giving answers corresponding to new perspectives of renaissance and ecological transition with 'salutogenic design strategies' becomes an objective that can no longer be postponed, and technological design is among the disciplines called upon to give increasingly targeted and concrete answers from this perspective. Urban design can offer cities new metabolisms, oriented towards wellbeing and health, by carrying out a combined strategy of material recovery and technological adaptation, but also stimulate the process of collective consciousness, with targeted interventions, directing society towards a culture of conscious and evolved healthy living.

Keywords: regeneration, green city, sustainability, resilience, co-design

1. Introduction - Research framework and methodology

The research moved along two parallel trajectories: on the one hand encouraging international scientific and technical comparison in order to develop a deeper scientific debate on the possible environmental regeneration systems that can be activated by means of urban parkification (analysing three case studies in Spain and the United Kingdom), and on the other transforming theories into technologically competitive actions and strategies for direct verification on the territory of Porto Empedocle (AG).

In operational terms, the research identified those environments of the city that we could define as characterising/strategic, or rather capable by their nature not only of offering a new

service to citizens, but also of giving a sign of change, creating places and architectural spaces with the capacity to increase environmental wellbeing.

Vectors of development of the research project

1. in-depth study of the physical consistency, typological articulation and in general of the environmental situation in the territory of Porto Empedocle (AG);

2. comparison of urban and environmental regeneration solutions in European realities that have adopted specific programmes and projects;

3. construction of new information systems for the detection and monitoring of criticalities in the built environment;

4. experimentation of participatory processes for the implementation of adequate contrast policies.

Operational phases of the technological survey

- on the identity structure - survey on the different built areas that constitute the identity values (historical centre, periphery, coastline) including the peri-urban and agricultural areas surrounding the urban settlement and which constitute a reservoir of great potential for the redevelopment to be carried out

- on the environmental phenomenological structure - analysis of particular local environmental instability and/or imbalance factors and landscape: considerable presence of degraded and disused buildings both in the urban and suburban centre including the building aggregates of the disused industrial area and railway area.

The role of landscape study in Architecture Degreee courses

Sodano Cecilia – Sapienza Università di Roma, Roma, Italia, e-mail: cecilia.sodano@uniroma1.it

Santopuoli Nicola – Università *Alma mater studiorum*, Bologna, Italia, e-mail: nicola.santopuoli@unibo.it

Abstract: This contribution, which arises from the experience of teaching 'Principles of landscape protection' within the master's degree course in Architecture (Restoration) of the Sapienza University of Rome, focuses on the teaching of landscape disciplines in Architecture degreee courses.
At the end of their training, the students of the master's degree course in Architecture (Restoration) will been prepared for the design of the new architecture with particular attention to the modalities of intervention on the historic city, on the architectural heritage and on the existing landscape. The teaching of landscape disciplines stands as a related and related discipline, but it is no less worthy of attention for this.
We want to propose a reflection on what should be the basic skills of an architect who has to deal with an architect or the restoration of a building, an archaeological area or a settlement that relate to the landscape and draw from it part of their identity.

Keywords: teaching landscape, architecture, Lynch, Cullen, Norberg-Schulz.

The contribution will describe the teaching experience of Principles of landscape protection that architect Cecilia Sodano held as a lecturer in the Master's Degree course in Architecture (Restoration) of Sapienza University of Rome between the years 2019 and 2022, proposing a reflection on which landscape skills must be acquired, at the end of their training, by the students of architecture courses.
We will then take into account the training course proposed in teaching Principles of landscape protection over the years and the reasons that led to the choices of the particular educational program. This is the result of the discussion with the two presidents of the course who have alternated (one of which is Prof. Nicola Santopuoli, co-author of this contribution) from 2017 to 2021.
The course consists in two parts: a theoretical one, in which the Italian heritage protection legislation and the most important European and international documents on the landscape are presented, and a theoretical-methodological one in which some methods of perceptual analysis of space are presented. On these methods the application of which exercises were then proposed.
The method of serial visions of Gordon Cullen, the method of 'mind maps' of Kevin Lynch and the theory of the 'qualitative' phenomenology of architecture developed by Christian Norberg-Schulz and described in his book *Genius loci* were presented, showing some examples of application of the methods taken from the papers that students made as exercises.
We will try to account for the didactic choices and the fact that the knowledge of the proposed space perceptual analysis methods can be useful to future architects not only in the landscape field, because these methods help the designer to be aware of the characters and the identity of the place he or she is getting ready to modify: the space, whether urban or natural, represents the daily bread of an architect, the main subject of his work.

A teaching experience in cooperation between University and Municipality for the reuse of an architectural complex in Northern Italy

Eva Coïsson – CICCREI, University of Parma, Parma, Italy, eva.coisson@unipr.it

Chiara Vernizzi – CICCREI, University of Parma, Parma, Italy, chiara.vernizzi@unipr.it

Elena Zanazzi – DIA, University of Parma, Parma, Italy, elena.zanazzi@unipr.it

Abstract: The paper presents a teaching experience, which took place as part of a studio course in the bachelor's degree program in Architecture Regeneration Sustainability (University of Parma). The students were involved in an intensive workshop for the restoration and reuse of a public residential complex located in a small village in Northern Italy. The building was subjected to a large intervention more than 20 years, but since then it was left unused and now is in critical conditions, waiting to find a new use to serve the community. This formative project developed within the framework of a research collaboration with the local Municipality and saw the active involvement of both the Department's internal professionals and the municipal administration, thus creating stimulating opportunities for students to discuss a concrete issue.

Keywords: reuse, restoration, workshop, didactics

1. Introduction

In the last few years, the debate on the teaching of conservation and restoration has certainly proved to be a lively field [Di Biase, 2019; Ottoni et al., 2021], which was analyzed from various points of view: internationalization, distance learning, practical approach to the subject with site visits or case study analysis. In this context, there are numerous contributions [Pittaluga, 2017; Scala, 2017] that argue that giving students the opportunity to interface with a concrete case study undoubtedly provides valuable and fruitful support for the transmission of knowledge. This is even more true when the students have the opportunity to confront the real problems and needs of a community, and they are challenged to provide possible solutions.

This paper presents the teaching experience that took place in April 2022 as part of the Laboratory of Analysis and Design for the Recovery of existing buildings, related to the bachelor's degree program of Architecture Regeneration Sustainability (Department of Engineering and Architecture, University of Parma). 24 students were involved in an intensive week-long workshop on the theme of the restoration and reuse of the residential complex named "Ex-Iside", in the small village of Vianino, in the municipality of Varano de' Melegari, in the province of Parma (Northern Italy). This formative project developed within the framework of a research collaboration between the Municipality of Varano and CICCREI (Interdepartmental Center of the University of Parma for the construction, conservation and regeneration of buildings and infrastructures) and saw the active involvement of both the Department's internal professionals and the municipal administration, thus creating, during the workshop, stimulating opportunities for students to discuss a concrete topic.

2. The case study: the complex “Ex-Iside”

The complex, named ex-Iside, consists of two adjacent buildings: a historic one and one built in the late 1990s in substitution of a previous masonry construction. The new construction underwent renovations in 2013 that were never completed and is now in a condition of structural non-compliance with current seismic, energy and plant engineering regulations. Moreover, the original intended use, i.e. public housing, conceived more than 20 years ago, no longer appears to conform to the needs of the territory of Vianino. Therefore, this building, located in the center of the small village, is currently without its function and definitely oversized compared to the context. The municipal administration, owner of the property, given the needs expressed by the territory, asked the students to evaluate the possibilities of transforming the complex into a multi-purpose center, hosting some medical activities and meeting the design criteria of sustainability, not only from an energy and environmental point of view but also from the social and economic ones. The students were then encouraged to look for possible additional public functions themselves, which would meet both the vocation of the building and the needs of the local community [Della Torre, 2010; Pugliano, 2017], with a view to the overall redevelopment of the central area of the hamlet of Vianino.

3. Workshop results

Once the site inspections had been carried out and the local administration's requests had been exposed, the students worked for a week divided into small groups, under the supervision of the teachers, producing graphic designs and reports, which were then presented on the final day to the municipal referents. The experience turned out to be successful and interesting both for the students of the Laboratory, who found themselves in contact with a real theme of reuse and refurbishing of an existing complex, and for the Municipal Administration, which was able to evaluate different possible architectural responses to its requests: a collaboration between the University and the territory that allowed the establishment of interesting moments of discussion in the context of third mission activities.

References

[1] S. Della Torre (2010) Economics of planned conservation, in M. Mälkki, K. Schmidt Thomé (eds.), Integrating Aims. Built Heritage in Social and Economic Development, Helsinki University of Technology, Centre for Urban and Regional Studies Publications, pp. 141-156

[2] C. Di Biase, F. Albani (eds.) (2019) The teaching of architectural conservation in Europe, Santarcangelo di Romagna: Maggioli Editore

[3] F. Ottoni, E. Coïsson, A. Donatelli, M. Acierno (eds.) (2021) Il giuramento di Vitruvio. Spunti e riflessioni per la didattica nel Restauro, Roma: Quasar

[4] D. Pittaluga (2017) Sperimentazione e ricerca in cantiere: un’opportunità di formazione, una risorsa per la conservazione di lunga durata, in S. Della Torre (eds.), RICerca/REStauro – Sezione 3a: Progetto e cantiere: orizzonti operativi, Roma: Quasar, pp. 689-698

[5] G. Pugliano (2017) La centralità del tema dell’‘uso’ nel progetto di restauro architettonico contemporaneo. Questioni metodologiche ed operative, in S. Della Torre (eds.), RICerca/REStauro – Sezione 3a: Progetto e cantiere: orizzonti operativi, Roma: Quasar, pp. 617-625

[6] B. Scala (2017) Pratiche costruttive e pratiche di riparazione. Imparare dalla tradizione edilizia storica: alcuni casi nel territorio bresciano, in M. Sette, F. Mariano, E. Vassallo (eds.), RICerca/REStauro – Sezione 6: Ricerca in-formazione, Roma: Quasar, pp. 1102-1113

Traditional Materials in Higher Education

Ana Velosa – University of Aveiro, Aveiro, Portugal, avelosa@ua.pt

Abstract: The wide spatial and temporal use of traditional materials justifies their in-depth study, which may be transversal to various areas that intervene directly in conservation processes. This paper provides theoretical and practical basis for this meed and gives the example of a new curricular unite "Traditional Materials" prepared for and taught in the degree of Building Cnservation at he University of Aveiro.

Keywords: traditional materials; teaching; higher education; case study

1. Introduction

Interventions in the building stock have become common practice as there is a significant number of buildings that need refurbishment and maintainance. If these buildings are previous to mid 20th Century, there original construction was performed with what may be designated as traditional materials, many of which still prevail. Prior to the inetervention itself, an evaluation of the conservation state must be performed encompassing a complete characterization of the building materials. This characterization and the subsequent choice of materials for the intervention is a relevant step towards adequate conservation practice. In this procedure various formation backgrounds intervene and there is a necessary dialogue between conservators/restorers, architects, engineers and others. For this purpose common ground in terms of knowledge of traditional materials may be advantageous for an adequate outcome. This paper will focus on the curricular unit "Traditional Materials" taught in the Building Conservation degree at the University of Aveiro.

2. Context

After a period of strong performance in the construction sector supported by an economic cycle that favored new build, there is currently a substantial building stock in Portugal. Existing buildings need periodic intervention actions, whether maintenance or more specific and designated as rehabilitation works. As the building stock was erected and intervened over several periods, the use of different materials and different construction techniques is evident.

According to the document "Guidelines for Education and training in the conservation of Monuments, Ensembles and Sites" [1], guiding principles are established for the training of professionals who have the ability to intervene in the delicate area that is heritage. These principles establish, among others, the need to know the principles of intervention, to have bases of history and technology and the ability to perform work in multidisciplinary teams.

The wide spatial and temporal use of traditional materials justifies their in-depth study within a degree that aims to intervene in the built heritage. This study should be directed towards the identification of materials and knowledge of their characteristics, but also towards the development of theoretical and practical skills in the context of their use in traditional construction techniques. In the practice of heritage rehabilitation, in addition to the adequate

historical context of the building and the interventions carried out, a broad knowledge of the materials used is necessary in order to structure interventions that meet the requirements of compatibility and maintenance of authenticity recommended by the maps that indicate the criteria of intervention. This need is contextualized by the Krakow Charter, where it is specified that "...the knowledge of traditional construction materials and techniques must be stimulated, as well as their proper maintenance in the context of contemporary society, considering them as important components of cultural heritage. ..." [2].

The new curricular unit "Traditional Materials", was created within the scope of a new degree (Building Conservation) which aimed to fill a gap in the market, generating skills for future professionals in this area and allowing students to be able to, in a real context, identify and characterize traditional materials and techniques, and to develop integrated rehabilitation solutions based on the use of these materials and on theoretical principles.

2. Contents and methodology

Since there is no consensus on the definition of traditional materials, due to the history of production of construction materials, which began in the 19th century semi-industrial and industrial production processes, the selection of traditional materials was carried out taking into account the relevance of their use and leaving from outside materials executed in an industrial way. Thus, the natural materials stone and earth, used profusely in the walls until their replacement by brick and concrete, were addressed, taking into account their widespread presence in the heritage until the 1930s, when modernist architecture promoted the use of reinforced concrete. As an essential material for rendering and plastering, but also an integral part of walls, air lime appears, in widespread use until the 50s/60s of the last century. Several techniques, more or less elaborate, are associated with this material, the versatility of which has allowed a variability of applications. As a binder, gypsum and stucco techniques were also extremely relevant in the ornamentation of buildings until the last century, and gypsum is still often used in coatings today. Glazed tiles, of manual and semi-industrial production, profusely applied since the 19th century, were included for their relevance in Portuguese heritage. In order to ensure in-depth knowledge of local materials and techniques, a particular focus was given to earth as a building material, addressing its use around the world and across the country, but focusing on locally manufactured adobe. Another natural material, wood, used both as a structural material and as a final coating material was analyzed in the national context, but also in the local context of use in the wooden houses on the coast, a particular heritage in the Aveiro area and in need of protection and protection actions. rehabilitation.

Methodologically, theoretical and practical classes were prepared and performed in close interconnection., providing theoretical introductions to laboratorial classes in which students worked with traditional materials and applied traditional techniques. In addition to the theoretical and laboratory knowledge it was thought essential to exercise the skills achieved. In this context, the identification, analysis and proposal of solutions for traditional materials was carried out in a real context in the final moments of the curricular unit.

3. Conclusions

It was ntended that students acquire skills in terms of generalist identification of traditional materials and the contextualization of their use, through the curricular unit "Traditional Materials" taught at the University of Aveiro. This knowledge proved to be useful for

professionals in the area and a reflection should be undertaken for its widespread to other areas in higher education.

References

[1] Guidelines for Education and training in the conservation of Monuments, Ensembles and Sites, ICOMOS, 1993

[2] Krakow Charter, Principles for conservation and restoration of built heritage

Krakow (Poland), 26 October 2000

The Sacro Monte and the Convent of San Vivaldo in Montaione (FI)

Giovanni Pancani - G.P. University of Florence, Florence, Italy, giovanni.pancani@unifi.it

Lorenzo Matteoli - L.M. University of Florence, Florence, Italy, lorenzo.matteoli@unifi.it

Extended abstract

This research project is part of a wider programme originating from the collaboration between the Department of Architecture of the University of Florence (DiDA), the ISCTE-IUL of the University of Lisbon, the UB of the University of Barcelona and the UCP-CEHR of the Portuguese Catholic University, under the common name of "F-ATLAS - Franciscan Landscapes: the Observance between Italy, Portugal and Spain" (http://www.f-atlas.eu); the European project is part of the JPI-CH (Joint Programming Initiative in Cultural Heritage) programme. The Holy Land, where Jesus Christ was born and lived, witnessed the last days of his life, and also witnessed the events of his Passion, Death and Resurrection, thus becoming, from the 4th century onwards, the preferred destination of pilgrimage and proving an important aspect of religious life and participatory devotion. However, with the weakening of Western influence in the Holy Land and the consolidation of the Ottoman Empire, pilgrimages to Palestine became increasingly difficult in practical terms. To remedy this, but with the aim of preserving the feeling of peregrinatio, so-called substitute practices were introduced, designed precisely to acquire an indulgence that was equivalent to a pilgrimage to Jerusalem. To make this practice possible, some friars of the Order of Friars Minor of St. Francis who were present in the Holy Land at the turn of the 16th century reconstructed the Holy Places of Palestine in a faithful imitation upon their return: this was how the New Jerusalem of Varallo Sesia in Piedmont by Friar Bernardino Caimi, and the New Jerusalem of Montaione in Tuscany by Friar Tommaso of Florence came to be. The first evidence in the area subject to investigation is the church of Santa Maria in Camporena in Bosco Tondo (c. 1185-1187), belonging to the diocese of Volterra. Records tell us of a hermitage known as locus sancti Vivaldi as early as 1220, while a small church with an adjoining hermitage (Sancta Maria del Romitorio) is documented in 1224. Following various events, from the 12th and 14th centuries, the Selva di Camporena was the site of small hermit communities, which in 1497, were acquired by the Franciscan friars. Tradition has it that Saint Vivaldo was a native of San Gimignano and belonged to the Third Order of Saint Francis. In 1300 he supposedly retired to live a hermit's life in the Camporena forest [4]. About ten years after the death of San Vivaldo (around 1320), a small church was built at Castagno, in the care of Romites of the Third Order of Saint Francis: this currently corresponds to the chapel on the side of the church porch. Later, in 1405, the church of Santa Maria in Camporena was built by a number of citizens of Montaione. It was with Fra Tommaso da Firenze, who was certainly present in the Holy Land where the Franciscans had always guarded the Holy Sepulchre, that the construction of the Sacro Monte di San Vivaldo took place: it was a set of small chapels recalling the Holy Places of Jerusalem, and inspired by the Varallo Sesia complex already founded in 1493. The construction of the San Vivaldo complex therefore took place between 1500 and

1515. As things stand, complete surveys of the 18 chapels that make up the Sacro Monte complex have been carried out, and measurements of the exterior of the convent and the interior of the church have also been commenced. The Chapels were surveyed in the spring of 2021 and the first results of the work were summarised in Greta Safina's degree thesis. The first phase of the survey was carried out with a Z+F 5016 laser scanner, thanks to which it was possible to perform high-definition scans with a very high texture quality. The general point cloud involved the registration of all the scans of the interiors with the more general scan of the exteriors, by means of a working procedure that can be liken to a closed polygonal topographic type. Parallel to the laser scanner survey and the photogrammetric survey from the ground, a first aerial-photogrammetric SfM (structure from motion) survey was also carried out with a dji Mavic2 Pro drone, to scan the territorial context of the Chapels and the San Vivaldo convent. In the 1:50 scale reconstruction of the chapels of the sacred mountain, all the profiles of the buildings were accurately described and accompanied by an accurate photogrammetric reconstruction of all the internal and external surfaces. In addition, special care was taken to represent the terracotta sculptures depicting the Passion of Christ. The orthophoto plans were produced using SfM photomodelling methods, for which 3DZephyr software was used. In spring 2022, the complex of the exterior of the monastery together with the interior of the church of San Vivaldo was surveyed. The survey was performed using a Faro M70 laser scanner to conduct 135 scans, with an average mesh size of approximately 7 mm. In this case, the scans were performed without the acquisition of the corresponding photographic image. For this aspect, an SfM photogrammetric survey carried out with a drone was chosen for the realisation of the orthophotoplans. The interiors of the church, the monastery and the exteriors of the small entrance square were rendered first. The same graphic methodology used in the reconstruction of the chapels of Sacro Monte was used for these reconstructions, CAD profiles and orthophoto plans for describing the texture of the surfaces and decorations. The comparison of the Valdelsa layout with that of 15th-century Jerusalem, or rather with the image that emerged from the various travel journals published in the 14th to 17th centuries, is only one aspect of the research carried out at San Vivaldo. The entire spectrum of documentation, such as the layout of the various chapels on the ground, their architectural history, up to the orographic conformation of the area itself must be taken into consideration. San Vivaldo is a topographical imitation of a territorial model and, therefore, the reasons for its apparent disorganisation can be explained by the compromise adopted between the placement of the various chapels, with respect to the contours of the terrain, and the correct sequencing of the scenes of the episodes depicted.

The superimposition of the scaled Jerusalem floor plan on that of St. Vivaldo's to compare the coinciding points.

Architectural heritage: intervention to continue

Malheiro, Miguel – Universidade Lusíada Norte – Porto/ CITAD*, miguelmalheiro@por.ulusiada.pt*

Abstract: Intervention in the architectural heritage is the subject of this article, where a reflection is made on the criteria and solutions that were produced to adapt the interventions in a set of pre-existing monuments whose coordination was in our charge or we participated in it, namely in the Church of São Mamede de Vila Verde, Torre de Vilar, Church of the Monastery of Travanca, Cathedral of Beja, Chapel of Nossa Senhora da Conceição and Paço de Dona Loba. The intervention common to all of them is conservation, where a critical/creative action is proposed that sought the unity of the monument. If in individual intervention we are always interested in individualizing monuments in order to intervene efficiently in them, that is, to characterize them, determine their attributes and weaknesses in order to define the most coherent criteria, it now seemed appropriate to determine the paths followed, the criteria adopted in these interventions and which, in a way, constitute a practice of intervention in the architectural heritage over two decades.

Keywords: Architectural Heritage; Intervention; Conservation; Continuity

1. Introdução

O artigo debate a problemática da intervenção no património arquitectónico, evidenciando que conhecer, proteger e valorizar acabam por ser as três tarefas fundamentais e indissociáveis que se procuraram compatibilizar nas intervenções realizadas nos monumentos. Temos o dever de consolidar a relação entre o valor cultural e científico do monumento, em especial enquanto elemento identitário de uma comunidade inserida numa região, com as realidades sociais e económicas dessa mesma comunidade e região, melhorando-as através da valorização dos seus monumentos, esses ícones de identidade, para que essas comunidades continuem a estabelecer laços de identidade com eles e com a sua proteção.

2. Os monumentos

A avaliação que no presente atribuímos à herança que recebemos, é a primeira etapa que deve ser empreendida, através da identificação do valor e significado do objeto herdado. O entendimento que temos dos monumentos, deriva especialmente das comunidades que com eles convivem que neles veem uma projeção da sua própria identidade, um testemunho do seu passado histórico. No fundo, um edifício adquire esta qualidade quando a comunidade lhe atribui um valor documental e significativo, por muito simples que ele seja, ou mesmo quando se encontra em ruína. A noção de Monumento é ampliada para a noção de bem cultural através da Carta de Cracóvia, passando, para além da edificação e ambiente físico em que se insere, a "*integrar*" a sociedade que historicamente atuou nele. A nossa intenção sempre foi a conservação do monumento, a legibilidade da identidade arquitectónica, a beneficiação das infraestruturas, a dignidade, integridade e conservação dos restos originais. Definem-se os fins, objetivos e uma estratégia.

3. Conservação para quem?

O monumento é a soma dos valores de carácter documental, arquitectónico e de significação [2]. O objetivo último da intervenção no património arquitectónico assenta na proteção destes três valores que se relacionam intimamente com a comunidade, bem como com a humanidade, já que ele tem a capacidade de nos contar a história do seu passado como dos que a ele estiveram ligados e, testemunhar acontecimentos passados. Acima de tudo, a intervenção nos monumentos faz-se para a comunidade, para garantir ou melhorar o seu estado de conservação, uso ou significado coletivo, tanto do imóvel como da sua envolvente. A conservação do património arquitectónico pressupõe começar qualquer projeto de intervenção pelo conhecimento do monumento e da sua envolvente. A leitura, interpretação e compreensão de uma obra, é um caminho hermenêutico, implicando uma espécie de afastamento inevitável do objeto, depois de nele, fundamentalmente, se elaborarem os vários levantamentos, estudos e inspeções que se considerem adequados e imprescindíveis para a intervenção e difusão do conhecimento. A possibilidade de compreensão da obra constitui a meta mais ambiciosa da conservação. Qualquer ação implementada num monumento transforma-o. A conservação, ou melhor, a intervenção que se leva a cabo, é feita para que a coletividade, a população que convive com o monumento, o possa usufruir, possa disfrutar dele, como bem cultural e como bem quotidiano, sem separação entre bem e uso. Os monumentos são para os que historicamente os habitam e para os que se emocionam com o seu conhecimento e contemplação. Assim, torna-se importante que os usos que se lhes atribuem, em especial nos monumentos em ruína, sejam úteis à comunidade, relacionando passado e presente. As intervenções realizadas necessitaram de desenho e de construção, de projeto desenhado e sua materialização. Foi através da leitura de outros edifícios da época, da reinterpretação de outros desenhos, da sua própria citação, que procuramos inovar na tradição construtiva quando houve a necessidade de construir de novo. Quando foi necessário construir de novo ou sobre a preexistência, pressupós uma alteração irreversível, que sabemos existir, mas que foi inevitável.

4. Conclusões

A intervenção no património arquitectónico levanta várias questões que só podem ser esclarecidas por rigorosos diagnósticos multidisciplinares que reconheçam claramente os valores dos imóveis e patologias de que padecem. Conhecer, proteger e valorizar foram as tarefas fundamentais e indissociáveis que se tentaram compatibilizar nas intervenções realizadas. Verificou-se que a autenticidade não é um valor absoluto e foi no papel que o monumento tem para a comunidade, a sua história, que foi avaliado o grau de intervenção. A alteração, substituição e valorização de alguns materiais que constituem a materialidade foi feita de forma consciente para que se consiga salvaguardar a identidade, integridade e autenticidade do monumento/bem cultural.

Agradecimentos

Este trabalho é financiado por Fundos Nacionais através da FCT – Fundação para a Ciência e a Tecnologia no âmbito do Projecto UIDB/04026/2020.

Referências

[1] González Moreno-Navarro, Antoni (1999). *La restauración objetiva : método SCCM de restauración monumental*. 2 vol. Barcelona : Institut d´Éditions de la Diputació de Barcelona.

Villages and regeneration

Battaino Claudia - University of Trento - Department of Civil, Environmental and Mechanical Engineering, Trento, Italy, claudia.battaino@unitn.it

Gatti Maria Paola- University of Trento - Department of Civil, Environmental and Mechanical Engineering, Trento, Italy, mariapaola.gatti@unitn.it

Abstract: Abstract: Italy is dotted with numerous villages characterised by different cultural and local identities. Villages and communities in inland areas are the most critical, due to marginalisation phenomena.
The particular situation brought about by the pandemic and the pursuit of better living conditions has brought villages back to the centre of debate as the basis for the country's sustainable development.
The objective is not only to rethink the value of villages, with the aim of assigning them an important role in revitalisation of the territory, but at the same time to review the strategies and actions necessary to place them at the centre of new models of living and of utilising the historical built fabric, landscape and environment, in line with current demands and needs.
Starting from the cultural debate on the issue and the complex regulatory apparatus of regeneration programmes, the point of view identifies the need to implement a renewed planning process able to integrate traditional and innovative knowledge, a project based on a strategic document that looks to the future to fully discuss and decide which themes to invest in and which criticalities to resolve, in order to guarantee citizens and communities a better quality habitat and establish a priority grid for political, cultural and economic intervention.

Keywords: villages, regeneration, minor centres, enviroment, sustainability

Figure: From abandoned village to tourist village. Canale (Trento)

Diagnostics archive data for the analysis of the Architectural Heritage's conservation state

Morero Laura[1,2] **- Visone Francesca**[1,2] **- Porcari Vito Domenico**[1] **- Guida Antonella**[1,2] **- Masini Nicola**[1,2]

[1] University of Basilicata, DiCEM - Department of European and Mediterranean Culture: Architecture, Environment and Cultural Heritage, Matera, Italy, e-mail: (francesca.visone, laura.morero, vito.porcari, antonella.guida)@unibas.it

[2] CNR - National Research Council of Italy, ISPC- Institute of Heritage Sciences, Potenza, Italy, e-mail: nicola.masini@cnr.it

Extended abstract

Placed as a hinge between analysis and decisions on interventions, the diagnosis involves interpretations on whose correctness may depend largely on the outcome of restorations and the future life of the building.

In the context of diagnosis, an important role is played by the knowledge of the history of restoration interventions and the investigations connected to them in order to orient and finalise new diagnostic investigations and to compare data acquired at different times with the dual purpose of integrating them and discovering constructive and structural variations occurred.

In fact, the knowledge of buildings can benefit from a significant advancement by means of instrumental investigations through which it is possible to retrace techniques and measuring instruments used throughout the various epochs, analysing their complementarity, interpretations, limitations and progress over time.

The diagnostic cognitive project is therefore a complex procedure that defines, depending on the characteristics of the property under examination, the set of scientific investigations preliminary to restoration and related to monitoring during and after interventions.

This integrated methodology aspires to multiple objectives including the support and design of a new investigation plan made reliable and effective through "archival diagnostics".

Such diagnostics opens infinite opportunities: validating or refuting operational hypotheses of previous investigations, filling knowledge gaps, integrating and expanding the available datasets by intervening on the technological gaps of previous diagnostic investigations that may not have allowed data to be acquired at the appropriate resolution, etc.

The methodological procedure that is going to be proposed would allow to carry out a diagnosis of the state of preservation using non-instrumental diagnostics by replacing laboratories with archive rooms, reading and interpreting folders full of documents, reports.

In this sense, archival research stands as a means of adding information on the conservation history and degradation, representing a useful diagnostic tool.

Whether in addition to the diagnostic data, anamnestic data are also available, and therefore the history of the restorations carried out over time and traced through archival study, the value of the data is even greater, as is the multiplying effect of the process of integration and interrelation of them that will be catalogued, classified, processed, and normalized.

It will thus be possible to obtain an ordered and standardized database capable of managing, containing, comparing, analyzing, and interpreting the corpus of information collected, which becomes a valid implementation of pre-existing computer platforms dedicated to architectural heritage.
This approach, in a view to future developments, can be made more immediate and effective from an operational point of view through the structuring of communicating and correlated cards that would contain all the information recorded or deduced in the various survey campaigns, generating a data system of great interest for the historical-critical process of knowledge.
The card designed for diagnostic surveys would, in fact, make it possible to relate a considerable amount of heterogeneous data by means of key elements such as the type of investigation conducted, the architectural element investigated, the construction material, etc.
Each card would talk about the individual experimental test, indicating its type, the methodology of execution, the staff involved and the results obtained.
The system, therefore, would be configured as a sort of expeditious cataloguing that collects a dataset of information common to several folders, from which it will then be possible to extrapolate information of a specific nature in a critical and comparative manner.
This generates a fluid process of information exchange and sharing, all aimed at integrating the conservation project and the maintenance plan.
Hence the intention to begin a critical and methodological reasoning on the added value that anamnesis and diagnosis based on archive data can provide from a cognitive and design point of view.
A case study that significantly validates the proposed methodology is the Cathedral of Troia (province of Foggia), one of the most valuable examples of Romanesque architecture in southern Italy.
The archival anamnesis of the Cathedral has allowed to explore how knowledge has grown over time through the study of restorations conducted over a time range that has no equal: from the mid-19th century to the entire 20th century, up to the early 2000s.
In this perspective, the Cathedral of Troia, as a palimpsest of practices and techniques, represents a useful tool for planning further studies and research on the architectural structure.
The paper retraces the history of the diagnostic investigations and monitoring carried out on the Cathedral between 1992 and 2004 from the analysis of published sources and unpublished archival funds.
The present work aims to discuss the potential, limits and opportunities provided by the integration of data obtained from laboratory analyses, in situ investigations and the study of constructive aspects, as a methodology suitable for a multiscale assessment and a complete vision of the monument's state of conservation, which is fundamental for the realization of conservative and preventive interventions (also to optimize maintenance costs).

Keywords: Troia Cathedral, Diagnostic methods and tools, Archive diagnostics, Big Data, Architectural conservation

IDENTITY OF APULIA'S WINE HERITAGE

Knowledge and valorisation of the F.lli Folonari wine establishment in Squinzano(LE)

Antonella Guida - Università degli Studi della Basilicata, DiCEM - Dipartimento delle Culture Europee e del Mediterraneo, Matera – antonella.guida@unibas.it

Graziella Bernardo - Università degli Studi della Basilicata - Dipartimento delle Culture Europee e del Mediterraneo (DiCEM) – Matera, Italia – graziella.bernardo@unibas.it

Antonio Monte – CNR-ISPC; Università degli Studi della Basilicata - Dipartimento delle Culture Europee e del Mediterraneo (DiCEM) – Matera, Italia – antonio.monte@cnr.it

Alessandro Lanzolla - Università degli Studi della Basilicata - Dipartimento delle Culture Europee e del Mediterraneo (DiCEM) – Matera, Italia – alessandro.lanzolla@unibas.it

Alexia Giannone - Università degli Studi della Basilicata - Dipartimento delle Culture Europee e del Mediterraneo (DiCEM) – Matera, Italia – alexia.giannone@unibas.it

Abstract:

Industrial heritage (IH) consists of the remains of industrial culture that have historical, technological, social, architectural and scientific value. These remains consist of buildings and machinery, workshops, factories, mines and sites for processing and refining, warehouses and shops, places where energy is generated, transmitted and used for transport and all related infrastructure, as well as places used for related social activities such as housing, religious worship or education1. The article focuses on the analysis of the industrial wine heritage of the Apulia region, focusing on the former F.lli Folonari plant in Squinzano in the province of Lecce, one of the largest and most important factories ever built, whose productivity and profitability strongly influenced the growth of the area.

Area that, no longer fulfilling its original functions, was abandoned, triggering a slow and progressive process of obsolescence that involved not only the structures, but also the urban, economic, environmental and social context surrounding them. The objective is to valorise, through knowledge and analysis, the industrial wine-growing heritage of Salento, which in the early 20th century was the protagonist of the productive economic growth of the entire Apulia region. A heritage, therefore, to be safeguarded and enhanced.

After the Second World War, the industrial sector suffered a crisis that led first to a reduction in production and then to a slow abandonment of all those industrial structures and buildings unable to adapt to new conditions. The study carried out focuses on the analysis of the wine-growing heritage of the Apulia region in the various phases in which it was involved.

As part of this experimentation, the study focuses on the entrepreneurial evolution of the Folonari family, who played a catalytic role in the region's productive development, building five wine-making plants between 1902 and 1910.

In particular, this work is a part of a detailed analysis of the area of the F.lli Folonari plant in Squinzano in the province of Lecce, the largest and most representative establishment, starting from the historical evolutionary analysis up to its decommissioning, with the objective of knowledge, valorisation and protection of the site.

This modus operandi, which has become widespread in recent years, is seen as an opportunity and a resource for the development of the territory; it highlights how the inheritance of a vast and substantial cultural heritage implies important choices of preservation, recovery and valorisation that must be preceded by the community's recognition of the elements that define local identity and collective memory.

Only in this way is it possible to keep traditions alive and extend the single intervention from the urban scale to the surrounding territory. The objective of this work, therefore, is to activate a process of knowledge of a small part of disused industrial heritage by enhancing the historical, social and urban memory transmitted by the many individual and interconnected stories of all the people who have lived in that place. The Squinzano plant must still be recognised as a historical and cultural heritage to be safeguarded and protected in respect of its architectural and technological features, investigated in this study.

It is precisely the need to raise awareness and publicise these industrial, physical and social heritages that is at the basis of this work, but above all as the start of a digital collection of knowledge on the territory of all these entrepreneurial and productive realities that today need a physical and media rebirth, passing through the need to bring these places back to the land and culture of the place that must accompany the rebirth not only of these artefacts but of the communities that have lived in them and must regain possession of them.

Keywords: Industrial Heritage, Knowledge and Valorisation, Wine Heritage, Apulian Heritage.

Documentation, conservation, and reuse planning activities for disused cultural heritage

Morandotti Marco – Department of Civil Engineering and Architecture DICAr, University of Pavia, Pavia, Italy, marco.morandotti@unipv.it

Doria Elisabetta - Department of Civil Engineering and Architecture DICAr, University of Pavia, Pavia, Italy, elisabetta.doria@unipv.it

Abstract: The present contribution illustrates the process of documentation and setting-up of a digital database of a portion of Bellisomi-Vistarino Palace in Pavia (Italy). Despite recent restoration work, there are still disused portions of the complex. The approach to a disuse portion of the building is the pilot case in the perspective of a broader work of integral documentation of the whole complex. The aim is to define a digital support for diagnostic and restoration planning activities in the perspective to enhance and create a new cultural attraction for the city. This is achieved by structuring a tridimensional digital twin and database connected to it to monitor the assets and generate digital environments for cultural and touristic enhancement.

Keywords: Documentation, Cultural Heritage conservation, Information System, 3D Model, Pavia.

1. Introduction

Bellisomi-Vistarino Palace was edified from the aggregation of several buildings arranged in a single block and is one of the examples of Lombard *barocchetto*. The Palace is based on the *Villa di delizia* Renaissance archetype, and the renovation that characterizes it occurred through the design of architect Francesco Croce. Today Palace Bellisomi-Vistarino is defined by a court of honour, a service court, a large garden with a boundary wall and Belvedere, an important grand staircase and a noble floor with mezzanines and service rooms. Last restoration on the building was completed in 2013, however the garden and the ground floor rooms facing the loggia remained excluded from this intervention and are still in a state of disuse. The contribution proposes a preliminary analysis and the results of the survey and documentation of the Palace garden as a starting point for developing an intervention proposal for the reuse of the still unused rooms to connect again the garden of the Palace and the Palace itself, to the citizenship. The process described is part of a more ambitious goal of the Foundation *Alma Mater Ticinensis* and the University for the enhancement of the Palace and its use through cultural offerings. A scientific group has been established to develop this research, including Prof. Olimpia Niglio, Prof. Sandro Parrinello and Prof. Massimiliano Savorra of the University of Pavia.

2. Actions conducted and proposals for enhancement

The garden is the core of a larger project that reconnects the built architecture of the Palace with the surrounding landscape. The integral survey involved the use of digital instrumentation such as Terrestrial Laser Scanner for metric reliability, UAV instruments for roof acquisition, and Structure from Motion photogrammetry for generating metrically reliable orthophoto and models. Starting from the survey and the analysis of the architectural decorative elements, were developed reliable drawings for the description of the architecture as a basis for the analysis of pathologies and present. The final products processed enable a process of documentation of critical issues prior to future restoration work as a historian of the evolution of the pathologies found. With careful restoration and enhancement, the Palace lends itself to triggering a regeneration and identity reappropriation. On the one hand, the cultural functions already carried out by the Foundation will be able to take advantage of the open and redeveloped space of the park for cultural events; on the other hand, the public

opening of the park to a wider user base will constitute an element of social rapprochement to a space that is now forgotten. The project involves the conservative restoration of two architectural elements tightly integrated with the park: the loggia, and the opposite front of the park, the Belvedere. The morphology of the park and the connections that already exist today will provide a series of differentiated accesses and adequate separation of user distribution flows. The goals of the restoration and enhancement proposal focus on the following issues: to enrich the Palace and the city with new cultural interest; to guarantee of high standards of management, maintenance, safety, and welcome ensured by the presence of the Foundation; to manage over time following rapid evolution of scientific research topics; to strengthening the identity of the places of the building and the city by opening the space to urban usability; to promote sustainability in the regeneration of a multipurpose space open to the recovery of environmental issues.

3. Conclusions

To develop these objectives, was produced a three-dimensional model of portion of the Palace that can be used as a digital support for intervention and enhancement planning; it is used as a support for the creation of navigable virtual environments and as a structure of an information system enriched with information and data on the state of conservation of the elements surveyed during the documentation phase. The stages of the process described in this contribution included: Historical archival analysis; Survey and digital documentation of the sites; Implementation of an information system aimed at the management of the asset; Support to the identification of architectural restoration strategies; Support to the definition of intervention techniques; Support in defining actions to enhance the value of the asset. Among future goals, it will be useful to extend the survey and digital documentation to the entire Palace to obtain a comprehensive model. Desirable long-term goals are the improvement of cultural and service offerings, to foster the development of ecosystem functions with direct and positive environmental impacts, and to strengthen and disseminate scientific, technical, environmental, and architectural sustainability know-how.

References

[1]. Vicini, D. (1978) Per l'architettura pavese del Settecento: palazzo Bellisomi-Vistarino, note preliminari, Bollettino della Società Pavese di storia Patria, Pavia, Tipografia del Libro, pp. 23.
[2]. Forni, M. (1989) Cultura e residenza aristocratica a Pavia tra ’600 e ’700, Milano, Franco Angeli.
[3]. Erba, L. (2000) Spunti per una storia del giardino a Pavia. Annali di Storia Pavese, n° 28, pp. 193-206.
[4]. Forni, M. (2020) Palazzo Bellisomi Vistarino, Almum Studium Papiense, Storia dell’Università di Pavia, Vol. 3, II, Milano, Monduzzi Editoriale srl. pp. 683-698.
[5]. Giardini, E. (1839) Memorie topografiche dei cambiamenti avvenuti e delle opere state eseguite nella città di Pavia sulla fine del secolo XVIII e nel principio del XIX infino all’anno MDCCCXXX, Pavia, Stamperia Fusi e C, p. 177.
[6]. Morandotti, M. (2018) Planning the re-use: sustainability trough resilience evaluation of existing historical buildings. Innovative Built Heritage Models, vol. 3, London, CRC Press / Balkema, pp. 194.
[7]. Doria, E., Galasso, F., Morandotti, M. (2022). Heritage documentation and management processes: Castiglioni Chapel in Pavia. ACTA IMEKO journal, Vol. 11, No 1.



Behavioural decision-making in sustainable conservation of built heritage

Joana dos Santos Gonçalves – TU Delft, Delft, The Netherlands, e-mail: j.m.dossantosgoncalves@tudelft.nl

Ricardo Mateus – ISISE, University of Minho, Guimarães, Portugal, e-mail: ricardomateus@civil.uminho.pt

José Dinis Silvestre – CERIS, IST, University of Lisbon, Lisbon, Portugal, e-mail: jose.silvestre@tecnico.ulisboa.pt

Ana Pereira Roders – TU Delft, Delft, The Netherlands, e-mail: a.r.pereira-roders@tudelft.nl

Abstract: The role of heritage buildings in pursuing a more sustainable built environment has been widely discussed in the last decades. Norms, policies, standards, and design-aid tools have been developed to encourage urban conservation, but a question persists: why are best practices not yet widely implemented? Decision-making processes have an intrinsic behavioural dimension. This research uses the Theory of Planned Behaviour (TPB) to analyse design decisions and reveal the common beliefs, challenges, and opportunities in the conservation of heritage buildings. The results show that while responsibility for the failure in the implementation of conservation is often attributed to third parties, individual attitudes and personal beliefs strongly correlate to the adopted behaviours and, thus, need to be targeted for effective change. Understanding the behavioural dimension of the decision-making process in the adaptive reuse of built heritage is essential to maximise the effect of tools and policies that support actual change toward the growth of a circular economy and a more sustainable future.

Keywords: heritage; sustainability; sustainable conservation; behavioural decision making

1. Introduction

Sustainability is part of the vocabulary of interventions dealing with heritage buildings, yet its implementation is still far from being a reality. Implementation is dependent on decision-making processes that result from a conjugation of multiple factors, however, human behaviour is rarely considered a parameter when analysing built heritage conservation processes [1]. According to the TPB [2, 3, 4], the consistency between intention and behaviours depends on the alignment of three main conditions: 1) attitudes (personal evaluations); 2) subjective norms (normative and social expectations); and 3) perceived behavioural control (barriers to performance). Understanding which of these factors are affecting the implementation of intentions is essential to developing interventions that contribute to effective behavioural changes.

This research aims at analysing what factors are hindering implementation of conservation behaviours and contribute to achieve a more sustainable conservation of built heritage.

2. Understanding the intention-behaviour gap in heritage conservation

This research surveyed architects and engineers and observed and analysed architecture students' design decisions. With practitioners [5], it was possible to identify positive attitudes towards heritage conservation. However, there is a low perceived control over final

decisions, with challenges related to knowledge, skills, economic resources, and cooperation with other stakeholders in the process.

With architecture students, the intention-behaviour gap was quantified using a TPB survey and statistic correlation [6]. Students assume design decisions as self-chosen and autonomous, derived from personal beliefs, demonstrating that the former are deeply rooted in attitudes. The results also showed that sustainability is still perceived as the opposite of conservation. Targeting this belief, a building passport to assess the sustainability of heritage buildings [7] was applied by architecture students, allowing to compare attitudes and intentions with and without the use of this tool.

3. Conclusions

The use of the TPB to measure the intention-behaviour gap contributes to a better understanding of the factors affecting the implementation of good practices. The results show that low perceived behavioural control affects practitioners' implementation of sustainable conservation intentions and that personal attitudes have a key role in built heritage conservation. This suggests that switching from normative approaches, centred on social pressure and reward, towards approaches that target the internal motivation of designers is essential to achieve an effective change in the field of heritage and sustainability.

Acknowledgements

The authors would like to acknowledge the support granted by the Portuguese Foundation for Science and Technology (FCT), in the scope of the Doctoral Program EcoCoRe, to the PhD scholarship of the first author with the reference PD/BD/127853/2016, and the support of UMinho, IST-UL, and TU Delft.

References

1. Gonçalves, J., Mateus, R., Dinis Silvestre, J., and Pereira Roders, A., *Going beyond good intentions for the sustainable conservation of built heritage: A systematic literature review.* Sustainability, 2020. **12**(22): p. 9649.
2. Ajzen, I., *The theory of planned behavior.* Organizational behavior and human decision processes, 1991. **50**(2): p. 179-211.
3. Fishbein, M. and I. Ajzen, *Predicting and changing behavior: The reasoned action approach*. 2011: Taylor & Francis.
4. Sheeran, P., *Intention—behavior relations: a conceptual and empirical review.* European review of social psychology, 2002. **12**(1): p. 1-36.
5. Gonçalves, J., R. Mateus, and J.D. Silvestre. *Mapping professional practice challenges in built heritage*. in *Professionalism in the Built Heritage Sector: Edited Contributions to the International Conference on Professionalism in the Built Heritage Sector, February 5-8, 2018, Arenberg Castle, Leuven, Belgium*. 2019. CRC Press.
6. Gonçalves, J., Mateus, R, Dinis Silvestre, J., Pereira Roders, A., and Bragança, L., *Attitudes matter: measuring the intention-behaviour gap in built heritage conservation.* Sustainable Cities and Society, 2021.
7. Gonçalves, J., Mateus, R, Dinis Silvestre, J., Pereira Roders, A., and Bragança, L.., *Building passport for the sustainable conservation of built heritage.* Journal of Cultural Heritage Management and Sustainable Development, 2022.

Microclimatic monitoring as basis of a project process: an experimentation in Rome

Turchetti Gaia – PDTA Dip. Sapienza University of Rome, Italy, e-mail: gaia.turchetti@uniroma1.it

Abstract: The monitoring and analysis of outdoor climatic factors is one of the basic operations for a correct design intervention at different scales. A prudent intervention cannot ignore this type of anamnesis which is added to the investigations and assessments already more consolidated at an operational level in the design process. Timing, tools, and operational methodologies are elements on which to reflect and experiment to improve the operational process that from data collection leads to project definition, as part of a cognitive path. Understanding climatic or rather micro-climatic factors must not be the exclusive prerogative of disciplines 'other' than that of the designer, but must become part of the training course, so that the professional knows how to correctly dialogue with the specialists in the sector and draw from this dialogue a design reading of the problem. Starting from the experimentation of an expeditious microclimatic monitoring campaign in the historic city of Rome, the work presented here attempts to answer some of the questions that have emerged, proposing a calibration of collection and investigation tools and methodologies aimed at the design action.

Keywords: Microclimatic monitoring; historical city; urban regeneration; city of Rome; academic training

1. Introduction

The monitoring and analysis of outdoor climatic factors is one of the basic operations for a correct design intervention at different scales. A careful intervention cannot ignore this type of anamnesis which is added to the investigations and assessments already more consolidated at an operational level in the design process. The thing that frights in undertaking monitoring operations is very often the time factor, which hardly fits in with the client's requests. Although it is true that to obtain a stable climatic data it is necessary to carry out monitoring in extended temperature ranges, the time factor must be read in a long-term planning perspective, which means abandoning the incorrect practice of emergency intervention in favor of scheduled maintenance at different scales. This is more mandatory in complex fabrics such as historical ones where the time factor takes on an even more important value. A further cognitive and methodological step is then necessary: the understanding of climatic or rather microclimatic factors must not be the exclusive prerogative of 'other' disciplines than that of the designer, but must become part of his training path, so that the professional knows how to correctly communicate with the specialists in the sector and draw out from this dialogue a planning reading of the problem.
Therefore, the intervention here presented aims to analyze these problems, starting from the shortcomings and deficiencies emerged from an in-depth investigation of the state of the art and experimenting in the field the problems and potentialities of these surveys applied to the historical fabric of the city: as case study the historical city of Rome.

2. The importance of field research for the understanding of climatic factors in the complex systems of the historic city. The case of the historical city of Rome

The research here briefly presented aims to emphasize the importance of environmental monitoring in the urban context as a basis for the correct planning operations, especially in complex areas such as historical ones, that must be protected [8]. The topic of climate monitoring has been analyzed from two different points of view, a theoretical one - to acquire an adequate knowledge base - and operational-experimental one, different approaches necessary for a critical-propositive action of microclimatically sustainable and integrable transformation of urban space.

Thus, in the first part we analyze what the literature reports by extending the field of investigation to the city as a whole, with attention mainly to urban adaptation and mitigation policies, considered the most effective tool to actively act on causes and effects determined by climatic changes in place. Given the multiplicity of possible actions, both top-down and bottom-up, those carried out in the Mediterranean area, and specifically national ones, were selected, selecting strategies, plans, guidelines, and projects useful to understand 'if' and 'how' the theme is dealt with in interaction with other elements of the urban fabric, identifying any problems and/or negativity that have emerged and any gaps for further studies. [1-2-3]. The second part of the research, on the other hand, deals operationally with the topic using the analysis tools most suited to the area of investigation analyzed in the field, carrying out a calibration of direct and analytical instruments, in scale, parametric and computational. The transition from the first to the second macro-phase of research, however, would not be possible if not thanks to an intermediate experimental phase addressed to the heart of the problem: understanding the trend of climatic parameters within a real urban center, by evaluating its concrete limitations and potentials, and by touching the operational difficulties of approaching this type of analysis in complex areas. This fundamental phase involves two types of data collection, which we will define as 'direct data': a data above the canopy layer - collected by meteorological stations located in urban areas which, on Rome, are located within the 'perimeter' of the historic city - and one below, that is, at the pedestrian level, to understand how and to what extent the conformation of the urban space affects climatic factors and their consequent interpretation. [4] A real database was therefore built that combines the data of the main urban weather stations with those collected in the field at the pedestrian level recorded through measurement campaigns carried out for the research purposes. Therefore, 'expeditious measurement campaigns' were tested, defined as they were carried out with manual instrumentation, easier to find, with optimal immediacy in reading the results, developed over five months, and conducted in ten selected areas in the historic city of Rome. This database, in addition to providing in itself an important source of information on the specific case of the capital, is also a useful tool for the calibration of models, in particular simulation models [6-7], which increasingly build the basis of the operations of intervention on a urban scale, but that must be managed correctly in order to intervene in complex spaces to be protected, such as those of the historic city.

3. Conclusion

The work carried out has wanted to reread the bases of urban meteorology and climatology in an architectural key, read in a multidisciplinary vision that aims to extract a common thread from this 'collaboration' and define a synthetic epistemology, useful not only for specialists, but potentially basic for a re-discussion of the theme with a view for educating and training the designer.

Considering the characteristics of both resilience and invariance of fabrics that characterize a city, a systematization and calibration of the positive elements was sought, minimizing the problems of existing methodologies and tools, and aiming to define possible answers at the methodological-operational level for the analysis of climatic factors in the context of the transformations of the open space of the historic city, so as to provide an evaluation tool that allows to acquire greater operational awareness and that supports the selection of one or more intervention methods.

References

[1] Bröde P., Fiala D. (2012), Deriving the operational procedure for the Universal Thermal Climate Index (UTCI), *Int J Biometeorol* n.56, vol.3, pp.481-94.

[2] Johansson, E. (2014). Instruments and methods in outdoor thermal comfort studies – the need for standardization, *Urban Climate* n. 10, pp.346-366.

[3] Nikolopoulou, M. (2004), *Designing Open Spaces. In The Urban Environment: A Bioclimatic Approach*. Centre for Renewable Energy Sources (C.R.E.S.)

[4] Oke T.R (2006), *Initial guidance to obtain representative meteorological obseration at urban scale*, World Metereological Organization, Genevre.

[5] Park S., Tuller S. E., Jo M. (2014), Application of Universal Thermal Climate Index (UTCI) for microclimatic analysis in urban thermal environments, *Landscape and Urban Planning* n.125, pp.146–155.

[6] Salata F., Golasi I., de Lieto Vollaro R., de Lieto Vollaro A. (2016), Urban microclimate and outdoor thermal comfort. A proper procedure to fit ENVI-met simulation outputs to exerimental data, *Sustainable Cities and Society* n.26, pp.318-343.

[7] Turchetti G. (2017), Microclima urbano: ventilazione naturale e ridefinizione dello spazio della città storica/Urban microclimate: natural ventilation and space redefinition of historic city, *Urbanistica*, 157, pp. 156-159, INU Edizioni, Roma ISSN 0042-1022

[8] Vitiello, M. (2012), *Prospettive ecologiche per il restauro. Riflessioni intorno ad alcune parole chiave*. Franco Angeli, Milano.

Around roman square: digital documentation and comunication

Martina Attenni – Sapienza University of Rome, Rome, Italy, e-mail: martina.attenni@uniroma1.it

Vittoria Castiglione – Sapienza University of Rome, Rome, Italy, e-mail: vittoria.castiglione@uniroma1.it

Alfonso Ippolito – Sapienza University of Rome, Rome, Italy, e-mail: alfonso.ippolito@uniroma1.it

Mahsa Nousrati Kordkandi – Sapienza University of Rome, Rome, Italy, e-mail: mahsa.nousratikordkandi@uniroma1.it

Simone Helena Tanoue Vizioli – Architecture and Urbanism Institute of the São Paulo University, Sao Paulo, Brazil, e-mail: simonehtv@usp.br

Abstract: The knowledge of built heritage is now deeply connected to the survey and massive data capture methodologies associated with the integrated digital model. These methodologies enable researchers to gather a wider range of information, which is increasingly connected to technological advances. A multi-scalar approach, in which the criteria for data capture and for data elaboration depends on the goals of the survey, is needed to optimize the relationship between information and the scale of the models to be built. This research involving a selection of square in the historical centre of Rome aims to apply these principles to urban contexts defining the strong spatial connection with its architectural and elements. Survey can express the interaction through complex, dynamic, and effective digital models disseminated through digital system. They allow information to be linked to the various purposes of the investigations that can be conducted on the elements of the built heritage, expanding their knowledge and, with it, the possibility of safeguarding and enhancing them.

Keywords: integrated digital model, survey, urban and architectural heritage, Rome

1. Introduction

The urban fabric, understood as the place of sedimentation of secular cultural processes, stands in memory of the inevitable evolutions and transformations that have been imposed on it by the times. It therefore constitutes, together with the individual architectural elements, a fundamental part of our cultural heritage.
The "modello Italia", highlighted by Salvatore Settis in Patrimonio S.p.A. [1], brings out the power of a system which, even before the birth of the unitary state, and until not many years ago, has placed a modern and special attention on artistic and architectural heritage, recognizing them, before their economic value, their civil function of historical memory at the basis of the feeling of identity that generates the broadest concept of cultural heritage. The definition of cultural heritage, in fact, presupposes and derives from a marked tendency towards conservation, which has spread in European states as an instrument and / or consequence of the search for a national identity, and today constitutes an important factor of attraction and development of the territory. In particular, the strength of the current concept of cultural heritage lies in its nature as a *public thing*, or as a good of citizenship protected by the state - regardless of property rights - as an expression of the national tradition built over the centuries. The urgent need to accurately and consciously document this priceless legacy is evident in order to protect it, preserve it for the benefit of the society of the future, and make it truly available to all through communication strategies.

In this context, the digitization of cultural heritage plays a fundamental role. The policies of the European Union rely on this opportunity, allowed by the ever increasing development of technologies for data acquisition and communication through digital models, as the engine of that urban transformation that will lead us towards a sustainable and inclusive future. With the signing of the 2019 "Declaration of Cooperation for the Digitization of Cultural Heritage" [2] and with the "Declaration on joining forces to stimulate sustainable digital transformation in cities and communities in the EU" of 2021 [3], the member states of the European Community are committed to the digitization of cultural heritage to strengthen its dissemination and accessibility. It is therefore necessary to exploit the widespread agility in the use of data to prepare communication plans, understood as dissemination, aimed at increasing the vitality of cultural assets.

2. Methodology and obtained results

This research is the result of a project that starts from the current needs of digital documentation applied to the architectural and urban heritage of a portion of the historic center of the city of Rome. The experimentation examined Piazza della Maddalena, Piazza di Pietra and Piazza Capranica, in the Colonna district, Piazza Rondanini in the Sant'Eustachio district, Piazza della Rotonda and Piazza della Minerva in the Pigna district. The choice fell on reservoirs in which historical buildings of particular architectural value are located and, in some cases, such as that of di Pietra square, examples of deep stratifications and evident and important transformations. The ambitious goal of the conservation of built heritage is pursued by implementing the documentation currently available on the case studies examined within an archiving system based on integrated digital models, designed for free use by heterogeneous users. La model construction is based on a solid process of knowledge ranging from data acquisition, integrating range-based and image-based technologies [5], to their processing. It envisaged the definition of the typologies and the scale of the models with the aim of offering a multiscale reading of the examined context. A first level concerns the urban environment, the relationships between the different squares, their connections, the perception of space and its morphology; the second, on the other hand, analyzes the individual architectural emergencies from a formal and compositional point of view.
The models created allow us to recognize the space that surrounds us, proposing a digital replica that collects geometric and chromatic data, information related to the state of conservation of the surfaces. The summary of the activities carried out finds space in the https://guiderionalidiroma.wixsite.com/guiderionali portal, which allows to use the models interactively, offering a contribution to the interaction between the user and the architectural and urban heritage, linking information to the various surveys that it is possible to conduct, expanding knowledge and, with it, the possibility of safeguarding and enhancing it.

References

[1] S. Settis (2002) "Italia S.p.A. L'assalto al patrimonio culturale". Torino: Einaudi

[2] https://digital-strategy.ec.europa.eu/en/news/eu-member-states-sign-cooperate-digitising-cultural-heritage [june 2022]

[3] AA. VV. (2021) Declaration on joining forces to boost sustainable digital transformation in cities and communities in the EU, Online, https://www.living-in.eu/declaration. [june 2022]

[4] F. Remondino F., S. El-Hakim, E. Baltsavias, M. Picard, L. Grammatikopoulos (2008) Image-based 3D modeling of the Erechteion, Acropolis of Athens. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 37-B5, pp. 1083-1091.

The reuse of S. Domenico Church in L'Aquila; adaptive strategies for the design of a new congress hall

Bellicoso Alessandra - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: alessandra.bellicoso@univaq.it

De Berardinis Pierluigi - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: pierluigi.deberardinis@univaq.it

De Vita Mariangela - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: mariangela.devita@guest.univaq.it

Di Donato Danilo - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: danilo.didonato@univaq.it

Di Giovanni Gianni - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: gianni.digiovanni@univaq.it

de Rubeis Tullio -Department of Industrial and Information Engineering and Economics, University of L'Aquila, Italy, e-mail: tullio.derubeis@univaq.it

Rotilio Marianna* - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: marianna.rotilio@univaq.it (corresponding)

Tosone Alessandra - Department of Civil, Building and Environmental Engineering, University of L'Aquila, Italy, e-mail: alessandra.tosone@univaq.it

Abstract: The contribution aims to show strategies and methods that represent the basis of a design experimentation aimed at the reuse of the Church of San Domenico, L'Aquila, in a conference hall. The ancient building, which has great potential in terms of attractiveness for the city thanks to the spiritual specificities that characterize the religious complex as a whole, is the subject of a proposal for functional redevelopment that must take place through reversible interventions, addressed to its conservation and enhancement. The need of defining new models of use for its spaces has involved the draft of several flexible design layouts, in order to adapt this architecture to several unpredictable future functions. Therefore, the criteria of adaptive reuse are particularly consistent with the suggested design experimentation in terms of spatial flexibility and low impact on this particular case study.

Keywords: San Domenico Church, Compatibility, Flexibility, Conservation, Adaptive Reuse

1. Introduction

The agreement draft for the use of the Church of San Domenico in L'Aquila between the local authorities, the Curia, the owner of the property, and the University, the future tenant, is the premise for an adaptive reuse project. It aims at the necessary conservation of one of the most significant monuments of L'Aquila but also at its complete rediscovery and enhancement, in order to solve the condition of partial disuse of the building that started even before the 2009 earthquake.

Part of the large complex of the convent of the Order of Preachers, the church lost its original liturgical function as early as the nineteenth century and remained unused for about a century, until 1971 when the Abruzzese Symphonic Institute proposed to use it as a "large regional auditorium". However, the proposal did not realize and the hall was used

for decades only for the rehearsals of the local Conservatory and for some concerts. The damage caused by the recent earthquake required the start of its restoration, not yet completed. Pending its conclusion, however, the complex question of the future destination of the building remains open. Within these dynamics, the University of L'Aquila intends to use the spaces of the Church as a conference and concert hall, while retaining the fundamental requirement of a high level of layout flexibility, in order to facilitate the reorganization of the hall as an exhibition space, adequate to host a wide range of events.

2. The design for the adaptive reuse of the Church of San Domenico

The University of L'Aquila will have the building available for a limited period of time, after which it will return to the property. This assumption was fundamental for the definition of adequate and coherent design strategies as it was due to the choice of guaranteeing the almost total reversibility of the intervention; this latter aspect, in particular, also required the design of a series of low-impact transformation actions on the spaces of the Church of San Domenico. These premises are linked to design guidelines aimed mainly at preserving the original architectural features but also at guaranteeing the achievement of adequate levels of performance for the new functions to be located in the ancient building, also in compliance with the current regulatory framework. The adaptive nature of the reuse design can therefore be translated into two modalities: the first of them responds to a short-term scenario and is linked to the theme of the flexibility of spaces, to enhance the attractiveness of the architecture by guaranteeing multiple models of use and the possibility of hosting inside it different types of events; on the other hand, the second is calibrated on a long-term scenario and meets the requirement of the reversibility of the technological solutions for the reuse design. Compared to this dual-modality, the proposed project actions are synergistic because they are able to respond to both of the identified modalities and not just to one of them. In particular, these actions immediately translate into compatible and consistent design choices which opt for the use of dry and "light" technologies - instead of traditional and, above all, heavy solutions, that are really difficult to remove - and which are also characterized for a low transformation impact. The achievement of these objectives also implies the identification of a correct and integrated location of all the new technological systems, wisely concealed to preserve the perception of the original spaces.

3. Conclusion

The insertion of new functions within a monumental building is always a complex action and implies the need to lead to a univocal solution of the numerous, and sometimes unpredictable, problems that an ancient building inevitably transfers together with its historical and architectural significance. A good balance between conservation aspects, aimed at preserving the original features of the spaces, and those related to their rediscovery and regeneration, functional to their enhancement, can represent the basis for an adaptive approach to design reuse as demonstrated by the experience carried out in the project of the Church of San Domenico, capable of establishing a fil rouge between old and new, past and future.

Sustainable reuse of vernacular architecture for rural tourism development

Scioti Albina – Department DICATECh, Polytechnic of Bari, Bari, Italy, albina.scioti@poliba.it

De Fino Mariella – Department DICATECh, Polytechnic of Bari, Bari, Italy, mariella.defino@poliba.it

Fatiguso Fabio – Department DICATECh, Polytechnic of Bari, Bari, Italy, fabio.fatiguso@poliba.it

Abstract:

Vernacular architecture refers to settlements, buildings and structures, whose characteristics exhibit the peculiarities of the site and the community they belong to. The paper is going to focus on the qualification of ancient farmhouses in Apulia Region (South Italy) toward the definition of some typological "invariants" and the identification of compatible functions for tourism and hospitality. In detail, a case study is discussed, where the reuse and enhancement of a 18th century farmhouse and two groups of *trulli* in the countryside of the *Murgia dei Trulli*, was achieved by the reconversion as a diffuse guesthouse for rural tourism.

Keywords: vernacular architecture, typological assessment, compatible reuse and enhancement, rural tourism

1. Introduction

Vernacular architecture is acknowledged as a unique heritage to be preserved and protected as a testimony of sustainable and resilient building solutions and techniques. Therefore, it is paramount to address its assessment and recovery through strategies of use and usability that should meet both conservation principles and compliance with current performance standards and regulations [1]. In particular, the reuse of ancient farmhouses should address, on the one hand, the rehabilitation of minor building structures, as tangible evidence of local wisdom and handcraft, although without any specific architectural/artistic value, and, on the other hand, the development of functions for public utility and enjoyment. To this end, the selection of functions for hospitality in the framework of rural tourism is a reconversion opportunity that allows the revitalisation of these assets, by boosting rehabilitation and retrofitting actions.

2. Materials and methods

The Apulian rural farmhouses are different, in terms of shape and size, especially whenever they have undergone specific construction transformation phases. However, they share some common typological elements, which are clearly recognizable as "invariants", even if the buildings have been abandoned or no longer used for the same purpose. In particular, starting from a single-cell unit, different aggregation of basic modules results in a variety of building types. To these, a number of recurring accessory modules might be present. The possible combinations of these modules give rise to bi-cellular or multi-cellular building systems with different aggregative layouts, up to complex aggregate

solutions such as compact block, courtyard with enclosure or linear with tower. Starting from a census analysis of the Apulian farmhouses, a detailed plano-volumetric analysis has been carried out for the most recurring basic and accessory cells in view of the selection of compatible functions and relative interior design layouts within a reuse strategy for rural tourism and hospitality. Furthermore, from the analysis, a correlation matrix has resulted that highlights all the suitable combination among typologies of rooms in ancient farmhouses and typologies of rooms in modern guesthouses for rural tourism.

3. Case of study

The real estate complex under study consists of a main building, known as Farmhouse Sodomenico, and two groups of isolated *trulli*. The reuse proposal of the farmhouse and the trulli as a hotel accommodation facility for rural tourism involves the arrangement of 13 rooms, for a total of 26 beds, along with internal and external common areas, breakfast rooms, tasting and training lounges, exhibition rooms, kitchens and services. Starting from the recognition of the basic and accessory cells and moving on to the application of the correlation matrix, the reconfiguration was designed in compliance with the original interior distribution and through the implementation of minimally invasive interventions such as opening new door compartments where strictly necessary, closing existing compartments and building a limited number of partitions. In particular, the stables have been used as a training room, tasting room, bar, breakfast room, exhibition rooms, service rooms and suites. The work areas and warehouses, due to their position and architectural connotations, have been used as service rooms, kitchens, exhibition halls and suites/bedrooms. The farmer's lodgings have been converted into bedrooms, the master’s dwelling into common rooms, suites and bedrooms, and the *trulli* into suites and bedrooms.

4. Conclusions

The research aimed at the development of a methodology as a decision-making support tool for the recovery of farmhouses. To this end, starting from the typological and morphological-spatial analysis of the environments and units, some invariants were identified, in the form of basic cells and accessory modules, that are characterized by specific dimensions, constructional/architectural characteristics and original uses. Thus, a system of inventory forms was developed in order to collect data for some case studies and carry on a detailed analysis for the selection of compatible functions and relative interior design layouts within a reuse strategy for rural tourism and hospitality. Furthermore, from the analysis, a correlation matrix has resulted that highlights all the suitable combination among typologies of rooms in ancient farmhouses and typologies of rooms in modern guesthouses for rural tourism. The proposed methods and tools were applied to a specific case study, which proved that the identification of the most appropriate functions to be associated with each room, based on the specific morpho-typological characteristics and strictly linked to the original features, enables low intrusive and highly compatible rehabilitation and reinforcement works, too.

References

[1] Stival C.A., Berto R., Morano P., Rosato P. (2020) Reuse of Vernacular Architecture in Minor Alpine Settlements: A Multi-Attribute Model for Sustainability Appraisal. Sustainability 2020, 12(16), 6562; https://doi.org/10.3390/su12166562

The training of the conservator-restorer in the School of Arts of the Universidade Católica Portuguesa (Porto-Portugal). The challenges of 21st century towards sustainable conservation

Vieira, Eduarda – Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, evieira@ucp.pt

Moreira, Patrícia – Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, prmoreira@ucp.pt

Abstract: Conservator -restorer's training is currently framed by guidelines issued by the European Confederation of Conservator-Restorers Association (ECCO) and by the European network of higher education in Conservation and Restoration ENCoRE. Although the profession has been consolidated in the last two decades in Portugal and in Europe in general, the challenges posed by Climate Change, mass tourism, the search for more sustainable solutions that guarantee more ecological and financially sustainable interventions as well as the enhancement of heritage resilience, compelled new approaches to a new paradigm. On the other hand, the need to address some of the gaps in the tender system and the constitution of teams in the areas of architectural rehabilitation and conservation led us to a survey of practices of the main stakeholders in the sector. This communication aims to highlight the innovation carried out in the last seven years in the School of Art's Master of Conservation and Restoration, either in the curricular period, either within MA dissertations or Final reports.

Keywords: Conservator-restorer training; Innovation, MA Conservation-Restoration, Green Conservation.

Introduction

Conservation and restoration profession is today a higher education-based activity where access to the job market relies on 5 years of training [1-2]. Although the School of Art's degree approach is mainly focused on movable assets, content related to the built heritage has been slowly incorporated. In 2014, a specialization in integrated heritage was also incorporated the 2nd cycle of studies (Master's), which comprises a mixed approach of principles of built heritage and architectural decorative techniques. All classes are theoretical-practical with a strong teaching load of practical classes in the real workshop context and laboratory [2].

The introduction of more sustainable and safer methodologies for the user (professional) and for cultural goods has led to the introduction of several related topics such as i.e. the use of gels [3] in cleaning operations, products that guarantee greater efficiency with less consumption time, which contributes to the reduction of the budgets of works or methodologies that improve the classic operations of desalination, de-acidification, consolidation are a common practice in our training, shared by the teaching team that regularly carries out recycling training or organizes workshops with international experts [4] and conferences with relevant partnerships [5].

Framework

To follow the market evolution on the research needs of diverse problems that need new approaches or new products and trying, at the same time, to incorporate the research advances, several partnerships have been established with companies, museums, and laboratories [6] that enable sharing of information and a permanent updating and recycling of the training of master's and doctoral students. Accordingly, several MA dissertations have been outlined approaching topics like new chemical methods for cleaning scientific collections or Public Art (Sculpture), Natural History collections study and conservation, Heritage and

Citizen Science, or more focused on Built Heritage centred in the survey of Rehabilitation practices in Porto and the impact of Mass Tourism, or even the need of a new profile of a conservator-restorer specialized in this area.

Conclusions

The challenges of the current conjuncture will imply changes in the curricula of conservation restoration degrees, with the acquisition of transversal skills [7] and lifelong training being increasingly urgent. Some relevant funded projects like BIONANOSCULP [8, 9], BIO4MURAL or the most recent HAC4CG [10] are the result of our mindset for a new paradigm within the trends of conservation and restoration of cultural heritage for the next decades. This communication aims to present an overview of this innovative panorama.

References

[1]. Competences for the access to the Conservation-Restoration Profession. ECCO. 2014 Recovered from ttps://www.ecco-eu.org/wp-content/uploads/2021/01/ECCO_Competences_EN.pdf

[2] Aguiar, Maria; Eduarda Vieira; Carolina Barata. "A formação em Conservação e Restauro na Escola das Artes da Universidade Católica Portuguesa". Comunicação oral apresentada no III Encontro Luso-Brasileiro de Conservação e Restauro, Évora, 2015. [3] Decreto Lei 140, 2009 de 15 de junho. Recovered from https://dre.pt/dre/detalhe/decreto-lei/140-2009-494543

[3] Gueidão, M.; Vieira, E; Bordalo, R.; Moreira, P.(2020) “Available green conservation methodologies for the cleaning of cultural heritage: an overview”. ECR-Estudos de Conservação e Restauro (12), 22-44. https://doi.org/10.34632/ecr.2020.10679

[4] Workshop "Limpeza superficial e remoção de substâncias filmogénias em arte antiga e contemporânea", com Paolo Cremonesi. Recoverd from: https://citar.artes.porto.ucp.pt/pt/central-eventos/7-10-marco-workshop-limpeza-superficial-e-remocao-substancias-filmogenias-arte

[5] 3rd International Conference in Green Conservation of Cultural Heritage. Recovered from: https://www.yococu.com/news/3rd-international-conference-in-green-conservation-of-cultural-heritage/

[6] https://resmonuh.pt/

[7] Charter European Cultural Heritage Skills Aliance (2022). Recovered from: https://www.ecco-eu.org/bbp-charter/

[8] Moreira, P.R; et al (2018) “BIONANOSCULP, an ongoing project in biotechnology applications for preventive conservation of outdoor sculptures”. IOP) Conf. Ser.: Mater. Sci. Eng. 364 012075. Recovered from: https://iopscience.iop.org/article/10.1088/1757- 899X/364/1/012075

[9] Silva, N. et all (2018) Biotechnology for Preventive Conservation: Development of Bionanomaterials for Antimicrobial Coating of Outdoor Sculptures. Studies in Conservation: DOI: 10.1080/00393630.2018.1475037

[10] HAC4-CG- Heritage, art, creation for climate change - living the city: catalysing spaces for learning, creation, and action towards climate change. Recovered from: https://citar.artes.porto.ucp.pt/en/node/26808

The theoretical foundation of architectural restoration

Cesare Crova – Ministero della Cultura – Istituto Centrale per il Restauro, Roma, Italia,
cesare.crova@cultura.gov.it

Abstract: What's happening today takes us back in time, to the theoretical reflections followed in the Second World War. These were the years in which critical restoration took hold, the result of considerations starting from the end of the nineteenth century and which had found fertile ground in the activities, especially ministerial, of the first part of the twentieth century. In 1939 the first school of restoration was born, the I.C.R., Thanks to Giuseppe Bottai, Giulio Carlo Argan and Cesare Brandi, where the State centralized activities hitherto left to the empiricism of the workshop. The transience linked to the world conflict leads to new reflections on interventions, in the architectural field, on the historicized building fabric or on the single and singular monument. Like the theories (restoration, integral conservation, criticism) damage from war can be caused in restoration with continuity. History shows that all this has been possible, even to intervene following the great natural disasters.

Keywords: Restoration theory, Conservation, Central Institute for the Restoration, War damage, Natural disasters.

Introduction

There are two themes that require careful reflection on the theoretical basis of restoration in architecture. On the one hand, the current world situation, in the light of the conflicts that have attracted the attention of the companies in recent months, takes us back in time to the reflections gained following the Second World War. On the other hand, natural disasters, which have now assumed aspects previously little considered, which only with the birth of the Civil Protection in 1992 find their systematization, which will increasingly take hold with the creation, within the Ministry of Culture, of operational structures for the safeguarding of cultural heritage.

The contemporary age. From architectural to urban restoration.

Attention to cultural heritage goes beyond the nineteenth-century and early twentieth-century reflections, which, especially after the Second World War, led to a change of course with respect to the conservation and reconstruction of ancient fabrics. The theoretical foundation of the restoration must necessarily address good conservation practices, to avoid that approximation and empiricism still prevail, which produce, as we often see, many disasters, perpetrated daily in the field of design on the pre-existing, often in the name of the spectacularization of the restoration. seen more as a media event, going beyond the specialist profession, understood as a scientific and critical activity, of a dutiful public service rendered to the historical-artistic heritage. The norms, the restoration papers, the guidelines, the rules and the control activities of the institutions, have the purpose of stemming bad jobs, avoiding irreparable damage, while the good and excellent ones have the ability to persuade with the quality of work carried out. However, a solid formation, a historical-philological preparation and a specific critical attitude are necessary; where the specialized approach to restoration has its own specificities, linked to the greater ability to study and understand the cultural heritage, the reference to a general theoretical framework that can also be linked to precise

currents of thought, a specifically cultivated technical competence, which favors a a scientific rather than a professional mindset, above all that is detached from the improvisation and empiricism that can generate a rough and poor restoration design. Thus the restoration can be guided by a theoretical and method awareness, historical knowledge, critical spirit and design skills, with the consequences that will ensue in terms of image, presentation, use, favoring interventions aimed at the perpetuation of the asset, its transmission to the future in the best possible conditions, guaranteeing full readability and enjoyment. In the field of natural disasters, already with the 1976 earthquake in Friuli Venezia Giulia a conscious work of preservation of the cultural heritage had begun, of which the Venzone Cathedral is an example, which although destroyed, was the subject of careful reconstruction work in anastilosi (1988-1995), which entailed the cataloging of over 9000 stone elements, of the ancient walls that had been collected and numbered, according to the position in the collapse phase, to then be relocated on site. To this is added the interest, already matured in the fifties of the twentieth century, for the protection of historic centers, on which Antonio Cederna's commitment from the columns of "Il Mondo" was important, with his campaigns against the havoc that a hasty and speculative post-war reconstruction required historical centers and cultural heritage in general. They represented a detailed and highly impactful denunciation, destined to arouse opinion movements capable of countering some of the most devastating projects, which produced as effects the Charter of Gubbio (1960), that of Venice (1964), the results of the Commission Franceschini (1967) and the 1972 Restoration Charter of the Ministry of Public Education, inspired by Cesare Brandi, who was the first to expressly speak of historic centers.

Conclusions

Since the Nineteenth century, a series of reflections have been outlined on the concept of restoration, in particular architectural, which lead to the birth of the different theories, in France, England and Italy, which will outline the main currents of restoration according to the style that it is due, where architecture is a model to be resumed and replicated, and that of the recognition of historical stratifications, of the conservation of the signs that time and man have produced on the cultural asset, therefore the monument as a document. Hence, the reflections and orientations of the twentieth century, the foundation of the Central Institute of Restoration, which will expand the discourse of conservation also to the historical fabric and the birth, after the second world war, of a more precise and attentive reflection on the different needs, where a primary role was played by Cesare Brandi's Theory of Restoration. In Italy, in particular, the concepts on a different philosophy of restoration will reverberate in the three great schools of thought: maintenance and restoration in a Roman environment with Paolo Marconi, pure conservation carried out by Marco Dezzi Bardeschi in a Milanese environment and critical restoration with Cesare Brandi and, at the same time, Roberto Pane and Renato Bonelli for the architectural aspects, which will decline towards the end of the twentieth century in the historical-critical restoration and later in the critical-conservative restoration resulting from the reflections of Giovanni Carbonara in the Roman School. To all this is added the activity linked to the seismic risk and the safety of cultural heritage, which over the years has led the Ministry of Culture to develop specific operational structures within it, which can carry out their tasks both in Italy and in the abroad. In the latter case with the "Task Force MiBACT Unite4Heritage" (MiBACT-U4H), which constitutes the technical-scientific component of the Italian Task Force Unite4Heritage, which operates in all areas of crisis, in collaboration with the Cultural Heritage Protection Unit of carabinieri.

Il restauro architettonico tra ricerca e progetto: risultati del primo decennio di esperienze nel corso di Ingegneria Edile-Architettura (2012-2022)

Architectural Restoration between Research and Project: results of the first decade of experience in the Building Engineering-Architecture Course (2012-2022)

Nicoletta Marconi – University of Rome Tor Vergata, Rome, Italy, marconi@ing.uniroma2.it

Valentina Florio - University of Rome Tor Vergata, Rome, Italy, florio@ing.uniroma2.it

Historical building techniques and new technologies: a useful integration

Interaction between complementary disciplinary competencies is recognized as the only useful way forward for the restoration, preservation and proper enhancement of historic building heritage. Architecture – by ancient, modern, and contemporary era - is subject to rules that are not compatible with the limits set by obsolete disciplinary fences. The correct interpretation of its delicate structural balances, the recognition of the precipitous historical-artistic, functional, and material specifications, as well as the full control of historical building practices, and the critical analysis of the processes of conception and realization, constitute the indispensable tools for the drafting of respectful and conscious restoration projects. Neglecting these components can prejudice not only the preservation of the architectural work, but also its proper critical interpretation. Structural arrangements, equilibrium conditions and stress analysis cannot be separated from knowledge of the chemical and physical characteristics of materials, processing techniques, especially pre-industrial, types of degradation and mechanical alterations produced by different climatic conditions. Similarly, the restoration project cannot neglect or ignore the building's main historical-architectural features, nor its formal, spatial, typological and constructive specificities. According to this conviction, raising awareness of the control of the anatomical connotations of historic buildings and the adoption of appropriate restoration and consolidation procedures constitute indispensable educational objectives in the training of Engineer-Architects. They will be able to usefully accredit their professionalism to the practice of restoration if supported by mastery of traditional masonry materials and practices, structural principles and pre-industrial seismic prevention methods. Methodological framework and educational objectives of our course in Architectural Restoration, fundamental to the master's degree program in Building Engineering-Architecture at the University of Rome Tor Vergata, are based on knowledge of materials, traditional building practice and the architectural organism.

In our opinion, the need for conservation must necessarily be balanced with contemporary functional and normative requirements. As well as in evaluations of the stability of the historic building the control of the "rule of art" remains a priority, within which the material and the criteria by which it has been adapted to the needs of the building constitute an indispensable basic plot for the restoration project. Full knowledge and control of traditional building techniques are imperative for the fulfilment of conservation requirements and for the achievement of an effective structural homogeneity, which can also be pursued with 'homeopathic' methods [Cangi 2012]. These are the only devices capable of meeting the obligation to perpetuate our culture and transmit our history to

future generations. On these assumptions, the cognitive supports and design instruments for introduction to the many facets of a complex and multifaceted discipline such as architectural restoration are provided. It can be integrated into contemporary architectural design as long as it respects the special characteristics of historical architecture and exercising that good practice of the trade, which only those who proceed philologically from the study of historical documents and construction techniques to the functional transformation of the building possess and control.
Therefore, our Lab's exercises involved a wide repertoire of historic buildings, selected by type, era and functional purpose, extended to the sphere of urban and archaeological restoration, as well as to the complex world of plant upgrading. The outcomes of such research, presented in this paper, thanks to the survey campaigns and direct analysis of the buildings, have provided new cognitive elements and important contributions for future interventions. Among others, mention should be made of the research on Villa Adriana in Tivoli, conducted in agreement with the Villa Adriana-Villa d'Este Autonomous Institute and the Italian Ministry of Culture, focusing in particular on the complexes of the Hospitalia, the Libraries, the Tempe Pavilion, the Caserma dei Vigili and the so-called Casa d'Offizi in the Palestra area [Cinque, Marconi 2018]. Collaboration with the Suburbicarian Diocese of Palestrina, on the other hand, provided an opportunity to survey, analyse and study the churches of Palestrina's city (Rome) [Marconi 2017], from the "minor" ones to the Cathedral-Basilica of Sant'Agapito [Marconi 2016; Marconi 2019] and the Church of Santa Rosalia in the Colonna Barberini Palace [Marconi in publishing; Marconi, Eramo 2017; Cornaro, Marconi, Sapori 2016]. Collaboration between institutions has also been declined in research activities aimed at the protection and enhancement of the Roman hinterland municipalities. Notable among these is the collaboration with the Municipality of Castel San Pietro Romano, aimed at the knowledge and protection of the architectural heritage (Rocca Colonna, Polygonal Walls, Church of St. Peter Apostle and Mocci Palace). The extension of the field of investigation to the urban scale, which also interested the historic centre of Tivoli, in the case of Castel San Pietro Romano was aimed at the drafting of the *Guidelines for the Recovery of the Historic Centre*, presented in 2021 [Marconi, Florio, Pizzuti 2021]. This is a non-prescriptive management instrument that, in agreement with the Superintendence of Architectural and Landscape Heritage of Lazio, establishes a repertoire of identity values of the ancient urban core, from which projects on the built-up area cannot disregard. Private interventions on textures and wall surfaces, valuable architectural elements, materials of local tradition, fixtures and roofing, no longer left to the initiative of individuals, often capable of irreparable obliteration, will be able to be directed by an abacus of virtuous solutions, including plant improvement.
This constitutes another relevant topic of investigation for our research group, in which the relationship between architecture, rehabilitation and systems is complicated by regulatory constraints and the almost natural incompatibility of modern technological innervations with the historic building. In contrast, some "plant" arrangements of the past, although different in their role in the building's constructive, distributive and architectural economy, could be potentially repurposed [Florio 2020]. Only a deep knowledge of the architectural object can lead to a conscious plant restoration and improvement project, certainly supported by knowledge of the guiding principles, but unrelated to the uncritical repetition of pre-established schemes and formulas, rather founded on constant research aimed at the invention of appropriate solutions. The complexity of the plant-engineering theme in historic buildings thus comes to be configured for architects and engineers as a stimulating design challenge. This accommodates the theme of the design and reuse of historic buildings by soliciting reflections on compatibility and flexibility of use and encouraging the identification of respectful and reversible technologies that can meet the needs of our time and

satisfy the demands of current regulations, in the sign of the subtle semantic boundary between adaptation and plant improvement.

References

[Cangi 2012]
G. Cangi (2012), *Manuale del recupero strutturale e antisismico*, Roma 2012.

[Cinque, Marconi 2018]
G. E. Cinque e N. Marconi (2018), *Villa Adriana. Passeggiate iconografiche*, ed. by G. E. Cinque, N. Marconi, Foligno 2018.

[Cornaro, Marconi, Sapori 2016]
C. Cornaro, N. Marconi, D. Sapori, *Sustainability aspects related to preservation of historical buildings: a case of intervention*, in Proceedings of 16th CIRIAF - National Congress Sustainable Development, Human Health and Environmental Protection, Assisi, Italy. April 7-9, 2016.

[Florio 2021]
V. Florio, *Restauro architettonico e miglioramento impiantistico: dalla pratica storica all'integrazione delle Linee Guida d'intervento*, University of Rome Tor Vergata, Faculty of Engineering, PhD Thesis, Roma 2020.

[Marconi 2016]
N. Marconi (2016), *Filologia, cultura, significato. Ricerche sui centri storici e sul patrimonio architettonico del territorio prenestino*, in *Paolo Marconi architetto-restauratore. Filologia della ricostruzione e cultura del patrimonio*, ed. by E. Pallottino, A. Pinelli, "Ricerche di Storia dell'Arte", 116-117, 2016, pp. 60-62.

[Marconi 2017]
N. Marconi (2017), *Conoscenza, recupero e valorizzazione degli edifici di culto prenestini: ricerche e nuove proposte,* in *Conoscere, conservare, valorizzare. Il patrimonio religioso culturale*, ed. by O. Niglio, C. Visentin, Roma 2017, II, pp. 37-46.

[Marconi 2019]
N. Marconi (2019), *Furio Fasolo per la basilica cattedrale di Sant'Agapito in Palestrina: restauri 1957-1974*, in *Realtà dell'architettura fra materia e immagine. Per Giovanni Carbonara: studi e ricerche*, ed. by D. Esposito, V. Montanari, Roma 2019, I, pp. 869-874.

[Marconi in publishing]
N. Marconi, *La chiesa di Santa Rosalia nel palazzo dei principi Barberini a Palestrina. Architettura e costruzione dai documenti della Biblioteca Apostolica Vaticana*, "Studi e testi della Biblioteca Apostolica Vaticana", Città del Vaticano, in publishing

[Marconi, Eramo 2017]
N. Marconi, E. Eramo, *La chiesa di Santa Rosalia nel palazzo dei principi Barberini a Palestrina: committenza e cantiere*, "Studi e Ricerche di Storia dell'Architettura", December 2017, pp. 48-63.

[Marconi, Florio, Pizzuti 2021]
N. Marconi, V. Florio, S. Pizzuti, *Castel San Pietro Romano: Linee Guida per il recupero del "Borgo più bello d'Italia",* Castel San Pietro Romano 2021.
[Florio 2020]

Teaching Architectural Conservation Design: a resilient experience during COVID-19 pandemic in Brazil

Pedro Murilo Gonçalves de Freitas – Federal University of Sergipe, Laranjeiras, Brazil, e-mail: pedromurilo@academia.ufs.br

Abstract: The mandatory social isolation due to the COVID-19 pandemics was severe and abrupt for Brazilian education. Brazilian Architectural Conservation Design subjects in Architecture and Urbanism undergraduate courses needed to adapt drastically to maintain secure education quality. This paper presents teaching experiences conducted at the Architecture and Urbanism undergraduate course of the Federal University of Sergipe, Brazil. It aims to describe how strategies were applied for teaching Architectural Conservation Design under the global health emergency in 2020. Methodology was based on problem solving during social isolation periods to promote conservation as an holistic design process. Although new forms of "remote" adaptations faced difficulties in the efficiency of individual training, the experience showed that any strategy to guarantee and enhance teaching quality of Higher Education in adverse scenarios must show resilience and creativity.

Keywords: Architectural Conservation Design, Education of Architects, Teaching Strategies, COVID-19.

The COVID-19 pandemic in the world as of January 2020 has directly impacted contemporary education [1]. The mandatory social distancing, which in the past could meant drastically reducing formal education, gained a new significance with the immediate operation of "online" alternatives. The availability of technological resources of distance learning made institutions of several levels of education transfer course contents into new teaching platforms [2], as well as demanding meetings, video conferences and recording lectures, in a new digital movement to cope with forced social isolation.

One of the most impacted teaching areas was Architecture Conservation Design. For Architecture Conservation Design training, basic field tasks such as survey, documental research, interpretation of built materials, decay analysis and risk assessment [3], procedures that are being considered fundamental to enhance quality of design [4], became extremely difficult to perform, since the buildings themselves had suddenly "disappeared". How could it be possible to teach Architecture Conservation Design in a context of social isolation? [5]

This paper presents teaching experiences conducted at the Architecture and Urbanism undergraduate course of the Federal University of Sergipe, Brazil. It aims to describe how strategies were applied for teaching Architectural Conservation Design under the global health emergency in 2020. Methodology was based on problem solving, targeted on keeping education quality during social isolation and promote conservation as an holistic design process. In spite of the pandemic disrupted the University's calendar structure to work with daily, it was possible to critically analyze the experience as a tool to make visible underlying difficulties of Brazilian Architectural Conservation Design education.

The outburst of the pandemic happened in Brazil in March 2020, when the first cases of COVID-19 became evident. The proposal of a remote course with 25 vacancies on *"Contemporary Theories of Architectural Design in Preexisting Features"* turned to be an opportunity to create a prototypical experience for testing the demands between learning afar and dealing with preexisting features. Apart from that, it could also recover student's moral and become a way to refocus attention to the heritage site itself, suddenly abandoned. This was

made by proposing students to “virtually return” to a known environment, expecting that those lessons would somehow cope with the frustration of a short-term resolution for the pandemic, a question affecting not only Higher Education but different aspects of everyone’s life.

As a general teaching experience, the course was extremely helpful, creating a positive framework of knowledge and study in such difficult times. Students have also concluded the last discussion with a lot of interest, being grateful for the opportunity in their formation. Although the remote course demonstrated difficulties in the adaptation of individual training, the experience also showed that any strategy to guarantee and enhance teaching quality of Higher Education in adverse scenarios must show *resilience* and *creativity*.

References

[1] Santos, B. S. A cruel pedagogia do vírus. São Paulo: Boitempo, 2020.

[2] Monteiro, A. M. G., Ensino de Arquitetura e Urbanismo à Distância, Remoto, Híbrido: Para onde queremos ir? Revista Projetar - Projeto e Percepção do Ambiente, v. 6, n. 1, p. 157–162, 2021. Available at https://periodicos.ufrn.br/revprojetar/article/view/238652021.

[3] Torsello, B. P. La materia del restauro. Roma: Marsilio, 1988. p. 36.

[4] International Council of Monuments and Sites. European Quality Principles for EU-funded Interventions with potential impact upon Cultural Heritage (2018). Recommendations & Selection Criteria. Paris: ICOMOS, 2020. 2nd Ed. Available at https://openarchive.icomos.org/id/eprint/2436/

[5] International Council of Monuments and Sites. Guidelines for Education and training in the conservation of Monuments, Ensembles and Sites (1993). Paris: ICOMOS, 1993. art. 5. Available at https://cif.icomos.org/my-first-guideline/

Behavioural-design-based risk assessment and mitigation against floods in historical urban built environment: a virtual reality approach

Bernardini Gabriele - Università Politecnica delle Marche, Ancona, Italy, g.bernardini@univpm.it

D'Amico Alessandro - Universita degli Studi di Roma La Sapienza, Roma, Italy, alessandro.damico@uniroma1.it

Enrico Quagliarini - Università Politecnica delle Marche, Ancona, Italy, e.quagliarini@staff.univpm.it

Ruggiero Lovreglio - Massey University, Auckland, New Zealand, r.lovreglio@massey.ac.nz

Abstract: Flood is a critical disaster in historical Urban Built Environments and risk-mitigation strategies should be designed by considering not only historical scenario and hazard features but also their users and how they respond to emergencies. A behavioural-design approach could support risk assessment and effectiveness evaluation of mitigation strategies since it relies on analyses of users' emergency behaviours. This work develops and tests a novel approach to these tasks, by combining Virtual Reality and Serious Game criteria. More than 100 volunteers are involved in experiments. Results demonstrate the adherence between human behaviours in VR-SG and real-world scenarios, thus encouring the use of these tools for preliminary assess flood risk and mitigation strategies impact.

Keywords: historical urban built environment; risk mitigation; flood; virtual reality; behavioural design

1. Introduction

Floods are critical disasters in Historical Urban Built Environment (UBE) because of the combination of vulnerability and hazard, which affects floodwater spreading into the UBE layout and possible damages not only to the Heritage, but also to the hosted users [1]. As remarked by the Behavioural-Disegn (BD) approach [1], risk-mitigation strategies should be hence tested in respect to the human behaviours in emergency before defining how to implement them in the UBE. In this sense, Virtual Reality (VR) supports this goal, since it allows representing and testing different UBE features, flood conditions and mitigation strategies in a sustainable manner [2]. VR can be combined to Serious Games (SG) to ensure a high volunteers' engagement in tests [3]. VR-SG results can then support the effectiveness analysis of strategies and the development of simulation models for flood evacuation and strategies analysis. Anyway, it is not clear how VR-SG solutions can provide reliable data in respect to real-world events. This work is hence aimed at developing and preliminarily verifying a VR-SG-based approach to support risk assessment in historical UBE and to evaluate the effectiveness of risk-mitigation strategies before their implementation in the physical scenario. Verifications rely on the comparison of VR-SG and real-world behaviours, by implementing a typological, historical UBE into the developed tool.

2. Methodology

The first work phase concerns the development of the VR-SG approach and of the related tool, using the Unity game engine, for Immersive/non-immersive VR tests. Elements of BE (buildings, roads, signs, benches, raised areas in outdoor public spaces), floodwaters

(including movable obstacles) and emergency dynamics (other Non-Players Characters-NPCs as other pedestrians and rescuers; gathering areas) are simulated. Literature evacuation behavioural interactions are modelled (path and safe area choice; interaction with obstacles, both fixed and dragged by waters; interaction with other people) into 5 main SG "story modules" (building ground floor; street with obstacles; crossroads; street with pedestrians; square with gathering areas). The second phase regards the tool application to a typological riverine scenario [3] and its verification with respect to real-world behaviours in flood emergencies in UBEs [1], by involving more than 100 volunteers in non-immersive VR tests.

3. Results

Results show the general adherence of VR-SG and real-world behaviours [1]. In particular, along the streets, people prefer to move close to buildings (being about 1m to 2m far from them) and far from dragged obstacles. Volunteers were also attracted by benchs and group of NPCs, looking for support while moving. Volunteers tended to remain in unsafe position in path selection tasks, but negative effects are mitigated by the proper path selection thanks to floodwaters estimation and UBE wayfinding signs. 77% of volunteers reached the final square where gathering areas were placed, by preferring to select th outdoor raised area as final destination. Although similarities to real-world behaviours, some differences exist indeed, as the VR approach can limit the level of engagement of people in respect of the floodwater conditions and the related realism [2]. Mainly, differences concern the specific movement trajectories, which could be influenced by the familiarity with the navigation methods.

4. Conclusions

This work succeeds in demonstrating how the use of a VR-SG approach is valid thanks to the disclosed main behavioural similarities between real-world and VR conditions. Future works should test immersive VR solutions, by also locating volunteers in pools, to evaluate if differences with real-world data can be reduced. Further tests could imply different "story modules" organization, typological versus real world UBEs. VR-SG tests can thus increase users' preparedness to flood emergencies and support the dissemination of emergency plans while helping decision-makers in risks assessment and mitigation strategies design (comprising both emergency management and architectural interventions in the historical UBE).

Acknowledgements

Go for IT Project - Research Grant "Flood Risk Assessment, Mitigation and Management in Coastal Cities through a Behavioural Design Approach", funded by MIUR, Special Integrative Fund for Research - Contribution of the CRUI Foundation.

References

[1] Bernardini G., et al. Investigating Exposure in Historical Scenarios: How People Behave in Fires, Earthquakes and Floods. in: SAHC, RILEM Bookseries 2019:18, pages 1138–1151

[2] Lovreglio R., et al. Prototyping virtual reality serious games for building earthquake preparedness: The Auckland City Hospital case study, Adv Eng Inf 2018; 38: 670–682

[3] Bernardini G, et. al. How urban layout and pedestrian evacuation behaviours can influence flood risk assessment in riverine historic built environments, Sust Cities & Soc 2021;70:102876

Toward quick multi-risk mitigation in historic Public Open Spaces: a behavioral-design approach in typological scenarios for heatwaves and terrorist acts

Bernardini Gabriele - Università Politecnica delle Marche, Ancona, Italy, g.bernardini@univpm.it

Enrico Quagliarini - Università Politecnica delle Marche, Ancona, Italy, e.quagliarini@staff.univpm.it

Marco D'Orazio - Università Politecnica delle Marche, Ancona, Italy, m.dorazio@staff.univpm.it

Abstract: Public Open Spaces (POSs) in historical built environment generally host significant users' densities, thus representing critical scenarios, especially in case of disasters combination. Risk assessment and mitigation should include the analysis of users' behaviours in emergency and use typological risk conditions to quickly trace general intervention criteria. This work proposes a behavioral-design approach to assess multi-risk in POSs considering multi-risk conditions. A simulation model is developed considering that a slow onset disaster (i.e. heatwave) influences the starting conditions for a sudden event (i.e. terrorist act) implying evacuation. The approach is applied to a relevant typological POS to demonstrate the approach capabilities.

Keywords: historic open spaces; multi-risk; evacuation simulation; terrorist acts; heatwaves

1. Introduction

Squares are fundamental Public Open Spaces (POSs) in the historical urban built environment, since they are characterized by complexities in terms of physical vulnerability exposure and social vulnerability, and hazard [1, 2]. Herein, SLow (SLODs, e.g. heatwaves, air pollution) and Sudden (SUODs, e.g. terrorist acts, earthquakes) Onset Disasters can occur in a combined manner [3]. SLODs affect how users behave in the square in normal fruition, that is before SUODs, implying evacuation. POS risk thus depends on human behaviours in emergency. A Behavioural-Design (BD) approach could support risk assessment and mitigation thanks to the representation and analysis of human-built environment-emergency interactions, through simulations [4]. This work applies the BD approach to assess multi-risk in POSs and propose risk-mitigation solutions. A SLOD-to-SUOD simulator is been developed and preliminarily validated in the context of heatwaves (as SLOD) and terrorist act (as SUOD) combination. The model is applied to typological POSs derived by the BE S^2ECURe project within the Italian context [2]. Using such typological risk conditions can trace rapid intervention criteria that can be then validated in specific case-studies.

2. Methodology

An agent-based model to simulate SLOD-to-SUOD conditions is developed, implemented in the NetLogo and verified. The model considers that the POS is initially populated depending on the heatwave effects on users' behaviours (in terms of percentage of acceptability relating to the air temperature), and then a terrorist act-related evacuation is simulated, implying that users try to move towards the available square exits (according to experimental density-speed correlations). The model uses a cellular automata approach for users' generation and movement, integrating probabilistic rules. The model is applied to an

Italian typological case study [2] (a trapezoidal square, including a special building), populated according to recurrent exposure and social vulnerability conditions (about 1200 users), by testing 3 different outdoor layout configurations (with: poles along the carriageway; only a central monument; both of them) and 4 terrorist acts types ("false alarm, bomb, weapon and vehicle attacks). Evacuation results are assessed in terms of: evacuation curves, time and flows; number of casualaties; number of falls/physical contacts over time.

3. Results

Results show that risks in SUOD evacuation process due to terrorist acts seem decrease when the outdoor layout has the presence of regularly-placed obstacles (e.g. poles along the carriageways, dehors, monuments), implying an increase of evacuation flows up to 51% in respect to POSs with a limited relevance of such obstacles. Such results seem to suggest that the re-organization of outdoor spaces could be a key leading strategy to mitigate risk. Such architecturally-integrated strategies can also reduce possible interferences among users leading to falls and physical contacts (up to about -40%) since users can orderly enter evacuation paths. Anyway, as expected, the severity and dynamics of the attack increases the number of casualties, up to about 14% of initial hosted users for vehicle attack. In this case, the presence of regularly-placed obstacles can increase risk for users who are placed along the bound vehicle trajectory.

4. Conclusions

The BD approach can support multi-risk assessment in POSs by analysing the impact of built environment features, environmental conditions (due to SLODs, i.e. heatwaves affecting the users' distribution in outdoors) and immediate disaster effects (due to SUODs, i.e. the terrorist act) on human behaviours. Simulations on other typological POSs should be carried out to confirm research outcomes and highlight differences due to single and multi risk factors. Decision-makers could take advantage of the proposed approach and simulation tool for risk assessment and strategies effectiveness evaluation before "tailoring" depending on the specificities of each real POS. The same SLOD-to-SUOD approach can be used for any other coupled risks (e.g. heatwaves and earthquakes).

Acknowledgements

Funded by the MIUR (the Italian Ministry of Education, University, and Research) Project BE S^2ECURe - (make) Built Environment Safer in Slow and Emergency Conditions through behavioUral assessed/designed Resilient solutions (Grant number: 2017LR75XK).

References

[1] Sharifi A. Resilient urban forms: A review of literature on streets and street networks, Building and Environment. 2019;147:171–187.

[2] D'Amico A, et al. Built Environment Typologies Prone to Risk: A Cluster Analysis of Open Spaces in Italian Cities, Sustainability 2021;1:9457.

[3] Curt C (2021) Multirisk: What trends in recent works? – A bibliometric analysis, Science of The Total Environment. 2021;763:142951.

[4] Bernardini G, et. al. Towards a "behavioural design" approach for seismic risk reduction strategies of buildings and their environment, Saf Sci 2016;86: 273–294.

Implementing open-source information systems for assessing and managing the seismic vulnerability of historical constructions

Ramírez Eudave, Rafael - Universidade do Minho, ISISE, Departamento de Engenharia Civil, Guimarães, Portugal, r.92@outlook.es

Rodrigues, Daniel – - Universidade do Minho, ISISE, Departamento de Engenharia Civil, Guimarães, Portugal, dsr@civil.uminho.pt

Ferreira, Tiago Miguel - Department of Geography and Environmental Management, University of the West of England, Bristol, UK, Tiago.Ferreira@uwe.ac.uk

Romeu, Vicente - RISCO, Departamento de Engenharia Civil, Universidade de Aveiro, Portugal, romvic@ua.pt

Abstract: Reducing the uncertainty about the structural vulnerability of historical constructions comprises the selection of reasonably generalised approaches in a context of a significant typological variability; the difficulty of performing large-scale assessments with reasonable reliability; and the lack of dedicated infrastructures for efficiently storing, sharing, managing, and updating data – an issue that is even more relevant for small (and often isolated) settlements. This work presents a proposal to set up a geographic database for surveying, calculating and storing the seismic vulnerability index of masonry constructions using an adapted version of the GNDT-II approach. Some critical steps for setting up Geographical Information System (GIS) databases for storing and managing the fields of a parameter-based vulnerability assessment are presented. Then, some alternatives for distributing the database are introduced, including cloud-based distribution and Transactional Web Feature Service (WFS-T) protocols, even using virtual servers. Additionally, an alternative front-end for accessing data and calculating the vulnerability index of constructions and levels of damage is presented. The main objective is to offer a replicable and feasible workflow to be performed even with reduced infrastructure and computational resources but can be easily connected and associated to a progressively enlarged system based on free and open-source software.

Keywords: GIS, Seismic Vulnerability Assessment, GNDT-II, QGIS, GeoServer.

1. Introduction

The characterisation of the seismic vulnerability of large sets of constructions is a challenging task. When dealing with large samples of constructions (e.g., in the context of a Historic Urban Landscape (Ramírez Eudave and Ferreira 2021a)), it is convenient to use simplified parametric-based approaches for certain typologies. The model proposed for this workflow (Vulnerability Index-based Methodology or "VIM") is the calibration used for the city of Atlixco (Puebla, México) of Ramírez Eudave and Ferreira (2021b).

2. The vulnerability index-based methodology for assessing the seismic vulnerability of masonry buildings

This methodology allows calculating a vulnerability index, which, for ease of use, is usually normalised to range from 0 to 100. This normalised value can be used to calculate the vulnerability value, which, in turn, together with the ductility of the structure and the macroseismic intensity allows for the estimation of a mean damage grade, μ_D.

3. Geodatabases for managing the GNDT-II survey

Using geodatabases is an efficient way of systematising the information related to vulnerability index-based approaches. These environments facilitate the association of multiple types of data on georeferenced entities (points, lines, polygons etc.). A very common free and open-source software for this purpose is QGIS. QGIS data organisation depends on managing layers with geographical and geometrical entities in which every instance is related to attributes with numeric, alphanumerical or Boolean data.

4. Complementary resources for GIS data acquisition and management

The presented workflow considers complementary tools for enlarging the QGIS capabilities as VIM database, namely for performing read/write operations outside of QGIS software through a Front-end and remote services for hosting GIS layers or QGIS files (WFS-T protocol and Mergin service). This workflow is specifically significative for carrying large-scale surveys by the means of remote access and real-time synchronisation.

5. Outcomes and potential use for mitigating damage and loses

The data acquisition process for a determinate urban environment may involve many of the strategies for achieving the parametric description of all the considered constructions. The calculation of the vulnerability index of the buildings can be easily obtained by using the front-end software, including the results in the database as well. The vulnerability index of a set of constructions is easily representable by using straightforward maps from QGIS.

6. Conclusions

Firstly, it is explored the possibility of developing and implementing a Python-language based front-end for reading, managing, and editing GIS layers. This would facilitate the management of geodatabases outside of GIS environments but would also offer a user-friendly interface for collecting core and complementary input data for the methodology. Secondly, two alternatives for remote distribution of GIS databases are presented and discussed. This capability is highly relevant for performing field campaigns with an almost immediate synchronisation. Both approaches represent strategies for implementing a free, enlargeable and online system. Finally, the generation of vulnerability maps is the base for anticipating damage and losses scenarios given a determined seismic intensity, which might impact the design of emergency planning and nominal-life oriented urban decisions.

Acknowledgements

This research was funded by the Portuguese Foundation for Science and Technology (FCT) through the grant number PD/BD/150385/2019.

References

Ramírez Eudave R, Ferreira TM (2021a) Characterisation of the Historic Urban Landscape through the Aristotelian Four Causes: Towards Comprehensive GIS Databases. Remote Sens 13:1879 . https://doi.org/10.3390/rs13101879

Ramírez Eudave R, Ferreira TM (2021b) On the potential of using the Mexican National Catalogue of Historical Monuments for assessing the seismic vulnerability of existing buildings: a proof-of-concept study. Bull Earthq Eng. https://doi.org/10.1007/s10518-021-01154-5

Probabilistic analysis of the corrosion hazard at territorial scale for supporting the preservation of concrete structures in coastal areas

Quaranta Giuseppe – Sapienza University of Rome, Rome, Italy, e-mail: giuseppe.quaranta@uniroma1.it

Giaccu Gian Felice – University of Sassari, Sassari, Italy, e-mail: gigiaccu@uniss.it

Briseghella Bruno – Fuzhou University, Fuzhou, China, e-mail: bruno@fzu.edu.cn

Nuti Camillo – Roma Tre University, Rome, Italy, e-mail: camillo.nuti@uniroma3.it

Abstract: Corrosion is a significant threat for the built heritage exposed to marine atmosphere and is one of the most critical issues to address for the conservation of the cultural patrimony in coastal landscapes. Since the corrosion due to marine aerosol promotes the rapid deterioration of steel and reinforced concrete structures, there is the need of suitable tools for supporting the proper management of existing constructions in coastal areas. In this perspective, assessing the corrosion hazard at territorial scale would allow the optimal allocation and prioritization of the resources required for in-situ surveys, structural monitoring, maintenance, and restoration. Therefore, this contribution illustrates ongoing efforts towards the development of a rational methodology for estimating the corrosion hazard at regional scale. The proposed approach encompasses three main steps. First, the building stock vulnerable to chloride-induced corrosion is identified and quantified. Environmental conditions are examined next, including data about sea waves and salinity, wind, temperature, humidity, rainfall, and chloride deposition rate. Finally, the corrosion hazard is estimated in probabilistic sense over the study area. The proposed methodology is presented together with preliminary results related to a case-study.

Keywords: bridge; chloride; corrosion; hazard; reinforced concrete.

1. Introduction

Deterioration phenomena due to the corrosion induced by chlorides transported by sea aerosol turns out to be very severe for several structures and infrastructures, and thus deserves special consideration [1,2]. Within this framework, the present work aims at proposing a general, yet rationale, workflow for the elaboration of chloride-induced corrosion hazard maps for coastal zones. It basically develops into three main steps. First, built heritage vulnerable to chloride-induced corrosion is identified and quantified. This requires the collection of relevant features about the built heritage exposed to chlorides originated by sea aerosol, such as construction type, position, and age. The second step is concerned with the analysis of the exposure conditions in the study area. This is a preparatory investigation that requires the analysis of data about direction and height of sea waves, sea salinity, temperature, relative humidity, rainfall, speed and direction of wind, and chloride deposition. Chloride-induced corrosion hazard maps are then elaborated in the last step. To this end, the intensity measure that serves at quantifying the hazard must be specified. The selected intensity measure is thus evaluated over the study area considering the involved uncertainties through a probabilistic approach. It is important to highlight that the final hazard maps are meant at illustrating the spatial and the temporal variation of the selected intensity measure in a probabilistic sense at large territorial scale whereas they are not intended to provide the actual local value at a given point in space.

2. Application

The selected case-study is Oahu Island, which is the third largest of the Hawaiian Islands, United States. The focus of the proposed application is on concrete bridges. In this regard, it is noted that several concrete bridges close to the shoreline within the study area are ranked with a high preservation value or are eligible for some preservation measures. A significant data mining task has been performed to gain a comprehensive understanding of the corrosion hazard. The corrosion current density at the reinforcement level has been selected as intensity measure to map the chloride-induced probabilistic corrosion hazard. For instance, Fig. 1 shows the probabilistic corrosion hazard map in terms of corrosion current density for an exposure time window equal to 100 years with a probability of exceedance equal to 5% (cement content and water-to-cement ratio are 406 kg/m^3 and 0.50, respectively).

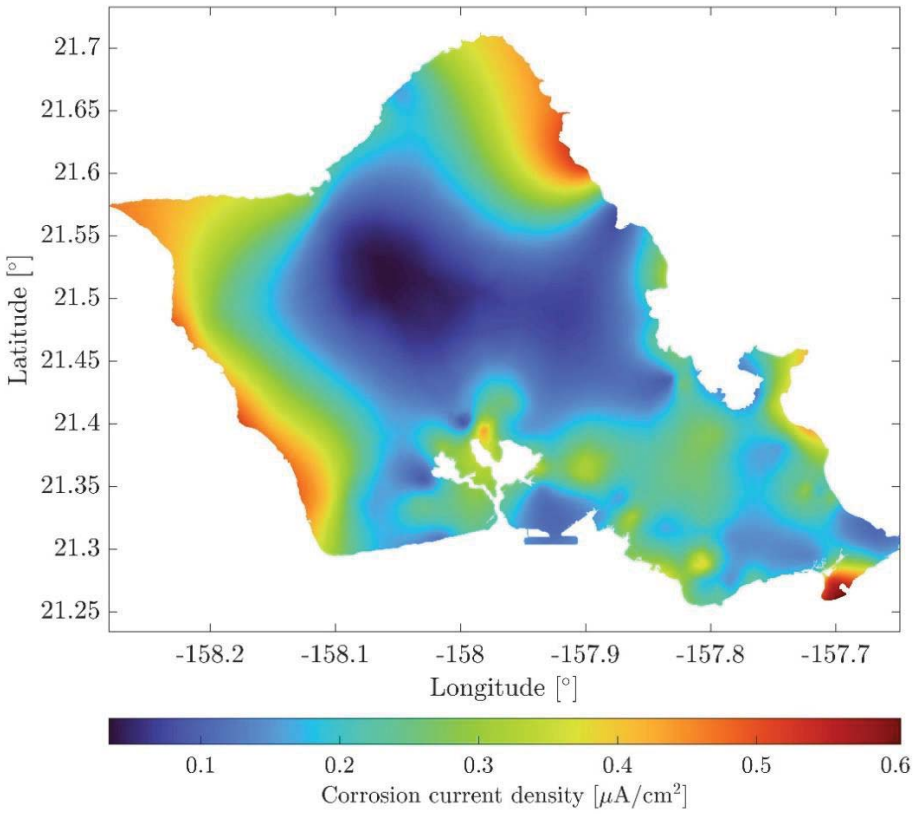


Figure 1. Probabilistic corrosion hazard map in terms of corrosion current density for an exposure time window equal to 100 years. The probability of exceedance is 5%, whereas cement content and water-to-cement ratio are equal to 406 kg/m^3 and 0.50, respectively

References

[1] Pelle A, Briseghella B, Bergami AV, Fiorentino G, Giaccu GF, Lavorato D, Quaranta G, Rasulo A, Nuti C. Time-dependent cyclic behavior of reinforced concrete bridge columns under chlorides-induced corrosion and rebars buckling. Struct Concr 2022; 23: 81-103.

[2] Pelle A, Briseghella B, Fiorentino G, Giaccu GF, Lavorato D, Quaranta G, Rasulo A, Nuti C. Repair of reinforced concrete bridge columns subjected to chloride-induced corrosion with ultra-high performance fiber reinforced concrete. Struct Concr 2022; in press.

Spontaneous rural settlements in the Emilia 2012 seismic aftermath: strategies for the enhancement of the countryside landscape

Montuori Manlio – Department of Architecture, University of Frttata, Ferrara, Italy
e-mail: manlio.montuori@unife.it

Abstract: Spontaneous built heritage in a seismic-prone area calls for extensive measures to take care of their critical tangible features and intangible values made of vernacular construction techniques and traditional use. The operative strategies should be continuously enhanced, starting with the damage survey and moving through the provisional safety measures to the final intervention. This paper illustrates an example of the methodology used to preserve the distinctive values of the anthropized countryside landscape in the Emilia lowland by identifying spontaneous evidence resulting from rural culture's practical knowledge. By analyzing historic construction methods, it is feasible to understand informal architecture by recognizing its variance and exploring the topic of brick masonry constructions. The aim is to show that spontaneous architecture, far from being an endangered type as a result of seismic sequence, despite its inherent vulnerability backed by the lack of materials and the modest construction techniques used, help to define the distinctive character of the anthropized rural landscape and that preserving their spontaneity ensures the persistence not only of the collective memory but also the image of the landscape itself.

Keywords: vernacular architecture, building type, traditional construction techniques, preservation

1. Introduction

The images that, in the aftermath of the recent seismic events that struck Italy, most remain imprinted in the collective memory – e.g., the devastation of Amatrice and forms of Parmigiano-Reggiano damaged due to the collapse of scalere in Emilia-Romagna – perhaps more than any other thought give the idea of how every earthquake is a unique event in its kind, addressed by many variables: the energy released, the extension of the involved area, the natural, social and economic characteristics of the territories. All of this results in significant variability of damage that the seismic event produces, in the impact of the short and long period on the territory, in emergencies and in the way the return back to normality is faced. In this sense, the consequences on the economic framework vary differently: often accelerate trends of decline already in progress; other times, the activities generated by reconstruction interventions can be a critical incentive to the recovery of the declining economies or the start of development processes in the lagging areas.
Infact, in many cases, the seismic event conveyed a fast population reduction, while in the medium-long term, this starts to grow again, albeit at much lower rates. The earthquake accelerates processes already in place, pushing further the abandonment of agricultural activities in the territories concerned. Neither should it be ignored as in the scale of the emergency, which determines the priorities of intervention in the aftermath of the event, agriculture is placed among the first places in sporadic cases. Moreover, this causes a delay in the reinstatement of the business conditions that, in some sectors – particularly the zootechnical and agri-food industries – can be crucial to the survival of such economic activities.
Therefore, emphasizing the attention toward a heritage as sensitive as the spontaneous built heritage in countryside highlights the need to identify intervention instruments capable of

acting as a flywheel for the recovery of the agricultural economy in the aftermath of any disaster. This attitude, linked to the testimonial value of the material document, is the most effective tool for promoting an aware action toward the preservation of the traditional characters of these vernacular architectures according to a territorial scale approach.

2. The spontaneous architecture at the earthquake test

The most outstanding and representative buildings in the agricultural domain are, actually, the typical rural constructions of service which can be traced back to the model outlined by the Bolognese architect Carlo Francesco Dotti, who in the 1700s introduced the building type stable-barn/*barchessa*, with a portico on two or three sides, particularly familiar in the rural territory from Modena to Bologna. Pillars or pilasters represent the architectural and compositional features of these barns, often paired, with large arched or squared openings, in addition to impressive walls arranged with the construction technique of *gelosie* (i.e., grid masonry wall), initially introduced for hygienic reasons.

2.1. The strategies of the anthropized landscape reconstruction

The damage of seismic events to the rural territory, on its economic resources but also the identity values linked to the landscape, requires consideration of the objectives of reconstruction. In the post-earthquake phase, it was necessary to respond to new requirements and requests from the territory while contributing to shaping a contemporary rural landscape, firmly rooted in the structures and signs of the historical landscape but renewed in functionality and safety.

The reconstruction of the lower central Emilia plain can be assessed as the implementation of a collective project involving citizens, professionals, and local government agencies. This process could not ignore a unitary vision, a project that, going beyond the emergency, knew how to seize the opportunities to renew the existing spontaneous context, investing in safety, functionality but also in quality features (i.e., quality of rural settlements, in their relationship with the landscape, and quality construction of rebuilt buildings). In order to manage the phases of this dynamic transformation, the definition of guidelines has been strategic to support operations without establishing a strict set of constraints and rules. The regulatory framework prepared by the Emilia-Romagna Region, also through the work of the Agency for the Reconstruction, established a series of criteria that, orienting the transformation interventions, addressed the design options about the context in which the intervention is going to be placed.

3. Discussion

Those who had the opportunity to research an archive or have the experience of an archaeological excavation know that the documents preserved there have their order that not only should not be altered but is also itself part of the information that the single document can provide. Even those voids left by objects, not in the location where they should have been, represent research data. Once the order is changed, the documents are moved, and a part of the information is lost. This is what happens to the landscape, and to the agricultural landscape in particular, where things often change, for reasons linked to cultivation, to the technologies used, due to the inadequacy of buildings to the needs of work and daily life. In the case of a dramatic event such as an earthquake, it is inevitable that an archive of historic heritage is put at risk by the choices of reconstruction. In this case, it is the single building (i.e., the single document) to occupy the center of interest, for reasons linked to the single property and the specific plan of reconstruction, for the procedures and the methods with which interventions are managed.

Diagnostic campaigns and structural assessment of an existing masonry buildings

Azzara Riccardo Mario - Istituto Nazionale di Geofisica e Vulcanologia (INGV), Osservatorio Sismologico di Arezzo, Arezzo, Italy, e-mail: (riccardo.azzara@ingv.it)

Cardinali Vieri - Università degli Studi di Firenze, Dipartimento di Architettura (DiDA), Florence, Italy e-mail: (vieri.cardinali@unifi.it)

Cristofaro Maria Teresa - Università degli Studi di Firenze, Dipartimento di Architettura (DiDA), Florence, Italy e-mail: (mariateresa.cristofaro@unifi.it)

Tanganelli Marco - Università degli Studi di Firenze, Dipartimento di Architettura (DiDA), Florence, Italy e-mail: (marco.tanganelli@unifi.it)

Keywords: existing buildings, destructive campaigns, dynamic identification, structural modelling, seismic analysis

Introduction

The structural evaluation of the existing buildings requires the comprehension of the acting resistant system as the definition of the mechanical properties of the adopted materials. The first issue is achievable through accurate geometrical structural surveys pursued by recent advanced technologies (laser scanner, photogrammetry) combined with the studies on the historical evolutions of the building and the execution of diagnostic campaigns. Nonetheless, once the structural system is clarified, the adopted materials still need to be defined in terms of mechanical values. In the structural assessment of existing structures, National and International codes define three specific Knowledge levels KL1, KL2 and KL3, based on the information collected [EN 1998-3 (2003), NTC 2018, MIT2019]. For each KL, a relative Confident Factor CF is accounted, targeted at reducing the mechanical properties considering the uncertainties not clarified during the knowledge phase. The CF accounted by the codes are equal to 1.35 for KL1 (the lowest KL), 1.20 for KL2 (intermediate), 1.00 for KL3 (exhaustive knowledge). Considering the masonry buildings, the Italian code [NTC2018] defines the mechanical parameters that must be used for several masonry typologies in absence of more refined definitions. Hence, for the higher KLs these parameters are then updated by Bayesian procedures.

This paper took advantage of a knowledge study carried on a nursing home for elderly person located in Tuscany to critically discuss the influence of the executed tests and the KLs to the structural response of the structures. The differences within consecutive achieved KLs are presented in terms of seismic analysis and safety indexes.

The case study “Fabbri Bicoli RSA” in Bucine

The Fabbri Bicoli RSA is a masonry structure located in Bucine, in the province of Arezzo (IT) which hosts a nursing home for elderly people (Fig. 1). The historical research allowed to date the building during the 30’s, when it held a kindergarten. The construction is characterized

by a regular architectural disposition. The building has semi-underground level, a ground level and a first floor. The plan is symmetrical respect to the entrance, where the staircase serves at the upper level.

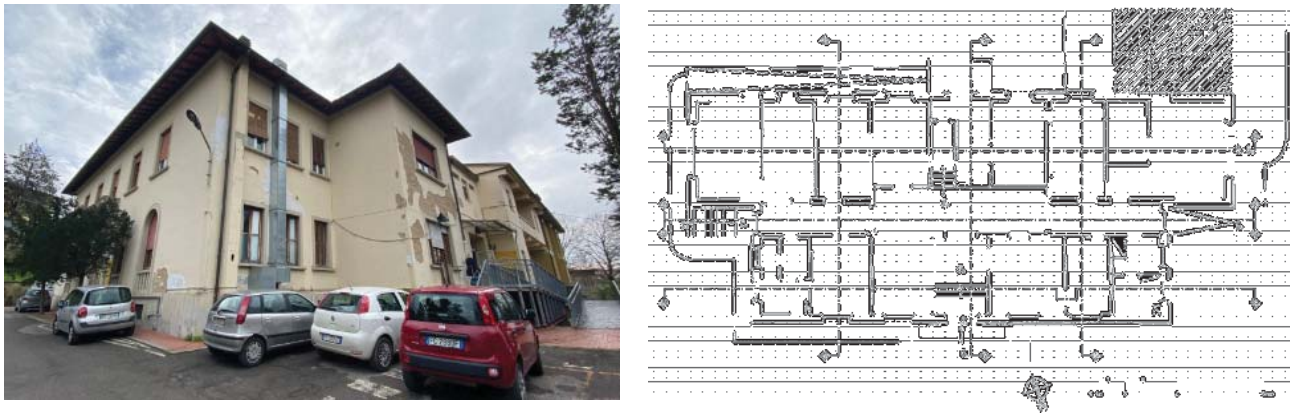


Figure 1. View of the building and ground floor plan

Conclusions

In this work a critical overview on the determination of the mechanical properties for seismic analysis of the existing structures have been presented with respect of a modern masonry building placed in Tuscany. The calibration of reliable structural models for the seismic vulnerability assessment of the existing buildings is crucial. The outcomes of the work point out dual results. Based on the poor performances of the building, the increasing of the knowledge does not correspond to an increase of the seismic performances, since the effects of the confidence factors is attenuated by the poor mechanical properties of the masonry materials. If the different results indicate that in this case, the achieve of KL1 was sufficient to determine the safety indexes of the structure with a limited overestimation of the performances (lower than 20%), the bad results of the mortar characterization and the masonry walls could also indicate that a global behaviour may be not exhibited during seismic events. Hence, particular attention should be paid. The dynamic identification of the buildings, although the useful indications that may provide to point out the real behaviour of the structures is not accepted yet by the Italian codes, confining its use for academic research and special structures. Further steps of the work will regard the calibration of structural models based on the evidence of the dynamic identification, in order to compare these structural models with the ones of the manuscript and assessing their performances during seismic events.

References

EN 1998-3 (2005) (English): Eurocode 8: Design of structures for earthquake resistance – Part 3: Assessment and retrofitting of buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]

NTC 2018 (2018), “Aggiornamento delle «Norme tecniche per le costruzioni». G.U. No. 42 del 20 Febbraio D.M. Ministero Infrastrutture e Trasporti 17 gennaio 2018, Roma (in Italian). NTC (2008) Norme tecniche per le costruzioni. D.M. Ministero Infrastrutture e Trasporti 14 gennaio 2008”, G.U.R.I. 4 febbraio 2008, Rome, (in Italian).

MIT 2019 (2019), “Circolare 21 gennaio 2019, n. 7 Istruzioni per l'applicazione dell'«Aggiornamento delle "Norme tecniche per le costruzioni"» di cui al decreto ministeriale 17 gennaio 2018. G.U. n. 47 del 26/02/2009”, Supplemento Ordinario n. 27, Rome, (in Italian).

Compression behaviour of heavily damaged concrete specimens confined with FRP

Cobo Escamilla, Alfonso – Universidad Politécnica de Madrid, Madrid, España, alfonso.cobo@upm.es

Prieto Barrio, María Isabel - Universidad Politécnica de Madrid, Madrid, España, mariaisabel.prieto@upm.es

Zaragoza Benzal, Alicia – Universidad Politécnica de Madrid, Madrid, España, alicia.zaragoza@upm.es

Ferrández Vega, Daniel – Universidad politécnica de Madrid, Madrid, España, daniel.fvega@upm.es

Abstract: In this work, the effect of confinement on concrete specimens previously tested to failure and subsequently confined with carbon fibre and glass fibre fabrics has been analysed. High-strength unidirectional carbon fibres MAPE WRAP C UNI-AX and glass fibres MAPE WRAP G UNI-AX manufactured by the company MAPEI have been used. The results of this study show that i) the reinforced specimens reach or exceed the strengths of the initial specimens, with a much higher ductility, ii) the use of glass fibres provides lower strengths than the carbon fibre reinforced specimens and iii) with both types of fibres there is an enormous increase in the ductility of the specimens.

Keywords: Concrete, Confinement, Compression, FRP

1. Introduction

The technique of confinement by external bonding of fibre fabrics with epoxy resins has been extensively studied at laboratory level and has been successfully implemented on site. At the same time, international standards, documents and regulations have been developed for its analysis and execution [1-2]. However, after an extensive literature review on the subject, no studies have been found where the behaviour of highly deteriorated concrete specimens subsequently reinforced by confinement has been evaluated. In practice, this situation can be found in compressed elements that have suffered severe damage in some areas due to an accidental action or some type of pathology.

The aim of this work has been to evaluate the behaviour of concrete specimens that have been tested in compression to failure and then confined by means of carbon and glass fibre fabrics bonded externally with epoxy resins. The results obtained allow to verify i) the compression behaviour of the confined specimens and ii) the difference between the response of the carbon fibre and glass fibre reinforced specimens.

2. Materials and techniques used

Twelve cylindrical concrete specimens with a diameter of 150 mm and a height of 300 mm were tested to failure. The specimens were manufactured in accordance with the UNE-EN 12390-2 standard. The tests were carried out by controlling the deformation, at a speed of 6.9-10-6 s-1, until breakage according to the UNE-EN 12390-3 standard. The

compressive strengths achieved were between 20 and 30 MPa for the unconfined specimens. The specimens were then confined with carbon and glass fibre fabrics and retested to failure. Table 1 shows the characteristics of the fibres used.

Table 1. Properties of the fibre and resin used

Thickness (mm)	Ultimate stress (MPa)	Elasticity modulus (GPa)
0.166	4830	2.300
0.240	2560	0.810
0.315	40	0.002

Figure 1 shows the stress-strain curves of unconfined (SC) and confined carbon fibre (CFRP) and glass fibre (GFRP) specimens.

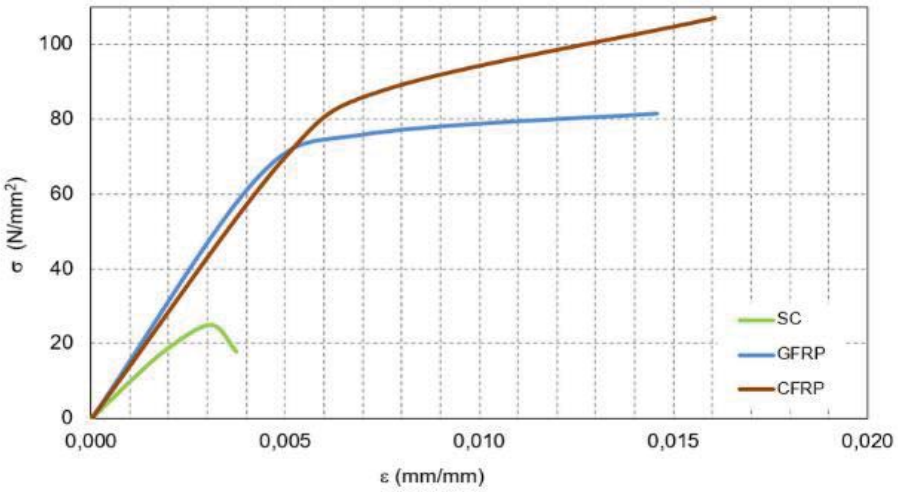


Figure 1. Stress-strain curves

3. Conclusions

In all the specimens tested in this study, the compressive strength of specimens previously tested in compression to failure and subsequently confined with carbon or glass fibre fabrics is much higher than the strength of the initial unconfined specimens.

Under the conditions of this work, the value of the ultimate stress of the confined specimens depends on the ultimate load of the confining fabrics, regardless of the value of the modulus of elasticity of the fabrics.

References

[1] ACI PRC-440.2-17. Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, American Concrete Institute; 2017.

[2] FIB. Externally bonded FRP reinforcement for RC structures. International federation for Structural Concrete, Laussanne; 2001.

Use of stainless-steel corrugated bar as reinforcements in new and heritage concrete structures that require enhanced durability

Bautista, Asunción – Universidad Carlos III de Madrid, Leganés (Madrid), Spain, e-mail: mbautist@ing.uc3m.es

Velasco, Francisco - Universidad Carlos III de Madrid, Leganés (Madrid), Spain, e-mail: fvelasco@ing.uc3m.es

Abstract: One of the most frequent causes of failure of reinforced concrete structures is the corrosion of the embedded steel. Hence, the proper selection of the material for the metal reinforcement in the most exposed regions to corrosion is a key point when reinforced concrete structures of foreseen long durability are built in corrosive environments, or when restoration of already corroded areas of historical buildings and structures is tackled. Moreover, the joining method to the other carbon steel reinforcements must be adequate to avoid corrosion problems. The present contribution summarizes relevant results obtained about the passivation mechanism of stainless-steel corrugated bars in alkaline media. The effect of pH decreases due to carbonation on the passive layer is also shown. In restoration, corrosion of embedded steel sometimes occurs due to the thin concrete cover of the original structure, which is unable to offer an efficient protection to the embedded bars. Generally, this point should not be modified. The joining of the replacing, corrosion resistant stainless-steel bar to the carbon steel bars existing in the structure must be carried out by welding. The eventual effect of this process on the durability is also summarized in this contribution.

Keywords: Reinforced concrete, Corrosion, Stainless steel, Electrochemical tests, Welding

1. Motivation and objective of the research

Stainless steel reinforcements are increasingly being used in the most exposed areas of concrete structures to guarantee the durability in corrosive environments. They are also used in restorations, as those carried out in the Roman Colosseum or in the Sydney Opera House, to assure a better performance than that the original building materials can provide.

For a reliable use of this type of materials in alkaline medium (as the one contained in the concrete pore solution), a deep study must be carried out. Moreover, the surface of welded stainless steel reinforcements change during high-temperature exposure. These changes can affect their corrosion resistance, and further in-service performance. The effect of post-welding cleaning procedures is also briefly summarised.

2. Relevant results and conclusions obtained

The X-ray photoelectronic spectroscopy (XPS) analysis carried out in surfaces of different grades of stainless steel corrugated bars [1] demonstrate that the alkalinity of the compounds present in concrete pore solution transform the pre-exiting passive layers on stainless steels. The oxides comprised in the passive layers become chromium rich; hence, they are more protective against corrosion than those formed in air on the same grades (**Figure 1**). The amount of oxidized Cr increases when the amount of Cr in the steel also does. When the pH of pore solution decreases due to carbonation (to pH about of 9), Cr_2O_3 content decreases. It also becomes clear from **Figure 1** that the 2205 type always shows the highest Cr_2O_3 content

in the passive layer of all the three studied stainless steels studied, while the 204Cu type shows the lowest.

The welding procedure affects the mechanical properties of the bars in a moderate way that keeps them inside the limits fixed by the standards [2]. However, the welding oxides have a meaningful effect on the corrosion resistance of the stainless steel, decreasing it. The length of the passive region (E_p-E_{corr} distance), determined from polarization curves in simulated pore solutions with chlorides (**Figure 2**), is related to the pitting nucleation probability. The corrosion resistance of the welded corrugated bars can be almost restored for high corrosion resistance grades by sand-blasting cleaning procedures. The corrosion performance of stainless steel welded bars after being welded in mortars in carbonated and non-carbonated mortars with chlorides have been monitored for years and the results can be found in [3,4].

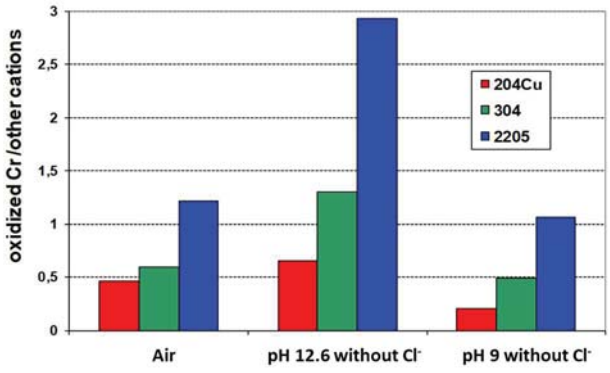


Figure 1. XPS results about the influence of the pH in the amount of Cr in the passive layer

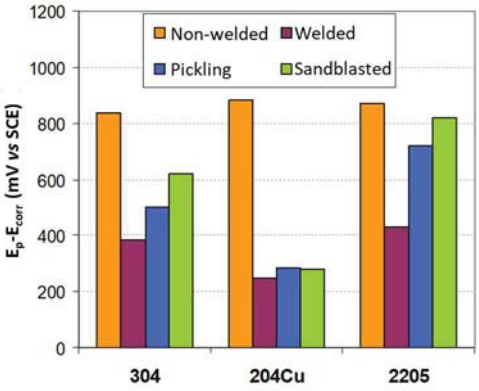


Figure 2. Length of the passive layer obtained from polarization polarizations curves carried out for stainless steel corrugated reinforcement in simulated pore solutions with 0.5% NaCl

Acknowledgements

This study was funded by the Ministerio de Ciencia, Innovación y Universidades of Spain through project RTI2018-096428-B-I00.

References

[1] Bautista A., Blanco G., Velasco F., Gutiérrez A., Soriano L., Palomares F.J., Takenouti H. (2009) Changes in the passive layer of corrugated, low-Ni, austenitic stainless steel due to the exposure to simulated pore solutions, Corrosion Science Volume 51, Pages 785-792. Doi: 10.1016/j.corsci.2009.01.012

[2] Velasco F., Blanco G., Bautista A., Martínez M.A. (2009). Effect of welding on local mechanical properties of stainless steels for concrete structures using universal hardness tests, Construction and Building Materials Volume 23, Pages 1883-1891. Doi: 10.1016/j.corsci.2009.01.012

[3] Bautista A., Blanco G., Velasco F., Martínez M.A. (2007) Corrosion performance of welded stainless steels reinforcements in simulated pore solutions, Construction and Building Materials Volume 21, Pages 1267-1276. Doi: 10.1016/j.conbuildmat.2006.03.007

[4] Bautista A., Paredes E.C., Alvarez S.M., Velasco F. (2016) Welded, sandblasted, stainless steel corrugated bars in non-carbonated and carbonated mortars: A 9-year corrosion study, Corrosion Science Volume 103 Page 363-372. Doi: 10.1016/j.corsci.2015.10.029

Extreme wind events and risk mitigation: overview and perspectives for resilient building envelopes design in the Italian context

Mazzucchelli Enrico S. – Politecnico di Milano, Milano, Italy, e-mail: enrico.mazzucchelli@polimi.it

Scrinzi Giacomo – Politecnico di Milano, Milano, Italy, e-mail: giacomo.scrinzi@polimi.it

Pastori Sofia – Politecnico di Milano, Milano, Italy, e-mail: sofia.pastori@polimi.it

Rigone Paolo – Politecnico di Milano, Milano, Italy, e-mail: paolo.rigone@polimi.it

Lucchini Angelo – Politecnico di Milano, Milano, Italy, e-mail: angelo.lucchini@polimi.it

Trabucco Dario – Università IUAV, Venezia, Italy, e-mail: trabucco@iuav.it

Milardi Martino – Università Mediterranea di Reggio C., Reggio Calabria, Italy, e-mail: mmilardi@unirc.it

Abstract: Resilient buildings need to face many challenges in many combinations (hurricanes and high wind resistance, wildfire events, etc.) but today their design hardly includes these aspects. During extreme wind events, threats are mainly due to the detaching and flying of materials and pieces from buildings and other man-made structures: roof tiles, façade elements, antennas, etc. are dragged away becoming flying debris that endanger people and properties, hitting surrounding buildings at high speed. Therefore, wind can cause direct damages to the building envelope (building elements failure under wind loads or detachment from the source) and indirect damages (flying debris impact on other buildings). The paper deals with effects and consequences of strong wind events on the built heritage, with a focus on the Italian context, proposing risk mitigation strategies which are part of mitigation and adaptation actions to respond to current and future climate threats.

Keywords: resiliency, risk mitigation, climate change, building envelope, storm wind

1. Introduction

The built environment adaptation to climate change is nowadays an essential challenge to be faced, from several different points of view. The world is experiencing a huge pressure on living conditions and an increase in damage to assets and asset value due to extreme weather events, notably in coastal areas where most of the world's population lives. In fact, the expected impacts of climate change, including sea level rise, heat waves, droughts and storms, will increasingly affect the built environment and in turn the society as a whole [1]. The paper deals with effects and consequences of strong wind events on the built heritage, with a focus on the Italian context.

2. Resilient building envelopes design methodology and risk mitigation

In 2019, strong winds were responsible for 38% of the recorded injuries and 16% of the recorded fatalities caused by extreme weather in Europe [2]. Among others, the impact of wind-borne debris on building envelopes at high speed is one of the major risks related to powerful storms and extratropical cyclones [3]. However, very few investigations have been conducted concerning debris impacts and resulting damages [4]. The major goal of the existing measures is preventing damages to people and properties due to flying debris. The aim is pursued by adopting two sets of actions: reducing the likelihood of the flying debris phenomenon, by improving the resistance of man-made elements to wind; mitigating the

consequences of flying debris, by setting design guidelines and testing methodologies to ensure the resistance of the building envelope to the flying debris impact.

A proposed assessment methodology for resilient building envelopes design is shown in Fig. 1. Based on the building location analysis, the design wind loads should be first identified according to current standards and local regulations. The data concerning the maximum records over the past decades should be analysed to check whether they are in line with the minimum design wind load requirements. The analysis of the surrounding environment should highlight which of the building components could potentially fly under extreme wind conditions and hit the façade. This phase is fundamental to identify the various flying debris typologies where the wind engineering studies should be conducted on, for an integrated design.

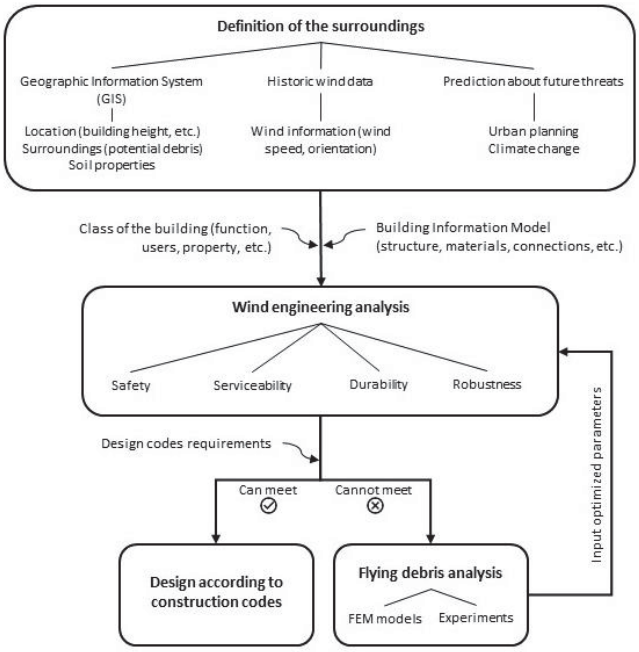


Figure 1. Proposal of a resilient building envelope design strategy flowchart.

3. Conclusions

Flying debris resilience of building façades is fundamental to avoid building envelope failures and internal pressure growth with consequential damages to the building. A design tool must be developed for façade engineers to assess adequate airborne debris resilience of façades, based on local environment, and aerodynamic simulation of debris flight in strong wind conditions. This design implementation should lead to a safe building envelope design both for new constructions and retrofit solutions.

References

[1] Buildings and Climate Change Adaptation – A call for action (2021), Global Alliance for Buildings and Construction, Report 2021.

[2] ESSL Annual Report. European Severe Storms Laboratory (2019), Amtsgericht München.

[3] A. Mejorin, P. Rigone, G. Kopp, D. Trabucco (2020) Wind-borne debris resistant façades. The European case of flying debris: roof tiles, Advanced Building Skins 2020, Bern, Switzerland.

[4] X. Zhang, H. Hao, G. Ma (2013) Laboratory test and numerical simulation of laminated glass window vulnerability to debris impact, International Journal of Impact Engineering 55, pp. 49-62.

Effect of corrosion on the mechanical behaviour of reinforcement in concrete structures

Cobo Escamilla, Alfonso – Universidad Politécnica de Madrid, Madrid, España, alfonso.cobo@upm.es

Prieto Barrio, María Isabel - Universidad Politécnica de Madrid, Madrid, España, mariaisabel.prieto@upm.es

Zaragoza Benzal, Alicia – Universidad Politécnica de Madrid, Madrid, España, alicia.zaragoza@upm.es

Ferrández Vega, Daniel – Universidad politécnica de Madrid, Madrid, España, daniel.fvega@upm.es

Abstract: In this work the effect of corrosion on the mechanical behaviour of reinforcement in reinforced concrete structures has been analysed. The results obtained on B 500 SD steel bars with varying degrees of corrosion show that the effects on the steel are manifested by the loss of strength and ductility. The use of the equivalent steel concept in this type of situation has been shown to be very beneficial when evaluating a reinforced concrete structure with corrosion problems.

Keywords: Corrosion, Reinforcement, Ductility, Ductility, Concrete

1. Introduction

Since their inception, reinforced concrete structures (RCS) were envisaged to have a virtually unlimited lifetime. However, degradation processes of RCS due to the passage of time are inevitable, especially in aggressive conditions where the steel can react with its environment, causing corrosion, which can affect its serviceability and durability. Reinforcement corrosion is the main factor in the deterioration of RCS located in aggressive environments. Once the process is triggered, the rehabilitation of RCS with methods that have proven to be effective is very burdensome. The consequences of corrosion on carbon steel reinforcement are manifested by the loss of bearing capacity of the bars, mainly due to the reduction of the cross-section, and by the variation of their stress-strain behaviour, which affects their ductility [1].

The aim of this work has been to evaluate the behaviour of B 500 SD steel reinforcement when subjected to different degrees of corrosion. The results obtained show i) the loss of mechanical capacity of the bars, ii) the variation in the ductility of the reinforcement and iii) the advantage of using the concept of equivalent steel when there is a problem of reinforcement corrosion.

2. Materials and techniques used

B 500 SD steel bars have been subjected to an accelerated corrosion process, and have been tested at tensile strength until breakage, evaluating their mechanical properties according to their degree of corrosion. The degree of corrosion was obtained as the average loss of section of the metal.

The tests carried out show the changes experienced in the stress-strain diagram of the

steel, showing a systematic decrease in the deformation under maximum load with the degree of corrosion, to values which in many cases are below the minimum required by the standards and regulations in force, and an increase in the ratio between the maximum stress and the elastic limit. In these cases, the use of the equivalent steel concept as a ductility criterion, based on the combined consideration of the deformation under maximum load and the ratio between the maximum stress and the yield strength, can be very advantageous [2].

Figure 1 shows the stress-strain curves of reinforcement subjected to different degrees of corrosion.

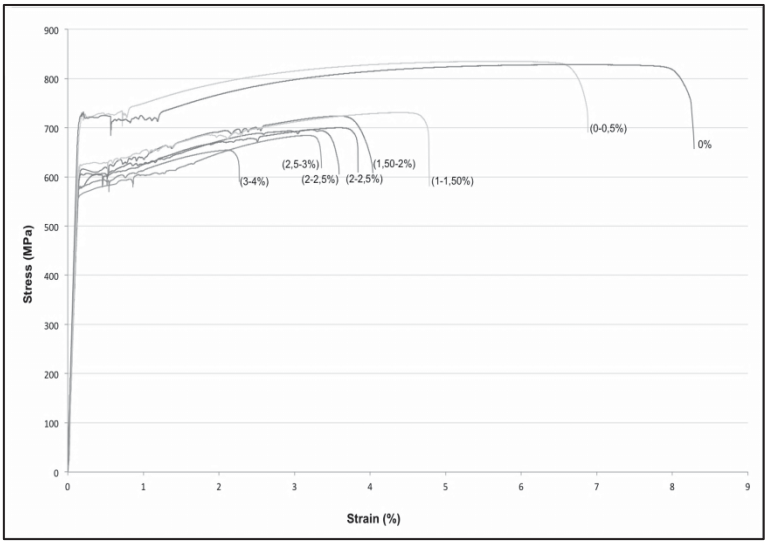


Figure 1. Stress-strain curves

3. Conclusions

In situations of reinforcement corrosion in concrete structures, the use of the equivalent steel concept as a ductility criterion, based on the joint consideration of the deformation under maximum load and the ratio of the maximum stress to the yield strength, can be very advantageous.

References

[1] Moreno E, Cobo A, Cánovas MF. Ductility of reinforcement steel with different degrees of corrosion and the ‘‘equivalent steel criterion’’. Mater Constr 2007;57:5–18.

[2] Cosenza E, Greco C, Manfredi G. An equivalent steel index in the Assessment of the ductility performances of the reinforcement. Ductility of Reinforced Concrete Structures, Comitè Euro-international du Betón. Bollettin nº 242. Lausanne, 1998, pp. 157-170.

Traditional stone masonry walls subjected to blast and axial loadings

Conceição, J. F. M – CINAMIL, Military Academy, Lisbon, Portugal, conceicao.jfm@academiamilitar.pt

Pinho, Fernando F. S. – CERIS, FCT NOVA, Lisbon, Portugal, ffp@fct.unl.pt

Joaquim, B. – FCT NOVA, Lisbon, Portugal, b.joaquim@campus.fct.unl.pt

Abstract: Explosive action, although not frequent, can be catastrophic when it occurs, since it can cause the collapse of a structure. This consequence has great relevance for structures that were not designed for this action, which is the case of most traditional masonry structures. This paper presents conclusions obtained in a MSc thesis [1] developed in the NOVA School of Science and Technology (FCT NOVA) regarding the blast behaviour of traditional stone masonry walls. In order to understand this phenomenon, two types of tests were performed, using two traditional stone masonry specimens (M1 and M2) with dimensions 1.20 m × 1.20 m × 0.40 m (length × width × thickness), produced by Pinho [4]. Firstly, the specimens were subjected to three unconfined explosions (without physical barriers between the explosion and the target/wall). Secondly, after the explosions, the axial compressive strength of the two walls was evaluated. In this paper, the results and discussion of these kind of tests are presented.

Keywords: Traditional stone masonry walls; Explosion; Axial compressive strength.

1. Experimental work

Traditional stone masonry walls are usually (external) "resistant walls". Thus, a testing system was developed to apply a pre-load of 0.25MPa to each wall, before the blast loads, Fig.1, which in turn may simulate a lower floor wall of a traditional Portuguese ancient stone building. It was not possible to test the walls in the horizontal position, similarly to tests previously performed [2] under the Project PTDC/ECI-EST/31046/2017 – PROTEDES, with which this work is related, due to their constitution, weight and pre-load applied. Therefore, field tests took place using a testing facility of the Portuguese Competence Centre for Infrastructure Protection (CCIP), which comprises a foundation and reinforced concrete walls (0.35m thick), 1.65m apart [1, 3].

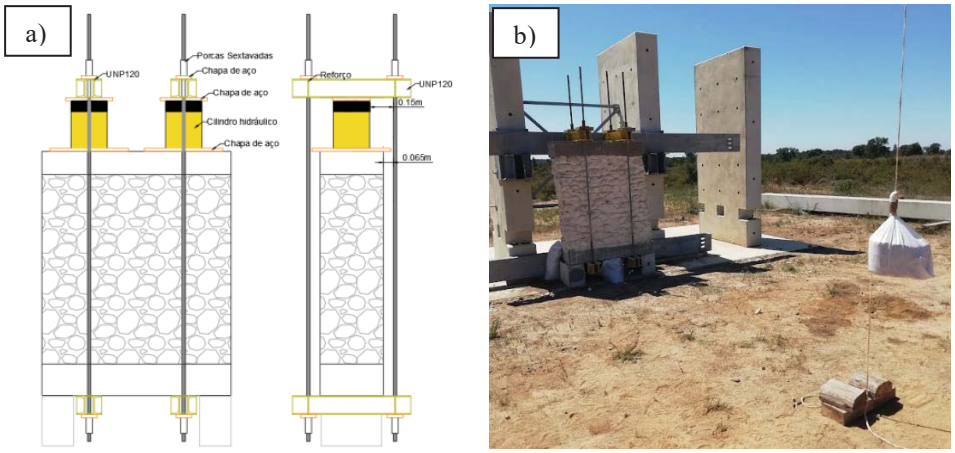


Figure 1. a) Schematic representation of the tested specimens (M1 and M2) [1, 3]; b) Application of vertical pre-load of 0.25MPa to the specimens, before the explosive actions

The instrumentation used provided the measurement of the values necessary to characterise the events and effects that occurred. In the first type of test, two incident pressure sensors and one reflected pressure sensor were used. In the second type of test, it was used a deflectometer.

2. Results and Conclusions

By comparing the experimental values with the theoretical formulations, it can be seen that primers are closer to a surface explosion (Table 1). The most significant discrepancies are for the incident pressure, with an error of 87.5% observed in the first test and 41.4% in the second test; however, the error decreases in the third test, observing a value of 10.2%. This can be justified by the experimental test conditions in natural conditions outside the laboratory. In the case of the second test, a sensor recorded a higher peak of 2.583MPa, and the other one of 1.651MPa which is closer to the theoretical values. Regarding the reflected pressure, it has a minor error between its theoretical values and spreadsheets being respectively 10.4%, 3.4% and 15.5% in the first, second and third tests.

Table 1. Incident and reflected pressures obtained experimentally and theoretically

Values (MPa)	1st Test (M2)		2nd Test (M2)		3rd Test (M1)	
	P_{so}	P_r	P_{so}	P_r	P_{so}	P_r
Experimental	0,60	1,35	2,12	9,40	2,82	23,85
Theoretical Air Blast	0,20	0,67	0.99	5,43	2,15	14,01
Theoretical Surface Explosion	0,32	1,22	1,50	9,09	3,14	20,64

Figure 2 shows the results of the loading tests. Although the curves depicted in the graph correspond to walls with lower age than M1 and M2, at the testing date (thus benefiting from the carbonation effect, as well as from the use of more resistant laying mortar [4]), and the test system is different from the one used in the tests of the other walls [4], it can be observed that the resistance of M1 and M2 is higher. Similarly, M1 and M2 are stiffer than those previously tested, which seems to indicate that the explosive actions did not interfere with the mechanical characteristics of the walls M1 and M2. To obtain a more reliable comparison, it would be required to measure the strength of undamaged walls of the same age.

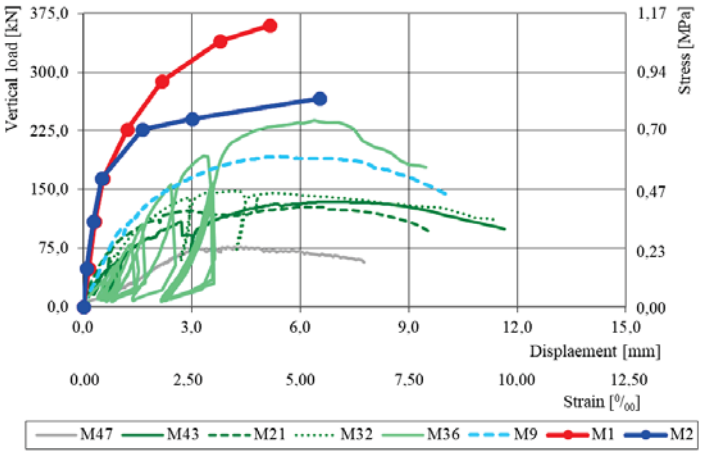


Figure 2 - Comparison of the axial compressive strength of walls M1 and M2 with the experimental results presented in [4].

References

[1] Joaquim B. (2021): Behaviour of traditional stone masonry walls subjected to blast loading. Master Thesis Civil Engineering. Lisbon: FCT NOVA. (in Portuguese)

[2] Pereira, V. (2017): Innovative System for Explosion Protection of Buildings - Reinforced Concrete Facade Panels with Thin Walled Steel Connectors. Master Thesis Military Engineering. Lisbon, Military Academy / Instituto Superior Técnico. (in Portuguese)

[3] Joaquim, B.; Conceição, J.; Pinho, F. F. S (2022): Comportamento de paredes de alvenaria de pedra tradicional face a explosões. TEST&E 2022 - 3º Congresso de Ensaios e Experimentação em Engenharia Civil. FCT NOVA, Campus de Caparica, 21 a 23/jun/22

[4] Pinho, F. F. S. (2007): Ordinary Masonry Walls - Experimental study with un-strengthened and strengthened specimens. Ph.D. Thesis. Civil Engineering. Lisbon: FCT NOVA, 17/out/07. (in Portuguese)

Evaluation of the seismic vulnerability of Coimbra's old city center: A comparative study between 2009-2021

Marcos Antonio Chiamulera - Universidade de Coimbra, Coimbra, Portugal, e-mail: marcoschiamulera@gmail.com

Tiago Miguel Ferreira - University of the West of England (UWE Bristol), Bristol, United Kingdom, e-mail: Tiago.Ferreira@uwe.ac.uk

Romeu Vicente - RISCO, Universidade de Aveiro, Aveiro, Portugal, e-mail: romvic@ua.pt

J. Mendes Silva - CERIS, Universidade de Coimbra, Portugal, e-mail: raimundo@dec.uc.pt

Abstract: This paper targets the comparison between the current state and seismic vulnerability of the masonry building stock of the old city centre of Coimbra in Portugal carried out in 2009 and the recent reassessment and data survey, updating the information on the general state of conservation and sequentially the seismic vulnerability assessment of the masonry facades using the same methodology specifically developed back in 2009. Once updated the building inspection information, the analysis consists in comparing data collected in 2009 with the current information to identify changes that occurred over the last decade. The current survey is based on original criteria, whose objective will be to update information about the current state of the buildings, verify the evolution of their state of conservation, and identify the evolution of building defects. The collected data was integrated into a Geographic Integration System (GIS) to easily compare the information and the spatial visualization of the seismic vulnerability index and physical damage scenarios results from the two different years, ten years apart. Results reveal that, in general terms, the seismic vulnerability of the traditional masonry facades in the urban area assessed presents a growing trend. In particular, some streets with highly vulnerable facades are correlated with no remedial or conservation measures. In this sense, the results presented can be very relevant in what regards to supporting decision-making concerning future intervention processes in the Old City Centre of Coimbra.

Keywords: Old City Centre, State of conservation, Masonry buildings, Seismic vulnerability, GIS

1. Introduction and metodology

The main motivation of this work was to reassess an urban area of the old city centre of Coimbra to identify the current state of conservation and the seismic vulnerability of a significant group of buildings using the same methodology and tools used in 2009 when the first large-scale assessment was performed. That was carried out in two interdependent stages. The first stage involved a comparative analysis of the general state of conservation and the level of changes/interventions observed in the buildings, having as reference these same conditions recorded in similar research conducted back in 2009 [1]. The second stage was focused on the assessment of the seismic vulnerability of the façade walls. The present extended abstract addresses the second stage only, presenting the main observations from the comparative analysis of the current situation and the seismic vulnerability of the same buildings assessed in 2009. The methodology used in this investigation for the evaluation of the seismic vulnerability of the building included in the study area was proposed in 2009 by [2]. This methodology is based on the determination of a vulnerability index, I_{vf}, calculated based on the evaluation of 13 vulnerability parameters associated with geometric, mechanical characteristics and the state of conservation of the buildings.

2. Comparison of the seismic vulnerability scenarios

For comparison purposes, Figure 1 presents two maps with the seismic vulnerability index ranging from 0-100 obtained in 2009 and 2021. From the analysis of the figures below, it is possible to appreciate meaningful differences between the situation observed in 2009 and the most recent reassessment, particularly for some streets (Direita, Moeda, da Louça, and Corvo). This trend of increase in the seismic vulnerability of the buildings is reflected clearly in the average (mean) seismic vulnerability index obtained for the buildings assessed, which increased about 14% from 36.08 to 41.25. The standard deviation value decreased from 12.60 to 11.73 (slightly less than 7%), meaning that the level of seismic vulnerability across the study area is not only higher but also more homogeneous. However, some positive exceptions can be observed; for example, buildings located on Sofia Street were evaluated and have lower values of seismic vulnerability when compared with 2009.

Figure 1. Seismic vulnerability index for 2009 (a) and 2021 (b).

3. Final remarks

Although the estimation of damages was not included in this extended abstract, the comparison between the vulnerability results obtained in 2009 and 2021 anticipates that the consequences in terms of physical damage resulting from seismic activity can potentially be very significant. In addition to providing an integrated and up-to-date view of the evolution of the degradation of the building and its seismic vulnerability, the results of this evaluation will also allow the assessment and comparison of human and economic losses estimated for different macroseismic intensity scenarios.

References

[1] R. Vicente, S. Parodi, S. Lagomarsino, H. Varum, and J. A. R. M. Silva, "Seismic vulnerability and risk assessment: case study of the historic city centre of Coimbra, Portugal," Bull. Earthq. Eng., vol. 9, no. 4, pp. 1067–1096, Aug. 2011, doi: 10.1007/s10518-010-9233-3.

[2] T. M. Ferreira, R. Vicente, and H. Varum, "Seismic vulnerability assessment of masonry facade walls: development, application and validation of a new scoring method," Struct. Eng. Mech., vol. 50, no. 4, pp. 541–561, May 2014, doi: 10.12989/sem.2014.50.4.541.

Optimal reinforcement of existing masonry and reinforced concrete structures using evolutionary algorithms

Di Trapani Fabio – Dipartimento di Ingegneria Strutturale, Edile e Geotecnica (DISEG), Politecnico di Torino, Turin, Italy, e-mail: fabio.ditrapani@polito.it

Antonio Pio Sberna - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica (DISEG), Politecnico di Torino, Turin, Italy, e-mail: fabio.ditrapani@polito.it

Cristoforo Demartino - Zhejiang University - University of Illinois at Urbana Champaign Institute, Haining, China, e-mail: cristoforo.demartino@me.com

Giuseppe Carlo Marano - Dipartimento di Ingegneria Strutturale, Edile e Geotecnica (DISEG), Politecnico di Torino, Turin, Italy, e-mail: fabio.ditrapani@polito.it

Abstract: The design of seismic upgrading interventions for existing structures concerns the determination of the structural elements where the retrofitting intervention should be implemented and the type and arrangement of the reinforcement. In the current practice, this procedure is mainly based on a trial-and-error approach, mainly based on engineers' experience, without a formal implementation of cost/performance optimization. Nevertheless, retrofitting interventions are generally associated with relevant costs but also with significant invasiveness, and noticeable downtime. This paper presents the results of the application of some novel optimization framework aimed at the minimization of seismic retrofitting-related costs by an optimal position (topological optimization), and sizing of the reinforcements within the structure. The applications concerned both existing masonry and reinforced concrete structures. The framework connects a 3D FE model implemented in OpenSees with a genetic algorithm routine developed in MATLAB®. The optimal configurations are found by that iterating reinforcement configurations to match the optimal arrangement. Results will show that retrofitting costs can be significantly reduced without reducing the reference safety levels.

Keywords: Seismic retrofitting, evolutionary algorithms, optimization, existing structures, reinforced concrete, masonry

1. Contents and results

Seismic events have a dramatic impact on communities belonging to earthquake-prone areas in terms of loss of human lives, disaggregation of social tissue, and massive financial commitments required to repair and rebuild. For these reasons, seismic retrofitting of existing structures emerges nowadays as a major priority of governments to increment the resilience of communities toward seismic risk.

Retrofitting interventions are generally associated with noticeable costs, significant invasiveness, and relevant downtime. Despite the vast type of efficient technical solutions available on the market, nowadays retrofitting design phases are mainly entrusted to the engineers' intuition and experience, and this requires several trial-and-error attempts with noticeable time consumption. Furthermore, this empirical design approach may also entail an overestimation of the extent of retrofitting interventions.

In this frame of reference, artificial intelligence applications emerge as efficient computational tool for the appropriate employment of funds allocated for the seismic retrofitting of existing structures. Their applications on structural optimization allow

engineers to obtain cost-effective designs. In the last years, the scientific interest in this discipline was mainly focused on sizing and shape optimization of new structures. On the contrary, the issue of the optimization of seismic retrofitting of existing structures has not been investigated many times in the past, while noticeable interest is emerging in the last years. Different AI-based frameworks for the optimal design of retrofitting interventions are presented in this paper [1-4]. The problem of finding efficient retrofitting configurations is tackled by developing genetic algorithms that are aimed to provide the optimal position (topological optimization) and design (sizing optimization) of retrofitting interventions so that their implementation costs are minimized. The novel genetic algorithm routines are defined by developing modified genetic operators capable of addressing retrofitting optimization for both masonry and reinforced concrete frame structures (Fig. 1). Results will show that seismic reinforcement interventions for existing structures can be effectively designed by minimizing their cost under the reference design safety standards.

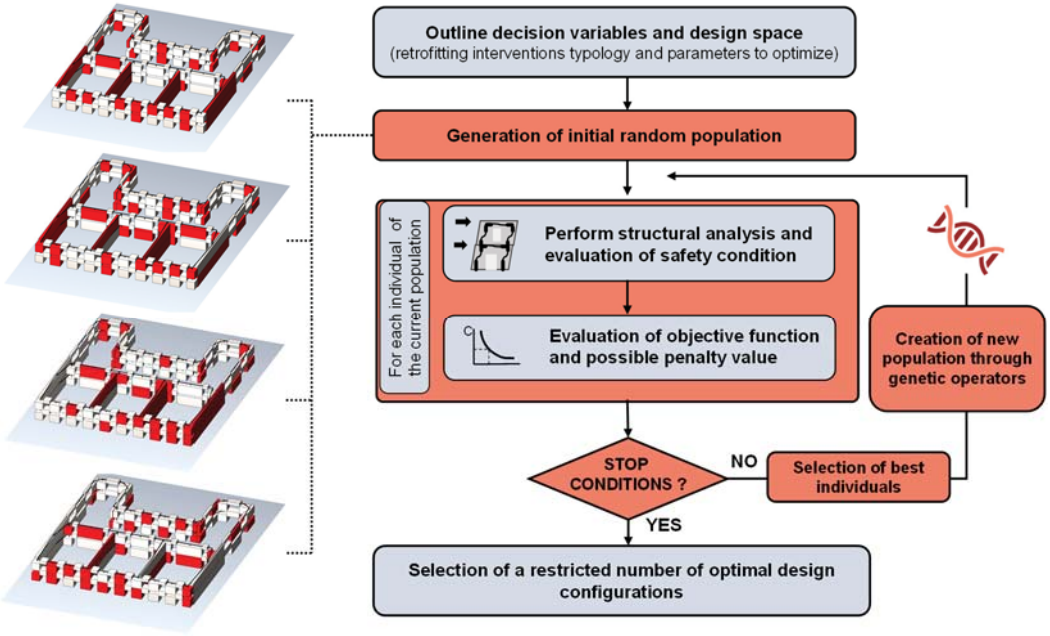


Figure 1. Retrofitting design optimization framework.

References

[1] Di Trapani F, Malavisi M, Marano GC, Sberna AP. Greco, Optimal seismic retrofitting of reinforced concrete buildings by steel-jacketing using a genetic algorithm-based framework. Eng Struct 2020;219:110864.

[2] Di Trapani F, Sberna AP, Marano GC. A new genetic algorithm-based framework for optimized design of steel-jacketing retrofitting in shearcritical and ductility-critical RC frame structures. Eng Struct 2021;243:112684.

[3] Di Trapani F, Sberna AP, Marano GC. A genetic algorithm-based framework for seismic retrofitting cost and expected annual loss optimization of non-conforming reinforced concrete frame structures. Computers and Structures 2022; 271: 106855.

[4] Di Trapani F, Sberna AP, Demartino C, Marano GC. Genetic algorithm-based seismic retrofitting optimization for existing masonry structures. 3rd European conference on earthquake engineering & seismology. Bucharest, Romania, 2022.

Methodology for Assessing the Degradation Level of Existing Structures with a Parameterized Cubic Damage Model

DUTRA, Erik Filipe Alves - University of Brasilia (UnB), Brasília - DF, Brasil, e-mail: erik.engcivil@gmail.com

PANTOJA, João da Costa - University of Brasilia (UnB), Brasília - DF, Brasil, e-mail: joaocpantoja@gmail.com

Abstract: The rehabilitation of existing structures is a complex process that requires the analysis of several factors relevant to the state of conservation of the building. There are several methodologies for inspection and analysis of degradation in structures that can be applied as a tool to quantify and assess existing damage, among them is the methodology for quantitative assessment of the degree of deterioration in GDE/UnB reinforced concrete structures, initially developed by Castro (1994) and improved by several authors. This article presents a proposal for parameterization of the cubic analysis model of the GDE/UnB methodology, proposed by Marques et al. (2016). For this, a parameterization of the cubic model of the degree of damage was performed, then its application was made on a walkway with a mixed structure, composed of metallic structural elements and reinforced concrete, located at the Faculty of Law of UnB in Brasília, DF, Brazil, in which a survey and quantification of damage to the structure was carried out using the GDE/UnB methodology Parameterized by models for analyzing the degree of bilinear and cubic damage. The results demonstrated the effectiveness of using the cubic model to analyze the degree of damage in the evaluation of existing structures.

Keywords: GDE methodology; Pathology; Degradation; Rehabilitation; Existing structures.

1. Introduction

The parameterized GDE/UnB methodology has been used in conjunction with probabilistic methodologies that consider, in a coupled way, the parameters of durability and structural safety, producing more accurate information regarding the actual behavior of an existing structure.

Seeking to contribute to the studies on the application of the GDE/UnB methodology parameterized together with integrity factors, reliability indices and numerical modeling, the present study aims to develop a parameterized model of cubic analysis of the degree of damage.

2. Methodology

The present study sought to adapt the GDE/UnB methodology parameterized by Pantoja et al. [1] to a nonlinear model, governed by a smooth curve that portrays the mechanisms of deterioration of structures over time. Using several pairs of points, the following cubic parabola was found by polynomial regression:

$$D = (a1 + b1\ Fi - c1\ Fi^2 + d1\ Fi^3) \times Fp \quad (1)$$

Being: a1 = 0,0084, b1 = 0,0633, c1 = 0,5642, d1 = 1,5048.

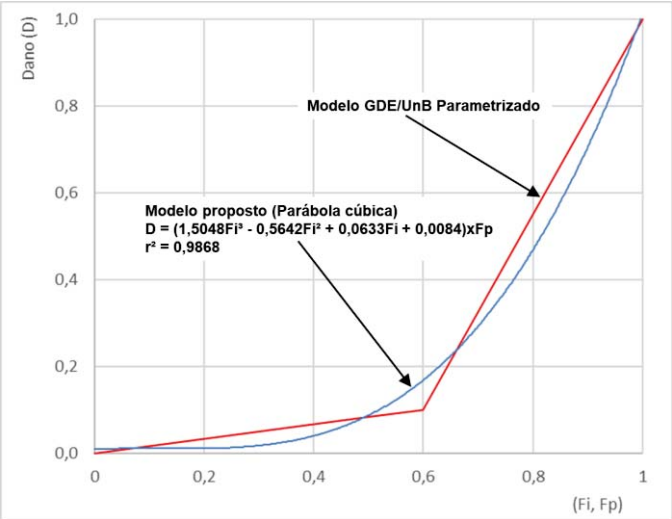


Figure 1. Parabola fitted to the GDE/UnB model data Parameterized considering 6 pairs of points. Source: Own authorship.

In this way, it was proposed to replace the two equations of the bilinear model of the degree of damage (D), by a single equation: equation 1.

The Parameterized GDE/UnB methodology was applied, in both damage degree models (D), bilinear and cubic, in a pedestrian walkway, of the hybrid type (composed of metallic structural elements and reinforced concrete), located at the Faculty of Law (FD) of the University of Brasília (UnB) in Brasília – DF, Brazil. Then, the results obtained by the two models were compared.

5. Results and Conclusions

The value found for the Degree of Global Deterioration of the Structure (Gd), according to the bilinear and cubic damage degree models, classified the walkway under study as having a low level of degradation, suggesting the need for a long-term intervention.

It was observed that in both models for calculating the degree of damage tend to present similar results, attesting to the same level of deterioration and severity for the elements evaluated. Thus, both methods presented results that represent the reality identified during the inspections. Therefore, the cubic model proved to be a viable option to determine the degree of damage and consequent state of degradation of the structure, simplifying the calculation model by replacing the two equations of the bilinear model by a single equation.

References

[1] PANTOJA, J. C.; VARUM, H.; HENRIQUES, A. A. Metodologia probabilística para avaliação de edificações com estrutura existente em betão armado. Encontro Nacional Betão Estrutural - BE2018, LNEC, 2018.

[2] CASTRO, E. K. Desenvolvimento de metodologia para manutenção de estruturas de concreto armado. Dissertação de Mestrado. Universidade de Brasília, Brasília, Brasil, 1994.

[3] MARQUES, M. W. M.; PANTOJA, J. C.; OLIVEIRA, A.L. A. Metodologia para Avaliação do Nível de Criticidade de Estruturas Mistas com Modelo de Dano Cúbico. Anais do XII Congresso internacional sobre Patologia e Recuperação de Estruturas - Cinpar 2016, Porto, Portugal, 2016.

SHM for failure propagation detection in steel truss bridges

Buitrago, Manuel. – ICITECH – Universitat Politècnica de València, Valencia, Spain, e-mail: mabuimo1@upv.es

Caredda, Giacomo. – ICITECH – Universitat Politècnica de València, Valencia, Spain, e-mail: gcaredd@upv.es

Bertolesi, Elisa. – Department of Civil and Environmental Engineering – Brunel University London, Uxbridge, UK, e-mail: elisa.bertolesi@brunel.ac.uk

Porcu, M. Cristina. – Department of Civil and Environmental Engineering and Architecture – University of Cagliari, Cagliari, Italy, e-mail: mcporcu@unica.it

Calderón, Pedro A. – ICITECH – Universitat Politècnica de València, Valencia, Spain, e-mail: pcaldero@upv.es

Adam, José M. – ICITECH – Universitat Politècnica de València, Valencia, Spain, e-mail: joadmar@upv.es

Abstract: This study aimed to experimentally and computationally analyse the robustness of riveted steel bridges based on truss-type structures in order to define recommendations for Structural Health Monitoring (SHM). This paper describes a unique case of a 21m full-scale bridge span tested under laboratory conditions with an extensive monitoring system to evaluate structural behaviour and robustness as damage progressed in its elements (See Figs. 1-2). A computational analysis was also included to examine other possible causes not included in the experiment (See an example on Fig. 3). The results proved the structural redundancy of this type of truss structure based on different Alternative Load Paths (ALPs). The study carried out and the extracted recommendations for SHM it produced are now being applied in three similar bridge case studies.

Keywords: Robustness; SHM, steel truss, failure propagation, ALPs

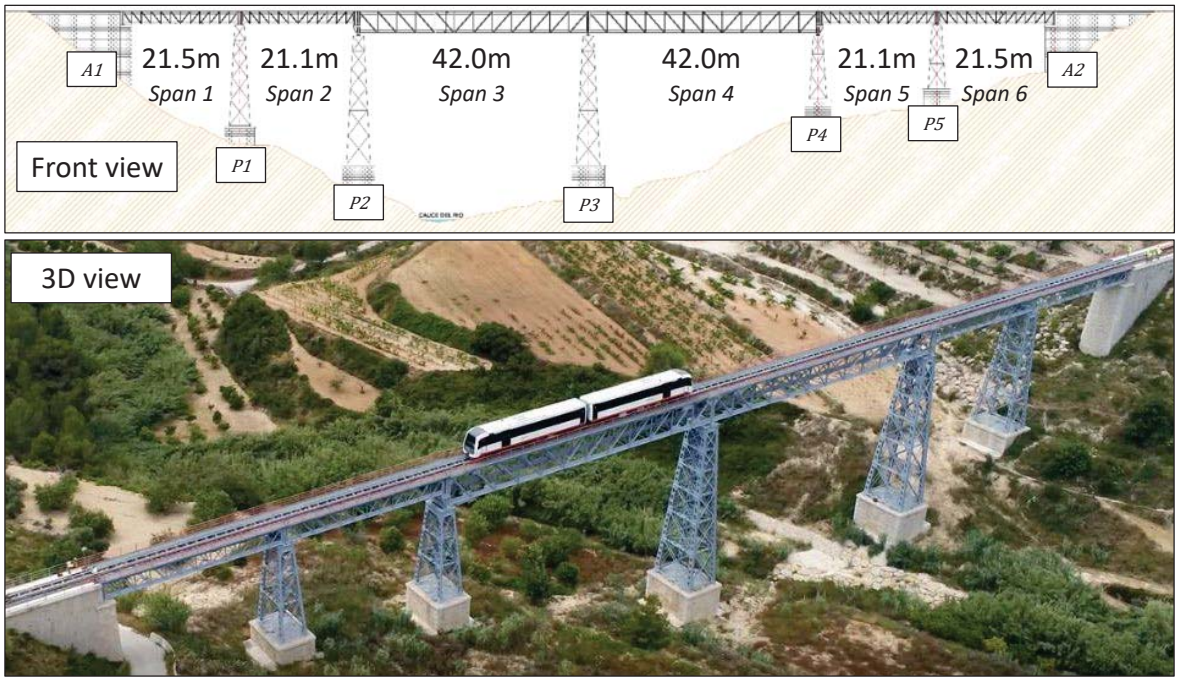


Figure 1. Geometry of the bridge and 3D view.

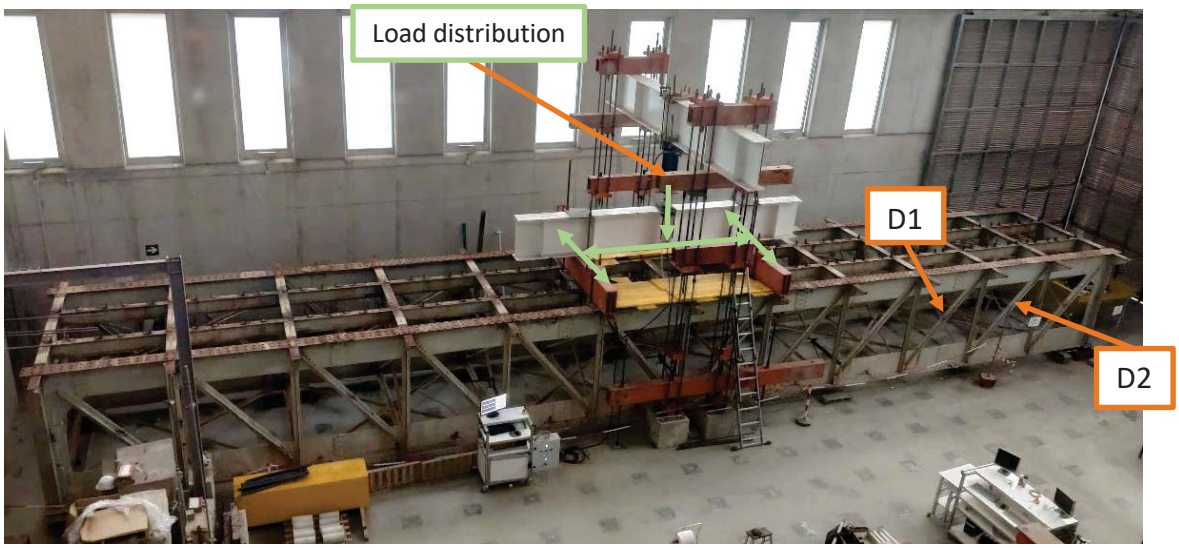


Figure 2. Test setup.

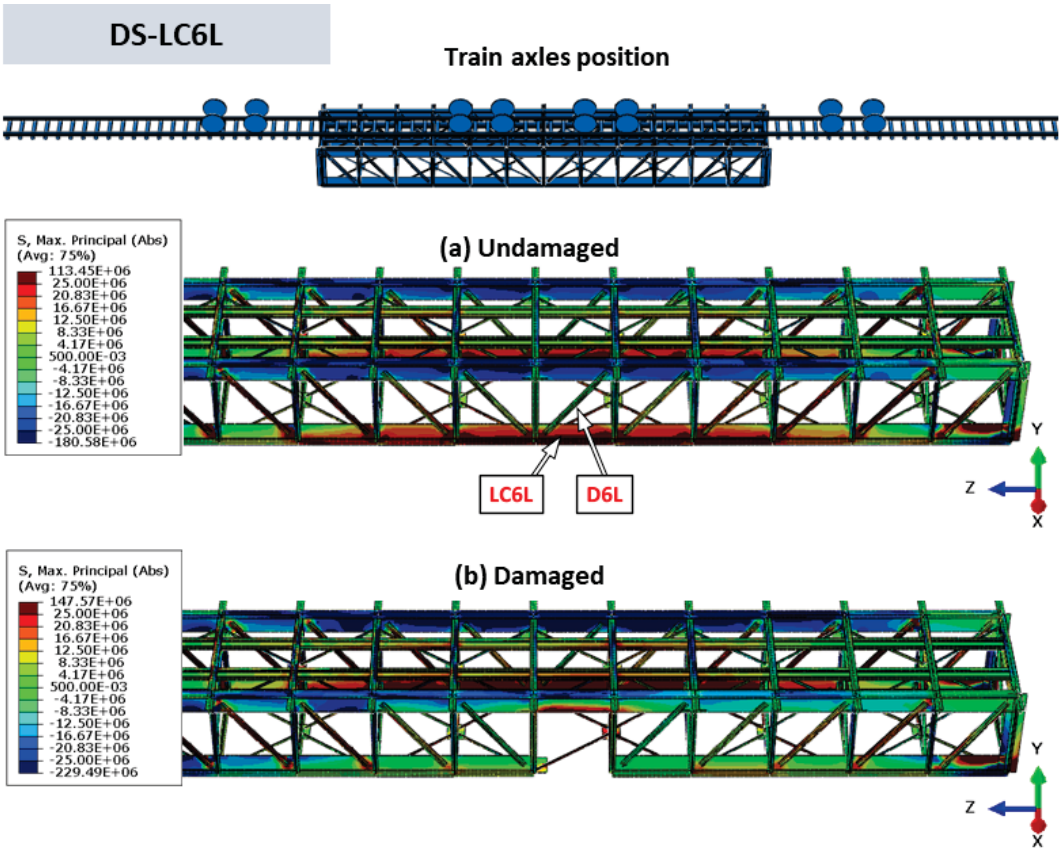


Figure 3. Principal stress contour maps for the removal of a Lower Chord. Units: Pa.

Acknowledgements

We would like to express our gratitude to the *Ferrocarrils de la Generalitat Valenciana* (FGV), Calsens company and Juan Antonio García Cerezo, of FGV, for their invaluable cooperation and recommendations.

Seismic vulnerability assessment of a Medieval urban cluster identified as a complex Historical Palace: Palagio di Parte Guelfa in Florence

Cardinali Vieri - Department of Architecture, University of Florence, Florence, Italy, e-mail: vieri.cardinali@unifi.it

Caranti Anna - Department of Earth's Science, University of Florence, Florence, Italy, e-mail: anna.caranti@gmail.com

Ciuffreda Anna Livia - Department of Earth's Science, University of Florence, Florence, Italy, e-mail: annalivia.ciuffreda@unifi.it

Coli Massimo - Department of Earth's Science, University of Florence, Florence, Italy, e-mail: coli@unifi.it

De Stefano Mario - Department of Architecture, University of Florence, Florence, Italy, e-mail: mario.destefano@unifi.it

Tanganelli Marco - Department of Architecture, University of Florence, Florence, Italy, e-mail: marco.tanganelli@unifi.it

Keywords: cultural heritage, seismic assessment, Medieval buildings, masonry structures

1. Introduction

The present work deals with the seismic vulnerability assessment of a complex palace occupying an entire urban aggregate. The analysis of the *Palagio di Parte Guelfa* required the comprehension of the structural units of the cluster. To this aim, a specific knowledge path has been followed. The study of the historical evolution concerned a significative literature research, validated through *in-situ* evidence and diagnostic phases. The ND (non-destructive) and MD (minor destructive) tests provided information on the quality of technologies and materials adopted [1]. Finally, the seismic analyses were executed according to two approaches; a simplified one, targeted at defining a global safety index of each structure, and kinematic analysis, resulting the most reliable approach due to the lack of connections between the structural parts.

2. The knowledge path and the seismic vulnerability assessment

The Palagio covers an entire urban block and the area where the palace stands is an urbanized territory since the Roman period. The Palace incorporates pre-existing structures as the Church of Santa Maria Sopra Porta and Medieval terraced houses. Filippo Brunelleschi in the XV century and Vasari in the XVI realized new portions of the structure leading the Renaissance style in the Palace. Other restorations occurred in the XIX century. The structural survey has been conducted through a laser scanner campaign. The historical analysis and the structural survey made it possible to define the 6 structural units. A ND campaign was carried out for the palace: the significance of the asset was not requiring further investigations that could potentially damage the building. The extensive use of ND techniques (GPR, sonic, thermography, drilling test) combined with the architectural survey and the historical research have allowed the comprehension of the structural features of the building. The masonry typologies have been associated with the

classifications available in literature, provided by the Tuscany Region and from the Italian technical code [2].

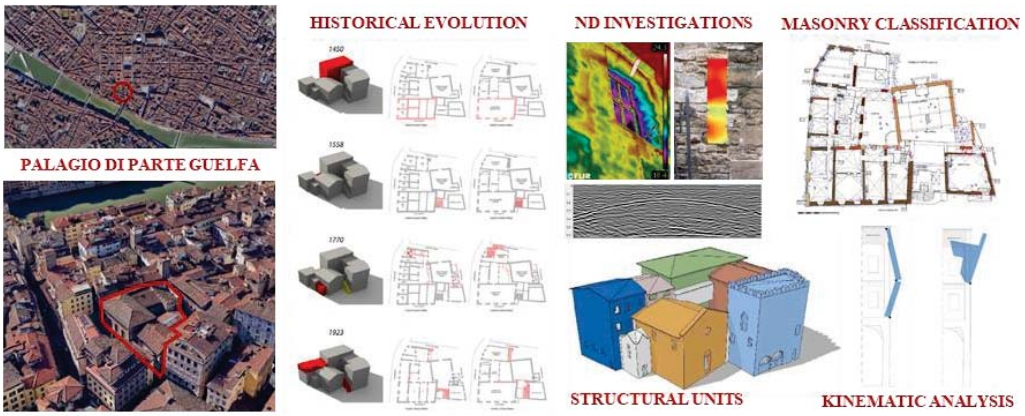


Figure 1. The knowledge path of the Palagio di Parte Guelfa.

The Mibact Guidelines [3] identify three levels of evaluations (LV1, LV2, LV3) based on consequently detailed analysis. The LV1 represents a simplified approach targeted at defining a risk's ranking of the different Cultural Heritage structures (Tower, Palace, Church, Bridge). For the Palagio were adopted the Palace and the Church models. The LV2 is based on the kinematic assessment of the most-likely mechanisms of the different structural units. The kinematic approach has been preferred to global assessments as the knowledge path showed units without a significant box-behaviour, where the big dimensions of the spaces leads to independent parts not concurring to resist the seismic forces. Applying the principle of virtual work it is possible to compute the multiplier that activates the kinematic action. For the levels of evaluations, the confidence factors have been defined based on the achieved informations obtained [4].

3. Results and conclusions

The results show critical safety indexes that can be justified by several factors: the Palace has not been designed following seismic codes but only via empirical assumptions; the big dimensions of the buildings do not lead to box-behaviour structures, as the different macroelements tend to comport independently; the important class function of the Palace increases the seismic demand for verification. Further deepen studies could be executed, proposing limited minor destructive/destructive campaigns to validate the assumptions. Yet, the influence of the aggregations and of the adjacent structures towards the seismic performance of the single buildings can be evaluated in further step of the research.

References

[1] Cardinali, V., Castellini, M., Cristofaro, M. T., Lacanna, G., Coli, M., De Stefano, M. and M. Tanganelli. (2021). Integrated techniques for the structural assessment of cultural heritage masonry buildings: Application to Palazzo Cocchi Serristori in Florence. Journal of Cultural Heritage Management and Sustainable Development.

[2] MIT. (2019). Circolare 21 gennaio 2019, n. 7 Istruzioni per l'applicazione dell'«Aggiornamento delle "Norme tecniche per le costruzioni"» di cui al decreto ministeriale 17 gennaio 2018. G.U. n. 47 del 26/02/2009, Supplemento Ordinario n. 27, Rome: Gazzetta Ufficiale, (in Italian).

[3] MIBACT. (2011) Linee Guida per la valutazione e riduzione del rischio sismico del patrimonio culturale allineate alle nuove Norme tecniche per le costruzioni (D.M. 14 gennaio 2008), (in Italian).

[4] Cardinali, V., Cristofaro, M.T., De Stefano M., Tanganelli, M. (2022). Cultural heritage buildings and strategic uses: seismic vulnerability assessment in Florence, REHABEND 2022, accepted

Three in one. A step towards a rehabilitation 4.0

Bentes Isabel – UTAD / CMADE, Vila Real, Portugal, ibentes@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Pinto Jorge - UTAD / CMADE, Vila Real, Portugal, tiago@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Pereira Sandra - UTAD / CMADE, Vila Real, Portugal, spereira@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Teixeira Carla – Módulo Curioso, Gabinete de Arquitetura, geral@arquitetacarlateixeira.pt (Avenida 5 de Outubro, Nº. 23, Almacave, 5100-065 Lamego)

Paiva Anabela - UTAD / CMADE, Vila Real, Portugal, apaiva@utad.pt: (Quinta de Prados, 5000-801 Vila Real)

Abstract: This paper intends to share some adopted technical building solutions during the rehabilitation process of an ancient house in the city centre of Lamego, Portugal. This building presented a level of conservation of ruin. It was a dwelling, and it had inferior construction quality. However, it is located in the historic part of the city, just near the Lamego castle. Its rehabilitation had to comply with the requirements imposed by the regulations of this historic area and be approved by the General Directorate of Culture and a mandatory archaeological study. Therefore, its rehabilitation was worth and required to evaluate that critical area of Lamego city. In order to have a profitable project, a three-floor building (a flat per floor) was built. At the same time, it was intended to change the utilization of the building from dwelling to touristic accommodation. These options were very challenging because of the limitation of the area and its location. As a result, steel and glued laminated timber structural solutions were considered, specific insulation solutions were performed, and some remote-control solutions were adopted. This case study may give some guidance for reaching rehabilitation 4.0.

Keywords: Rehabilitation, case study, traditional construction, rehabilitation 4.0

1. Introduction

Rehabilitation is a wise option because it can be profitable, preserve cultural identity, and be sustainable. It gets even more interesting when reusing is also possible.

The rehabilitation of the city centres is already a common practice nowadays. In a rehabilitation process, each building is a specific case that requires special attention considering its particularities such as the building characteristics, the level of conservation, the new layout, among other aspects. In these cases, the lack of space of the construction sites, the difficult accessibilities, the limitation of storing building materials and the short deadlines are some constraints that require new building approaches.

In general, a rehabilitation process requires additional building steps than new construction. For instance, inspection, evaluation of the integrity of the elements, demolition and retrofitting may be

some of these building steps. Considering the stage of degradation, the fact that the building may be abandoned and the limited accessibility, the complexity of these works may increase sharply. These constraints may require alternative solutions. On the other hand, all these solutions may also be sustainable orientated. In this context, adopting environmental friendly options may be the key step. Some possibilities are maintaining, reusing, applying natural building materials, and reducing water and energy consumption. In addition, new building processes such as prefabrication may also be adequate alternatives [1]. Complementary, also considering the automation of the rehabilitated building towards a remote-control process may also be an essential solution to adopt [2].

This paper intends to contribute to the above aspects by presenting a study case of a rehabilitation process. After this introduction, the building of the study case is presented, followed by the building constraints. Some adopted structural, and building detail solutions are introduced. A brief description of the remote-control option is also considered. Finally, the main conclusions are presented.

From a tiny old dwelling, it was possible to build a block of three flats for touristic accommodation [3]. The design of the rehabilitation required additional concerns in order to gain space. The adopted structural solution contributes to this aspect and also to the overall sustainability of the rehabilitated building. It can be disassembled and reused in other projects.

The advancement of technology associated with rehabilitation 4.0 will bring more quality to the final product, improve productivity, improve continuous monitoring of energy consumption and allow to collect of relevant data for the proper functioning of the building as well as safer work environments and less physically intense work, helping companies to act in an environmentally, socially and economically sustainable way[4].

2. Conclusions

The project was done successfully, considering the constraints of the location. The demolition was done without putting at risk the attached building. The adopted steel and glulam structural elements were ideal because they allowed them to gain space, speed up the building process, and simplify the construction site. At the same time, they can be disassembled and reused afterwards. The adopted sound insulation solution also worked well because it met its purpose and reduced space. The remote-control options such as thermal control, ventilation control and access to accommodations have shown interest because they are energetically more efficient, less time-consuming and more convenient. Therefore, this building process seems to meet some goals of rehabilitation 4.0.

Acknowledgements

This work was supported by the FCT (Portuguese Foundation for Science and Technology) through the project UIDB/04082/2020 (CMADE).

References

[1] Schultmann, F. (2005) - Deconstruction and materials reuse: an international overview. Report 2 - Deconstruction in Germany. CIB Report. Publication 300: ISSN 90-6363-044-1.

[2] Kim, D.; Yoon, Y.; Lee, J.; Mago, P.J.; Lee, K.; Cho, H. Design and Implementation of https://doi.org/10.3390/ en15124278.

[3] Carla Teixeira, António Moutinho, Isabel Bentes (2018). Reconstruction of “The Castle House” in Lamego. Proceedings of the 8th International Conference on Safety and Ductility of Structures. ICOSADOS 2018. May 23-25, LLU, Latvia.

[4] Marco Casini. Construction 4.0: Advanced Technology, Tools and Materials for the Digital Transformation of the Construction Industry. Duxfoird: Woodhead Publishing, 2022. ISBN 9780128217979.

Reflections on the mismatch between historic preservation and risk management policies in Brazil: case study of the municipality of Cachoeira, Bahia.

Alexandra Cruz Passuello - Civil Engineering Professor, Universidade Federal do Recôncavo da Bahia, Cruz das Almas, Bahia, Brasil, passuello@ufrb.edu.br

Eloisa Maria Adami Giazzon - PhD candidate in the Graduate Program in Civil Engineering - Construction and Infrastructure, Universidade Federal do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brasil, eloisagiazzon@gmail.com

Vanessa Gomes Gonçalves - Master's candidate in the Graduate Program in Civil Engineering, Universidade Federal da Bahia, Salvador, Bahia, Brasil, vanessaedfgg@gmail.com

Bruna Souza Rosa - Master's candidate in the Graduate Program in Civil Engineering, Universidade Federal da Bahia, Salvador, Bahia, Brasil, brunarosa94@hotmail.com

Maria da Graça Andrade Dias - Civil Engineering Professor, Universidade Federal do Recôncavo da Bahia, Cruz das Almas, Bahia, Brasil, gracadias@ufrb.edu.br

Abstract:

In Brazil, restrictions on the implementation of cultural heritage preservation actions often lead to the onset of intensifying deterioration processes in historic buildings over time and lead to risks that go beyond the loss of cultural heritage, but can also threaten the physical integrity of users, the population in general, surrounding buildings and infrastructure. In the context of this problem, this article aims to propose a reflection on the Brazilian policy of cultural heritage conservation and risk management, highlighting the diverging points that are ultimately the reasons for the failure of the objectives set for both. To illustrate the reflection, the historical site of Cachoeira, a city in the interior of the state of Bahia, is studied and the situation before and after the partial collapse of the Casarão do Antigo Hotel Colombo is considered.

Keywords: cultural heritage, building deterioration, risk mitigation, public police

1. Introduction

The lack of appropriate measures for the preservation of the built heritage leads to a scenario of concerning risks, especially in the context of historic sites, where a large number of buildings are concentrated, whose characteristics do not fall under the rules and specific incentives of an individual listing, but are part of an urban space where only the external architectural features, such as roofs, facades and surroundings, should be preserved by the owners and are taken into account in the inspection strategies of IPHAN. The municipality of Cachoeira - BA fits this scenario.

In this context, this paper provides reflections on the Brazilian policy of historical heritage conservation and risk management, pointing out the inconsistencies between these two areas. To illustrate the considerations, the historical site of Cachoeira is used as an object of study, especially the situations before and after the partial collapse of the Casarão do Antigo Hotel Colombo.

2. Case study: Cachoeira, Bahia - Brazil

2.1. Cachoeira, the Jewel of the Recôncavo da Bahia

Cachoeira is characterised by an important political-economic past and has an architecture with numerous buildings that represent different eras of Brazil since the colonial period. In addition to a considerable number of buildings individually listed, the architectural and Landscape Complex of about 670 buildings was listed in 1971 [1]. Due to the loss of economic centrality, Cachoeira was affected by a strong population exodus. As a result, many buildings in the area were abandoned and fell into disrepair, leading in some cases to partial or total collapse.

2.2. Preservation and risk management in relation to the architectural heritage of Cachoeira.

In Brazil, some incentive programs have been carried out to revitalize historical sites, Monumenta being the most famous [2]. Cachoeira benefited from this program [1], but still many buildings in the city remained without the necessary actions. National newspapers described the problem of Cachoeira residents related to the risks at their homes due to their proximity to buildings with signs of structural instability [3]. Among these buildings is the former Hotel Colombo.

2.3. Former Colombo Hotel - Example of the lack of alignment between the policies under analysis

The deterioration of the old Hotel Colombo began after the death of its founder and intensified after its closure and sale in 1992. Subsequently, the building was abandoned, and no action was taken. As far as responsibilities are concerned, the Decree Law of 37 stipulates those interventions must be taken over by the owner. However, the definition of who owns the building is still subject to judicial discussions. On another hand, according to Law 12608:2012, it is the duty of public authorities to take the necessary measures to reduce the risk of disaster [4]. In this case, there is a lack of coordination and responsibilities between the parties.

4. Conclusions

From the discussions in this article, it appears that in Brazil there are inconsistencies between the policies of preservation and risk management, both on the part of the owners and on the part of the government, when it comes to mitigating events that can cause damage and losses. As far as risk management is concerned, it is a fundamental duty of the government to make an adequate diagnosis of the existing risks in its territory and to take measures to reduce events that can lead to damage and losses.

References

[1] FARIAS, S. C. (2018). O Programa Monumenta e a sua Implementação em Cachoeira. Dissertação de mestrado. Programa de Pós Graduação da Faculdade de Arquitetura e Urbanismo da Universidade de Brasília. Brasília. Disponível em: < l1nq.com/L6XeW >.

[2] RIBEIRO NETA, D. S.; PASSUELLO, A. (2020). Estado de Conservação das Fachadas das Edificações Restauradas pelo Programa Monumenta-Cachoeira-BA. Revista Eletrônica de Ciências Exatas e Tecnológicas, n. 1. Disponível em: < l1nq.com/vcBTI >.

[3] BELO, M. (18 de julho de 2022). Em cidade histórica, tombada pelo Iphan, família convive com risco de ser atingida por casarão abandonado. Disponível em: < l1nq.com/jGg2O >.

[4] BRASIL. Lei nº 12.608, de 10 de abril de 2012. Institui a Política Nacional de Proteção e Defesa Civil - PNPDEC; dispõe sobre o Sistema Nacional de Proteção e Defesa Civil - SINPDEC e o Conselho Nacional de Proteção e Defesa Civil - CONPDEC. Brasília.

The Assessment of Urban Identity: A Methodological Approach

Mansour, Hasan - PhD student PDPT/ Faculty of Engineering/CITTA, University of Porto, Porto, Portugal, up201309995@up.pt

Alves, Fernando - Faculty of Engineering/CITTA, University of Porto, Porto, Portugal, alves@fe.up.pt

Costa, António – Instituto Superior Técnico/CESUR, University of Lisbon, Lisbon, Portugal, antonio.ricardo.da.costa@tecnico.ulisboa.pt

Abstract: Urban identity is a major scholarly controversy. After decades of polarized viewpoints and theoretical study, it seems this topic's value is restricted to being a rich material for conversation and idea exchange, while empirical research is neglected. Applied studies on urban identity are confined to "place identity" on a local scale or to urban preservation and urban heritage, which yet represents another challenge in comprehending urban identity by framing it in the past.

The relationship between people and urban environments, objective, subjective, tangible, and intangible factors, time, urban memory, and heritage ...etc., all has been studied and linked to urban identity. Despite the numerous research on, we have so far found it difficult to provide a comprehensive understanding of the phenomenon. However, we believe that we reached a point where we have a very strong database of research and theories regarding urban identity that allow us to provide a comprehensive understanding and assessment of urban identity.

As a method, a systematic analysis of the theoretical debate is provided in order to identify and understand the descriptive and analytical approaches to the concepts of identity and urban identity, the processes of evaluation of urban identity, and the identification of the main debates, issues, and related gaps. The second phase builds a proper methodology to assess the urban identity based on the arguments learned from the previous theoretical analysis. The proposed methodology combines the various approaches in studying urban identity covering its objective and subjective components.

Keywords: Urban Identity Assessment; Place Identity; Cultural Heritage; Spirit of Place.

Catastrophic Destruction of the Cultural Heritage of Odessa, XX-XXI c.c

Nadiia Yeksarova, Odessa State Academy of the Civil Engineering & Architecture, Odessa, Ukraine, eksareva@gmail.com

Vladimir Yeksarov, Odessa State Academy of the Civil Engineering & Architecture, Odessa, Ukraine, va.eksarev@gmail.com

Andrii Yeksarov, Master Degree, M.Arch. The Architecture of Building and Structures eksarev@gmail.com

Extended abstracts

"... it's spiritual values alone that mankind will live on." N. Roerich

The article deals with aspects of the catastrophic loss of the richest cultural heritage of Odessa as a result of aggressive forms of conflict of interests and values. During its existence, Odessa has experienced many social upheavals and hostilities - the First World War, the October Revolution, the Civil War, the Second World War and ... the military conflict of 2022.

Heritage is a phenomenon of spiritual life, way of life, inherited, adopted from previous generations. The material and spiritual values of the historical and cultural heritage of Odessa are important for the preservation and development of the identity of the multinational people, their contribution to world civilization.

The main idea of the founders of the city, the "essential" core, the scenario in the process of modeling of the urban environment of Odessa was the priority development of culture. At the end of the 19th century, the port city of Odessa became one of the socio-economic, trade and cultural centers of the world scale.

At the turn of historical eras (1917-1920) Odessa turned into an arena of fierce class struggle. The fate of the cultural heritage of the city was decided by individual actions without any tangible results. Many years of war and economic ruin did not allow financing even the most limited needs of cultural and educational institutions. The destroyed housing stock, industrial enterprises and the transport system of Odessa and the region needed to be restored.

At the same time, the crisis of the “era of change” acted as a catalyst for almost all types of architectural and artistic activity. The range of decadent and futuristic moods in Odessa ranged from serious philosophy to the emergence of new artistic styles. In artistic practice, there was a total approval of the ideas of "left" art, the formation of a new creative environment. Avant-garde in Odessa has become a powerful stimulus for fundamental changes in the general perception of the world, the development of a new visual language. The energy of the dream of a new universal culture and the democratization of society revived the utopian ideas of artists about the possibility of transforming the world with the help of art.

The new government set new priorities, sought to form a new image of cultural heritage as the foundation of communism. Science, culture, art turned into a tool of the state to "serve current tasks" - the industrialization of the country, the collectivization of agriculture, etc.

Unfortunately, militant materialism in the 30s of the last century caused the explosions of 16 Orthodox churches and temples, 4 synagogues in Odessa, as well as a large number of German and Catholic churches in the Odessa region. As a result of these social and armed conflicts, terrorist acts of vandalism, priceless cultural monuments of Odessa were lost, constituting the spiritual and historical memory of the development of a multinational people (more than 130 nationalities). The short period of peace was accompanied by difficulties in preserving artistic and historical values.

The material environment of the historic city is not always able to withstand the impact of time, slow "natural" degradation, and even more so, acts of sudden violence - the deliberate vandalism of the Second World War. According to the Extraordinary Commission, the damage to the Odessa housing stock amounted to 387 destroyed buildings (345,000 m^2) and 902 damaged buildings (168,000 m^2). The Odessa port lost nearly 90% of its capacity. The expression "consequences of war" refers to the delayed consequences, locally and globally, in space or time, from the actions of war. The economic, humanitarian and health, cultural and environmental impacts are varied, both overt and covert. Wars are often accompanied by a desire to destroy or appropriate monuments, libraries and archives, cultural and religious symbols, cemeteries, etc. These losses are often irreparable in terms of the written culture and collective memory of the population.

The active development of the restoration school in Odessa took place after the large-scale destruction of the city in 1941-1944. The destroyed monuments of architecture were restored on the basis of author's drawings, iconographic materials and archival documents.
The theory of conservation and restoration of monuments of architecture and town planning of the post-war period has received a new round of development, it became possible due to the high level of education of architects and unprecedented scale of tasks.
After the catastrophic cultural losses of World War II, the world again turned its attention to the Roerich Pact. This legal document marked the beginning of a new era in the relationship of humanity to its culture. Its principles and norms are reflected in the Conventions and protocols aimed at the protection of cultural heritage.

Military operations in Ukraine are currently taking human lives and destroying cultural heritage. In any war, historical monuments and cultural heritage sites become one of the most vulnerable items. As of June 27, 2022, UNESCO has confirmed the destruction or damage of 154 cultural sites: 70 religious sites, 30 historical buildings, 19 buildings intended for cultural events, 16 monuments, 12 museums and 7 libraries. Public funds of many countries help to preserve the cultural heritage of Ukraine from destruction; creative teams of designers and builders discuss and develop concepts for the restoration of cities, the restoration of architectural monuments. Currently, there is an active discussion, development of directions, the concept of urban improvement, restoration of Ukrainian architectural monuments. Of course, an extremely urgent task is the active development of scientific and educational centers, as well as production bases for the diagnosis, fixation, restoration, rehabilitation of cultural heritage sites, architectural monuments.

"Peace through Culture" - this simple but deep idea of N. Roerich should become the concept of the world order of the 21st century as well. It is impossible to win the cultural war... Culture, Beauty and Knowledge are the most effective means of ending armed conflicts, which was recorded in the Washington Treaty of 1935 and later in the Hague Convention of 1954. Giving priority to the preservation of cultural heritage on the international agenda opens up great opportunities for intercultural communication. These and many similar problems make this study of the causes, extent of destruction and loss of the cultural heritage of Odessa relevant.

Keywords: Cultural heritage, social upheavals, military destruction, Odessa, 20th and 21st centuries.

Sarajevo military brownfields. Principles for adaptive reuse.

Salihbegović Amra – Politecnico di Milano, Fondazione F.lli Confalonieri, Milan, Italy, amra.salihbegovic@polimi.it

Chizzoniti Domenico – Politecnico di Milano, Milan, Italy, domenico.chizzoniti@polimi.it

Abstract: Strategic military bases in Bosnia and Herzegovina sought to provide a defence system for the protection of the society and to transform the commonly viewed as complex and diverse historically, culturally, and socially interlocking territories into an ordered and unified identity. Today, this architectural and political project still witnesses the utopian visions of former military systems and their importance and collective power. However, this endangered heritage indicates the lack of integration into contemporary society due to complex political, social, and cultural misuses. Therefore, this research aims to shed light on the rather unexplored military architecture in the city of Sarajevo. To question the concept of power and protection as a source of revival for a new ideological role of social, cultural, and educational inclusion.

Keywords: post-war reconstruction, military brownfields, adaptive reuse, methodological framework, Sarajevo

1. Introduction

The phenomenon of military architecture has been an inseparable part of human history due to the need to protect and defend the territory [1]. It became a materialization of the political strength and transformation, and a process of recognition of diverse ethnicities. Especially its integration into the contemporary challenges became a crucial question in several studies aiming to provide possible future solutions[2].On European soil after WWII, Bosnia and Herzegovina became a place of demonstration of the immersive force a political system can turn against its citizens. The dissolution of former Yugoslavia added to the already complex cultural, political, and historical turmoil this area went through. The urban fabric of many cities on the territory of Bosnia and Herzegovina demonstrates the superimposition of different layers of these political transitions but also witnesses the leftovers of destruction, violence, and tragedy accompanied by those dissolutions and war events. In all these events the destruction of cultural heritage was the main target as it carries the historical, cultural, and social identity, and is an essential asset a society conserves and manifests.
Vast military structures owned and built during different periods in Bosnia and Herzegovina testify to the former political power and complete neglect because of complex war history, where this substantial architectural body bears an utter abandonment by today's society. Therefore, this research seeks not only to highlight the importance of this architectural legacy but also to question what could be its future outcome. It intends to provide a critical review of the value of the endangered heritage and to question methods for its adaptive reuse. The objective of the article is to trigger a new discourse on the legacy of the abandoned military architecture, and to rethink its use as a means for a cultural revival. This architectural transformation has essential importance as it adds additional value for a cultural revival but also shifts the negative connotation these facilities have due to the complex historical transitions. For that reason, the research intends to pose the questions: what is the importance

of the former military architecture in Sarajevo, and how to rethink the endangered heritage of these structures in contemporary society?

2. Military brownfields – a methodological framework

Reconstruction as an act of rebuilding or recreating a new architecture out of some pre-existence already shows that in its core lies an antidote of two polarities between past and future, its memory and new life that should evolve. Especially reconstruction becomes even more questioned in the case of former military architecture that initially served as a defence but became the source of destruction, war planning, demonstration of violence, political and military propaganda, to even conversion into war camps and prisons. Besides the common difficulties of regeneration due to political problems, recognition, and unresolved ownerships, these buildings stand also as a witness to a destructive and even difficult history since their connotation in the individual experience opens rather unpleasant memories. The four years long siege of a city, not only left the devastation of the city but engraved this military heritage with the burden of political shifts and converted potential urban fabric into abandonment memorials of destruction. Of 180 buildings previously owned by the Ministry of Defence there are around hundred buildings that still wait to be allocated to different municipalities[3]. They represent an enormous architectural potential that could follow up with the prospects of new urban regeneration.

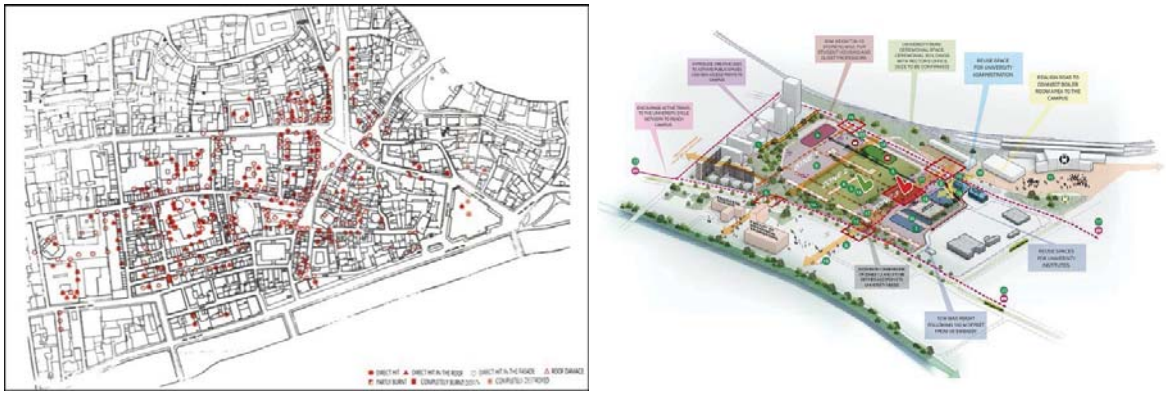


Figure 1-2. From mapping of the destruction of buildings built over 500 years in Sarajevo to a parameter plan for the reuse of former military barracks Filipović Lager

3. Conclusions

Post-war reconstruction processes in the case of the city of Sarajevo even today prove difficulties due to urban planning regulations, problems of ownership, or economic deficits. The inability to respond to turbulent historical moments even further reinforced the neglect of highlighting the importance of the history of the city, some of its most-important historical traces in ex-Yugoslavia, abandoning the theoretical or practical guidelines and scenarios for a critical reconstruction of the city. An outlook of contemporary interventions rather lacks an appropriate aesthetic, cultural or social response. If we take into consideration the importance of the architectural heritage, the significance of the local culture and tradition, and the plan for future development of the city, it is quite complex to respond to a process of post-war reconstruction due to interlocking cultural breaks and shifts that are superimposed over the city of Sarajevo.

References

[1] See F. Richter (1900) Handbook of Architecture, Part IV., Section 4: Buildings for Military Purposes (Handbuch der Architektur, IV. Teil, 4. Abschnitt: Gebäude für Milirärishe Zwecke); Arnold Bergsträsser Publishers, Stuttgart; K. Mallory (1979) Walls of war: a history of military architecture in North West Europe 1900-1945, London: Astragal books; D. S. Denman (2020) On fortification: Military architecture, geometric power, and defensive design, Security Dialogue, Volume 51, no. 2-3, 231-247; M. Piana, C. Carlsson (2014) Archaeology and architecture of the military orders: New studies, London and New York: Routledge.

[2] See M. Brzoska 1999. Military Conversion: The Balance Sheet. Journal of Peace Research, Volume 36, Issue 2, 131–140; L. Rodrigues, S. Glebov (eds.) (2009) Military Bases: Historical Perspectives, Contemporary Challenges. Amsterdam, Berlin, Oxford, Tokyo, Washington, DC: IOS Press; J. Cidell (2003) The conversion of military bases to commercial airports: existing conversions and future possibilities, Journal of Transport Geography 11 (2), 93-102, doi.10.1016/S0966-6923(02)00071-6; D. Havlick (2007) Logics of change for military-to-wildlife conversions in the United States, GeoJournal, Volume 69, Issue 3, 151-164, doi.10.1007/s10708-007-9086-8; J. Krcho (2013) From Military Bakery to Kulturpark: The Problematics of the Regeneration of the Former Military Warehouse Complex in Košice, Architecture & urbanism, 3–4, 254-265; K. Kádár, (2014) The rehabilitation of former Soviet military sites in Hungary, Hungarian Geographical Bulletin, Volume 63, Issue 4, 437-456, doi.10.15201/hungeobull.63.4.5; K. Kradov, I. Tabak (2014) Who owns the former military property? Experiences of conversion in Croatia Zagreb. (Kome pripadaju bivse vojne nekretnine? Iskustva prenamjene u Hrvatskoj Zagreb). Centar za mirovne studije i Zavod za sociologiju Filozofskog fakulteta u Zagrebu; A. Guida, A. Pagliuca, G. Damone (2014) "New life" for defence military architecture: The case of the sighting towers in Basilicata, WIT Transactions on the Built Environment, Volume 143, 29-39; C. Clark (2015) Coming into the light: the rediscovery and reuse of naval heritage buildings, WIT Transactions on The Built Environment 79, 33-44.

[3] Estimate of military brownfields according to law proposal and principles for military ownership presented at the Parliament of Bosnia and Herzegovina.

Mosul's cultural and social heritage reconstruction after ISIS war

Nicolini Laura – University of Florence, Florence, Italy, e-mail: laura.nicolini@unifi.it

Abstract: The recent and unfortunate events of war are demonstrating that the war scenarios of the 21st century are scenarios similar to the SWW. The deployment of war forces results in severe human casualties and unquantifiable damage to cultural and built heritage. Although we would not want to cultivate expertise in post-war reconstruction, we must learn from recent experiences to draw lessons to be replicated and improved. The painful story of the war in Mosul offers matter for thought to understand the extent of the impacts of the war on both cultural, intangible and built heritage. Moreover Mosul, as past symbol of tolerance and co-existence, is emblematic of the need to act synergistically on the material and social reconstruction of the city. This study intends to support a broad view of the issues due to the impacts of the war on the ancient city, ranging from the methodology to approach the reconstruction of the cultural heritage as well as the need to include the social involvement in all project phases. The reconstruction phase of Mosul, is particularly significant due to this complexity and offers the opportunity for a mid-term effectiveness evaluation of the implementing programs and their results on site.

Keywords: Cultural and Social Heritage, Mosul, Gypsum, Alabaster, Ballistic, UNESCO

1. Introduction

This article is the result of the author's experience in Iraq and in Mosul in particular, gained as project manager within the framework of two projects financed by UNESCO. Its development has convinced her that restoration must be charged with an ethical value and also exercise a political guiding role to avoid the risk of being 'a banal repair job'.

2. The Old City of Mosul, symbol of tolerance and co-existence

Mosul has been a strategic location in the Middle East region since it has been a crossroads and bridge of historic, cultural and commercial routes between north and south, east and west of the world [9]. Historical documentation [2-5] confirms the singularity of the Old City of Mosul as a symbol of tolerance and coexistence. The rich cultural heritage of religious buildings reflects the uniqueness of Mosul with its religious cultural variety [3].

3. The destruction of the cultural heritage of Mosul

The city and the Iraqi territory have also witnessed numerous disasters, social, cultural and religious conflicts that caused the destruction of the heritage. The last armed conflict protracted from 2014 until the liberation of the city in 2017, has leaded to an extensive destruction of the urban heritage and significant historic monuments of the city [4] documented by various International, UN agencies [1-7-10] and NGOs. Unfortunately, the destruction has also affected a large part of the population.

4. Effects of the war damage on the architectural heritage of Mosul

A correct approach to restoration strategy must consider the damage caused on surfaces by primary effects which is often amplified by the secondary effects associated with the combined use of explosives. The studies of terminal ballistic [6] are crossed with the physics of explosives to evaluate the damage by grenades with an explosive effect. The presented result is a summary of the effects of the war damage on the Mosul's architectural heritage structures which are characterized historical and traditional materials as the alabaster stone (*al Faresh),* the local sandstone (*Hillan stone)*, the gypsum plaster and fired bricks.

5. The reconstruction programmes and the involvement of local society

The reconstruction phase of Mosul is particularly significant due to this complexity and offers the opportunity for a mid-term evaluation of the results. It is seeing an immense mobilisation of resources and organisations including the UNESCO with the initiative "Revive the Spirit of Mosul". All programs include the involvement of local society but the initiatives for reconstruction create several local criticisms that testify the complexity of acting in a context where material and social wounds are alive despite the end of hostilities.

6. Conclusions

The main lesson-learning from the post-war projects in Mosul pertains the need to pay special attention to the social context by a more egalitarian and genuinely participative involvement of the local community in post-war reconstruction and restoration projects.

7. References

[1] M. Q. A. G. Al Ani, Mechanisms of safeguarding urban heritage at risk -Mosul Heritage as case study, Periodicals of Engineering and Natural Sciences (PEN), 2020

[2] C. Eroğlu, M. Babuçoğlu, O. Özdil, Mosul in the Ottoman Vilâyet Salnâmes, Ankara 2012.

[3] A. Harrak, Mossoul: le crépuscule de la symbiose islamo-chrétienne, Chrétiens dans le monde Musulman, Oasis, 2014

[4] M. Melčák, K. Nováček, L. Starková, O. Beránek, Monuments of Mosul in Danger, The Oriental Institute, Science around us, Challenges and questions, 2017

[5] Fr. J. M. Mérigoux, Les chretiéns de Mossoul et leurs églises pendant lea période ottoman de 1516 à 1815, Ninive-Mossoul 1983.

[6] L. Mol, M. Gomez-Heras "Bullet impacts and built heritage damage 1640–1939", 2018

[7] K. Nováček, M. Melčák, O. Beránek, L. Starková, Mosul after Islamic State. The Quest for Lost Architectural Heritage, Palgrave studies in cultural heritage and conflict, 2021

[8] M. Qasim Abdul Ghafoor Al Ani, Mechanisms of safeguarding urban heritage at risk - Mosul Heritage as case study, Periodicals of Engineering and Natural Sciences, 2020

[9] Y. Sarınay, C. Ekici, Iraq During the Ottoman Period: Plans, Photographs and Documents, 2006.

[10] UNEP, Mosul debris management assessment, Technical report, 2018

[11] UN-Habitat, City profile of Mosul, Iraq, Multi-sector assessment of a city under siege, 2016

[12] https://www.civita.it/Associazione-Civita/.. /La-Cultura-strumento-di-pace-Editoriale

[13] https://www.cam.ac.uk/research/news/cultural-heritage-after-conflict

[14] https://www.earmi.it/balistica/baltermi.htm

[15] https://www.unesco.org/en/revive-mosul#

Architectural heritage and armed conflicts. The bombing of Potenza in Basilicata in 1943

Enza Tolla – Università degli Studi della Basilicata, Potenza, Italia, enza.tolla@unibas.it

Giuseppe Damone – Università degli Studi della Basilicata, Potenza, Italia, giuseppe.damone@unibas.it

Abstract: In September 1943 the city of Potenza was hit by a destructive bombing which caused death and devastation. Many historic buildings, such as the cathedral, are severely damaged. Whole neighborhoods are demolished by bombs and the reconstruction, in some parts of the city, will initiate a process of building replacement. By studying the documents preserved in various archives in the city of Potenza, it was possible to grasp all the 'strategies' put in place for the defense of the architectural and artistic heritage, reconstruct the hours of the bombings, the damage caused and the reconstruction of the city.

Keywords: artistic heritage, architecture, armed conflicts, reconstruction.

1. Introduction

What is more terrifying and traumatic than a bombing? The alarm that sounds, the escape into the night in search of a refuge that may seem safe and then the waiting. The waiting for everything to pass and that we can get out of that nightmare alive.

Traumatic and sudden events, such as a bombing or an earthquake, deeply and forever mark the life of those who have lived it.

In addition to death and individual tragedies, the sudden loss by an entire community of a portion of their habitat and social space leads to a condition of hardship that is not easy to heal.

All this speeds up the timing of decisions, and imposes new rules, offers opportunities for change and clarifies wills and sides.

The reconstruction that follows, however, very often takes on a temporary nature and the opportunity for a broader rethinking of the damaged parts and the city more generally, is often lost.

2. The reconstruction of the image of Potenza damaged by the bombings

On the night of September 8, 1943, a devastating bombing raid on the city of Potenza began. The allied forces dropped fire bombs in several points of the city: some buildings in via del Popolo, in Portasalza and, in an important way, via Addone, located in the eastern part of the historical fabric of the city, are hit. Due to the inaccuracy with which the bombing was carried out, many civil buildings were hit and the cathedral of San Gerardo as well as the adjacent bishop's palace and seminary were set on fire.

The next day, around 10:00 am, a second and more destructive bombardment of the city begins.

At the end of the military operations Potenza presents itself as a scenario of death and destruction. The victims, including civilians and soldiers, are over a hundred and many buildings have been destroyed. In particular, Santa Maria district pays the highest price in the second bombing.

Inside the city, the Government Offices Building, the elementary schools in the 18 Agosto square, Prefettura square, Villa Janfolla, the 48th Infantry depot, and the Rivisco railway tunnel are also damaged.

The examination of the archival material has made possible to highlight some interventions aimed at protecting the population and the artistic heritage of the city. But, the partial execution of the interventions desired for the defense of the objects of art, will have as its epilogue the loss of many artistic testimonies of the past destroyed under the bombings.

In July 1940, the expenditure of 76,000 lire was authorized for the construction of the project for adapting some premises in the city of Potenza to anti-aircraft shelters. The project mainly involves works consisting of shoring and reinforcement of flat floors, arches and vaults, and the construction of walls with earth sacks covered with planking, on the basement and ground floors of various city buildings.

In various points of the city, instead, public anti-aircraft shelters are being built in tunnels, many of which will remain incomplete with the onset of the bombings in September 1943. A few weeks before the bombings, the director of the Provincial Museum of Potenza, Concetto Valente, by a letter asks that measures have to be taken in defense of the works of art collected in the museum. Not all the interventions hoped for by director Valente will materialize and the destruction of the Provincial Museum and the city cathedral will be the cause of the loss of various art objects, as well as part of the diocesan archive.

To get a more comprehensive picture of the damage to the built heritage caused by the bombings of 1943, the analysis of the documents relating to the restoration, maintenance and reconstruction of the artifacts involved in the war operations becomes of fundamental importance.

After the war, there were many reconstruction interventions in the city, both in the historic center area and in the Santa Maria district which was significantly damaged by bombing.

4. Conclusions

The bombings of September 1943, as seen, are the cause of considerable damage to the built heritage of the city of Potenza: entire areas of the historic center and of the areas of expansion of the city, located immediately outside the primitive medieval structure, are destroyed. In addition to minor buildings, historical monumental buildings or parts of them are also razed to the ground or significantly damaged.

Thus begins the process of reconstruction of the city that will lead to renovations and replacements that will have as an epilogue, in some parts of the building fabric, the 'cancellation' of the oldest city, pursuing that plan for the modernization of the historic center that has already begun, albeit using a different architectural language in the 19th century.

La guerra ieri e oggi. La documentazione delle distruzioni e dei danni sugli edifici storico-monumentali attraverso il racconto e la testimonianza dei mass media

War, yesterday and today. Documentation of the destruction of and damage to historic-monumental buildings through testimony and recounting by the mass media

Maria Giovanna Putzu – SAAD Università di Camerino, Italia, e-mail: mariagiovanna.putzu@unicam.it

Fabrizio Oddi – Sapienza Università di Roma, Italia, e-mail: oddifabrizio@gmail.com

Abstract: Monuments, according to the word's etymology, are memories, witness-bearers, some born involuntarily and recognized as such by the time that has assigned them this role, and others clearly conceived, designed, and built as a "stone manifesto" to communicate a political, social, and religious programme – being, in fact, the expression of a civilization and a given historic moment. Conversely, their destruction is seen as destruction of the collective memory with which a people identifies. War, and armed conflicts generally, in the lucid madness whose goal is devastation and annihilation, sometimes destroys everything in its path – even targeting the historic monuments and constructions themselves. Again, memory is linked to communication. Over time, even as increasingly sophisticated means of destruction evolve, the aims remain unchanged. When rereading a newspaper published during World War II (*L'Osservatore Romano*), and the documentation offered by today's journalism as well as online documentation, we see the same atrocities – although in the latter the difference lies in information speed and the abundant details and images travelling in real time. The research examines the mass media's role in recounting and documenting the devastations – considered actual war crimes by the 1954 Hague protocol – of historic-monumental buildings, underscoring how these media have changed over time and stressing their importance for conservation.
Keywords: War, mass media, historic buildings, monuments, conservation.

1. Introduzione

In un momento storico in cui, purtroppo, le tematiche legate alla guerra, nella complessità delle problematiche che ne derivano, sono più che mai attuali, lo studio intende evidenziare il compito gravoso e al tempo stesso imprescindibile svolto dai mezzi di comunicazione, sia per quanto concerne l'informazione sia per quanto riguarda la documentazione di ciò che, in alcuni casi, può e deve risorgere dalle macerie. L'arco temporale preso in considerazione nello studio in oggetto va dagli anni Quaranta del XX secolo fino ai giorni nostri.

2. Mass media e Seconda Guerra Mondiale: L'Osservatore Romano. Quotidiano politico – religioso della città del Vaticano (M.G. P.)

L'Osservatore Romano, così come enunciato nel titolo stesso, nasce come quotidiano ufficiale dello Stato Pontificio con il fine principale di creare un mezzo di divulgazione dei principi cattolici e di difesa e affermazione delle proprie posizioni religiose e politiche, muovendosi, dunque, secondo una linea editoriale ben definita e precisa. Il quotidiano pur volgendo uno sguardo particolare alla situazione della città del Vaticano e della provincia romana, presta attenzione alle sorti di tutti i paesi coinvolti dal secondo conflitto mondiale,

documentando i tristi avvenimenti che ne hanno segnato la storia. Lo spoglio degli articoli del presente studio, abbracciando l'arco temporale tra la guerra e gli anni immediatamente successivi la sua conclusione (1943-1947), ha permesso di cogliere uno spaccato della realtà e della temperie culturale contemporanea, nella delicata fase in cui, mentre ancora si contavano i danni e non si conosceva la stima esatta degli immani disastri, si dava comunque inizio all'opera di ricostruzione. Il quotidiano si occupò di tutti gli aspetti della ricostruzione, a partire da quelli di carattere etico-morale e religioso, socio-economico e politico, per arrivare a quelli più prettamente materiali. L'Osservatore Romano offre, dunque, uno spaccato significativo della temperie culturale degli anni a cavallo tra la fine della Seconda guerra mondiale e gli anni del dopoguerra e in esso è possibile individuare i principi, le problematiche e i "compromessi" con i quali si dovettero confrontare quanti si trovarono ad intervenire sugli effetti della guerra, nella ferma convinzione e, al tempo stesso, nella necessità di dover conservare e tramandare qualcosa di più delle sole rovine.

3. Rapporto tra conflitto e informazione (F. O.)

I conflitti che ciclicamente interessano numerose aree del pianeta, con vari livelli di gravità ed estensione, oltre all'evidente e primaria minaccia per le popolazioni coinvolte, recano grave rischio anche ai patrimoni artistici e culturali delle zone di guerra. Giova ricordare che durante qualsiasi conflitto armato, la distruzione dei beni storico/culturali, è da considerarsi a pieno titolo un crimine di guerra, come chiaramente afferma il Protocollo dell'Aia del 1954, proprio riguardo alla protezione dei beni culturali. Poter disporre quindi di informazioni tempestive circa le azioni in corso nelle aree di interesse ed immediata contezza dei danni inflitti, diviene fondamentale per pianificare interventi di tutela, dove possibile, rendendo pubblico lo scempio in atto. Come intuibile, il rapporto diretto tra mezzi di comunicazione di massa e la guerra è stato, fin dalla nascita dei primi strumenti d'informazione, caratterizzato da un crescente ed intenso legame di reciproca dipendenza. L'informazione è un'arma estremamente potente e il suo controllo può risultare determinante in un conflitto estremo come quello siriano riportato. Analizzando le fonti, si può infatti notare che quelle considerate ufficiali e quindi attendibili sono in realtà caratterizzate dalle contraddizioni più evidenti; diventa quindi imprescindibile, per formare un quadro realistico della situazione, confrontare costantemente le varie informazioni e versioni fornite effettuando un'analisi critica dei fatti riportati. Per il patrimonio culturale ed i danni ai monumenti diventa fondamentale la costante informazione disponibile, sia per avere informazioni in tempo reale dei danni causati sia per poter programmare le possibili azioni di tutela, diretta o indiretta, per la salvaguardia dei beni, laddove attuabile e possibile.

4. Conclusioni

Dalla disamina delle testate giornalistiche e dei reportage di guerra emerge il ruolo imprescindibile tanto dell'informazione sugli eventi, quanto della documentazione, anche fotografica, dello stato dei luoghi e, in particolare, dei monumenti e degli edifici storici prima e dopo la loro spietata e inaccettabile distruzione. Grazie al mirabile lavoro svolto instancabilmente nel secondo dopoguerra, così come chiaramente si evince anche dalle testate giornalistiche dell'epoca, e con un continuo e progressivo affinamento perseguito nei decenni successivi, si approdò alle moderne teorie del restauro, quelle che con coscienza e lungimiranza dovranno guidare anche gli interventi sulle città colpite dalle devastazioni delle guerre recenti e in corso.

The Fairground of Lebanon in Tripoli between pre-war and post-war period. Events, Meanings and Future

Albani Francesca – Department of Architecture and Urban Studies, Politecnico di Milano, Milano, Italy, francesca.albani@polimi.it

Zaatar Joe - Ph.D. program in Preservation of the Architectural Heritage, Department of Architecture and Urban Studies, Politecnico di Milano, Italy, joe.zaatar@polimi.it / joe.zaatar@hotmail.com

Abstract: The famous Fairground of Lebanon in Tripoli, designed by Oscar Niemeyer in collaboration with many Lebanese architects and engineers, was built from 1963 to 1975 and never completed. It was occupied by armed forces and then by a foreign army during the "civil" war (1975-1989) until it was abandoned around 1995. Since such information is sensitive, it is not easy to find or gain access to documentation about the wartime period. The rare traces of the military occupation can be found in the documentation preserved in the basement of the Fair, in some feasibility studies held by former politicians, in visible traces on concrete walls, and in some interviews. These sources confirm that this unique utopian place was used for a considerable time for violent actions. The paper aims to investigate what happened during these years (1975-1995). Recently, the high interest from abroad stimulated the promulgation of a law in March 2022 for its reorganisation. A knowledge of events during this period could contribute to defining the strategy for the future of this architectural complex, as an outstanding example of Lebanese Modernism in architecture.

Keywords: Lebanon, Modernism, Oscar Niemeyer, War, Conservation

In March 1957, the Government of the Republic of Lebanon was studying the idea of building a trade fair site. The idea was to promote trade and commerce with the world. Given Lebanon's liberal structure, economic motivations were on the agenda of the central government. Back then, after the Second World War, the Lebanese economy was closely related to that of the international developed countries, mainly for imports and less for exports. In the Middle East, following the withdrawal of the colonial powers, many Arab countries were governed by dictatorships. At the same time, Lebanon was a Republic open to outward services-oriented sectors (between the West and the Arab world). Designed by Oscar Niemeyer [1] and built in a single phase, the Fair was intended for trade, commerce, and exchanges [2], but Lebanon have changed. The Fair's inauguration, planned for June 1976, was suspended because in 1975 war broke out and would last almost 15 years. In the past, many studies have dealt with the Fair, its conception, design, and implementation [3], but very few have looked at its use during the 14 years "civil war". Some physical traces of the war are still visible in the Fair: the graffiti in Arabic in black on the internal reinforced concrete wall of the customs and firefighters building, praising the Syrian army's presence (see figure 1); traces of bullets and minor explosions on the south side wall of the administration building. Another speciality of the occupiers during their physical presence in Lebanon was looting. They stripped materials from the buildings they seized in Lebanon took them back to their own country. No one can say where and how many architectural elements were lost, but at least one bulky piece has left traces in a letter and a report [4]. In the underground archive room of the Fairground, some first-hand technical reports and photocopies are conserved. During these years (1967-1981), foreign consultants were involved in different periods, proposing studies for relaunching the Fair (or part of it). In 2006, the International and Permanent Fair of Lebanon in Tripoli was included by the non-profit organisation World Monuments Fund in a list dedicated to monumental sites at risk

Figure 1: A graffiti on the wall saying Arab Syrian shield forces.

of conservation. In 2019, the international competition for the design of the Knowledge Innovation Centre was launched by the Tripoli Special Economic Zone, the Lebanese government, the Lebanese Order of Engineers and Architects, with the endorsement of the International Union of Architects (UIA) and the Union of Mediterranean Architects (UMAR) for the creation of a technological development hub in the area of the customs, firefighters and administration buildings in the Fair, with the aim of attracting investment to Tripoli. The on-off war in Syria, the tragic explosion in Beirut and the destruction of a large part of its port may perhaps shift the balance of trade towards Tripoli. We know it has already entered the interests of major investors including China. In all these processes, the local community is still excluded. The values and meanings of this complex go far beyond its architectural qualities and the political and commercial purpose for which it was conceived. This place, the image of different societies (before and after the war), is a record of how Lebanon's political, economic, and cultural goals have changed. To highlight the multiple meanings of which the built heritage is the messenger, it is necessary to investigate even the most painful phases of our past, which we often want to forget, especially the recent past. Erasing the traces and signs of that evidence may be a first consolatory effort, but the elaboration of a painful past and the process of reconciliation with it, is long, and involves a broad discussion on the architectural heritage (from any period). The debate on the conservation and reuse of the Fair, which has now acquired an international dimension, should involve this reflection linked to the troubled memory of the events that took place here during the war. The internationally known strategies, not only commercial, but also cultural and socially inclusive, would contribute positively to the internal peace process, which has become crucial at this time and in this part of Lebanon. The knowledge and awareness of the values and their meanings (positive and negative) of which this complex is part, can contribute, within the divided community of Tripoli to the beginning of a process of reappropriation of these places and achieving reconciliation with the painful past, to preserve a unique architectural complex.

[1] O. Niemeyer (1962), "Feira Internacional e Permanente do Libano em Tripoli". Revista Modulo, Rio de Janeiro, v. 7 n. 30, pages 1-33.

[2] Unknown author (1962) "Niemeyer Soumet au chef de l'Etat les plans de la Foire de Tripoli" L'Orient, 2nd September 1962 page 2

[3] J. Zaatar (2021) "Local Modernism in danger until this day. The case of the Lebanese Pavilion in the International Permanent Fair of Lebanon in Tripoli by Oscar Niemeyer", Ana Tostões and Yoshiyuki Yamana,(editors), "Inheritable Resilience: Sharing Values of Global Modernities," volume 3, Global/Local Modernities, Docomomo International, pages 924-929

[4] A. Chalhoub, Report in Fairground archive in the Entrance Porch building, 1977

The DALIH database for recording disaster damage and loss data for cultural heritage

Romão, Xavier - Faculty of Engineering, University of Porto, Porto, Portugal, xnr@fe.up.pt

Paupério, Esmeralda - Faculty of Engineering, University of Porto, Porto, Portugal, pauperio@fe.up.pt

Tikhonova, Olha - Faculty of Engineering, University of Porto, Porto, Portugal, olechka.tikhonova@gmail.com

Abstract: The Sendai Framework for Disaster Risk Reduction (SFDRR) upholds the development and implementation of measures to reduce hazard exposure and vulnerability to disasters. Among other aspects, the SFDRR recognizes the importance of cultural heritage for society, thus emphasising the need to assess the impact that potential hazards may have on the built cultural heritage. Developing adequate risk assessment and management processes are fundamental towards this end and disaster damage and loss data are known to be essential for such processes. The development of systems, models and methods to collect and handle such data is, thus, seen as a worldwide priority. In this context, the paper presents a database framework for the worldwide collection of immovable cultural heritage disaster loss data currently under development. The concepts and technical aspects related to the data being collected and its structure are discussed, as well as the type of indicators being recorded. Challenges regarding disaster loss data collection for cultural heritage are discussed, as well as the benefits of these data for developing more rational disaster risk management approaches for cultural heritage.

Keywords: Cultural heritage, disaster damage, disaster loss data, database.

1. Introduction

Existing international frameworks and programmes for disaster risk reduction (DRR) emphasize the need to develop and implement measures to reduce hazard exposure and vulnerability to disasters. In particular, current DRR initiatives recognize the importance of cultural heritage and its irreplaceable value for society. Therefore, such initiatives clearly highlight the need to assess the impact that potential hazards may have on the built cultural heritage. Developing adequate risk assessment and management processes are fundamental towards this end and it is known that systematically collected and robust disaster damage and loss data are essential for such processes. The development of systems, models and methodologies to collect and handle such data should, therefore, be a worldwide priority.

Existing disaster loss data recording initiatives such as the EM-DAT/CRED, SIGMA/SwissRe, NATCAT/MünichRe or DesInventar/UNISDR databases are undoubtedly important sources of information in terms of the damage and losses that occurred in worldwide disasters. Recording such data is known to be useful for the purpose of loss accounting, forensic analysis of disasters and disaster risk modelling. For example, this data can provide an objective baseline for risk assessment as well as for mitigation prioritization and decision making. However, the data from these databases does not include damage and losses to cultural heritage. Still, without this component, current loss estimation procedures are unable to provide a comprehensive quantification of disaster impacts.

There is currently no systematic collection of data about the impacts of hazardous events on cultural heritage properties. Existing data on damages and losses to cultural heritage is

scattered among various agencies (national and international) without any coherence and coordination. Furthermore, no standardized methods and tools have been developed for cultural heritage disaster data collection until now. Therefore, specific approaches and methods are required to address these issues.

2. Overieww of the DALIH database

A database specifically devised for the collection of cultural heritage disaster loss data named DALIH has been developed within the project RIACT (Risk Indicators for the Analysis of Cultural heritage under Threat). The database aims to provide a standard for diaster loss and damage recording in worldwide immovable cultural heritage supported by international institutions such as UNESCO, ICOMOS or, ICCROM, as well as other organizations dealing with cultural heritage. The main objective of this initiative is to develop an efficient tool that provides institutions managing and protecting cultural heritage with: a systematic and standardized recording of cultural heritage disaster-related data, from both natural and man-made hazards; a reliable accounting of cultural heritage losses; adequate data for analysing disaster trends and risk mitigation needs in cultural heritage.

One of the key issues of the database development was the definition of a simple system of categories for the type of cultural heritage properties that are considered by the database. To accommodate different types of immovable cultural heritage assets in a simple, general and structured way, the following Heritage Categories were selected which establish the importance of a certain immovable cultural heritage item: UNESCO World Heritage Sites, Properties Protected by the Hague Convention, Listed National Heritage, Listed Subnational Heritage, IUCN Protected Areas, Properties of Local Significance.

Given that some of these categories may overlap (e.g. a UNESCO World Heritage Sites can also be a Listed National Heritage), more than one Heritage Category can be assigned to a certain property. For each of these categories, an additional descriptor is also assigned to describe the type of cultural heritage item. This descriptor establishes that a given cultural heritage item belongs to one of the following Unit Identification types: Single unit property (an individual monument or a natural landscape); Multiple unit property (a group of monuments, an historic landscape, an historic town, an urban block of cultural significance)

The hazardous events recorded by the database range from small-scale events that only affect a single property to large-scale ones that affect a larger number of heritage assets. For each event, the database records information about the cultural heritage properties affected by the event. This includes basic descriptions about the cultural heritage properties before they have been damaged along with a description of the damage and losses they suffered. Each property affected by an event is then associated to a Heritage Category and an Identification Type, to one or more Property Classes, to a Value (qualitative) and to Construction Materials (only for built properties). Regarding disaster data, the (qualitative) damage level of each cultural heritage property and available information on economic losses are recorded.

Acknowledgements

This work was financially supported by: Project POCI-01-0145-FEDER-030469 - RIACT - Risk Indicators for the Analysis of Cultural heritage under Threat, funded by FEDER through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI) and by national funds through FCT - Fundação para a Ciência e a Tecnologia; and by Base Funding - UIDB/04708/2020 of CONSTRUCT - Instituto de I&D em Estruturas e Construções, funded by national funds through FCT/MCTES (PIDDAC).

The renovation of the urban space of the industrial areas discontinued after the second world war. The case of the Costantino cotton factory in Bari

Chiarantoni Carla – Polytechnic university of Bari, Bari, Italy, e-mail: (carla.chiarantoni@poliba.it)

Abstract: The article investigates an industrial area in the contemporary profile of environmental and settlement sustainability. Industrial sites within the urban reality can have different origins and can differ in spatial and functional organisation, with significant impacts also on adjacent urban systems. The different levels of interference with the social and spatial dynamics of the urban systems to which they are connected turn them into extremely interesting models for their potential influence on the transformation and restoration processes of contemporary cities. The long process of formal and social recovery that has involved many urban realities in recent decades has once again highlighted the extreme importance of these places seen as open laboratories for the experimentation of innovative settlement models. In this regard, some Italian realities have initiated significant transformation processes, triggering profound reflections on settlement sustainability that have significantly affected the local socio-economic fabric. Therefore, the hypothesis of a project scenario for the recovery of the disused industrial area, ex-Cotonificio Costantino, in the urban context of Bari emerges. The document is divided into three phases: analysis of the industrial context of the Apulian region, analysis of the case study and its urban context and, finally, formulation of the regeneration project.

Keywords: Functional regeneration, social housing; domestic space, regeneration of ex-industrial areas

1. Introduction

In Italy, as in the rest of Europe, after the Industrial Revolution of the second half of the 1800, the sprawl of industries has progressively modified, together with the economic structures, the appearance of the territory and the urban landscape. However, the development of new centres of production did not occur uniformly within the peninsula, but the territory of settlement, the inspiring principles, and the method of use of the soil have notably differentiated the various industrial sites. It is especially in this period that the large gap between north and south started to manifest, caused by different conditions of the agricultural systems, the transportation systems, and the issues connected to the state funding and the institutes of credit. In Apulia, and in particular in the area of Bari municipality, the industrial construction started to expand in the first half of the 1900, despite the lack of a viable infrastructure within the region connecting Bari with the most important centres of Apulian production, such as: Barletta, Trani, Monopoli, Brindisi, Gallipoli and Taranto. In contrast, the presence of somehow efficient ports, allowed a suitable connection with the northern markets, where both the agricultural and manufactured products were shipped. The presence of the fist industries in the city of Bari contributed to its urban development, however it did not have the peculiar traits which marked other Italian urban realities. [1]

1.1. Bari and the industrial expansion in brief

The bases for the structuring of an industrial area in the city of Bari, trace back to the period between 1911 and 1913, in which possible areas of expansion of the productive and industrial areas started to be identified. These industrial areas included in the directions of

the Veccia plan of 1918 were those in the west, within the area between “Marisabella” inlet and “San Cataldo” promontory. However, this was not sufficient to the birth of a proper industry in the municipal territory of Bari, as since the beginning there was unwillingness to create a strong labour class. This caused a hindrance to the realisation of a proper industrial estate, and as a consequence, of all the necessary infrastructure to its development. In the same years, the structuring of the city provided an additional obstacle, as priority was given to the realisation of institutional buildings of representative, administrative and also residential kind, completely neglecting the idea to realise an industrial citadel. As a consequence, the industries developed in a disordered and systematic way mainly along the southern periphery of the urban development or along the extramural axis not far from the great road arteries of the city. The two principal industrial hubs were those in the south-east and north-west, many of which arose spontaneously, were strongly self-referenced, and satisfied internal needs of every single enterprise and the opportunities given by the availability of economic means, often neglecting the environmental problems. Between the 20s and 30s, the additional birth of the industries west of the city, on the road to Modugno and the one to Valenzano, actually circumscribed the urban development. [2]

2. The cotton factory Costantino

2.1. The urban context

The “Cotton Factory Constantino” was born in an urban area north-west of Bari municipality, originally peripheric and included between important busy road axes such as via F. Crispi, via M. Pagano and via Brigata Regina. These axes connect the area with the nearby industrial area called STANIC, with the urban centre on one side and the modern city on the other, as well as the bordering towns. Moreover, the area is enclosed by an important railway hub in the south, which still represents a significant barrier to the development of the whole area, despite providing interurban connection; in the east there is a long row of residential buildings. The crucial elements which characterise the area are the Monumental Cemetery, which influenced the birth of small, dedicated industries to its service, and the presence of the penal and civil Court. Apart from these, in the area there is a middle school, several dilapidated shacks and artefacts in advanced state of decay, artisanal activities for wood stocking, as well as the flanders complex of the former Cotton Factory Costantino.

References

[1] Bernardini, E., & Cascella, S. (2011). “La rigenerazione urbana nell’esperienza pugliese”. In: Atti della XIV Conferenza Siu–Abitare l’Italia. Territori, economie, disuguaglianze.

[2] De Mattia, F., Verdoscia, C., (1999). *Bari Industriale. Documenti per una archeologia degli edifici produttvi del XIX secolo agli anni ’40*. Adda Edizioni, Bari

Workflow for virtualisation of historic gardens and their vegetation. The historic garden of la Arguijuela de arriba (Cáceres, España)

Rodríguez Sánchez, Carlos - Universidad de Extremadura, Cáceres, Spain, crodriguhc@alumnos.unex.es

Cruz Franco, Pablo Alejandro– Universidad de Extremadura, Cáceres, Spain, pablocruzfranco@unex.es
Gómez Bernal, **Elena** - Universidad de Extremadura, Cáceres, Spain, egomezbe@alumnos.unex.es

Abstract: There are historical sites that are little known to the general public. It is therefore of great importance to make them known to everyone. To this end, there are new informative techniques that make it possible to visit places without the need to visit them. For this purpose, the complete virtualisation of the space has been proposed, combining photogrammetric techniques with traditional survey techniques. All these together form a complete model of the location, its topography, layout, buildings, vegetation and the surrounding environment. With this we propose the survey of the historic garden of La Arguijuela de Arriba, located in the province of Cáceres (Spain) in an area of great importance due to its defensive character during the Reconquest period. With all this we have managed to combine different techniques to obtain a digital copy of the enclave on which we have been able to plan an intervention that improves accessibility [1, 2] and conservation.

Keywords: Photogrammetry, Surveying, Heritage conservation, RPAS systems, Vegetation.

1. Introduction

This paper shows a workflow for the virtualisation of historic gardens that allows us to document the topography, architectural elements and plant species. For this purpose, photogrammetry, traditional modelling and proxy models have been combined. This digital model was finally used to develop a (digital) universal accessibility proposal and a traditional accessibility proposal

2. Methodology

At the beginning of the project, the objective was to carry out a complete survey of the site using RPAS systems, but after taking the first data and processing them with the software, it was detected that the results were not adequate for this project.

2.1. Survey of the historical trace. The first survey necessary to obtain the complete model is to obtain the historical trace and its topography. For this, the original approach of the project has been respected. This has been done using drone photogrammetry.

2.2. Survey of buildings and architectural elements. The historic garden ensemble has several distinct architectural elements that can be separated for individualised survey. The complex has 2 arbours, a greenhouse, a pergola and its enclosure.

2.3. Inventory and positioning of vegetation The third element that makes up the final model is the vegetation, which is the most important part of the enclave, but the most complex one to be surveyed with photogrammetry. For this reason, a referenced positioning of the different plant species has been carried out, which will later be placed in the final model by means of parametric proxy elements.

2.4. Creating a unique model Until now, separate independent surveys have been carried out, the objective being to achieve a single parametric model.

Figure 1 General view of the vegetation of the ensemble.

3. Results

With the use of this workflow it has been possible to obtain a complete digital model of the garden. This model serves as the basis for making this historic space known to the entire population, having created virtual visits [3], render images and has also allowed the projection of a proposal for universal accessibility[4] for the enclave to further facilitate its conservation and its use for events and visits.

(a) (b) (c)

(d) (e)

Figure 2 (a) QR of the video tour of the site (b) Refurbished state of the greenhouse (c) recreation of the current state of the greenhouse (d) proposed accessibility of the site (e) Intervention in the greenhouse

4. Conclusions

It may be noted that this workflow, despite combining three methodologies for data collection, is fully functional. It allows a high quality model to be obtained. This allows a lot of versatility, depending on the resources available and the particular situation, being able to choose one methodology or another or to combine them.

Referances

1. Rodriguez Sánchez, C., *Levantamiento y propuesta de accesibilidad en el jardín histórico de la Arguijuela de Arriba (Cáceres)*, in *Expresión Gráfica*. 2021, Universidad de Extremadura.
2. Romero, M.L.H., Inocencia García y Becerra Raquel Nodar *Proyecto de adecuación integral CASAD EL ANFITEATRO.* Concurso de la ciudad monumental, histórico-artística y arqueológica de medida, Julio de 2018
3. Pérez Sendín, M., *Prototipado físico a partir de gemelos digitales aplicado a la Torre de Bujaco*, in *Construcción*. 2022, Universidad de Extremadura: Cáceres. p. 144.
4. Gómez Bernal, E., *Levantamiento planimétrico y propuesta de accesibilidad en la casa romana de la Alcazaba de Mérida*, in *Diseño Gráfico*. 2021, Universidad de Extremadura: Cáceres. p. 144.

Some remarks on the interoperability performance of HBIM models for structural conservation and upgrading of building aggregates in the Italian minor centres

Marra Adriana - University of Molise, Campobasso, Italy, e-mail: adrianamarra.am@gmail.com

Fabbrocino Giovanni - University of Molise, Campobasso, Italy, e-mail: adrianamarra.am@gmail.com

Trizio Ilaria - Institute for Construction Technologies - Italian National Research Council, L'Aquila, Italy, e-mail: ilaria.trizio@itc.cnr.it

Abstract: The article deals with the definition and evaluation of a workflow to demonstrate that the parametric model of a historic building with a high level of digital maturity can be configured as a tool that fosters collaboration between the various professionals involved in the recovery and rehabilitation process of historic buildings. It also represents the starting point for developing structural models for quantitative analyses. The implementation of HBIM to the building aggregate called "La Giudea" in Santo Stefano di Sessanio (AQ), an artefact that is particularly representative of the historical building heritage of the small medieval village in the Abruzzo Inner Areas, has provided a model for managing the information deriving from the knowledge process. At the same time, this model delivers to the use of the state of conservation, and it represents the base for the structural analysis of the asset and the identification of the measure and interventions for its preservation. The parametric model was developed to assess the structural performance of the aggregate from the same model and to verify the vertical interoperability between different software.

Keywords: Architectural Heritage, Digital survey, HBIM, Structural analysis, Interoperability

1. Introduction

The survey, digital representation and documentation of historical buildings represent an essential and preparatory set of actions in view of analyses and design required for their conservation and safety. These activities are particularly relevant when working on complex building aggregates typical of many historical centres located in the Inner Areas of the Italian Apennines. These aggregates are characterised by typological and constructive peculiarities that need to be safeguarded from the several anthropic and natural risks. The advantages offered by digital technologies, and the several operational workflows implemented within the three-dimensional survey and modelling, facilitate the process of knowledge, documentation [1,2] and analysis [3] supporting the design of proper recovery interventions to be implemented in the context of the post-earthquake reconstructions [4], still in progress in Italy after the most recent earthquakes. The present paper aims to offer some reflections on the results of an operational simulation, carried out from the perspective of a qualified technician, on the whole process of knowledge and structural performance analysis of an architectural complex typical of the villages of the Abruzzo Apennines [5].

2. Results and discussion

The work has been aimed at assessing interoperability issues associated with the integration of the different information delivered by the specialists involved in the process. The selection of the software platforms has been made among those are widespread and commonly used by professional engineers and architects. The results confirm the effectiveness of the workflows

used for developing HBIM models, characterised by a high level of digital maturity, of complex artefacts. At the same time, they validate the availability of tools that encourage collaboration between the different professionals involved in the restoration and reconstruction process since the parametric model constitutes a starting point for the development of structural models for quantitative analysis. IFC format represents the main tool [6,7] for the interoperability between different software and that has to ensure the exchange of all information acquired during the survey processes and properly digitised within a single model. However, the performed experimentation revealed the loss of data and information on horizontal structures and singularities in the passage from parametric to structural models. This sometimes causes the dissipation of the available information and the necessity to duplicate modelling operations for structural analysis purposes. These circumstances demonstrate the need to investigate the issues concerning the horizontal and vertical interoperability between the different parametric software guaranteed by the IFC format and bring to the operators' attention the necessity to proceed with an accurate design of the parametric model and the operational procedures used in modelling. In relation to some issues faced in this study, Figure 1 illustrates a workflow based on the selected software. It proved to overcome the limitations observed on simple models but should be further investigated and validated on models of complex architectural aggregates.

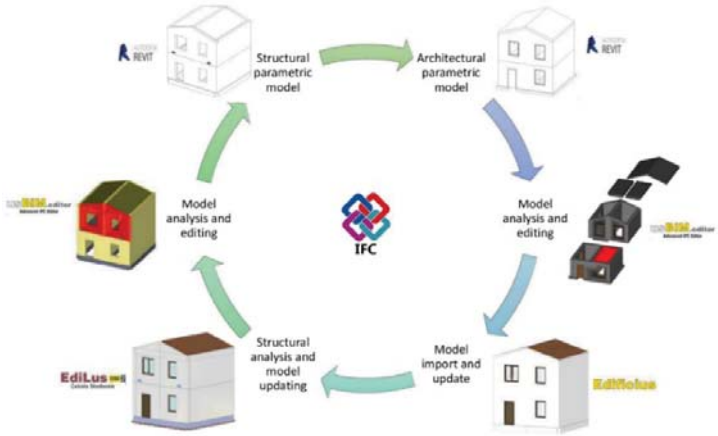


Figure 1. Operational workflow for interoperability.

References

[1] D. Oreni, R. Brumana, S. Della Torre, F. Banfi (2017) "Survey, HBIM and conservation plan of a monumental building damaged by earthquake". Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLII-5/W1, Pages 337–342.

[2] Trizio, F. Savini, A. Giannangeli, R. Boccabella, G. Petrucci (2019). "The Archaeological Analysis of Masonry for the restoration project in HBIM". ISPRS - Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLII-2/W9, Pages 715-722.

[3] M. Pepe, D. Costantino, A. Restuccia Garofalo (2020). "An efficient pipeline to obtain 3D model for HBIM and structural analysis purposes from 3D point clouds". Applied Sciences, 10(4), 1235.

[4] R. Brumana, S. Della Torre, D. Oreni, L. Cantini, M. Previtali, L. Barazzetti, F. Banfi (2018). SCAN to HBIM-post earthquake preservation: Informative model as sentinel at the crossroads of present, past, and future. In: Ioannides M., Fink E., Brumana R., Patias P., Doulamis A., Martins J., Wallace M. (eds.), Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection 7th International Conference, EuroMed 2018. Springer, Cham, pp.39-51.

[5] C. Bartolomucci, A. Donatelli (2012). La conservazione nei centri storici minori abruzzesi colpiti dal sisma del 2009: esigenze di riuso e questioni di conservazione. In: Biscontin G., Driussi G. (eds.), La Conservazione del Patrimonio Architettonico All'aperto: Superfici, Strutture, Finiture, Contesti, Arcadia Ricerche, Marghera-Venezia, pp. 101-111.

[6] BuildingSMART (2022). Industry Foundation Classes (IFC). https://www.buildingsmart.org/standards/bsi-standards/industry-foundation-classes/

[7] S. Gerbino, L. Cieri, C. Rainieri, G. Fabbrocino (2021) "On BIM Interoperability via the IFC Standard: An Assessment from the Structural Engineering and Design Viewpoint". Appl. Sci., 11(23), 11430.

Pantalica Rupestre: digital survey for the image of rock-cut Architecture

Inglese Carlo - Sapienza, University of Rome, Department of History, Drawing and Restoration of Architecture, Rome, Italy, carlo.inglese@uniroma1.it

Barni Roberto - Sapienza, University of Rome, Department of History, Drawing and Restoration of Architecture, Rome, Italy, roberto.barni@uniroma1.it

Griffo Marika - Sapienza, University of Rome, Department of History, Drawing and Restoration of Architecture, Rome, Italy, marika.griffo@uniroma1.it

Abstract: The analysis of the rock-cut architecture arises complex issues on both methodological and applicative point of view, it affects the sphere of representation through models. Because of its very particular formal and functional aspects, it lies halfway between artifice and nature, between sculpture and landscape and, again, between architecture and the city. The research here presented is declined on three rock-cut churches located in the archaeological site of Pantalica: San Micidiario, San Nicolicchio and the cave of the crucifix. The documentation through 3D models and the elaboration of 2D models of synthesis highlight the complexity of the theme. Starting from the three-dimensionality of the object, based on new approaches of form synthesis experimented on rock architecture, the contribution aims to update the existing documentation on the three case studies and to provide new reading tools for the morphological and architectural study

Keywords: rock-cut architecture, Pantalica, 3D modeling, data capture, representation

1. Pantalica and its caves

The archaeological site of Pantalica (most probably, the term comes from the Arabic: Buntarigah, meaning caves) is enclosed at the junction of the two geological formations of the Climiti and Carlentini mountains and it is considered one of the first inhabited places in Eastern Sicily, where, in the Late Bronze Age (13th century B.C.), a native settlement developed.
Around the sixth century, during the Byzantine domination period, villages were founded in Pantalica, often implanted on the caves of the pre-existing necropolis and developed around rock-cut churches. Today we can observe the remains of three main villages, each one is characterized by the presence of a rock-cut church (Fig. 1). The first of them is located close to the necropolis of Cavetta, and consists of about 70 dwellings in addition to the oratory of the cave of the Crucifix; the second one is under the Anaktoron, in the South necropolis with the oratory of the cave of S. Nicolicchio, while the third one, the largest of these rocky agglomerations, is the one located between the South necropolis and the saddle of Filiporto, consisting of more than 150 dwellings with several rooms and the cave of San Micidiario [2].

2. Rock-cut architecture

The rock-cut architecture, unlike the traditionally designed and built one, highlights its character through its morphology. That is expressed by the total deviation from the regular volumes and shapes, due to the irregularity that comes from being an excavated artifact with a substantial continuity between the internal and external environment.
We can say that, given its origin as excavated space, as architecture obtained directly in and with the territory, rock-cut architecture is a borderline case of architecture itself. This

circumstance is adequately resolved with the current survey methodologies. In this occasion, the problem of the systematization of the procedures of architectural survey in the rocky environment has been faced in the light of the technologies of laser scanning, of digital photogrammetry. If the phases of massive acquisition of data, through 3D laser scanning and *SfM*, reach, in the field of rock-cut architecture, one of the highest levels of functionality, it is the post-production processing phase that involves a necessary critical action with respect to the same methodology. In a following phase, therefore, we have dealt with the experimentation in the specific field of the architectural representation. It was therefore necessary, basing on previous experience, to conduct an experimentation of representation techniques not usual for architecture, mostly used in cartography, such as the representation by the mean of contour lines and the development of complex surfaces [1].

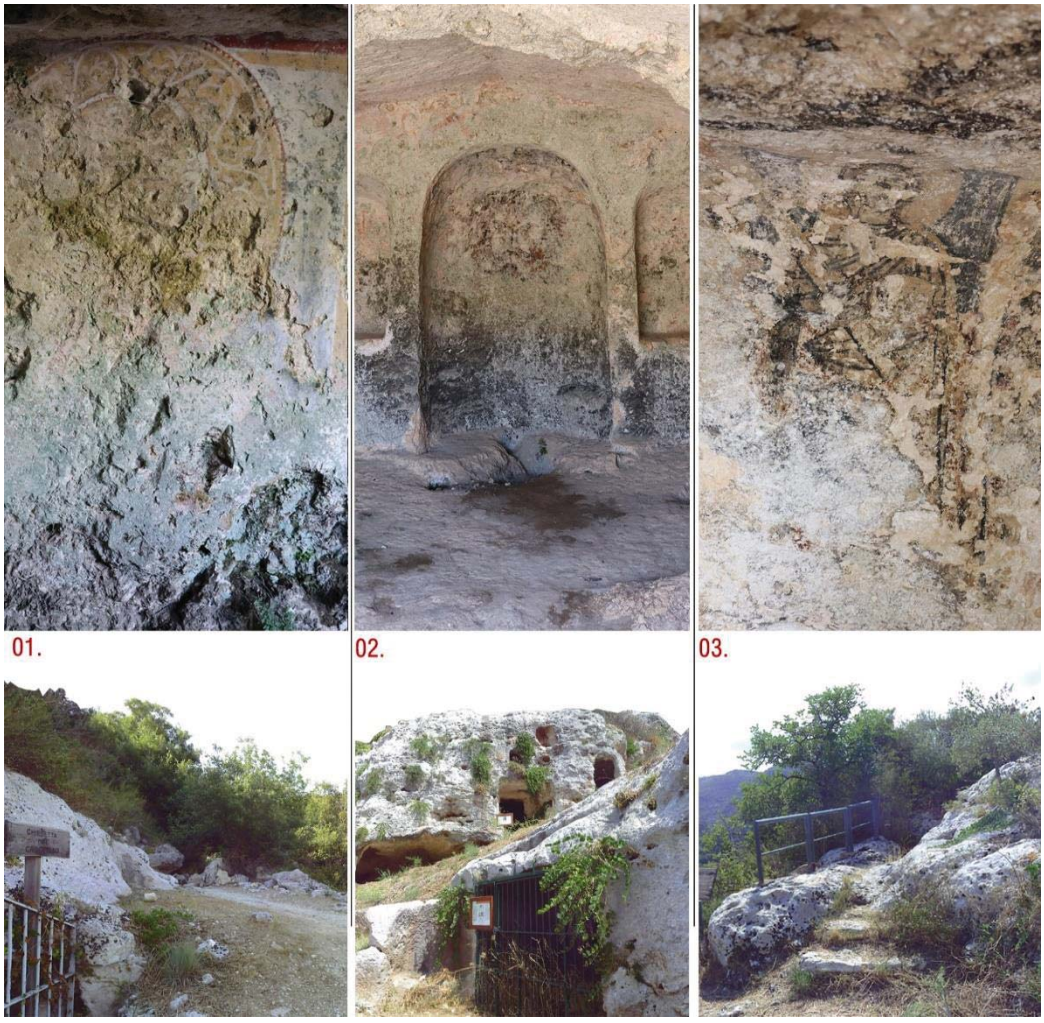


Fig. 1 Photographic documentation of the three sites and their mural paintings: 1. Grotta del Crocifisso, 2. San Micidiario, 3. San Nicolicchio

References

[1] M. Carpiceci, A. Angelini (2020). “The shape of colour. The cave of San Michele on Monte Tancia (Italy)”. Archeologia e calcolatori, n. XXXI.2, pp. 233-244.

[2] Leighton (2019). “Pantalica: recenti ricerche sulla topografia e cronologia delle tombe e delle abitazioni rupestri”. M. Blancato, P. Militello, D. Palermo, R. Panvini (eds). Pantalica e la Sicilia nelle età di Pantalica. Atti del Convegno di Sortino (Siracusa), 15-16 dicembre 2017. In Creta Antica. Rivista annuale di studi archeologici, storici ed epigrafici. Aldo Ausilio editore in Padova - Bottega D’Erasmo.

Assessing the quality of Terrestrial Laser Scanning and Mobile Laser Scanning for a preliminary approach to a study on laser scanning of historic gardens

Machado, Caroline – Lisbon School of Architecture - University of Lisbon, Lisbon, Portugal, e-mail: (carolinemachado@edu.ulisboa.pt)

Del Duca, Graziella – Lisbon School of Architecture - University of Lisbon, Lisbon, Portugal, e-mail: (gdelduca@ulisboa.pt)

Abstract:

This paper aims to compare Terrestrial Laser Scanning and Mobile Laser Scanning point clouds of a wooded area located in Monsanto Park in Lisbon, to evaluate their quality for documentation and the estimation of the tree attributes. The evaluation is based on visual observation and graphic comparison of the two point clouds acquired in different instances. After the required data post processing and registration, it was observed that both methods produced useful outcomes for the research scope within their limitations. Terrestrial Laser Scanning is still the method that offers more accurate point clouds with a higher point density and less noise level. However, the more recent Mobile Laser Scanning is able to survey in less time, significantly reducing the costs for site activities, data postproduction and registration. Both methods have limitations that are amplified by site features, mainly the lack of plans for the geometric alignment of scans and for the Simultaneous Location and Mapping process. We also offer the results of a comparison of the functional range of the two machines, as well as for a comparison of their terrain information extraction capabilities.

Keywords: terrestrial laser scanning; mobile laser scanning; SLAM, forest inventory, historic garden documentation

1. Introduction

The research presented in this paper compares data captured with both Mobile Laser Scanning (MLS) and Terrestrial Laser Scanning (TLS) of the same forested area, and analyse the efficiency of each method. The evaluation is based on visual observation, graphic comparison an measuremnts between the two point clouds acquired in different instances, and it aims to assess their quality for documentation and estimation of the tree attributes. The case study on which the tests were conducted is a wooded area of 2400 m^2 located in Monsanto Park in Lisbon.

2. Materials and methods

The surveys were done on two consecutive days and a single scanner was used on each day. On the first day, the area was surveyed with the FARO Focus by the researchers. On the second day, the same area was scanned by a surveyor from Leica Geosystems with the BLK2GO. The TLS survey required the use of five reusable spheres, ten black-and-white fixed targets, and took about 3.5 hours to be finalised. For the acquisition of the point cloud via TLS, we decided not to acquire colour because it would have significantly increased the data acquisition time in the field and the final file size. The BLK2GO survey required only one person in the field holding the device and walking at a continuous pace around the trees. The scanning started and ended at the same point in one “walk”. The survey took about 20

minutes. We did not applied cleaning filters to the raw data; the objective was to perceive the quality of the raw data produced by each piece of equipment.

3. Results

Regarding the quality of the cloud information, the TLS data shows more clearly the definition of the boundaries of the objects in the scene, such as the tables, the benches and, mainly, the tree trunks. The MLS generates more noise throughout the scene, which contributes to more inaccuracy in the definition of the surfaces and the scanned objects. Making a 10 cm thick slice of the two clouds we also visually verify that the two clouds coincide over the entire extent of the survey area. The absence of major deviations between the two point clouds indicates that the SLAM system of MSL works well in sites with morphological characteristics similar to the ones analysed. Another point that we wanted to test was the quality of the terrain information to create contour lines. The result shows similar contour lines, with both TLS and MLS able to provide a general morphology of the terrain. Other important piece of information to be analysed is the quality of the definition of the trunks' boundaries in the horizontal cross sections. Comparing the point cloud sections obtained with the two machines, a difference in the definition level of the points on the trunk perimeters is visible. The sections produced by Faro Focus present a greater density and uniformity of points and, consequently, a better geometric definition of the trunks. Although the MLS point cloud has a higher noise level, it is important to emphasise that MLS is able to detect more trees in a shorter scan time than TLS and, in doing so, is able to determine the complete shape of their trunks. Another parameter we evaluated was the maximum crown height of the trees, captured by the two scanners. Although the two scanners operate with different technologies and have differing degrees of operative limitations related to light/shadow conditions and canopy movement, the general results were similar.

4. Analysis

The main objective of the results presented above is to provide adequate information on the quality of point clouds generated for the creation of graphic documentation used by professionals for garden conservation projects. In light of what has been said and the data collected in this research, the choice between TLS or MLS for surveying historic gardens falls under the following considerations: it depends on what the site conditions are, the information to produce and, above all, the time available for the survey. TLS still produces information that is more accurate. In general, MLS is able to represent the total scanned area more comprehensively and in less time than TLS.

5. Conclusions

In general, MLS is able to survey a larger area, in less time and with greater ease of use on field than TLS. TLS, however, is still the method that produces more accurate results with a higher density of points on the surfaces of the objects present in the scanned area, which implies a better definition of the elements present in the site. Regarding the survey of historic gardens, the research concludes that the type of laser scanning to be used depends on the conditions available for the survey, its objective and the type of material one wants to produce. Both TLS and MLS present qualities to be exploited in the production of graphic documentation to support the preservation actions of green areas.

Computational 3D modeling supporting the preservation of historic timber roofs: the case of San Pietro's Cathedral in Bologna

Massafra Angelo, Alma Mater Studiorum Università di Bologna, Bologna, Italy, angelo.massafra2@unibo.it

Davide Prati, Alma Mater Studiorum Università di Bologna, Bologna, Italy, davide.prati5@unibo.it

Giorgia Predari, Alma Mater Studiorum Università di Bologna, Bologna, Italy, giorgia.predari@unibo.it

Keywords: Cultural Heritage (CH), timber trusses, non-destructive structural analysis, Terrestrial Laser Scanning (TLS), computational 3D modeling

Extended abstract

This study analyzes the structural behaviour of historical roofs through an innovative non-destructive method to support their conscious maintenance and conservation. Starting from the case study of San Pietro's Cathedral in Bologna (Italy) - an impressive example of a 16th and 17th-century timber-framed roof preserved in all its authentic parts - this research aims to understand the causes and possible repercussions of structural deformations that timber trusses have undergone over their lifecycle and propose some criteria for their efficient preservation.

Wooden structures have constantly been used worldwide in historical constructions with different configurations and technologies depending on the local availability of materials, their conception, and the expertise of workers. So they may present complex configurations as well as various ways of assembling linear elements, cutting joints, and connecting metal brackets and, above all, beams with irregular cross-sections. For this reason, the use of LIDAR (Laser Imaging Detection and Ranging) and TLS (Terrestrial Laser Scanning) techniques spread in the Cultural Heritage (CH) field in the last decades due to their precision and accuracy in surveying the geometry of elements that compose structures in short periods. While surveying methods are well-established in practice, the automatic transformation of laser-scanned point clouds into valuable information 3D models is still a recent issue. Visual Programming (VP) tools seem to be a leading technology to perform this issue since they require fewer programming skills than code programming; therefore, they are accessible also to experts in the Architecture, Engineering and Construction (AEC) domain without specific programming expertise.

Gathering such information about these structural systems is critical for three main issues. First, studying their history and the transformations they have undergone throughout the centuries is essential for comprehending their material culture and holding their historical values. Secondly, knowing the current state of these objects is necessary for performing a conscious conservation design, planning maintenance and allowing the everyday use of buildings that they cover. Thirdly, investigating and monitoring their conservation state can help get information about the health of the underlying structures and the whole building.

The method used for investigating the structural behavior of San Pietro's roof framing is based on a different approach from traditional Structural Mechanics, both from the instrumental and theoretical points of view. It mainly consists of archival studies, in-situ

inspections, digital surveys, computational 3D modeling algorithms, and reverse engineering procedures.

The premise behind the method consists of taking advantage of the large amount and accuracy of spatial information produced by the TLS survey. These data are used to enable a highly detailed analysis of timber trusses and, thus, to develop comparative information on their static behavior and preservation state. Moreover, the combination of processed geometrical data with historical research makes it possible to build up hypotheses on the structural behavior of the trusses. In addition, a monitoring phase could be performed to control structural displacements or deterioration of elements over time or after accidental events, such as fires, windstorms, or earthquakes.

The method was applied, tested and validated by previous analyses that allowed acquiring and processing of consistent information about several wooden roofing systems in Bologna (Italy), belonging to a set of remarkable historic churches and theaters from the 16th and 18th centuries. This paper illustrates the most recent update of this research. Since the assessment method is continuously under development, it has been extended for San Pietro's Cathedral in Bologna, whose trusses are the most complex among the previously examined in terms of structural type and size (about 26 meters in span).

Based on a few theoretical assumptions on the in-situ behavior of timber trusses reported in earlier studies, the trusses' original deformation state was determined by removing both in- and out-of-plane displacements. The principal hypotheses accounted for the lateral bearings remaining in their original position, the projection of the centroidal axes of all beams onto the vertical plane of the truss, a slight bending deformation of the tie-beams, the inward translation and lowering of the joints between rafters and posts, the rotation of bottom rafters around the virtual center of the lateral bearings, and the absence of axial deformations of beams.

The analyses conducted on the Cathedral's trusses have shown that most of them have similar structural behavior in terms of hypothetical deformations undergone since their original state. According to results, the maximum hypothetical vertical translation documented for the primary joints is equal to 13 centimeters. These deformations are modest considering that all the trusses cover a span of about 26 meters and comparing them with other case studies. These low displacements are probably related to the unique structural scheme of the San Pietro's trusses, as well as to their exemplary construction technique. Nevertheless, the asymmetrical behavior registered for most of the trusses must not be disregarded. Non-symmetrical loads on the roofing system could be provoked, for example, by the persistence of snow on the North-facing pitch after heavy snowfalls. They could trigger kinematics for which the trusses cannot respond, causing unexpected tension changes in the elements or excessive displacements of joints that could cause the loss of connection between the elements

The whole analysis suggested that it would be appropriate to insert metallic straps connecting the primary truss beams, such as rafters, straining beams, tie beams, and posts, inhibiting the structure's vulnerability to non-symmetrical loads, and increasing the degree of the constraint of joints and notches. These minimal and reversible interventions are strictly necessary to preserve the cultural values of these fascinating construction systems and ensure the safety of the building. Programmatic maintenance and monitoring of the wooden roof are also required to keep the state of preservation of trusses under control, suggesting timely intervention and preventing deterioration phenomena from spreading to the collapse of the structures.

On surfaces over time: assessment of degradation and monitoring of the effectiveness of consolidation and protective treatments

Graziella Bernardo - DiCEM - Department of European and Mediterranean Culture: Architecture, Environment and Cultural Heritage, University of Basilicata, Matera, Italy – graziella.bernardo@unibas.it

Antonella Guida - DiCEM - Department of European and Mediterranean Culture: Architecture, Environment and Cultural Heritage, University of Basilicata, Matera, Italy – antonella.guida@unibas.it

Francesca Visone - DiCEM - Department of European and Mediterranean Culture: Architecture, Environment and Cultural Heritage, University of Basilicata, Matera, Italy – francesca.visone@unibas.it

Extended Abstract

"Preserving in time an object, as well as preserving any existing material, is nothing more, from a strictly technical point of view, than an attempt to slow down the evolutionary processes caused by the unbalanced conditions existing between the object and its environment." (Massa et al., 1982) As is known, the deterioration of stone artefacts includes all those phenomena (intrinsic properties and extrinsic factors) that act in altering the appearance, texture, size, or chemical behaviour of the material, also as part of a structure. The causes of decay of historical buildings, in particular made of very porous stone materials, have been investigated, assembling a growing body of evidence that indicate the implication of change of the earth's climate and the role of human activities in the increase of deterioration phenomena. Several research projects have faced with the threat over the years, showing that changes in temperature, water content within the materials, relative air humidity, precipitation and concentrations of atmospheric pollutants are mainly responsible for processes that will contribute, in the near future, to increase the deterioration phenomena of artifacts exposed outdoors.

Based on these considerations, conservation of cultural heritage, understood as the slowdown of the alteration processes, make maintenance as the only means to maintain the kinetics of decay processes at a reduced level. This aim is also not free of theoretical and practical difficulties. Moreover, the conservation activities, require the development of increasingly innovative, effective, long-lasting, and less costly protection strategies, e.g. new materials and innovative techniques for restoration, able to guarantee the effectiveness and durability of the interventions and the safety and health of the operators. In recent years, research activities have been oriented to new protective and consolidant nanomaterials, to the transition from organic solvent-based materials, potentially harmful to health and the environment, to green waterborne products and to tailor-made materials conceived for each specific case studies. Traditionally, a wide array of protective and consolidation methods and materials to treat critically weakened stones has been used, each of which constitutes a specific process and methodological approach. The interest in designing new materials based on NPs for the conservation of stone buildings has increased in the last 20 years: the study of the properties and synthesis of nanostructured materials undoubtedly represent one of the most important and emerging fields of research.

Within this framework, the paper presented give (i) a synthetic overview of the principal deterioration phenomena occurring in stone artifacts worsened by several natural and

human-induced factors, (ii) an introduction on traditional and novel methods for the consolidation of calcareous-based stone materials. An integrated, multi-analytical approach is also proposed to define an operative protocol for the study of calcarenite and the related decay phenomena with the final purpose to test and develop nanoparticle (NPs) consolidant materials for the conservation of the UNESCO Site of "The Sassi and the Park of the Rupestrian Churches" of Matera, continuously impacted and weathered by several natural and human-induced factors. The Calcarenite di Gravina is a weakly lithified limestone, yellowish-white in colour, with high porosity (prone to absorb water) and low mechanical strength. Due to its availability and easy workability, despite its mineralogical-petrographic, physical, and mechanical properties, the calcarenite has been widely used over the centuries as a building material both in the Apulia and Basilicata regions. The study and the monitoring of the intrinsic characteristics of the case under study (constituent materials, building techniques, alteration phenomena, etc) in relation to the environment in which it is located allow to define critical issues for conservation and their progress over time. Diagnostic activities are so configured as a research tool useful to know and understand the peculiarities of a case-study and to relate them to the context in which they are set, with the purpose to carry out the most appropriate conservative and preventive actions.
The experimental results will converge in a digital platform to support the activities of knowledge, analysis, and planning of conservation interventions, making the UNESCO Site of "The Sassi and the Park of the Rupestrian Churches" of Matera a *laboratory of practices* with the ambition to become a standard for planned and preventive maintenance of architectural Heritage.

Keywords: calcarenite, diagnostic techniques, degradation phemonena, stone consolidation, stone protection

Decay detection in historic buildings through image-based deep learning

Silvana Bruno – Polytechnic University of Bari, Bari, Italy, e-mail: silvana.bruno@poliba.it

Rosella Alessia Galantucci - Polytechnic University of Bari, Bari, Italy, e-mail: rosella.galantucci@poliba.it

Antonella Musicco - Polytechnic University of Bari, Bari, Italy, e-mail: antonella.musicco@poliba.it

Abstract: Nowadays, built heritage condition assessment is realized through on-site or photo-aided visual inspections, reporting pathologies manually on drawings, photographs, notes. The knowledge of the state of conservation goes through subjective and time or cost consuming procedures. In this context, advancements in the field of Computer Vision and Artificial Intelligence provides an opportunity to address these criticalities. The proposed methodology is based on a Mask R-CNN model, for the detection of decay morphologies on built heritages, and, particularly on historic buildings. The experimentation has been carried out and validated on a highly heterogeneous dataset of images of historic buildings, representative of the regional Architectural Heritage, such as: castles, monasteries, noble buildings, rural buildings. The outcomes highlighted the significance of this remote, non-invasive inspection technique.

Keywords: built heritage, historic buildings, decay detection, deep learning, Mask R-CNN

1. Introduction

Currently, building surveyors working in refurbishment and maintenance activities execute the condition assessment during on-site or photo-aided visual inspections, reporting pathologies manually on drawings, photographs, notes. In this regard, advancements and innovative findings in Computer Vision represent a beneficial opportunity in decay recognition, for the detection of multiple or individual objects in images with a valuable accuracy. In the context of building defect detection, and, particularly, in Cultural Heritage, efforts have been done to automatize the detection of visible decay on masonry surfaces, through the implementation of Machine Learning [1] [2]. However, they are not extensive and requires in-depth investigation. For this reason, the paper aims to propose an innovative deep learning based-approach, for an expeditious detection of multiple kinds of decay morphologies, starting from 2D images, in order to support the technicians within the diagnostic process.

2. Materials and Methods

The proposed methodology is based on a Mask R-CNN model [3], for the automatic detection of multiple decay morphologies on built heritages [4] [5]. The image dataset is subdivided into three parts belonging to as many sub-processes of the workflow: train (70%), validation (10%) and test (20%) images, respectively. First of all, images are examined, and proposals of probable areas are generated; then, the proposals are classified producing bounding boxes and masks, in correspondence of the objects. The whole architecture is articulated into three main stages, which, on their side, can be furtherly divided into sub-steps (Figure 1).

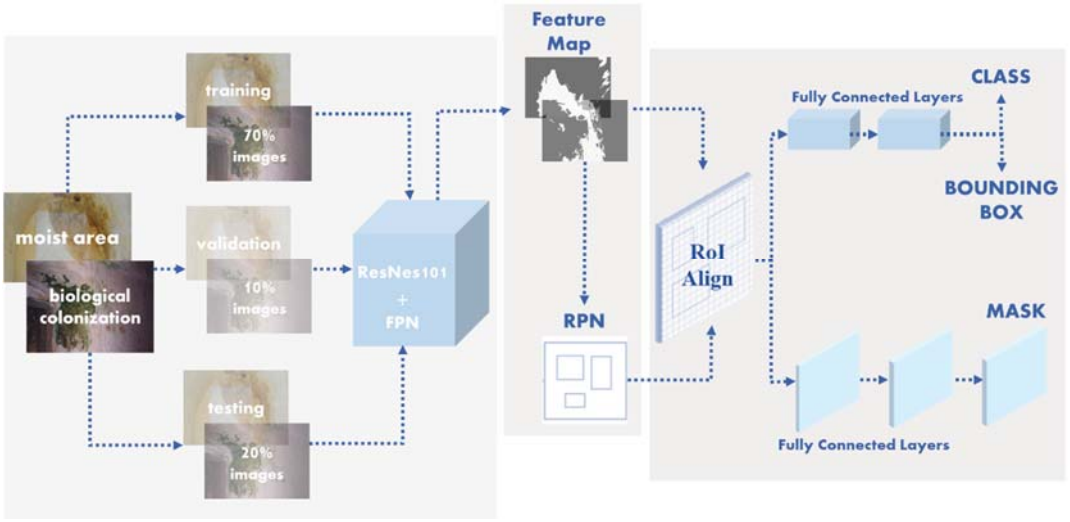


Figure 1 Workflow of the model

3. Experimental application and main results

The experimentation exploited a collection of on-site images of historic buildings. The network has been performed for two classes (moist area and biological colonization). The outputs of the model (bounding box and segmentation mask) have been confronted with the relative ground truth. For the moist area, the model has been tested with three different sizes of test images (10, 25, 50). The mean Average Precision (mAP) on testing data for both the epochs 50 and 100 images is higher then 0.5. Thus, the prediction is good. The value of mAP, regarding biological colonization for validation set of 13 images, is 0,34. Also, for the testing with 100 epochs mAP is low (0.18). Therefore, the prediction for biological colonization is not sufficient.

4. Conclusions

This work implements and validates an expeditious automated decay recognition and classification of two different kinds of damage, starting from heterogeneous quality, type or conditions image datasets. For moist area, the outcomes are highly accurate. For biological colonization, future developments could expand the input data for the training. In addition, the class could be divided into further subclasses, such as lichen, mousse, mould and plant. In conclusion, the model could represent a remote, non-invasive inspection technique, to support the preliminary knowledge and monitoring of the building state of conservation.

References

[1] M. Mishra, Machine learning techniques for structural health monitoring of heritage buildings: A state-of- the-art review and case studies, Journal of Cultural Heritage. 47 (2021) 227–245. doi:doi.org/10.1016/j.culher.2020.09.005.

[2] M.E. Hatir, M. Barstuğan, İ. İnce, Deep learning-based weathering type recognition in historical stone monuments, Journal of Cultural Heritage. 45 (2020) 193–203. doi:https://doi.org/10.1016/j.culher.2020.04.008.

[3] K. He, G. Gkioxari, P. Dollár, R. Girshick, Mask R-CNN, in: 2017 IEEE International Conference on Computer Vision (ICCV), 2017: pp. 2980–2988. doi:10.1109/ICCV.2017.322.

[4] UNI, UNI 11182 Beni culturali - Materiali lapidei naturali e artificiali - Descrizione della forma di alterazione - Termini e definizioni, (2006).

[5] ICOMOS, ISCS, Illustrated glossary on stone deterioration patterns, 2008.

Methodology for the generation of 3D city models and integration of HBIM models in GIS: Case studies

Carrasco César A., University of Cantabria, Santander, Spain, cesar.carrasco@unican.es

Lombillo Ignacio, University of Cantabria, Santander, Spain, ignacio.lombillo@unican.es

Sánchez-Espeso Javier M., University of Cantabria, Santander, Spain, javier.sanchez@unican.es

Abstract: The architecture, civil engineering and construction (AIC) sector increasingly demands the availability of semantic and interactive digital models with the environment, capable of simulating decision-making during its life cycle and representing the results achieved. GIS&HBIM platform is a useful tool, with potential applications in the world of built heritage. The objective of this contribution is to propose a procedure for the generation of 3D visualization models of existing cities by integrating HBIM models in GIS environments.

Keywords: HBIM; GIS; Semantic; Integration.

1. Introduction

Work is currently underway to develop more realistic and collaborative methodologies based on the Geographic Information Systems (GIS) environment and its integration with Building Information Modelling (BIM) [1]. The application of BIM technology in built heritage is called HBIM. The integration of GIS and HBIM constitutes a powerful tool for managing the life cycle of built heritage [2]. However, several drawbacks have been identified in this integration, mainly related to the interoperability of formats and the semantic definition of geometry. The most recognised and widely used open standard format in GIS is *CityGML*, while in BIM/HBIM it is the IFC format [3]. In relation to the geometry with which the model is represented in the different preformats, one can speak of "Levels of Detail" (LoD) in the case of GIS and "Levels of Development" (LOD) when referring to BIM/HBIM.

2. Methodology and case studies

A methodology with 3 key stages is proposed in Fig. 1. It is applied and developed in 4 sites, namely: Santander (area of the University of Cantabria), the historic centre of Santillana del Mar, Mogrovejo and San Vicente de la Barquera. ArGIS Pro, a specialised GIS software, was used to generate the 3D model of these areas; in addition, Revit and SketchUp were used. The paper also deals with the integration of HBIM models in GIS environments; for this purpose, the HBIM model of the School of Civil Engineering of the University of Cantabria was generated and integrated into the 3D GIS environment of Santander.

For each site, in Stage ① an orthophoto and a digital terrain were used as a base map. Stage ② is developed from the cadastral database of each city. From the point cloud of the LIDAR flight (PNOA 2012) [4], the points corresponding to the terrain are filtered and, using algorithms implemented in the GIS software, the Digital Terrain Model (MDT) combined with the assigned orthophoto is created.

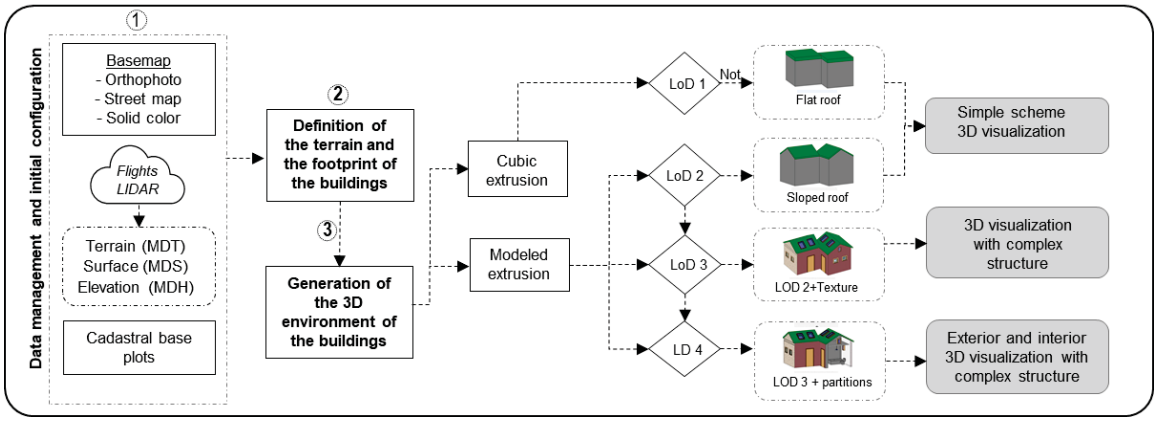
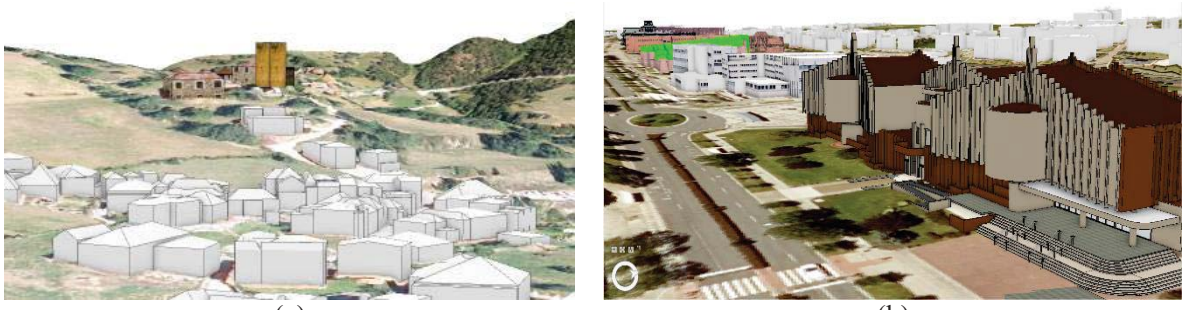


Fig. 1: Methodology to generate a GIS 3D model integrating HBIM models

Finally, in Stage ③ GIS 3D models of the cities are generated with different LoD, Fig. 2.



(a) (b)

Fig .2: Some examples of models generated. (a) GIS 3D of Mogrovejo (LoD 2-LoD 3). (b) GIS & HBIM integrated model (LoD 4-HBIM LOD 300) of Civil Eng. School - Univ.Cantabria.

3. Conclusions

HBIM models and geospatial technologies offer 3D data models that provide information about buildings and the surrounding environment. GIS and HBIM are widely used platforms in the construction sector due to their various individual characteristics. Although there are technical inefficiencies related to the integration of GIS & HBIM, few theoretical studies address how to fully integrate their respective strengths. This paper has presented a useful procedure for generating 3D models of cities through various software packages commonly used in the AIC sector. This methodology has proven to be very useful for the visualisation of the built environment of the project and other applications related to simulation in decision making.

4. References

[1] A. M. Abd, A. H. Hameed, and B. M. Nsaif, "Documentation of construction project using integration of BIM and GIS technique," *Asian J. Civ. Eng.*, vol. 21, no. 7, pp. 1249–1257, Nov. 2020, doi: 10.1007/s42107-020-00273-9.

[2] A. Baik, R. Yaagoubi, and J. Boehm, "Integration of jeddah historical bim and 3D GIS for documentation and restoration of historical monument," in *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, 2015, vol. 40, no. 5W7, pp. 29–34, doi: 10.5194/isprsarchives-XL-5-W7-29-2015.

[3] M. Del Giudice, A. Osello, and E. Patti, "BIM and GIS for district modeling," in *eWork and eBusiness in Architecture, Engineering and Construction - Proceedings of the 10th European Conference on Product and Process Modelling, ECPPM 2014*, 2015, pp. 851–854, doi: 10.1201/b17396-136.

[4] Gobierno de Cantabria, "Mapas Cantabria," 2022. https://mapas.cantabria.es/ (accessed Jul. 06, 2022).

Implementation of a structural health monitoring using optic fiber sensors in the Monastery of Batalha

Bourgeois Inês - RISCO, Departamento de Engenharia Civil Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal, inescbourgeois@ua.pt

Pereira Luís - I3N, Departamento de Física Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal, lmpereira@ua.pt

Antunes Paulo - I3N, Departamento de Física Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal, pantunes@ua.pt

Marques Carlos - I3N, Departamento de Física Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal, carlos.marques@ua.pt

Ferreira Victor - RISCO, Departamento de Engenharia Civil Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal, victorf@ua.pt

Rodrigues Hugo - RISCO, Departamento de Engenharia Civil Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal, hrodrigues@ua.pt

Abstract: This paper presents an implementation of a structural health monitoring system on a UNESCO World Heritage site, as it is the Monastery of Batalha. The system is constituted by 4 strain and 1 temperature sensor, based on Fibre Bragg gratings (FBG). The main goal of the implementation of these sensors is to gather data that will give knowledge regarding the structural behaviour of the joins in the ceiling of the refectory. At the end of the paper is presented the ongoing work, by briefly introducing the existing monitoring network expansion to other monastery spaces that are presenting signs of structural movements.

Keywords: Structural health monitoring, Optic fibre, Bragg gratings, Building Heritage

1. Introduction

The concept of Structural Health Monitoring (SHM) is increasingly used in built heritage once it allows to monitor the dynamic and static responses of these structures and to detect anomalies in them [1], [2]. In this context, the use of fibre optic sensors has proven to be a technology that allows the remote monitoring of structures with high precision and in a minimally evasive way [3]. Additionally to being immune to electromagnetic interferences, FBGs sensors enable to present several sensors with a single network for strain and/or temperature monitoring, and to have great flexibility, which is an advantage in built heritage[4]–[6]. The goal of this work is to study the movements of a part of the Monastery of Batalha, a UNESCO World Heritage site, through the installation of fibre optic sensors to monitor joins in the celling of the refectory.

2. Implementation of a prototype SHM system

The idea of implementing a SHM system in the Monastery was driven by the need to understand the cause of joins movement in the Monastery's refectory. The first step contemplated the geometry survey of the cracked elements. Through the analyse of the joins, it was defined that the SHM network would be constituted by 1 temperature sensor and 4

strain sensors, located where the most important deformation was found. Trough the difference between the wavelength shifts of the displacement sensor and the temperature sensor, it's possible to overcome the strain-temperature cross sensitivity and to calculate displacements [1].

Through the results analyse of the data collected by the monitoring system, it was possible to visualize displacements, what lead us to the conclusion that the joins in the celling are suffering from movements.

Figure 1. Monastery of Batalha (left); Sensors implementation (center); Monitoring results (right)

3. Ongoing work

Works are being done in order to extend the SHM network of the Monastery, namely to the church walls, where can be observed serval cracks. For that purpose, 2 temperature sensors and 6 strain sensors were developed and are in process of installation. Through the pathologies survey, it was possible to detect that the King João cloister suffered some structural movements after the roof system replacement, and, for that reason, an extension of the network is being studied for this space.

References

[1] H. F. Lima *et al.*, "Structural health monitoring of the church of santa casa da misericórdia of Aveiro using FBG sensors," *IEEE Sensors Journal*, vol. 8, no. 7, pp. 1236–1242, Jul. 2008, doi: 10.1109/JSEN.2008.926177.

[2] T. Siwowski, M. Rajchel, T. Howiacki, R. Sieńko, and Ł. Bednarski, "Distributed fibre optic sensors in FRP composite bridge monitoring: Validation through proof load tests," *Engineering Structures*, vol. 246, Nov. 2021, doi: 10.1016/j.engstruct.2021.113057.

[3] C. Rodrigues, F. Cavadas, C. Félix, and J. Figueiras, "FBG based strain monitoring in the rehabilitation of a centenary metallic bridge," *Engineering Structures*, vol. 44, pp. 281–290, Nov. 2012, doi: 10.1016/j.engstruct.2012.05.040.

[4] E. Verstrynge, K. de Wilder, A. Drougkas, E. Voet, K. van Balen, and M. Wevers, "Crack monitoring in historical masonry with distributed strain and acoustic emission sensing techniques," *Construction and Building Materials*, vol. 162, pp. 898–907, Feb. 2018, doi: 10.1016/j.conbuildmat.2018.01.103.

[5] B. J. A. Costa and J. A. Figueiras, "Fiber optic based monitoring system applied to a centenary metallic arch bridge: Design and installation," *Engineering Structures*, vol. 44, pp. 271–280, Nov. 2012, doi: 10.1016/j.engstruct.2012.06.005.

[6] F. Tang, G. Zhou, H. N. Li, and E. Verstrynge, "A review on fiber optic sensors for rebar corrosion monitoring in RC structures," *Construction and Building Materials*, vol. 313. Elsevier Ltd, Dec. 27, 2021. doi: 10.1016/j.conbuildmat.2021.125578.

Physical prototyping of digital twins for the documentation, protection and dissemination of Heritage.

Pérez Sendín, María - Universidad de Extremadura, Cáceres, Spain, mperezppf@alumnos.unex.es

Cruz Franco, Pablo Alejandro– Universidad de Extremadura, Cáceres, Spain, pablocruzfranco@unex.es

Gordillo Guerrero, Antonio– Universidad de Extremadura, Cáceres, Spain, anto@unex.es

Abstract: The aim of this work is to present the results obtained in the field of the elaboration of physical twins (models) from digital twins of architectural heritage. These digital twins have been obtained using the new technologies of photogrammetry (SfM), terrestrial laser scanner (TLS) or a combination of both techniques.

As a final result will be high-resolution physical models (50 microns-100 microns) that create new ways of disseminating and protecting heritage. These new models open up a multitude of possibilities: documentation, teaching, tourism, dissemination and even a new way of understanding universal accessibility by being able to produce typhlological models with these new technologies.

Keywords: heritage, digital twins, physical prototypes, resin, 3D print, digital survey.

1. Introduction

The purpose of this communication is to show the workflow developed to obtain physical prototypes from digital twins obtained by photogrammetry, Terrestrial Laser Scanner (TLS) or both methods.

Photopolymer resin and SLA (selective exposure to light by laser) laser technology have been used to obtain the physical models.

The project has been developed in the Smart Open Lab. It is a FabLab hosted at the University of Extremadura. It is an open production space that has supported this project with tools, machines and knowledge of the community that composes it.

This workflow has been carried out in the city of Cáceres, which is a UNESCO's World Heritage Site, specifically, it has been proposed on several parts of the Almohad Wall . The Wall has a perimeter of approximately 1174 m and a surface of 8.2 ha.

2. Background and Related Works

Nowadays, the way of understanding reality in our society is in constant evolution given the ease of access to the digital tools currently available to us, in addition, the use of new technologies has increased given the situation that COVID-19 has generated, producing a great change in the way we relate to each other and to the heritage that surrounds us. The need arises to bring heritage closer to any part of the world in the simplest possible way, the need for digital twins has begun to be relevant and, going a little further, by combining digital twins with the most avant-garde technologies related to 3D printing, we obtain physical

prototypes that allow us to get to know cultural and architectural heritage in a different and more economical way.

3. Materials and Methods

3.1 Obtain the digital twin

Work has been carried out by combining point clouds obtained by SfM (with images acquired from UAVs) and clouds obtained by TLS digital instruments, the result is a parametric three-dimensional model. It is a high quality model of the city wall and can be said to have been obtained using a low-cost and accurate "smart workflow".

3.2 Obtain the physical prototype

The processing of this "twin" has been carried out using Rhinoceros 3d software. The three-dimensional mesh was assembled and refined using this programme. We have focused on the surroundings of the wall and we have modelled the terraced houses in a simplified way. Once this first modelling phase was completed, we proceeded to divide it into fragments according to the physical limits imposed by the printer model we used (form2), which measures 145 × 145 × 175 mm.

A versatile workflow is generated that allows the information obtained from photogrammetry (digital twins) to be converted into high-resolution physical twins.

Figure 1. Different examples of physical models of architecture obtained using different 3D printing and laser cutting systems. TAD3 Lab. Collaborative work between the Universidad de las Americas de Puebla and the Universidad de Extremadura

4. Conclusions

- Firstly, as a society we have an obligation to digitize the world we live in to preserve it as a digital twin for future generations: database of the present.
- The proposed methodology allows us to increase our capacity to disseminate, protect and conserve our heritage. Digital borders are transposed and we obtain prototypes that can be distributed in open source to promote knowledge regardless of location, physical or economic conditions.
- On the other hand these proposals represent a revolution at the educational level, our students can have in their hands replicas of the monuments with a millimetric quality.
- On the other side, these physical prototypes are a tool that opens the doors to the aforementioned universal accessibility through tiflological models of our heritage.

Integration of 3D modelling with photogrammetry applied on historical images for cultural heritage

Francesca Condorelli - Free University of Bozen, Bozen, Italy, francesca.condorelli@unibz.it

Sara Morena - University of Palermo, Palermo, Italy, sara.morena@unipa.it

Abstract: The recovery of past architecture through 3D modelling is an important challenge today to the preservation of heritage. Decisive support for the interpretation of architecture can certainly come from historical images and old photographs that fix a portion of space at a specific time, keeping it unchanged over time. This acquisition is decisive for the study of architectures of the past that can be reinterpreted and studied. An additional advantage is when these period images can be processed through SfM procedures and, the results obtained, used as support for 3D modeling of buildings that no longer exist. The work shows an interesting pipeline applied to the Caltanissetta Central Station and the possibility of "recovering," even if virtually, a phase of its architectural evolution through the integration of photogrammetry from historical images and 3D modelling. The case study is an opportunity to analyze the procedure still under development, as well as to identify the main difficulties encountered in this process and possible future developments.

Keywords: Rediscovery, 3D Model, Photos, Railway station, Sicily

1. Introduction and Case Study

During history, cities have undergone changes dictated by needs or catastrophes that inevitably make changes to the existing buildings, losing the evolution of structures and traces of city memory. Analysis of iconographic sources has often been useful in interpreting buildings, especially in finding information before the advent of photography. The latter, in fact, stands as one of the most useful tools for knowing the past. Hence, historical images represent a great potential because they contain essential information for deciphering the buildings. Nowaday, in addition, thanks to continuous technology evolution, they can also be processed with a photogrammetry process able to extract metric information that can be used for restoration and virtual reconstruction of destroyed or altered objects. The metric information that can be extracted from the photogrammetric model, in fact, is fundamental to the process of modelling and virtual reconstruction of the building. The modelling represents an important moment to understand the building, its characteristics and composition [1]. An additional advantage of this process of representation, especially of nonexisting heritage, is the possibility of restoring, albeit virtually, a historical phase.

This paper aims to integrate the 3D modelling with the photogrammetry from historical images of the Caltanissetta Central Station in Sicily, particularly of an intermedy phase of the station that does not exist today, to rediscover part of the evolution that the architecture has undergone over time.

2. Metodology and results

Commercial software cannot process historical images that present the problems outlined above. This is because it does not allow the algorithms underlying the processing to be customised, generating problems that lead to the failure of image alignment. for this reason,

open source software was used for data processing in this research, in particular COLMAP [2] open-source Structure-from-Motion and Multi-View Stereo (MVS) algorithm implementation, developed by ETH of Zurich (https://github.com/colmap/colmap, 2022). Generally from photogrammetric processing of historical images a sparse or low density point cloud is obtained. In some cases, the number and quality of photos was not sufficient to orient enough points to obtain a point cloud. For this reason, the proposed workflow aims to extract the coordinates of specific feature points in order to use them as a metric basis for the 3D modelling phase.

The proposed workflow is divided into two main phases. The first one concerns the extraction of specific feature points during the SfM pipeline introducing a manual step in the automatic implementation [3]. The second phase is the 3D modelling phase starting from specific coordinates extracted from the historical images and through modeling with Non-Uniform Rational Basis-Splines (NURBS).

3. Conclusions and future works

The research showed the potential of integrating photogrammetry from historical images with 3D modeling and the possibility of "survey" buildings that, due to various vicissitudes, have been modified over time. Specifically, based on metric references detected on the current state of the building and based on correspondences between old and new buildings, it was possible to scale the sparce cloud generated by the SfM process and subsequently employ it as the basis for modeling.

The results of this study, although still in the development stage, are very encouraging. The results presented in this paper show that the presented automatic workflow can be effective even under critical conditions. This evaluation is interesting because it shows how available historical material can be used in the event of heritage destruction by guaranteeing some reliability of 3D reconstruction from historical images, taking into account all the limitations inherent in primary data. The proposed workflow also has the great advantage of being replicable on other case studies, for example to reconstruct heritage destroyed by war or which has undergone major alterations. Future research will explore new ways to integrate recent data such as contemporary images with historical ones to improve the 3D reconstruction process.

References

[1] Avella F. Un'opera giovanile di Giuseppe Damiani Almeyda: il caffè del 1859. Dal disegno d'archivio alla visualizzazione digitale. In Le vie dei mercanti. S.A.V.E. Heritage safeguard of architectural, visual, environmental heritage. Napoli: La Scuola di Pitagora editrice, 2011

[2] Schönberger JL, Frahm, JM. Structure-from-motion revisited. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2016, Vol. 2016, 2016; 4104-4113.

[3] Condorelli F, Higuchi R, Nasu S, Rinaudo F, Sugawara H. Improving performance of feature extraction in SfM algorithms for 3D sparse point cloud. International Archives Of The Photogrammetry, Remote Sensing And Spatial Information Sciences, XLII-2/W17, 2019; 101–106.

LabSAMPA – Laboratory for documentation of historical architecture in São Paulo: An experience of didactic cooperation between the Faculdade de Arquitetura e Urbanismo da Universidade de São Paulo and the Dipartimento di Architettura dell'Università degli Studi di Firenze, using Laser Scanner 3 D technology and photogrammetry.

Stefano Bertocci - DIDA/UniFI, Firenze, Italia, e-mail: stefano.bertocci@unifi.it

Regina Helena Vieira Santos - FAU/USP, São Paulo, Brasil, e-mail: rhvs@alumni.usp.br

Luciano Migliaccio - FAU/USP, São Paulo, Brasil, e-mail: migliac@usp.br

Beatriz Piccolotto Bueno - FAU/USP, São Paulo, Brasil, e-mail: beatrizbueno@usp.br

Extended Abstract

The scientific cooperation initiative "Labsampa – Laboratory for Documentation of Historical Architecture in São Paulo" originated in 2017 from the internship held at the Dipartimento di Architettura dell'Università degli Studi di Firenze by Dr. Regina Helena Vieira Santos, during her doctoral research, supervised by prof. Luciano Migliaccio, at the Postgraduate Program of the Faculdade de Arquitetura e Urbanismo da Universidade de São Paulo. The research included a stage in Florence, under the direction of professor Silvio Van Riel, and the collaboration of professor Stefano Bertocci. Some Italian undergraduate students and researchers were interested in carrying out the 3D digital scanning of a section of Avenida São João involved in the enlargement carried out during the first two decades of the 20th century. In this context, the Edifício Baraúna was selected, designed by the Portuguese engineer Ricardo Severo. It stands out for the novelty of the constructive solutions in relation to the average buildings carried out in São Paulo at the time, and the adoption of a neocolonial decorative repertoire in the facades. The survey was carried out in September 2017, in the format of a free workshop, by an Italian team with the participation of students enrolled in the Undergraduate and Graduate Courses at FAU USP. The positive results of the workshop activities with a duration of 100 hours/class induced to involve undergraduate students from FAU USP, to introduce the methods of digital survey with 3D technology adopted by the Florentine team within the scope of the training offer provided by the Brazilian faculty.

Since the second semester of 2018, the optional topic AUH 237 *Urbanização e Urbanismo no Brasil*, in the undergraduate course of the FAU USP, has started to include a practical cooperation activity between the Brazilian school and the *Dipartimento di Architettura dell'Università di Firenze*. Since 2020, this activity forms part of a new optional topic: AUH 335 *Labsampa: Laboratório para a documentação histórica da arquitetura in São Paulo*. The objective of the discipline was to combine fieldwork and the theoretical-methodological dimension of the survey activity, to train students in the use of 3D laser scanner technology aimed at documentation for historical research, preservation and restoration of architecture.

Focusing the area of São Paulo downtown, the discipline presents and discusses theories and methodologies of documentation for the study of the history of urbanization and architecture

in its relations with archeology and material culture. The field experience in the historical center of São Paulo helped to deepen students' understanding of the evolution of the urban environment and the fundamental function of historical records for the protection of cultural heritage. The program included intensive field activities during a week. In this period, the examination of a selected building was carried out, through computerized processing of digital survey data combined with those of the manual metric survey and of photography and photogrammetry. For the representation of the façades, photogrammetry was performed using the Photo-Scan software, which allows the survey of the three-dimensional elements. For the inaccessible parts of the façades, a DJI Spark drone was used. Finally, the model obtained from the point cloud produced by 3D laser scanning was superimposed on the data, in order to create a final drawing capable of representing the whole of the data.

The results obtained with the application of these architectural survey and historical methodologies emphasize the educational potential of using technology, in communicating the significance of buildings as a document in the urban history. This led in 2020, to a cooperation agreement between the Faculdade de Arquitetura e Urbanismo, and the Museu da Cidade de São Paulo, an organ of the Secretaria da Cultura da Municipalidade de São Paulo.

The buildings chosen as case studies were selected not so much for their monumental importance, but above all, for their significance in the history of the urban development, techniques and construction industry. The following case studies will be presented: the Edifício Baraúna on the Avenida São João (2017 and 2020), the Sucursal do Grande Hotel in Largo do Café (2018), the Solar da Marquesa de Santos (2019 and 2021), headquarters of the Museum of the City of São Paulo, at Rua Roberto Simonsen. They show the variety of situations, contexts, interventions present in the history of countless buildings, many not yet considered in the action of cataloging and preserving by the public power.

This is certainly an important contribution to the modern professional training of future architects. In addition to this acquisition in the field of knowledge and training, the methodology begins to be applied concretely, with very promising results in graduate and in Postgraduate research.

Since this year, the cooperation project, in addition to the Florence Architecture Department, and the Museum of the City of São Paulo, will include another partner of great relevance, that is, the CITI (Center for Interdisciplinary and Interactive Technology Studies). The center stands out for its excellent research on the use of digital graphics in the field of threedimensional modeling and on cultural heritage digital cataloging procedures.

In addition, to the buildings in the downtown, digital survey of historical constructions from the colonial period on the coast of the State of São Paulo was executed, that is: the Ruins of the settlement known as the *Sítio do Abarebebê*, in the municipality of Peruíbe; and the architectural ensemble of the Church and Ruins of the Convent of Nossa Senhora da Conceição, and the Igreja Matriz de Santana, both in the municipality of Itanhaém.

Digital technology, through new forms of mediation and communication, can transform the university's relationship with the external public, allowing the synthesis of different types of information, helping to develop a new, more democratic, territorial management that could preserve the historical values and the cultural memory in the territorial planning.

Scan-to-BIM applied to heritage conservation: a case study of Aldeia do Fujaco

Sugiyama, Gabriel – Civil Engineering Department, University of Aveiro, Aveiro, Portugal, e-mail: gabrielts@ua.pt

Rodrigues, Hugo – RISCO, Civil Engineering Department University of Aveiro, Aveiro, Portugal, e-mail: hrodrigues@ua.pt

Rodrigues, Fernanda – RISCO, Civil Engineering Department, University of Aveiro, Aveiro, Portugal, e-mail: mfrodrigues@ua.pt

Abstract: Despite the development of the construction techniques throughout the latest decades and their associated advantages, the preservation of the built heritage depends, amongst other factors, on the knowledge perpetuation concerning the traditional construction techniques. In this regard, the Scan-to-BIM methodology and the use of HBIM models might be helpful in many ways, such as through the documentation of the as-built construction, serving as an instrument to administrators and authorities, and having information regarding the knowledge of the heritage asset's construction techniques. In the preservation field, the HBIM model can provide multiple useful tools, for instance, documentation, and multiple information about conservation or renovation works. Based on these topics, this work involved selecting two buildings in a small village with heritage interest to apply the Scan-to-BIM and HBIM modelling, to serve as study cases for demonstrating how to use them as traditional techniques preservation and live training.

Keywords: Scan-to-BIM, HBIM, Heritage Conservation, Traditional Construction Techniques

1. Introduction

The modern materials and construction techniques development led to traditional techniques and related materials to be increasingly put into disuse due especially to the fast and easier way of built that the most recent methods can provide, as well as the associated visual and comfort characteristics. Despite the benefits the technological advances can offer to the construction sector, the preservation of the built heritage depends on the perpetuation of knowledge involving the corresponding processes of construction and edification [1].

In this regard, it is of the utmost importance to document and disseminate content related to the theme, that should be available to the community and disposed of in a simplified and open access mode, to reach as many people as possible. The digital technologies, in respect of the range and intelligibility of use and access, have great potential to host the information, as well as serve as a tool for registering, learning and consulting. Even though BIM (Building Information Modeling) is still little explored regarding existing buildings [2], this work intends to explore the potential of the HBIM (Historic Building Information Modeling) model [3], obtained through the Scan-to-BIM process, in the preservation of the built heritage, specifically by aiding the perpetuation of the intergenerational knowledge involving the traditional construction techniques [1]. This is exemplified through two case-studies, each of them corresponding to a building in a small historic village in Portugal named Aldeia do Fujaco, in the municipality of São Pedro do Sul, in mainland Portugal.

The case-studies involve the obtaining of the digital data using photogrammetric methodology, the Scan-to-BIM process to obtain the HBIM model, as well as loading the

model with relevant data regarding the traditional techniques. Besides that, in one of the case studies there is a proposal of renovation, which considers the improvement of the conditions towards current comfort requirements, suited to the present-day needs, nevertheless respecting the authenticity and urban insertion of the study object, in historic and landscape terms.

2. Case-studies

The case-studies consist in two buildings located in a village named Aldeia do Fujaco, in the São Pedro do Sul municipality, in mainland Portugal. The buildings are characterized by their traditional and vernacular architecture, with schist stone masonry walls and slate roofs. Although they both had originally housing uses, one of them is currently in state of ruin, and has only its walls left.

The procedure of the study included surveying the buildings with a drone, specifically the DJI MAVIC MINI, to carry out the Scan-to-BIM process, which included a photogrammetry process to obtain point clouds. The point clouds were, then, inserted into a BIM software separately, which, for this study, was Autodesk Revit.

The work that followed was then to proceed with the modelling of the buildings over the point clouds in order to obtain the HBIM model and load it with the desired information, such as a guide to the constructive technique related to the walls. This could be done by using a feature named “Shared Parameters”. With this functionality, you can enter various types of information, from text to URLs, which can be associated with the family type of the building element, meaning that the information entered extends to all identical elements, or it can be associated with the instance, which leaves the information associated with only that selected element.

Regarding the building that is currently in state of ruin, it was also developed a renovation solution, so as to provide it with habitability once again, making use of sustainable and local materials. The solutions were tested and compared with the original building in terms of thermal and acoustic comfort.

3. Conclusions

This study reveals the possibility of using the HBIM models as means to encourage the perpetuation of knowledge regarding the tradicional construction techniques, which is a key factor in preservation of historic and vernacular built heritage. With the ideal digital tools they could easily be reached so as to make themselves accessible and intelligible. Another outcome is the possibility to renovate heritage buildings in a sustainable way, increasing the habitability and comfort to meet the nowadays needs, without decharacterizing and affecting the urban settlement or landscape.

References

[1] International Council on Monuments and Sites. (1999). Charter on the Built Vernacular Heritage.

[2] Volk, R., Stengel, J., & Schultmann, F. (2014). Building Information Modeling (BIM) for existing buildings—Literature review and future needs. Automation in Construction, Volume 38, March , 2014, Pages 109–127. https://doi.org/10.1016/j.autcon.2013.10.023

[3] Murphy, M., McGovern, E., & Pavia, S. (2009). Historic building information modelling (HBIM). Structural Survey, Volume 27, August 27, 2009, Pages 311–327. https://doi.org/10.1108/02630800910985108

3D digitalisation techniques for the HBIM modelling of an existing building. Application to the inventory of defects and the management of the maintenance of a facade

Carrasco César A., University of Cantabria, Santander, Spain, cesar.carrasco@unican.es

Sánchez-Espeso Javier M., University of Cantabria, Santander, Spain, javier.sanchez@unican.es

Lombillo Ignacio, University of Cantabria, Santander, Spain, ignacio.lombillo@unican.es

Abstract: Building Information Modelling (BIM) is a parametric solution that is rapidly becoming popular because it allows the 3D modelling of construction projects, facilitating the linking of all types of information in the digital model. Its implementation in the built heritage is known as HBIM, favouring the integral management of the building throughout its life cycle. The objective of this document is to suggest a methodology to generate an HBIM model of an existing building. This methodology is implemented to a real case and, subsequently, the generated model was used to several applications.

Keywords: BIM; HBIM; Photogrammetry; Laser scanning; Facility Management; CMMS

1. Introduction

HBIM allows optimising the necessary resources, achieving a better knowledge, protection, conservation and dissemination of heritage [1]. Photogrammetric and laser scanning techniques can be combined to obtain the data to generate the HBIM model. However, there are important limitations related to the lack of object libraries that represent the complex characteristics of historic building elements [2][3]. The resulting model is a tool with multiple applications, several of them associated with the monitoring of refurbishment works and the management of existing documentation.

2. Methodology and case study

Fig. 1 illustrates the methodology used, applied to the digitisation of the south facade of the Interfaculty building of the University of Cantabria. The capture of the data (Stage ①) was carried out using a combination of terrestrial architectural photogrammetry and laser scanning. In the data processing phase (Stage ②), the *Metashape Agisoft pro* software, version 1.8, was used for the photogrammetric model, and the *Leica Reality capture* software for processing the data obtained by laser scanning. The obtained point cloud was exported to *Autodesk Recap*, Fig. 2a. For the generation of the HBIM model (Stage ③) the 3D design tool *autodesk Revit 2019* was used, Fig. 2b. Finally, the resulting model was given various applications (Stage ④). A first use was to inventory the existing facade defects. Furthermore, from the perspective of HBIM 7D, the generated model was linked to *Revizto v4*, Fig. 3, a Computerized Maintenance Management System (CMMS). This software was configured to visualise the measurements, manage the maintenance of the facade and document the process of the refurbishment works.

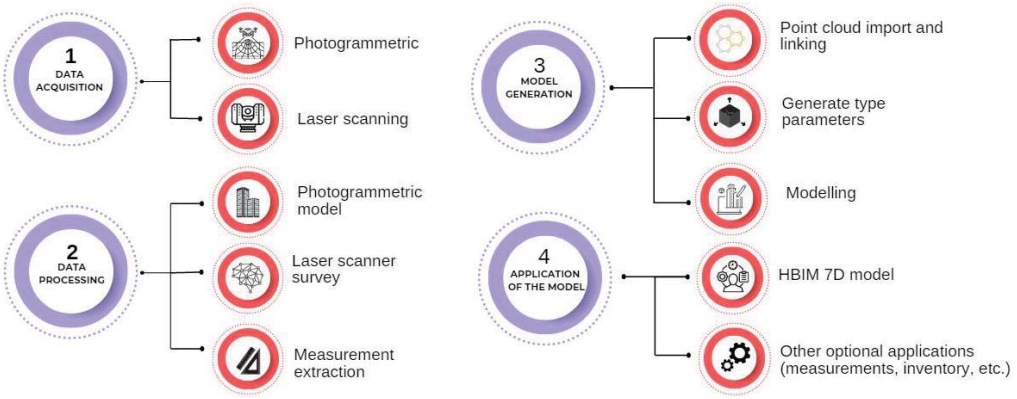
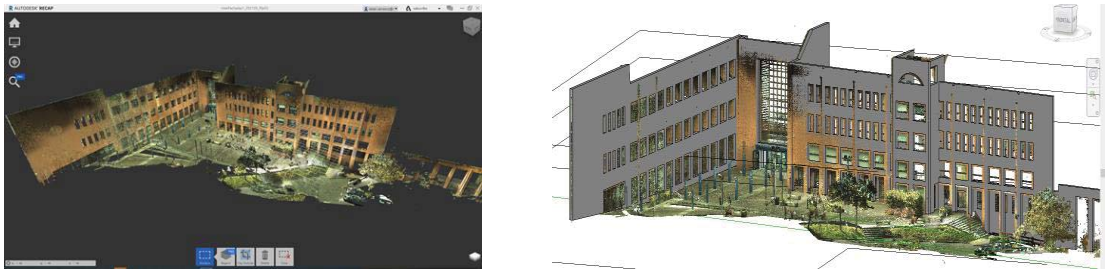


Fig. 1: methodology used in the research.



(a) (b)

Fig. 2: (a) Point cloud in *Autodesk Recap*; (b) View of the HBIM model with the integrated point cloud.

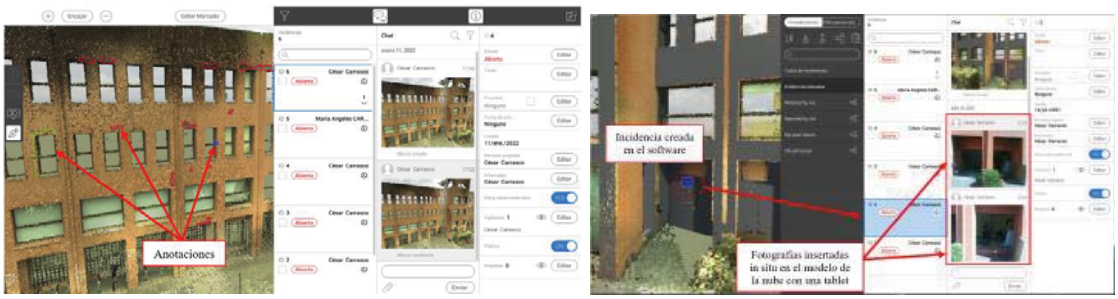


Fig. 3: Annotations and monitoring of works with *Revizto*.

3. Conclusions

This article presents a workflow for the 3D modelling of an existing building (HBIM). Photogrammetry, laser scanning, GNSS and classical topographical surveying tools have been combined. An HBIM model has been generated in Revit and linked to a 3D virtual management tool (CMMS *Revizto* v4 software). The resulting model was given various applications associated with data management within maintenance and refurbishment works.

4. References

[1] M. Castellano-Román and F. Pinto-Puerto, "Dimensions and Levels of Knowledge in Heritage Building Information Modelling, HBIM: The model of the Charterhouse of Jerez (Cádiz, Spain)", *Digit. Appl. Archaeol. Cult. Herit.*, vol. 14, Sep. 2019, doi: 10.1016/j.daach.2019.e00110.

[2] A. Mol, M. Cabaleiro, H. S. Sousa, and J. M. Branco, "HBIM for storing life-cycle data regarding decay and damage in existing timber structures", *Autom. Constr.*, vol. 117, Sep. 2020, doi: 10.1016/j.autcon.2020.103262.

[3] F. M. Hidalgo Sánchez, "Interoperabilidad entre SIG y BIM aplicada al patrimonio arquitectónico. Exploración de posibilidades mediante la realización de un modelo digitalizado de la Antigua Iglesia de Santa Lucía y posterior análisis", 2018, [Online]. Available: https://idus.us.es/handle/11441/79394.

Photogrammetry and 3D printing for conservation and disclosure of Cultural Heritage

Sara Gonizzi Barsanti – Università degli Studi della Campania Luigi Vanvitelli, Department of Engineering, via Roma 29, Aversa, Italy, sara.gonizzibarsanti@unicampania.it

Adriana Rossi - Università degli Studi della Campania Luigi Vanvitelli, Department of Engineering, via Roma 29, Aversa, Italy, adriana.rossi@unicampania.it

New technologies can help in documenting, preserving and disseminating cultural contexts. Although photogrammetry is a well-known technology for preserving cultural heritage, its combined use with 3D printing is worthwhile to simultaneously provide a digital twin for conservation and restoration purposes and for disclosure of Cultural Heritage. The possibility that 3D printing gives in the field of Cultural Heritage is wide and goes from the creation of small models for bookshops to scaled models for helping blind people to visualize sculptures or artistic artifacts through touch. They can also be valuable resources for all museum visitors allowing them to experience the monument or artefact. This paper presents the pipeline followed for the survey and the creation of high- and low-resolution models of the Tomb of Giulio II in Rome, providing on one hand the Superintendence with a 3D model useful for study and virtual restoration, and on the other blind people with an accurate 3D printed model for enjoying and understanding the monument. Each step of the process is explained highlighting the critical passages starting from the difficulties during the 3D survey to the creation of an accurate 3D reality-based model to the production of a valuable 3D printed model. There are two categories of optical 3D acquisition of objects and structures that can be used also in combination to reach the maximum accuracy and completeness of the survey [1-2]. 3D reality-based models through photogrammetry or laser scanning can be of great use for virtual restoration as basis for the physical one. Virtual restoration can help in the selection of the best procedure without damaging the real object. The opportunities that derive from 3D replicas are not limited to fruition only by blind people [8] but can be valuable resources for children and all museum visitors, given that touch is one of the approaches underlying the experimentation and understanding of outside world. For this project it was decided to use photogrammetry essentially because of the location of the monument and the fact that is constantly visited. The tomb of Giulio II (Fig.1a) is an architectural and sculptural project by Michelangelo Buonarroti which, in its final but reduced version, is in the basilica of San Pietro in Vincoli in Rome. Photogrammetry was chosen as a survey technique to overcome logistic difficulties. The software used for obtaining the model was Agisoft Metashape. The final model consisted of more that 30 mil triangles and about 800 images were used.

The second step for the creation of the 3D printed models was the post processing of the photogrammetric result. Once the model was rotated with the z axis up and scaled, it was exported to be processed in 3D Studio Max where it was segmented in different parts and then scaled accordingly to the requests of the customers with three different scaled models: one of the entire architectures (1:100), one of the statues of Moses (1:50) and one of his head (1:1). The 3D reality-based model was imported in Zbrush after being segmented in its main parts, to proceed with the closing of the holes on the rear part of the statues (Fig.5). This

passage was fundamental to obtain closed models needed for the 3D printer. The holes were closed and then the smoothing brush was used to level the surface and made the model flatter. It was decided to use this process because the part was not visible and so it was acceptable to have a lower accuracy, considering also the final goal of the project. The final part regarded the 3D printing of the three models. In accordance with the costumers, it was decided to use resin because the results would have been smoother and so the geometries and the details of the architecture was more readable by touching the surface. The most important part concerned the finish of the models, because it was mandatory to have a flat, smooth surface. Considering that the 3D printer used for this project had a smaller printing volume than the models to be printed, these had to be cut in pieces and then glued together. The lines interconnecting the different parts were then cancelled with the use of sandpaper and a polish to uniform the surface because it was important to produce an artefact that was an accurate copy of the original Heritage, granting the suitable surface for blind people to understand with the touch the details. Considering this, it is obvious that for example, roughness or connecting lines could give a wrong impression and so the wrong understanding of the geometry. The 3D printed models were placed in front of the monument (Fig.1b) accessible to everyone interested in touching it and experiencing the sensation.

References

[1] F. Fassi, C. Achille, L. Fregonese (2011) Surveying and modelling the Main Spire of Milan Cathedral using multiple data sources. The Photogrammetric Record, Vol.26, pp. 462–487

[3] G. Guidi, F. Remondino, M. Russo, F. Menna, A. Rizzi, S. Ercoli (2009) A Multi-Resolution methodology for the 3D modelling of large and complex archaeological areas. International Journal of Architectural Computing, Vol. 7(1), pp. 39-55

[8] C. Karbowski (2020) See3D: 3D Printing for People Who Are Blind. Journal of Science Education for Students with Disabilities. 23. 10.14448/jsesd.12.0006.

a

b

Figure 1. The Tomb of Giulio II (a); the printed models in front of the Tomb (b).

New life for on-site concrete demolition for a recovery project in Tres Cantos, Madrid: from residue to green finishing

Trinchese Giuseppe - Università degli Studi di Napoli Federico II, Naples, Italy,
Universidad Politécnica de Madrid, Madrid, Spain,
e-mail: giuseppe.trinchese@unina.it ; giuseppe.trinchese@upm.es

Verniero Alessia - Università degli Studi di Napoli Federico II, Naples, Italy,
Universidad Politécnica de Madrid, Madrid, Spain,
e-mail: a.verniero@studenti.unina.it ; a.verniero@alumnos.upm.es

García López de la Osa Gregorio - Universidad Politécnica de Madrid, Madrid, Spain,
e-mail: g.garcia.lopezosa@upm.es

Keywords: reuse, demolition, recycled aggregates, sustainability, circular economy.

Abstract

The research work concerns an analysis of the on-site reuse of demolished concrete for the realization of non-structural products, such as building finishes. The case study dealt with concerns a building in Tres Cantos, a city of the autonomous community of Madrid, Spain.
The aim is to trigger a process of reuse of the material of a building to be demolished, totally or partially, testing it in the laboratory and already planning a recycling plan of the materials on site.

To achieve this, the research method is developed in four phases.

The first is a preliminary phase that consists of a study on the subject of the reuse of materials, thus strengthening an updated state of the art, analyzing the techniques adopted so far and the underlying strands of thought.
Critically reading the studies on Roman masonry, the analysis of building materials over time, research on the techniques of realization of finishes, plaster, flooring, and interior and exterior cladding, and investigations into the storage of building site waste and its efficient use will help to raise awareness of recovery and lead to appropriate choices.

Reconstructed the historical analysis and developed the state of the art, we proceed with the second phase relating to the acquisition of data regarding the production and recycling of Construction and Demolition Wastes (also referred to as CDW) through an investigation, in our case, at European level, whose main source is the EUROSTAT database.

Then the third phase is developed, which consists of the development of future prospects and the search for innovative solutions in the field of recovery of materials: the theme of recycled aggregates resulting from demolition or collapse is introduced, their treatment process, the sectors that use them and the concept of CE marking, that is the certification required by current

legislation to be able to define the cessation of the state of rejection and the simultaneous promotion to product.
By establishing, for example, the "passport of the material", it will be possible to evaluate the material for its performance characteristics and not according to its origin.
The advantages and problems related to the use of recycled aggregates are analyzed, through the search for existing applications to be referred to, accompanied by actions aimed at promoting the development of the sector, such as regulatory and organizational adjustments, incentives, simplifications, and training of the operators involved.

The fourth and final phase consists of the development of a project that outlines a possible way to go both to reduce the material to be demolished, through a reasoned and partial demolition, and for the in situ reuse of the demolished concrete, that is, in the specific case, through the production of building finishes.

The concrete demolished by the site under study (Tres Cantos - Madrid) is distinguished according to the different grain sizes:

- inerts with a grain size greater than 4 mm prepared for the construction of a draining floor on site, ensuring the return of water to the subsoil to replenish the aquifers;
- inerts of particle size of less than 4 mm, that is to say, 2-1-0,50-0,250 mm tested in the laboratory by tests of resistance (bending and compression) and water absorption, in order to realize on-site non-drivable external pavements;
- inerts of particle size of less than 4 mm, that is to say 0,125 mm and 0,063 mm excluded from testing because in the form of powder, but potential research can be carried out with these in the field of geo-polymerization.

In line with the objectives of the circular economy, the decision to use only screening, to determine the particle size of aggregates, should be read, without therefore resorting to machines that grind inerts to avoid energy expenditure and work directly with the material found on site.

In this research work, therefore, an alternative proposal is advanced to the total demolition of the building and, depending on the future use and state of conservation, the possibility of partial demolition is pursued, recovering some environments and, at the same time, preparing on-site interventions aimed at the recovery of demolished concrete.

This logic, proposed for each yard, would allow the introduction of the concept of "intelligent demolition", that is, an operation that promotes environmental protection, the eco-compatibility of materials in the construction sector, innovation in new recycling experiences, the creation of new reuse solutions and the transformation of waste through the development of the circular economy.

Monitoring the thermal comfort of a multifamily housing building from the Modern Movement period

Silva, Ivo – EAAD, Lab2PT, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal, e-mail: ivo_1284@hotmail.com

Maia, Carlos - EAAD, Lab2PT, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal, e-mail: cmaia@eaad.uminho.pt

Mendonça, Paulo - EAAD, Lab2PT, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal, e-mail: mendonca@eaad.uminho.pt

Abstract: This paper presents the thermal comfort monitoring of a heritage multifamily housing building from the Modern Movement period. The objective of this analysis is related to the need of defining appropriate strategies for (re)use, maintenance and possible intervention in heritage buildings of this period in order to fulfil contemporary expectations of thermal comfort, but still maintaining its identity. In situ measurements were carried out to verify the passive thermal response of this now unoccupied building designed by Architects Armenio Losa and Cassiano Barbosa. Good solar orientation, wood window frames incorporating ventilation and shading systems, insulation and water-proofing were part of the construction lexicon of these architects that were applied in this building. From the analysis carried out to the original design, it can be concluded that thermal passive comfort was already intrinsic and appeared as a central concern. Our expectation is that, minimum adjustments and repairs in the already integrated systems, combined with occupancy, can be enough to fulfil contemporary expectations in users' thermal comfort, considering the Adaptive Comfort Model. If future intervention reveals necessary, we believe that this study can contribute to adequately decide the most appropriate strategies: if functional refurbishment replacement of elements or simple repair.

Keywords: Thermal Comfort; Modern Movement; Heritage Intervention; Adaptation; Functional analysis

1. Introduction

The building here analyzed was built between 1951 and 1954 in Porto, Portugal, and was designed by Arménio Losa and Cassiano Barbosa, two architects that had a leading role in the implementation of the Modern Movement architecture in Portugal. This building, known as "Edifício Lino", was evaluated in terms of its comfort parameters [1].

2. Thermal Comfort Measurements

With the measurements carried out in situ we expected to verify how the mechanisms designed in order to respond to the demand for comfort, imposed by the architects of the Edifício Lino correspond to contemporary expectations of thermal comfort and which changes will have to be implemented [1]. The experimental evaluation of the hygrothermal performance of the building requires monitoring during the cooling and heating season in order to obtain key summer and winter data. The Adaptive Thermal Comfort model described in EN 15251:2007 and other studies [2] and the comfort conditions defined by EN 16798:2019 were considered for this analysis. Measurements of temperature and relative humidity were performed in situ by placing portable temperature and humidity monitoring datalogger

equipments (Extech 42270), two indoor and one outdoor. For the measurements, the portable dataloggers were installed in two different apartments located in the same floor of the building, one with all blinds closed (Scenario 1) and the other with all blinds open (Scenario 2) (shown in Figure 7). During the tests performed there were no changes in the opening of the glazed windows and the apartments were without any occupancy.

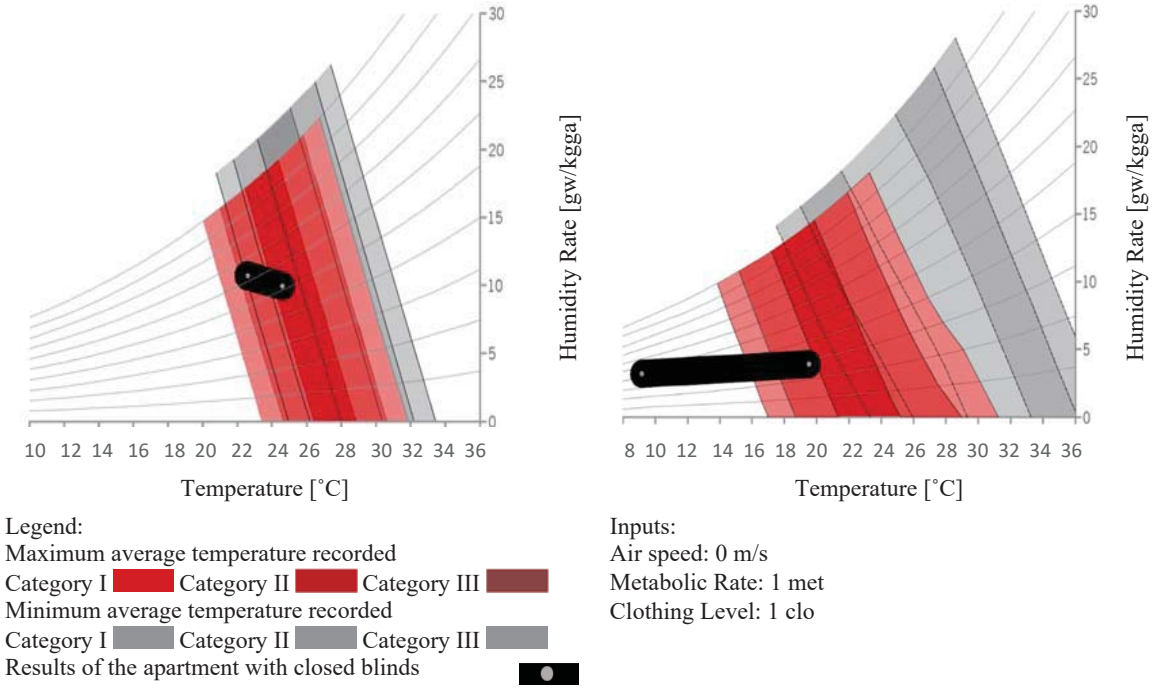


Figure 7. Evaluation of the comfort in the apartment with the blinds open (right), from 05 to 12 January.

3. Conclusions

Despite the poor condition of the construction, abandoned and unused for decades, this research proved that we can extend the life of the building and almost match current comfort standards. The proof of this are the results obtained by the "in situ" measurements. The operative temperatures measured allow the building to be between categories I and II of the adaptive comfort model in cooling season. During the heating season the oscillation was significantly higher, 11 ºC, complying to Category II during part of the day, but not complying during the night time.

Acknowledgements

This work has support of Project Lab2PT - Landscapes, Heritage and Territory laboratory - UIDB/04509/2020 through FCT - Fundação para a Ciência e a Tecnologia.

References

[1] Silva, I. Analysis of the Comfort Indexes of Edifício Lino from Architects Arménio Losa and Cassiano Barbosa: Basis for an intervention. Master Thesis in Architecture on the University of Minho, Guimarães 2021 (in portuguese)

[2] Nicol J., Humphreys M. Adaptive thermal comfort and sustainable thermal standards for buildings Energy Build, 34 (6) (2002), pp. 563-572, 10.1016/S0378-7788(02)00006-3

Remote Sensing and architectural survey for the restoration of Al Raabiya mosque, Mosul (Iraq).

Bertocci Stefano - DIDA Dipartimento di Architettura - Università degli Studi di Firenze, Florence, Italy, stefano.bertocci@unifi.it

Bigongiari Matteo - DIDA Dipartimento di Architettura - Università degli Studi di Firenze, Florence, Italy, matteo.bigongiari@unifi.it

Becherini Pietro - DIDA Dipartimento di Architettura - Università degli Studi di Firenze, Florence, Italy, pietro.becherini@unifi.it

Abstract: Il testo presenta il progetto di rilievo e documentazione digitale della Moschea di Al-Raabiya a Mosul (Iraq) svolto dal Dida che ha seguito le fasi di rilievo remote sensing, laser scanner e fotogrammetrico, e di restituzione grafica degli elaborati bidimensionali.

Keywords: Mosul, Remote Sensing, Digital Survey, Drone, Restoration

1. Introduzione

Lo scopo di questo paper è presentare il progetto di documentazione e rilievo architettonico digitale della moschea Al-Raabiya di Mosul (Iraq) iniziato nel Giugno 2021; il progetto è stato progettato e realizzato in collaborazione con un gruppo di lavoro, rappresentato e coordinato dall'associazione Archimedia Trust Onlus, sulla base di una proposta di finanziamento che ha ottenuto buona valutazione e disponibilità economica dalla fondazione Aliph, che principalmente si occupa di supportare progetti a base culturale su territori e patrimoni che hanno subito eventi legati alla guerra. Nello specifico il progetto proposto si prefigge l'obiettivo di dare nuovamente un punto di riferimento sociale alla comunità del centro storico di Mosul con la riqualificazione del complesso della Moschea di Al-Raabiya; le operazioni di documentazione sono quindi state finalizzate all'acquisizione delle conoscenze morfologiche, quantitative e qualitative dei fabbricati, che potesse supportare scientificamente la redazione di un progetto di recupero e restauro del complesso religioso, che nel 2017 ha subito ingenti danni, come la maggior parte del centro storico della città, a causa dei raid dovuti alla guerra per la liberazione della città dalle milizie del Daesh.

2. Il caso studio

La moschea Al-Raabiya è un complesso religioso del centro storico di Mosul, di modeste dimensioni rispetto alle moschee maggiori della città (Al Noori). Nel tempo il complesso è stato più volte ingrandito e restaurato pesantemente fino ad apparire oggi come uno spazio chiuso su sé stesso, in angolo ad un isolato del centro storico, ben identificato dal minareto

in acciaio, non certo dalle pareti perimetrali spoglie rivestite con pietra locale, senza nessuna apertura se non il portale di ingresso, di piccola dimensione.

2.1. Metodologie

Il rilievo laser scanner della moschea Al-Raabiya è stato progettato per descrivere tutte le superfici dell'architettura con una definizione che consentisse la resa grafica dei disegni necessari alla redazione delle indagini diagnostiche sia per verificare la presenza di degradi, sia per valutare le meccaniche dei dissesti. Il rilievo fotogrammetrico 3d è stato effettuato con lo scopo principale di produrre immagini rettificate delle superfici architettoniche da utilizzare per le indagini diagnostiche e per integrare quelle porzioni del modello difficilmente misurabili, sia per la complessità nel portarvi il laser scanner sia per la presenza a terra di cumuli di macerie che non garantivano la sicurezza del rilevatore; per ottenere questo risultato è stato utile combinare le acquisizioni realizzate da terra con camera fotografica con le acquisizioni ottenute dai voli con droni ed integrare successivamente i modelli ottenuti.

3. Creazione di un database digitale al fine della catalogazione, studio e analisi.

A seguito della campagna di rilievo, la fase di post produzione dei dati raccolti *in situ* è iniziata con la creazione, per la gestione e analisi, di un database contenente tutto il materiale prima acquisito e poi registrato, tramite laser scanner, reflex e drone. Il fine della catalogazione di suddetto materiale ha la valenza di semplificare il lavoro di controllo, anche a distanza di tempo, quindi di interrogazione e creazione di output 2D/3D che serviranno allo studio, confronto e analisi del presente caso studio

4. Conclusions

Il rilievo tridimensionale della moschea, come descritto ampiamente nel paragrafo precedente, ha così prodotto un corpus di documenti sulla morfologia dell'edificio e sullo stato di conservazione superficiale e strutturale dei suoi paramenti murari utili allo scopo della redazione di un progetto di riqualificazione e restauro dell'area. Sulla base delle indicazioni fornite dal rilievo infatti il gruppo di lavoro capitanato da Archimedia Trust, ha avuto la possibilità di valutare con precisione interventi ed incidenza in termine di volumi e costi.

Acknowledgements

Il progetto di rilievo della Moschea di Al Raabiya, di cui è responsabile scientifico Stefano Bertocci, è stato affrontato durante una missione di rilievo svolta a Giugno 2021, coordinato da Matteo Bigongiari. Si ringrazia Archimedia Trust per la collaborazione al progetto di documentazione e Matteo Sordini di ATM srl, per il progetto di rilievo fotogrammetrico svolto a Mosul.

Material re-use in 3D printed building components

Stelladriana Volpe - Dipartimento di Ingegneria Civile, Ambientale, del Territorio, Edile e di Chimica, Politecnico di Bari, Bari 70125, Italy, e-mail: stelladriana.volpe@poliba.it

Sangiorgio Valentino*- Department of Engineering and Geology, University G. D'Annunzio of Chieti-Pescara, Pescara, Italy, e-mail: valentino.sangiorgio@unich.it

Andrea Petrella - Dipartimento di Ingegneria Civile, Ambientale, del Territorio, Edile e di Chimica, Politecnico di Bari, Bari 70125, Italy, e-mail: andrea.petrella@poliba.it

Michele Notarnicola - Dipartimento di Ingegneria Civile, Ambientale, del Territorio, Edile e di Chimica, Politecnico di Bari, Bari 70125, Italy, e-mail: michele.notarnicola@poliba.it

Humberto Varum - CONSTRUCT-LESE - Faculdade de Engenharia da Universidade do Porto, Porto, Portugal, e-mail: hvarum@fe.up.pt

Fiorito Francesco - Dipartimento di Ingegneria Civile, Ambientale, del Territorio, Edile e di Chimica, Politecnico di Bari, Bari 70125, Italy: e-mail: francesco.fiorito@poliba.it

Abstract: The advent of 3D printing with viscous materials in the building construction sector, opened up the possibility of exploiting reused materials in the printing process. Indeed, several investigations are proposing the conversion of different waste materials into 3D printing material. On the other hand, studies on the thermal performances of 3D printed building components exploiting reused and recycled materials are still missing in related literature. The current work proposes a methodological approach to design a building component with effective performance that can be 3D printed with reused material. The approach is based on three steps: i) *Reuse design*, i.e. definition of the processes to recover material; ii) *Parametric modelling, simulation and performance optimization* of the component; iii) *3D printing setting* to define an effective extrusion path. To show the potential of the method, the proposed approach is applied to a prefabricated 3D printed envelope exploiting a printable mortar including recycled glass and rubber and insulated by using glass fibres material. The result shows the possibility of designing customized geometries in order to optimize resource consumption and achieve the required performances by including recycled and reused material in the printing process.

Keywords: Material Reuse, 3D Construction Printing, Parametric Modelling, Thermal Performances, Building envelope

1. Introduction and Methodology

Resources consumption, waste production and energy demand of buildings and infrastructures is a critical issue that is becoming increasingly important in the scientific and technical world. At a global level, the research and development funds are directed toward responsible consumption and production to reduce waste generation through prevention, reduction, recycling and reuse within 2030 according to the Agenda 2030 [1]. In the last decade, the possibility of revolutionizing construction processes is offered from the advent of 3D concrete printing technology. In particular, additive manufacturing is able to achieve lower costs, reduce waste, and simplify the supply chain. Moreover, such a promising technology can be effectively used in combination with recycled materials for printable mixtures and the possible reuse of printed products [2]. The current work proposes a methodological approach to design an effective 3D printed building component including reused material in both the printing admixture ad the insulation layer exploiting three steps:

i) **Reuse design**, in which the intervention or demolition techniques for the recovery of materials are defined; ii) **Parametric modelling, simulation and performance optimization** of the building component (exploiting the reused material defined in the first phase) to achieve target thermal performances; iii) **3D printing setting** useful to improve the printability of the designed component by design the extrusion path.

The proposed approach is applied to design a prefabricated 3D printed envelope exploiting a mortar including recycled glass and rubber for the printable material and glass fibres for the insulation layer.

2. Application and Results

The case study concerns the application of the proposed methodology to a prefabricated 3D-printed building envelope. In the proposed application, the reused material is included in both the printing admixture ad the insulation layer. The printing admixture is a cementitious material consisting of magnesium potassium phosphate cement prepared by replacing sand with recycled rubber or glass. The thermal conductivity of the achieved potassium phosphate cement is investigated through the ISOMET 2104 device. Beyond, the printing material the performance of the use of recycled material is investigated also for the insulation layer, filled with glass fibres. As a result, the proposed FEM simulations demonstrate the potential of the 3D printing technology in combination with reused materials. Indeed, the proposed building component reaches effective thermal performances with thermal transmittance lower than 0.3 W/m²K with a thickness of the whole component of 40 cm. Figure 1 shows the parametric model on the left and the thermal simulation carried out with the FEM software "Ansys" to the right.

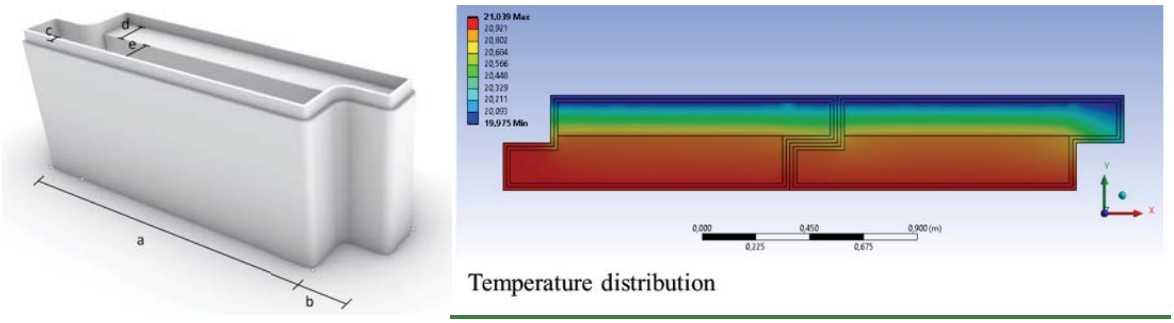


Figure 1. Model with parametrised values to the left: total length (a); half-lap joint length (b); boundary thickness(c); insulation thickness (d); air cavity (e). Thermal analysis to the left.

Future research will investigate both the combination of structural and thermal performances by automating the simulation and parameter adjustment process to obtain an effective topological optimization system for 3D printed components.

References

[1] W. Colglazier, "Sustainable development agenda: 2030," *Science (1979)*, vol. 349, no. 6252, pp. 1048–1050, Sep. 2015, doi: 10.1126/science.aad2333.

[2] T. Ding, J. Xiao, S. Zou, and Y. Wang, "Hardened properties of layered 3D printed concrete with recycled sand," *Cement and Concrete Composites*, vol. 113, p. 103724, 2020, doi: 10.1016/j.cemconcomp.2020.103724

Integrated approach based on UAV and NDT for assessment of Roman Concrete Groin Vaults

Santini Silvia – Architecture Dept, Roma Tre University, Rome, Italy, silvia.santini@uniroma3.it

Baggio Carlo – Architecture Dept, Roma Tre University, Rome, Italy, carlo.baggio@uniroma3.it

Sabbatini Valerio – Architecture Dept, Roma Tre University, Rome, Italy, valerio.sabbatini@uniroma3.it

Sebastiani Claudio – Architecture Dept, Roma Tre University, Rome, Italy, claudio.sebastiani@uniroma3.it

Keywords: Roman concrete; NDT; UAV; 3D modeling; FEM;

Extended abstract

In Roman Baths the Romans employed barrel and groin vaults of great dimensions, with maximum span more than 20 m. The study of the structural behavior of historical masonry vaults has never been a simple task, in particular for what concerns large Roman concrete vaults, due to geometrical and material complexity.

The technical literature usually deals with Roman masonry arches in bridges [1] [2] and aqueducts [3] but few papers have been dedicated to the structural analysis of large Roman concrete vaults as the case of the Basilica of Maxentius in Rome [4].

Several methods and computational tools are available for the assessment of the mechanical behavior of historical monuments with different level of complexity. A general overview of the state of the art of the approaches to structural analysis of historical masonry construction is in [5].

In the present paper, the authors deal with the study of the large groin vaults that form the structural system of the Roman thermal complexes. The object is the great Hall I of the Baths of Diocletian, the study starts from a similar research project on another portion of the complex (the Octagonal Hall) [6]

In general, the structural system of the main body of the baths can be easily understood. Larger central vaults are counteracted by secondary peripheral barrel and groin vaults of smaller dimensions which conduct the thrust to buttresses and foundations.

Nonetheless a number of questions arise: are the pillars alone able to resist the lateral thrust of the vaults or they are aided by the adjacent walls? What is the contribution of the parts to the stability of the system? The aim is to estimate the better approach to capture these and other aspects by studying the collapse behavior, under horizontal static action, of a corner cross vault of the Baths of Diocletian in Rome (Hall I).

Two methods of analysis are here used: non-linear incremental finite element and limit analysis. In both cases 3D models have been developed by means of UAV inspection, NDT measures and AVT monitoring. The construction of the overall 3D geometry has been here afforded with a specific pre-processing approach. Midas commercial program has been

employed for FEM analysis, assuming a constitutive law specifically developed for roman concrete. In limit analysis, masonry is discretized as a system of interacting rigid bodies in no-tension and frictional contact. The computational code consists in a linear approach which make use of a series of optimization packages via lower and upper bound techniques. In the paper, a strategy based on FEM analysis including discontinuities has been tested and results have been discussed and compared with the more classical approaches.

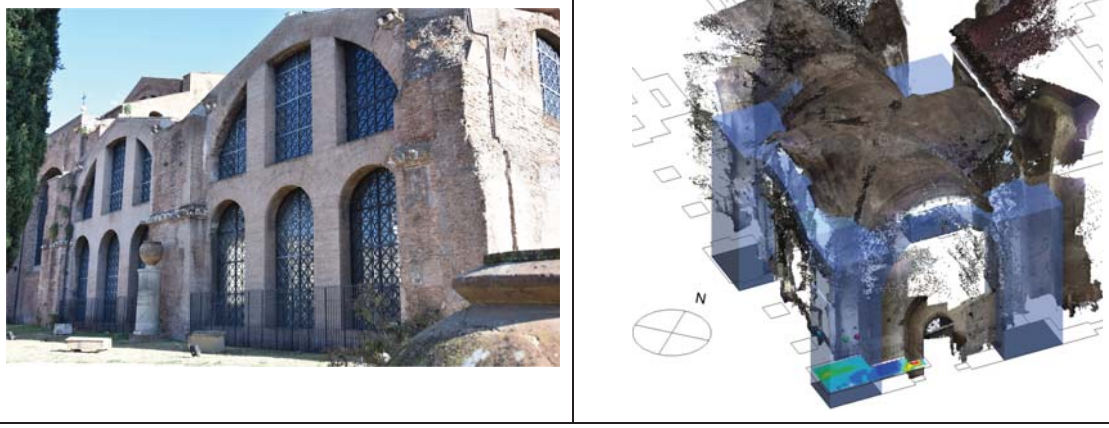


Figure 1. South view of the Great Hall and HBIM including point cloud, NDT and monitoring set up.

References

[1] Frunzio G, Monaco M, Gesualdo A. 3D FEM Analysis of a Roman Arch Bridge. Historical Constructions 2001; 8.

[2] Demirel IO, Aldemir A. A Simplified Approach for Seismic Performance Assessment of Dry-Joint Masonry Arch Bridges. Buildings 2021; 11, 313.

[3] Gonen S, Pulatsu B, Erdogmus E, Karaesmen E. Quasi-Static Nonlinear Seismic Assessment of a Fourth Century A.D. Roman Aqueduct in Istanbul, Turkey. Heritage 2021; 4:401-421.

[4] Pau A, Vestroni F. Vibration Assessment and Structural Monitoring of the Basilica of Maxentius in Rome. Mechanical Systems and Signal Processing 2013; 41:454-466.

[5] Roca P, Cervera M, Gariup G, Pelà L. Structural Analysis of Masonry Historical Constructions. Classical and Advanced Approaches. Arch Computational Methods Eng 2010; 17:299-325.

[6] Santini S, Baggio C, Sabbatini V, Sebastiani C. Setup Optimization of Experimental Measures on a Historical Building: The Octagonal Hall of the Diocletian Baths. Heritage 2021; 4:2205-2223.

Implementation of a wireless structural monitoring system and reverse engineering for numerical analysis purposes of a 16th century church

António Arêde – CONSTRUCT, Faculdade de Engenharia da Universidade do Porto, Porto, Portugal, e-mail: aarede@fe.up.pt

Susana Moreira – CONSTRUCT, Faculdade de Engenharia da Universidade do Porto, Porto, Portugal, e-mail: smtmoreira@fe.up.pt

Gabriel Ferreira - CONSTRUCT, Faculdade de Engenharia da Universidade do Porto, Porto, Portugal, e-mail: gabrielnaferreira@gmail.com

Clara Vale - Centro de Estudos de Arquitetura e Urbanismo da Faculdade de Arquitetura da Universidade do Porto, Porto, Portugal, e-mail: clara.vale@gmail.com

Hugo Pires - Centro de Estudos de Arquitetura e Urbanismo da Faculdade de Arquitetura da Universidade do Porto, Porto, Portugal, e-mail: miqhapaqnan@gmail.com

Luís Garcia - Centro de Estudos de Arquitetura e Urbanismo da Faculdade de Arquitetura da Universidade do Porto, Porto, Portugal, e-mail: luisph.garcia@gmail.com

Orlando Sousa - Direção Regional de Cultural do Norte, Porto, Portugal, osousa@culturanorte.gov.pt

Abstract: The conservation of built heritage structures requires constant attention to the progression of existing damage and the assessment of their probable structural response to different phenomena or interventions. Using state-of-the-art technologies such as quasi-real time monitoring and reverse engineering of LiDAR data, one can address these pressing concerns, besides generating baseline data for archival purposes or future applications. Quasi-real time structural monitoring allows the observation and measurement of the structure's response over time, registering different kinds of metrics, which enable early detection of damage or changes on the structure. When combined with structural analysis it allows for a better contextualization of physical metrics and the possibility of assessment of global response, even analysing parts of the structure not being monitored directly or that do not yet have visible damage. Within the scope of the SIAP project (Artificial Intelligence System for Risk Detection and Alerts on Heritage), the first steps are being taken towards the development of a quasi-real time risk detection and warning system, based on these tools. In the long term, through machine learning, the system will be able to issue alerts, based on the analysis of monitoring data and integration into numerical models. This paper focuses on the implementation of the structural monitoring system in the main church of Freixo-de-Espada-à-Cinta and the process of reverse engineering based on the three-dimensional model acquired with LiDAR technology. The monitoring system included the installation of wireless smart sensors in two areas of the church, where significant cracking is found, one next to the main façade (West) and the other next to the wall adjacent to the triumphal arch (north nave). In order to measure crack openings, rotations of the walls and the vibration of the structure, nine crackmeters, three tiltmeters (each one measuring the in-plane and out-of-plane rotations of the wall) and five accelerometers were installed in the church, respectively. Additionally, four temperature and humidity sensors were installed to study their influence on the results obtained from the other sensors. Through the reverse engineering process, it was possible to build a three-dimensional finite element model from the point cloud obtained by laser scanning the church. In this exploratory phase of the model, different conditions and scenarios are being studied, through preliminary linear and nonlinear phased analyses.

Keywords: LiDAR, monitoring, reverse engineering, 3D-structural modelling, heritage

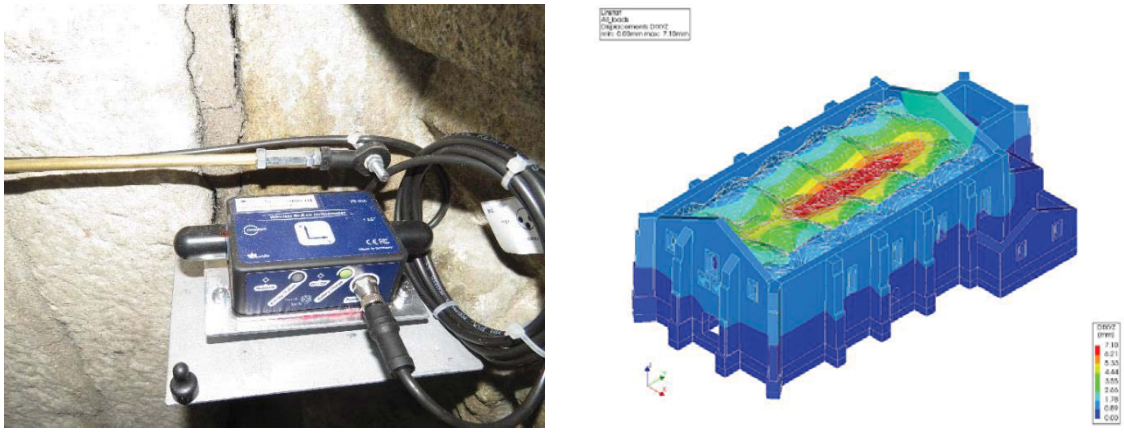
1. Introduction

Management and maintenance of several heritage assets is a complex task that mobilizes a great number of resources, human and otherwise. The project SIAP - Artificial Intelligence Warning and Alert System for Cultural Heritage was developed as an attempt to tackle these challenges and therefore, proposes a shift from a reactive to a proactive management system. This paper focuses on the Freixo-de-Espada-à-Cinta church, particularly on the works related with the implementation of the monitoring system and the preliminary structural analysis made with the finite element model created from the LiDAR acquisition.

2. Developments

The monitoring system was designed with the purpose of controlling the opening of existing cracks and formation of new ones on the walls and rib vault, as well as the inclination and vibration of the walls. It comprises a total of twenty-one sensors, among crackmeters, biaxial tiltmeters, triaxial accelerometers, and temperature and humidity sensors (see Figure 1a).

Through the process of reverse engineering, it was possible to construct a 3D finite element model, ready for numerical analysis, from the 3D point cloud data obtained with the LiDAR technology. Preliminary linear and nonlinear phased analyses were carried out (see Figure 1b).



(a) (b)

Figure 1 Tasks developed: (a) implementation of monitoring system (e.g., tiltmeter); (b) numerical model (e.g., total deformations).

3. Results and Conclusions

The wireless monitoring system is fully operational and enables a better control over the evolution of the existing damage. Data can be later integrated in the numerical model.

Transitioning from a cloud point model to a finite element model requires several steps, being the main output the CAD model that describes a simplified structural geometry. These operations are time consuming and will benefit from a semi-automated construction of CAD models from point clouds.

Preliminary results, point out that improved modelling the structural connections might be necessary and the removal of the annexes that had existed adjacent to the main façade probably had low impact on the church structural performance. Future developments should include material characterization through non-destructive testing and ambient vibration tests to calibrate the model material properties and levels of connectivity between elements.

Para lá do visível: densificação de informação prévia ao projecto de reabilitação

Visual and beyond: densifying data for rehabilitation projects

André Ferreira - Morph – Geociências, Coimbra, Portugal, e-mail: (andre.ferreira@morph.pt)

Nuno Ramos - Morph – Geociências, Coimbra, Portugal, e-mail: (nuno.ramos@morph.pt)

Miguel Almeida - Morph – Geociências, Coimbra, Portugal, e-mail: (miguel.almeida@morph.pt)

Sílvia Aires - Morph – Geociências, Coimbra, Portugal, e-mail: (silvia.aires@morph.pt)

A intervenção de reabilitação de edifícios antigos comporta problemas específicos decorrentes da complexidade dos próprios objectos a intervencionar, nomeadamente:

- A complexidade da sequência de construção, utilização, reparações e reformulações dos edifícios;
- As características dos materiais e técnicas de construção originalmente utilizados; e
- A avaliação do estado de conservação e funcionalidade de cada um dos elementos construtivos.

Acresce que a dimensão patrimonial das paisagens urbanas implica actualmente que a reabilitação preserve o valor intrínseco dos edifícios enquanto objectos históricos, repositório de informação acerca da evolução do espaço urbano envolvente, das comunidades que os habitaram/ocuparam e mesmo das ideias programáticas (políticas, sociais, económicas, culturais, …) da sociedade coeva.

A resposta a estes desafios (de eficácia e de relevância histórica) das intervenções de Engenharia/Arquitectura, que em Portugal assume a urgência de um parque urbano profundamente envelhecido e degradado, nomeadamente nos centros históricos, exige uma capacidade de investigação prévia sobre o objecto a intervencionar que ultrapassa em muito a prática corrente dos actuais projectos de reabilitação.

O arsenal tecnológico de que hoje dispomos permite actualmente responder às questões críticas, incluindo:

- Parametrização mecânica da estrutura geológica de suporte;
- Caracterização e mapeamento de materiais de construção;
- Identificação de elementos activos de suporte, incluído o dimensionamento de elementos em betão armado ou outros materiais de construção;
- Mapeamento de infra-estruturas enterradas e embutidas nas paredes;
- Determinação do faseamento construtivo e obras de manutenção/ reformulação; e
- Detecção de patologias degenerativas e indícios de funcionamento deficiente.

Na prática, estes estudos prévios combinam ensaios não-intrusivos (por inspecção geofísica), intrusivos (geotécnicos e de Engenharia Civil) e laboratoriais (caracterização de materiais) cuja correcta interpretação depende da subsequente integração de dados em modelos digitais tridimensionais as-is, ditos digital twins.

Estes modelos consistem em reconstituições detalhadas e com elevada precisão geométrica do objecto real produzidas por métodos de Geomática avançada (laser scanning, fotogrametria, aerofotogrametria, …), que são já utilizados como base de representação dos resultados dos ensaios referidos e abrem perspectivas inovadoras face à capacidade actual de desenho de projectos informados de reabilitação de edifícios e monitorização estrutural dos edifícios.

Gestire la complessità che è nei dettagli. Studi per il riuso della 'scuderia' del castello di Calendasco.

Managing a complexity of details. Studies to re-use the stable of the Calendasco's castle.

Michela Marisa Grisoni – Politecnico di Milano, Milano, Italia, michela.grisoni@polimi.it

Nicola Badan Istituto Italiano dei Castelli, Presidente Sez. FVG, Udine, Italia, nicolabadan9665@gmail.com

Davide Zanon – Istituto Italiano dei Castelli, Belluno, Italia, davidezanon@icloud.com

Keywords: re-use, historical selection, stable, stratigraphical analysis

Extended abstract

The issue. To manage a building and to decide how to rearrange it, not only it is a compositional matter, albeit very important, or utilitarian one, albeit essential. It should rather be also planned as a wider evaluation of its features considering that architecture could be a truly ready-made resource. Without this regard, a reuse presents all its ambiguities: the term can be adapted to the most heterogeneous interpretations and managed by a too large variety of professionals; the excuse for a deep change that even pass themselves off as virtuous adaptative solutions to reduce soils consumption and to recovery abandoned buildings. For this reason, we should not ignore that a building survey goes beyond measuring and calculating useful areas and volumes. To investigate the building's materials by remarking their nature and production, means to understand its structural reasons. To recognize the decay means to measure its severity, to identify the causes and possibly its recurrence. To distinguish the decay itself from the alterations leads to accept all that it is only a harmless expression of time rather than obsolescence or strain of the building elements. To analyse the plan's distribution, also acquiring any subsequent changes, leads to slight potentialities and sometimes unexpected vocations, often re-evaluating what at first glance appears as mortifying

The case study. On this regard, the case study, the so-called 'scuderia' [stable] of the castle of Calendasco (Italy, PC), offers the opportunity of crossing different visions. It is an architecture, formerly part of the nearby castle from which it was separated in 1992, listed as an historical building since 1995, a public property since 2003. After years of inactivity and disregard it has been currently admitted to a "Regeneration urban program", granted of regional and national funding. it is an ambitious and enthralling challenge: this small town (of about two thousand inhabitants) is located along the Via Francigena, next to the famous "Guado of Sigeric", the archbishop whose travel's diary traces the official path that an increasing number of 'travellers' is appreciating and following. The issue is to strengthen the attractiveness of the territory, capturing the current sensitivity for the enhancement of historical paths (commercial or pilgrimage roads whatever they were) which today are re-proposed or conceived for a different type of tourism (closer and sustainable) and mobility (slower and green). Piacenza is only about ten kilometres away; served by fast roads which shorten distances but also deny the opportunity to keep and cross an engaging and fragile landscape; being, to the south, the foot of the first Apennine reliefs and to the north the floodplain area of the great river Po.

A collaborative action. The municipality is embracing the idea to reactivate the "village" (to be intended as a synonym of historic settlement and small town), together with other similar places. But it is also pursuing a wise management plan of its listed or not listed estate assets. It is necessary to relocate the historical archive and public library. They are also thinking to organize some slow cost facilities to host pilgrims. To think alternatives places to locate some functions that are currently uncomfortable or absent (like the public library or the historical archive on one hand, and a hostel and equipped public spaces on the other) by re-evaluating the intended use of public spaces (the city hall, the castle and the stable) trigger that animated discussion table mentioned above. To join it, because of the agreement between the university (Politecnico di Milano) and public body (Municipality of Calendasco) has allowed us to build a fruitful collaboration. Since a year after the agreement, the proposed paper refers the first results. While the castle has been already restored by others,

for the adjacent building, the ‘scuderia’, a research program to investigate the history of the construction and its changing over the time was proposed and is now being carried out.

First results. Substantially unexplored object, the so called ‘scuderia’ has come to our days as a rural architecture abused by internal partition interventions (an unquestionably rather bulky reinforced brick concrete floor) built to make a stable with an upper barn, before listing the building as an historical monument (1995). Before its demolition could even provoke further losses of precious traces, it was therefore proposed a preliminary study to plan the choices of intervention; especially since this building has long been looked with interest by scholars of the military architecture and castles too, and by historians who compare some of its features with those of the close castle (considering the still private sector) but also with others in the nearby (like Rottofreno and Sarmato). Scholars underlines the strategic and tactical role Calendasco played between the Middle and the Modern age as it is on the border between counties (of the Val Tidone), duchies (Milan to the north-west and Parma and Piacenza to the south-west) and states (the Pope's push over the Padan Pianura). An in deep analyses of the bibliography, supported by new archival research, made it possible to ascertain and integrate the known chronology. Even if it doesn’t explain all the building history, it orders a chronological framework to hypothetically place those transformations or to push the further investigations. At the same time, a in-deep building survey is gradually suggesting and focusing unexpected data in a map board which is specifically designed to share the results with those in charge of drawing up the project (architects) or validating it (like the National Monument Service). To this purpose, the authors drafted a ‘map of signs requiring protection’ using a chromatic metaphor which recalls road signage. Such an easy metaphor enlightens where limited modification or full integrity of the elements are suggested to preserve their testimonial value.

The wall pattern and the stratigraphic analysis of both internal and external are revealing a totally new and very complex picture of the building and its management. A thorough analysis of materials and wall bonds and patterns has shown that the solid bricks making up the building feature vast heterogeneity in colours and sizes, but also in textures, suggesting complex sequences of constructive and transformation actions. Stratigraphic analysis has led to the recognition of two units (A and B). Despite a split which is already mirrored by the current cadastral layout, the investigation not only is showing that unit A pre-exists unit B and but that is resulting of articulate transformation dynamics.
Unit A, which was used as a dwelling, has a rural rather than aristocratic appearance, but still keeps some faint yet perceivable traces of refinement within – such as the first floor ceiling, still showing some fragments of decoration with designs recalling those found in the main castle hall – while the outside also recounts a story about residential uses following one another in a complex sequence, resulting in several recognisable actions of construction and alteration. Unit B also carries a weave of signs left by human action on its surfaces. Just to mention some, certainly a cross-vaulted system existed in a phase – now signalled by ‘negative interfaces’ left along the whole internal perimeter of the walls by its removal – and the roof structure was changed from a previous layout. The relationship between unit B and unit A was a matter of investigation as well, with architectural stratigraphy offering interesting discoveries. Moreover, hints from historiography – pointing at some stylistic elements on the N-E and N-W fronts recurring on the nearby castle walls as well – have been compared to stratigraphic evidence as a possible proof of closely related construction activities. As for an attempt at developing a relative sequence and its bindings to absolute chronology, is has been possible to draw up an enlightening ‘depositional sequence’ consisting of nine periods. More clues can be found e.g. in the Confalonieri coat of arms emerging from the decoration of the aforementioned wooden ceiling – pointing at their presence in Calendasco around the 15th and 16th centuries – and from matching stratigraphic observation with historical cadastral data.

Conclusion
Selecting is a risking approach for many reasons: it favours restoration of an ideal rather than preservation of an authentic reality. The proposed case study proves how architecture is a manifold product whose care requires to face complexity. It also shows the opportunity to change the original use for a new one as a possible and sometimes necessary event.
We will measure in the designer sensibility to preserve, without obliteration and reducing, the many pre-existing structures and features, even the minor ones. At the usual comparison before-after, it is hoped that the outcome will still offer the opportunity to appreciate the pulsating data reservoir we received. That is to hope, that no one, provocatively, rather than overbearingly or naively, acts on such a kind of building to underline an historical phase over another. Even if partial or badly compromised, architectural relics can tell many things.

Climate impacts on architectural heritage overview on deterioration processes and potential use of new technologies

Diogo Bernardes Pereira - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, dfbernardes@ucp.pt Institution

Pedro Miguel Rodrigues - Universidade Católica Portuguesa, Centro de Biotecnologia e Química Fina (CBQF), Porto, Portugal, pmrodrigues@ucp.pt

Eduarda Vieira - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR), Porto, Portugal, evieira@ucp.pt

Patrícia Moreira - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR) & Centro de Biotecnologia e Química Fina (CBQF), Porto, Portugal, prmoreira@ucp.pt

Liliana Araújo - Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes (CITAR) & Centro de Biotecnologia e Química Fina (CBQF), Porto, Portugal, lparaujo@ucp.pt

Abstract: An overview of the variability in environmental factors related to climate change is presented, as well as their impact on the deterioration processes occurring on built heritage materials. It is also discussed how new technology can be helpful in designing solutions to halt, reduce or mitigate these deterioration processes.

Keywords: architectural heritage; climate change; degradation mechanisms; emerging technologies.

1. Introduction

Architectural heritage is threatened by several environmental factors, enhanced by tourism, real estate pressure, population growth and industrialisation. These constitute extrinsic and indirect causes of degradation and are related to the current social, economic, and demographic situation as they promote alterations in environmental factors and variations in the physical, chemical, and biological properties of each material.

2. Climate change impacts on architectural heritage

European cities have been experiencing gradual changes in air temperature, surface temperature, atmospheric moisture, precipitation, wind intensity, acidification of rainwater, increase in volatile organic and sulphuric compounds, and other indicators of climate change and environmental quality reduction [1]. The variations and alterations of such factors promote rapid changes in the chemical and physical characteristics of the materials [2], resulting, not only, but above all, in the degradation of the building fabric and the interior and exterior decorative elements [3].

Table 1 summarises the factors and related mechanisms that promote degradation in the properties of materials associated with architectural heritage.

Table 1. Mechanisms that promote accelerated degradation of architectural heritage.

Factor	Mechanisms	Material susceptible	Consequences
Temperature	Freeze-thaw cycles	Porous materials	Volume increase Internal stress
	Thermoclastism	Stone	Superficial disaggregation Cracking Exfoliation Erosion
Precipitation	Corrosion	Metal Glass Carbonate stones	Disaggregation Structural function loss Aesthetic alteration Material loss
	Biological colonization	All	Aesthetic alteration Fractures Movements Chemical and physical alterations Structural function loss
	Salt crystallization (crypto/efflorescence)	Porous materials	Dimensional variations Mechanical stress Aesthetical alteration
Wind	Impulse	All	Collapse Fatigue in structures
	Erosion	All	Abrasion Water penetration of porous materials
	Pollutants transport	All	Dirt deposit Aesthetical alteration Chemical and physical alterations

3. New technologies in support of the built heritage

In recent years, new technologies have been developed, establishing fundamental tools for the understanding, conservation, and dissemination of heritage. Digital technologies (with or without artificial intelligent support), allow for the understanding of the construction and diffusion of architectural heritage, such as 3D modelling, BIM, and other virtual technologies [4]. Parallel with these, for a more holistic approach to conservation and preservation of built heritage, extensive development of compatible and reversible materials for reparation, restoration, and rehabilitation as well as furthering the new methodologies for seismic assessment and structural rehabilitation are also needed and, in some cases, still lacking

4. Conclusions

Through the literature review, it can be concluded that the degradation mechanisms of building materials are relatively well understood and studied. A less explored aspect is the use of emerging technologies for understanding the degradation processes and how climate change impact has influenced this comprehension. In addition, there is still lack of solutions regarding the creation of solutions based on new materials for the mitigation of degradation in architectural heritage.

In this sense, the HAC4CG project aims to produce and adopt emerging technologies to help the relationship between specific degradation processes and climate and environmental changes with the aim of reducing their impact on architectural heritage.

Acknowledgements

HAC4CG project (NORTE-01-0145-FEDER-000067) (Heritage, Art, Creation for Climate Change. Living the city: catalysing spaces for learning, creation, and action towards climate change), promoted by the Catholic University of Portugal and coordinated by the unity of R&D, Research Centre for Science and Technology of the Arts, and funded by Comissão de Coordenação e Desenvolvimento Regional do Norte

References

[1] Casimiro, P. (2021). "Alterações climáticas: Factos, indicadores, recursos", Faculdade de Ciências Sociais e Humanas, Universidade Nova de Lisboa. Associação de Professores de Geografia, Lisboa.

[2] Sesana, E.; Gagnon, A; Ciatelli, C; Cassar, J.; Hughes, J. (2021). "Climate change impacts on cultural heritage: A literature review", WIREs Climate Change, Vol.12, Iss.4.

[3] Camuffo, D; Fassina, V., Havermans, J. (2010) "Basic Environmental Mechanisms Affecting Cultural Heritage, Understanding deterioration mechanisms for conservation purposes, Nardini Editore, COST action D42

[4] Ippolito, A. (Ed.). (2017). "Handbook of research on emerging technologies for architectural and archaelogical heritage", IGI Global