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Index

Preface I

This special issue constitutes an excellent and representative testimony of the variety of contributions presented during YOCOCU 2016.

The reader will find that the 41 papers in this special issue cover a wide range of materials (stone, gypsum, lime, mortar, ceramics, metal, paper, videos, textiles, paintings, plastics, pigments …), from different types of art and heritage: architectural and archaeological; contemporary and digital art; industrial heritage, vernacular, art caves and ethnographic heritage; museum collections, landscapes and intangible cultural heritage (CH).

Among the techniques covered in this special issue, some innovative techniques, such as nanotechnology and nanomaterials, digital documentation, mobile apps, 3D technology, etc. are included, besides the more traditional ones for characterization, diagnosis, conservation and restoration (consolidation, protection, repairing, replacement and biocidal techniques).

One of the successes of the conference was to give a significant place to studies not always considered in this type of scientific conferences. In this regard, papers dealing with CH socio-cultural benefits and impacts, dissemination, tourism and economics, management, education, guidelines and management are present in this issue.

108 authors from 17 countries in four continents contributed to this special issue: China, Croatia, Germany, Greece, Italy, Mexico, Namibia, Pakistan, Portugal, Romania, Russia, Serbia, South Africa, Spain, Turkey, United Kingdom and the United States of America.

Most of the contributors are young students, researchers or professionals working in the field of CH, to whom YOCOCU conferences are devoted, as well as all the YOCOCU associations (Italy, Spain, Belgium, Azerbaijan, Turkey, Croatia, Romania and Germany).

The first and main goal of YOCOCU is to create an international platform to foster the role of youth in the field of research in CH conservation and restoration, in all disciplines related to CH, from the most modern and avant-garde to the traditional ones.

Some other objectives pursued by YOCOCU are to promote the conservation and value enhancement of cultural heritage; to give voice to young professionals and to provide them with tools and opportunities to develop their careers as well as the CH sector; and to match senior conservators with junior professionals.

I would like to acknowledge the reviewing tasks performed by the 25 reviewers, most of them members of YOCOCU 2016´ Scientific Committee, for their time and effort, and who contributed to improve the quality of the papers.

I want also to express my gratitude to this journal, GE Conservation, for the confidence and the opportunity given for the dissemination of these papers, and for the excellent editing of this special issue.

Last but not least, thanks to my colleagues of the Petrology applied to Heritage Conservation research group, to YOCOCU Spain and to all the members of YOCOCU 2016´ Organizing Committee. They made possible the conference, and therefore, this special issue.

I wish this publication will encourage young people, on the one side, to focus their interest on CH, and on the other side, I hope that young people who are already working in the field of CH of all over the world, will attend next editions of YOCOCU international conferences.

Monica Alvarez de Buergo

Chair of YOCOCU 2016, Madrid (Spain), 21-23 September 2016

Geosciences Institute IGEO

Spanish Research Council CSIC and Complutense University of Madrid UCM

Youth in Conservation of Cultural Heritage YOCOCU – Spain association

Preface II

Awareness of the importance of preserving and transmitting cultural heritage to future generations has been growing enormously over the last two decades. An indicator of this is the continuous growth in the number of cultural heritage sites and monuments inscribed in the UNESCO World Heritage list, which passed from 551 in 1987 to 1054 in 2016. Furthermore, the gap that once divided Europe and Northern America from other countries in terms of protection policies, development of practices and procedures for the restoration has been reduced. However, in the last two decades the number of World Heritage sites in danger strongly increased, passing from 10 in 1987 to 37 in 2016.

Growing attention to heritage and cultural identity and the increasing risk factors (from natural to anthropic (including archaeological looting and vandalism), require the development of a global strategy aimed at bringing together all the 'energies', best practices and knowledge, with the support of science and technologies, in order to preserve and manage cultural heritage in danger, ensuring a long life for the benefit of future generations.

To this end, a strong alliance between Research and Conservation needs to be made in order to improve the operational effectiveness of science, technologies and practical experience for preserving and restoring works of art, monuments, historical cities, archaeological sites and cultural landscapes.

This volume is the result of an effort aimed at creating a bridge between Research and the Conservation of cultural heritage, according to the mission of YOCOCU community.

Most of the crucial issues that characterize the debate of scientists and conservators for two decades has been discussed in this special issue, among which: i) the effectiveness and compatibility of remedial treatments, including those based on nanocomposites; ii) the best way to use and integrate in situ investigations and laboratory tests to study and evaluate the decay processes of heritage material; iii) the most reliable strategies and methods of safeguarding, maintenance and preservation of cultural heritage sites, including the protection of archaeological areas by shelters.

Finally, this special volume collects some overviews related to issues linked to sustainable management, fruition and valorization of cultural heritage, and case studies on cultural tourism, local perception of heritage values, and the use of urban and architectural heritage for contemporary art production and exhibition.

In conclusion, this volume is an innovative example of effective synergy and integration between research and conservation that we need more and more if we want to secure a future for our past.

Nicola Masini

Chair of YOCOCU 2018, Matera, Italy, 22-26 May 2018

Institute for Archaeological and Monumental Heritage IBAM

Italian Research Council (CNR)

Papers

Asilah Arts Festival (Morocco): encounters in the urban space

María Gómez López

Abstract: This essay aims to present Asilah Arts Festival through its history, program and outcomes, as an interactive platform for international and local cultural interchange and diffusion but especially, as the essential preservative source it still is, particularly regarding the town's urban and architectural ensemble and the national and international, material and immaterial legacy it celebrates. The methodology for this research combined a critical bibliographical analysis, followed by a three weeks stay in the Moroccan town carrying out fieldwork that included interviews, visits to sites of interest or participation in the event's activities. The results obtained from this investigation have in this paper been grouped in four sections: "Urban and architectural heritage", "Cultural heritage", "Social impact" and "Everyday life". These tackle how the event affects local economy, contributes to the population's education, raises awareness towards the importance of the patrimony's safeguarding or renders explicit the value of the town's quotidian existence.

Key words: Festival, Asilah, intercultural exchange, heritage preservation

El Festival de las Artes de Asilah (Marruecos): encuentros en el espacio urbano

Resumen: Este artículo presenta el Festival de las Artes de Asilah a través de su historia, programa y resultados como plataforma para el intercambio y la difusión cultural tanto a nivel nacional como internacional y, especialmente, como el esencial recurso preservador que todavía hoy es, particularmente en relación al patrimonio arquitectónico y urbanístico de la ciudad, así como a la cultura material e inmaterial, local e internacional que celebra. La metodología utilizada combina un análisis crítico de los recursos bibliográficos seguido de tres semanas de trabajo de campo en Asilah, realizando entrevistas, visitas a lugares de interés o participando en las actividades del evento. Las conclusiones obtenidas son aquí presentadas en cuatro apartados: "Patrimonio urbano y arquitectónico", "Patrimonio cultural", "Impacto social" y "Vida cotidiana". Estas secciones abordan cómo el evento afecta a la economía local, contribuye a la educación de la población, genera conciencia de la necesidad de salvaguardar el patrimonio o revela el valor de la cotidianeidad.

Palabras clave: Festival, Asilah, intercambio cultural, preservación del patrimonio

Introduction

Every summer since 1978, the small Atlantic coastal town of Asilah, located 42 kilometers away from Tangier, holds its renowned Arts Festival. A complete program of cultural activities is developed during two weeks, turning the village into an artistic outburst that attracts artists, scholars and public from all over the globe.

Some years before 1978, the journalist and politician Mohamed Benaïssa (b.1937) and the artist Mohamed Melehi (b.1936) returned to their hometown and found it highly deteriorated (Al Radi 1994: 47). The two friends started a campaign that aimed to encourage the population to collaborate in creating better life conditions in a more hygienic and carefully preserved town, an enterprise that started from simple responses like the easing of the garbage collection (Al Radi 1994: 47).

In parallel to these improvement tasks, Benaïssa and Melehi dealt with the Town's Council to remodel the external appearance of the almost ruined town by paving the streets with a wavy design by Melehi or restoring ancient houses and historic buildings like the Portuguese Kamra Tower or the Rassouni Palace (Al Radi 1994: 55), headquarter of the Festival during its first years. Most of these works were accomplished by local craftsmen using traditional methods, forms and materials, contributing this way to simultaneously preserve the tradition,

engage population with the protection of their environment and help them benefit from their own work (Lin E.M).

The rehabilitation project aspired to be coherent with the original image of the town and, through the insertion of arches or doorways from ancient ruined buildings or the inclusion of traditional features of the region like the *zelij* tiles, it paid tribute to the local architectural tradition (Al Radi 1994: 55). This respectful architectural intervention received the Aga Khan Award of Architecture in 1989 and the town was declared National Monument (Harrouni 2010: 5).

In 1978, with the first successful efforts, the two friends launched an event under the slogan "Culture and Art for Development" (Gilbert 2009), in which a wide range of cultural activities brought together international and local participants (Hayes , D. B. 1994). This was the first edition of the Festival, which would later crystallize into a long lasting traditional celebration still alive today thanks to the foundation of Al Mouhit Association (Al Radi 1994: 51), now the Forum of Asilah.

Methods and methodology

This research project was conceived within the framework of the Final Dissertation for the MA in History of Art and Architecture of the Islamic Middle East, School of Oriental and African Studies (SOAS), University of London. Publications on AAF are rare and thus, an academic and critical theoretical research was necessarily complemented by a stay in Asilah, endorsed by the Ralph Pinder Wilson Award 2015. This article will therefore be partially based in the conclusions drawn from this investigation.

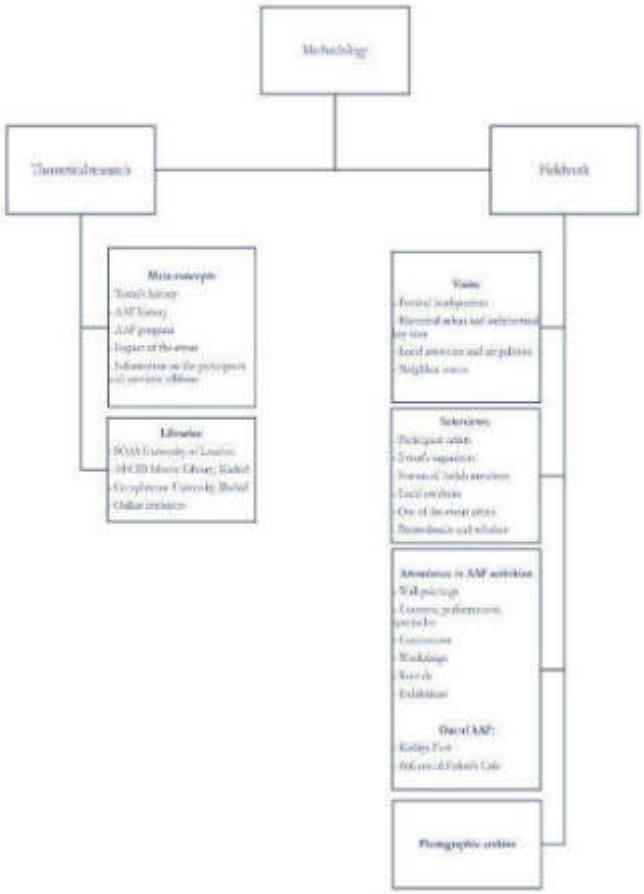
In order to balance the scarce bibliographical resources and to build a photographic archive of the festival, the town and its surroundings, the author used three means during her visit to Asilah, as previously reported in Gómez López, (in press):

- Interviews with participant artists (e.g. Othman el Bahri, Hakim Ghailan, Malika Agueznay or Mizue Sawano), event organizers and coordinators (e.g. Mohamed Anzaoui, Abdallah El-Hariri), Forum of Asilah members (e.g. Majdouline Khalladi), local residents or artists not included in the Festival's program (e.g. Mustafa, Karim). Gallerists and knowledgeable professionals were also interviewed (e.g. Mareta Espinosa, Said Messari or Anne Judith).

- On site visits to the Festival quarters (e.g. Bibliothèque Prince Bandar, Centre Hassan II, Raissouni Palace or medina), Asilah art galleries (e.g. Aplanos, Monassilah), local artists' ateliers located in traditional restored houses (e.g. Hadik Haddari) and urban and architectural key sites (e.g. Kamra Tower, Raissouni Palace, Kirikiya, Lakma).

- Attendance to the programmed activities for summer 2015 and out of the Festival events with local residents (e.g. Fishers' Café Sufi recital).

Graphic 1.- Methodology.



The town

Asilah was founded in 1500 BC standing now in the Atlantic coast 42 km southeast Tangier (Harrouni 2010: 1) [figure 1]. This strategic location led the Phoenician, Carthaginian, Roman, Byzantine, Arab, Norman, Portuguese or Spanish civilizations to settle down there. The coastal town remained under Phoenician and Carthaginian control, until the 9th century when it was occupied by the Arabs and Normans, when the original medina was built (Lin E.M). Between the 15th and the 17th centuries, Asilah was disputed by the Portuguese, Moroccan and Spanish, a period from which still stand the constructions of Raissouni Palace, the Kamra Tower or the walls.

Figure 1.- Asilah general view from the port.

In 1692 the town came back to Moroccan hands to become a piracy base until the beginning of the 20th century, when it was incorporated for a short period of time as part of the Spanish Protectorate (Lin E.M). It wasn't until 1956 that Morocco reached its independence, this small town remaining as a crossroad of architectural styles and grounded customs from the superimposed civilizations that had inhabited it.

Urbanistically speaking, Asilah is today compounded by two well differentiated areas: the newly developed one, articulated around the Avenue Hassan II and the Place Mohamed V that includes the Spanish quarter or the Lakma, and the medina, founded in the 9th century, altered by the Portuguese in the 15th century and finally restored in the late 70's of the 20th century, but still preserving its original labyrinthine layout (Nakhli 2009: 195).

The outskirts of the medina are chaotic and dynamic, they being the location of the main restaurants, markets and shops. The medina, perfectly integrated in this chaos, is a quiet place compounded by a small labyrinth of narrow streets accessible through the gates that pierce the still standing Portuguese walls. Inside the medina there is a touristic souk, few cafes, some shops dispersed in its streets, mosques, the Centre Hassan II and Raissouni Palace, ancient cemeteries, some residences and hotels, artisanal bread ovens or a wide number of galleries and artists' workshops located in traditional houses.

The Festival

Generally speaking, the Festival annually includes similar activities. Among these, the mural paintings are probably the most accessible and famous ones. Year after year, the walls of the medina are whitewashed and international and national artists, in collaboration con local youth, transform the external appearance of the town by decorating its walls with new designs [figure 2].

Figure 2.- Hiba Khamlici. Medina wall painting. AAF 15.

In previous editions of the Festival, some of the participants have been Moroccan Sanae Sarghini and Abderrahman Rahoule, Spanish María Ángeles Testera, Syrian Khaled al Saaï or Japanese Mizue Sawano.

Interestingly, the artists are spread in the labyrinthine medina, in their allocated walls, it being necessary to wander and get lost to find them. This encourages a different bodily interaction with the urban space: international visitors are led to hidden corners they would otherwise miss and local population rediscovers the known and apprehended space through the artistic catalyst. On the other hand, the lively evolution of these urban canvasses surrounded by the drafts the artists do on the wall, emphasizes the "here and now" idiosyncrasy of the event and the "always being and becoming" character of any urban space.

Together with these street art works, there is a wide range of artistic workshops, among which we can count the engraving, painting, children or writing ones [figure 3]. They are usually held at the Raissouni Palace, an historical site inserted at the core of the medina and thus, in permanent dialogue with Asilah medina's everyday life. Some pieces are later displayed in different venues as part of a whole program of indoor and outdoor exhibitions that also show the work of other emergent and consolidated, national and international artists.

Figure 3.- Artistic workshops, Raissouni Palace. AAF 15.

Awards like the Prix Bouland al Haïdari de la Jeune Poésie Arabe or the Prix Tchicaya U Tam'si de la Poésie Africain are conceded in order to promote and encourage creative production. A complete program of international music concerts is also held at the Bibliothèque Prince Bandar during these weeks, including in past editions artists and groups like fado singer Cuca Rosetta, Ensemble Ahl Assilah, flamenco singer Mariana Collado, Indian artist Vidya Shah or Moroccan Saloua Chouair.

Finally, and in a more theoretical line, a program of interdisciplinary conferences and colloquiums given by the most expert scholars coming from all over the world is offered, among which subjects we can find lectures on identity, cinema, climate change or literature. In previous editions the titles have been "Arab media in the era of digital information", "The cinema and the novel in the films of the South", "The new contours of orientalism in international and Arab contemporary arts" or "Seasons in the Arab Uprising as seen by us and by the others" (www.issuu.com).

Discussion and results

The on-site research results could be divided in general terms in four sections that will present in first place, the preservative claim towards the town's urban and architectural heritage. Secondly, the preservative and spreading attitude towards different cultural manifestations. Following the second point, is the social impact of the event in educational, spatial and economic aspects. And finally, the fourth section will present those results linked to Asilah's everyday life and its local artistic panorama.

— Urban and architectural heritage

The preservative claim towards Asilah urban and architectural sites is an inherent aspect of the Festival since its foundation. In fact, the origins of the event are unavoidably linked to the previously mentioned preservative initiative by Melehi and Benaïssa. The two friends' enterprise was born to revitalize and restore a neglected and almost ruined town in collaboration with its inhabitants, and the Festival was then presumably funded to maintain this positive and careful attitude towards their city.

As a matter of fact, a preventive attitude towards their heritage has been developed over the years since this intervention in the late 70's and the survival of the *moussem*. This is evidenced in the periodical interventions of the sites, a pre-Festival annual inspection and an updated use of its renovated historical installations as Festival headquarters. As an example, we could cite the case of the Raissouni Palace, funded in 1909 by the pirate Pasha Ahmed Raissouni and today used as headquarter for the artistic workshops and as a residence to accommodate international participants (Lin E.M.).

The proposal of conferring the buildings a more actualized function, more coherent with the new circumstances and needs, instead of turning them into museums or leaving them to their fate, has successfully enabled their optimum (and now, as Festival headquarters, necessary) maintenance while keeping them open and accessible to the public.

—Cultural heritage

Secondly, a preservative and bidirectional (local-international) disseminative attitude towards traditional and contemporary cultural expressions was revealed during the study. Evidence of this fact were the interweaved celebration of gnawa or fado music performances beside the latest artistic manifestations or the interdisciplinary conferences and both of them, in turn, celebrated side by side with local artistic production. Thanks to their celebration, these manifestations are spread and perpetuated, while simultaneously transforming the city into a stage for intercultural dialogue.

The use of *moussem* as Festival's designation seems to be all in all a statement of intent. This is an Arabic word used to describe a traditional and seasonal Moroccan festivity with an ontological nature, related to agricultural cycles and religious events (such as Ramadan) during which varied rituals and cultural activities are performed (Reysoo 1988; Benaïssa, M. et al. 1979: 34). The celebration of Asilah Moussem is, in the fullest sense, a perpetuation of this ancestral practice and a metaphorical expressive claim towards the survival of the whole ensemble of the Moroccan cultural heritage (Gómez López, In press).

—Social impact

The Festival has become an important cultural event in Morocco, bringing with it a lot of advantages to the coastal town and its population since its first edition.

AAF has disclosed a clear educational claim based on the inhabitants' active engagement. Most activities are free access and attempt to bring a bit of the international cultural panorama to the town while encouraging a festive and entertaining approach to their own heritage as well (Gómez López, In press).

This inclusive attitude has been present since the event's origins, when the local population was employed for the restoration works or invited to collaborate with the rest of participants in the different activities of the program. Today, this has been perpetuated through the inclusion of activities like the already mentioned artistic workshops for children, concerts or conferences and the attractive possibility of interacting with the visiting international participants, usually accessible during those days.

In parallel to this cultural learning, the Festival has also fostered a different bodily, hands-on interaction with the inhabited space. For example, the Raissouni Palace children's workshops frequently depart from a previous urban and architectural experimentation in their hometown on which they later develop their artistic works [figure 4]. Besides this, the local youth assists the participant artists in the wall paintings, rediscovering the urban space they inhabit through its artistic intervention,

and the adults are still involved in the town's restoration campaigns, as they were in the 1970's original preservative proposal by Melehi and Benaïssa. This has interestingly led to a rediscovery and better knowledge of their hometown, while simultaneously raising awareness of its safeguarding needs and procedures (Gómez López, In press).

Figure 4.- Children workshop, Raissouni Palace. AAF 15.

As concluding point of this social impact section, it has been considered important to mention the economic benefits the Festival annually brings (Benaïssa M. et al. 1979). Originally conceived as an activity which incomes would directly reward local population, the renovated aspect of the town and the raising interest in the activities organized as part of the Festival reactivated local tourism, essential resource for Asilah's economy.

This touristic boom brought along several debates and international interests in building resorts and touristic complexes, rejected by Benaïssa, President of the Municipal Council since 1983 (Al Radi 1994: 51). The founder of the Festival defended the population to keep on being the main beneficiary of the Festival's profits, the controlled growth of the town and the preservation of its traditional image and identity (Al Radi 1994: 55).

AAF still attracts people from all over the world, keeping alive local tourism and annually boosting the town's economy, having as well an indirect impact in surrounding towns like Tetouan, Tangier, Lixus or Larache.

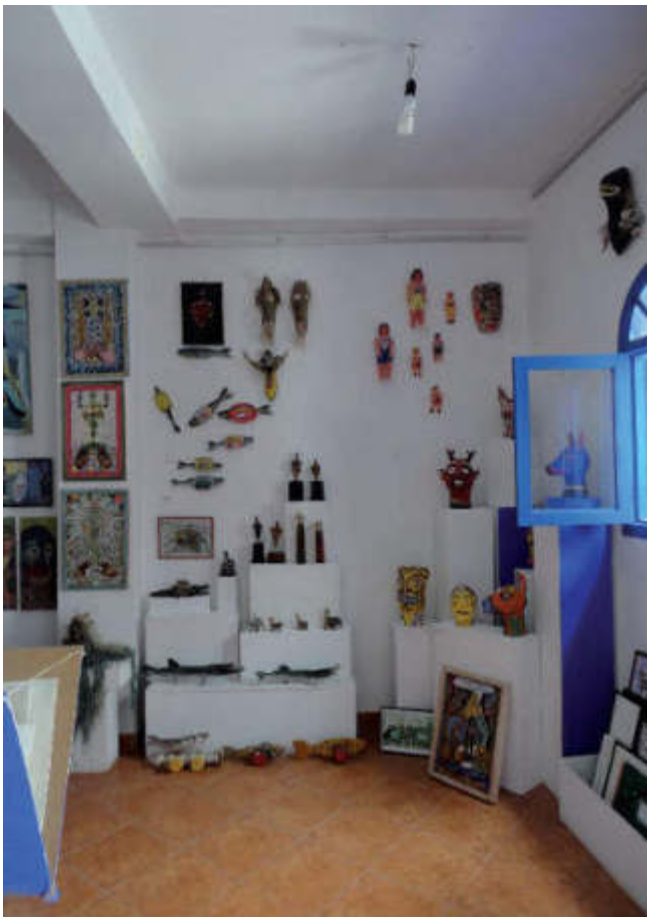


Figure 5.- Monassilah art gallery. Asilah, July 2015.

—Everyday life

Thanks to the urban staging of the event, Asilah's everyday life is rendered explicit. The performance of the quotidian and the spectacle meet, redefining Asilah's medina during the festival and revealing the performance of the ordinary through the urban staging of the extraordinary. This way, the city embracing different cultural manifestations, conversely obtains international visibility.

Together with the town's everyday life and its traditional customs, the local cultural panorama emerges before the audience's eyes these days. From its cultural fabric, we could mention the daily gnawa performance at the Krikiya fort, the weekly Sufi recital at the Fisher's Café or the presence of art galleries such as Monassilah or Aplanos which, during those weeks prepare special shows usually devoted to local creators [figure 5].

Among the artists based in Asilah, we would like to cite the calligrapher Hadik Haddari, which decorated studio in the heart of the medina could easily be confused with a mural of the Festival. Mustafa and his brother, well known for their stylized Berber and Sufi musicians and dancers made of grinded natural pigments on cement wrapping paper. Their atelier, placed in a tiny second-floor room in a traditional house of the medina, can be visited daily. Another prominent artist from Asilah is the known as "the

painter of medinas", whose works are a chaotic and colorful superimposition of hardly recognizable Asilah urban details (street lamps, doors, windows, domes, mosques) on wood planks, canvas or fabrics, present in all the city stalls [figure 6]. Finally, Karim, born in Zagora, sells his intervened Berber pieces and his painted wooden boards beside the Portuguese walls, close to the Krikiya Fort.

Figure 6.- Painter of medinas. Asilah, July 2015.

AAF has steadily become more complex and crowded, receiving lesser critics concerning its repetitive character, the weak information distribution or the activities' limited places. However, its organizers still fight for preserving its authenticity and those aspects that differentiate it from other national festivals. Its main challenges today are to avoid falling in reiteration, conformism and restriction, evolving into a facile touristic bait lacking of its original powerful and praiseworthy principles and disregarding its fundamental inclusive, preservative and instructive function (Gómez López, In press).

Conclusion

Asilah's Festival is not unique in Morocco. Other *moussems*, contemporary art events and festivals in which the latest trends are combined with ancestral traditions are celebrated in the country throughout the year. Essaouira Gnawa, Moussem Moulay Idriss Zarhoun, Agadir Festival, Marrakech Popular Arts Festival, Timitar Festival, JIDAR in Rabat, Marrakech Biennale, Boulevard Festival in Casablanca, Remp' Arts Festival in Azemmour or Al Dusheira are some examples.

Together with these events, the foundation of dynamic cultural institutions, the improvement of the existing ones and the progressive proliferation of specialized publications, both inside and outside the country, are making out of Morocco an interesting emerging field for contemporary art production, promotion and exhibition that is still in the process of finding its place in the international artistic arena.

Throughout the paper, the central role AAF has played in the last years has been presented, aspiring to introduce it as the essential preservative and educative source with wide impact in different spheres it is. Further on, we have aimed to demonstrate to what extent this event has been crucial in reactivating the hosting town's awareness towards the preservation and dissemination of its rich legacy and the other foreign cultural expressions celebrated as part of the festival.

With this educative and preservative nature, the *moussem* of Asilah was a pioneer initiative in the late 20th century, standing out from other Moroccan festivals while broadly demonstrating since its foundation the grand and diverse potential of art. Beyond these characteristics, its great value resides in the power of claiming towards the importance, not only of the town's urban and architectural ensemble or of the wide range of cultural manifestations it promotes, but also of the town's everyday life, appreciating the known and ordinary besides the staged and unusual.

Through its annual launch, the event has steadily found itself a place in Asilah's life, becoming an inherent part of the town's history and the cultural heritage it aims to preserve.

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She has collaborated with institutions like Santander Bank Foundation, Sabrina Amrani Madrid and Selma Feriani Tunis galleries or Casa Árabe and published the results of her investigations in Reorient, Ibraaz or Afribuku. She was beneficiary of the 9th Mutua Madrileña Postgraduate Scholarship and the Ralph Pinder Wilson Award 2015 and she has been grantee participant in the ISESCO and FUNDEA Youth Course on Islamic Culture in Rabat (2016) and Connecting Cultures Oman winter journey (2017).

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Heritage value of building materials: Former Workers Hospital of Maudes, Madrid (Spain) case study

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Abstract: Building materials used at the Former Workers Hospital of Maudes, Madrid (Spain) were studied. The study addressed the information both achieved from documental resources and characterization techniques. Documentary work has enabled to know about the architect thought, the ideology of the project or the grounds that conditioned such materials selection; it also permitted to learn about materials provenance and/or its elaboration. Analytical studies provided information about petrographic features of the materials and their composition; limestone provenance was confirmed and new data on material manufacture were provided. Such information, which deserves to be known and disseminated, provides a significant heritage value to materials that shape cultural assets. Studies with a multidisciplinary approach represent a commitment to improve the knowledge and conservation of heritage.

Key words: documental resources, analytical techniques, heritage conservation, limestone, decorative ceramics, artificial stone.

El valor patrimonial de los materiales de construcción: caso de estudio en el Antiguo Hospital de Jornaleros de Maudes, Madrid (España)

Resumen: Se estudian los materiales empleados en la construcción del Antiguo Hospital de Jornaleros de Maudes, Madrid (España). El estudio atiende a la información obtenida a partir de la consulta de fuentes documentales y del empleo de técnicas de caracterización. El análisis documental permite conocer el pensamiento del arquitecto, la ideología del proyecto o los motivos que condicionaron la selección de estos materiales, proporcionando además información sobre su procedencia y/o elaboración. El estudio analítico ofrece información sobre características petrográficas de los materiales y su composición, permite confirmar su procedencia y/o aporta nuevos datos sobre su fabricación. Este tipo de información, que merece ser conocida y difundida, otorga un importante valor patrimonial a los materiales que configuran bienes culturales. El estudio de estos materiales con un enfoque multidisciplinar supone una apuesta por el mejor conocimiento y conservación del patrimonio.

Palabras clave: fuentes documentales, técnicas analíticas, conservación patrimonio, caliza, cerámica decorativa, piedra artificial.

Introduction

This study focuses on the building materials used at the façades of the Former Workers Hospital of Maudes (Madrid, Spain), built by the Galician architect Antonio Palacios Ramilo (1874-1945) [figure 1]. Some features that characterize his work are the utilization of materials intrinsic properties, their local usage as a commitment with the identity of the places where he built and materials reuse in order to keep the costs down (González-Amezqueta 1967: 5, 7-9, 11, 13).

The Former Hospital, built between 1909 and 1916 on the northern side of the city of Madrid, was conceived as a benefic institution to provide free medical care to the working class people without economical resources (Ciudad and Carrillo 2001: 13, 20). Taking advantage the healthsome breeze of the area, Palacios designed a building comprised by four wings arranged diagonally around several courtyards. The architect conferred to the property a strong hygienist and humanitarian character (Crónica e Información 1912: 1). He created a warm atmosphere by means of gardens as well as with the conjunction of lights and shades (Pérez-Rojas 1987: 115). The building was enclosed by a surrounding wall.

The façades and the wall are comprised by stonework (mainly a light-colored limestone) grouted by joint

Figure 1.- Galician architect Antonio Palacios Ramilo (1874-1945) and the Former Workers Hospital of Maudes (Madrid, Spain). Images yielded by the Specialized Documents Centre of Madrid Environmental Regional Department.

mortars. Some parts of the façades are decorated with ceramic materials. A fountain is placed at the central courtyard and it is also adorned with ceramics. In some areas of the façades, artificial stone and stone imitation coatings are used. The property remained vacant between 1970-1984 years. It was listed as a National Artistic-Historic Monument in 1979 and since 1986 it houses various headquarters of the regional government of the Community of Madrid (Spain).

Two major interventions have been undertaken: a comprehensive rehabilitation in 1984-1986 (Perea 1990), and in 2006-2008, the façades restoration (Perez-Monserrat et al 2011: 298-299). Both have overall kept the message that Palacios provided to the property through the building materials used, although some original materials had to be replaced. Thereby, limestone is an original material while decorative ceramics, joint mortars, stone imitation coatings and artificial stone are both original as replaced.

The study of these building materials, taking into account the information provided by documental resources and characterization techniques, entails a valuable knowledge. Therefore, the significant heritage value of these building materials is stated and the information provided may afford more respectful interventions committed to its preservation.

Methodology

Graphic and written documentary sources related to the architect and his work, to the Former Hospital and interventions carried out or to the provenance areas of its building materials were consulted. Besides, most of Palacios´ buildings and the original quarries were visited, and materials on the Former Hospital façades were surveyed. Moreover, people linked to the Former Hospital were interviewed.

Laboratory studies were performed to characterize the building materials that shape the Former Hospital, to confirm the limestone provenance as well as to provide new data about ceramics, joint mortars, stone imitation coatings and artificial stone manufacturing.

Limestone cores were extracted directly from the façades and stone samples were taken from quarries in order to compare their macroscopic and petrographic features (Gomez-Heras and Fort 2004: 36). Decorative ceramics, original and replaced at the 80s from both the façades and fountain, were characterized. Both original and replaced at 80s artificial stone and stone imitation coatings were studied. Regarding the joint mortars, three main groups have been established from documentary sources consulted and *on site* visual survey: i) the original one within joints, ii) those that in 2006 were at the façades (both original or replaced at the 80s, before or after), as well as at the surrounding wall (built over the 60´s), and iii) the joint mortar placed during the 2006-2008 restoration. Joint mortars of each group were characterized.

Minimally destructive analytical techniques were used: Polarised Optical Microscopy/POM (belonging the equipment used to the Geological Sciences Faculty of the Complutense University of Madrid, UCM), X-ray Diffraction/XRD (Microscopy and Mineralogy Unit of the Geosciences Institute, CSIC-UCM) and Scanning Electron Microscopy (secondary and backscattered electron -SE and BSE- images) with Energy-Dispersive X-ray Spectroscopy/SEM-EDS (National Center of Electronic Microscopy of the UCM). The glazes of the decorative ceramics were also characterized by the non-destructive technique Ultraviolet-Visible Absorption Spectrophotometry/ UV-Vis, belonging to the History Institute of the Spanish Research Council (CSIC).

Results and discussion

—Natural stone: a light-colored limestone

The stonework of both the façades and the surrounding wall is made up of varied shape and size blocks of a light-colored limestone. These limestone blocks are entirely original and

their surfaces were cleaned twice by bead blasting (at 1984-1986 and 2006-2008).

At the Former Hospital, the main role played by natural stone at Palacios´ constructions as well as the character that he provided to the hospital are collected in the selected limestone. Therefore, a single stone type homogenizes the construction (González-Amezqueta 1967: 23-24) and its lightness contributes to the warm ambience the architect intended to provide. Besides, Palacios chose a rusticated surface finishing and bossage work to highlight the natural appearance of the stone. Both resources, as well as the walls stonework design, shaped by blocks of many different volumes, also responded to the need to keep the costs down by using to the maximum the quarried stone.

Taking into account the usage of local materials that Palacios was used to, the limestone selected leads to the geological substrate of the Southeastern Community of Madrid. In that area, the carbonates from the Miocene Upper Unit of the Tertiary continental basin were traditionally exploited (Del Prado 1864: 129-131). The documents of López-Urrutia (1926: 36) and the one related to the commercial promotion of Cornicabra´ quarries around 1907, found at the Railway Museum of Madrid, enabled to establish in the natural area of Valhondo (Morata de Tajuña, Community of Madrid) at least one old -historical- quarry working front. In this area, the limestone quarrying was quite easy because of the scarce of sterile material to be removed. Moreover, a railway line directly connected to the city of Madrid, was just located at the bottom of the quarries. Therefore, the limestone selection was factored by the active quarries and the ways of transportation available by then in the region. Furthermore, it should be taken in mind that at the beginning of the 20th century traditional building stones used in the region were being replaced by stones from other parts of the country and even abroad (Fort et al 2002: 20). Therefore, with the limestone finally selected, Palacios was still committed with the employment of local material.

The macroscopic and petrographic (by means of POM technique) comparison of the limestone extracted from the façades and the stone samples taken from the historical quarry working front was performed. The most frequently limestone used at the façades and surrounding wall is a compact and light-colored limestone that corresponds to the homogeneous (micritic limestone) and stromatolitic-oncolytic (bioesparite) -with many molds of bioclasts such as characea algae, gastropods and stromatolitic structures- facies of the lacustrine carbonates from the Miocene Upper Unit of the Tertiary continental basin of the Southeast of the region (Perez-Monserrat et al 2011: 298, 301). The significant recrystallization and cementation features, typical of these carbonates (Calvo et al 1989: 285, 295; Alonso-Zarza 1992: 24, 27), reduce the primary porosity and provide a high compactness to the rock. Therefore, these carbonates entail a building material especially appropriated to withstand compression stresses and to resist water action and ageing. [figure 2]

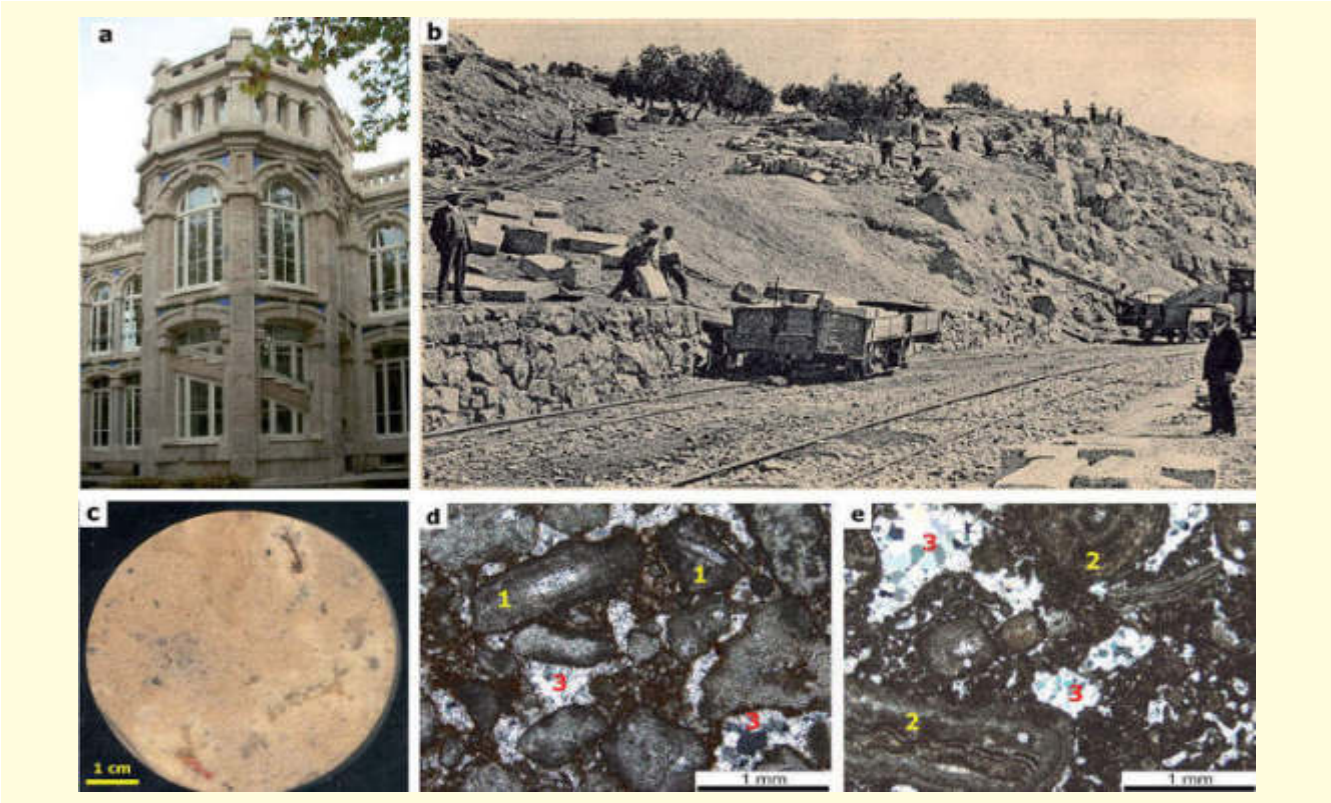

Figure 2.- Natural stone: a light-color limestone. a: façades stonework shape by limestone; b: limestone quarrying on Cornicabra´quarries at the beguining of the XX century (courtesy of the Historic Railway Archive from the Railway Museum Madrid and Spanish Railways Foundation); c: macroscopical features of the limestone used at façades (with light-color and high cementation degree); d: polarised optical micrographs of façade limestone (parallel nicols) and e: from quarry limestone (crossed nicols) -cemented characea algae (1), stromatolitic structures around characea algae sections (2) and interparticle porosity cemented and/or recrystallized (3).

—Decorative ceramics: ceramic panels and tile trencadiç

Ceramic panels are made up by colorful tiles known as raindrop tiles, framed in a turquoise and ocher color string. The body of the fountain is decorated with similar raindrop tiles -only with a bluish tone- and its basin is adorned with a *trencadiç* tile (mosaic made mainly of cut and/or broken tiles and/or glass) tailored mainly by blue color pieces. Palacios used decorative ceramics in order to confer movement to façades and to enhance the pleasant atmosphere (Perla 2001: 290, 295).

At the 80s, the original ceramic panels were almost entirely substituted, fountain raindrop tiles were preserved and the upper part of the *trencadiç* of the basin was partially replaced by green colored fragment of tiles. During the 2006-2008 restoration works, ceramic materials were all conserved, the colors both of the raindrop tiles and tile *trencadiç* were regained by wiping them and the joints between pieces were reintegrated.

Perla (1990; 2001) provided information about the raw materials and processes used to elaborate these decorative ceramics. Original raindrop tiles and string pieces were manufactured by Daniel Zuloaga around 1914 in Segovia (Spain); iron oxide-rich red clay and silica -as an additive- were used; the pieces were fired in an oxidising atmosphere at 1200 ºC. Ceramic panels replaced at the 80s were elaborated by a Madrilenian company; clays of the region, sand from Segovia and grog from Teruel were used; great amount of quartz was added; the pieces were mechanically pressed and fired under oxidising conditions at 1200-1250 ºC. The original *trencadiç* tile of the basin of the fountain was manufactured by Sevillian and/or Eastern -from Valencia o Castellón- companies; it should be considered that the interior of the Former Hospital is decorated with ceramics processed by Ramos Rejano in Seville city, using the nearby calcium-rich clays. The tiles used to repair the *trencadiç* of the basin were elaborated at the Madrid's School of Ceramics with red mud, calcium-rich pastes and Madrilenian sand, by extrusion and fired at 1030ºC.

By means of POM, XRD, SEM-EDS and UV-Vis techniques, Perez-Monserrat et al (2013: 489-490; 2016: 61-62) provided new data on the manufacture of these ceramic materials. Therefore, Zuloaga´s pieces contain grog and quartz inclusions of very heterogeneous shape and size. A lead glaze (with circa 60 wt% Pb) was applied. Titanium and zirconium oxides were added and the bluish tone could be achieved by means of using the Zr-V blue pigment; the uneven textural features observed by POM and SEM mainly respond to their manual processing. In the replaced panels, ceramic bodies contain a high amount of quartz inclusions; the similar size and shape of these inclusions as well as the very even texture of glazes are primarily due to the mechanised manufacturing of the replaced panels. Glazes are also leaded (40 wt% Pb), zinc oxides were added and Cu^{2+} ions provide the turquoise color of the string pieces.

Regarding the *trencadiç* of the basin, the original tiles were made from calcium-rich clays, so the Sevillian company that manufactured the interior decorative ceramics could also process these tiles. The repair ones were deliberately elaborated to be stronger than the original ones, chiefly by adding more quartz inclusions and firing at higher temperatures. From the mineral paragenesis detected by XRD, it can be inferred that original tiles were fired at temperatures higher than 800 ºC and the replaced tiles at temperatures higher than 900 ºC. Glazes display a heterogeneous texture with abundant particles, a lead content over 22 wt% was determined; VI-Vis pointed out that the blue color of original pieces is mainly due to the presence of Co^{2+} ions and the green color of the replaced ones is achieved by the existence Co^{2+} and Cr^{6+} ions. [figure 3]

—Artificial stone, stone imitation coatings and joint mortars

Artificial stone, stone imitation coatings and/or joint mortars are widely used at both the façades and the surrounding wall. The employment of these materials was conceived by Palacios from the beginning of the project. Indeed, the construction section of Palacios (1909) points out the use of artificial stone. On the one hand, he wanted to enrich the façades texture by applying joint mortars. On the other hand, he conceived the use of artificial stone as modernity distinctive. Besides, in some areas and mainly to avoid a costs raise, he used stone imitation coatings that imitated the limestone in color and roughness.

During the 60s, a very thick and straight joint mortar was applied at the external face of the surrounding wall. Later on, during the 80s, different interventions were performance: the artificial stone was cleaned and new artificial stone was made to replace some elements; some original stone imitation coatings were preserved -and cleaned- and others were replaced; some joint mortars were also conserved as well as cleaned, and in some areas new joint mortars were applied. In the 2006-2008 restoration, both artificial stone and stone imitation coatings were entirely preserved -they were cleaned and painted again- and the joint mortars were replaced almost entirely.

Results from POM, XRD and SEM-EDS studies pointed out that the artificial stone, stone imitation coatings and joint mortars studied are mainly composed of silica and/or calcitic aggregates with lime and/or cement as binders. The detection by means of XRD and/or SEM-EDS of belite, alite and/or gehlenite mineral phases revealed if natural or artificial cement (Portland) was used. While belite and gehlenite are normally formed in natural cements, alite mineral phase defines artificial cement (Lea 1976; Callebaut et al. 2001: 400, 402).

Therefore, the original artificial stone is made of natural cement and the one placed during the 80s is made of lime and artificial cement. Related to the limestone imitation coatings, the original ones were made using also natural cement; those elaborated at the 80s are constituted by aggregates obtained from the crushing of limestone and lime binder. Regarding joint mortars, original gypsum mortars within joints have been identified; the thick joint mortar that before the 2006-2008 intervention was at the external face of the surrounding wall (applied by the 60s) was made of silica aggregates and artificial cement binder. The joint mortar placed during the 2006-2008 intervention was composed of calcite aggregates and lime binder. [figure 4]

Figure 3.- Decorative ceramics: ceramic panels and tile *trencadiç*. a: upper part of façades decorated with ceramic panels; b: original raindrop tiles on the body of the central fountain; c: basin of the fountain adorned with tile *trencadiç* -original tiles (1) and tiles placed at 80s (2)-; d: original tiles manufactured by Zuloaga and e: tiles elaborated at 80s (both SEM-BSE mode images) -differences on texture and on ceramic body/glazes contact were observed-; f: polarised optical micrograph of the original tile *trencadiç* (crossed nicols), quartz inclusions in ceramic body and the glaze applied on the ceramic body were observed.

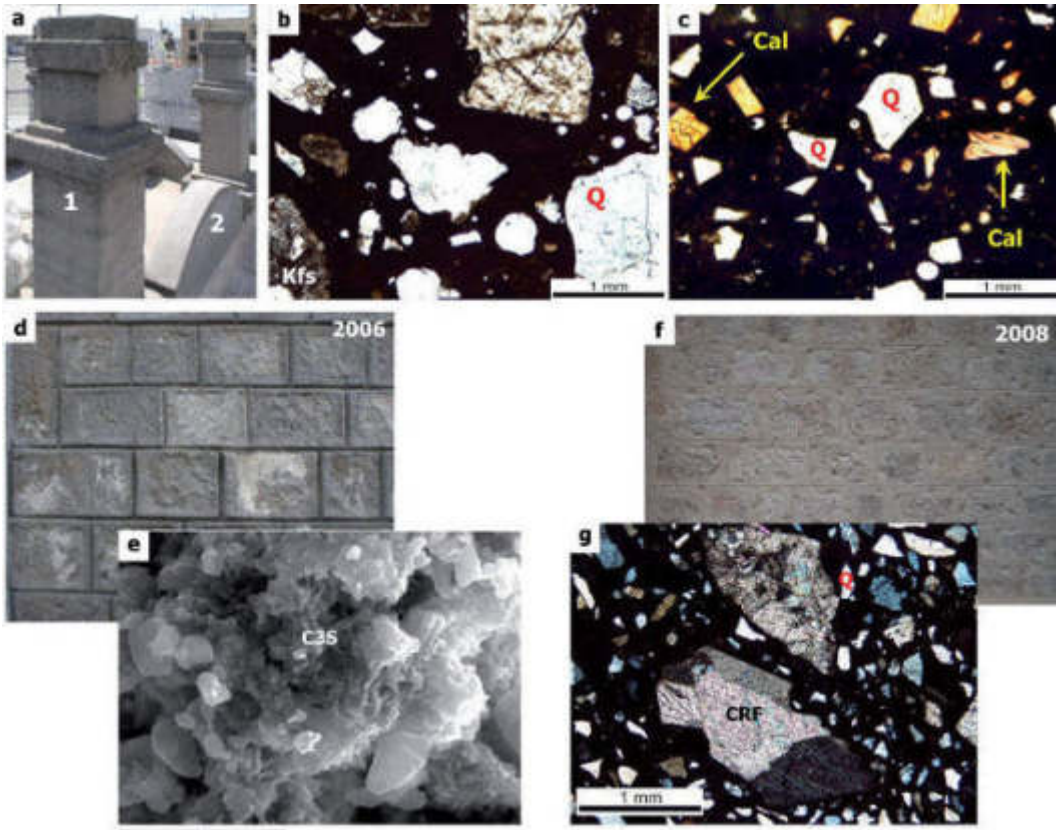

Figure 4.- Artificial stone, coatings and joint mortars. a: top construction elements made by artificial stone -original elements (1) and replaced at 80s-; b: polarised optical micrograph corresponding to original artificial stone and c: to replaced one (both crossed nicols) -quartz (Q), potassium feldspar (Kfs) and calcite (Cal)-; d: joint mortar applied at 60s and e: observed by SEM-SE mode, with alite (C3S) phase mineral presence; f: joint mortar placed in 2006-2008 restoration and g: observed by polarised optical microscopy (crossed nicols) -quartz (Q) and calcitic rock fragment (CRF)-.

Conclusions

Regarding to the building materials used at the Former Hospital of Maudes, the search of documentary resources allowed to know about the main role of natural stone at Palacios´ constructions, how the limestone and ceramics participated on the message that the architect desired to provide to the property or why Palacios decided to used ceramics or artificial stone since the beginning of the project. Moreover, such resources pointed out, on the one hand, the limestone provenance in quarries located at the Southeastern of the region (Community of Madrid). On the other, that this limestone was very competitive because of its relatively easy extraction and transport by rail directly from the quarry.

The information achieved from the analytical studies permitted to confirm the provenance of the limestone and to relate its petrographic features with its good behavior as a very resistant building material. Besides, more information on raw materials and technologies used to produce decorative ceramics, both original and replaced ones, was provided. Physical and chemical data from the characterization of the artificial stone, stone imitation coatings and joint mortars were achieved. In addition, as the external joint mortars were almost completely removed in the last intervention (2006-2008), the data provided entailed a valuable document. Such knowledge pointed out a criterion for establishing whether ceramics, artificial stone, mortars and stone imitation coatings were original or not. Therefore, it would enable its new manufacturing if new replacement operations were necessary.

This study tried to entail a commitment with the better knowledge, dissemination and preservation of the building materials used in the Former Workers Hospital of Maudes, Madrid (Spain). If people in charge of these building materials conservation are aware of their heritage value, it would be much more possible to accomplish respectful interventions that may ensure the adequate conservation of the property.

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Stone provenance and conservation of the Trinitarias Descalzas of San Ildefonso convent, Madrid (Spain)

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Abstract: The characterization of building stones used in monuments and the location of their historic quarries is key for maintenance and restoration works. The four most representative building stones of Madrid: flint, granite, Cretaceous dolostone and Miocene limestone, have been used in the Trinitarias Descalzas of San Ildefonso convent of this city. A plaque of Carrara marble was placed on the convent façade in honour of the Spanish writer Miguel de Cervantes in 1870.

The decay of the stones was determined by characterization techniques such as optical polarization and fluorescence microscopy and spectrophotometry. This technique gave information about the colour change between the plinth granite of the convent and quarry granite where it was extracted. The historical documentation complements these data.

Key words: provenance, preventive conservation, building stone, microcracks

Procedencia y conservación de la piedra del convento de las Trinitarias Descalzas de San Ildefonso de Madrid (España)

Resumen: La caracterización de piedras utilizadas en monumentos y la ubicación de sus canteras históricas es clave para los trabajos de mantenimiento y restauración. En el convento de las Trinitarias Descalzas de San Ildefonso de Madrid se han utilizado las cuatro piedras de construcción más representativas de esta ciudad: sílex, granito, dolomía cretácica y caliza miocena. En 1870 se colocó una lápida tallada en mármol de Carrara en la fachada principal en honor al escritor Miguel de Cervantes.

El deterioro de las piedras se determina con técnicas de caracterización como microscopía óptica de polarización y de fluorescencia, así como la espectrofotometría que da información sobre el cambio de color que han experimentado las piedras con relación a las extraídas en cantera. La documentación histórica complementa estos datos.

Palabras clave: procedencia, conservación preventiva, piedra de construcción, microfisuras

Introduction

Much of the built heritage that exists today was made in times when current decay agents that can reach and degrade it were not known. Today these buildings are vulnerable to these agents, natural or man-made, which act continuously or in short periods of time. The risks affecting building heritage should be evaluated using different techniques (Del Egido 2013: 7) to define prevention strategies as the heritage stones are irreplaceable and are part of the human history and therefore its preservation is of utmost importance (García 1999; Rodríguez 2009: 246). As various disciplines are involved in conservation, decisions on preservation or restoration of the built heritage must be consensual. It is essential to carry out a preliminary investigation before undertaking any intervention (Gómez and Gómez 2001: 640; Gómez 2008). European directives and the scientific community advocate preventive conservation against the interventional conservation done in the past, which means that causes of decay should be identified and measures taken to mitigate against them (Bruquetas 2014: 12). Conservation and restoration are complementary actions and a restoration program must always include appropriate methods of safeguarding, maintenance and prevention of damage (Cirujano and Laborde 2001: 696).

The convent of Trinitarias Descalzas of San Ildefonso (CTDOSI) in Madrid (Spain) was installed in houses of the Cantarranas street in 1612, today known as Lope de Vega street (Tovar Martin1974). The first work was the construction of a small provisional church where the Spanish writer Miguel de Cervantes Saavedra was laid to rest in 1616.

The demolition of the church and some houses began in 1673. A new church was built on Cantarranas street. The first mass in the church was held in 1697. The façade of the church is composed of three levels. There are three arcades occupying the entire width of the façade in the first level. These arches are carved in granite. On the second level a central bas-relief and three coats of arms are prominent. Two are located on the sides of the bas-relief and the other is above it. Above both lateral shields there is a crown and a porthole and above the central shield there is a crown and a central window with jambs and lintels of granite. The third level features a triangular pediment brick bordered by granite ashlar and in whose centre a porthole opens also with a granite edge which finishes off the church. The pediment is crowned by a central cross and lateral decorative vases of granite. Corner stones of granite are on both sides of the main façade of the church.

Once the church was completed, the new convent was built. Neighbouring houses were bought and reformed to form the present convent between the streets of Huertas and Lope de Vega until the eighteenth century. The plinth is the structural element where more building stones have been used [Figure 1] , since the building's walls are built with bricks. The convent was declared a national monument in 1921. The Royal Spanish Academy restored the church in 1869 and 1939 to prevent its possible demolition. Today the convent is listed as a building of cultural interest.

The objectives of this paper are to determine the stones used in the construction of the convent and their origin quarries and the decay that occurs in the granite plinth to ensure that in future interventions restoration work uses original stones or stones with similar characteristics.

The geological history, petrographic and petrophysical properties of building stones in addition to climate, pollution and conditions of use, in conjunction with other factors influence the durability of building stones (Fort et al. 2011: 142; Sousa 2014: 584). When the stones are subjected to temperature changes (Gómez-Heras, 2006, 2008, 2009; Liu et al. 2015; Vazquez et al. 2016), humidity (Freire-Lista and Fort 2016: 239) and urban environment are more susceptible to decay (Pérez-Monserrat et al. 2013: 1076; Sajid et al. 2016: 53).

Methods & methodology

An intensive search of historical documentation was done. Historical documents have provided data about stone provenance and historical photographs have provided information about materials used during interventions in the last centuries.

A small granite sample was taken from the plinth. A thin section from this sample was impregnated with fluorescein. Sawing was performed at a low speed (120 rpm) and a low strain so as not to generate microcracks.

Figure 1.- The three façades of the Convent of Trinitarias Descalzas of San Ildefonso (Madrid).

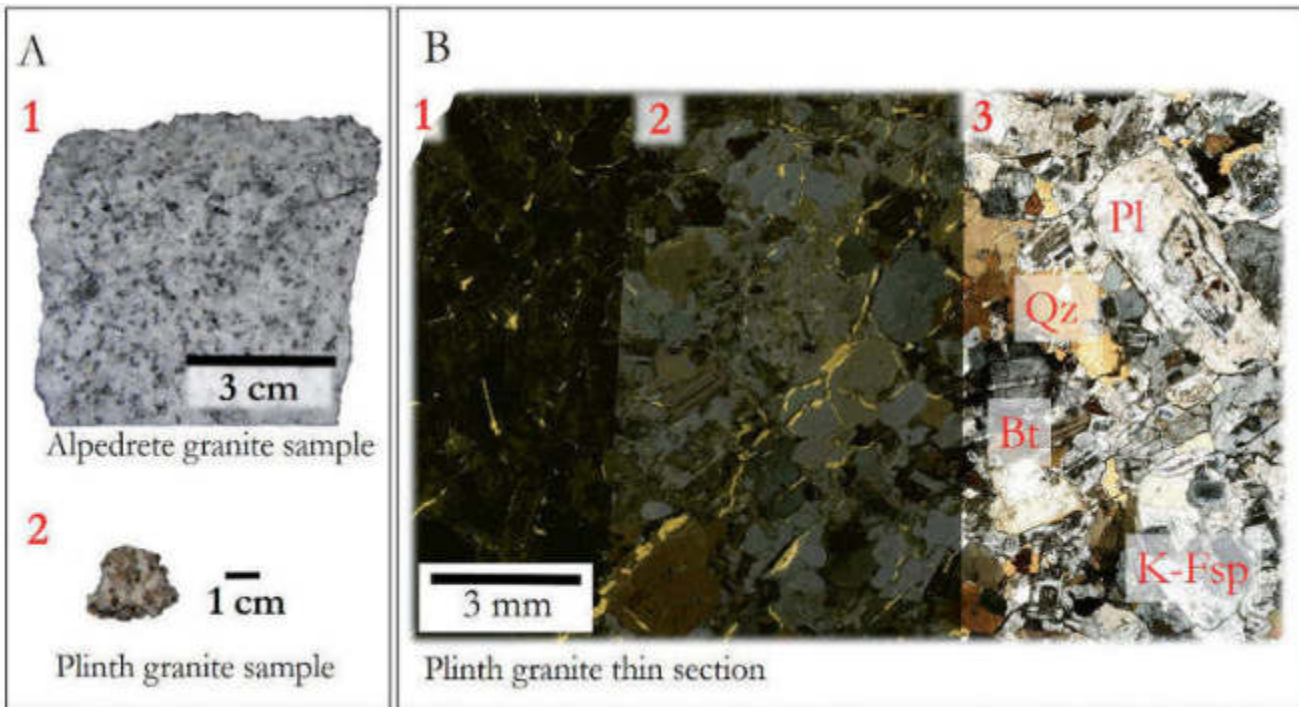

Figure 2.- A: Granite samples. A1. Fresh granite sample from an Alpedrete quarry. A2. Plinth granite sample. B thin section removed along a granite ashlar sample from CTDOSI plinth. B1: Fluorescence light micrograph mosaic, showing microcracks. B2: Fluorescence micrograph mosaic overlaid on polarized micrograph mosaic showing microcracks and mineralogy; B3: crossed nicols mosaic; Biotite (Bt), quartz (Qz), plagioclase (Pl), Potassium feldspar (K-Fsp).

Granite was characterized under an Olympus BX 51 polarized light microscope fitted with a DP 12-coupled (6 V/2.5 Å) with an Olympus digital camera and Olympus DP-Soft software (version 3.2). Microcracks were characterized with the same equipment configuration by adding a mercury lamp and fluorescence microscopy Olympus U-RF-T. Photomicrographs were performed with both polarized light and mercury lamp light. With the photomicrographs of each microscopic technique a mosaic made up of 120 photomicrographs with an area of approximately ± 4 cm^2 was built. Polarization microscopy has been used to study mineralogy and texture and fluorescence microscopy to study microcracks [Figure 2]. Six equidistant lines (1.5 cm each) were drawn on the fluorescence micromosaic and microcracks intersecting the six lines were counted (Freire-Lista et al., 2015a). The result of the count number was divided by 90 to obtain the linear microcracks density (microcracks per millimeter) (Sousa et al., 2005: 158). A sample from an Alpedrete quarry, located at coordinates 40.662563, -4.013308, was taken to compare the colour between the granite from the quarry and the CTDOSI plinth [Figure 2A]. Once the plinth granite sample had reached a constant mass, 10 colour measurements were taken. These measurements were averaged. Granite colour was measured with a Minolta CM-700d / 600D with a CM-S100 W COLOR DATA Software SpectraMagic NX spectrophotometer.

The CIELAB system (CIELAB, 1976) colour parameters were used: luminosity (L*), red to green coordinate (a*) and blue to yellow coordinate (b*). The Spanish and European standard UNE-EN 15886, 2011 yellow (YI*) and white (WI*) indices were obtained. The overall colour change, $\Delta E^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$ was determined.

Historical books and documents of the convent were used to determine the provenance of flint used in the plinth, the stones used in the coat of arms, crowns, bass-relief and memorial plaque.

Results & discussion

—Characterization and origin of CTDOSI stones

The stones used in the CTDOSI are those that are traditionally used in Madrid (Fort et al. 2013: 421). These include flint, Alpedrete granite, Cretaceous dolostone and Miocene limestone of the Madrid basin. Some of these stones have been reused from the houses that were previously on this site. Thus, the convent has plinth masonry sections with flint and granite ashlars. Plinth of the Huertas street is composed by granite ashlars. The plinth of Costanilla de las Trinitarias street is composed of masonry flint. There are granite ashlars and rough flint stones in the plinth of Lope de Vega street [Figure 1].

All CTDOSI façades were coated with lime plaster in 1889, and the plinth was plastered in 1899. This plaster was removed after the Spanish Civil War, leaving the brick and stone faces exposed as currently preserved [Figure 3].

Figure 3.- Top: Photography by the 1930s (Before the Spanish Civil War of 1936-39). Bottom: Current photographs (2016).

The original granite ashlars have very similar characteristics and therefore correspond to the same extraction area. Granite is a hypidiomorphic monzogranite, equigranular of fine to medium crystal size, petrography identical to Alpedrete granite, which has been nominated as a 'Global Heritage Stone Resource' due to its significance in the built heritage of Madrid. (Cooper et al. 2013, Freire-Lista et al. 2015 c, d). The analyzed thin section has mainly intercrystalline and transcrystalline microcracks (Figure 3B). The granite linear microcracks density is 0.7.

Chromatic parameters of the CTDOSI plinth are represented in Table 1. The ΔE* between CTDOSI plinth granite and Alpedrete granite extracted in an active quarry is 11. Plinth granite yellow tones are due to the ashlars extracted from a shallow quarry and therefore they are more altered [Figure 3A] in addition to the decay *in situ*. Therefore the granite building is more altered than the quarry and it has more yellow tones and less luminosity. Figure 4A shows a granite ashlar of the convent plinth with bush-hammered marks, the traditional finishing of granite ashlars in Madrid.

Flint used in the plinth [Figure 3B´ and 4B] comes from quarries around Madrid, probably from Vicálvaro, at Cerro de la Mesa quarries (latitude and longitude coordinates: 40.416783, -3.590903). The rock that contains flint is a micritic limestone. Different types of flint, in colour and quality, have been identified. Silicification initially gave rise to opal, which diagenetic weathering subsequently transformed into quartz (Bustillo et al. 2012: 239).

The ornamental part of the building (coat of arms and bass-relief of the church) are carved from creataceus dolostone [Figure 4C and D] (Tovar Martín 1974, 1990). This stone is formed by rhombic dolomite crystals. It is occasionally banded because remnants of its original depositional texture (stromatolitic structures) are preserved. The crystals are microcrystalline, equigranular (<50 μm) and dark, with few mottled cores. Porosity is high and poikilotopic and blocky mosaic cements predominate. The presence of localized iron oxyhydroxide deposits gives this stone its reddish colour (Fort et al. 2013: 423).

The stone used for the crowns [Figure 4C and D] is an Upper Miocene limestone from the Madrid sedimentary basin. It is classified as a lacustrine biomicrite/biosparite formed by a bioclast skeleton (40% characeae, ostracods and gastropods) and a paste where the micritic matrix (20–30%) alternates with sparitic cement (30–40%). The micrite is a cryptocrystalline mass, calcitic in composition and dark-coloured (Fort et al. 2013: 423).

The commemorative plaque of Cervantes is carved in Carrara marble from the western central area of the Apuan Alps, Tuscany region-Italy. It is a marble lithotype of homogeneous composition of highly uniform white colour, variety commercially identified as Michelangelo marble statuary. This plaque was installed in the convent in 1870 [Figure 4E].

—Stone decay of the CTDOSI

Pollution agents change over the centuries (Cassar 2016). The convent was built in a rural environment on the outskirts of Madrid and now it is in the city center with pollution and subject to an important tourism flow.

Alpedrete granite has suitable properties to combat humidity and capillary rise. However intrinsic, anthropic or weathering microcracks (Sousa et al. 2016; Kronlund et

Table 1.- Chromatic parameters of CTDOSI plinth granite and quarry granite.

	L*(D65)	a*(D65)	b*(D65)	WI(E313-73)	YI(E313-73)
Granite plinth	62.6	1.0	9.9	6.0	20.6
Granite quarry	69.3	-0.6	1.0	34.9	1.8

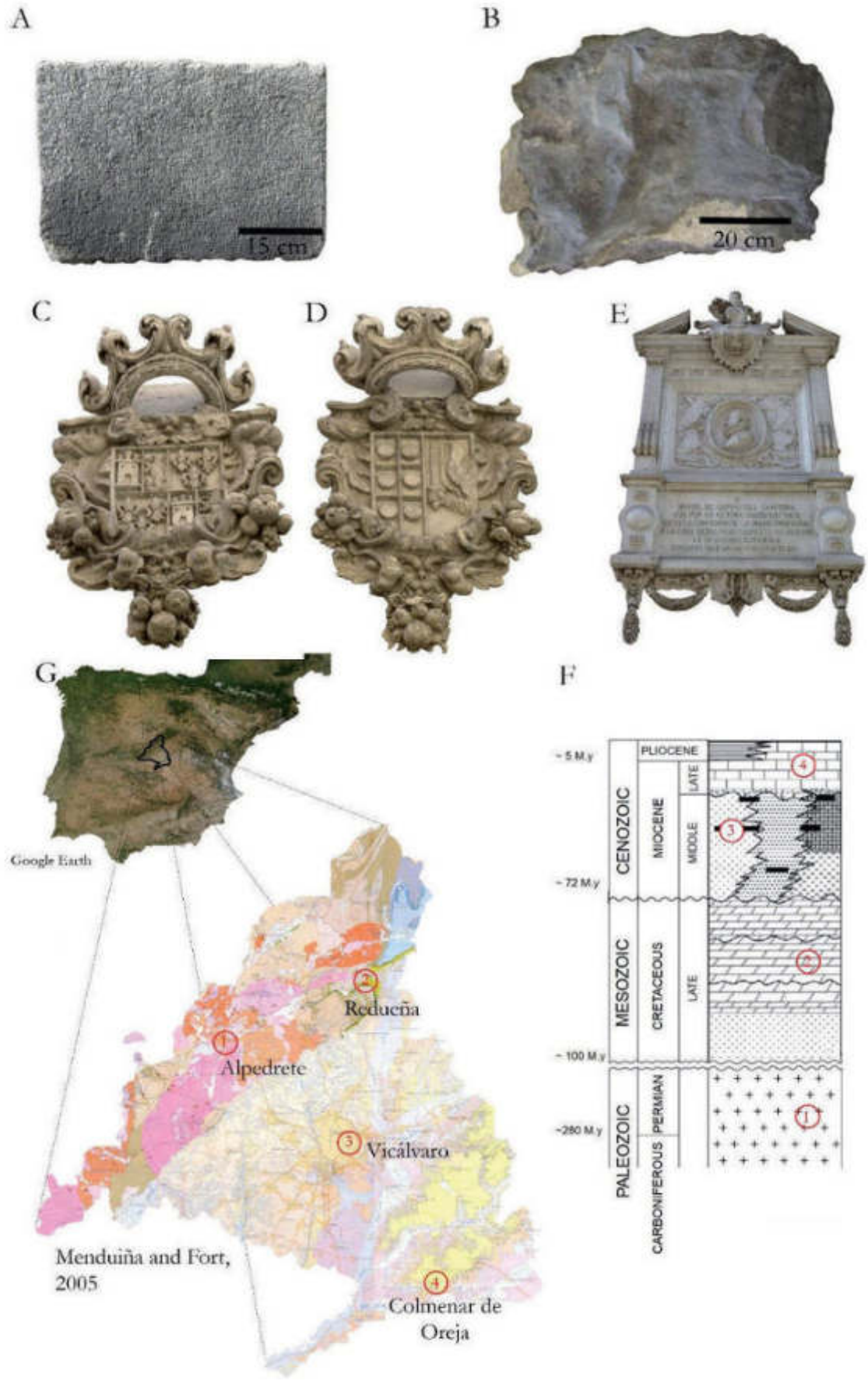

Figure 4.- A: Granite ashlar of the plinth. B: Rough stone of plinth flint. C and D: Lateral crowns: Miocene limestone from the Madrid Basin, Coat of arms: Cretaceus dolostone. E: Carrara marble. F: Location of the historic quarries. G: Schematic stratigraphic column of Madrid area. Showing only those units from which stones was extracted to build the convent. Modified of Fort et al. 2013.

al. 2016) like those induced by bush-hammering, produces coalescence of microcracks and creation of a microcracked area between 1-3 mm from the surface which may generate scaling (Freire-Lista and Fort 2016: 937, 2017: 90). Generally the outer surface of granite ashlars follows the exfoliation microcracks direction, so that microcracks are perpendicular to the ground. The water capillary rise along the exfoliation microcracks is a factor contributing to significant decay. Comparing current and historical photographs has revealed that the most deteriorated granite ashlars are located where there are downpipes. Saline efflorescences (Lopez-Arce et al. 2010), microcracks (Siegesmund et al. 1991, 1993), soiling, rounding and granular disaggregation (due to the loss of quartz crystals, potassium feldspars and plagioclase alteration) (Freire-Lista et al. 2015b), fragmentation (Vasconcelos et al. 2008), biological colonization by micro-organisms (Sanjurjo et al. 2011), black crust (Casal Porto et al. 1991; Silva et al. 2009) and anthropic decay (Rivas et al. 2012; Pozo-Antonio et al. 2016) are the most important forms of decay in the CTDOSI plinth.

The traditional finishing of masonry flint is coarse with conchoidal fractures. These fractures generate planes which have a very smooth surface without internal microcracks due to microcrystalline grain size of the flint. The rough stone flints have a better performance against decay agents.

The dolostone coat of arms shows loss of cohesion and soiling. The limestone of the lateral crowns is, along with the flint, the best preserved stone because lateral limestone crowns have been installed in the CTDOSI more recently [Figure 3A and A´].

The Carrara marble is generally in good condition, its black patina has been eliminated in the subsequent restoration after the Spanish Civil War [Figure 3B and 3B']. Its surface has slight dissolution and increased surface area, which increases vulnerability to decay.

The Huertas street façade has been modified. Doorways have been built by replacing original granite with lower quality artificial materials like ceramic tile. The use of Portland cement between ashlar joints and covering them may also be observed, as well as granite cladding plaques with differing dimensions to the original ashlars have been placed in the lowermost part of the plinth and graffities were painted [Figure 5]. Architecture, restauration and the urban planning must be focused on sustainable conservation (Compitello 1999, Larson 2003).

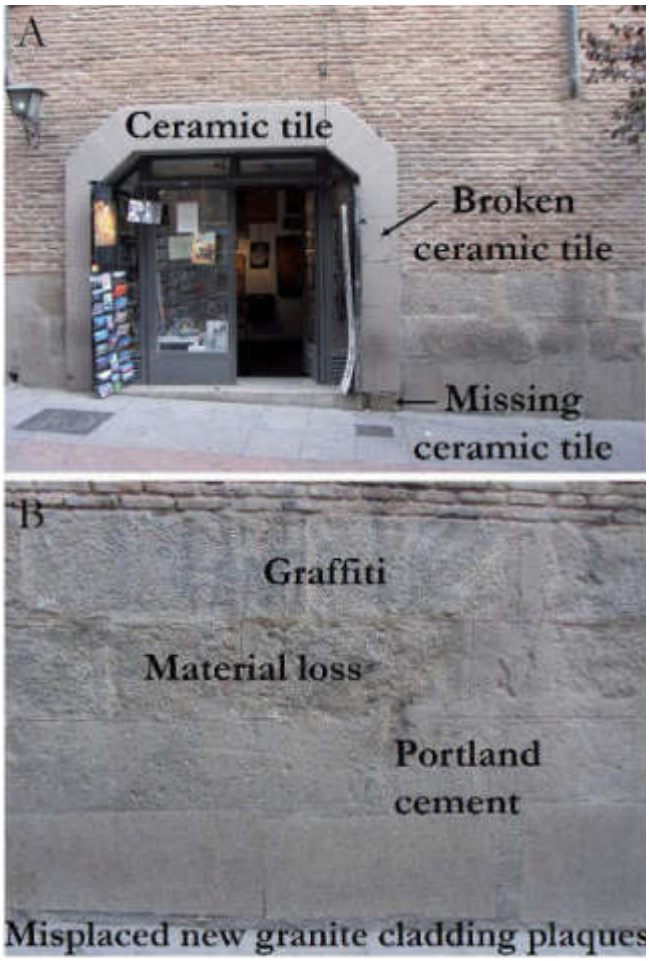

Figure 5.- CTDOSI plinth facing Huertas Street. A: Granite replacement by ceramic tile. B: Anthropic decay in the plinth.

Conclusions

CTDOSI preserves most of the original building stones. Knowledge of stones, historic quarries and causes of stone decay are necessary for conservation interventions, especially for reintegration of damaged ashlars and replacing the original stone with compatible materials. Each type of stone that forms the CTDOSI has a different response to decay agents to which they are exposed. CTDOSI features flint masonry plinth on the façades, which face towards Lope de Vega and Cuesta de las Trinitarias streets. Granite is in ashlars of the plinth, arcades of the church façade, corner stones and other elements such as jambs and lintels. The coats of arms are carved in dolomitic stone and the crows are in Miocen limestone of the Madrid basin. The Cervantes commemorative plaque is carved in Carrara marble. The stones show loss of cohesion, soiling, scaling, saline efflorescences, anthropic decay and microcracks (detected by fluorescence microscopy techniques). The granite is beginning to yellow. The flint stones are the best preserved.

Madrid flint originates from ancient quarries near Madrid while the dolomitic stone corresponds to the Cretaceous formations of Madrid. Granite is from Alpedrete pluton and limestone probably from Colmenar de Oreja quarries both in Community of Madrid.

The type of maintenance or cleaning to be applied to these centuries-old stones will be influenced by the decay type, finish and mineralogy, taking special care in the most damaged granite ashlars.

Granite ashlars of the plinth present a colour difference of 11 with respect to that currently being mined at the quarry. For this reason, when replacing ashlars they should be used from more superficial quarry stones. The surface finishing of the replaced ashlars should be the same or similar to those already *in situ*.

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Ge-conservación
Conservação | Conservation

How to evaluate shelters for archaeological sites: some recommendations based on the use of exposure trials

Cristina Cabello Briones

Abstract: Shelters are commonly considered effective preventive conservation methods for excavated archaeological sites. However, archaeological remains covered with shelters are still deteriorating in many cases, and the shelters can even exacerbate the damage. Therefore, regular evaluations of the shelter behaviour are extremely important. This paper presents a summary of the main approaches to shelter performance assessment carried out to date. In addition, the application of geomorphological methods to heritage conservation has been reviewed. The objective is to determine their suitability for the evaluation of shelters. This paper also presents the main results from the study on the shelters at the Bishop´s Palace (Witney, England) and Hagar Qim (Malta) on limestone conservation using exposure trials. To conclude, recommendations based on the case-study sites have been made to improve the effectiveness of future approaches.

Key words: shelters, archaeological sites, preventive conservation, limestone, exposure trials, the Bishop´s Palace, and Hagar Qim.

Cómo evaluar las cubiertas para yacimientos arqueológicos: algunas recomendaciones basadas en ensayos de exposición de probetas

Resumen: Las cubiertas son frecuentemente consideradas métodos efectivos de conservación preventiva para yacimientos arqueológicos excavados. Sin embargo, los restos arqueológicos cubiertos siguen deteriorándose en muchos casos, y las cubiertas pueden incluso exacerbar el daño. Por lo tanto, inspecciones regulares del comportamiento de la cubierta son extremadamente importantes. Este artículo resume los principales enfoques en la evaluación de la actuación de las cubiertas hasta la fecha. Además, la aplicación de métodos geomorfológicos para la conservación de patrimonio ha sido revisada. El objetivo es determinar su idoneidad para la evaluación de las cubiertas. Este artículo también presenta los resultados principales del estudio sobre las cubiertas del Palacio del Arzobispo (Witney, Inglaterra) y Hagar Qim (Malta) en la conservación de piedra caliza usando probetas. Para concluir, se han incluido recomendaciones basadas en los casos de estudio para mejorar la efectividad de futuras estrategias.

Palabras clave: cubiertas, yacimientos arqueológicos, conservación preventiva, piedra caliza, exposición de probetas, el Palacio del Arzobispo y Hagar Qim.

Introduction to shelters for archaeological sites

Shelters are commonly considered one of the most effective methods of preventive conservation for excavated archaeological sites (Roby, 2006). They attempt to provide optimum conditions for the preservation of the remains. They are also considered to be less intrusive than remedial treatments.

It is generally agreed that the main criteria for shelter design are long-term maintenance, cost efficiency, materials and design, public access, and non-intrusion into archaeological deposits (Rivero Weber, 2011, Zanelli, 2015). In this respect, the visual interaction of the shelter with the landscape is especially emphasised (Pesaresi and Rizzi, 2007, Michaelides and Savvides, 2008). However, all of these values must be balanced with the necessity of physical protection for the archaeological materials when a shelter is designed (Cassar et al., 2001, Aslan, 2007).

As shelters can provide a physical barrier to rain and direct sunlight, appraisals of shelters in the literature have generally been based on the idea that covering a site will always be better than leaving it exposed to the environment. However, shelters do not reduce environmental damaging factors and/or keep the microclimate stable in most cases (Demas, 2013). For example, the open shelters made of metal panels over

adobe remains in Joya de Cerén (El Salvador) were found to be affected by excessive air infiltration and strong winds from outside (Maekawa, 2006). Another example is the glass enclosure over the mosaics at Villa del Casale (Italy) characterized by frequent temperature and relative humidity fluctuations and extreme values (Ministero per i Beni e le Attività Culturali and Instituto Centrale per il Restauro, 2006). Furthermore, shelters may have a negative impact on archaeological features. In a survey conducted by the Israel Antiquities Authority, it was found that half of the 106 mosaics covered with shelters were still deteriorating deteriorating and that, in some cases, the shelters were exacerbating the damage due to insufficient roofing and lack of drainage or maintenance (Neguer and Alef, 2008).

Shelter effectiveness has been commonly evaluated by a qualitative point factor system (Cacace et al. 2006). More than 100 sheltered archaeological sites in Italy were evaluated with this system (Laurenti, 2001). Aspects such as the morphology of the archaeological area, materials used for shelter construction, state of building components, and functionality were studied. It was found that only 38.7% of the shelters were considered efficient. For example, the transparent roofs of the House of Ariadne at Pompeii were classified with a score of 5.5 (intermediate protection). However, a study on the murals paintings in 2008 demonstrated that the shelters were enhancing excessive temperatures, particularly in summer and, as a result, a new shelter made of opaque sheets of cement was constructed the following year (Merello et al., 2013). This second assessment was determined after undertaking microclimatic monitoring. This demonstrates that visual assessments rarely provide a complete understanding of the problems affecting a site when used on their own. Although some other publications gathered the results of extensive environmental monitoring programmes (Stewart et al., 2004, Siegesmund et al., 2012, Becherini et al., 2016), most of the studies on shelters are merely descriptive (Demas, 2013), and a more critical review of the effectiveness of the shelters is required (Zanelli, 2015).

Assessments of shelter behaviour should be based on the identification of possible decay factors and analysis of environmental data, but also an evaluation of the material decay and shelter condition (Tringham and Stewart, 2008). However, to date, few studies that have provided a scientific explanation of the decay processes affecting a site based on these aspects (Getty Conservation Institute and Instituto Hondureño de Antropología e Historia, 2006). This could be the result of project limitations such as those related to budget and duration. An alternative could be found in the use of geomorphological approaches (Cabello Briones, 2013).

Introduction to geomorphological methods

The main geomorphological approaches to studying stone weathering at heritage sites are in situ investigations, laboratory tests and on site exposure trials. In situ assessments are based on direct measurements and analyses on materials from the site. For example, micro-erosion measurements to monitor surface recession rates (Trudgill et al., 2001) or analyses of decay products to evaluate the conservation state of ruins (Doehne, 1991, Moropoulou and Bisbikou, 1995). Some authors, such as Siedel (2011), believe that in situ investigations may provide more reliable information about weathering than exposure trials or laboratory tests. However, original materials are usually altered by past interventions or deterioration patterns, which can change the response under current weathering conditions (Viles, 2013). This makes observed weathering phenomena difficult to extrapolate to other cases or even to other parts of the same site. In addition, sampling using invasive techniques may compromise the structural integrity and aesthetic quality of original surfaces, and destructive analysis causes material loss. Therefore, they have been criticised in the conservation field (Carson and Giacomo Chiari, 2010).

Laboratory tests simulate the impact of certain degradation factors on specially prepared specimens under controlled conditions. For this purpose, it is frequent to use environmental cabinets, where samples are subjected to conditions in excess of the magnitude and/or frequency that would be expected in real-life situations. For example, Laycock et al. (2008) used accelerated laboratory tests to select a replacement stone for Truro Cathedral, England. To test their suitability, several stone types were subjected to sodium sulphate crystallization and freeze-thaw tests, following national standards. Laboratory tests are designed to measure decay in a replicable way so results benefit from comparison with other studies, but they have been criticised for their lack of representativeness of historic buildings (Viles, 2013). Although results can be obtained in months, these tests do not reproduce natural conditions and it may be unrealistic to transfer the results to real monuments, where diverse combinations of factors might be acting (Trudgill and Viles, 1998).

Exposure trials consist of placing stone samples (discs, tablets or blocks) in real-life conditions. Their behaviour may be employed as an indicative 'sensor' of decay under complex environmental conditions. The specimens can be brought into the laboratory at intervals for evaluation, which can provide a link between laboratory simulations and field observations (Trudgill and Viles, 1998). Exposure trials last from a few months to determine early stages of decay (Viles, 1990) to several decades to establish dose-response functions (Tidblad et al., 2001). Although there have been some attempts to implement this approach to the study of shelters, the result is of limited success because shelters are not similar in typology (Ministero per i Beni e le Attività Culturali and Instituto Centrale per il Restauro, 2006).

Materials & methods

The shelter assessment at Hagar Qim (Malta) and the Bishop's Palace (Witney, England) [figure 1] was based on the use of exposure trials. The objective was to determine their suitability for the evaluation of shelters and draw some recommendations to improve the effectiveness of future approaches. Analytical investigations of the exposed stones samples were complemented with visual surveys of stone remains and shelters, and environmental assessments. The methodology was intended to be simple and low-cost so it could be applied widely (Cabello Briones, 2016a).

Four replicates (90x90x30 mm) of Portland, Cotswold, Chalk, Globigerina and Coralline limestones were placed outside, on the periphery and inside the shelters [figure 2]; Portland, Cotswold and Chalk stones were used at the Bishop´s Palace between August 2012 and July 2013, and Globigerina and Coralline stones at the Bishop´s Palace and Hagar Qim for a comparative study between August 2013 and July 2014. The samples were cut from fresh quarried limestone, and their different types were chosen to represent different degrees of vulnerability to decay [table1].

Figure 2.- Globigerina and Coralline limestone blocks with hygrochrons attached with synthetic rubber in a ring-shape (Cabello Briones, in press).

Changes in the following stone properties were documented periodically at regular intervals: weight (Sartorius AG Göttingen balance), elasticity (M-K5, Grindosonic), hardness (Equotip 3, Proceq), ultrasonic pulse velocity (UPV) (Pundit Lab, Proceq), colour (CM-700d, Konica Minolta) and general appearance (USB optical microscope VMS-001, Veho). The results were compared with control samples that were stored

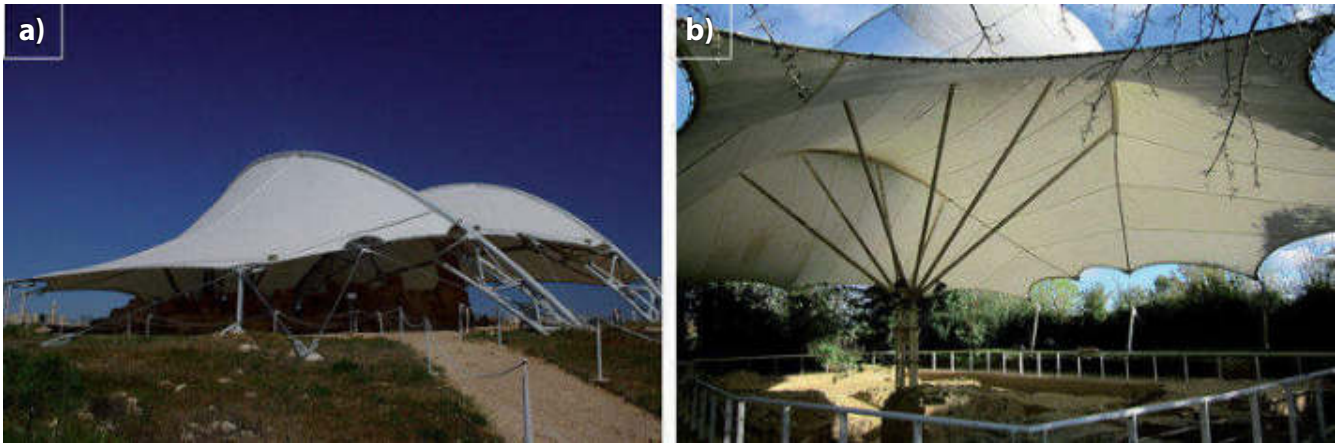

Figure 1.- Hagar Qim (Malta) and b) the Bishop´s Palace (Witney, England), both covered with glass fiber and PTFE open shelters (Cabello Briones, in press).

Table 1.- Physical properties of the stones used in this study (Cabello Briones, in press).

		Portland	Cotswold	Chalk	Globigerina	Coralline
BS EN 3755:2008	Water absorption at atmospheric pressure (Ab)	6.96%	12.52%	18.51%	14.75%	3.36%
BS EN 1936:2006	Open porosity (Po)	14.46%	22.02%	31.17%	31.18%	11.01%
BS EN 1936:2006	Apparent density (ρb)	2100 Kg/m3	2375 Kg/m3	1773 Kg/m3	1789.72 Kg/m3	2356.52 Kg/m3

in the laboratory for the duration of the study period. These techniques have been extensively used to measure a wide range of decay processes (Nicholson, 2002). Additionally, low-cost and non-destructive equipment was selected to reduce costs and minimise the need for many replicates. Temperature, relative humidity and wetting events were measured using dataloggers (i-button® hygrochrons, and Tinytag® leaf wetness logger). The number of NaCl crystallisation cycles and frost events were derived from temperature and relative humidity RH data (Sabbioni et al., 2010).

Additionally, twelve Portland limestone tablets (50x50x20 mm) were attached to freely rotated carousels inside and outside the shelter at Bishop's Palace for 18 months in 2014 [figure 3]. Carousels allow more equal exposure of all faces, in addition to preventing samples from standing in water when it rains (Moses, 2000). Tablets were used to compare results on stone dissolution with those obtained from the NMEP project (Butlin et al., 1993). Examination by scanning electron microscope (JSM 5910 SEM, Jeol) was complemented with a study on salt ion content (Dionex ion chromatograph), pH of the rain (pH meter, Orion Model 410A) and NO_2 and SO_2 concentrations (Gradko® combined diffusion tubes).

Figure 3.- Free rotating carousel used in this study (Cabello Briones, in press).

Results

All stone blocks located outside the shelter at the Bishop's Palace lost more weight than those located inside, but particularly the Chalk and Globigerina. The outside blocks also changed colour to a greater degree and showed an increase in surface roughness. These samples were wetter for longer and were exposed to lower temperatures. Additionally, higher temperatures, temperature fluctuations and freezing events were reduced inside the shelter. On the other hand, the periphery tended to have higher RH values than the centre, and outside and an increase in temperatures in early afternoon during summer could be seen as a sign of a fault in the shelter design (Cabello Briones, 2014). Higher levels of RH on the periphery and outside the shelter are most probably responsible for biological growth observed at the site during the visual assessment and likely explain the observed discolouration.

Portland limestone tablets outside the shelter at Witney lost more weight due to the different microenvironmental conditions. These also changed significantly more in colour. As this is a relatively unpolluted site, the colour change could be of biological origin due to higher water availability. Salts tended to accumulate in sheltered tablets but, in comparison with the sites of the NMEP, the concentrations of sulphates, nitrates and chlorides were lower than expected due to a change in pollution regime since the 1980s (Butlin et al., 1993).

At Hagar Qim, temperature and RH outside the shelter fluctuated more than in the centre and on the periphery. Additionally, the temperature was higher outside the shelter than in the other two positions, especially in summer. However, a fault in the shelter design made temperatures increase on the periphery when the sun reached the ruins at specific times of the day in winter. The shelter was effective in reducing wetting events and subsequently, the possibility of biological growth on the ruins. However, alveolisation, often related to the action of salts, was found to be the main decay mechanism at the site after the preliminary visual assessment. Results in the weight changes indicate that limestone blocks could be affected by a combination of physical weathering due to temperature fluctuations and accumulation of salts, with the samples outside the shelter the most affected (Cabello Briones, 2016b). Globigerina blocks placed outside were more discoloured than those inside, but there was no significant difference for the Coralline blocks, which could indicate a natural weathering process.

In contrast to colour and weight changes, results for UPV, elasticity and hardness were consistently non-significant statistically, although this may change with a longer period of exposure.

Discussion & conclusions

Exposure trials are an established technique in the field of geomorphology but can be adapted to determine the effectiveness of open shelters on the preservation of limestone remains at archaeological sites. Short to medium term exposure trials provide evidence of early stages of decay and represent a compromise between the time available for a project and the time necessary to obtain indicative results. They are especially useful for projects with low budgets and/or with a limited time for research. This approach should always be accompanied by a visual inspection of the condition state of the remains and shelters, as well as environmental monitoring.

Exposure trials are not destructive for ruins themselves and allow a wide variety of techniques to be employed. In addition, replicates can strengthen statistical confidence because they minimise the influence of stone heterogeneities and differences in mineralogical and chemical composition. However, it may be difficult to match decay mechanisms seen in stone samples with those on the ruins themselves because of, for example, differences in the stone types and the influence of past interventions [table2].

Table 2.- Advantages and disadvantages of the methodology used in this study (Cabello Briones, in press).

Advantages	• Non-destructive for the ruins • More information than studying the ruins directly • Rapid results (early-warning method to detect decay) • Greater variety of techniques (destructive and non-destructive) • Stable conditions for measurements if taken to a laboratory • Possibility of having replicates for strong statistical results • Suitable for sites with low budgets • Suitable to be undertaken by non-experts • Adaptable by choosing different stone types or analytical techniques • Different positions can be studied with simultaneous monitoring of decay • No necessity to close the site to the public (samples are small and discreet) • Comparisons of sites/environments possible through the use of the same materials
Disadvantages	• May be difficult to match decay mechanisms seen in the stone samples with those on the ruins • Sample size could be too small to accurately represent conditions of the ruins • Samples can be stolen/lost

Table 3.- Summary of the techniques used in this study for the monitoring of stone property changes and observations based on the experience of the author (Cabello Briones, in press).

	Equipment and purpose	Advantages	Disadvantages	Overall
Weight	Balance: material loss/ deposition	Precise, easy to use, low cost, can detect changes in short time periods, non-destructive	Highly affected by handling errors, laboratory conditions and dried samples needed	X
Elasticity	Grindosonic: change in EMOD (increase in pores and inner cracks)	Easy to use, non-destructive	Only good for homogenous stones, more than 1 year of exposure may be needed for significant results, influenced by environmental conditions, samples of specific shape needed, high variability between replicates	
Hardness	Equotip: change in surface hardness (weathering /deposition)	Easy to use, field work equipment	Many measurements needed (large sample surfaces), micro-destructive, more than 1 year of exposure may be needed for significant results, influenced by environmental conditions, high variability between replicates	
UPV	Pundit: change in UPV (increase in pores and inner cracks)	Easy to use, field work equipment, non-destructive	Stain samples, no good for samples with irregular surfaces, more than 1 year of exposure may be needed for significant results, influenced by environmental conditions, dried samples needed, high variability between replicates	
Colour	Spectrophotometer: colour change (soiling/ biofilms)	Precise, easy to use, field work equipment, non-destructive	Influenced by environmental conditions	X
Visual changes	DSLR camera and USB microscope: surface erosion/ soiling	Easy to use, good for field work, non-destructive, good for before/after measurements	Only visible changes, low magnification	X
Salts	Ion chromatography: salt content (amount and type)	Precise	Requires preparation of samples (time consuming and expertise required), micro-destructive	X

Stones with low apparent density, high water absorption and high open porosity, such as Chalk and Globigerina, are likely to weather after only a short time in situ (a year in the case of this study). Stones with higher apparent density but which are fine-grained, such as Portland limestone, are also good indicators of decay but the time of exposure needed to obtain significant results may be longer. On the other hand, stone samples with very rough surfaces and a heterogeneous surface colour, such as Coralline and Cotswold, increase the variability of baseline data and are, in comparison, not good indicators of decay.

The techniques used in this study were selected to monitor a wide variety of physical, chemical and biological weathering processes. Weight loss, elasticity, hardness and UPV detect physical weathering in terms of loss of material (cracks, erosion and increase in porosity). In addition, analyses of salt content and weight gain can provide information about chemical weathering processes. Colour and visual changes (by macroscopic and microscopic imaging) can be used to corroborate the presence of biological films as well as signs of physical weathering and soiling. A summary of the techniques used to determine stone decay is presented in Table 3. The advantages and disadvantages are based on the experience of the author. An overall evaluation refers to the recommendations of the author after taking into consideration their simplicity of use and the results obtained.

Stone blocks and tablets provide an indication of the relative aggressiveness of different environments across the sites. Therefore, their use has been found to be a suitable option for monitoring the effects of shelters on archaeological sites mainly when comparisons are required and/or direct tests on original surfaces need to be avoided.

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Preliminary investigation of the preparation of repair mortars for the Temple of Diana, Mérida, Spain

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Abstract: In this paper, characterization of the mortars of different constructive elements in Roman Temple of Diana for its conservation is presented. Mortar samples collected from different parts of the Temple were characterized by means of polarized optical microscopy (POM), X-ray diffraction (XRD), thermal analysis (TGA-DSC) and X-ray fluorescence (XRF).

The optical microscopy results revealed that the mortars are composed of lime binder and quartz, feldspar and biotite grains together with granitic and metamorphic rock fragments as aggregates. XRD analysis supports the microscopic observations and adds the information of the presence of actinolite in the aggregates. XRD analysis further indicates the same origin of the granitic and metamorphic rocks from the surroundings and reveals an absence of biotite in the flooring mortar and only a trace of quartz in the masonry mortar of *criptoporticus*. According to results of TGA-DSC and XRF analyses, mortars were used in the channel in front of the Temple, the foundation of granite ashlar, and the inner wall of *criptoporticus* has higher hydraulic character.

For the future conservation of the monument, the information provided here about the composition of original mortars will be useful.

Key words: conservation, Roman mortar, microstructural and thermal analyses.

Investigación preliminar de la preparación de morteros de reconstrucción para el Templo de Diana, Mérida, España

Resumen: En este trabajo se presenta la caracterización de los morteros de diferentes elementos constructivos en el Templo Romano de Diana con vista a su conservación. Las muestras de mortero que fueron recogidas de diferentes partes del Templo se caracterizaron por microscopía óptica polarizada (POM), difracción de rayos X (DRX), análisis térmico (ATG-DSC) y fluorescencia de rayos X (FRX).

Los resultados de la microscopía óptica revelaron que los morteros fueron realizados con un aglomerante de cal, y con agregados de cuarzo, feldespato y biotita junto con fragmentos de rocas graníticos y metamórficos. Los análisis DRX apoyan las observaciones microscópicas y añaden la información de presencias de actinolita en los agregados que indican el mismo origen de las rocas graníticas y metamórficas del entorno geológico de Mérida (España) y muestra la ausencia de biotita en el mortero de suelo y poco cuarzo en el mortero de mampostería de *criptoporticus*. Según los resultados proporcionados con ATG-DSC y FRX los morteros utilizados para la construción del canal frente al Templo, la fundación de sillería de granito y la pared interna de *criptoporticus* tienen alto carácter hidráulico.

Para la conservación futura del monumento es necesario tener presente estas características para el diseño de los morteros de restauración a utilizar.

Palabras clave: conservación, mortero romano, análisis microestructrales y análisis termales.

Introduction

Unfortunately, the practice of heritage conservation is often perceived as the prompt and cursory repairs that coincide with the utilization of restoration work to attract tourism. However, appropriate interventions and compatibility with original building materials are just as indispensable as aesthetic concerns. Therefore, to extend the long term durability of the monuments and historical buildings, detailed characterization of building materials is necessary.

In the conservation intervention decisions of built heritage it is necessary to know the characteristics of building materials to determine the most appropriate restoration techniques (Elert et al. 2002). It is important

as much for the joint and filling mortars, coatings, and the foundation as for the building stone. Mortars are the first materials that tend to deteriorate and end up lost, in other words they are the scarifying materials in a building complex. This criterion is necessary to keep in mind in all interventions but especially concerning the monuments of Roman times where mortars were used in construction with a very strict care. Hydraulicity and the proportions of components in the mortars differ according to the function of the construction. These mortars are usually preserved in very good condition until the present day, but it is often necessary to use repair mortars for restoration. For this purpose, it is essential to use lime mortars with the addition of appropriate aggregates that allow the physical, chemical properties and degrees of hydraulicity to be compatible with the original Roman mortars (Rodriques and Henriques 2002; Veiga et al. 2009; Stefanidou 2016).

The most compatible materials are those that have the same composition as existing materials or incorporate compounds that do not generate risks of damaging the original materials (Maravelaki-Kalaitzaki et al. 2005). To this end, there is a tendency to incorporate a variety of organic additive components in repair mortars such as natural fibres or synthetic polymers (Maravelaki-Kalaitzaki 2007; Soufi et al. 2016), inorganic nanoparticles (Rao et al. 2015; Arizzi et al. 2015), or bio-consolidants (Ducasse-Lapeyrusse et al. 2015). Such additives increase the repair mortars' consistency and may improve their qualities by increasing their resistance to deterioration.

Although previous studies have been conducted on the Temple of Diana, no information exists on the composition of the original mortar used to construct this Roman monument. This paper aims to characterize the original mortars with different constructive functions in the Temple of Diana of the Roman city of *Emerita Augusta* with a view to its future restoration.

Temple of Diana

The Temple of Diana is located in the Colonial forum (*forum Coloniae*) (Ayerbe et al. 2009) (Álvarez Martínez and Nogales Basarrate 2003) situated approximately 500 meters northwest of the theatre and amphitheatre of the Roman city of *Emerita Augusta* [figure 1]. The city was founded in 25 BC by the emperor Octavian Augustus as a retreat area for Veterans. When the city was converted into the capital city of the Roman province of *Lusitania*, it reached a great splendour. Currently the city retains many preserved monuments: the theatre, amphitheatre, circus, and several aqueducts, the bridge over the Guadiana River, the House of Mitreo, the Arch of Trajan, neighbourhoods like Morerías, part of the Roman wall, and walkway of the Via de la Plata. Today, the city is called Merida and in1993 was declared a UNESCO World Heritage Site (Barroso and Morgado 1996).

Figure 1.- Map showing the location of Temple of Diana.

The Temple of Diana represents the typology of such temples of the era, having a rectangular plan with a hexastyle *portico*, *peripteros* with 11 columns, which consist of 10 m high Attic bases, fluted shafts and Corinthian capitals that stand upon a 3 meter high podium. The dimensions of the NE-SW oriented temple are 40.75 m in length and 21.90 m in width, its main façade faces south and lies back to *decumanus maximus* of the city [figure 1]. A portico surrounds the temple on three sides (*cryptoporticus*) and encloses a garden (*themenos*). Within the garden area, parallel to the western and eastern fronts, there were two tanks with their channels. The temple was built entirely of granite; the podium has large granite ashlars forming a well-built *opus quadratum*. The *cryptoporticus* was built in granite masonry in regular courses.

With its architectural features, the Temple of Diana fits into the Augustus period or the early years of the Julio- Claudia dynasty (de la Barrera 2000), the lineage having shown their allegiance to the imperial cult (Álvarez Martínez 1991; Mateos Cruz 2006).

Based on archaeological excavations, it is estimated that the monument was abandoned during the 5th century, between period of Constantine and Theodosius (Álvarez Martínez 1991). In the late 15th century the Palace of the Corbos was built inside the temple, using the podium and columns as structural support, maintaining that function until 1972 when it was expropriated by the State. The temple was declared a National Monument on the 13th of December 1972.

Various archaeological excavations have been undertaken in the temple. Among others, the most important were carried out by José María Álvarez Martínez (1972-1975 , 1985-1986 , 1992) and Felix Palma from 2001 to 2011 (Álvarez Martínez 1991; Palma 2003). Based on these excavations, the most significant restoration was undertaken by Jose Menendez-Pidal in 1975, in which architectural elements were replaced with granite, and some parts of the Palace were removed.

Later, several interventions were carried out by Dionisio Hernández Gil between the years 1985 and 1992. A partial reconstruction of the temple was constructed based on the findings of archaeological excavations. There have been recent developments in landscape regulation and urbanization, by the architect José María Sánchez García, which began in 2011.

The objective of this study is to improve the knowledge of the composition and durability properties of the mortars used in the construction of the Temple of Diana, which is necessary for its conservation.

Materials and Methods

Samples of five mortars were taken from different parts of the Temple of Diana according to the function of the mortar in the structure [table 1].

The M1 sample is light brown-beige colour mortar that constitutes 5 mm to 4 cm diameter coarse aggregates (*caementa*) and lime lumps 1-4 cm in size. Poorly sorted aggregates in the porous lime binder are angular to sub-angular, which indicate crushed fragments of the rocks [figure 2]. Sample M2 is a whitish mortar that has coarse 5 mm to 2 cm diameter aggregates (*caementa*). These poorly sorted aggregates are sub-angular to round in shape. The whitish-yellow M3 mortar sample contains 4 mm to 1 cm diameter coarse aggregates (*caementa*), and 1.5 – 4 cm lime lumps. Poorly sorted aggregates in the porous lime binder have angular to sub-angular forms. Sample M4 is whitish in colour and contains smaller, (0.5 to 5 mm diameter) aggregates. Moderately sorted aggregates in the porous lime binder have angular to sub-angular forms, indicating crushed rocks. Sample M5 is whitish-beige mortar with smaller aggregates (0.5 to 5 mm in diameter) and 2 cm lime lumps. Moderately sorted aggregates in the porous lime binder have angular to rounded forms. Although no ceramic fragments were visible to the naked eye, lime lumps were observed in the samples M1, M3, and M5.

Samples were characterized through different analytical techniques including Polarised light optical microscopy (POM), X-ray diffraction (XRD), X-ray Florescence (XRF) and thermogravimetric analyses.

Figure 2.- Image of Temple of Diana.

POM was conducted on an Olympus BX51 microscope fitted with an Olympus DP12 digital camera. Entire mortar samples, including binder and aggregates were analysed using this method.

Mortars were grounded and the powder samples were divided into three groups. The first group of samples were used in XRD analyses. A Bruker D8 Advance X-ray diffractometer fitted with a copper anode tube and PC-ADP diffraction software was utilized. XRD patterns were acquired by operating at 40 kV and 30 mA at 2θ angles of 2–68° with a 0.020-step scan, at a speed of 2° per minute, using a CuKα radiation and a graphite monochromator. EVA X-ray diffraction analysis software was utilized for the interpretation of graphs.

The second group of powder samples were formed into pellets for use in the XRF analyses. A portable (EDTRX) THERMO NITON model XL3T X-Ray Fluorescence device was used. For a better comparison with the literature, the results were converted into traditional XRF desktop equipment results, according to the correlation methodology implemented in the previous research (Ergenç et al. 2016).

Hydraulicity cementation indices were calculated for every sample to gain insight into the degree of hydraulicity [equation 1, equation 2].

Table 1.- Percentage content (%) of major elements and Hydraulicity Index (HI) and Cementation Index (CI).

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	HI	CI
M1	33.65	3.54	3.17	25.69	4.63	1.33	3.12
M2	21.88	2.21	1.39	35.65	5.33	0.62	1.50
M3	38.95	4.15	3.28	20.51	<LOD	2.26	5.65
M4	18.39	2.72	4.01	39.44	<LOD	0.64	1.45
M5	37.84	2.78	2.53	21.61	<LOD	2.00	5.13

Equation 1. Hydraulicity Index (HI) (Boynton 1980; Elert et al. 2002).

$$HI = \frac{SiO2 + Al2O3 + Fe2O3}{CaO + MgO}$$

Equation 2. Cementation Index (CI) (Eckel 2005; Lindqvist 2005; Elsen et al. 2012)

$$CI = \frac{2.8SiO2 + 1.1Al2O3 + 0.7Fe2O3}{CaO + 1.4\,MgO}$$

The third group of powdered mortar samples was analysed using Thermal analysis (TG-DSC), performed with a TA Instruments SDT-Q600, DSC Q-200 and General V4.1C DuPont 2000 thermogravimetric analyser, in a nitrogen atmosphere at a heating rate of 10 °C/min.

Results and Discussion

—Polarized Optical Microscopy

Microphotographs show the aggregates of quartz, calcite, feldspar, biotite, and rock fragments encased in a cryptocrystalline micritic matrix, that indicates use of a lime binder. Except for sample M3, all other observed mortar binders show dark-brown colour and carbonated appearance under the microscope. Granitic rocks, quartzite, slate and schist comprise the observed rock fragments [figure 3], which coincides with the geology of the surroundings (Robador and Arroyo 2013; Mota López 2015). Regarding the fragments; sample M1 contains polycrystalline quarzitic rock fragments, sample M2 has elongated metamorphic rock fragments with rounded edges and rounded opaque minerals, samples M3 and M4 has bigger edged feldspar grains, granitic rocks , and elongated schist, slate and limestone were observed in sample M5 [figure 3].

According to visual examination of thin sections, binder aggregate ratios are estimated 1:4 in M1, M2 and M5 and 1:3 in M3 and M4. 1 to 3 cm lime lumps are encountered only in the samples M1, M3 and M5. Presence of lumps either indicates dry slaking, lack of water in slaking, or poor workmanship (Silva et al. 2006; Moropoulou et al. 2016).

—X-Ray Diffraction

The mineral compositions of mortar samples determined by X-ray difraction is presented in igure 4. Difractograms of the samples show that the main constituents of the mortars are quartz, calcite, and feldspar (albite, anorthite). Biotite is the accessory mineral, which is omnipresent in all samples except M2, and is present in greater intensity in sample M3. Proportions of calcite and quartz vary in every sample: in M1, M3 and M5 quartz is predominent, while M4 has very a little amount of quartz. M1, M4 and M5 have the same peaks of actinolite (Ergenc and Fort, in press).

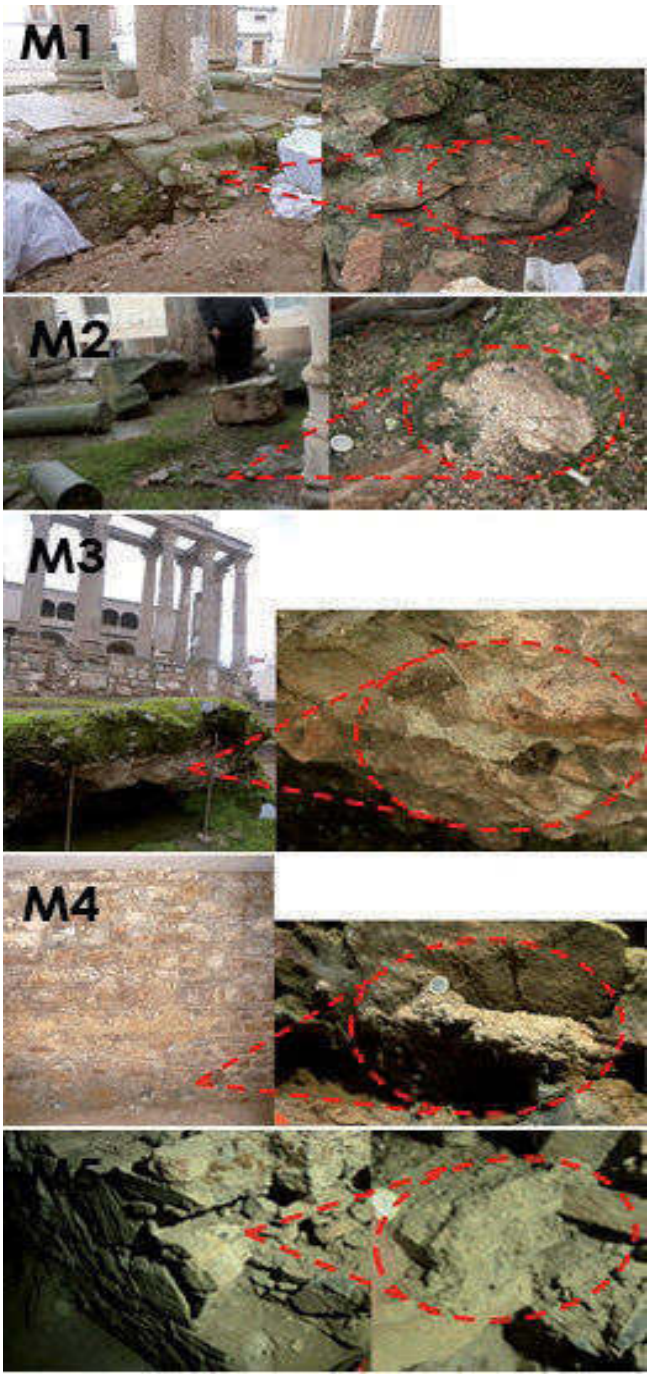

Figure 3.- Photos of collected samples with their location in the temple M1: Foundation of the granite ashlar, M2: Flooring, M3: Vault of fountain or channel in front of the temple, M4: Masonry wall of Criptoporticus, M5: Inner wall in Criptoporticus.

Results of X-ray diffraction analysis supports the petrographic analysis under polarized optical microscopy. In the XRD patterns, calcite, coming from the binder and quartz, feldspar, biotite and actinolite arereleased due to the granitic and metamorphic rocks that were used as aggregate.

—X-Ray Fluorescence

According to results of chemical analysis of principal major elements, samples M3 – M5 and M2 – M4 can be grouped

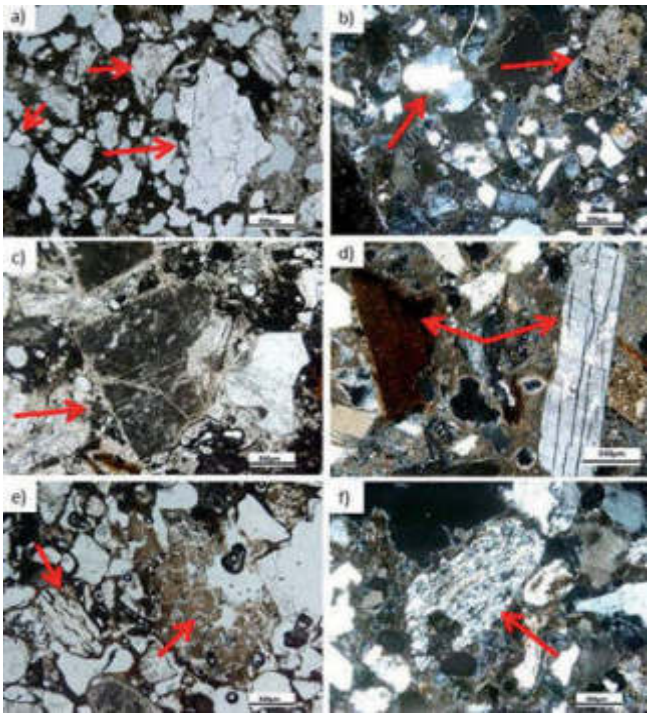

Figure 4.- a) Quartz and feldspar grains together with quartzite fragment embedded in carbonated lime binder in M1 under plane polarized light b) dark brown coloured lime binder with rounded to angular metamorphic rock fragments and quartz and feldspar grains in M2 under cross polarized light c) square edged altered feldspar in M3 under plane polarized light d) Biotite on the left and fragmented plagioclase on the right in M4 under cross polarized light e) Lime lump with recrystallization in its cracks in M5 under plane polarized light f) Schist fragment, quartz feldspar aggregates and large pores in M5 under crossed polarized light.

together. M3 has the highest hydraulic and cementation properties, which is due to the presence of the alkali reactive calcium-aluminum-silicate-hydrates (C-A-S-H). The highest MgO values are detected in the M1 and M2 samples, whereas the highest CaO and Fe_2O_3 and the lowest SiO_2 values are seen in sample M4 [figure 5]. M2 and M4 have the least hydraulic character with low HI and CI values (Elsen et al. 2012).

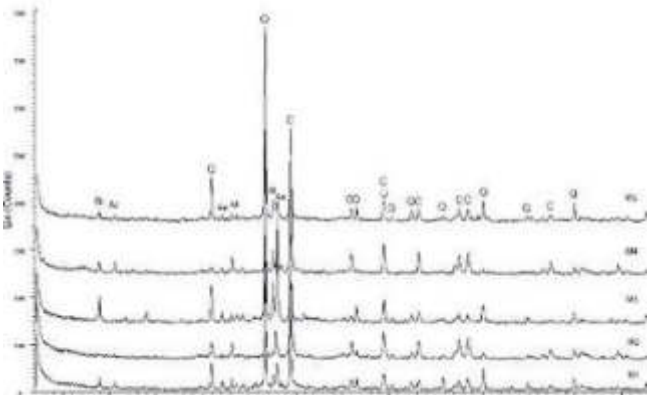

Figure 5.- XRD Patterns of mortar samples of Temple of Diana (Q: quartz, C: calcite, Al: albite, An: anorthite, Bi: biotite, Ac: actinolite).

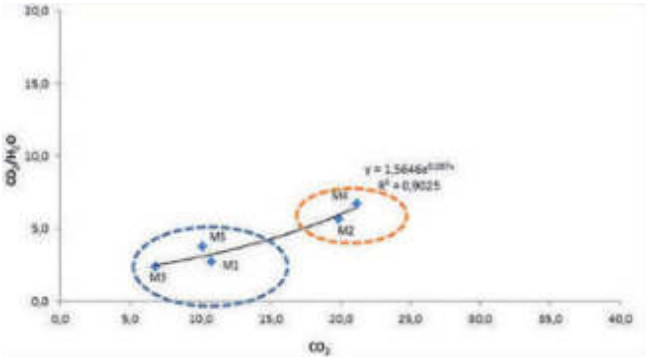

Figure 6.- CO_2/H_2O vs CO_2 plot.

—Thermal Analyses

Weight-loss percentages were calculated from the TGA–DSC curves within selected temperature ranges. In the temperature range below 120°C weight-loss is due to adsorbed water; from 120°C to 200 °C the weight-loss of water from hydrated salts or from gypsum occurs; between 200°C and 600°C the weight loss is due to structurally bound water from the hydraulic compounds and finally, the weight loss due to the release of CO_2 as a consequence of the decomposition of calcium carbonate ($CaCO_3$) takes place at temperatures above 600°C (Moropoulou et al. 2000; 2016).

The hydraulicity of mortars is represented by the inverse relation of decomposition of carbonates (CO_2 - weight loss% above 600°C) to structurally bound water (H_2O - weight loss% between 200°C – 600°C) (Bakolas et al. 1995; Moropoulou et al. 2000; 2016; Biscontin et al. 2002; Böke et al. 2008). Figure 6 shows the exponential increase of inverse hydraulicity with CO_2. This correlation allows classification of mortars according to their hydraulic properties. Since none of the samples show CO_2/H_2O higher than 10 and higher CO_2 values, this demonstrates that all have hydraulic character.

As shown in figure 6, two groups are glittered: the first group includes samples M1, M3 and M5, which are suited to 5 – 15% CO_2 and CO_2/H_2O below 5%, and the second group including samples M2 and M4 fall into the ranges of 15 – 25% CO_2 and 5 –10% CO_2/H_2O. First group can be classified as highly hydraulic (Bonazza et al. 2013) or natural pozzolanic mortars (Moropoulou et al. 2000; 2005; Genestar et al. 2006). The second group can be classified as hydraulic mortars (Bonazza et al. 2013), or artificial pozzolanic mortars (Moropoulou et al. 2000; 2005; Genestar et al. 2006).

According to Moropoulou et al. (2000) weight-loss after 700°C implies the complete decomposition of calcium carbonates in mortar as additive or aggregate or re-carbonation, so weight-loss near 750°C of in sample M3 indicates re-carbonation of lime concerning the lighter colour binder observed under the microscope as no calcitic aggregate is observed. Samples M1, M3 and

M5 reveal exothermic peaks between 200°C and 400°C which indicate C-A- S-H formation (Bruno et al. 2004) and show well marked transformation peaks of quartz at 573°C.

Conclusions

In this study, various analytical techniques were utilized to characterize mortars that were collected from the Roman Temple of Diana in Mérida. Results of macroscopic and microscopic analysis show that they are lime mortars with moderately to poorly sorted aggregates embedded in a cryptocrystalline micritic matrix which indicates an original lime binder composition. Quartz and feldspar grains are the main constituents in aggregates. In addition, the presence of actinolite in the diffractograms indicates the provenance of the aggregates is the granitic and metamorphic rocks from the local surroundings. XRD analysis also shows the absence of biotite in the flooring mortar and rarity of quartz masonry mortar used to construct the *criptoporticus*. According to TGA-DSC and XRF analyses, mortars were used in the channel in front of the Temple, the foundation of granite ashlars and the inner wall of *criptoporticus* has higher hydraulic character. Flooring and masonry mortars consist of predominantly poorer raw materials and so have lesser hydraulic properties. For the implementation of the conservation and restoration of the temple, repair mortars should be prepared in accordance with the characteristics revealed by this study.

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The Stair: An Anthropological and Symbolic Element. A research on the stairs in the Long Chang Temple (China)

Weiqiao Wang

Abstract: In the era of mass production, architecture is also on its way to rapid construction and industrialization. Stair space is one of those architectonic elements to be sacrificed. Simultaneously, we also pursue the texture and quality of architectural space of heritage with nostalgia. The value of architectural heritage has received increasing attention, not only because of their historic significance, but also due to their inspiration for contemporary architecture design.

Based on the Buddhist heritage—Long Chang Temple, the article is trying to conclude the inspiration to the design of public space, especially the connection space through basic architectonic element—stairs. Through visiting and field mapping on the stairs, it analyzes the relationship between stairs and other basic elements of architecture including route, light, water and time. It focuses on how stairs transmit information and atmosphere of different spaces through corporal perception. The essence of stair, as an anthropological and symbolic element, results in an inspiration thinking for contemporary architectonic design.

Key words: stair, anthropological, symbolic, corporal perception.

La escalera: un elemento antropológico y simbólico. Una investigación sobre las escaleras en el Templo de Long Chang (China)

Resumen: En la época de la producción en masa, la arquitectura está en camino a la producción rápida y la industrialización. El espacio de la escalera es uno de los elementos arquitectónicos que ha sido sacrificado. Al mismo tiempo, también perseguimos la textura y la calidad del espacio arquitectónico del patrimonio de nostalgia. El valor del patrimonio arquitectónico ha recibido una atención creciente, no sólo por su importancia histórica, sino también por su inspiración a la arquitectura contemporánea.

A partir del patrimonio budista, el Templo Long Chang, el artículo trata de llegar a la conclusión de la inspiración para el diseño del espacio público, especialmente el espacio de conexión a través de la escalera, uno de los elementos arquitectónicos básicos. A través de investigación y asignación de campos en las escaleras, se analiza la relación entre las escaleras y otros elementos básicos de la arquitectura: por ejemplo, el recorrido, la luz, el agua y el tiempo. Se centra en cómo las escaleras transmiten información de diferente espacio a través de la percepción corporal. La esencia de la escalera como un elemento antropológico y simbólico resulta en una inspiración pensada para el proyecto arquitectónico contemporáneo.

Palabras clave: escalera, antropológico, simbólico, percepción corporal.

Scope and aims

In contemporary architecture design, public space, especially the connection space, plays a more and more important role. Stair, as a vertical transportation space, it takes more physical effort to walk on the stair than on the ground, which may result in tiredness, discomfort or even pant of breath. Instead of giving rise to tiredness and boringness for visitors, could stair space become more interesting to give better experience and corporal perception? In order to demonstrate this possibility, the article is based on the 62 stairs of Long Chang Temple to investigate how they can transmit anthropological and symbolic significance of Buddhist space.

Introduction of Long Chang Temple

"*Chinese Buddhist temple is the place where Buddhists practice, study and interpret Buddhist sutra as well as worship Buddha. Also, it is the place for holding religious ceremony, as well as other activities for the soul of a deceased person. Besides all of these, it is also the place for daily life of Buddhist.*" Lin Luochen (Lin, 2013)

—Location

Long Chang Temple [figure 1] is located on the hillside of Baohua Mountain in Jiangsu Province, China, which is close to Shanghai. Baohua Mountain is called "t*he first mountain of Lvzong*" (LIU 1980), one of the most important schools of Buddhism in China. It is the highest mountain in the periphery, which is 431.2 meters above sea level. There is an area of over 50 kilometers, surrounded by over 360 mountains in different sizes. There is a well-known saying that "the sacred mountains are occupied by prestigious monks." It implies that there is a special relationship between mountains and temples, which means that construction of temples has to be adapted to the change of topography of mountains.

Figure 1.- The aerial view of Long Chang Temple, 2014. Photo by Yang Shuhui.

— History

Long Chang Temple was built in the first year (A.D. 502) of Liang Dynasty and logon name was Bao Chi Kung. Then after that until 1931, its name was Hui Chu Ssu while now it is called Long Chang Temple. Originally there were 999.5 bays in this temple (here one bay is equal to the distance between two rows of columns). According to rules of ancient China, only royal architecture could have more than 1000 bays. Compared to other temples, it was considered to have a significant scale at that time. In the later years or almost every dynasty, the temple has gone through several big evolutions because of fires, earthquakes, wars and so on. Nowadays there are only about 400 bays left with a total area of 7,240 m^2 and the available area is 5,725 m^2. Among them, the major of the existing buildings [figure 2] were built during the Ming dynasty (A.D. 1368-1644) and Qing Dynasty (A.D. 1636-1912). This temple was considered as one of the most famous and visited Buddhist temple in Southeast China.

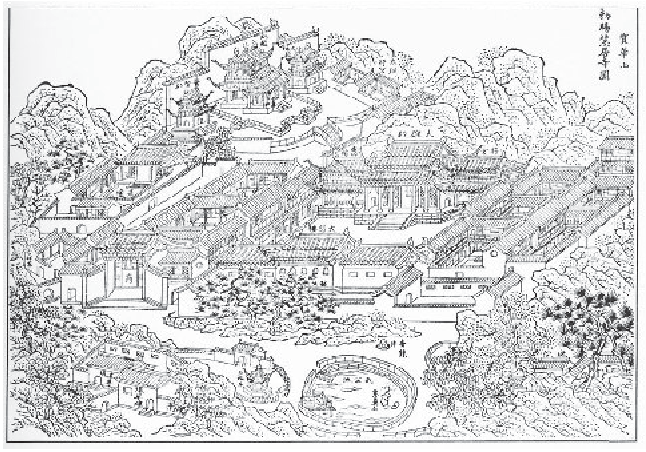

Figure 2.- Long Chang Temple, From woodcut in Bao Hua Shan chronicle. 1644-1911. LIU, M. (1980). *Bao Hua Shan chronicle.* Taipei: Mingwen Express.

— Construction process

"*Its peculiar plan, "built in the likeness of a lotus flower," is well worth recording in drawing as well as in Buddhism and partly because of the role the monastery has played and still plays in the history of Chinese Buddhism and partly on account of the deviations from the orthodox plan type which characterize its layout*." --J. Prip-Møller (Prip-Møller 1937)

From the quote of Prip-Møller (1937:1), who visited and mapped the temple in 1930s, we learnt that Long Chang Temple was quite famous for its special layout. It is a large temple with a small entrance. In contrast with other Buddhist temples that usually face to the south, it faces to the north. The construction of space was developed according to following symmetry principles and the respect for the topography changes of Baohua Mountain. There are several temple blocks in Long Chang Temple and each block has its own patio.

Among them, there are three most important building blocks: Copper Temple, Mahavira Hall and Jietan Hall. Copper Temple is the oldest building in Long Chang Temple, constructed around the year 1605. The building block of Copper Temple is still the most ideal space for meditation and practice Buddhism, which atmosphere is more peaceful and quiet. Mahavira Hall is the largest construction block, which was erected 38 years later. Usually there are a lot of Buddhism activities been held here, which attract many of pilgrims to worship Buddha. The atmosphere of space here is more solemn and ceremonious. Jietan Hall, constructed around the year 1663, is the most unique place of Long Chang Temple where religious discipline is taught and examined. The atmosphere of space here is more serious and mysterious. The flexibility of the layout can be fully adapted to the terrain environment, time changes and religious activities needs. In this construction process [figure 3], the stairs play an indispensable role, connecting these scattered fragment space into an organic whole with a solemn atmosphere.

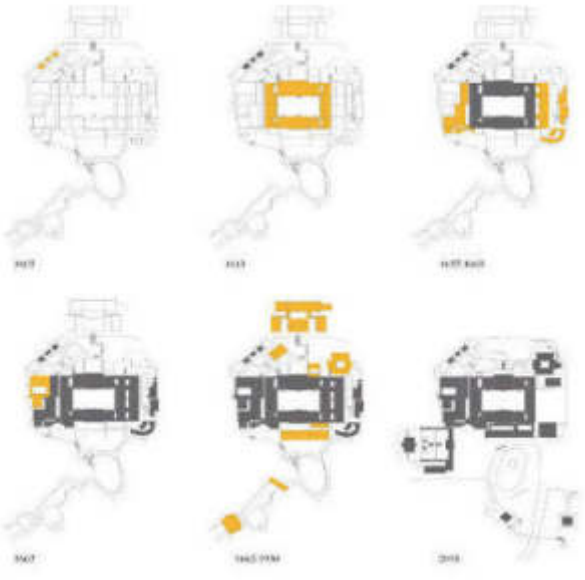

Figure 3.- Construction process of Long Chang Temple. Drawing by Author.

The importance of stairs for Long Chang Temple

— Introduction of the stairs

According to the investigation, there are totally 62 steps and stairs in Long Chang Temple, which are divided into 7 groups [figure 4]. Before the introduction, it is better that we could understand the differences between stairs and steps. Stair is the connecting element between different floors. Step refers to the element that connects indoor and outdoor space where there are usually 2 or 3 steps. The article treats steps and stairs in the same way, since it focuses more on their relationship with surroundings and how can they perform as anthropological and symbolic elements.

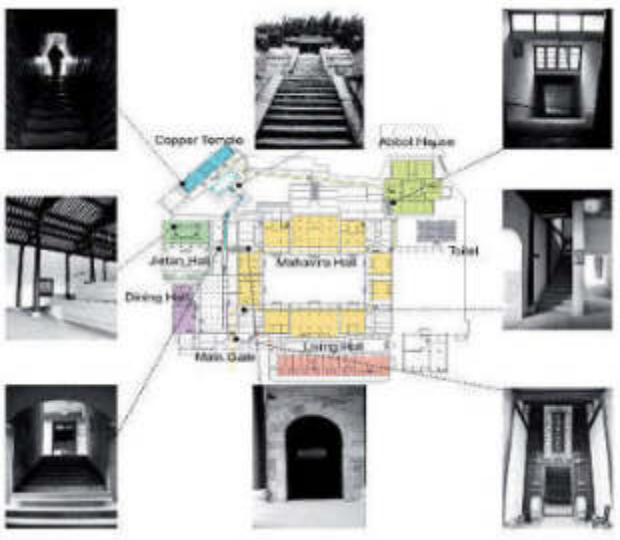

Figure 4.- Functional layout and important stairs. Drawing by Author (Plan of Long Chang Temple redrawn from the mapping drawing by Zhu Fuyi in 2014 and by J. Prip-Moller in 1937).

—Relation with other elements

To deeply understand stairs in Long Chang Temple, the research is developed according to the following four aspects: narrative of route, reveal of light, path of water, stairs and time.

• Narrative of route

The beauty of a stair not only depends on its concrete, physical shape, but also its possibility to provoke abstract preliminary thoughts as well as its influence on the space around. The route for architecture is as important as the clue for the story. For Long Chang Temple, the design of visiting route plays a significant part on the expression of Buddhist spiritual connotation. Here the visiting route is divided into two parts, the mountain route and the visiting route inside the temple.

–The mountain route

The original way to reach Long Chang Temple is a curved mountain road surrounded by woods. Its slope is very gently that the height of each step is only 60mm. Step by step, visitors climb up the mountain become nearer to the temple unconsciously. During the journey of climbing, with the ripple of the stream, visitors will go through two gate houses, and finally reach the Ch'ien Kung Ch'ih, the public pond of the ordination. Then pass through Lung Well, which is considered of special importance to the Feng Shui of the whole place. Then after passing a small Tu Ti Miao, a temple for the local god, the pilgrim turns to the right and walking up a sloping road paved with great granite slabs, one finds himself on the big, similarly paved square in front of the monastery.

The route up to the mountain is winding and long. To some extent, being influenced by the circumstances and walking repeatedly step by step, visitors will gradually calm down and feel the religious atmosphere more and more intensely. In this sense, the winding route is the transitional link between the secular world and the religious world and it leads people to the pure land of religion naturally.

–The route to worship Buddha in the temple

According to the rules of Buddhism, it is said that visitors should worship Buddha and visit temple in the clockwise manner, which creates a best way to visit the whole temple. On the main route of visiting Long Chang Temple, there are three stairs [figure 5] which play important role on connecting three main building blocks. They are a set of steps in the Main Gate of temple, the stair between Mahavira Hall and Jietan Hall and the stair between Jietan Hall and Copper Temple.

A set of steps in the Main Gate of temple [figure 6] is set as a dedicated media to lead visitors to pass through the gate slowly and quietly. Although only six steps to climb up while two to climb down, there are differences in their size, height

and material. All these change and details are working on rendering the atmosphere of entering the temple, and visitors have to notice the existence of steps and walking slowly and carefully, especially with devout gesture to pass through the Main Gate.

The stair between Mahavira Hall and Jietan Hall is a long stair with 25 steps, which is set between two walls. In the platform of the stair, there is two doors on both sides of the wall, leading to two patios of odorous osmanthus trees. The mysterious light entering from two doors attracts visitors to explore it in their steps slowly and carefully. The shifting light in the stairs guides visitors from the bustle and bright Mahavira Hall to the quiet and solemn Jietan Hall.

The stair between Jietan Hall and Copper Temple is a straight open stair of 40 steps. There is cloud pattern on the walls on both sides of the stair, which is good at creating strong religious atmosphere as well as stressing the specialty of Copper Temple. Through change of details, visitors could deeply feel the religious significance of the temple.

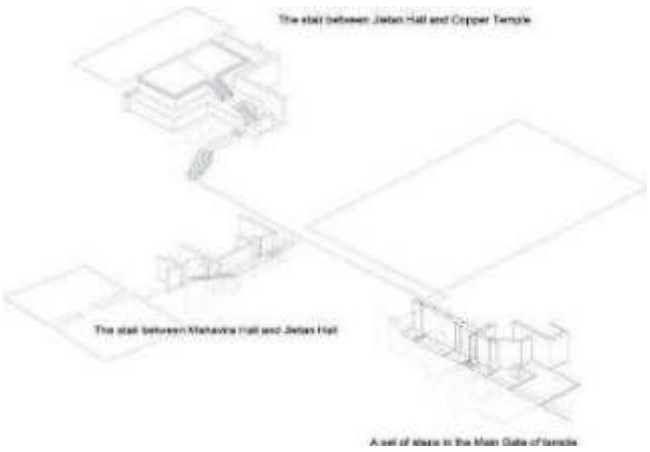

Figure 5.- The relationship between three important stairs in the main route. Drawing by Author.

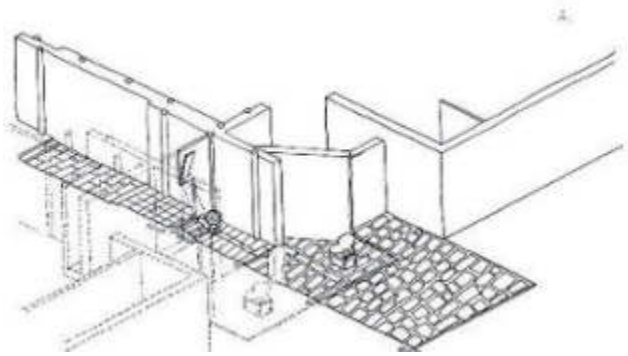

Figure 6.- The details of a set of steps in the Main Gate of temple. Drawing by Author.

"*Our body is both an 'object among objects and the which sees and touches them'.*"--Maurice Merleau-Ponty (PALLASMAA, 2012)

If the temple is imagined as a story, the route is the clue while the stairs are often the turning point or even climax. Stairs influence on people's feeling about the route and surroundings by influencing the steps and directions of walking. Stairs, in a sense, do have influence when visitors come to understand the story of the temple through their steps.

• Reveal of light

"*Architecture is the masterly, correct and magnificent play of masses brought together in light*." --Le Corbusier (PALLASMAA, 2012)

The stairs, essentially, is kind of traffic space, where light is required as best tool to show the change of heights. Usually, the first and last step as well as the turning platform need more light to call enough attention to visitors. Besides ensuring safety, light could bring more significance for stair space. It may suggest the importance of entrance, indicate the direction of route and introduce information of space around the stair.

–The boundary of stair

Generally, stair itself defines the possibility walking range while the introduction of light creates the real range for personal perception. For example, the stair from Mahavira Hall to Jietan Hall, there is a beam of mysterious light performing as hint of entrance. Stair is set inside a closed space. There are two small doors in the transitional platform so that the light can shine in. As light illuminates two small doors, together with the lightened platform create an important dividing line in the continuous stair. It creates a poetic pause in this platform of stair. Even though visitors still stand inside the stair space while they might be already attracted by scenery in the patio along with the entering direction of light. To some extent, the light here contributes to introducing the information of patio to enclosed stair space. Actually, it forms the real boundary of experience for visitors.

–Definition for light

Although light could define the boundary of stair, similarly stair space could decide the entering way of light. Usually, stair is set in an enclosed space. Then according to Feng-shui as well as construction demand, windows and doors are added to bring light and circulation for stair space.

• Path of water

In ancient China, water was considered as kind of

fortune, which was expected to be treated well. Usually, deep, clear and quiet water is regarded as beauty while torrential, rushing and noisy as inauspiciousness. It is very important to build up a legitimate drainage system in the temple. Long Chang Temple is on the halfway up the hill and faces north. The space layout is compact.

–Defined the path for flow

There are 10 groups of steps in Patio Danchi and they almost appear in the same way. The middle of Danchi is higher than the rest and the southeast corner is the lowest. The drainage of Danchi is elaborate and set up at the border all around the patio. There is small hole under the steps so that water can flow through them. However, the set of steps in front of Mahavira Hall is the exceptional case that without drainage hole, which manifests that it is more important than other set of steps. Therefore, rain water will flow clockwise and goes through those drainage holes. Finally, it accumulates at the southeast corner, falls into underdrain and finally converges with Jiegong Pool. It shows that drainage design is quite important in traditional society of China while steps can participate in determining the path for flow.

–Stress the importance of stairs

Concrete design of stair could affect the flow path of water, while through some decoration and construction details, water could stress the importance of stairs, for example, working as an emphasis on the juncture. In the stair up to Copper Temple, there is a drain passage made by marble in the juncture of corridor and outside stair. In rainy day, the sound of running water could be noticed before stepping to the stair from the sheltered corridor. It reminds the visitors that it is a turning point of space, after which stair will lead visitors to upper temple.

• Stairs and time

All the senses, including vision, are extension of the tactile sense; the senses are specializations of skin tissue, and all sensory experience are models of touching and thus related to tactility.

–The marking of time

"*Se debe tener en cuenta que las escaleras no son un elemento que se diseñe para cada individuo, sino que son genéricas. Es el hombre el que se adapta al diseño de las escaleras al utilizarlas, y a sus medidas genéricas que definen las dimensiones de huellas y tabicas*." --Juhani Pallasmaa (PALLASMAA, 2012)

The relationship between individuals and stairs doesn't only depend on one of them. In fact, experience of real moment that how our bodies get in touch with stairs seems more important. As body is the best media to measure the scale of stair. Time can change the state presented by stair, which made it more suitable for walking. Here time is reflected in the running process between visitors and stair. For example, the stair inside Beamless Hall is a result of time. Each step in the stairs to Beamless Hall has two pits between the tread and riser which is obvious in the light. This is the imprinting of time. It persists the walking status of visitors and shows it by the variance of the surface.

–Monologue of material

"*We wanted to let this historic terrain speak for itself*." --Peter Zumthor (Durisch 2014).

The old building itself couldn't speak, while through material, it reflects the story of time. In Long Chang Temple, most of the stairs are made by rough stone, which properly record the story that happen during hundreds of years. While in some of the long stairs, new stone is getting on well with old one. Together with some unexpected plants, they are showing time in a concrete and detailed way. Besides, the relationship between stairs and time is also embodied with pre-judgement of time. Many of the stones that make up the stairs are surface treated. It is presumable that the designer took into consideration that stairs will be more and more frictionless after years. People make it frictionless and it will do harm to people. Different kinds of stripes imply the significance of different stairs. In Long Chang Temple, time is demonstrated in these concrete images, pattern, handrail, decoration and so on. While the most important thing is that visitors could sense the trace of time through the change of material and finally themselves also become part of the story of time.

Research methodology

The research is mainly formed by three parts: investigation, analysis and reflections.

—*Method of investigation*

The author regards herself as a research instrument to perceive how stair performs as an anthropological and symbolic element in the space. Objectively, the body of author here becomes a criterion to evaluate stair as well as an instrument to experience the stair. The 62 existing stairs and steps are main subject for investigation. Historical records, old photos, architecture mapping in past time are supplement materials for investigation. The significance is to replenish objectivity through understanding the knowledge of history. Through analysis of experience perception, like sense of seeing, hearing, smelling and touching, it is deeply investigated the relationship with other elements: route, light, water and time.

— *Method of analysis*

Four aspects (route, light, water and time) are followed to analyze 62 steps and stairs. What´s more, prototypes and axonometric diagrams are drawn out in order to analyze different stairs in a more objective way.

— *Method of reflections*

With the support of anthropological and phenomenal theory, general conclusion and several principles will be abstracted in order to provide constructive inspiration for contemporary architecture.

Clear results

Through investigating in Long Chang Temple, a series of photos, drafts and data demonstrate how stairs can actively participate in creating better atmosphere of space. 62 stairs are separated into 6 groups according to their responding function. The functional layout and visiting route layout indicate that stair space, as an anthropological and symbolic element, plays indispensable role in the layout of Long Chang Temple, as specified in the following four areas:

Role transition: stair could actively participate in space design, especially the visiting route. For example, the set of steps in the Main Gate, by changing the size and paving material of steps, directly leads to the changes of visitors' walking speed, rhythm and posture.

Atmosphere catalyst: the relationship between the stair and its impact on the space can be summarized as three situations: gradual change, abrupt change and contrast. Stair plays the role of transition among spaces while light could bring more significance for stair space.

Cultural hint: to some extent, in Long Chang Temple the symbolic meaning of stair is more important than its real function. Therefore, stair stands for more cultural connotation by influencing the motion of the individual's body.

Time scale: time is the element invisible that only individuals can feel that it is flowing. The relationship between stair and time is essentially the relationship between stair and individuals. Visitors could sense the trace of time through the change of material and finally their pace on the stairs also become part of the story of time.

The stair, as a public space, is actually a crucial design element for contemporary architecture. Research on the stairs in Long Chang Temple, gives us a new revelation about how stair could be used as an anthropological and symbolic element. Therefore, in contemporary architectural design, it is needed to reinterpret and redefine the layout of the stairs with other elements of the place. Through the perception of the body, stair can perform as a platform for dialogue between different spaces.

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Local perceptions of cultural heritage and tourism development – case study Bač, Serbia

Lana Gunjić

Abstract: This paper presents a part of the wider research of a case study on Bač – a small town in the north-west of Serbia, inscribed on the UNESCO's Tentative List – whose aim was to explore if cultural heritage in Bač can be the driving force for the development of cultural tourism and in that way be an engine of local community development. Moreover, it explores if the value and potential of cultural heritage in Bač were recognized by the local community, since the residents are significant actors and can influence the success or failure of the local tourism industry. The results implied the absence of local initiative and their involvement in the tourism development. Although the local community is aware of significance and attractiveness of cultural heritage, it does not recognize cultural heritage in a more beneficial way, as an economic resource.

Key words: cultural heritage, cultural tourism, local community, tourism development, Bač, Serbia.

Percepciones locales a cerca del patrimonio cultural y el desarrollo del turismo: Bač, Serbia, como caso de estudio

Resumen: Este trabajo representa parte de una investigación más amplia sobre el caso de estudio de Bač – un pequeño pueblo al noroeste de Serbia que se encuentra inscrito en la Lista tentativa de la UNESCO – cuyo objetivo es explorar si el patrimonio cultural de la localidad puede ser considerado una fuerza impulsora para el desarrollo del turismo cultural y de esa manera funcionar como un motor para el desarrollo de la comunidad local. Por otra parte, explora si el valor y potencial del patrimonio cultural en Bač ha sido reconocido por la comunidad local, dado que los residentes son actores significantes que pueden influir tanto en el éxito como en el fracaso de la industria de turismo local. Los resultados muestran la ausencia tanto de iniciativa local de implicación en el desarrollo del turismo. Aunque la comunidad local tenga consciencia del significado y el atractivo del patrimonio cultural, no lo percibe de una manera beneficiosa, como un recurso económico.

Palabras clave: patrimonio cultural, turismo cultural, comunidad local, desarrollo turistico, Bač, Serbia.

Introduction

Tourism has assumed a vital role in the development of destinations around the world and, in many cases, culture is a major asset for tourism development (OECD, 2009). Cultural tourism is particularly attractive because of the spectrum of benefits it can deliver to local communities developing them at a considerable speed and diversifying continuously in a multifaceted way. Thus, Donovan Rypkema emphasizes in his studies the connection between heritage conservation and the local economy, giving examples of how good practices of cultural and heritage tourism influence the local community (Rypkema, 2008). Guided by many studies (Lehtimäki, 2008; Rypkema, 2008; OECD, 2009; UNESCO, n.d., World Heritage Sustainable Tourism Program; Günlü, et al, 2009) which have shown that cultural tourism can insure the benefits to the heritage sites and to the community, the research of case study Bač has been conducted with the aim to explore if cultural heritage in Bač can be an agent of cultural tourism development and thus instigating the development of local community as well. As a part of this wider research, the important section was to examine local perceptions and attitudes, considering that sustainability and community involvement concepts are the first and foremost agents in the development process within development paradigms, and giving local people central position in the development (Singh, et al., 2003).

The town of Bač is the centre of the municipality with the same name, in the south-west of Bačka – a sub-region in the Autonomous Province of Vojvodina, the northern part of Serbia. The preserved architectural heritage, built in the vast period from the 12th to the 19th century, represents a definite testimony to the cultural diversity, including the Bač Fortress (XIV century), a unique example of a "water town" with a fortified castle, reflecting Gothic and Renaissance influences, with suburb which presents a system of houses from the late 19th and early 20th century. The whole area has environmental values because of urban-regulatory characteristics of the settlements from the Austro-Hungarian Empire, which have been preserved. A plane where the fortress is located is a significant archaeological site with multi-layered historical remains from Neolithic period, Bronze and the older Iron Age, to Celtic traces and traces of life in the Classical period during III and IV centuries. Among the main heritage sites are also the Franciscan monastery (XII century), as a sacral architectural complex under the influence of Byzantine and subsequent Islamic art, with the final touch of Baroque and Classicism; the remnants of hammam from the period of Ottoman domination, as well as the Serbian Orthodox Monastery of Bođani (XVIII century) whose paintings, dating from 1737, displaying both Byzantine and Baroque artistic tendencies, represent a crucial point in Serbian art and some of the most valuable frescoes in the first half of the 18th century in South-East Europe. This combination of multi-layered cultural heritage classified as heritage of outstanding value, whose segments of diverse types are presented as parts of a body of a cultural landscape, was the reason why the Historical place of Bač and its surroundings were put on the UNESCO's Tentative Lists in 2010 and what makes it unique and very attractive for cultural tourism (UNESCO, n.d) [figure 1].

Last decade, the significance of mentioned cultural monuments was recognized and the notable incentives and investments were undertaken under the jurisdiction of the Development project of integrative protection "Centuries of Bač". It was derived from explorative excavations on the Bač Fortress site which later expanded into direction of conservation of the other cultural goods in Bač – the Franciscan monastery, the Lower Town, the Entrance gate and the Calvary, and afterword the Monastery of Bodjani. Hence, cultural heritage on the territory of Bač has become a part of national strategies and international projects, such as HEROMAT[1] and Realization of the rehabilitation of the Franciscan monastery project, supported by the Council of Europe and the European Commission through the "Ljubljana Process". Moreover, tourism has been seen as a potential niche and an agent of development in the future. Nevertheless, the needs and interests of local communities are the most important factors of local development and without taking them into account, it is not possible to plan a successful development of tourism. Likewise, it was significant to examine if such value and potential of cultural heritage in Bač was recognized by the local community, focusing on the following research questions: What are the attitudes of locals towards the tourism industry? Is the attractiveness of the Bač Fortress and the Franciscan monastery a sufficient motive for the local community be involved in providing complementary services to tourists?

Local communities are increasingly being drawn into tourism not only from the demand side, but also from the supply side, as communities are becoming aware of the potential of the products they can offer to tourists and the economic gains that can be made (Telfer & Sharpley, 2008). Irrespective of how tourism is introduced and developed

Figure 1.- Bač fortress, photo by Lana Gunjić.

in a community, residents are important players who can influence the success or failure of the local tourism industry. Residents may contribute to the well-being of the community through their participation in the planning, development, and operation of tourist attractions, and by extending their hospitality to tourists in exchange for the benefits obtained from tourism. In developing and attracting tourism to a community, the goal is to achieve outcomes that obtain the best balance of benefits and costs for both residents and tourism actors, which is argued in the theory of social exchange that evaluates the expected benefits or costs obtained in return for the services supplied. Hence, it is assumed that the host residents seek tourism development for their community in order to satisfy their economic, social, and psychological needs and to improve the community's well-being. As long as residents discern these benefits of tourism, there is enough reason for them to perceive it approvingly (Ap, 1992).

Methodology

So as to conduct this research, semi-structured interviews were held, face to face, as it was important to get the exact answers and due to focus of this research on obtaining insight and understanding. This method was chosen because of its ability to vary the sequence of questions and to ask further questions in response to what is seen as significant responses (Bryman, 2012). Interviews were conducted from 4th to 9th June 2015 in Bač with a duration ranging from 14.5 to 60 minutes, answers were tape recorded, using dictaphone and were later transcribed. There were no refusals and all respondents were willing to participate in the survey.

The sample of survey was chosen using purposive and non-probability sampling method which resulted in 14 local community representatives being divided in two groups. The division in groups was based on the following criteria – the experience in tourism activity so far in terms of providing complementary services/products to tourists. Hence, the first group of interviewees (group A) consisted of local community representatives who are already involved in tourism activity and this group includes: restaurant owner, owner of accommodation facilities (who was involved in serving the hunters), woman who creates and sells souvenirs (craftswoman), president of non-governmental organization which is dealing with tourism development, and a couple who owns an ethno house and rents rooms.

In the second group (group B) were interviewees who do not have previous experience in tourism activity, but have some potential to be involved as some of them are involved in certain associations: two women who are in non-governmental women's organization which deals with old crafts and preservation of tradition, one of which owns old national costumes; the president of Folk dance ensemble; women from the City choir association; individuals such as a woman who makes and sells handmade jewellery; a painter; a couple who have renovated the floor of their house and have the possibility to rent it. Thus, the heterogeneous survey sample was used with the aim to have an insight from various aspects and obtain a broader picture. The respondents answered two sets of questions – the first one, same for both groups, questioned their familiarity with the cultural heritage and the attractiveness they associate to it. The second set, related to tourism, evaluated their opinion, experience and motives for participation in tourism activity.

Findings

The results of the interviews suggest that there is the absence of local community initiative for tourism development, as well as a lack of willingness to be more actively engaged in tourism activity. The reason for that can be found in their attitude and opinions towards tourism. Although there are opposite beliefs, generally, people are not against the idea of tourism development, but apparently they are dissatisfied with the organization level and the current results of tourism development. Following statements illustrate this point:

The woman who sells jewellery: "*Tourism is at a starting phase, but I stay positive*"

The president of the Folk dance ensemble: "*What has been happening and is being done now, I do not think is the right thing*"…"*A lot is moving in the positive direction, but that is still insufficient, and a lot of things are done just to be done, there must be a thorough approach, more serious and better work to be done*"

The couple with the renovated room: "*That would not be bad, just if we had some support, a little bit more open door, both from municipality and tourist office…*"

"*It is possible, but, unfortunately we do not have something else to offer, except the sightseeing, so we have only the summer season. That would be just the additional source of income, it cannot be relied on*"

Restaurant owner: "T*hat must be improved totally, people are not informed…*"

Craftswoman: "*It is present to some extent, tourism exists, but somehow, that is not it…neither is it advertised enough. There are a lot of flaws…tourists, when they come, they see nothing…nothing is full of life here*."

Furthermore, when they were asked about tourism development, each person related their attitude/ perception with some of the hindrances. Even when they are in favour of tourism development, there is always a "but". Mentioned problems concerned the lack

of accommodation and hospitality amenities, limited access to the Tower, insufficient promotion, organization at planning level (regarding the Tourist Office and municipality), lack of human resources (tourist guide) and experts in tourism field.

The president of Folk dance ensemble: "*Tourists would come, see, leave, and spend nothing…he will go to sleep somewhere else*."

President of NGO which deals with tourism development: "*Lack of interest, and attention to set up a higher level of organization…there is no initiative from the top*."

The owners of ethno house: "T*here are very few tourists. Tourists in Bač are coming on their own, not so much through the Tourist Office, but they see on the map, think it would be interesting, visit and leave. That is what I am talking about, more promotion is needed….and Bač is not ready for the guests because we in Bač, we have maybe fifty beds*."

The woman from City choir: "*In order to attract more visitors, our municipality needs more capacity, such as accommodation facilities, which are very poor, and a better, more complex and different program is needed, not just to guide tourists to the Fortress…it should organize more events…*"

In addition, in the answers of the respondents it is noticeable that any incentives in terms of support for their potential involvement are welcomed. Even representatives of group A state that: "*there is no initiative from the top"* or *" if Municipality, Province or State had given the incentives for old buildings, as it did in the case of couples from Vojvodina, well if only interested in tourism would get some subsidies like that*", or that political situation is such that every time is a new beginning, hence, they are always in the same position without any progress. It seems that local community does not have motivation or sufficient reason to think about provision of complementary services to tourists or to be a part of tourist offer, because of the stage of tourism development in general. It is obvious that the local community have expectations from the authorities to deal with that issue, regarding content and offer improvements as well as infrastructure improvements. In addition, people who are already involved in tourism activity did not start because of tourists, but had other reasons, and they accidentally entered tourism activity. Hence, the hobby was transformed to the creation of souvenirs and later selling, the ethno house became one of the main tourist offers, started initially as an idea to maintain tradition; renovation of the rooms was not intended for providing accommodation to tourists, but rather a necessity at that moment. Only two interviewees from group A entered deliberately into tourism. On the other side, respondents think that cultural heritage is significant and also attractive to visitors, but seems like it is not a sufficient motive for their involvement in the provision of complementary services as they see more obstacles and problems than benefit from it. In addition, people compared and said that before it had been much better, there had been more tourists, and now the activity has stalled. Consequently, the local community does not see any progress in tourism development, and if we add the strong influence of external factors such as the economic crisis and the turbulent political situation, which are often stated in the interviews, it can be concluded that people are demotivated, so that until they see any tangible results, it will be hard for any initiative to be undertaken. Moreover, local community is not educated in terms of the benefits of tourism, which is one more factor that influences their perception, besides financial reasons. This conclusion derives from the interviews in which it can be noticed that some individuals from the group B are not well informed about possibilities to categorize the accommodation facilities, sell handcrafts as souvenirs via Tourist Office, or for instance, to offer national costume in private possession for exhibitions, tourist presentation or similar use.

Discussion

Many scholars were exploring interrelationships between local perceptions of impacts and the level of tourism development, interpreting the results in the context of a number of theoretical models (Butler, 1980; Perdue et al, 1990; Ap, 1992; Hernandez et al, 1996; Madrigal, 1993; Teye et al, 2002; Hunta and Stronza, 2014). Most researchers suggest that residents' attitudes towards tourism are initially positive and in later stages of development more negative, such as for example Butler's most influential stage-based tourism TALC (Tourism Area Life Cycle) model implying that attitudes are positive in earlier stages, when cycle starts with the "exploration" stage, where there are very few tourists (Butler, 1980). Furthermore, some authors argued a segmentation approach like Madrigal (1993) who stated that one of the most persistent segmentation variables in research on this subject was employment in the tourism industry (i.e., that those who worked in the industry would have more positive attitudes towards tourism). This was also a sort of criteria for hereby sampling method, however, there is no significant differentiation among respondents' answers between the groups A and B, due to the fact that not only does neither person involved in tourism perceive it positive as a whole, but they are also pessimistic to some extent and dissatisfied. In addition, the other models imply positive perceptions of local residents: embracement (eager welcoming of tourism), (Ap and Crompton, 1993), euphoria (Doxey, 1975 cited in Hunta and Stronza 2014), adoption (Dogan, 1989).

Nevertheless, in terms of this case study, it is obvious that interviewees were not adopting, exploring, embracing or euphoric about tourism and thus not exhibiting attitudes characteristic of the early stages of the models. This is in accordance with the Hunta and Stronza's view that "the initial phases of the stage-based tourism models appears to only have relevance where residents already have

at least some understanding and exposure to tourism prior to its development or consolidation" (Hunta & Stronza, 2014, p. 292). Bač can be considered to be in its pre-development stage of tourism development, when residents have little or no exposure to tourism, for which Miossec (1977) proposed the notion of a "pre-tourism" phase. Moreover, the attitudes towards tourism can be supported by social exchange theory (Ap, 1992) – when the community residents perceive higher benefits than costs, they will have a positive attitude towards the development, which is not certain at present time in Bač, due to the rate of development, a low number of tourists and lack of significant results.

On one hand, there is a positive attitude about tourist potentials and attractions in Bač, and locals see it as very appealing. On the other hand, they are not motivated to be involved in providing complementary services due to: (1) discontent with the level of organization, (2) lack of visible outcomes of tourism development, (3) expectation from others (local authorities) to address it and resolve the difficulties, (4) perceptions that expenses prevail the benefits, (5) lack of knowledge and education with regard to possible gain of tourism and how they can be involved in such activities. Accordingly, despite the potentials around them, people do not find either enough motivation or support to be engaged in tourism activity. For the local community to accept and understand tourism, various workshops on different topics should be organized: on identifying potential tourism activities to be developed and promoted; on developing links with surrounding tourism attractions to determine how the village can be positioned and packaged as part of an attractive tourism destination; on several topics such as conservation, guiding, categorization, homestay and product development. In addition, a study trip "community to community" is effective way of exposing the community to real life situations and examples of good practices, as well as village tours for locals in order to get familiar with all potentials, informed about projects, heritage rehabilitation and plans, allowing them to propose their ideas and suggestions.

In parallel with the conservation works, tourist offer and content should be improved and enriched, involving local community. It is important to identify local labour force and their knowledge as unique resources, using their knowledge, skills, and products in tourist presentation, that would provide, without lots of investments, a real gain to the locals through more employment opportunities and promotion of local products and services, at the same time raising awareness of the benefits they could gain from the direct contact with visitors. Moreover, the locals could be trained to become guides and cultural performers. Likewise, the tourist products should be developed in terms of presentation of old crafts, traditional dances, songs, gastronomy, staging dramas in the Fortress or developing thematic tourist routes, for instance culinary tour, cycling tour, the Traces of Šokci[2]. In pursuance of developing cultural tourism, local community should recognize and understand cultural heritage as an opportunity and benefit, as an economic, not just as a cultural-historical resource.

Note

[1] Project HEROMAT is directed towards the development of innovative environmental friendly materials with value added functions aimed to the protection of immovable Cultural Heritage assets. This project concerns revitalization and protection of Bač Fortress. http://www.heromat.com/ (accessed on Sep 4, 2015).

[2] Ethnic group inhabited in Bač and Serbia, mainly identified as Croats

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Lana Gunjić was born on April 24th, 1991 in Belgrade, Serbia. She obtained her undergraduate degree in 2014 at the University of Belgrade, Faculty of Geography, Department of Tourism. Her interests in cultural heritage, cultural tourism, project management and the desire to connect two domains – culture and tourism – led her to pursue a master's degree in interdisciplinary studies, UNESCO Chair: Cultural Policy and Management at the University of Arts in Belgrade, the partner study program with the Université Lyon 2. Throughout her studies, she has been actively engaged in the non-governmental organization "Youth for Tourism" (currently the president) organizing and participating in different workshops, projects, study tours, lectures and seminars, being the workshops leader and conference lecturer. Her professional experiences include being a journalist contributor for the tourist magazine Turistički putokaz, an intern at the Tourist Organization of Belgrade and Cultural Center of Serbia in Paris, Belgrade Irish Festival Coordinator, as well as an associate on different projects. Currently she is working as a coordinator of the Association Independent Cultural Scene of Serbia; at iBikeBelgrade and she is engaged in the project of *Supervision of works for rehabilitation of the Franciscan Monastery in Bač* as a junior tourism expert.

Ge-conservación
Conservação | Conservation

Namibia's vernacular architecture: insights towards the sustainable development of local communities

Rui Maio, Elao Martin, Jon Sojkowski, Tiago M. Ferreira

Abstract: Vernacular architecture is commonly recognized as the fundamental expression of the world's cultural diversity. Natural disasters, the lack of knowledge and awareness of local communities, the desire for modernization and the well-known globalization phenomenon are some of the most frequent evoked issues responsible for endangering the survival of vernacular heritage in Africa. Hence, this paper aims to address some of these issues by providing a detailed architectural and morphological characterization of the "Owambo" tribe, the largest cultural area of Namibia. With this case study, the authors aim to highlight the outstanding universal value of vernacular architectural heritage in Namibia and to raise awareness to the increasing need, not only the protection of these structures' integrity but also for the preservation of such ancient and sustainable building techniques as a living heritage.

Key words: African vernacular architecture, Namibia homesteads, Owambo tribe, multi-hazard risk mitigation, architectural and morphological characterization, sustainable development.

La arquitectura vernácula de Namibia: perspectivas para el desarrollo sostenible de las comunidades locales

Resumen: La arquitectura vernácula se reconoce comúnmente como la expresión fundamental de la diversidad cultural del mundo. Los desastres naturales, la falta de conocimiento y la sensibilización de las comunidades locales en general, el deseo de modernización y la globalización son algunos de los problemas más frecuentes responsables por amenazar la supervivencia del patrimonio vernáculo en África. Por lo tanto, este trabajo tiene como objetivo hacer frente a algunos de estos problemas relativos al patrimonio cultural vernáculo africano, proporcionando un detalle arquitectónico y la caracterización morfológica de la tribu "Owambo", en el norte de Namibia. Con este caso de estudio, los autores tienen como objetivo destacar el valor universal excepcional del patrimonio cultural vernáculo en Namibia, y sensibilizar a la necesidad inmediata de proteger no sólo la integridad de estas estructuras, sino también de preservar estas técnicas antiguas y sostenibles de construcción como tradiciones vivas.

Palabras clave: Arquitectura vernácula africana, granjas de Namibia, tribu de Owambo, mitigación de multi-riesgos, caracterización arquitectónica y morfológica, desarrollo sostenible.

Introduction

Vernacular architectural heritage plays a crucial role in safeguarding and expanding the cultural features of communities and their relationships with the land, contributing decisively to the expression of the world's cultural diversity. It is worth noting that vernacular heritage encompasses, not only the built environment but also intangible aspects, such as construction techniques, lifestyles, and territorial connections, which are intrinsically connected to communities (ICOMOS 1999). Furthermore, it is believed that approximately one-third of the world's population lives in vernacular structures, stressing the importance of vernacular architecture not only for its cultural outstanding universal value but also as a feasible housing strategy for the sustainable development of local communities worldwide, moving towards the concept of livable heritage. The preservation of vernacular architecture in a holistic approach is believed to revive people's faith in their own culture. Nevertheless, due to several globalization-related matters, vernacular heritage is becoming more and more vulnerable, facing serious problems of obsolescence, internal equilibrium, and integration. Therefore, the management and protection of vernacular architectural heritage depend highly on the capacity of identifying and interrelating all the variables at play.

Besides the richness and diversity of Southern African countries' natural heritage, this region of the globe also has a very rich and heterogeneous cultural heritage that lacks coverage from scholars and decision-makers, being, therefore, under-represented both in literature and on the internet. From the projects and initiatives lately conducted in this regard, it is worth referring the African Vernacular Architecture project, which aims to collect and store photographs of vernacular architecture in Africa in an open-source database that can be accessed by invited explorers who want to share their own photographs.

Furthermore, the occurrence of disasters in Africa is increasing in frequency and severity, compounding the challenges to sustainable development and undermining Africa's prospect of achieving the Millennium Development Goals. Climatic and hydrological hazards, in particular drought, floods, cyclones and landslides, dominate the disaster profile of the Africa region, affecting, on average, around 12.5 million people per year (African Union Commission and UNISDR 2015). Moreover, the extreme social vulnerability of some African nations has the potential itself to transform minor hazard events into major human disasters. In developing countries, disasters are known to disproportionately affect poor people the most and have the potential to trigger food supply crisis, human losses, constrain progress, and the destruction of infrastructure and natural environment. For this reason, the establishment of disaster risk management policies, focusing on disaster risk reduction within the broader context of sustainable development, are of vital importance. However, reducing disaster risk across Africa requires a radical shift in the current view of governments and an even more radical shift from rhetoric, centralized and top-down instructions to decentralization and respect for local knowledge and initiatives (López-Carresi et al 2014).

Bearing in mind the above, this paper aims at providing a clear insight on the main issues that are contributing to an accelerated degradation and potential extinction of vernacular architecture in rural areas of Namibia. This paper also aims to highlight the outstanding universal value of a particular vernacular typology, commonly observed within the "Owambo" tribe, in northern Namibia, and to raise awareness to the urgent need, not only that of protecting these structures' integrity, but also of preserving such ancient and sustainable construction techniques as a living heritage (Maio et al., in press (a).

Owambo tribe case study, in northen Namibia

The area traditionally known as Owamboland is placed in the far north of Namibia between the Etosha National Park and the Angolan border (as illustrated in Figure 1). This region is by far the most densely populated rural area of Namibia. Many of the villages and farmlands situated on the raised ground between water-courses are typically

Figure 1.- Location of the Owamboland region and exact site of the documented homestead.

flooded after heavy rains, despite the average rainfall in this area varies between 400 and 550 mm (see Figure 2a). Actually, flooding is the most frequent and hazardous natural phenomenon in this region, which severely affects the livelihoods of these communities by triggering massive population displacement, loss of human life and livestock, and the destruction of vernacular homesteads, crops, and social infrastructure.

As a result of rapid population growth, scarcity of arable land near permanent water-supply points, socio-economic lifestyle changes and township development, many of the Owambo people no longer live in traditional homesteads. During the past two decades, large villages have sprung up in the proximity of the main routes. People stay in rectangular houses built with poles, corrugated iron, and other materials. Moreover, the felling of trees for the construction of huts, cattle enclosures and fences has resulted in extensive deforestation. Other socio-economic factors that are affecting deforestation in north Namibia have been identified: population growth, settlement patterns, land use practices, the structure of production, consumption patterns of wood, and valuations related to forests. In Owamboland's wilderness, settlers not only cut down large amounts of poles to construct huts, palisades, kraals, and fences but also destroy most of the tree and bush vegetation on their prospective farm plots. The fire was the settlers' most powerful tool when clearing land for farms and fields (Kreike 2010), and in Namibia, forest and veldt fires are responsible for burning 3.5 to 7 million hectares of forest and veldt land every year. IIn fact, in the span of just two years between 2001 and 2002, almost 10 million hectares of land have burned in Namibia (Republic of Namibia 2011). Albeit these figures fluctuate annually, they show the seriousness of this hazard in Namibia (see

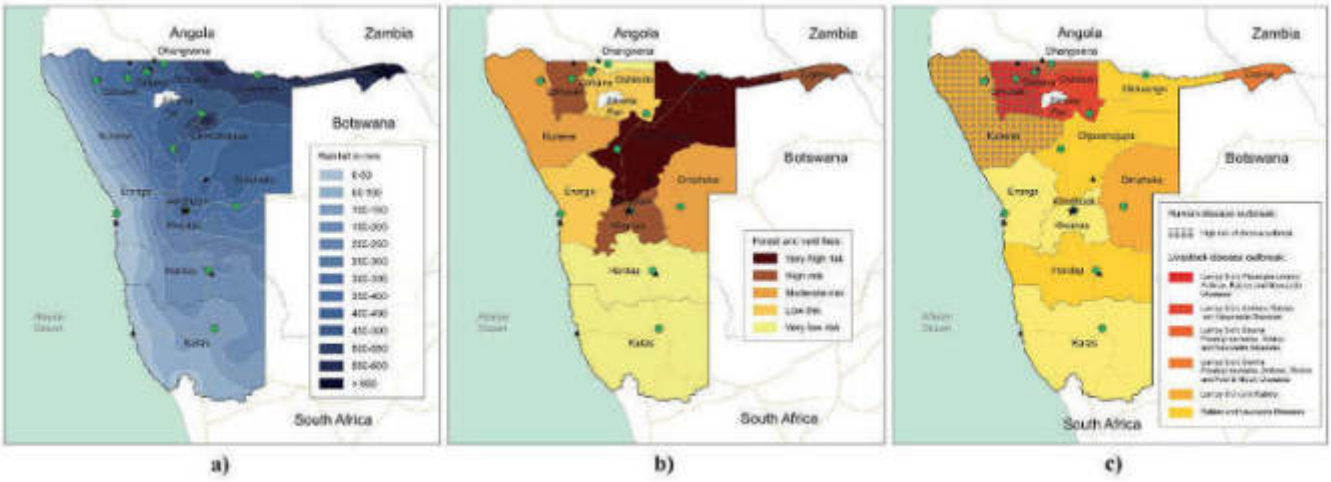

Figure 2.- a) Spatial distribution of the average annual rainfall, adapted from V2030 report (insert footnote number). b) Spatial distribution of the forest and veldt fire outbreak, adapted from the NDRMP 2011 (insert footnote number) (source: Directorate for Forestry). c) Spatial distribution of both human and livestock disease outbreak, adapted from the NDRMP 2011 (insert footnote number) (sources: Ministry of Health and Social Services and Directorate for Veterinary Services, respectively).

Figure 2b). With regards to disease outbreaks, as shown in Figure 2c, Namibia has experienced several outbreaks in the past that have demanded state intervention. In this respect, It is particularly worth noting the August 1970 cholera epidemic that had stricken more than 150,000 people, killing about 20,000 of them (Goodgame and Greenough 1975). Livestock disease outbreaks, such as Foot and Mouth Disease, as well as outbreaks of Anthrax, Rabies and lung diseases, also constitute a global threat in Namibia (Republic of Namibia 2011).

Considering each hazard individually has proven to be a good approach for looking at specific health issues that might be linked to each of them. However, it is also important to identify potential hotspots where the population might be exposed to multiple hazards at the same time. In the literature review carried out by Kappes et al. (2012), not only the main challenges associated with each step of a multi-hazard risk analysis were identified, but also the latest studies and approaches addressing these issues were presented and discussed. In order to get the spatial distribution of the intensity level of multi-hazard, El Morjani et al. (2007) assigned weights in a first stage to each of the addressed hazards, on the basis of the human and economic impact of each event reported in different databases. Consequently, for each hazard, the regional averages of these indicators have been computed, standardized, weighted and aggregated.

Despite the great value of this work, multi-hazard analyses should account not only for the features of single hazardous events but also their mutual interrelations, as for example, landslides caused by extreme rainfall or tsunamis triggered by offshore earthquakes. However, the way that multiple hazards with distinct reference units (nature, intensity, return period, etc.) and complex interrelations can be compared, remains a fundamental challenge.

As depicted in Figure 3, the multi-hazard risk approach presented in this study is based on a multi-hazard risk index, which results from the product of hazard and vulnerability (Maio et al., in press (b). As explained bellow, the exposure model is implicit in the formulation. The scale, magnitude, and probability of single hazards are defined within the hazard module. Moreover, in order to take into account climate changes, a range of possible climate scenarios are also considered. Concerning the exposure module, it results from the multiplication of a set of indicators related to the elements at potential risk. The analysis of such elements is used to create reference baselines of qualitative and quantitative features of residents and infrastructure, which are used to identify and define elements that are potentially more exposed. FFinally, the individual vulnerability of the elements exposed to different hazards is also assessed, taking into account their mutual dependencies (cascading effects).

The integration of the results into a Geographic Information System (GIS) tool represents the last but key step of this multi-hazard risk approach. Such tool allows the user to perform the spatial analysis of the study area (considering different scenarios) and to manage data regarding the features of the elements exposed. Based on this GIS-based analysis system, it is then possible to outline optimized pre-disaster planning, including risk communication campaigns, and post-disaster intervention, such as emergency planning and reconstruction (Maio et al., in press (b).

After Namibia's independence on 21 March 1990, the Owamboland was divided into the regions of Omusati, Oshana, Ohangwena and Oshikoto. Amongst the traditional Owambo tribe, family groups live in round, stockade homesteads (ongandjo) built on the raised ground between the oshanas, surrounded by a few

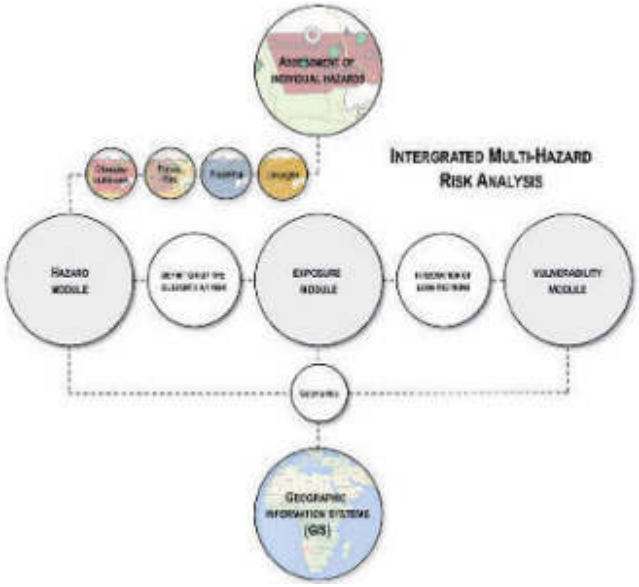

Figure 3.- Example of a diagram for the integrated multi-hazard mitigation approach.

hectares of cultivated land (Maio et al, in press (a). With the resulting scattered settlement pattern, the homesteads are able to constitute villages administered by selected headmen who report to local and traditional authorities. The homestead is enclosed by a wooden palisade or millet-stalk fence and is composed of several quarters of huts articulated with walkways and corridors for controlling the movement patterns in the household. In the past, this wooden palisade (made of tree trunks) distinguished the Owambo architecture from that of its neighbors (Malan 1995) and protected its occupants from wars and cattle raids. However, the lack of wood in this region due to extreme deforestation and several forest and veld fires, led local communities to search for innovative construction techniques and materials, which justifies the appearance of small adobe huts within this area, distinguishing again this tribe's vernacular architecture and building technique from the others, see Figure 4.

As can be seen in Figure 5a, the vertical structure of these huts is mainly composed by load bearing masonry walls, made of adobe blocks with a very poor mortar. These walls are erected resorting to manual adobe manufacture and an ancestral earthen constructive technique (still in use in several African countries) that consists on shaping or sculpting units of plastic earth manually, which are then sun-dried before used for the construction of the walls (Maio et al, in press (a). It is thought that this technique has been the primitive cuboid form of the adobe blocks existing today (Fernandes 2006). Figure 5b instead, captures the detail of the connection between the thatch roof and the vertical structure. Finally, Figure 5c reflects the dismal trend of abandoning and substituting vernacular architecture and ancient construction techniques for new building technologies and materials. For the set of reasons given in the following section, the authors believe that such trend might not help fostering the sustainable development of local communities.

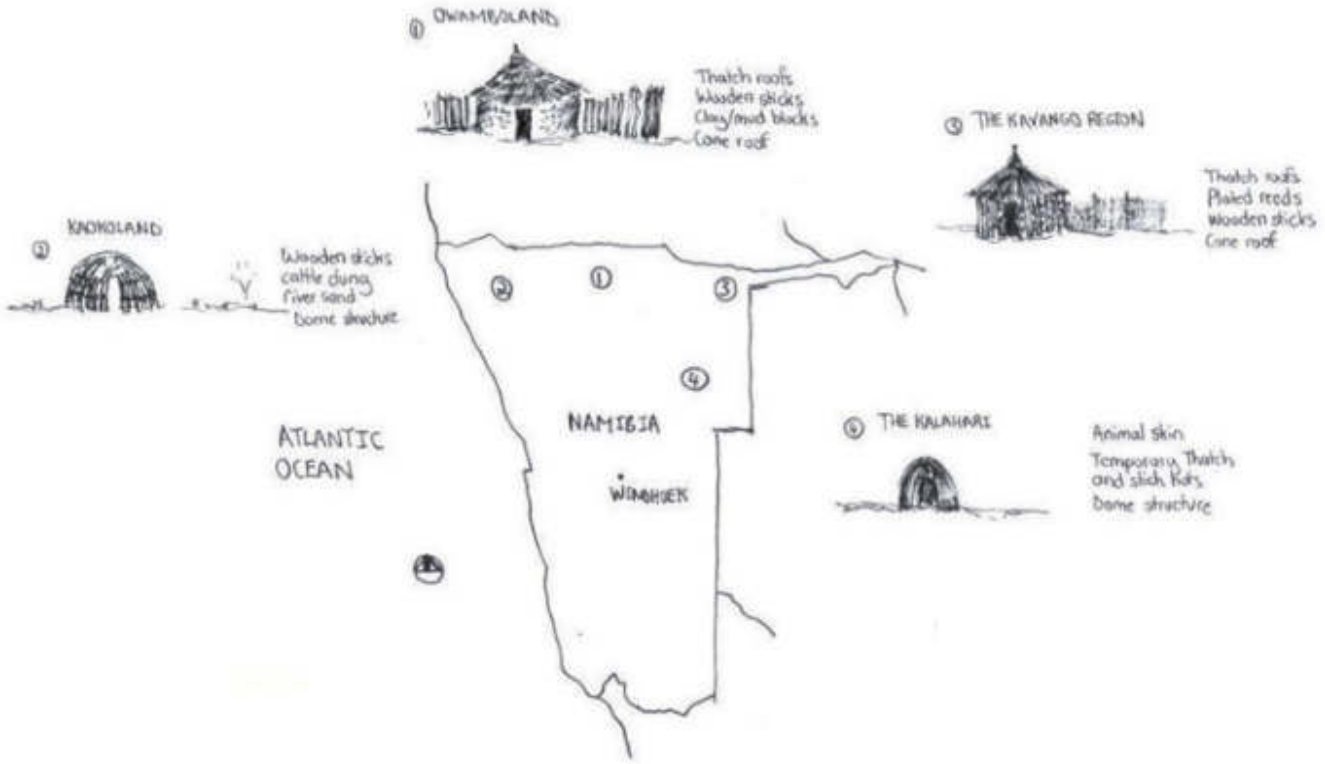

Figure 4.- Sketch of some of the most common typologies of huts and their location in northern Namibia.

Figure 5.- a) One example of an adobe hut within the case study homestead. b) Detail of the connection between adobe masonry walls and the thatch roofs. c) An example of a vernacular structure in an advanced state of degradation due to the increasing abandonment of vernacular constructive techniques to the detriment of imported building technologies and materials.

Sustainable development of local communities

According to Whitfield (2010), sustainability can be generally defined as economically viable development, socio-culturally acceptable and environmentally friendly. Therefore, the following recommendations are thought for the sustainable preservation vernacular architecture of the rural settlements in the Owamboland region:

—rational use of local materials and resources, instead of importing new technologies and materials at a higher cost with large carbon footprint.

—sustainable site planning and management to preserve vernacular cultural heritage from hazards, avoiding population displacement and local communities' growing backlog, just to cite a few.

—rational water management by introducing rainwater harvesting and water recycling policies.

—safe and healthy environment by improving the indoor air quality (optimizing the use of natural light and the solar exposure), acoustics, thermal comfort, health conditions, and energy efficiency.

—reduction of waste through recycling.

Moreover, another fundamental aspect concerning sustainable development policies is that they should be unavoidably centered on social equity, meaning that the transfer of knowledge and the need for involving the community on the preservation of the Namibian cultures should be established as the pillars of such policies. In this sense, not only local communities need to be sensitized about the cultural value of vernacular architecture, but also the urban myth of that living conditions provided by this type of constructions are not decent, has yet to be clarified. The authors instead, are strongly convinced that the sustainability of vernacular housing is irrefutable. It is however necessary to control the quality of materials and the subsequent construction phase to make sure that satisfactory performances are attained. Moreover, the particularities of the construction process itself and its details need to be taught by experts to younger generations in order to ensure the quality of these structures and the safety of their residents. Additionally, capacity building drivers need to be put in place to encourage the community involvement on the preservation of vernacular heritage. Finally, the authors also believe that it is fundamental to establish strategies to reduce the vulnerability of homesteads facing the most recurrent hazards (Maio et al, in press (a).

Conclusions

This paper intended to raise awareness to the preservation of vernacular architecture in Africa, particularly in northern Namibia, in order to safeguard these ancient structures to future generations. Acknowledging that the intrinsic features and environmental circumstances of vernacular architecture in Namibia vary considerably from site to site, this paper focus on the Owambo tribe's homesteads. Moreover, recognizing the Namibian Government's efforts in tackling disaster risk reduction, the authors aim to raise awareness for the importance of implementing multi-hazard risk mitigation policies, which benefits are widely recognized, particularly in the decision making process. Hence, it is fundamental that all actors and ministries can use a compatible language when assessing individual hazards. Additionally, the authors believe that using open-source GIS tools in the mapping and interpretation of outputs for decision making purposes is also fundamental to move towards more efficient and proactive strategies. Local communities need to be proactively sensitized about risks so that they can be prepared when

disasters strike. Moreover, capacity building programmes need to be put in place to facilitate the involvement and the participation of community. Finally, having all these sprocket wheels work together will definitely increase the preparedness of local communities and contribute to a more efficient approach for disaster risk mitigation of Namibian vernacular architectural heritage.

Future developments should focus the debate on how vernacular architecture can be adapted to current human needs and standards, including a desire for modernization, in a sustainable way, i.e., without limiting future generations from accessing heritage of the past. The full architectural characterization of homesteads within the Owambo tribe, as well as the materials' mechanical characterization, should be also conducted. As a final comment, the authors would like to refer that, despite the influence of the preservation of vernacular cultural heritage over tourism in the Owaboland region was not addressed in this study, it is naturally understood as a key aspect towards the development of local communities and a topic to be reflected in future studies.

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An overview of nanolime as a consolidation method for calcareous substrates

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Abstract: $Ca(OH)_2$ particles with submicrometric dimensions (nanolimes) represent one of the most promising consolidants for the conservation of calcareous substrates. The nanolime treatment is similar to the limewater technique, traditionally used for its durability and high compatibility with the calcareous matrix but requiring a large number of applications and not always yielding a highly effective consolidation. Since 2001, alcohol-based dispersions of $Ca(OH)_2$ nanoparticles have been synthesised to overcome the limitations of the limewater treatment. Nanolimes present the same high compatibility and durability of the traditional technique but superior properties in terms of higher consolidation, penetration and reactivity, and fewer side effects. Since their discovery, nanolimes have been investigated by several research groups with the aim of refining their synthesis process, properties and applications. This paper presents an overview of the most relevant literature about nanolime as a consolidant for calcareous substrates.

Key words: Nanolime, Calcium hydroxide, Consolidation, Limewater, Conservation, Nanoparticles, Synthesis, Calcareous substrates.

Una visión general de la nanocal como método de consolidación para sustratos calcáreos

Resumen: Partículas de nanocal, $Ca(OH)_2$ con dimensiones sub-micrométricas, es uno de los principales consolidantes emergentes dentro de la conservación de sustratos calcáreos. La nanocal se basa en la técnica de agua de cal, utilizada tradicionalmente por su alta compatibilidad y durabilidad con el substrato calcáreo; pero su aplicación requiere de un gran número de aplicaciones y la consolidación no siempre es muy eficaz. Desde 2001, dispersiones alcohólicas de nanopartículas de $Ca(OH)_2$ se han sintetizado para obviar las limitaciones de los tratamientos tradicionales. La nanocal presenta la misma alta compatibilidad y durabilidad del método tradicional y propiedades superiores en términos de mayor consolidación, penetración, reactividad y menores efectos secundarios. Desde su creación, estas formulaciones han sido estudiadas por varios grupos de investigación con el objetivo de perfeccionar su proceso de síntesis, propiedades y aplicaciones. Esta publicación revisa la bibliografía más relevante para identificar áreas donde un mayor estudio es necesario.

Palabras clave: Nanolime, Hidróxido de calcio, Consolidación, Agua de cal, Conservación, Nanopartículas, Síntesis, Sustratos calcáreos.

Introduction

The recent development of nanoscience and nanotechnology has opened the way to new applications in many scientific fields, including that of the conservation of cultural heritage. One example of a nanomaterial developed over the last decades is the so-called "nanolime", nanoscale particles of $Ca(OH)_2$ with potentially superior consolidation properties compared to traditional lime-based treatments. So far, nanolime has been studied mainly within the built cultural heritage conservation field.

Scientific investigations on nanolime began around the year 2000 at the University of Florence -CSGI, in Italy, with the first results on its synthesis and application for the conservation of wall paintings published in 2001 (Ambrosi et al. 2001). The researchers in Florence modified the synthesis methodology several times by reactions in diols (Salvadori and Dei 2001), aqueous solutions (Ambrosi et al. 2001) or water-in-oil (w/o) micro-emulsions (Nanni and Dei 2003). In 2003, another research group (Ziegenbalg 2003) prepared nanolime from a heterogeneous-phase reaction, which was patented under the brand name Calosil®. This was the first nanolime product introduced to the market in 2006 (IBZ-Salzchemie GmbH & Co. KG) followed by Nanorestore® (CSGI) in 2008. With these products made available to the scientific community, European researchers began investigating the properties

and consolidation efficacy of nanolime. Three main EU research projects, STONECORE (2008 - 2011), NANOMATCH (2011 - 2014) and NanoforART (2012 - 2015) have made significant contributions to understanding the technologies and preparing the way for a range of applications of nanolime in the conservation field.

Nanolime is used mainly to recuperate the cohesion between particles in calcareous substrates such as wall-paintings, limestone, lime mortar, etc. In the past, organic and inorganic consolidants have been used for the consolidation of these substrates. The use of organic consolidants such as acrylic, epoxy, or vinyl resins were very common in restoration treatments since 1960 (Dei and Salvadori 2006). However, the low compatibility with the substrate and poor aging and durability of these treatments may cause unwanted degradation processes, including cracking and aesthetic changes, and may interfere with future treatments. In contrast, inorganic-based consolidants such as barium hydroxide and limewater have a high physico-chemical compatibility with the substrate and good durability, although their use requires a large number of applications and the consolidation is not always highly effective. The effectiveness of the traditional limewater technique has been controversial. Price (Price et al. 1988) concluded that the limewater technique does not produce a noticeable consolidation as most of the lime is deposited within the outer 2mm and the low amount of particles does not produce consolidating effect. Nevertheless, another research (Brajer and Kalsbeek 1999) demonstrated that a prolonged and uninterrupted application of limewater over 80 days produces a positive consolidation effect. However, this treatment is tedious and has to be repeated up to 40 times due to the low solubility of calcium hydroxide in water (1.7 g/L^{-1} at 20°C). Other limitations are the reduced penetration depth of the lime size-particles and the possible decay processes associated with the use of large amounts of limewater solution (salt movement, etc.). The use of nanolime in alcohol allows incorporation of larger amounts of lime into the treated substrate with far less water, yielding better penetration and faster carbonation (Ambrosi et al. 2001). TThis paper expands the extended abstract (Otero et al. in press) reviewing the considerable literature on this topic.

Synthesis

Nanoparticles can be produced through either the top-down or bottom-up processes. In the top-down method the nanoparticles are created by "breaking" a bulk micro-scale particle until fragments in the nanometer range are obtained. This normally involves using a source of high energy in processes such as laser ablation, thermal decomposition or mechanical milling. In the bottom-up method, the nanoparticles are built atom by atom through chemical precipitation using several techniques for the deposition and crystal growth from vapour (Chemical Vapour Condensation (CVC)) hydrogen plasma hydrogen plasma-metal reaction (HPMR) and liquid phases (micro-emulsions, solvo-thermal, etc.). Most calcium hydroxide nanoparticles are synthesized through the bottom-up reaction by chemical precipitation from a liquid phase.

A survey of different synthesis methods from literature is summarized in Table 1. In 1997, colloidal dispersions of calcium hydroxide in organic solvents were obtained (Delfort et al. 1997) and, in 2000, CSGI-group (Giorgi et al. 2000) also obtained stable alcohol dispersions of $Ca(OH)_2$ particles. Both researchers found that dispersions in alcohol are far more stable and able to incorporate larger amounts of lime than limewater. With the aim of preparing stable nanoparticles of $Ca(OH)_2$, the researchers at CSGI carried out a series of studies based on the works of Matijevic group (Pe et al. 1998) in the field of colloid synthesis. They reported that nucleation of nanoscale particles is affected by reaction time, high temperature (above 100°C) and high degree of super saturation, and it can be achieved with slow synthesis and peptization processes. In 2001, CSGI group (Dei and Giorgi 2001) obtained $Ca(OH)_2$ particles (1-2μm) by a hydrolytic method at medium-high temperature (60°C) and super-saturation. In order to reduce the size of particles, they synthesized calcium hydroxide nanoparticles (30-60 nm) from diols, which allowed higher temperatures to be reached during the process (Salvadori and Dei 2001). However, this synthesis method proved to be time consuming and produced a low quantity of nanoparticles. In the same year, they successfully obtained highly reactive and colloidal sub-micrometer $Ca(OH_)_2$ particles (±300nm) via an homogeneous phase following the aqueous reaction $CaCl_2 + 2NaOH \rightarrow Ca(OH)_2 + 2NaCl$, heated up to 90 °C under supersaturation conditions (Ambrosi et al. 2001). But, this process has drawbacks: 1) slow mixing rates; 2) the necessity of removing the produced NaCl by washing; and 3) low yield of nanoparticles production. $Ca(OH)_2$ nanoparticles (2-10 nm) were also obtained using w/o micro-emulsions (Nanni and Dei 2003), but low yield and high production time make this method less practical. The synthesis method developed by CSGI (Dei and Giorgi 2001; Ambrosi et al. 2001; Dei and Salvadori 2006), which was commonly named "drop by drop method", was also adopted by several research groups with the aim of refining the synthesis process and properties (Sequeira et al. 2006; Daniele and Taglieri 2010; Daniele et al. 2008). In 2012, the Taglieri team (Daniele and Taglieri 2012) managed to reduce the synthesis time while decreasing the particle size (<50 nm) by adding a surfactant (Triton X-100) in the initial aqueous solution. In other synthesis pathways based on CSGI researches, Bhattacharya (Bhattacharya 2010) obtained nanolime by hydrolysing calcium nitrate tetrahydrate [$Ca(NO_3)_2 \cdot 4H_2O$] as a precursor in diols at a high temperature (175°C) and Samanta (Samanta et al. 2016) synthesized nanolime using calcium nitrate

Table 1.- Brief summary of literature on the synthesis of nanolime.

Year	Research group	Synthesis route	Inorganic precursor(s)	Synthesis media	Processing	T (°C)	PS (nm)
2008	CSGI group	CP-HS	CaO, and NaOH	aqueous	high T, wash. and pept.	60	1-2 (μm)
2008	CSGI group	CP-HS	$CaCl2{\cdot}2H_2O$ and NaOH	diols	high T, Filtration, wash. and pept.	195	30-150
2008	CSGI group	CP-HS	$CaCl2{\cdot}2H_2O$ and NaOH	aqueous	high T, wash. and pept.	90	800
2008	CSGI group	CP-HS	$CaCl2{\cdot}2H_2O$ and NaOH	w/o microemulsions	wash. and pept.	< 15	2-10
2010	Bhattacharyya et al.	CP-HS	$Ca(NO_3)_2{\cdot}4H_2O$ and NaOH	diol (1,2-ethanediol)	hot vacuum filtration and pept.	115	35
2010	Liu et al.	CP-HPMR	melted Ca ingot and H_2O	H plasma	Ca vapour reacts O, CaO reacts with H_2O	room T	10-100
2012	Taglieri et al.	CP-HS	$CaCl_2$ and NaOH	aqueous & Triton-X100	wash. and pept.	90	<100
2013	Taglieri et al.	CP-HS	$CaCl_2{\cdot}2H_2O$ and AER (OH)	aqueous	pept.	room T	<200
2016	Sarmento et al.	CP-HS	$Ca(NO_3)_2{\cdot}2H_2O$ and NaOH	aqueous	pept.	room T	350
2016	CSGI group	CP-HPS	calcium metal	alcohol and H2O (high P & T)	high P reactor (High P & T)	60-130	200

CP (chemical precipitation), HS (homogeneous synthesis), HPS (heterogeneous phase synthesis), HPMR (hydrogen plasma metal reaction), H (hydrogen), Ca (calcium), $CaCl_2$ (calcium chloride), NaOH (sodium hydroxide), w/o (water in oil), $Ca(NO_3)_2{\cdot}4H_2O$ (calcium nitrate tetrahydrate), CaO (calcium oxide), w/o (water in oil), P (pressure), T (temperature), PS (particle size), AER (anion exchange resin), wash (washing with deionized water), pept (peptization process)

dihydrate [$(NO_3)_2{\cdot}2H_2O$] as a precursor in an aqueous medium at room temperature without requiring purification, obtaining nanoparticles of about 250 nm.

Other approaches for obtaining nanosized $Ca(OH)_2$ use calcium alkoxides as precursors (Ziegenbalg 2003; Poggi et al. 2016; Rodriguez-Navarro et al. 2013). Nanolime also has been developed from a hydrogen plasma-metal reaction method (HPMR), obtaining low cost, high purity and crystalline particles (10-100nm) (Liu et al. 2010), and recently the Taglieri team (Taglieri et al. 2015) synthesised nanolime by means of an anion-exchange process using an anion-exchange resin (OH^- group), obtaining nanoparticles with better features in terms of size, morphology and reactivity, and reducing the synthesis time by eliminating purification processes.

Applications

During the last two decades nanolimes have been tested as conservation treatments for various substrates. Most of these studies focused on the pre-consolidation of wall paintings, limestone, lime mortars, renders and plasters; and on the de-acidification of cellulose-based materials such as paper, canvas and wood (Poggi et al. 2016).

The use of lime dispersions in alcohol was first reported by Giorgi et al. (Giorgi et al. 2000), who obtained higher consolidation effect than with aqueous solutions and less superficial white glazing. Later, Ambrosi and co-workers, (Ambrosi et al. 2001, Dei and Giorgi 2001) successfully tested the first synthesized $Ca(OH)_2$ nanoparticles in lime mortar, limestone and wall paintings, achieving good results and good re-adhesion of detached pigment flakes without side effects. The nanolime developed by CSGI was further tested on several Italian frescoes (Baglioni et al. 2003, Baglioni and Giorgi 2006), limestone (Dei 2006) and a wall painting in the archaeological site of Calakmul (Baglioni et al. 2006) in Mexico, achieving a good degree of consolidation. All work undertaken by CSGI between 2001 and 2006 achieved better superficial re-cohesion and quicker carbonation with fewer applications than limewater and without any aesthetic changes; thus demonstrating that nanolime is so far the best treatment for the consolidation of wall paintings.

Calosil® and Nanorestore® were tested by several authors in Europe since 2008. Using Calosil®, Drdácký (Drdácký et al. 2009) documented significant strength increase in lime mortars with far fewer applications than with limewater. Other authors (Daniele et al. 2008; Campbell et al. 2011; Daniele and Taglieri 2011) studied the consolidation and penetration of nanolime on limestone(s) and lime mortars and found high superficial strengthening, although nanolime penetration only occurred within 200 μm-1 mm from the surface, depending on the porosity and degree of deterioration of the treated limestone (Ruffolo et al. 2014). These results highlight the importance of the material's pore structure in the effectiveness and penetration of the product. Other authors (Borsoi et al. 2012; Costa et al. 2012) observed insufficient nanolime penetration, no consolidation and nanolime migration back to the surface of the substrate in highly porous limestone, renders and mortars. Afterwards, it was verified that this phenomenon occurs during evaporation of the solvent (Borsoi et al. 2015). The strength and penetrability of Calosil® products in plasters, lime mortars and wall paintings was also studied (Daehne and Herm 2013). It was found that the strength of lime mortar can be increased up to seven times when Calosil® E-25 is applied with cellulose ether gels (hydroxypropylcellulose gel) and that the addition of a low amount of Calosil®-Micro (contains 1-3 μm calcium hydroxide particles) enhances penetration and reduces back-migration.

Treatments combining nanolime and other products were also studied. The CSGI team (Baglioni et al. 2003; Baglioni et al. 2006) used a combined treatment of barium hydroxide and nanolime for the treatment (desulphation and consolidation) of wall paintings. This combined application was improved later in 2010 (Giorgi et al. 2010) with nanoparticles of both barium and calcium hydroxides. The combination of nanolime dispersions (CaLoSiL®) with silicic acid esters (SAE) can be used to enhance the affinity of SAE to a calcareous

matrix (Piaszczynski and Wolf 2011). Photo-catalytic nanolime (Nuño et al. 2015) has been successfully used for self-cleaning coatings and environmental pollution control.

Factors influencing nanolime performance

There are several factors influencing the effectiveness of nanolime as a consolidant: nanolime characteristics (concentration and type of solvent, particle size, morphology and specific surface area), physical and mechanical characteristics of the substrate, extrinsic factors (RH, temperature, exposure time, CO_2 available) and application method. Some of the published literature explains its effectiveness as a consolidant.

It has been shown that nanolimes have superior consolidation properties to limewater, including both higher and faster carbonation with greater penetration (Ambrosi et al. 2001; Dei and Giorgi 2001; Dei and Salvadori 2006). A short-chain alcohol dispersion provides the following benefits: 1) greater colloidal stability (Dei and Giorgi 2001); 2) solvent evaporation so that higher concentrations of $Ca(OH)_2$ are attained (Giorgi et al. 2000); 3) higher amounts of lime (up to 30 times higher), resulting in an increased lime incorporation into the treated substrate and lower number of applications (Dei and Salvadori 2006); 4) enhancement of carbonation kinetics and $CaCO_3$ polymorph nucleation (Rodriguez-Navarro et al. 2013); 5) significant reduction of the amount of water introduced into the treated material. Nanoparticles in an alcohol dispersion penetrate better in porous structures and carbonate faster due to their higher specific surface area (Sequeira et al. 2006).

The role of the solvent for in-depth consolidation was studied recently (Borsoi et al. 2016). It was found that solvents with high boiling points improve the depth of nanolime deposition in stones with large pores (35–40 μm), while solvents with lower boiling points perform better in materials with finer pores (0.5-2 μm), which reduces nanolime migration back to the surface during the solvent drying. Comparison of different concentrations (5 and 25 g/L in isopropanol) of different products (Calosil®, Nanorestore® and Merck®) for the consolidation of lime mortars found that lower concentrations (Calosil® 5 g/L) yield the most significant improvement in the degree of carbonation in the pores (Arizzi et al. 2015). A percentage of residual water content in the alcohol medium (1:10 w/a ratio) clearly enhanced the carbonation process (Dei and Salvadori 2006; Daniele and Taglieri 2010). The colloidal behaviour of $Ca(OH)_2$ nanoparticles in alcohol was studied (Rodriguez-Navarro et al. 2013; Rodriguez-Navarro et al. 2016) and showed that, upon contact with alcohol, $Ca(OH)_2$ nanoparticles partially transform into Ca-alkoxides via the reaction $Ca(OH)_2 + 2ROH \rightleftarrows Ca(OR)_2 + 2H_2O$. The Ca-alkoxide conversion is time-dependent; therefore a long period of storage will produce higher conversion. The rate of carbonation of $Ca(OH)_2$ particles is reduced by this conversion, so that a freshly prepared alcohol dispersion should be preferred. The influence of repeated applications (1 to 6) of Calosil® with different concentrations on high porosity stone showed that the appropriate amount of consolidant has to be chosen in relation to the stone porosity; the optimal treatment for stones with large pores (±48 μm) seems to be 2 applications of Calosil® at 25 g/L concentration (Slizkova et al. 2012).

Relative humidity, temperature, and exposure time strongly influence the carbonation kinetics and the precipitation of $CaCO_3$ polymorphs (López-Arce et al. 2010). It was shown that the nucleation of polymorphs varies as a function of RH and time, and the optimum carbonation rate is achieved at high RH (75-90% RH). The full carbonation may be achieved in 9-10 days at room temperature, ambient CO_2 concentration and high RH values (75%) (Baglioni et al. 2014). An important factor in the consolidation of porous substrates using nanolime is the availability of sufficient CO_2 in the pores of the treated material for the calcium hydroxide to fully carbonate. Some research groups investigated the possibility of increasing the amount of CO_2 in the pores of treated substrates. For example, the Taglieri team (Daniele et al. 2008) achieved full and faster carbonation by adding sodium bicarbonate ($NaHCO_3$) to the alcohol solution. However, the addition of $NaHCO_3$ may induce the formation of salt efflorescence. Other researchers (Lopez-Arce and Zornoza-Indart 2015) obtained good results and a full conversion in 21 days by creating a CO_2-rich atmosphere in a yeast-sugar environment.

Conclusions

The paper gives an overview of the available literature about nanolime as a consolidant for calcareous substrates. There is no question that nanolime represents one of the most promising materials for the conservation of calcareous substrates because of its compatibility and minimal side effects. However, it is clear that more technical and practical knowledge needs to be acquired. The main conclusion is that whilst nanolime appears to be an effective consolidation treatment for superficial consolidation, when an in-depth consolidation is needed, as in the case of large portions of weathered porous substrates, the results vary significantly between materials. In-depth consolidation is influenced by several factors such as substrates' porous structure and nature, nanolime concentration, nature of solvent, RH, time, CO_2 exposure, additives, storage and application method. The interaction between all of these factors requires further study. Furthermore, the literature lacks data on the long-term performance of nanolime treated materials. The popularity of nanolime is growing and future investigations will hopefully contribute to addressing its current limitations.

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Influence of the calcination process in traditional gypsum with structural behavior

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Abstract: Gypsum is used as a finishing material with a principal aesthetical purpose. It is assumed that this binder has a poor structural behavior. However, it is also found as a structural material in many ancient constructions. In Spain there are several examples of architectural heritage with structures, floors and façades made of pure gypsum. In the studied area (Teruel), traditional gypsum represents the main material used in its architectural heritage. Nowadays, commercial gypsum is being used in restorations, but the different behavior between current and traditional gypsum results in non-compatible restorations. Here, we analyze the traditional gypsum calcination process by building two traditional ovens, assisted by locals masons, and we study how the differences in the calcination procedure can generate different gypsum products, which can be used either as a finishing material or as a structural material with a high mechanical resistance.

Key words: calcination, structural, traditional, gypsum, oven construction.

Influencia del proceso de calcinación del yeso trasicional para uso estructural

Resumen: El yeso se utiliza como un material de acabado con una función principalmente estética. Se le asume un pobre comportamiento estructural. Sin embargo, también se encuentra como material estructural en muchas construcciones antiguas. En España hay numerosos ejemplos de patrimonio arquitectónico con las estructuras, los suelos y fachadas de yeso puro. En la zona estudiada (Teruel), el yeso tradicional representa el principal material utilizado en su patrimonio arquitectónico. Hoy en día, el yeso comercial está siendo utilizado en las restauraciones, pero el diferente comportamiento entre el yeso actual y el tradicional, está produciendo restauraciones no compatibles. Aquí se analizan las fases de calcinación del yeso construyendo dos hornos, asistidos por dos artesanos locales, estudiando como las diferencias del proceso de calcinación pueden generar diferentes productos de yeso, obteniendo un material de acabado o un material estructural de alta resistencia mecánica.

Palabras clave: calcinación, estructural, tradicional, yeso, construcción de horno.

Introduction

The current perception regarding the use and performance of gypsum as a building material is that a poor mechanical behavior is expected. However, historically, traditional gypsum elaborated in traditional ovens, was used as a structural material in countless ancient constructions (Almagro 1986). In Spain, in the East and South areas of the Iberian Peninsula (Tarragona, Barcelona, Lérida, Zaragoza, Huesca, Teruel, Castellón, Valencia, Cuenca, Albacete, Murcia, Alicante Almeria, Jaen, Granada Málaga and Sevilla) (Rubio 2006). Examples of such structural applications of gypsum include:

—Structural massive walls: "Torres Mudejares" in Teruel or the castles from Calatayud, Maluenda, Cadrete and "Salón del Cuco" in Burbáguena. (Bel-Anzué 2016) [figure 1].

— Structural nerves: Cathedral of Zaragoza's "Seo" and Cathedral of Tarazona.

—Façades made of pure gypsum: historical centers of Albarracin, Cuenca, Madrid, and Valencia (Mileto 2011; La Spina 2015).

Specific conditions during the processing and calcination of gypsum-based materials can yield different products

Figure 1.- "Salón del Cuco" construction placed in Burbáguena made with columns of pure gypsum.

despite the fact that the initial original material is always raw gypsum stone ($CaSO_4 \cdot 2H_2O$) [Table 01]. As a result, a large number of multi-product mixtures can be obtained (Bel-Anzue et al., in press). Depending on the calcination by-product(s), the behavior of set gypsum (after re-hydration) can fluctuate. For example, it has been observed that set α-hemihydrate can obtain a four times higher compression strength than concrete (Arredondo 1961; Ye 2011). Unfortunately, once rehydrated, the estimation of the mineralogical composition of the original calcined product is nearly impossible. This is a strong handicap to precisely reproduce the properties of gypsum used in the past.

In view of the current demand of gypsum for heritage restoration/conservation interventions, we focused our research on how to achieve a calcined product with properties as similar as those of structural gypsum elaborated in the past (Singh, 2007) (Freier, 2003). For this task, we analyzed the traditional production of gypsum by replicating the construction of two ovens built according to the different ancient traditions transmitted over generations in the area of Teruel.

Here we define how traditional ovens are dimensioned and constructed and how such evidence enable us to parameterize the conditions (temperature, pressure and moisture) during the calcination process and to establish the relationship between these parameters and the final product properties. This research thus represents the first step for improving our current knowledge on the traditional use of gypsum as a structural material and has implications in the future use of gypsum in heritage conservation.

Methods

• Phase 1: Building new ovens, according to traditional procedures.

a) *Bibliographical revision*

Some ethnographers and researchers such as Maorad (2002) or Monesma (2006) published researches describing gypsum calcination using traditional ovens in the studied area, and we contrasted it with the know-how from the masons.

b) *Interview with Old masons*

Different local old masons such as Maximiano Malo, Santiago Bailón, Ignacio Bailón, Pepe Rodrigo, Esteban López, Antonio Mena, who were involved in the production of gypsum using traditional ovens until ca. 1950 were interviewed. They inherited this knowledge from their families. Basically, such a know-how has been communicated from parents to children for generations. However, in some areas this "transmission" of knowledge has been lost.

c) *Study of remaining ovens and industry of gypsum production*

In the gypsum quarry of "Navarrete del Rio" it has been possible to locate the existence of 24 similar "primitive" gypsum ovens made of gypsum stones or just a hollow (or trench) dug on a sloped terrain. In the region of Leciñena (Zaragoza) five more traditional ovens were found, one of them completely set to be fired and another already

Table 1.- *T*-dependent products obtained after the calcination of raw gypsum. (MNCARS).

Calcination T	Mineral phase	Name
120-180ºC	→ $CaSO_4 \cdot 1/2H_2O$	→ β-hemihydrate
100-120ºC (autoclave oven, ↑Pressure)	→ $CaSO_4 \cdot 1/2H_2O$	→ α-hemihydrate
220-380ºC	→ $CaSO_4$	→ anhydrite III- Soluble
380-1200ºC	→ $CaSO_4$	→ anhydrite II - Not soluble
1200-1350ºC	→ $CaSO_4$	→ anhydrite I
>1350ºC	→ $CaO + SO_2$	→ hydraulic gypsum

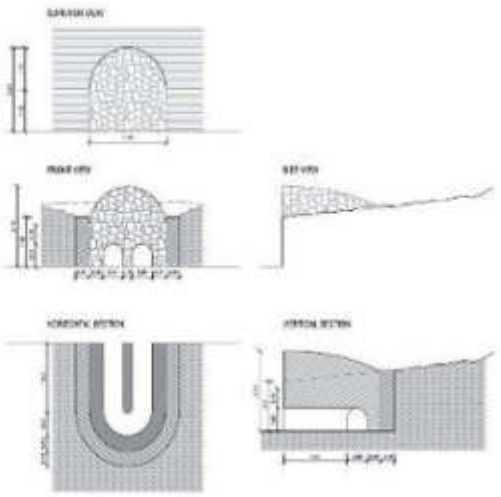

Figure 2.- Morphology and dimensions of a representative gypsum oven in the area. (MNCARS).

calcined, but still standing [figure 2]. All of them displayed very similar morphology and dimensions.

We also found additional gypsum ovens with analogous design and dimensions in Belchite (Zaragoza), La Almunia (Zaragoza), La Almolda (Zaragoza), Arenas del Río (Granada), and Baza (Granada).

In some of these towns (Leciñena, La Almunia, Calatayud, Navarrete) with historical gypsum quarries and primitive traditional ovens, we also found a technology development implemented since 1950 (aprox) and involving the use of new materials as concrete for the sep up of the ovens, or to increase the size of the combustion area.

• Phase 2: Obtaining the material for combustion.

In the studied literature from ethnographers and researchers, we found references on the quantity and type of wood used for firing. Such information was compared with that provided by the local masons.

• Phase 3: Combustion monitoring.

The selection of the right monitoring instruments was problematic because this experiment was never done before. Indeed, a great uncertainty existed regarding what would be the maximum temperature reached during calcination in traditional gypsum ovens. The ranges (T, pCO_2, pH_2O) to monitoring in situ the calcination procedure required the cooperation of various experts in the field of measurement and monitoring.

• Phase 4: The role of masons during the calcination procedure

Gypsum production was a manual process with an important component of knowledge transmitted for generations, involving non-absolute measurements and relaying on a variable (empirical) calcination control. Each family of masons had some know-how or recipe that allowed them produce a different product. In this respect, a bibliographical research was conducted in parallel with masons interviews.

Results

• Phase 1: Building new ovens, according to traditional procedures.

The outcome of our ethno-historic research and the interviews with the old masons showed that the most commonly used oven in the area was a simple excavation called "casa". This so-called "casa" (house) was a trench dug on a sloped terrain with square proportions of approximately 2.5 x 2.5 m, with three sides dug into the hillside, and a height of 2 m.

For our purposes, and to ensure the correct size and temperature distribution during the calcination process, we restored to the correct proportions the remains of a former oven made of gypsum stones and located in a gypsum quarry [figure 3].

Figure 3.- Remains of a former oven in Navarrete.

Figure 4.- Old masons placing gypsum stones in the oven, Navarrete.

In placing gypsum stones, the experience of the old masons was extremely important: The stones with larger size and density were placed at the bottom part of the oven to withstand the weight of the other pieces as well as the most intense fire. These stones were placed in the lowest and central portions of the oven, as well as in the areas around the fire [figure 4]

• Phase 2: Obtaining the material for combustion.

In several towns from the studied area, the material for combustion was collected from the surroundings. In general, the majority of the species used as fuel were bushes of rapid growth with a high combustion power that could be freshly cut a day before the calcination begins. The specie most frequently used is *Genista scorpius*, but the following are also employed: *Rosmarinus officinalis, Quercus coccifera, Salsola vemiculata,* and *Santolina chamaecyparissus*.

From these kinds of bushes, masons cut 70 bushels of 35 kg each. Approximately 2.450 kg of this type of fuel were placed in each oven.

We also found some towns in the area (such as Albarracín) with a large amount of forested area. In this case, the masons from these towns used tree wood as well. Masons cut wood from *Populus* and *Juniperus thurifera* and placed approximately 1.900 kg of wood in each oven.

The effect of the type of fuel was evaluated. For this purpose, each combustion material (bush vs. wood) was used in a different oven. Therefore, two ovens were built.

• Phase 3: Combustion monitoring.

Temperature: Several types of Dataloggers can record temperatures up to 1000°C over time. We have a security margin considering the uncertainties concerning the value of extreme temperatures.

Pressure: We coudnt obtain any instruments that measure pCO_2 and pH_2O at temperatures over 200 C, as in our case. Instead, a pressure gauge connected to a tube inside the oven can give an estimation of the maximum pressure reached during calcination.

Humidity: At present we do not have this instrument,, the firewood will be considered before the combustion procedure, comparing the weight after the combustion procedure.

• Phase 4: The role of masons during the calcination procedure.

Beginning of the calcination procedure: According to the interviewed masons, the best moment to begin the calcination depends on the season. In winter, they preferred to start in the morning because it's possible to finish in 10-14 hours before the temperature drop in the night. In summer, they preferred the evening because of fresher temperatures.

Furthermore, the interviewed masons preferred to start during days with waning moons because they observed a lower ambient pressure which affects the behavior of the smoke and results in faster combustion.

Fueling speed: Independent of the fuel type, the fire was fed as fast as possible.

Plugging the oven with mud: In some regions, a mud cover on the front part of the oven was used to concentrate the heat inside of the oven.

End of calcination procedure: After 10-14 hours of calcination, the gypsum was ready. The masons were able to determine the end of the procedure by observing the aspect of the stones in the top part of the oven. Other references were also used to determine the finishing of the calcination process, such as the moment at which have thrown on top of the oven set on fire.

Discussion

There are important similarities among the studied ovens which were built prior to ca. 1950. The similar size, proportions and construction system enable them to be identified as primitive ovens, used with little changes in design and construction procedure since the Xth century, a period when the oldest gypsum structures in the region were built by Muslim masons.

The combustion material can have a strong influence on the calcination products. It is necessary to study and compare the differences in the speed of combustion and heat evolution that each material produces. The presence of high pH_2O it is possible with green wood.

Monitoring the combustion procedure requires of specific equipment difficult to obtain. To study only the temperature evolution would not necessarily be relevant if this parameter can not be contrasted with pressure and moisture measurements. Indeed, as an example, obtaining β-hemihydrate or α-hemihydrate [Table 01] can be just due to a difference in pH_2O (not in T), but might represent a tenfold increase in the strength of set gypsum.

The large amount of manual work and decisions based on experience required at least two experimented masons to control the beginning (firing of the oven) and the fire intensity, and to determine when the calcination should be finished.

The clay used in the openings of the oven and the use of green wood as fuel, with a high water content which is released during combustion, can lead to high pH_2O during traditional gypsum calcination, thereby favoring the formation of α-hemihydrate, which outperforms the mechanical properties of β-hemihydrate. Similarly, *T* in excess to those required for the conversion of gypsum into hemihydrate, may lead to the formation of α-anhydrite, whose properties once is re-hydrated and transformed into gypsum might gave the use of this material for structural processes.

Conclusions

The use of an existing oven structure from Navarrete's gypsum quarry was appropriate and representative to study the calcination procedure of gypsum in a primitive traditional oven of the type used in the region until ca. 1950, when the industrialization changed the production system of gypsum.

The two different fuels, bush or tree wood, used historically depending on the region, demanded at least monitoring two individual combustions procedures to compare the results. This is why here two ovens were built.

If mud plastering is used to cover open areas of the oven, conditions during traditional gypsum preparation (calcination) can thus be similar to those achieved in autoclave ovens: high humidity and pressure.

In traditional ovens a-hemihydrate could be obtained with specific properties that enable its use as a structural and high strength material with a high durability. Similarly, if T higher than ~ 180 °C are reached in the oven, α-anhydrite can form. Its re-hydration resulting in the formation of gypsum. may also contribute to a high strength end-product that might have structural applications.

The next step in our on-going research will involve the actual firing of the two ovens and the monitoring of parameters such as pH_2O and T, as well as the analysis of the end-products formed at different heights of the oven (i.e., closer or further away from the fire).

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A microbial survey of the museal airborne fungal biodeteriogens

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Abstract: Tangible cultural heritage is exposed to multiple environmental risk factors able to affect its integrity and cultural function. Such factors are physical, chemical and also microbiological. Fungal biodeterioration is known to cause aesthetical and structural damage to materials, the effect increasing in the case of improper depositing or accidents like floods or water leakage. At the same time, air contamination with different fungal spores can add more a risking factor for heritage goods safety. Tracing of air biocontamination has a double significance: protection of museum` workers health from hazardous bio-aerosols and the control of the presence of biodeteriogens able to decompose museum pieces. The present paper will present the methodology used for the detection of the fungal species in the air of an ethnographical museum in Romania, in storage rooms, as well as in exposition rooms. Preliminary results show the predominance of fungal genera with known cellulolytic activity, such as *Aspergillus, Penicillium* and *Cladosporium* and direct correlation between the values of temperature and humidity and the concentration and types of air cultivable fungal species. Further more, the culture media used for the isolation of the air fungal species proved to be an important factor in the isolation methodology.

Key words: tangible heritage, heritage textiles, ethnographical textiles, ethnographical museum, fungal biodeterioration, air microbial load, aerobiology, cellulolytic fungi.

Un estudio microbiano de los biodeteriógenos fungosos aerotransportado en el museo

Resumen: El Patrimonio cultural material está expuesto a múltiples factores ambientales de riesgo que pueden afectar a su integridad y función cultural. Estos factores pueden ser físicos, químicos y también microbiológicos. El biodeterioro producido por hongos es un conocido causante de daño estético y estructural de los materiales, con un efecto mayor en el caso de deposición inadecuada o accidentes, como inundaciones o fugas de agua. Al mismo tiempo, la contaminación del aire con diferentes esporas de hongos puede constituir un factor de riesgo para la seguridad de los bienes patrimoniales. El rastreo de la biocontaminación aérea en museos tiene una doble utilidad: protección de la salud de los trabajadores en el museo ante bio-aerosoles peligrosos y el control de la presencia de agentes biodeteriorantes capaces de descomponer las piezas del museo. El presente documento presenta la metodología utilizada para la detección de especies de hongos en el aire de un museo etnográfico en Rumania, tanto en salas de almacenamiento, como de exposición. Los resultados preliminares muestran un predominio de géneros de hongos con actividad celulolítica reconocida, tales como *Aspergillus, Penicillium* y *Cladosporium* y una correlación directa entre los valores de temperatura y humedad con la concentración y los tipos de hongos presentes en el aire. Además, los medios de cultivo utilizados para el aislamiento de las especies fúngicas del aire se mostraron como un factor importante en la metodología de aislamiento.

Palabras clave: patrimonio material, textiles patrimoniales, textiles etnográficos, museo etnográfico, biodeterioro fúngico, carga microbiana del aire, aerobiología, hongos celulolíticos.

Introduction

Heritage Textile collections usually combine different types of natural fibres, either vegetal such as cotton, hemp, flax or animal, such as wool and silk. These natural macro-polymers are known to have physical-mechanical and physical-chemical properties that are modified over time by the action of different environmental parameters: temperature, humidity, light, ozone and microbial colonization (Bresee 1986; Luxford 2009; Duffus 2013). The combined action of all these factors leads to the ageing of the more fragile natural fibres, a process which today may be exacerbated by intensive cultural tourism, air pollution and climate change. The present debate regarding environmental conditions necessary for the conservation of collections is mainly focusing on the control of temperature and humidity being accepted that the more fragile a structure or a heritage object is, the tighter environmental controls are required (Atkinson 2014).

Most research considering environmental factors that affect the conservation status of heritage textiles is focused on the effect of temperature, humidity or light on these structures (Crighton 1992; Koussoulou, 1999; Luxford and Thickett 2011; Ren Yong-hua et al 2012), though other factors like the air microbial load or the air pollution can have an important impact to the safety of the Cultural goods, even bigger in certain cases, as water leakage accidents, or in a changing climate conditions.

Two standards have been issued in Europe, the first, EN 15757:2010 by Technical Committee 346 of CEN (European Committee for Standardization) and the second, PAS 198:2012, by the British Standards Institute that are addressing limits and ranges of values of temperature and humidity for safeguarding of collections (Atkinson 2014). In Romania, at national level there is a Governmental decision no. 1546 from 2003 which specify rules for maintain a microclimatic stability for temperature and humidity, the intensity of illumination and the control of air pollution with toxic gases (Gov. decision no. 1546/ 2003).

The biodeterioration which is seen as a process that induces undesired changes to the properties of a material determined by the presence and activity of organisms, is considered as an important risk factor for the conservation of cultural heritage objects (Pinzari et al 2011). Recent research underlines the effect of the bacterial and fungal communities on heritage objects and different molecular techniques are being currently developed for the non-invasive investigation of the microbial biodeterioration of the organic substrates (Capodicasa 2010; Sterflinger 2010; Montanari et al 2012; López-Miras et al 2012; Piñar et al 2015).

Air microbiological load is highly monitored in the health care sector but it could also be a risk factor for professional illness of workers in archives, libraries and heritage storage rooms. Through a rich enzymatic equipment microorganisms are able to degrade a broad range of materials (Allsopp et al 2004). They can also weaken the organic heritage materials and pave the road to an increased physical and mechanical degradation. Air can contain microbial species with a highly degradative potential for the heritage materials (Dyda et al 2016) and external atmospheric conditions can influence the quality and quantity of bacterial and fungal species inside museums and heritage buildings (Bulski 2016; Garcia 2016).

The aim of the research was the study of fungal species present in the air in the storage rooms and permanent exposition rooms of the Romanian Peasant Museum, an ethnographic museum in Bucharest, Romania. In order to achieve this aim, a monitoring methodology was developed and applied on the course of several months, starting with cold to warm weather conditions. The present paper presents the preliminary results of applying the chosen methodology.

Materials and methods

The museum characteristics

The National Romanian Peasant Museum, (MNTR) is an ethnographic and anthropological museum with extremely valuable collections, which has nearly 90 000 pieces representing costumes, ceramics, woods objects, icons and interior tapestry. The Museum is placed in Bucharest city center, at Victoria square, in a touristic area. Ethnographical textiles collections have a great significance, both because there are a great number of items, more than 30.000 pieces, and because they reflect all Romanian provinces starting with the first half of the 19th century. The heritage ethnographic textiles are fragmented in three collections deposited in modern storage rooms: The interior textiles collection, The rug collection and the Costumes collection [Figure 1]. A particular concept of the museum permanent exhibitions expose the ethnographic textiles together with objects from the traditional culture, wooden made, such as a church, a traditional house in open air, to increase visitor contact and understanding of the Romanian traditional culture. The structural materials of the ethnographic textiles are mainly natural fibers: hemp, flax, cotton wool and silk.

Figure 1.- The rug collection in a storage room (National Romanian Peasant Museum, Bucharest).

Measurement of the temperature and relative humidity

Simultaneously with the air microbial load sampling, the temperature (0C) and relative humidity (%) were measured in the same sampling points using a laboratory digital termohygrometer (Mannix, model SAM 990DW, Cole-Parmer).

Measurements of air microbial load

The air microbial load was determined in 7 storage rooms: interior textiles, rugs, light clothes, warm clothes, popular costumes and diverse textiles. In every room, the sampling was done in three points: in the front of the room, near

the ventilation system opening, between shelves and in the back of the room. The exposition rooms are situated on two levels, and on each level, they are interconnected. The air microbial sampling was done in a specific point kept the same for all the four rounds of samplings. Usually, the air sampling in the exposition rooms was done in the places where a bigger air load was supposed to be, i.e., under the roof of the "troița", a traditional wooden house for praying and resting. The sampling was done in seventeen exposition rooms for the first 2 rounds of samplings and in 10 rooms, for the last 2 round of samplings. The microbial air load sampling was achieved with SAMPL´AIR (Biomérieux) with 90 mm Petri dishes attached to the device and flowrates of 100 L/min and 200 L/min. The air sampling for measuring the microbial load was done in October 2015, January 2016, May 2016 and June 2016.

Determination of the cultivable fungal concentration in indoor air samples

The air fungal Petri dishes samples were incubated and the number of colony forming units was established for the determination of the fungal concentration expressed in CFU per cubic meter ($CFU.m^{-3}$).

Isolation of the fungal strains

The air sampling for measuring microbial load was done using Sabouraud Dextrose Agar (Biomérieux) and Sabouraud Dextrose Chloramphenicol (Biomériuex) culture media. After the incubation at 280C for 21 to 28 days, the colonies exhibiting different morphological characteristics, such as color of the colony on the face and reverse of the Petri dish, the texture of the colony surface, were isolated on Sabouraud Dextrose Agar with 3 concentrations in dextrose 2%, 4%, 6% and Potato Dextrose Agar. After the incubation of the fungal cultures, isolates exhibiting different morphological characteristics were selected for taxonomical identification.

Characterization of the fungal isolates

The fungal isolates were characterized by optical microscopy with lactophenol cotton blue staining technique at the Axio Imager A2 Optical Microscope (Carl Zeiss). The colonies surface morphology was observed at the Stereomicroscope Discovery V8 (Carl Zeiss). The growth characteristics were assessed by cultivation on four different media: Potato Dextrose Agar (Merck), Malt Extract Agar (Sanimed), Czapek-Dox Agar (Sanimed), and Yeast Extract Agar (Merck) and measurement of the growth rate at different intervals until the 14th day of incubation. The identification of the fungal isolates was done using dichotomous keys (Barnett and Hunter 1998).

Results and discussions

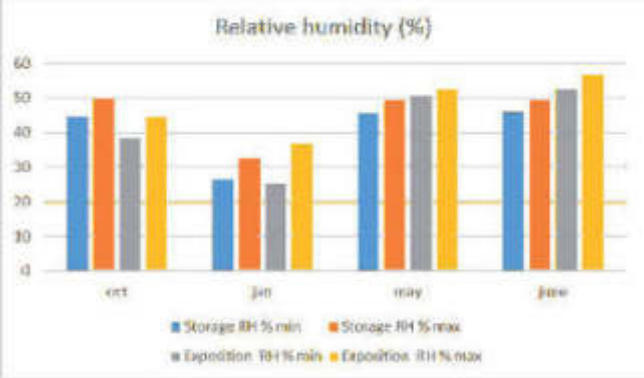
Air isolation of the cultivable fungal species and temperature and humidity measurements

When using Sabouraud Dextrose Chloramphenicol Agar (SABCh) the growth of fungal colonies after incubation of the plates was much more reduced then in the case of using Sabouraud Dextrose Agar (SAB) without any antibiotic. It can be suggested that at the initial sampling of an air sample, it is important to use culture media rich in nutrients for different fungal taxons, with different metabolic and physiologic behavior. A restricting media, such as it is SABCh, even though chloramphenicol it is an antibiotic used against bacteria, may also inhibit the formation of reproductive structures in the case of fungi. Another important aspect obtained during sampling and isolation of the fungal species from the air microbial load, was the type of culture media used in the 2nd round of cultivation. Our results showed that the use of another culture media, different from the culture media used in sampling increased the chance to obtain a fungal isolate. Thus, when using PDA (Potato Dextrose Agar), the colonies isolated from the SAB plates could further grow. When using the same type of culture media, i.e. SAB (Sabouraud Dextrose Agar), some of the colonies lost their ability to grow.

Differences in the number of colonies or species of obtained fungal isolates using air sampling flowrates of 100 L/min and 200 L/min were not found. However, the air sampling area was shown as an important factor determining cultivable fungal diversity. The fungal isolates increased in diversity in the case of the air samples taken at the opening of the air system ventilation in the storage rooms or under the roof of the" troița", the wooden praying construction from the permanent exposition room.

The measurement of the temperature and relative humidity during all 4 rounds of sampling comprising cold to warm weather showed a difference of 1 ^{0}C to 3 ^{0}C between rooms either storage or exposition rooms. Indoor air relative humidity had the highest levels in May, between 45% and 55 %. In January, this range was considerable low, with levels between 25 % and 35 % in both storage and exposition rooms [Graph 1]. In the months with increased levels of indoor relative humidity, the diversity of air cultivable fungal isolates was higher compared with the months with lower levels of indoor air relative humidity as for example in June, some yeasts were also isolated from the air samples.

The range of air fungal concentrations differed from one month to another, coinciding with differences in the temperature and relative humidity levels [Table 1]. Thus, the lowest fungal concentrations in the air samples were obtained in January, when both atmospheric parameters decreased drastically, especially the relative humidity. In storage rooms, without heating, the air fungal concentration was around 20.



Graph 1.- The measurement of relative humidity during the four rounds of air microbial sampling in storage and expositions rooms.

An exception was registered for the entrance of the storage room with summer costumes, were the fungal concentration was 70. In the expositions rooms, in January, the fungal concentration was approximately double than in storage rooms, but still under the number of fungi obtained in the other 3 sampling months. The highest concentration of fungi in the air was detected in October, with a mean value of 153 in storage rooms and 223 in exposition rooms. October is a month with high outdoor air relative humidity, because of the seasonal rains, and warm temperature (sometimes up around 20 0C). The combination of a high humidity and warm atmosphere could create favorable conditions for increasing fungal content in the air samples.

Characterization of the fungal isolates

Observations made with the stereomicroscope and light microscopy showed that some fungal isolates presented a dense mycelium of melanised hyphae, without the development of reproductive structures, which made classical taxonomical identification difficult [Figure 2]. The morphological features, like color of the colonies, the intensity of growing was slightly different, depending of the type of culture media used. The identified fungal species in the air samples were Aspergillus niger, Aspergillus flavus, Cladopsorium sp., Paecilomyces sp., Stachybotrys sp. and Penicilium sp., and also some unidentified yeast species [Figure 3]. All these genera and species are usually found in the indoor and outdoor air and are known to decompose cellulosic substrates (Pinar et al 2016; Amore et al 2013; Foladi et al 2013; Hussain et al 2012; Aro et al 2005; De Vries and Visser 2001; Das et al 1997). When cultivating the fungal isolates on different types of culture media, in order to assess the growth characteristic, the best growth was observed on the PDA culture media, followed by Czapek-Dox media. The growth on MEA was poor and for most fungal isolates Yeast Extract Agar didn't allow a good growth and sporulation.

The preliminary results of this research suggest that the air microbial load, in terms of quantity and diversity can be correlated with atmospheric conditions, such as outdoor temperature and humidity and the sampling area. The culture media used in the air sampling and further fungal strains isolation play an important role for the accurate monitoring. In the case of the ethnographical museum, Sabouraud Dextrose Agar and Potato Dextrose Agar gave the best results in sampling and isolation of the fungal air contaminats. The developed methodology for monitoring the fungal air load in the ethnographical museum can be part of a preventive conservation strategy in this museum, in which daily measurements of the temperature and relative humidity are also performed. Further more, the implementation of such a strategy can also favor the workers' healthcare, especially in places such as storage rooms or archives.

Table 1.- Concentration of the fungi in the air samples from storage and exposition rooms (CFU.m^{-3}).

Sampling Round	Storage rooms			Permanent expositions rooms		
	Interior textiles f/m/b*	Rugs f/m/b	Summer costumes f/m/b	The "beauty" room	The "troița" room	"Triumph" room
October 2015	180/-/-**	190/-/-	90/-/-	210	210	250
January 2016	20/20/30	20/20/20	70/30/20	40	50	40
May 2016	45/75/80	85/130/115	50/80/80	110	35	90
June 2016	45/30/35	45/35/15	40/40/10	90	80	40

* front of the room (f)/ middle of the room (m)/back of the room (b); **in the first round from storage rooms air samples were taken from the front of the room only.

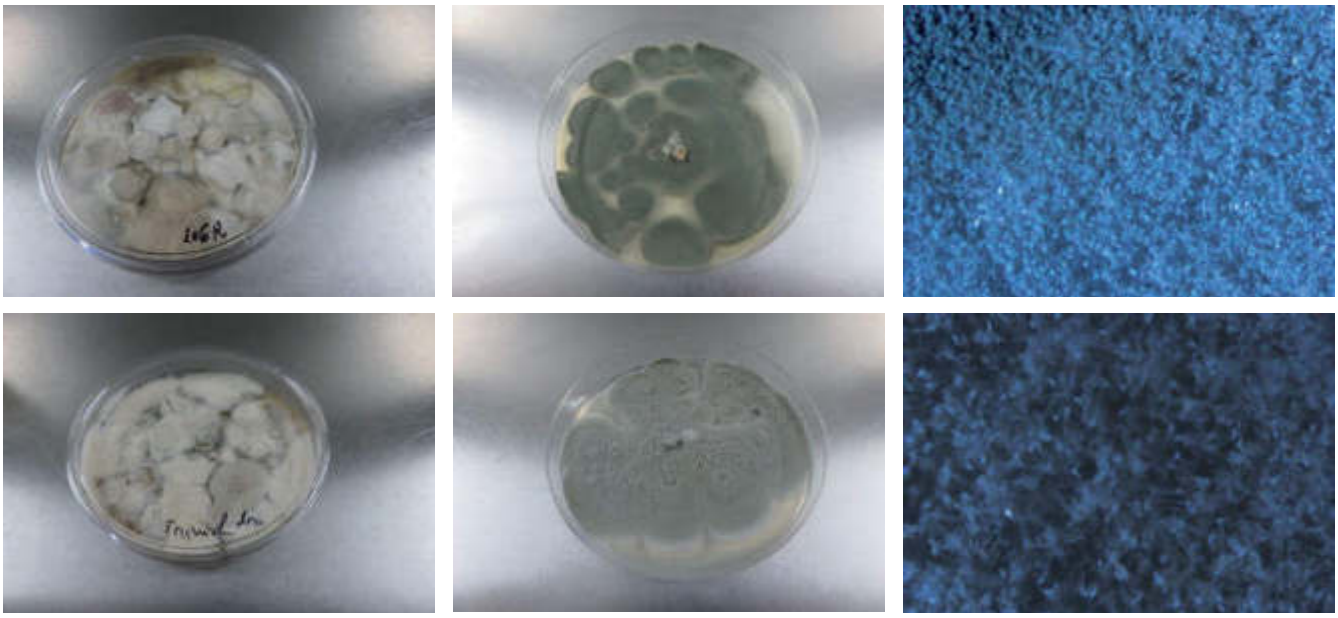


Figure 2.- Fungal growth after incubation of air samples plates (first image), isolation of a single colony (2nd image) and stereomicroscope image (3rd image) of fungal mycelium collected from storage room (up row) and exposition room (down row).

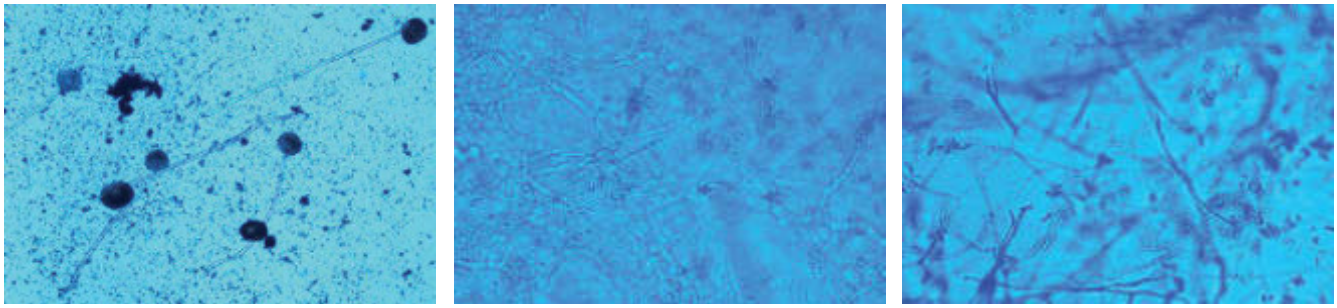


Figure 3.- Light microscope images of fungal isolates stained with lactophenol cotton blue: *Aspergillus* sp. (1st image), *Penicillium* sp. (2nd image) and *Cladopsorium* sp. (3rd image).

Conclusions

A methodology for monitoring the air fungal load was applied for the identification of the cultivable fungi in storage and permanent exposition rooms in an ethnographical museum. Fungal species belonging to different genera such as *Aspergillus, Cladosporium, Paecilomyces, Stachybotrys* and *Penicillium* were isolated and identified by classical methods. The comparison of results from air sampling done in cold and warm months, together with measurement of the temperature and relative humidity, have permitted to analyze the influence of these factors in fungal air content. The highest concentration of fungi in the air samples was obtained in the month with higher temperature and relative humidity values which could be favorable to sustain fungal growth.

Acknowledgments

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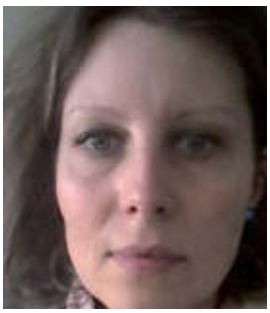

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A Pavilion in the Danish forest by Vilhelm Wohlert; Tradition and Modernity

Carmen García Sánchez

Abstract: Danish architect Vilhelm Wohlert (1920-2007), after a stay as a guest teacher at Berkeley University, designs his first building. Created in a period of a flourishing architecture, it achieves a balance between Danish tradition and modernity, where international references -American architecture and Japanese tradition- are significant. Its ability to fit into the circumstances, sets a model for the buildings of the future. There is a dialogue with the surrounding nature, her careful observation; establishing a great connection, where the Danish attitude towards her is not a domination. The architect knows the material and uses it in harmony with its essence. The study suggests that the vernacular may be a process that evolves and transforms over time involving a significant level of modernity, and that a look at it could be an answer to prevent the loss the identity of architecture.

Key words: Vilhelm Wohlert, Danish tradition, Japanese tradition, nature, material, vernacular.

Un Pabellón en el bosque danés por Vilhelm Wohlert; Tradición y Modernidad

Resumen: El arquitecto danés Vilhelm Wohlert (1920-2007), tras una estancia como profesor invitado en la Universidad de Berkeley, proyecta su primer edificio. Construido en un periodo de florecimiento arquitectónico, logra el equilibrio entre la tradición danesa y la modernidad, donde las referencias internacionales -la arquitectura americana y tradición japonesa- serán trascendentales. Su capacidad para adaptarse a las circunstancias, lo convierte en un modelo para los edificios del futuro. Hay un diálogo con la naturaleza circundante, su atenta observación; estableciéndose una gran conexión, donde la actitud danesa hacia ella no es de dominación. El arquitecto conoce el material y lo utiliza en armonía con su esencia. El estudio sugiere que lo vernáculo puede ser un proceso que evoluciona y se transforma con el tiempo, implicando un nivel significativo de modernidad, y que una mirada a ello puede ser una respuesta para prevenir la pérdida de identidad de la arquitectura.

Palabras clave: Vilhelm Wohlert, tradición danesa, tradición japonesa, naturaleza, material, vernáculo.

Introduction

In Denmark, around 1950, after the second war and a period being isolated, the economy begins to grow again, giving rise to a new era of architecture, the so called "Golden Age of Danish Modern Architecture". Young Danish architects experiment with ideas of an international origin, encouraged by different circumstances. They find the best field of rehearsal to be the domestic space.

The third generation of architecture, so named by Sigfried Giedion (1888-1968), developed in Denmark, shares values with past buildings, tracing its roots to the Danish tradition: deeply connected to craftsmen´s knowledge, the skilled use of materials and the wisdom of anonymous buildings. It brings together all artistic disciplines; advances and regenerates itself from the already known through the assimilation of international impulses; and develops an architecture which aim is to: renew itself preventing the loss of authenticity maintaining its Danish identity and know "the truth" and "the original essence" of the architectural act.

The Danish architect Vilhelm Wohlert (1920-2007) after a brief stay as a guest teacher at Berkeley University in California, comes back to Denmark to establish his office.

Aim

The aim of the investigation is to unveil some keys to Danish modernity in the field of architecture, through his earliest construction, in which the Japanese tradition took a special place; to identify, reveal and recover some of its teachings, which are considered prevailing today.

Methodology

The research analyses backgrounds, figures and buildings relevant to Danish tradition; and some examples of Japanese traditional and American architecture. Affinities and shared sensibilities are detected.

Development

The modest guesthouse that Wohlert built in 1957 for Niels Bohr, Nobel Prize in Physics in 1922, was his first building. Created in a period of flourishing architectural, it roots in the Danish tradition, where the principles of the *Skønvirke* are present. It achieves a balance between the vernacular tradition and modernity, where international references -American architecture and Japanese tradition- will be significant. [figure 1] [figure 2]

Professor Bohr commissions Wohlert to renovate his summer house and a new wing for guests. The plot was integrated in a remote virgin forest in the northern of *Sjælland*. The architect suggests construct a separate guesthouse to preserve the integrity of the existing house and to have other advantages. Bohr accepts the proposal, stipulating that the building should be inexpensive and finished by the end of the following summer. (Nyborg and Wohlert 1987: 9).

The architect designs a freestanding container that preserves the open area around it. His task will be perceiving the vocation of the place, respecting its identity despite the changes; to create a new place where architecture and nature will coexist, the "*genius loci*" will endure. The visitor is readied for the experience of the architecture, where the manner of approaching the building becomes significant. The impression is slowed, to liberate the individual of mental assumptions and to reach both an appropriate mood and a high level of intimacy.

He presents his building as a body of pure lines and characteristic abstraction. It shows its own entity, alluding the modern concept of pavilion. Its light enclosure and the way it can be unfolded, confer the sense of being a piece of furniture, a cabinetmaker´s delicate work. It seems deceitfully simple; a timber clad box that seems to float over the green meadow, opens to the southwest and closes to the northeast.

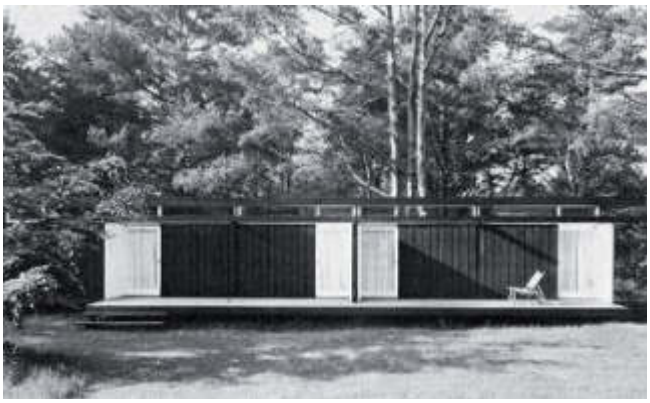

Figure 1.- Niels Bohr´s guesthouse. Photographer Jesper Høm. Jesper Høm´s collection. Sheridan, M., (2014). Landmarks, the Modern House in Denmark. Ostfildern: Hatje Cantz. p.56.

Figure 2.- Photographer Jesper Høm. Jesper Høm´s collection. Sheridan, M. (2014). Landmarks, the Modern House in Denmark. Ostfildern: Hatje Cantz, p.56.

Danish Tradition

Wohlert knew traditional Danish architecture´s bases by his mentor Kaare Klint (1888-1954). His father, the architect and teacher Jensen Klint (1853-1930), a key figure in the evolution of modern Denmark, understood that the architect's task was one less of creation and more of construction. He promoted respect for the context, the clear proportions, the use of traditional craftsmanship and material of the place, the importance of details and a good use of the effect of textures. He was inspired by Mathematics and nature's rules of growth, which he considered the latter key to recovering the form. He stated:

> "Let as cultivate, the object, the surface, the materia, in keeping with its essence and the requirements of the day, and never resort to copying old styles, but through a thorough cultivation and acquisition of the unfailing taste and dignified approach to style of ages past, pursue our personal style, with the aim of creating cozy, beautiful, and magnificent surroundings for modern man's life and activities" (quoted by Jensen 2009: 37).

Kaare Klint creator of the cabinetmakers school, in

connection with the School of Architecture within the Academy in Copenhagen, introduced his father´s teachings that were incorporated into the pedagogy of the Academy, the so called "School of Klint"; where Vilhelm Wohlert and others studied. The sensibility to the landscape, interest in topography, material and climate; an architecture begotten in part by nature; a feeling for rooted vernacular architecture; are concepts that were impressed by Jensen Klint on this generation.

Church of Grundtvig (1921-1940), J. Klint´s masterpiece, was fundamental point of reference for the precision of its craftsmanship and its use of uncut fair-faced brickwork throughout (Frampton and Cava 1995: 250). It clearly embodies the resurgence of Danish tradition of brick. [figure 3] It is based on the repetition of a single material, yellowish brick, the same for all; floors, walls, vaults, stairs, etc ... The exclusive use of a single modular material is also a feature of Niels Bohr´s guesthouse, built entirely of wood and rested on three concrete walls.

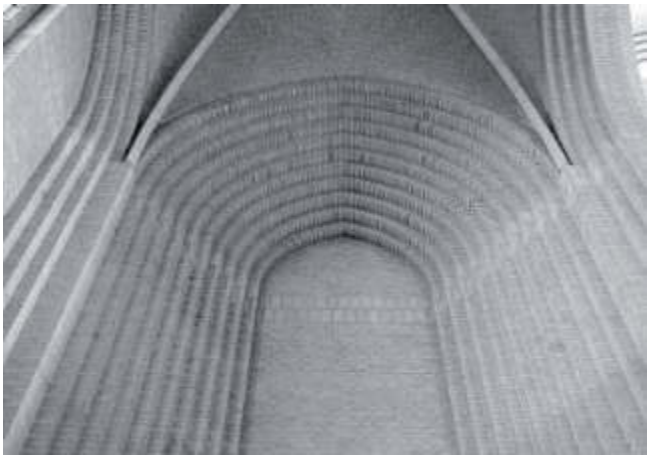

Figure 3.- Grundtvig church (1921-1940), by Jensen Klint. Photographer Carmen García Sánchez Copenhagen, December 2016.

The Danish architect and teacher, Carl Petersen (1874-1923), and his three lectures, keys in the evolution of Denmark towards the Modernity, are also present in the pavilion. He was interested in East Asian crafts, techniques and surface treatments of materials. In "Textures" (1919) (Paavilainen et al 1982: 35-38), he says that each material should show the suitable texture, which does not mask or destroy its essence. Petersen refers to wood as an essential material, the appearance of its surface is more appealing to the Danes for being familiar. The materials are no longer used for their historical value or refinement, but according to their surroundings, their color, their preparation, surface treatment or other attributes. In "Contrasts" (1920) (Paavilainen et al 1982: 45-48), he defends the moulding as a fundamental element in the art of contrast. He refers to the scale of the building, the logic of the proportion, of its components and its relationship with the environment where it is located. The preference for pure and bright colors, stemmed directly from "Golden Age" of Danish art and exemplified by Thorvaldsen´s Museum, are expressed by him in "Colors" (1923-24). Petersen had studied the effects sought by Nordic Neoclassicism´s architects, trying to integrate all the arts, handicrafts, references from other cultures and ages. Wohlert embodies the evolution of this tradition and its renewal, based on the adaptation of foreign influences.

Observing the guesthouse, the simplicity and the modular framework of vernacular building tradition of timber, from Danish farmhouses or fisherman´s cottages, are recognized. Vernacular models, which constructive form is characterized by the clear structural order and precise measurements, are marked by the modular logic and its good proportion.

Kay Fisker (1893-1965), and his partner Aage Rafn (1890-1953) designed some train stations in the island of Bornholm (1915); Fisker designed some summer houses with rectangular planshape, and a single bay (1916-1918). [figure 4] These projects evoke the "Long Danish houses" and typify Danish Functionalism. They are a source of inspiration for some architects´ projects of the third generation: as a summer shelter by Jørn Utzon (1918-2008), built in Ålsgårde (1939); some single-family houses by Arne Jacobsen (1902-1971); or the guesthouse by Wohlert. The Viking postulates reappear with the Functionalism. The elegant Viking ships, symbol of Danish culture, were the most precious jewels of its civilization (800-1050 a.c.). They, entirely built with wood, displayed the advanced stage of craftsmanship reached at that time. Their winter camps fortress, Dannevirke, surprise by their typological regularity of the buildings and the accuracy of the construction system used. Their buildings, the "Long Danish houses", like their ships, had very precise measurements.

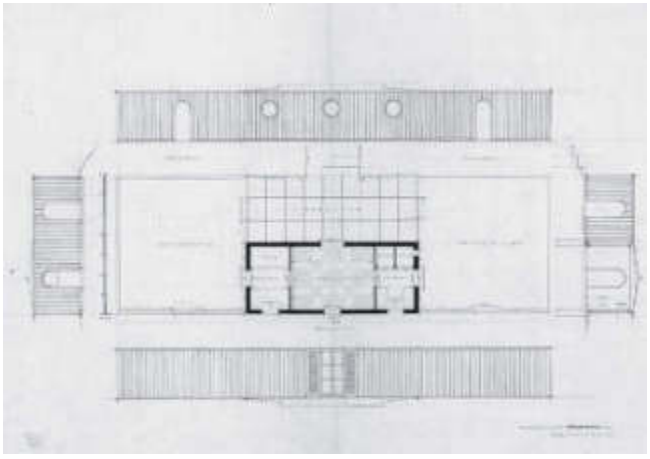

Figure 4.- Proposal for summer house by Kay Fisker (1919-1923), in Hareskovby. Original drawing property of Royal Danish Library-Danish National Art Library, Collection of Architectural Drawings.

American references

The connection with American architecture is crucial. However the great masters, the connection with those of the Bahia Area and their work stands out. Wohlert was very impressed by "(…) their close association with their luxuriant nature around them which enhanced them and made them significant" (quoted by Pardey 2007: 16). His project draws a line with the wooden buildings of the San Francisco and the American tradition of the timber houses. [figure 5] His commitment to users' comfort is shown since the beginning of the project. It has been thought for human activity. It is designed for the experience of its interior, is carefully designed and possesses a meaningful relationship with the surrounding exterior. American references also come from the architecture of Marcel Breuer (1902-1981). (Garcia 2015: 73)

Figure 5.- House Apartments (Malibu, Calif.), by Richard Neutra (1949) Photographer Julius Shulman. Archives of J. Paul Getty Trust. Getty Research Institute, Los Angeles (2004.R.10, Job 283.10).

Japanese Tradition

In the investigation, beautiful parallelisms to traditional Japanese architecture, designed for the perception of all the senses, are established. Wohlert had never been to Japan, but he knew its culture through different references: a real Japanese tea pavilion the "Zui Ki Tei", rebuilt in the Etnografiska Museet of Stockholm (1935), and the interior of a Japanese house exhibited at the showroom "H55" Helsingborg (1955), that he could have visited; and indirectly by relevant books like: "Das Japanische Wohnhaus" (1935) and "Japanische Architektur" (1952) both by Tetsuro Yoshida, "Des japanische haus und sein leben" (1936) by Bruno Taut; and through the work of some American architects, such as Frank Lloyd Wright (1867-1959) or Charles and Henry Greene (1868-1957, 1870-1954). The inspiration of the East will be a constant in Wohlert's trajectory. (Balslev 2004: 46, 61, 62).

He uses a module 1:2 that orders the plan of the building. [figure 6] Its proportion and dimension, are based on the measurements of the standard mat that orders the Japanese traditional house. It comes from the standardization of timber construction, governed by the desire of working with whole lengths and measures. Everything fits like a whole, without a single cut board and any waste of material, providing economy and unity. It is "mounted" architecture which has previously been studied. The modulated order, without wasting material, and the design adjusted to the human scale, come from teachings by Kaare Klint and Japanese culture; bringing out the great unity of the building. It is a moderate architecture, that lacks exaggerations, where avoid the striking is a sign of strength. Scale is valued. It conveys serenity and beauty. A beauty that is also based on its utility, as the Danish term "*brugkunst*"-the art of creating an object- expresses. On the other hand, the building evokes to Japanese traditional architecture that is raised off the floor due to the rain of the wet season. It, built with wood, is a type of construction easy to be ventilated, no permanent, simple and inexpensive. Some elements of the guesthouse remind us of them: the terrace evokes to the porch or *engawa*; moving parts such as the large shutters are inspired by the Japanese *shitomido*, wood doors that swing out and up; folding doors recall *biombos*… [figure 7]

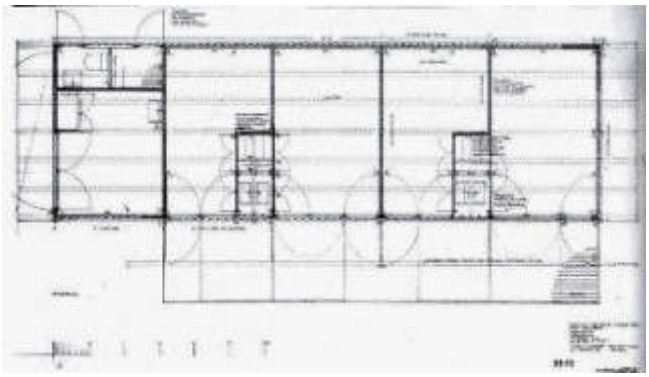

Figure 6.- Guesthouse plan, drawing by Vilhelm Wohlert. PARDEY, J., (2007). Louisiana and Beyond: The Work of Vilhelm Wohlert. Hellerup (Denmark). Blondal. p.26.

Figure 7.- Sanjūsangen-dō hall, Kyoto Prefecture (1164). Photographer Carmen García Sánchez April 2016.

The abstract wood building, conceived as a seasonal place, can be closed in the cold Danish winters, and be partially opened during the warmer seasons. It is an organic manifestation, a living being, which has the sensitive capacity for movement through the variable positioning of its layers and to change according to variations that take place with the passing of time or with the seasons. When the enigmatic box is open, it gives rise to revelations: the space extends towards the forest through its open enclosure; there is a great connection to the surrounding nature, which presence within the interior is very intense, as of it, her changes are ever-present. "It pays tribute to transformation, associated to the change between seasons" (Garcia, in press). A sensibility common to Japanese culture is detected, where nature and life are united.

Per Olaf Fjeld stated: "Day light is probably our most profound connection to nature and life". (Garnert et al 2011: 21) According to this, in the association between nature and the interior space, day light will play a transcendental role. The Nordic light, much dimmer and absence, constantly changes throughout the year; marks life, experience of the architectural spaces and the people´s mood (Garnert et al 2011). It, that gives everything its presence in the words of Louis Khan, interferes in the impression of surfaces by its incidence, that manifest their spatial value through their textures. Wohlert uses it wisely.

When the solid shutters and doors fold, air circulation creates a sense of freedom, and an architecture of horizontal spatial flow is set, associated with nature constant flux. The horizontal plane is dominant, there is a strong connection with the land; both circumstances offer order and security. The terrace is a delicate platform, that has a dual character, it is an extension of the house or an extension of the forest, a transitory space, like a Japanese *engawa*. But it also has a contemplative function, typical of the Eastern tradition, becoming an exciting place of exchange between nature and spirituality. On the other hand, it reminds the Japanese nō, or stage, where life takes place.

The pavilion could be seen as ikebana, the Japanese art of flowers, "the art of space", that is "rigorously constructed", something alive, which great emptiness projects tension and power; where is produced a circulation of air between its components (Barthes 1991: 44 cit. by Garcia, in press). Ikebana, an art that "gives life to flowers" -which true meaning is a positive interaction between the human being and nature, where there is a careful observation and dialogue with her and not a domination- shares characteristics with the guesthouse: the third dimension, the lack of symmetry reaching balance, the emotion of both the material and its texture… The asymmetrical concept that had already emerged at the Stockholm Universal Exhibition (1930), is also present in other Japanese references; like the shelves *chigaidana*, which suggest a changing world, where the hidden depths and potential extensions are possible.

The material inspires the architect according to its physical qualities: such as its surface texture, firmness, smoothness, density or structural capacity. Wohlert deepens into its essence, emotional expression and symbolic content, as in the Japanese culture; reaching certain intimacy with it. He knows the material and uses it in relation to what surrounds it. Its relationship with the environment and striking harmonious oneness, shows a great beauty. But it is not only a visual harmony, it is also haptic; were the power of the finish and its emotional character play an important role. The natural material, the wood, is not beautiful because it looks delightful, but because it has aged and lived an important experience, it is close to an end, and therefore, next to merge with death. In this way, when the construction disappears, a connection with both death and ecology could be established. The project alludes to the modern Japanese idea that the house is transitory. This is expressed by the *hyosatsu*, sign on the facade of traditional houses, finished by the word "Gū" (temporary residence) (Nakagawa 2016: 251) or the shrine buildings at Gekū and Naikū, in Ise Grand Shrine, rebuilt every 20 years as a part of the Shinto belief of the death and renewal of nature and the impermanence of all things, *wabi-sabi*. This transitory feeling was explained by Jørn Utzon who stated:

> "Well, we are not…really interested in how things will be in 25 years, whatever we build. Actually, what we are interested in is that if in 2000 years some people dig down, they will find something from a period with a certain strength and purity belonging to that period" (quoted by Frampton and Cava 1995: 289).

It could be said that the spirit of poverty as the basis of aesthetics, eliminating the superfluous that distracts from the experience of the place, and the presentation of material´s inherent appearance, are common to Nipponese culture. Wohlert creates an elegant balance between rustic and refined, by a careful design and attention to detail and jointing. He draws plans and sections scale 1:1, illustrating each board and part of the building. The project, developed at all scales, forms a global work. [figure 8]

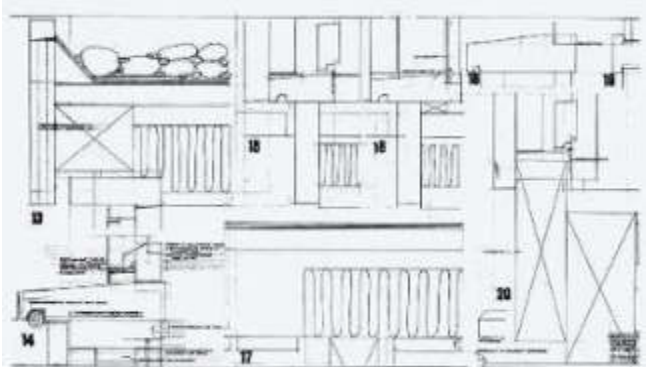

Figure 8.- Guesthouse constructive details, drawing by Vilhelm Wohlert. PARDEY, J., (2007). Louisiana and Beyond: The Work of Vilhelm Wohlert. Hellerup (Denmark). Blondal. p.27..

Professor Bohr hosted guests and relatives in the building until his death. Today it is protected by the Danish Agency for Culture to be preserved, has its original function and belongs to his descendants, that maintain it with devotion.

Conclusions

The guesthouse shows the scenery where life takes place, which remains exposed to the actions of the natural environment. Its architecture, surrounding nature, and life, all come together in harmony being gentle to human beings. It is a lesson entirely of the present.

"Respect for material" and "honest construction", two concepts handed down to Danish architects through the ages, are invaluable rules today. As the Danish architect Jørn Utzon pointed in 1948, the architect must become one with his materials and be able to form and use them in harmony with their nature. The time we live in, is different from any previous one, but the essence of architecture, is the same.

The pavilion represents a modern version of vernacular architecture, where the ability of the building to fit to the circumstances, like weather changes, seasons or guest´s preferences, makes it a model for the buildings of the future. The tradition can be seen as creative processes through which architects, interpret past knowledge and experiences to face the demands and challenges of today. On the other hand, it could be said that the look at the vernacular -an anonymous architecture which is concerned with the historic, rural and preindustrial heritage of construction- may be an answer to avoid the feared loss of identity brought about by the contemporary process of modernization and its universalization. Rather than being a nostalgic reflection upon the past, it may be a process that evolves and transforms over time, involving a significant level of modernity; and play a meaningful role as a provider of settlements and buildings more sustainable for the time to come, as a response to the pursuit of the "truth" and the "original essence" of the architectural act.

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The stone in a monumental masonry building of the Tyrrhenian coast (Italy): new data on the relationship between stone properties and structural analysis

Forestieri, G., Tedesco, A., Ponte, M.

Abstract: In order to assess physical-mechanical properties of building material ("Fuscaldo sandstone"), non-destructive tests have been performed in the main façade of "Palazzo Carelli - Pignatelli" (14th-15th centuries) in Fiumefreddo Bruzio (Italy), situated in the Tyrrhenian Coast (in the South of Italy). Mechanical properties have been assessed through Schmidt hammer hardness and ultrasound velocity tests. Structural analyses have been carried out to assess collapse mechanisms of the entire façade. Results provide a preliminary comprehensive understanding of the decay level and instability of the building.

Key words: conservation, non-destructive tests, structural analysis, heritage.

El material pétreo en un edificio monumental de la costa tirrenica (Italia): nuevos datos sobre la relación entre propiedades pètreas y análisis estructural

Resumen: Ensayos no-destructivos se han llevado a cabo en la fachada principal del "Palazzo Carelli - Pignatelli" (Siglos XIV-XV) en Fiumefreddo Bruzio (Italia), situado en la Costa Tirrenica de Calabria (en el Sur de Italia), para evaluar las propiedades físico-mecánicas de su material de construcción (Arenisca de Fuscaldo). Las propiedades mecánicas han sido evaluadas a través de las técnicas del martillo de Schmidt y de ultrasonidos. El análisis estructural se ha hecho para identificar los mecanismos de colapso de la fachada. Los resultados han permitido obtener una comprensión preliminar del grado de deterioro y de inestabilidad del edificio.

Palabras clave: conservación, ensayos no-destructivos, análisis estructural, patrimonio.

Introduction and geological setting

The main objective of this research is to assess the influence of deterioration and structural damage on the petrohysical and mechanical properties of the investigated building stone taking as example the case study of "Palazzo Carelli - Pignatelli" in Fiumefreddo Bruzio (Italy). The effects derived from decay have been evaluated combining different non-destructive techniques (NDT) with structural analyses, carrying out *in situ* and laboratory tests performed on selected samples.

For the selection of the case study to investigate, different criteria have been considered. First of all, the architectural importance of the monument. "Palazzo Carelli - Pignatelli" that is an example of the "Renaissance" architecture in the royal style of Naples of the 15th century, kwown as "durazzesco-catalano" (Forestieri et al., in press). In the same architectural style others important buildings have been built in the south of Italy, like "Sersale", "Giannuzzi Savelli", "Spiriti Sersale", "Pitelia", "Alecce" palaces etc. (Canonaco 2012). The portal is characterized by lateral pilasters, architrave and upper trabeation. Sandstone ashlars present smooth and furrowed surface, with ornamental elements, like flowers and vegetal motifs. Another criterion has been the role of the building stone material in the Calabrian context. The entire noble building and its main portal have been realized using the local stone named "Fuscaldo

sandstone". Macroscopically, this sandstone is compact, yellow/brownish colored and presents visible fossils from 1 mm to 6.50 mm. It is commercialized under the name of "Pietra dolce o di Fuscaldo" (sweet or Fuscaldo stone) due to its easy workability. It has been principally used by the most important schools of Calabrian stonemasons to build portals of many Calabrian old towns (Forestieri et al. 2015). Geologically, this stone belongs to the Sedimentary Successions of the Upper Oligocene-Middle Pliocene of the Tyrrhenian Coastal Range that includes not only sandstones but also calcarenites, arkoses, conglomerates, clays, marls, gypsums and evaporitic limestones, from 200 m to over 1.500 m in thickness (Critelli and Le Pera 2000). The last criterion has been the high degree of deterioration and the structural instability of the investigated monument. This building is, in fact, affected by different serious problems due to the deterioration processes and structural damages of the masonry.

In order to characterize the building material and its state of conservation, deteriorated samples, representative of the portal of the main façade were selected and compared to unaltered quarry samples of the same lithology. Quarry samples belong to the outcrops situated in "Località Scarcelli" in Fuscaldo, where it is located one of the most ancient Fuscaldo outcrops exploited by stonemasons for the construction of many Calabrian monuments (Forestieri et al. 2016). According to the geological map of figure1 (Casmez 1967), the Upper Miocenic sedimentary succession of this area is composed by dark and light sandstones with a calcareous cement and sandy horizons, locally conglomeratic and dark-light to dark-reddish conglomerates, made of rounded pebbles and fragments of granite, gneiss into an arkosic matrix.

Tests are aimed to show differences in properties of 'fresh' quarry and unaltered stones, and deteriorated sandstones. The overall aim is to clarify the links and the compatibility between these two local sandstones in order to replace the original material.

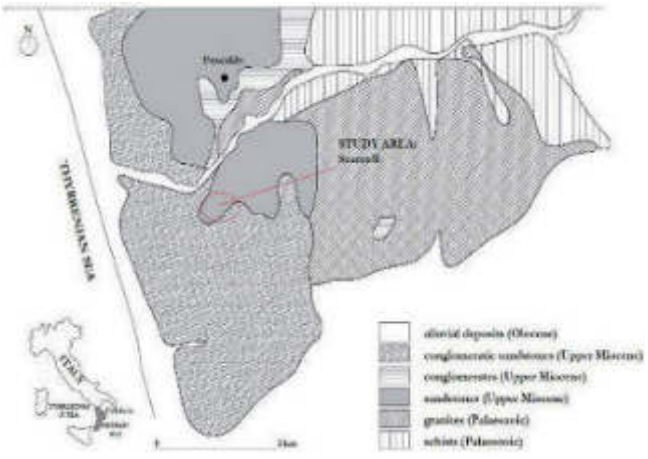

Figure 1.- Geological sketch map of the studied area of "Scarcelli outcrop" in Fuscaldo. Red circle shows the studied area (Casmez 1967, modified).

Methodology and sampling

Laboratory tests included chemical and morphological analyses. The chemical composition of the samples was determined by electron probe micro-analyzer (EPMA) - JEOL JXA 8230, while the morphological composition was obtained by scanning electron microscopy with energy-dispersive X-ray spectroscopy microanalysis (SEM–EDS) on a FEI Quanta 200 instrument, equipped with an EDAX Si (Li detector). The sample "C" was analyzed by the chemical-morphological analysis and taken from the right abutment of the portal at 2.00 m height above ground, that resulted the most deteriorated point thanks to the survey.

The description of the alteration forms which affect the building has been carried out according to the current standard recommendation (UNI EN 1182 2006). The observation of the alteration forms was performed through the naked eye and with the help of a 10X Canon EOS 750D camera.

The petrographic features on thin sections have been analyzed using a Zeiss Axioskop 40 polarized optical microscope.

The *in situ* mechanical tests have been performed in order to characterize physical and mechanical properties of the deteriorated parts. These tests included strength measurement of sandstone surface and deteriorated parts by means of Schmidt Geo-hammer (L-type), according to current standards (ASTM D5873-14 2014), to assess the hardness characteristics of the building stone. Schmidt hammer is a portable and low-cost equipment, nondestructive, which gives the material surface hardness value, being used in laboratory or in field. It is also useful to determine the mechanical properties of stones and can be used when there is only one face available for testing (Yagiz 2009). The rebound test hammer housing was held firmly by hand in a position aligned horizontally downward (~0 degrees) so that the impact plunger stroke at an angle perpendicular to the test surface of the portal. For each examined point twelve impact readings have been recorded. The relationship of Bieniawski (Bienawski 1984; Moomivand 2011) has been employed to determine the correlation between uniaxial compressive strength and Schmidt hammer rebound values. Values of porosity and unit weight employed are referred to fresh unaltered Fuscaldo quarry specimens investigated in other studies: $\gamma = 2,25$ g/cm^3 and P = 20,14% (Forestieri et al. 2015).

Through the ultrasonic portable equipment MATEST Ultrasonic Meter Ver, with an accuracy of 0.1 microseconds and equipped with two 55 kHz frequency transducers with a diameter of 1,5 cm, the ultrasonic velocity measurements (P-waves) have been obtained. The ultrasonic equipment is widely used in a variety of materials to verify the existence of fractures or internal discontinuities. This is a nondestructive method that aims to determine elastic wave's propagation speed inside the studied material

(Vasconcelos et al. 2008). During measurements, in order to improve coupling of the trasducers-transmitter and receiver, a couplant was applied. In order to obtain the spatial variability of the ultrasonic velocities, six measurements referred to different orientations were obtained in each ashlar. The obtained velocity values were compared to the ultrasonic measurements of eight quarry specimens (A1-A8). Tests conditions were: dry surfaces and indirect mode with the application of the trasducers parallel to the analyzed surfaces.

The structural analysis of the main façade of the building was performed through the linear and non-linear kinematic structural analysis to define the seismic vulnerability indices. In order to obtain the seismic indices a collapse mechanism of simple overturning of the main façade has been considered. The non-linear kinematic analysis performed aimed to determine the seismic displacement factor (f_d) and the linear acceleration factor (f_a). Structural analysis conditions have been: 1) unconsolidated system (actual condition); 2) consolidated system (applying metal tie-rods). The two considered limit states (LS) are the "damage" limit state (DLS) and the "safeguarding of life" (LLS). The acceleration factor fa,LS for the two possible limit states has been evaluated as:

$$f_{a,DSL} = \frac{a_0^*}{a_g \cdot S}$$

$$f_{a,LLS} = \frac{q \cdot a_0^*}{a_g \cdot S}$$

where the term (ag•S) is the maximum acceleration of the seismic demand compared to the stratigraphic and topographic conditions of the place evaluated through the coefficient S; a_0* is the spectral acceleration of activation of the considered mechanism; q is the structural factor taking into account the plasticity of the masonry system. The displacement factor fd,LLS has been obtained as:

$$f_{d,LLS} = \frac{d_u^*}{\Delta_d} \geq 1$$

where d^*_u is the ultimate capacity of displacement associated with the local collapse mechanism while Δd represents the displacement obtained through the spectral parameters.

To perform the structural analysis, the main facade of the building was schematized according to the representation in figure 2a. In function of the different values of the collapse multipliers (α0) associated to the specific considered mechanism, the lowest value of the multiplier was associated to a mechanism that provides the formation of a cylindrical hinge in a retracted position of 0,1 m in respect of the outer surface of the wall. For the masonry it was supposed a system of rigid blocks (one block for each level), characterized by a thickness ti and a height hi with the following values [figure 2a]: 1st floor 1 (h_i=4m and t_i=0,8m); 2nd floor (h_i=3,8m and t_i=0,65m); 3rd floor (h_i=3,5m and t_i=0,55m); 4th floor (h_i=2,0m and t_i=0,45m). Considered data about the masonry strengths were chosen according to the Italian seismic standards (NTC 2008): compression strength design value f_{md}=1,38 MPa; tensile strength design value f_{ctd}=0,138 MPa; shear strength design value f_{vmd}=0,021 MPa (considering the absence of vertical loads); a level of knowledge of the structure "LC1" corresponding to a confidence factor FC=1,35. Data about the spectral seismic action for the considered site were (NTC 2008): nominal life of the building V_N=50 years; class of use II; category of underground B (S_s=1,2); topographic category T2 (S_t=1,2). Data about the seismic spectral response were (NTC 2008): for the limit state DLS, the following values a_g=0,914 g/10, F_0=2,26, T^*_c=0,31s, C_c=1,4, T_B=0,15s, T_C=0,41s, T_D=1,96s; similarly, for the limit state LLS, the following values a_g=2,64 g/10, F_0=2,41, T^*_c=0,35s, C_c=1,33, T_B=0,17s, T_C=0,50s, T_D=2,65s. Data about the loads (P_i) of the walls of the different levels were: P_1=846,72kN, P_2=703,84kN, P_3=509,34kN, P_4=306,18kN; the vertical and horizontal components of the load trasmitted by the covering structure, respectively equal to $S_{V,C}$=18,81kN/m and $S_{H,C}$=4,2kN/m; the load of floors P_{Si}, equal to P_{S1}=P_{S2}=P_{S3}=350,72kN/m.

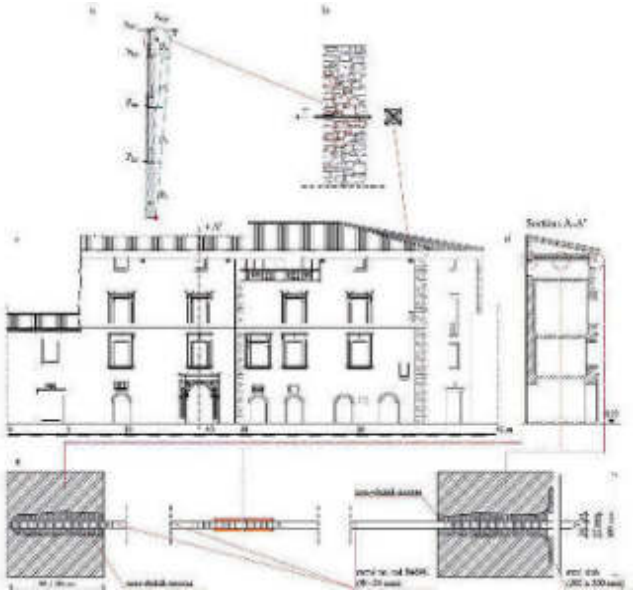

Figure 2.- Static representation of the main façade of "Palazzo Carelli - Pignatelli", divided in rigid blocks and subjected to an overturning mechanism of collapse (a); static effect on the masonry produced by the consolidation design by metal tie-rods (b); final aesthetic appearance of the masonry façade once the proposed metal tie rods consolidation technique is completed (c, d); detailed executive cross sections of the metal tie-rod intervention into the walls (e).

Results and discussion

The observation of the decay forms on the portal surface led to the graphic representation of figure 3. As reported in this picture, deteriorated parts are affected by: back weathering due to the loss of scale; alveolar weathering; missing parts due to the break out; efflorescence; superficial deposits/crusts; delamination and granular disintegration. Structurally, the high parts of the main façade are affected by a mechanism of collapse that shows a strong displacement in the horizontal direction of the façade.

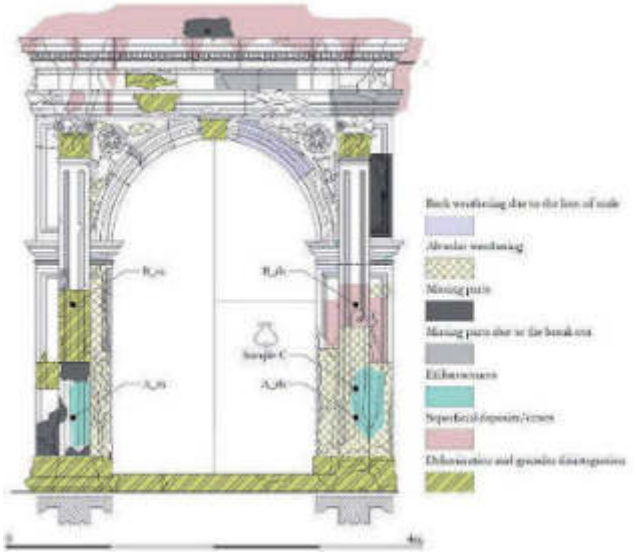

Figure 3.- Portal of "Palazzo Carelli - Pignatelli" with the deteriorated parts. The points A_dx, B_dx, A_sx and B_sx have been analyzed by Schmidt hardness test and by ultrasonic velocity pulse test. The point C (at 1.20 m of height) has been also tested by morphological analysis (SEM analysis).

Petrographycally, quarry samples "Fuscaldo sandstone (AF)" [figure 4a] are composed by 50% of clasts and 50% of carbonate matrix. They show a homogenous composition and texture and are composed by quartz, plagioclase, k-feldspar, biotite. The most significant accessory minerals are zircons and apatite. Subrounded fragments of granitic rocks are also present. The pores with a mean value of 25µm are distinguishable. Fossils attributable to microforaminiferas are also present. According to Pettijohn (1975) they can be classified as a *greywacke*. The building stone of the case study "Pignatelli sandstone (PS)" [figure 4b] shows the same petrographic characteristics of the quarry material. The only difference is due to the higher level of decay and the consequent higher porosity. Thus, it can be said that the two analyzed building stones have similar petrographic features.

Morphological analyses by SEM are reported in figures 4c and 4d. The chemical analysis of the sample "C" of the portal confirms the macroscopic decay analysis [figure 3] and reveals the presence of elements of Cl, Na and K. The analyzed sample shows the presence of crystals of salts of 5-10 x 5-10 µm, a medium level of porosity and an altered substrate. Furthermore fossils are visible and the presence of salts is concentrated along deteriorated areas.

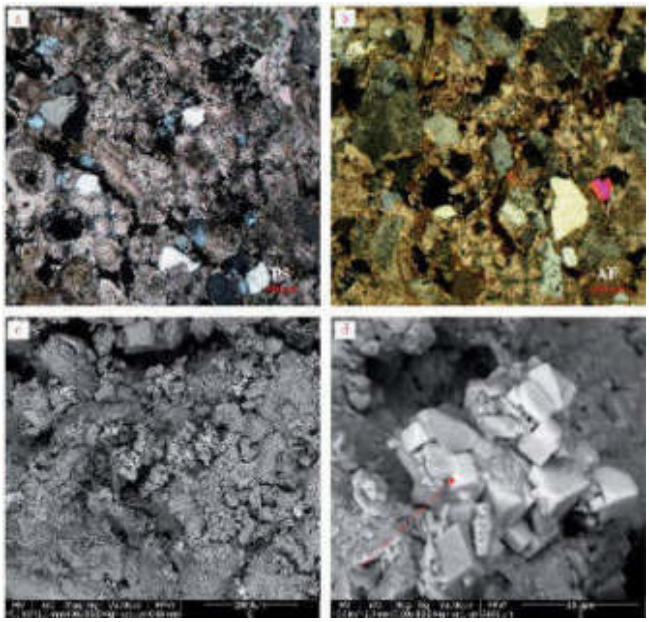

Figure 4.- Micrographs at the crossed polarized light of thin sections from: main portal sample "Pignatelli sandstone" (a); quarry sample "Fuscaldo sandstone" (b). SEM analyses of the sample C, taken from the right abutment of the portal of "Palazzo Carelli - Pignatelli" (c, d)..

Schmidt hammer rebound values (Hs), the uniaxial compressive strength values (UCS) calculated and ultrasonic velocities (Vp) are reported in table 1.

Analyzing values reported in table 1, it can be said that the most deteriorated part of the portal is its right part where have been registered lower resistance values. Moreover the lower parts (points A) are more affected by decay than the higher ones (points B). The higher the ultrasonic pulse velocity, the higher the uniaxial compressive strength as obtained by many authors (Molina et al. 2013) and viceversa. Pignatelli sandstone (PS) shows average resistance values similar to the quarry samples (AF). Thus, the quarry Fuscaldo sandstone can be used to replace the most deteriorated parts of the main façade. Quarry blocks should be placed in the most deteriorated parts, where have been registered the highest concentration of salts and the others forms of decay described above.

Data obtained from the petrographic analysis and mechanical tests are in agree with the structural analysis performed. Through the kinematic analyses, the check of the seismic vulnerability for the limit states DLS and LLS was performed to determine the safety factors listed in table 2.

Table 1.- Schmidt hammer rebound values (Hs), uniaxial compressive strength σc (MPa) and ultrasonic pulse velocity mean values Vp (m/s) for "Pignatelli sandstone" (PS_A; PS_B) and "Fuscaldo sandstone" quarry samples (AF1-AF4).

	ashlar/sample	H_s	σ_c (MPa)	V_p (m/s)
Pignatelli sandstone				
right	PS_A_dx	22 ± 1,5	23,2 ± 1,4	1.681,94 ± 286,00
	PS_B_dx	31 ± 1,8	33,4 ± 2,3	2.934,21 ± 301,67
		27 ± 4,9	*28,3 ± 5,5*	*2.308,07 ± 711,50*
left	PS_A_sx	24 ± 1,3	25,2 ± 1,3	1.847,85 ± 239,90
	PS_B_sx	31 ± 1,6	32,6 ± 2,1	3.100,69 ± 349,41
		27 ± 3,6	*28,9 ± 4,1*	*2.474,27 ± 713,95*
Fuscaldo sandstone				
	AF1	32 ± 3,0	35,4 ± 4,5	2.602,12 ± 500,50
	AF2	32 ± 1,8	34,3 ± 2,4	2.561,51 ± 269,17
	AF3	36 ± 2,4	40,8 ± 3,8	3086,08 ± 194,69
	AF4	32 ± 1,8	34,2 ± 2,6	2983,52 ± 287,21
		33 ± 2,9	*36,8 ± 4,3*	*2.808,31 ± 380,80*

Table 2.- Results of safety check for different limit states and values of the vulnerability factor evaluated for the main façade of "Palazzo Carelli - Pignatelli" as: a) unconsolidated system; b) consolidated system using metal tie-rods (DLS = damage limit state; LLS = safeguarding of life limit state; X = not satisfied; √ = satisfied).

	Kinematic analysis	Limit state	Safety check		Vulnerability factor	
a)	LLS	SLV	$a^*_0 > a_g \cdot S/q$	X	$f_{a,LLS}$	0,23
	LLS	SLV	$d^*_u > \Delta_d(T_S)$	X	$f_{d,LLS}$	0,65
	DLS	SLD	$a^*_0 > a_g \cdot S$	X	$f_{a,DLS}$	0,33
b)	Not Linear	LLS	$d^*_u > \Delta_d(T_S)$	√	$f_{d,LLS}$	1,02
	Linear	DLS	$a^*_0 > a_g \cdot S$	√	$f_{a,DLS}$	1,29
		LLS	$a^*_0 > a_g \cdot S/q$	√	$f_{a,LLS}$	1,01

From the low values of the seismic safety indices obtained for the condition of "unconsolidated system", resulted that the examined wall of the case study needs an improvement of the "box effect" with a connection among walls constituting the masonry structure. This intervention is necessary in order to avoid the detected overturning collapse mechanism that compromises the building static stability. The increase of the building safety indices has been obtained, in this study, through the application of 4 metal tie-rods [figure 2b] of B450C steel type, applied next to the eave line, for each cross-section, having a diameter of Φ=24 mm. Each metal tie-rod is blocked on the external wall by a steel slab of small dimensions (300 x 300 mm) while in the opposite wall it is inserted into the masonry thorugh non-shrink mortar [figure 2e] for a lenght at least of 40 or 50 cm. Thus, the final result of the proposed metal tie rods consolidation technique [figures 2c, d] does not modify the final aesthetic appearance of the masonry façade once the intervention is completed. Thanks to these devices the safety factors increased and the check of seismic vulnerability satisfied [table 2]. In fact, as reported in table 2, for the condition of "consolidated system", thorugh this proposed minimal design intervention, the wall seismic stability is satisfied for all the considered limit states and the "box effect" is obtained due to the tie systems blocking the opposite walls of the palace [figure 2e].

Conclusions

The petrophysical, chemical and mechanical characterization of the sandstone samples taken out from the active outcrops and from the case study "Palazzo Carelli - Pignatelli", reveals the compatibility from a petrographic and mechanical point of view, between replacing and replaced materials.

The typical forms of decay detected on "Palazzo Carelli - Pignatelli", symbol of the "Renassaince" architecture in Calabria (Italy), are material loss, deposits, cracks and salts. Tests results show how a high degree of decay of the building material affects the structural stability of the entire building. In particular, the worst action belongs to salts that provoke the formation of micro-cracks, fractures and the total material detachment in the points where salts concentration is higher. The resulting map of decay forms shows that the case study is in a bad state of conservation. For this purpose it is suggested a minimal design intervention that consists in both removing decay factors that could contribute to accelerate structural decay and in strengthening external walls with a "box effect" (through metal tie-rods) in order to prevent the individuated collapse mechanism of the main façade. The suggested minimal restoration design has been chosen as a correct

strategy of intervention for the protection, conservation and restoration of the building, because it is restricted only to the eave lines of the façade and it is compatible with its architectonical features without altering its aesthetics characteristics.

Salts detected by morphological-chemical analysis affect the durability of the stone material due to the crystallization mechanisms. The less deteriorated parts exhibit higher resistance values and better physical-mechanical properties. On the contrary, in the most deteriorated parts, sandstone is weakened by salts and shows a reduced durability. Resistance values decreases have been demonstrated by mechanical tests. In relation to the ultrasound pulse velocity measurements, the values obtained are compatible with sandstone changes, which is corroborated by the measures taken with the Schmidt hammer.

Moreover the same diagnostic techniques performed on quarry and deteriorated samples demonstrate the similarity between the two analyzed building materials: Fuscaldo sandstone, the quarry material and Pignatelli sandstone, the building stone of the case study. So, Fuscaldo sandstone can be used to replace the deteriorated building material, because resulted similar and compatible with Pignatelli sandstone.

Conclusively, combining modern restoration techniques (metal tie rods) with the traditional use of local stones, could have many advantages for the conservation of the cultural heritage. First of all, the sustainability of the intervention. Then, the compatibility with the environment, the local culture and the historical traditions. Furthermore, using sustainable local materials could be very useful for the development of the local economy exploiting the active quarries. Thus, an important aspect of this research is that the results can be applied for a correct approach in the restoration of monuments in the investigated area.

Acknowledgements

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A case of industrial heritage: the Ceramica Ligure Vaccari

Alice Cutullè

Abstract: An extraordinary case of industrial heritage, the Ceramica Ligure Vaccari in Santo Stefano di Magra (Italy), one of the most important italian factory of glazed ceramic exported in all over the world. This factory was abandoned after 2006 and then the municipality decided to not forgot its history and trying to create a new cultural life and a new engine of development of the site. For this reason, born the project NOVA, a cultural hub where the artists and the community have occupied the old warehouses and have given new life to the factory.

Key words: industrial heritage, ceramic, factory, NOVA, warehouses, company town, Vaccari.

Un caso de arqueologia industrial: Ceramica Ligure Vaccari

Resumen: Un caso extraordinario de patrimonio industrial, la Ceramica Ligure Vaccari en Santo Stefano di Magra (Italia), una de las más importantes fábricas italianas de cerámica esmaltada exportada en todo el mundo. Esta fábrica fue abandonada después de 2006 y luego el municipio decidió no olvidar su historia y tratando de crear una nueva vida cultural y un nuevo motor de desarrollo del sitio. Por esta razón nació el proyecto NOVA, un polo cultural donde los artistas y la comunidad han ocupado los antiguos almacenes y han dado nueva vida a la fábrica.

Palabras clave: patrimonio industrial, cerámica, fábrica, NOVA, almacenes, pueblo de los trabajadores, Vaccari.

Introduction

What is the industrial archeology? To answer to this question it would be enough to consult an encyclopedia to the corresponding item: "the study of the history of technology based on the discovery, examination, and sometimes preservation, of the buildings, machinery, etc. of earlier industrial activity (Webster's New World College Dictionary, 2010 by Wiley Publishing, Inc., Cleveland, Ohio.).

This definition, however, despite its clarity, is not exhaustive. First, there are no indications related to its history. This topic in fact was born in England, it is no coincidence that is the birthplace of the industrial revolution, thanks to a group of scholars-enthusiasts, most notably Kenneth Hudson, who began studying and cataloging this heritage. Today the industrial archeology is not only what is specified above, it is having, from the last decades, a real transformation. This transformation is the result of the need for people to regain possession of these abandoned and disused spaces and bring them back to a new life.

Often there are questions about what is the best way to exploit these areas, according to some should simply be transformed into shopping centers to produce again wealth. There are those who believe that the best way

is to turn them into creative and cultural spaces. The first cases of reuse of spaces have appeared in Germany, as in the case of the mining establishment of the Ruhr, and then developed throughout Europe, even up in Finland (Cable Factory Kaapeli). These factories have been converted for cultural purposes, proper cultural hub, where the community meets for cultural events, co-working etc.

But look at the Italian case. This is marked by a very early origin, as early as the late eighteenth century, with the case of San Leucio, and then from the end of the nineteenth century with Crespi d'Adda, Schio, etc.

But what do we mean exactly? These factories have had importance not only locally, creating jobs and growth within the communities in which they had settled, but which, thanks to their production, have become international.

Unfortunately, as often happens, some factories give way to more modern and therefore close and tend to be forgotten.

In Italy, there are many cases and only now we are trying to recover these buildings.

The common denominator of these experiences is the cultural conversion.

It's starting to understand that it is more useful to enhance and redevelop rather than building new buildings.

Some cases of conversion for culture can be seen in Rome (Ex Mattatoio, Ex Caserma Guido Reni, Centrale Montemartini etc.), Milan (Ex Ansaldo, Mudec, Fondazione Prada, Hangar Bicocca, BASE) Bologna, Ferrara (Grisù Space), Borca di Cadore (Dolomiti Contemporanee) and not least the case I studied, the Ceramica Ligure Vaccari of Santo Stefano di Magra (La Spezia, Italy) [Figure 1].

Figure 1.- The factory now.

Figure 2.- A kind of production of futurist's mosaic in Genoa (Fillia, The swimmer).

My research deals with this important glazed ceramic factory established at the end of Nineteenth century and I studied, during my master thesis, the history of the production from the beginning to the closure in 2006.

In fact, this factory was very famous in the mid-twentieth century, so much to export its tiles worldwide.

The typical production was a specific kind of tile, the 2X2 cm, which was used both for the ceramic coatings that for artistic mosaics, as the futuristic mosaics in the Thirties, for example "The swimmer" of Fillia, in the pool of Albaro (Genua, Italy) [Figure 2].

The basis of my work was the archive, a very important source of data and information related to the history of the factory, the people who worked there and machinery used.

But the most importance source was the oral evidence, thanks to the Vaccari family.

In fact, the founder of the factory, was Carlo Vaccari, who decided to change the old brick production in a ceramic production. He was an "illuminated" industrial man, he had indeed the intuition of not wasting the clay of quarry, and he understood the importance of giving a home to those workers who came from other regions.

For this reason, he created a company town.

The importance of this company town is closely linked to the others Italians company towns, which I mentioned before, like Schio and Crespi d'Adda. In fact, there is a Master House, in the case of Santo Stefano di Magra it is called Villa Vaccari, in which the owner of the factory lives and supervises the plant, and following the houses of workers, duplex houses divided into two floor. Then the others buildings for the common life of the workers, for relax and shop.

Carlo Vaccari assigned to engineer Mazzocchini to designed some of the buildings of the company town, as the House of workers, where there was the dining hall, the shower for the employees and the bicycle storage, and the Company Store.

Not least, to complete the company town, was built the church, called St. Carlo Borromeo, in memory of the founder.

After the ownership of Carlo Vaccari, the family Vaccari inherited the factory.

Following the shutdown due to the Second World War, the production was among the most popular in the world, it was required for ships, hospitals, houses ect., thanks to the economic boom of the postwar period.

Unfortunately, the Seventies proclaimed the production crisis, because other factories were producing the same product at a lower cost, and this deep crisis will lead to failure in 1972.

Despite several changes of ownership, the factory officially closes in 2006.

After the final closure the City Council has decided to maintain, at his own expense, the material derived from the factory and contained within it, which otherwise would have been quickly dispersed. The material in this warehouse is incredibly heterogeneous: tracing paper, seals, floor plans etc., but also artistic mosaics and old machinery.

In this context born NOVA, Nuovo Opificio Vaccari delle Arti, a project that aims to win a challenge: the creation of a cultural economy pole and urban reprogramming of the entire area.

The City took a portion of the area in free loan for eight years, and some buildings, following a public announcement, have been assigned to private cultural operators.

Figure 3.- The mosaic of the former stable calibration

Figure 4.- STUDIO ARCHEPTA, Project of the former stable calibration.

This is an innovative form of both public and private partnership, in fact the old warehouses have been restored and now there is a contemporary art gallery (Galleria Cardelli & Fontana), a design shop where the products are made by the reuse of industrial waste (La Stanza delle necessità), a school for sound engineers and entertainment technologies (Full Service), a music center (Industrie Musicali Acim), and a skatepark (SportXFun).

Furthermore, collaterally to these activities, thanks to a regional funding, the municipality has bought the former stable calibration, one of the oldest and most valuable warehouse of the factory, in fact it preserves ceramic mosaics in the facade [figure 3]. Here it takes place the Vaccari Archive, which preserves what has left of all the documentation of the various offices, along with old machinery. [figure 4]

In other spaces in free loan, in the Palace of Leadership, there was also new public functions: the library of the City, the urban center, and now the Municipality is creating a guesthouse, a kind of creative residence, in which artists, designers ecc. can use as a studio and living quarters, in line with the idea of making again a living area.

The cultural hub, NOVA indeed, holds up an archive and a space for exhibitions, but also some cultural activities in general.

Conclusions

After a deep analysis and study of the Ceramica Ligure Vaccari, I realized that the only use of this importance and extensive area is the re-use, strictly linked to the cultural purposes.

In fact, nowadays, the cultural hub is the answer: an abandoned factory becomes a new centre of culture.

The factory becomes a meeting point, place of exchange and growth, for the community, as in the past.

The future of NOVA depends on the citizens, on the municipality and on anyone who believes that drawing the attention to the plant is an innovative way to protect and endorse such an important resource.

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The Rupestral Crypt at Fornello. An Axis for a Sustainable Conservation in Apulia

Filip Adrian Petcu

Abstract: In this paper I put forward the claim that, Sant Angelo, the rupestral crypt at the site called Fornello, represents one of the very remarkable examples of that kind in the Apulia region, emphasizing furthermore its particular potential as a sustainable conservation pylon in the context of a larger ensemble of surrounding caves. The frescoed crypt designates the referential axis for such a project which should reconnect in a sustainable way, the church, the caves, the rural agrarian area and the people, in a favorable cycle of mutual benefit for tangible and intangible heritage. Our research becomes a pioneer to support an in-depth, on-site study of the three superimposed layers of frescos decorating the crypt. The study reveals new aspects of the Liturgical meaning of the frescos, as it also exhibits further relevant information describing the use of the caves through the ages, envisaging hereby a sustainable conservation perspective for the site.

Key words: conservation, rupestral paintings, caves, calcarenite, medieval, frescos, sustainability.

La Cripta Rupestre de Fornello. Un eje para un modelo de conservación sostenible en Apulia

Resumen: En este trabajo se reivindica que, Sant Angelo, la cripta rupestre en el lugar llamado Fornello, representa uno de los ejemplos más notables de su clase en la región de Apulia, acentuando todavía más su particular potencial como pilón de conservación sostenible en el contexto de un conjunto más grande de cuevas circundantes. El fresco de la cripta designa el eje referencial para tal proyecto el cual debería reconectar de nuevo de un modo sostenible, la iglesia, las cuevas, la zona rural y la gente, en un círculo favorable de beneficio mutuo para la herencia tangible e intangible. Nuestra investigación se hace pionera para apoyar un estudio a fondo, en el lugar de las tres capas superpuestas de frescos decorando la cripta. El estudio revela los nuevos aspectos del significado Litúrgico de los frescos, como también exhibe más información relevante describiendo el uso de las cuevas durante el paso de los años, previendo por la presente una perspectiva de conservación sostenible para el lugar.

Palabras clave: conservación, pinturas rupestres, cuevas, calcarenitas, medieval, frescos, sostenibilidad.

Introduction

The data yielded by this study provides convincing evidence that there is a need to focus on two major aspects regarding the site of Fornello, a rupestral settlement in the Apulia region. First of all, the particularity of this site in a regional context needs to be emphasized. The importance of the Archangel's crypt at Fornello is also shown by means of exposing its very unique iconographic program of wall paintings, which has not been published and researched until present. Secondly, the imminent need for a sustainable conservation plan for the church is presented in detail, while potentially advancing degradation phenomena are thought to be signaled about in this way. The local community of shepherds is encouraged to involve in the process of a long-term preservation of the site. According to Messors strategic plan one of the caves would be restored with the purpose of cheese-aging. The shepherds will be provided with a socio-economic benefit and will be able to sell their products on the international market worldwide. This could guarantee a permanent maintenance of this ensemble in a context of mutual benefit for the sake of the tangible and intangible heritage of Apulia.

Methods & methodology

The Preliminary framework

A primary research for relevant references shows that the frescoed cave-church at Fornello is known with two appellatives, *Cripta di Sant Angelo* or *Cripta di Sant Nicola* (Medea 2014: 47). Several sacred sites in Apulia are dedicated to these two patron saints. Archangel Michael is very common due of the miraculous apparition of the Archangel in 493 at the place called Monte Sant'Angelo at Gargano in northern Apulia. Saint Nicholas is preferred due to the veneration of his Holy Relics at the Basilica in Bari. The relics were transferred in 1087, from the Eastern city of Myra in Lycia (a province on the Southern coast of Turkey) to the West (on the Adriatic coast of Apulia). Most of the sources record it as Crypt of the Archangel. It might possible also that the dedication of the crypt may have changed in the course of time.

The funeral crypt of the Archangel represents for several reasons one of the most noteworthy rupestral examples of that kind – not only in the area of the city Altamura, but also in the province of Bari, in the context of the entire Apulia region. Being located in a remote place, at about 6 km east from Altamura, in direction of Santeramo, at the site called Fornello, the crypt is positioned in the middle of an agricultural field. The cave church at Fornello is not particularly close to the Via Appia Antica which runs rather more South nearby the city of Altamura, as we know that are two other important sites recalled by Ponzetti, *Masseria Jesce* and the nearby *Masseria San Giorgio at Carpentino* (Ponzetti 1934:6). This fact assigns it to a rather more retreated area, which could have suited the exigencies of a monastic community.

The crypt is part of an ensemble of about 25 various shaped caves disposed around a larger area, neighboring two 17th century built structures. A shepherd's house and a larger Masseria building show specific features of this type of farm house architecture. The Masseria is positioned in a strategic position, on the top of the higher hill, on the western part of the property. The current building may have been built upon an older preexistent structure.

The historical context

Apulia is located in Southern Italy – a confluential cultural areal, an essential crossroad for various civilizations and cultures along millennia. For many centuries a great deal of conquering entities exploited its rich agricultural and pastoral resources. They expanded their political authority by consolidating their strategic position within the Mediterranean Basin, through access to the Adriatic and Ionian seas. Oriental and Western civilizations superimposed gradually over the indigenous cultures. Medieval Apulian rupestral art indicates Middle Byzantine models of reference, evoking distinctive, rare, ancient Syro-Palestinian archetypes, which still reverberate in the surviving art from the similar timeframe or even earlier. References can be traced to art of Asia Minor, Syria, Lebanon, Egypt, examples of mural paintings from the region of Mani in Peloponese, Cappadocia and Caucasus Georgia (Petcu 2014).

The Southern Italy particularly preserved its orientalizing character due to the connections to Constantinople and the Middle Eastern ethnics, which used to be present in governing positions and administration, too (Lavermicocca 2012: 14). Therefore, after the massive invasion of Eastern Asia Minor, many monastics and fleeing Christians migrated towards Southern Italy, with the purpose of finding refuge, protection and liberal practice of the their faith.

The materials

Several of the preexisting carved caves became inhabited by monastics, which extended sometimes the ancient spaces and occasionally even previously carved graves. In most of the cases they created new ones, following elaborate architectural plans, excavating and carving the available mass of soft limestone, which was available in the region and had extraordinary properties due to its sedimentary origin and its particularly soft structural consistency. The excavation of the tufo layer for dwellings has definitely not emerged as an innovation of the medieval era, but had already been a recurrent practice since prehistoric times in Apulia.

The soft limestone called *Calcarenite di Gravina* is supposed to have formed during the interval between the Superior Pliocene and the Inferior Pleistocene, being a particular type of porous sedimentary limestone with granular structure, essentially based on calcium carbonate. The layer of *calcarenite* varied in its thickness and was formed in a marine environment during the progressive compaction of disaggregated shells, algae, marine animals and fossils. They all accumulated on the surface of the lower preexistent limestone bedrock, particularly along the so-called *lame*, disposed around the area of the local ravines. These ravines were created through the progressive erosion of the limestone bedrock with the action of water; the calcium carbonate was dissolved and shaped by the effect of the carbonic acid in contact with rainwater. The process induced interesting complex karst phenomena. The *calcarenite* formed inside the lame of the Murgian Plateau, after the disappearance of an assumptive sea that may have covered these lands. The rock is appreciated to be a softer, very workable material which allows quick shaping by easy manual carving comparing to the hard limestone and is called locally *tufo*, although it is not a volcanic tuff. A great workability of this material allowed the amazing excavation and embellishment of various architectural spaces – many of the rupestral churches and crypts, spectacular masterpieces analogously to the Cappadocian or Georgian examples.

Figure 1.- Photographic views of the cave at Fornello, north-south axis; credits: ©Filip A. Petcu.

If compared to the majority of cave churches in Apulia excavated in soft limestone, the particularity of the geological structure of Fornello is revealed in a vertical structure of the wall appearance and shows a superimposition of three distinctive layers. [illustration 1] The sedimentary *calcarenite*, on top is separated from the underlying layer of limestone at the bottom by an intermediate thin layer of scattered angular stones of medium size, which are spread almost regularly over the bottom limestone bedrock.

A bibliographic incursion

According to several prospections, in the Bari region there is evidence of 18 crypts, 19 crypts in Brindisi, 33 crypts in Lecce region, 50 around Taranto and another extra 14 crypts mentioned beside the previous ones in the appendix chapter of Medea's study (Medea 2014). That makes a total of minimum 134 crypts in the area, only in the Apulia, without counting the numerous rupestral churches that can also be found in the Basilicata region. Only in Matera there is evidence of 115 rupestral churches, but we must mention the fact that Matera is originally part of the historical Apulia region and was annexed to Basilicata in 1663. In the preface of Medea's publication, Antonio Ventura lists a chronology of bibliographical references to the rupestral churches of Apulia. French authors of the second half of the 19th century (Charles Diehl, Emile Bertaux, Francois Lenormant and Jules Gay) are mentioned together with the names of two pioneer Italian researchers from Lecce (Luigi De Simone, Cosimo de Giorgi, working between 1868 and 1875). Alba Medea, who started her activity in the 1920s and published her results in 1939 (Medea 2014: 3-4), is also listed. Ventura gives account on the work of Giuseppe Gabrieli. In 1936, this orientalist and librarian printed in Rome the topographic and bibliographic inventory of the Basilian crypts of Apulia (Medea 2014). He then presented it during the 5th International Congress of Byzantine Studies, held in Rome. During his research he encountered Medea's study from 1934 on the churches of the area of Taranto and acknowledged the quality of her work. In 1936 Francesco Maria Ponzetti published an article (Ponzetti 1936) related to a cave church from Altamura which Medea refers in her book when discussing the crypts around Bari. Five years later than Medea, in 1941, Ponzetti, originating from Altamura, published an extent article in Japigia XII about the medieval hermitic crypts of Altamura (Ponzetti 1936: 79). Noteworthy are the later studies on the rupestral churches of Apulia by A. Prandi, C. D. Fonseca, N. Lavermicocca, F. dell'Aquila, A. Messina and M. F. Castelfranchi, Giovanni Miglionico a.o. They all reveal series of lesser known aspects, but do not really bring forward information on the paintings at Fornello. Certain historical information about the Fornello crypt became available through their studies, but the hermeneutical picture of the Liturgical space of church, and certain details of the iconographic program have not been studied in depth so far. However, minor restoration works have recently revealed more evidence in that sense.

Ponzetti records an important Latin document describing certain communal territorial determinations. The document dates from 12 february 1243 and refers in his opinion to the site of Fornello, called with the appellative 'Pecia de la Graeca' and 'Cripta Campanina' (Ponzetti 1936), probably referring to 'pezza' (eng. piece) of land. This statement is supported with a set of arguments by Ponzetti, who excluded any other possibility, and concluded that the reference was strong enough to be identified and associated to the settlement of Basilian monastics living at the site of Fornello. It is notable that the areas of Altilia and Lupatia were seriously damaged during the Saracene raids and Altamura was not properly rebuilt as a city until Federico II di Svevia. That is why the lands around Altilia became deserted around the year 1000, so that people tried to find remoter places to carry on their living and occupied some of the available large prehistoric caves of the area. This fact is documented by Ponzetti in his study referring to about 50 caves, including the site of Fornello (Ponzetti 1936: 77).

The field work

The work on site was based on observation, assisted by measurements, digital photography, 3D Laser-Scanning

Figure 2.- Photographic details from preliminary observational studies on-site and during the first cleaning of the cave floor; credits: ©Filip A. Petcu.

of the crypt's space and minor cleaning tests carried on several areas with prominent salt crystallizations and surface efflorescence [illustration 2]. An updated plan of the cave has been drawn and the existent painted scenes have been partially decrypted and assigned to the plan. The sequence of the fresco layers was preliminary studied in order to develop a mapping process, and a subsequent understanding of the preserved pictures. One Greek inscription has been identified in the original layer, while other six Latin inscriptions have been traced and partially deciphered in more recent layers, revealing additional information on donors and the painted scenes. The floor has been cleaned on the very surface, gathering a large quantity of stone blocks scattered all over the crypt's floor. These have been carefully piled in a side-niche, outside of the perimeter of the painted area of the crypt. The aim was to reuse them in a sustainable way for any necessary consolidation works at walls and the entrance. A large quantity of soot and soil has been gradually removed from the floor surface, when a potential cistern became apparent, as well as stairs at the original entrance of the cave. Several *loculi*, carved rectangular recessions, with sepulchral value, excavated in the bedrock of the cave floor.

The special orientation of the church, in the context of the rupestral ensemble, just as its remarkable spatial division, make it one of the most refined examples of its type, worth to become subject of further scientific research. Most of the cited authors record it as a 'Basilian crypt', pointing out that the church belonged to a monastic community of Eastern Christian Orthodox monks which lived after the monastic code of rules developed in the 4th century by Saint Basil the Great, Bishop from Caesarea Capadoccia. The Medieval use of the cave is certified by carving marks and particularly by multiple layers of painted plaster, distributed on several of the cave's architectural elements. These marks give the impression that the cave was used as a church and as a crypt for several centuries. There are several arguments in favor of the initial use of the church – its iconography and a Greek inscription belonging to the first layer of mural decoration.

Despite the fact that not much is particularly known about the history of church, the past three editions of the Fornello project have revealed some understanding on the plan of the cave church ensemble as well as a new perception of the number of pictorial layers on each wall. Some descriptive elements for this ecclesiastic space would define a semicircular apse carving in the Altar area, two suggestive fragments of the former *cancellum* (*recinzione*), a dividing intermediate wall (carved into the tufo, in between the bema and the *naos*, as a rudimentary form of an early *iconostasis*), several niches of various shapes and depths, and a few arches with built-in elements (in some passage areas between communicating spaces and a more or less flat ceiling). It is worth mentioning some interventions from different timeframes which have damaged the painting through utilitarian carving of new niches in the frescoed areas. They show traces of tools which indicate the removal of the *calcarenite*, possibly by looters. Other areas exhibit drilling holes which might have been used to create a supporting system for a curtain. A particular area on a western pillar points on the closing of an early niche, which was filled in with mortar and stones, prior to the carving of the arch and plastering of the surface of the pillar.

The present overall appearance of the painting is of a palimpsest, due to the discontinuity of the fragmentary pictorial layers, showing extent random losses reflected both on the original and on the superimposed layers of lime plaster. [illustration 3] The conservation issues on the wall paintings are mostly developed by the degrading action of water, bio deterioration with mold-growth on the surface, the effects of the osmosis phenomenon, major losses of plaster and consistent salt crust formation on the surface. Salt recrystallization on top of the painted surface obscures major pictorial details and acts as a visual barrier on the global perception of the ensemble. Spiral grooves indicate the route of the water inside the porous rock, leaving traces of empty curved *lacunae*. Hammer picking marks caused by a tool called *bocciarda*, are particularly evident on the first layer, indicating a preliminary preparation of

Figure 3.- Photographic details showing the degraded superimposed layers of plaster and the massive crystallization of salts on the painted surface of the wallpaintings; credits: ©Filip A. Petcu.

the substrate by picking it in order to improve the grip of a new plaster layer.

Results & discussion

The prominent length of the cave corresponds to the direction of the church's plan space. Since its length is considerable, at least one possible argument can be brought out to support the reason for which the direction of the church nave follows the longest available room of the original cave, on the south-north direction, rather detrimentally to the specific canonical Eastern orientation of a church. Consequently, we can only assume that this compromise occurred due to the preexistence of this carved space on the north-south axis of the cave, prior to consecration of the space as a church. Nevertheless, although the orientation of the church points towards North a *lucernaria* was carved out on the Eastern wall's ceiling. Thus, it permitted the directed light to stream from the East through the carved skylight and to descend over the 'Holy Sanctuary' at the appropriate moment of sunrise, at the Morning Liturgy. The sanctuary block of the Altar has regrettably not been preserved.

The frescoed part of the cave corresponds to the single nave type, having a bema, a reminiscence of a *cancellum* (*recinzione*) and an aula opening to an additional space which could have functioned as a cistern or baptistery. Another secondary space located on the eastern part communicates through an arched entrance with the naos. It lies close to the *cancellum*, leading to a separate architectural unit which might have been a side chapel, *diakonikon* or *prothesis*.

Prior to cleaning the floor during the workshops the main church was unevenly and randomly covered with various sizes of stone blocks, animal dirt and soil which obscured the original level of the floor.

Four empty *loculi* were to be found during removal of the soil, having been carved in the naos floor of the cave, attesting its use as a funerary chapel. The condition of the floor evidenced also a recent use of the cave as shelter for domestic animals.

Investigation on the sequence of fresco layers points to a maximum of three superimposed layers depicting at different timeframes the same iconographic scheme, as evidenced by the Northern Altar apse composition. In this case the *Deeisis* scene represents the enthroned Pantokrator flanked by the two intercessors, the Theotokos and John the Baptist. The three layers of frescoes can be assigned to the 11-12th, 13th and 14th century. On the same wall with the Deesis, the apse appears framed on both sides by standing portraits of Saint Archangel Michael and Protomartyr Stephen. The western wall indicates the representation of the Pentecost, followed by four full portraits of Paul, Peter and two unidentified silhouettes. On the eastern wall we decrypted the symbolic representation of the 'Life-giving Tomb' of Christ with the cross and emerging vegetation painted just below the carved skylight. This depiction is further seconded by three standing portraits as palimpsest, a bishop saint, John the Apostle and a third unidentifiable figure.

The iconographic program of the aula can be characterized with reference to its western and the eastern sections. The eastern wall is very difficult to read, but what remains recognizable is a donor scene picturing a king offering a church-tabernacle in form of a *rotunda* to the Theotokos bearing the Christ child. Above the tabernacle, a winged figure with three faces can be distinguished as a symbolic representation of the Holy Trinity as 'one being in three persons'. On the opposite wall we can observe, from North

to South, the icon of the enthroned Hodeghitria depicted in two distinctive layers, a standing Saint Catherine from Alexandria, a palimpsest of three superimposed layers: The last layer depicts complex narrative hagiographic composition, a full portrait of an unidentifiable saint, possibly Panteleimon, and a last standing portrait of Saint Barbara. On two different pillars on both sides of the western arch we discover the icon of the Annunciation and the portrait of Mary Magdalene, both evidencing two superimposed layers. [illustration 4]

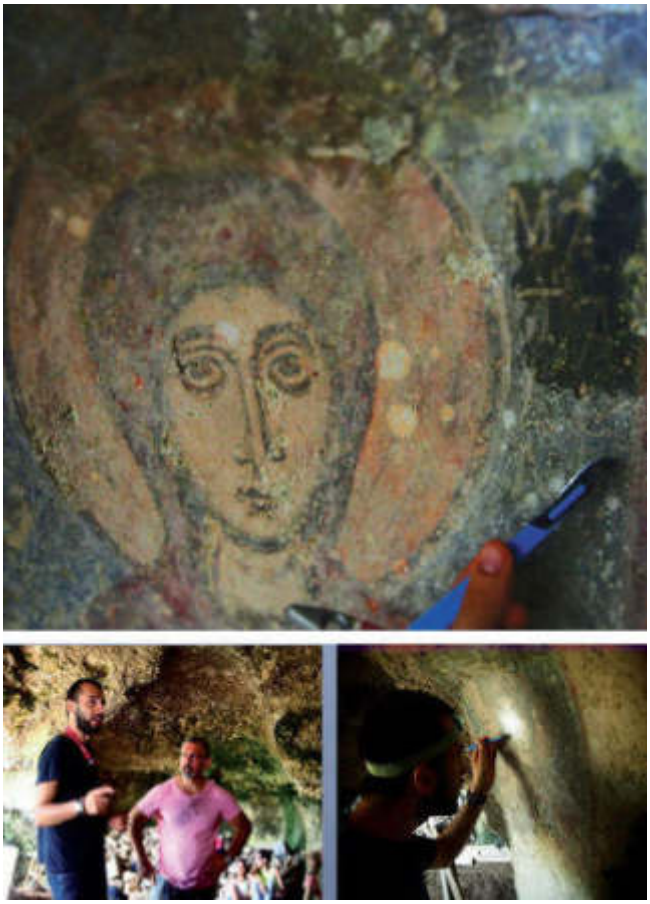

Figure 4.- Photographic details during the cleaning tests on the surface corresponding to the pillar of Saint Mary Magdalane; credits: ©Filip A. Petcu.

A Greek inscription connected to the icon of the Hodeghitria and six Latin inscriptions ascribed to the saints have been evidenced and translated during the past three workshops, exposing new information about possible donors and identity of some of the mentioned subjects. The hermeneutics of the iconographic program have been analyzed and discussed from the perspective of their highly important Liturgical significance.

Conclusions

The aim of this project envisages a long-term goal: to preserve the historical socio-cultural identity and the

Figure 5.- Photographic views showing aspects of team worki on the site of Fornello during the first edition of the workshop; credits: ©Filip A. Petcu.

features of the rupestral ensemble of Fornello, to conserve and exhibit the complex structure of the memory of the site, evidenced in such a complex mode by the current iconography and the spatial syntax of the crypt.

The site becomes itself an icon of Southern Italy, describing a surprising rich cultural stratification and a refined concept of space formed along centuries. Such a concept evolved through sedimentation of cultural and historical data, drawing the outlines of what we define as paradigm of the civilization of modern Europe.

Conserving the natural landscape, integrating renewable energy in the dynamics of the site, while consolidating and restoring the caves, the crypt and its frescoes in a sustainable way, are examples of good practice. This teaching tool involves volunteers and the local community through Messors Fornello project. All these actions converge to become financially supportive for the work of the shepherds, helping them to regain the dignity of their profession in a context of critical regulation changes on a global level, while reconnecting their vocational pastoring, as living heritage, to the ancient rupestral site, as a part of the tangible heritage and a prominent regional axis defining their belonging to a cultural landscape.

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Ge-conservación
Conservação | Conservation

Design of didactic units on Heritage conservation. What kind of teaching Heritage conservation topics require?

Javier Peña Poza, Cristina Gil Puente, Patricia Gómez Mayo, Juan Félix Conde Moreno, Fernando Agua Martínez, Manuel García Heras, María Ángeles Villegas Broncano

Abstract: The subject of teaching Historic and Cultural Heritage in primary and secondary schools has been widely covered in the last few years. However, the specific topic on Heritage conservation has been barely developed despite its transcendence from the point of view of future preservation of Heritage items. This paper presents the theoretical and practical background in which the design of a didactic unit on Heritage conservation has been based. Among the main objectives which are intended to be covered by such a didactic unit are the significance of the Cultural Heritage, the importance of its conservation, the recognition of Heritage locales, when is important to conserve them, differences between conservation and restoration, the influence of environmental conditions and so on. Possible evaluation activities and suitable schools in which the unit could be put into practice are also some of the subjects dealt with in this contribution.

Key words: didactic unit, Cultural Heritage, education, conservation, schools.

Diseño de una unidad didáctica sobre la conservación del Patrimonio. ¿Qué tipo de enseñanza requieren los temas sobre conservación del Patrimonio?

Resumen: La enseñanza del Patrimonio Histórico y Cultural en los colegios de primaria y secundaria se ha cubierto ampliamente en los últimos años. Sin embargo, el tema específico de la conservación del Patrimonio apenas se ha desarrollado a pesar de su trascendencia desde el punto de vista de la preservación futura de los distintos elementos que conforman el Patrimonio. En este trabajo se presentan los aspectos teóricos y prácticos en los que se ha basado el diseño de una unidad didáctica sobre conservación del Patrimonio. Entre los principales objetivos que pretende cubrir esta unidad destacan el significado del Patrimonio Cultural, la importancia de su conservación, la posibilidad de reconocer lugares con Patrimonio, cuándo es importante conservarlos, las diferencias entre conservación y restauración, la influencia de las condiciones ambientales, etc. Las posibles actividades de evaluación y los colegios más adecuados en los que poner en práctica la unidad didáctica son también alguno de los temas tratados en este trabajo.

Palabras clave: unidad didáctica, Patrimonio Cultural, educación, conservación, colegios.

Introduction

There is an important relation between education and Cultural Heritage since through education it is possible to value Heritage items. This subject has been widely covered by primary and secondary schools in the last few years (Prats and Hernández 1999). However, the particular topic on Heritage conservation, either in the curative or in the preventive side, has been barely developed, above all, in Spanish schools. This point should be highlighted since only things that are known are valued and, consequently, suitable for being preserved for the future.

Cultural Heritage is classified into two wide groups. One of them named material or tangible culture which refers to physical items produced by society. It includes built Heritage (e.g., monuments, civil and religious buildings, etc.) and objects (e.g., books, textiles, ceramics, metals, etc.) belonging to collections housed in museums and other institutions. The other group is named intangible culture and refers to practices, expressions, knowledge, and skills that some communities recognize as their own culture, such as traditions, dances (e.g. *flamenco* in Spain), songs (e.g. *fado* in Portugal), crafts, and so on (Munjeri 2004).

It is well-known the list maintained by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) on World Heritage, both for tangible and intangible assets. Spain occupies the third country in the list with the largest number of Heritage sites, which mean a tangible place or an intangible

item with a special cultural or physical significance. It is behind Italy or China but ahead of world powers such as France or Germany or USA. Apart from the number it is important to take into account also the state of conservation of these sites.

Heritage conservation is generally accomplished in two very distinct ways: the so-called preventive conservation and that named curative conservation. Preventive conservation is a strategy based on a systematic method of work which aims at identifying and controlling risks of deterioration of cultural goods. Accordingly, direct intervention on these goods is not required and, therefore, it is a strategy different to curative conservation in which a direct intervention is required to prevent loss or irreversible deterioration of such cultural goods (García 2014; Peña-Poza et al. 2014).

Aspects concerned with Heritage conservation are encouraged by international organizations such as the International Council of Musuems (ICOM) or the International Centre for the Study of the Conservation and Restoration of Cultural Property (ICCROM). This latter promoted the meeting of Vantaa (European Commission, 2000), where the most outstanding lines of action adopted for a common European strategy on conservation of Cultural Heritage were: institutional planning, developing strategies, training of professionals, and dissemination and social awareness. Education of school students can be seen as one of the most important activities of dissemination and social awareness to promote knowledge on Heritage conservation. For this reason, the aim of this work was to design a didactic unit on Heritage conservation for being applied and put into practice in some schools.

Main objectives

The main objectives which are intended to be covered by the didactic unit are the significance of the Cultural Heritage, the importance of its conservation, and the recognition of Heritage locales. Moreover, the unit also intends to give the students the necessary knowledge on their very local Heritage, on differences between conservation and restoration, and on the influence of environmental conditions in its conservation. Figure 1 shows the conceptual map in which the didactic unit proposed is based.

Initially, as a first approach, the didactic unit is going to be applied in three different schools, with distinct student communities, within the region of Madrid. The three schools selected are the following: 1) a public school located at a small village (Cadalso de los Vidrios); 2) a mixed public/private school at a middle-size town (Valdemoro); and 3) a public school at a larger town (Alcalá de Henares).

Methodology

Despite the didactic unit is going to be applied within the region of Madrid, the Spanish legal framework which justifies its application is based into the two following laws:

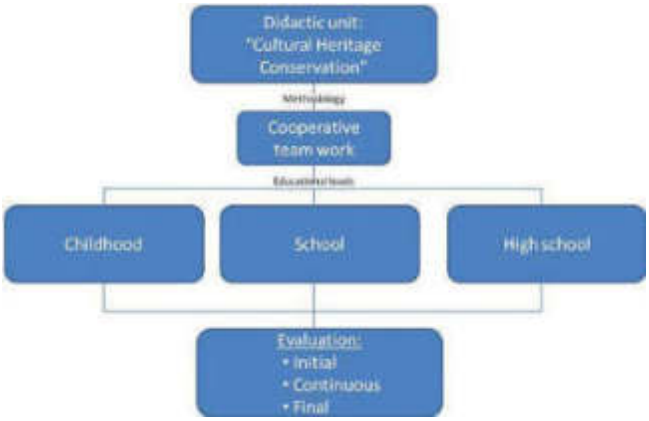

Figure 1.- Conceptual map of the didactic unit proposed.

As far as the four grade of the primary school is concerned, the law which establishes the basic curriculum is RD 126/2014 (RD 126/2014, de 28 de febrero). Based on this law the didactic unit could be developed within the knowledge areas of Natural Sciences, Social Sciences, and Arts.

As far as the second grade of secondary school or high school is concerned, the law which establishes the basic curriculum is RD 1105/2014 (RD 1105/2014, de 26 de diciembre). In this case, the didactic unit could be developed within the domain of the Natural Sciences and Social Sciences.

The methodology and the teaching techniques developed by the didactic unit have two different backgrounds: theoretical and practical. The theoretical background is based on the cooperative work methodology following the well-known five principles by Johnson & Johnson (Johnson et al. 1994): positive interdependence, individual accountability, face to face interaction, interpersonal and small group skills, and group processing. An outstanding example of this cooperative work methodology is the technique of the Aronson puzzle [figure 2]. It is a powerful tool to confront different points of view among the students and allows them an interactive learning since he/she is the real actor in the teaching-learning process. Furthermore, this methodology avoids the "stowaway effect" (Slavin 1987) since all the students take part at the same time of the process of learning.

Other well-known example is the brainstorming technique, which allows the students the interaction with other students without being aware of the learning process. Such a methodology provides an opportunity for students to show the previous knowledge on Cultural heritage to other school mates. It may drive also to a prior discussion, in advance to the learning process, in which they can show their opinion about the need for its conservation and those procedures necessary to carry out this conservation.

To help the learning process two roles have been designed and developed. These two roles are represented by two characters: Erik and Nono. On the one hand, Erik is a curator and restorer of the Cultural Heritage who will help and guide

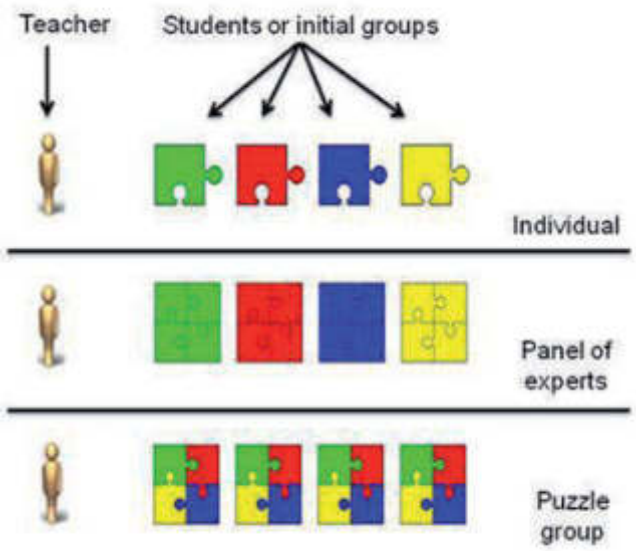

Figure 2.- Diagram of the methodology for the Aronson puzzle.

the students at the classroom. On the other hand, Nono is the personal computer for everyday tasks of Erik. The computer is very friendly and proposes the students some exercises to test the overall learning progress of the lesson.

Together with the theoretical educational program designed to be developed at the classroom, the didactic unit will be complemented with a practical program to be accomplished either outside or inside the classroom. A visit to a real Heritage site (e.g., a local historic building or a nearby museum) can be a good opportunity to reinforce the knowledge and the concepts learnt at the classroom. As a museum example, the visit can be undertaken to the Navy Museum of Madrid since its permanent collection is rich and diverse both from the point of view of materials and modes of exhibition, ranging from navigation instruments to ship's models for shipyards either in exhibition rooms or in showcases (Peña-Poza et al. 2014).

As a practical program, a restoration experience can be simulated inside the classroom. The activity may begin from a few fragments of a broken pottery vessel that the students could join to complete the whole shape of the original vessel. In a real case all the pottery fragments are not always available. For this reason, when the shape is completed, a set of gaps are observed. These gaps must be refilled with new material by the restorer and this new material must be easily distinguishable from the original one. To put students in place of the restorer when he/she is refilling the faults of a given Heritage good, they can be provided with a worksheet in which, for example, they have to refill some gaps in famous paintings.

Evaluation of the methodology applied

In order to undertake a suitable diagnostic evaluation of the knowledge acquired by the students on Cultural Heritage conservation through the didactic unit, two distinct evaluation procedures have been designed: continuous evaluation and final evaluation. One of the procedures for continuous evaluation is a worksheet to put into practice with small groups of students with the aim of encourage discussion on materials shown in the worksheet and restoration procedures to be applied. Such procedures should be friendly with preventive conservation in terms of temperature, relative humidity, illumination, and so on [figure 3].

This type of evaluation activities is based on the technique of the Aronson puzzle. To this end, the classroom is divided into different groups. A specialist in a given material is assigned to each of the groups. Once the specialist shows its knowledge to its group it can be simultaneously moved to the following group and so on. The activity consists in showing the students some images in a worksheet. The students should be able to answer different queries on its state of conservation, alterations, possible causes of such alterations, and suitable restoration tasks to help conservation among others.

A final evaluation will be accomplished at the end of the didactic unit to assess the level of learning reached by the students on Cultural Heritage conservation. The evaluation of the methodology applied will be also carried out by providing a teaching guide to the three schools in which the didactic unit is going to be put into practice.

Final remarks

The activities of education of school students can be seen as one of the most important actions for dissemination and social awareness to promote knowledge on Heritage conservation. A good avenue to undertake these actions may be the design and development of didactic units on topics of Heritage conservation. The work here presented deals with a pilot experience to put into practice a didactic unit of these characteristics in three different schools located in the

Figure 3.- Worksheet example for small groups of students.

region of Madrid. The project is an on-going experience at the moment and it is scheduled for the 2016-2017 course term in the three schools. It is worthy to mention that the didactic unit has been very well received by directors and teachers of the three schools since both have pointed out the lack of topics on Heritage conservation in regular teaching programs. Therefore, it is expected that results will be consistent with the main objectives proposed by the didactic unit. After the pilot experience in the three schools mentioned, it is intended to carry out an assessment of the results obtained to evaluate if this unit can be improved and perhaps extended to other schools, not only located in the region of Madrid but also in other regions or communities of Spain.

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Ge-conservación
Conservação | Conservation

San Lorenzo Urban Memory Museum – Slumm Mapcast

Andrea Macchia, Laura Rivaroli, Marta Fiacconi, Marta Rivaroli, Alessandra Donnini

Abstract: It is possible to create a museum where there are libraries instead of bookshops, craft shops instead of gift shops, where the employees are the citizens, the educational projects and the night events are linked together and art is a vehicle for narration and regeneration. This is SLUMM, San Lorenzo Urban Memory Museum. The aim of the museum is to preserve San Lorenzo memories and to address its social, political and cultural transformations through the voices and the memories of the people and the places. One of the approaches used by SLUMM is the use of the mobile app Mapcast, created by Etcware SRL, for the creation of personalised cultural itineraries. The users can select the quality of the material and add their own information in order to integrate the content and to be actively involved in the creation of culture and knowledge.

Key words: SLUMM, museum, urban regeneration, San Lorenzo, community, cultural itineraries, mobile app

Museo de la Memoria Urbana San Lorenzo - Slumm Mapquest

Resumen: Es posible crear un museo en donde existan bibliotecas en vez de librerías, tiendas de artesanía en vez de tiendas de regalos, donde los empleados sean los ciudadanos, los proyectos educativos y los eventos nocturnos estén unidos y el arte sea un vehículo de narración y regeneración. Esto es SLUMM, el Museo de la Memoria Urbana San Lorenzo. El objetivo del museo es preservar la memoria de San Lorenzo y abordar sus transformaciones sociales, políticas y culturales a través de las voces y de la memoria de la gente y de los lugares. Uno de los enfoques utilizados por SLUMM es el uso de la aplicación móvil Mapcast, creada por Etcware SRL, para la creación de itinerarios culturales personalizados. Los usuarios pueden seleccionar la calidad del material y añadir su propia información de manera que quede integrada al contenido y así involucrarse activamente en la creación de cultura y conocimiento.

Palabras clave: SLUMM, museo, regeneración urbana, San Lorenzo, comunidad, itinerarios culturales, aplicación móvil

Introduction

Traditionally, a museum is 'a building in which objects of historical, artistic or cultural interest are stored and exhibited' (Oxford English dictionary). However, during time, this concept has changed and museums have embraced different and wider roles than just the pure conservation. In fact, the International Council of Museum defines a museum as 'a non-profit, permanent institution in the service of society and is development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment'. This new enlarged concept of museum finds one of its main repercussions in the role that museums play in the urban setting and in the relationship between economy, urban requalification and local community. Several are the worldwide examples of museums and arts that have helped the regeneration of poor urban areas: the Tate Museum in Liverpool, the Guggenheim in Bilbao, the Tate Modern in London and the new forthcoming Louvre-Lens (France), Pompidou-Metz (France), Guggenheim-Hermitage (Lithuania) and Guggenheim-Abu Dhabi (United Arab Emirates). The term urban regeneration implies not only the regeneration of decaying buildings but also, and especially, of a deteriorated quality of life. In this sense, the impact of museums has an economic, environmental and social aspect: they create direct and indirect wealth with

sales, jobs and tourism; they can have a strong visual impact changing the street scene; and they can radically improve the quality of life thanks to their educational and entertainment value (Lorente and Lorente 1996). Additionally, the community involvement and access to the arts has to be a key element in the urban regeneration in order to shift from cultural heritage as a privilege for some to cultural heritage as an ownership of all. To achieve this goal, museums have to focus on the social aspects, such as a strong local identity and the preservation of urban memories to build a bridge between themselves and the territory. Medellin in Colombia and Nantes in France represent two examples where arts and culture have become key aspects of the economic development of the city and Rotterdam, in the Netherlands, a demonstration of the importance of the local community involvement. People need memories: not as a repository of their past, but as a token of their identity and a guide to the future (Rykwert 2008).

The concept of museum can therefore cross the boundaries of a physical space that encloses objects and extend to everything is vehicle for memories, such as the case of Open Museums. Traditionally, they correspond to old buildings and archaeological and/or historical sites preserved and exhibited with the intent of recreating past lifestyles. King Oscar II's collection, opened in 1881 in Norway, represents the first example of Open Museum; this Scandinavian model, known as Folk Museum, recalls an old-fashioned and static image of timber houses, rose paintings and traditional knitting (Mellemsether 2015). The Chiltren Open Air Museum in England and the Den Gamle By in Denmark are based on the same model by preserving historical buildings and recreating past lifestyles of 1700, 1800 and 1900. Some of the Open Museums are now trying to change this outdated structure by performing live shows where the public is transported back in time or trying to link with the present through educational projects. The Open Museum of Glasgow in Scotland aims to bring the collections outside the walls of the museum by organising travelling exhibitions and interactive events and Leicester's Open Museum delivers museum collections to the community and promotes community projects. However, these ideas represent often only local approaches or short-term solutions. Therefore, the deep role that those museums have in their context should become clearer and focus on the social, cultural and economic benefits that they can offer to the community where they belong. To provide these communities with the memory and knowledge about their past is not only a pre-requisite for the survival of the traditions and the identity but also part of our responsibility towards the future generations. But what happens if the community itself is the object to preserve?

SLUMM: San Lorenzo urban and cultural regeneration

San Lorenzo is one of the oldest and most unique areas of Rome as documented by the remains of Porta Tiburtina, dated back to the roman period, the monumental Campo Verano, the evidence of the Second World War bombing and its rich cultural, political and artistic past that has always attracted artists from all over the world. In the past, San Lorenzo was a working-class district mainly populated by workers with their families with a strong social and political identity. Today, however, its main attractions are the pubs, bars and breweries that crowd the streets set up in response to the growing number of students living in the area because of the nearby Sapienza University. The consequence of these transformations is the replacement of social and public spaces with bars and nightclubs that causes poor quality of life for the citizens and a loss of the local identity (Macchia et al., 2017). With the intent of preserving and promoting San Lorenzo memories and its community, Yococu in collaboration with ANPI San Lorenzo created SLUMM – San Lorenzo Urban Memory Museum [Figure 1].

Figure 1.- Gaetano Bordoni, historical barber of San Lorenzo, with its collection of photos and memories (ph credit: ANPI San Lorenzo).

The idea was to pick up the main concepts behind the Open and City Museum and take them beyond their limits and boundaries. To create a museum without walls that uses the local buildings and the architectural and artistic objects already present on the territory to tell stories and preserve memories, playing an important role in the cultural regeneration of the area and, therefore of the whole city. SLUMM tries to balance the business requirements and the needs of the local community by building a close relationship with the people who represent the community. The idea is to involve citizens, students, schools and private and public institutions in the social and cultural regeneration of this district using the buildings, libraries and craft shops and as an open and collective museum. The projects undertaken as part of the cultural activities might appear small and limited but, when viewed as a whole, their importance in blending together the culture and the community become clear.

—Guided and self-guided tours

The past of a city and the memories of its community are intangible assets and to show and explain those to the

visitors can represent a challenge. This is the reason why one of the main strategies used by SLUMM are tours that allow the visitor to access the places where these memories happened and to interact with the people who lived them. The guided tours are especially planned for students, because the social interactions happening during practical experiences and fieldtrips, as well as the process of sharing their experiences, are an important aspects of the learning process and improve it (DeWitt and Storksdieck 2008; Kelly and Groundwater-Smith 2009). On the other hand, the self-guided tours, based on the Mapcast mobile app, are the perfect instrument for tourists and citizens who are free to personalise their cultural experience by choosing their itineraries and adding information about the places visited. Through these walking tours people can learn also about the local business and cultural activities such as the local artisan shops and libraries [Figure 2].

Figure 2.- The students discussing the organisation of the cultural events within SLUMM.

— *Cultural events*

Because San Lorenzo district encloses the museum, the events organised in order to promote the memories of the area can benefit from types of experiences that would hardly be possible in a conventional museum: overnight events, debates, theatre shows and celebrations are interactive and innovative ways of approaching the culture.

— *Crowdfunding*

SLUMM is a museum created by the local community and that survives thanks to its work. However, it is possible to respond to specific calls for funding in order to increase the resources available, even if they are not essential for the growth and development of the museum.

— *Artistic installations*

The museum is an open-air gallery where artistic installations are used to remember and promote the memories and the story of San Lorenzo area. The first and most important of those installations will be the "House of Memory" where the testimony of the Second World War and its bombing are narrated.

— *Website*

SLUMM is online with its platform that includes all the information about the museum collection, the activities, the events as well as the pictures of the past and present people that are involved in the life of the area.

The aim of this paper is to present Mapcast, one of the tool used by SLUMM for the self-guided tours. Since the museum was created, the numbers of downloads of the app have increased by 12% and, in a short period of time, several cultural contents about San Lorenzo have been added to the itineraries available on the app. This allowed a further development of Mapcast that started sharing videos through the Youtube channel.

Mapcast

SLUMM is a complex museum, involving different types of contents, both physical and intangible, and therefore implies difficulties and challenges when it comes to its coordination and communication to the public. The solution came from the collaboration between Yococu and Etcware srl and thanks to a Research&Development funding that led to the creation of Mapcast (http://www.mapcast.it), a geo-semantic repository oriented towards cultural, green and specialised tourism. The name comes from the merging of *map* and *broadcast* and expresses the possibility to create and share geo-referenced stories, tying together places and maps. The geo-semantic repository is a part of Mapcast backend (that is the architectural component not directly accessible to the users) and it allows entities (places, stories and itineraries) categorization by using a thesaurus represented with SKOS (Simple Knowledge Organization System) that is a standard format to represent thesauri, classification schemes, subject heading lists and taxonomies within the framework of the Semantic Web. With Mapcast repository it is possible to find categorized entities by searching them with geographical position, SKOS categories, and content. With Mapcast the users can discover places, itineraries and monuments nearby through the GPS system. It is possible to visit both open air spaces and buildings where it is possible to obtain detailed historical and cultural information directly on the devices used for the navigation through QR codes provided. Mapcast is available on iOS and Android markets in multiple languages and includes the mobile app and a web editing console that offer different services [Figure 3].

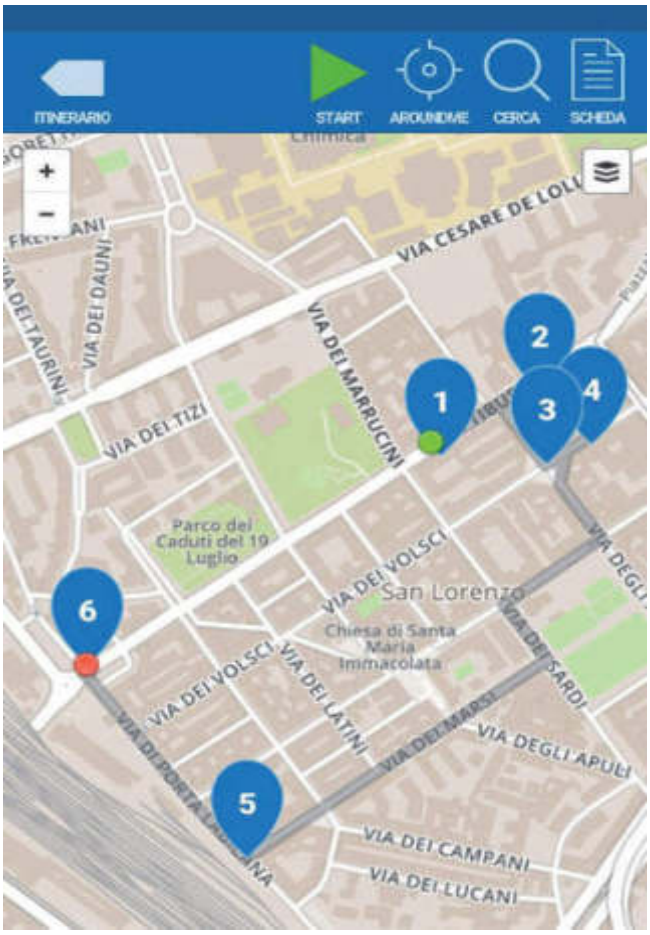

Figure 3.- Mapcast screenshot with suggested itinerary, points of interests and audio guides for San Lorenzo area in Rome.

The Mapcast App has the following features:

-Google maps or OpenStreetMap switching.
-The Tourist Navigator that guides tourists on itineraries with its voice and warns them of the presence of stories to listen to in different languages.
-POIs, stories and itineraries that can be searched by proximity and/or category (semantic search).
-Indoor navigation for museums and exhibits with QRcode recognition.
-POIs, stories and visited itineraries local storing to minimize access to data connection.
-The editors can create new POIs directly from the app at the current position and record audio and get photos stories that will be published by the web editing console.

The web editing console allows:

-To create places (Point Of Interest), stories linked to places or itineraries.
-To create QRcode to be put on the signs, when the GPS is not available (typically inside buildings).
-To publish stories - a multilingual and multimedia content (image, text, audio, video, youtube videos) - and itineraries - a set of stories linked together by our routing system or a GPX track – to make them visible on the app.

The users can select the quality of the material by rating the content and be actively involved in the creation of the content itself adding their own information so that they can play a key role in the creation of culture and knowledge.

Conclusions

San Lorenzo is one of the richest area of Rome in terms of cultural, political and artistic history and the perfect setting for the development of an Open Museum. The creation of SLUMM aimed to preserve and promote the cultural and historical transformation that characterised this area through the people who represented it. In order to achieve this aim, the project used San Lorenzo libraries, laboratories and social spaces as main element to build this new concept of museum and involved citizens, workers and students through educational projects and night events. The integration of traditions and new technologies also led to the use of Mapcast, a geo-referenced app that allows the creation of cultural itineraries, guiding the user to the discovery of the local culture and history through personalised choices and paths. Mapcast represents, therefore, a great achievement in terms of accessibility and divulgation and an essential step for the creation of a virtual space where memories, past and culture are preserved and shared for the future generations.

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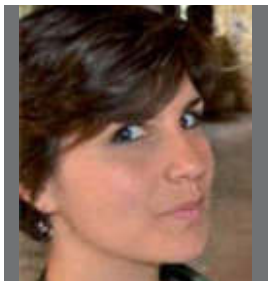

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Ge-conservación
Conservação | Conservation

Conservation of the contemporary public sculptures of Granada. Protecting the city's Heritage

María del Carmen Bellido Márquez

Abstract: Contemporary urban sculpture is an integral element of the landscape of the city of Granada (Spain). Therefore, the objetive of this research is to determine the conservation status of several public sculptures -produced by Miguel Moreno Romera- situated in the city and which currently evidence the need to improve their conservation, through restoration work or by optimising their preservation conditions. The study results show the alterations in the works, evaluates their damage, detecting possible deterioration and proposing interventions in order to reduce these problems, activating a preventive action protocol. In conclusion, there is a significant need to improve the conservation of these public sculptures by restoring their appearance, which also has positive effects on the city because they are an integral part of the urban fabric and bring the city closer to citizens.

Key words: public sculpture, conservation, bronze, city of Granada, contemporary art.

Conservación de las esculturas públicas contemporáneas de Granada. Protección del Patrimonio de la ciudad

Resumen: Las esculturas urbanas contemporáneas son un elemento integral del paisaje de Granada (España). Por ello, el objetivo de esta investigación es determinar el estado de conservación de varias esculturas públicas situadas en la ciudad, hechas por Miguel Moreno Romera, que en la actualidad presentan la necesidad de mejorar su preservación, siendo restauradas u optimizadas sus condiciones de conservación. Los resultados del estudio exponen las alteraciones de las obras, la evaluación de sus daños, la detección de los posibles agentes de deterioro que les afectan, la propuesta de intervención para reducir estos problemas y la activación de un protocolo de actuación preventiva que las beneficie. En conclusión, existe una importante necesidad de mejorar la conservación de estas esculturas públicas y renovar su imagen también repercutirá positivamente en la de la ciudad, porque son piezas integrales de su tejido urbano que la hacen más cercana al ciudadano.

Palabras clave: escultura pública, conservación, bronce, ciudad de Granada, arte contemporáneo.

Introduction

Contemporary public sculpture is an integral part of the landscape of a city, as well as being representative of its culture and identity. By understanding it as an artistic work located in a collective space, it grants the urban context a social and aesthetic identity that is charged with commemorative, historical, political and landscape significance, although its most important aspect must be its cultural value, substantiated by its creative concept and artistic accomplishment, in order for it to be considered as a dynamic element of the interaction between citizens, the place and its significance.

By understanding urban sculpture as an object "thrown into a space, with citizens commune, through its infinite visual approaches" (Marín-Medina 1977: 10) -compared to the more traditional conception of public sculpture-, we can observe that on many occasions these kinds of artworks do not receive appropriate care -which would benefit their preventive conservation-, thus neglecting the need to preserve and properly restore them, causing their poor state of conservation while they occupy key locations on public roads or areas (roundabouts, parks or squares), which implies a downgraded view of the city. However, public spaces must be displayed like museum pieces, because they are inhabited by man and

sculpture humanises space by turning it into a place for the timeless dialogue of citizens with history, urban planning, architecture, landscape, tradition, local culture and art. Therefore, an open museum becomes necessary, with no ceiling, no walls, allowing the sculpture to be in direct contact with the daily life of residents, making them -consequently- feel it as an integral part of their environment (Bellido 2017).

The city of Granada has numerous sculptures in outdoor public places. These include a significant number made by the sculptor Miguel Moreno Romera (Granada, 1935), who produces figurative works influenced by Brancusi and Henry Moore. Moreno initially trained as a goldsmith, he studied at the Granada School of Applied Arts and Crafts and eventually studied at the San Fernando School of Fine Arts in Madrid. He has received the most important artistic awards and set up his public works in many cities. His works represent the artist's sensitivity towards the study of the human figure and human condition, metaphor, abstraction and the animal world. He develops monumental works and metal craftwork. Julio Rodriguez said about him:

> Probably the uniqueness of Miguel Moreno's work stems from the symbiosis produced in it by his craft training -acquired in one of the most remarkable and traditional metal workshops of Granada, of which he was a pioneer- and his superior academic education, as well as his obsession with finding new ways of expressing his imagination and strength, always managing to find -dazzling those who follow his work- new and always accurate paths (1997: 8).

The monumental works of Moreno are not only characterised by their themes, but also by their technique, which emphasises the use of molded and welded metal sheeting to create sculptural volumes and a detailed study of hollows and concave-convex shapes that vitalise the expressiveness of forms. Thus, he "subjects the reality of the figure to its significance (...), almost managing to hide -from some points of view- real identities inside mysterious fragments" (Meadows 1988: 26). These are not defined spaces, which in many of his sculptures made with molded sheeting are left empty, with no matter, allowing them to interact with the surrounding space, which in turn can be observed through their hollows, as it occurs in the case of *Venus de Armilla* [*Venus of Armilla*](2007).

Amongst the Miguel Moreno sculptural works that are set up in the city of Granada, we find *Águila* [*Eagle*] (1973), a momunent made of forged brass sheet and autogenous welding (170 x 120 x 80 cm), located at the Federico García Lorca Granada-Jaén Airport; *Luna* [*Moon*], made of stone, of monumental proportions, situated at the post office roundabout, at the junction of Avenida de Pulianas, Street Pedro Machuca and Street Periodista Luis de Vicente, in addition, this work has a smaller sized 1974 replica which was cast in bronze (60 x 60 x 27 cm); *Homenaje al trabajo* [*Homage to Work*], made in forged and welded metal sheet (approximately 400 cm high), located at the Metropolitan and Industrial Park of Granada; *Fray Leopoldo de Alpandeire* (1997), made of forged sheeting and autogenous welding, (approx. 230 cm. high), located in Jardines del Triunfo; *Panteón del pintor Manuel Maldonado* [*Pantheon of the Painter Manuel Maldonad*o] (1985), lost wax bronze, chiseled and patinated (200 x 190 cm), exhibited at the cemetery of San José; *Reencuentro* [*Reunion*], made with the same technique (320 cm high), exhibited in Parque 28 de Febrero; *San Juan de Dios* (1986), made in forged and welded sheet metal (210 x 170 x 88 cm), situated at the entrance door of the San Rafael Clinic; *Venus Iliberis* (1977), cast in bronze and patinated (330 cm wide), which can be seen in the Jardines del Campus de Fuentenueva de la Universidad de Granada; Yehudá ben Sául ibn Tibbón (1988), lost wax bronze, chiseled and patinated, mounted on Calle de la Colcha; *Pareja* [*Couple*] (1996), made of forged and welded sheet metal (100 cm high), placed in the Zaidín Park; *Monument to Antonio Gallego Burín* (1999), cast in bronze and placed in the gardens of the artist's home workshop; *San Juan de Dios* (2000), made with the same technique and mounted in Jardines del Triunfo; *San Juan de la Cruz* (2010), made with a mixed technique (cast and forged metal), 220 cm high, also located in Jardines del Triunfo; and *Gran Capitán* [*Great Captain*] (2010), a monument to Gonzalo Fernandez de Córdoba, built in forged and welded sheeting (150 cm high), located on the Avenida de la Constitución boulevard.

Objectives

In face of various studies (Martin 2006: 15-33) that demonstrate that there is a real problem in terms of the adequate exhibition of bronze sculptures exposed to the elements and their continuous exhibition, the overall objective of this work is to determine the conservation status of several public sculptures of the city of Granada produced by Miguel Moreno, which have evidenced the need to improve their preservation, urging for their restoration or the optimisation of their preventive conservation conditions, without thereby losing their location, and proposing measures and actions to ensure such improvements.

Other specific objectives include: an analysis of the alterations observed in the works, an assessment of the damage seen in them, the identification of deterioration agents affecting them, determining their general condition, recommendations for their improved maintenance and the proposal of a protocol of preventive actions to ensure their preservation.

Methodology

For this study we have chosen the works *Luna*, *Venus de Ilíbiris, Gran Capitán and Yuhedá ben Saúl ibn Tibbón*

because they are located in different parts of the city and because their antiquity, technique, materials and state of conservation differ.

The methodology used was theoretical and practical. It included a documetal study and an on-site visual analysis of the works, which has enabled the direct observation of the alterations they present.

The documentary contextualization has focused on analysing research covering the conservation of sculptures, including the one conducted on the Leganés Sculpture Museum, some works from the Reina Sofía Museum in Madrid (García 2008: 23-31), public sculptures in the town centre of Aracena, pieces from the Museum of Contemporary Art of Andalusia (Camacho and Roldán 2011: 223-240), as well as the work undertaken on the *Conexiones urbanas* [*Urban connections*], exhibition organised by the IVAM (Valencia 2009, Alicante 2010) (Martinez and Vazquez 2011: 191-200) and that which was conducted on the sculptures bequeathed by the Universal Exposition of Seville -mounted in Isla de la Cartuja (Roldan *et al*. 2005: 125-130)-, and more general queries carried on the issues of conservation of sculptures in urban and natural settings (Blázquez 2011: 15-33), plus texts devoted to the artistic production of Miguel Moreno (Marín-Medina 1977 and 2007).

Figure 1.- Miguel Moreno, Luna. Natural stone, monumental proportions. Source: María del Carmen Bellido.

Results and discussion

The results obtained determine the alterations presented by the works studied.

—*Luna*

The sculpture *Luna* (Figure 1 and 2) was inspired by Federico García Lorca's *Romance de la Luna* [*Romance of Moon*], , and it forms part of the *Triología Lorquiana* [*Lorcan Trilogy*] with the sculptures *El poeta* [*The poet*] and *Ciprés* [*Cypress*]. Its circular composition features curved and enveloping shapes and is composed of large blocks of natural stone (travertine marble) which are bound together. It is situated at the centre of a large roundabout, which completes its design with vegetation. Its floor mounting was made with concrete formwork and an intermediate steel plate anchoring.

Figure 2.- Miguel Moreno, Luna. Natural stone, monumental proportions. Detail of the work's damage. Source: María del Carmen Bellido.

Amongst the work's alterations, we find the superficial discolouration of the stone due to weathering damage as well as the effect of ultraviolet rays, humidity and temperature changes. We can also see a widespread layer of dirt, which sharpens the change in colour and the stone finish, both aggravated by the presence of stains of various tones and types, such as those produced by graffiti, saline layers or fungal colonisation -located in the places that are most sheltered from light, dryness and high temperatures-, apart from those caused by rainwater runoff, dew, animal excrement and the accumulation of solid waste pollutants. The natural degradation of the stone produced by the dissolution and dissociation of the material has directly affected this sculpture, due to the sudden environmental changes that are typical of the city (great contrasts of temperature and humidity), the work's own design and the characteristics of its materials, which produce the accumulation of water on its surface and internal infiltrations, which may even cause material break up and cracks due to the accumulation of internal salt crystals (sub-efflorescence) in cavities and joints. Air pollution

aggravates these circumstances since air pollutants generate surface pollution accumulation and rainwater acidity, which favours the alteration of the materials.

We can also see that this work has suffered damage in terms of the synthetic material used as the adhesive to join its various stone blocks, by changing its colour or disappearing in many parts, ceasing to act as a binding element, which has resulted in noticeable gaps between its structural parts. This same material is distributed over much of the surface of the sculpture, having been used as a binder of pebbles, which serve as the filling of the stone's hollows.

Along with the damage described above, garbage and waste were found surrounding the piece, affecting its aesthetic contemplation, and there is no evidence of delimitation, site fencing or specific surveillance of the monument.

In general, the sculpture has been affected in its stone structure and the adhesive used for its construction due to environmental agents, exacerbated by the effects of the irrigation of the surrounding vegetation, environmental pollution, biodeterioration, vandalism, animal droppings and urination, and lack of specialised care and cleaning of the surrounding environment. Consequently, the work is in a bad state of conservation and its restoration is recommended, as well as a thorough cleaning of the sculpture itself and the surrounding site, the removal of current synthetic adhesives and use of more stable materials, protection of the stone surface, its maintenance and surveillance.

-*Venus de Ilíbiris*

The sculpture *Venus de Ilíbiris* (1977) (Figure 3 and 4) was inspired by Henri Moore's recumbent female figures, as Moreno travelled to London shortly before the completion of this work. It is a gift from the artist to the University of Granada, and its most notable elements are its synthetic and organisation-based design (Marín-Medina 2007: 38), its horizontal distribution and great proportions.

This work is mounted on the grounds in a garden (which is closed at night time) on a surface of cement mortar, surrounded by vegetation. It was made in cast and patinated bronze, and because of its location it interacts with the landscape and people visiting the park.

The work presents alterations caused by changes in the colour of the patina due to environmental reasons, the irrigation of the garden and the pollution it is subjected to. It also has scratches, surface grafitti and an accumulation of organic residue from plants and animals. Therefore, its conservation status is intermediate and a thorough surface clean is recommended, as well as the stabilisation of its patina, redirecting the irrigation systems in order not to affect the sculpture, controlling the growth of the surrounding vegetation (grass and bushes), carrying out periodic checks on it, as well as maintenance and surveillance.

Figure 3.- Miguel Moreno. Venus Ilíberis, 1977. Patinated bronze, 330 cm wide. University of Granada. Source: María del Carmen Bellido.

Figure 4.- Miguel Moreno. Venus Ilíberis, 1977. patinated bronze, 330 cm wide. University of Granada. Detail of the work's damage. Source: María del Carmen Bellido.

—*Gran Capitán*

The bust *Gran Capitá*n (Figure 5) is situated on the ground on a rock stand. It was commissioned by the City of Granada and was made of moulded sheet metal. It is displayed open, without its rear part, giving great importance to its concave shape. It stands on a stone pedestal that separates it from the ground.

The rear open space of the work favours the accumulation of waste such as paper, dry leaves, animal excrement and garbage in general. It has also been affected by pollution and environmental agents. Its placement in a crowded and surveilled central location helps to reduce vandalism. Its conservation status is good and does not require restoration work, although periodic checks and timely maintenance are recommended.

Figure 5.-Miguel Moreno, Gran Capitán, 2010. Forged and welded sheeting , 150 cm high. Source: María del Carmen Bellido.

—Yehuda Ben Saúl Ibn Tibón

The sculpture *Yehudá ben Saúl ibn Tibbón* (1988) (Figure 6), inspired by the wise Jew and patron of translators, is mounted on a stone pedestal on the main street at the entrance of Realejo -an old Jewish quarter- in order to welcome visitors. It was commissioned to the sculptor by a relative of this historical figure and was built in cast and patinated bronze.

Figure 6.-Miguel Moreno. Yehuda Ibn Tibón, 1988. Lost wax bronze, chiseled and patinated. Details of the work. Source: María del Carmen Bellido.

Prior to its restoration, carried out in 2014, the sculpture had gold coloured feet, plus small graffiti and scrapes, all caused by vandalism. At that time, it was displaced from its pedestal -due to a sharp blow- and snatched from its anchorage, leaving one of its feet outside the pedestal base, making it hazardous even in terms of possibly harming the public. For this reason, it was cordoned off, removed and restored, eliminating graffitti, scratches, corrosion, salt, biodeterioration and improving its anchorage (City of Granada from 2013 to 2015: 5-7). Then, it was mounted again. Today, its conservation status is good, although more surveillance is recommended as well as carrying out regular checks and maintaining it properly.

Conclusions

The study conducted enabled us to observe that public sculptures in Granada contribute to defining the city, and that the analysed works created by Miguel Moreno have suffered environmental damage due to inclement weather (rain, UV rays, contrast and sharp differences in temperature and humidity), air pollution (greenhouse gases, acid rain, solid waste, etc.), irrigation and cleaning of the gardens and settings, as well as aggressive human action (scrapes, scratches), vandalism (blows, graffiti, garbage dumping, etc.) and neglect (dereliction), together with the effects of biodeterioration (men, animals, plants and fungi). Therefore, these works display aesthetic, physical, chemical and biological alterations that illustrate the need to promote a better conservation, since these agents accelerate the natural aging of its constituent materials.

Nevertheless, the studied sculptures evidence diverse states of conservation, ranging from good and intermediate to bad, yet despite the damage suffered the play an important role in the integration and dialogue between citizens and their everyday habitat, as they humanise the city and its open spaces. Therefore, they should continue being exhibited outdoors, although their conservation durability will be shorter than if they were situated in an enclosed and environmentally controlled space. This results in the need to carry out an appropriate preventive conservation plan to halt the accelerating process of degradation, stabilise their materials and ensure their maintenance. Hence the necessity to create and develop an action protocol to improve from now on the conservation of public sculptures in Granada and prioritise conducting a detailed study on their state of conservation, advising whether they need restoration work conducted on them, for the sculptures analysed here are an example of many others situated in the city in similar sites and conditions.

It is also necessary for there to be greater public awareness regarding the conservation of public artworks in Granada, as they are distinctive elements that define the city's spaces. This could be carried out by means of an awareness and collective heritage educational campaign -on the care and need to maintain the Sculptural Heritage of the city,

especially amongst children and youngsters, promoting lectures and guided tours for pupils of various city schools. Thus, the eradication of vandalism and neglect would be promoted by valuing the cultural heritage of the city, advocating it as an asset that belongs to all its citizens.

In addition, it is necessary to further the training of the maintenance personnel of gardens and public spaces of the city regarding the conservation of public sculptures, taking into consideration artists' own opinions on the proper exposure and maintenance of their works, to avoid any interventions conducted without considering their conservation criteria.

And finally, we must promote Public Administration sensitivity, by obtaining from them a commitment to provide funds –annually- for the maintenance of public works in the city and enable the necessary preventive action protocol, which should include periodic reviews to detect any changes arising. Thus, a preventive conservation plan would be activated, improving their material condition, placing value on them, motivating the public in terms of their maintenance and improving the good appearance of the city.

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Ge-conservación
Conservação | Conservation

Silver/dioxide titanium nanocomposites as biocidal treatments on limestones

Javier Becerra, Ana Paula Zaderenko Partida, Pilar Ortiz Calderón

Abstract: Biodegradation of stones is a common and undesirable alteration in historical buildings. Restorers have been using different treatments, especially chemical methods, to prevent biodeterioration. These treatments often have disadvantages such as low long-term effectiveness, high toxicity on human health and the environment and/or physicochemical incompatibility with the original stone (chromatic alteration or chemical degradation).

In this research, different biocidal treatments based on silver and titanium dioxide nanocomposites have been tested on limestones from Utrera's quarry (Seville, Spain), a stone employed in historical buildings in the south of Spain. Two AgNPs syntheses have been studied; the principal difference between them was the use of trisodium citrate as stabilizer.

Optimum nanocomposite composition and dosage to minimize chromatic alteration after application of treatments without cut down the biocide effectiveness have been set up. Treatments based on silver-titanium dioxide (Ag/TiO_2) nanocomposites stabilized with citrate have been able to keep clean the limestone due to the biopatina formation reduction and the surface color change has been below 10%.

Key words: Silver/titanium dioxide nanocomposite, Biocide, Conservation, Limestone.

Nanocompuestos de plata / dióxido de titanio como tratamientos biocidas sobre calizas

Resumen: La biodegradación en piedra es una alteración común e indeseable en los edificios históricos. Los restauradores han estado utilizando diferentes tratamientos para la prevención del biodeterioro, especialmente métodos químicos. Estos tratamientos suelen tener ciertas desventajas, tales como baja durabilidad a largo plazo, alta toxicidad para el hombre y el medioambiente y/o su incompatibilidad físico-química con la piedra original (alteración cromática o degradación química).

En esta investigación, diferentes tratamientos biocidas basados en nanopartículas de plata y dióxido de titanio han sido probados sobre calizas procedentes de la cantera de Utrera (Sevilla, España), piedra utilizada en la construcción de diferentes edificios históricos del sur de España. Para ello, dos síntesis de nanopartículas de plata han sido utilizadas, cuya principal diferencia estriba en el empleo de citrato sódico como estabilizante.

La óptima composición y dosis de nanocompuestos que logra disminuir los incrementos de color del tratamiento sin mermar sus propiedades como biocida ha sido investigada. El nanocompuesto de plata/dióxido de titanio estabilizado con citrato ha permitido mantener limpia la piedra caliza, reduciendo la formación de biopátina y generando un cambio de color tras el ensayo menor del 10%.

Palabras clave: Nanocompuesto de plata/dióxido de titanio, Biocida, Conservación, Caliza.

Introduction

Biopatina formation on stones is a common pathology of historic buildings. The most common microorganisms forming biopatinas are bacteria, algae and fungi. They can cause physical impact but also chemical processes due to organic acids produced during their metabolism. These organic acids can be responsible of solubilisation or chelation of different minerals present in stone composition, as a consequence pitting, sanding and peeling may appear in stones. Apart from that, biopatina on stone surfaces can change the diffusion of water vapour into the material and in the capillary water uptake, although chromatic changes caused by a series of biogenic pigments are the most

evident alterations observable by the naked eye (Gaylarde et al. 2003). Current chemical treatments used to avoid biodeterioration (quaternary ammonium compounds, phenolic compounds, organimetallic compounds, or urea derivates) often have low durability, high toxicity and/or cause interaction on stone materials such as chromatic alterations, dissolution of calcite or oxidation of minerals induced by different additives or solvents (Nugari and Salvadori 2002).

The recent advances in nanotechnology are enabling us to develop new treatments to avoid microbial effects on the stone, such as the application of silver nanoparticles (AgNPs) which have biocidal properties (Lok et al. 2007; Sondi and Salopek-Sondi 2004) or titanium dioxide nanoparticles (TiO_2NPs) which have antibacterial properties (Foster et al. 2011) and high photocatalytic activity at ultraviolet light (Munafó et al. 2015). The mixture of the cited two types of nanoparticles allows us to create new nanocomposites combining both properties. Moreover, the reactivity of TiO_2NPs at visible spectrum is increasing by the Ag nanoparticles such as it has been demonstrated by Zhao et al. 2012. The biocide effects of silver/titanium dioxide nanocomposites have been checked for different applications such as medical devices, water filters, textile or leather (Yaşa et al. 2012; Lungu et al. 2014). The aim of this paper is to synthesize, characterize and evaluate different nanocomposites containing silver and titanium dioxide as potential biocidal treatment for stone conservation in Cultural Heritage.

Methods

—*Synthesis and characterization of nanocomposites*

Two different silver-based syntheses based on a bottom-up method have been employed for this study. The silver nanoparticles obtained were applied alone or with other nanoparticles such as titanium dioxide and activated carbon.

The first synthesis of silver is according to Flores et al. (2010) and contains trisodium citrate as stabilizer of silver nanoparticles. The second synthesis of silver is according to Caro et al. (2015) and does not contain any stabilizer for silver and the reducing agent used was sodium borohydride.

Ag@cit and Ag/TiO_2@cit were made with silver nanoparticles stabilized with trisodium citrate (Flores et al., 2010). Ag/TiO_2/AC, Ag/TiO_2, and ¼Ag/TiO_2 were made with silver nanoparticles stabilized without trisodium citrate (Caro et al. 2015).

The table 1 shows composition of the six different types of nanocomposites with Ag, TiO_2, citrate or active carbon employed. The silver concentration varies between 0.05-0.02 mg/mL, TiO_2 between 0.06-0.12 mg/mL and active carbon was included only in one of the products at 0.83 mg/mL concentration. TiO_2 nanoparticles were also tested in order to compare with the mixtures.

A Bruker Senterra confocal Raman spectroscope was employed to analyze the composition of the six synthesized nanocomposites.

The physiochemical characterization of nanocomposites has been realized using UV-Vis spectroscopy, hydrodynamic diameter and zeta potential measurements. UV-Vis spectroscopy carried out with an Ocean optics spectrometer equipped with a HR4000 detector allows us to study silver plasmon. Hydrodynamic diameter and zeta potential measurements were carried out using a Dynamic Light Scattering Zetatrac Analyzer. These properties allow us to check the stability of the product: hydrodynamic diameter is an estimation of diameters due to relationship

Table 1.- Nanocomposites composition and concentrations.

	Nanocomposites and Nanoparticles					
	TiO_2	Ag/TiO_2/AC	Ag/TiO_2	¼Ag/TiO_2	Ag@cit	Ag/TiO_2@cit
Ag (mg/mL)	-	0.02	0.02	0.005	0.005	0.005
TiO_2 (mg/mL)	✓	0.12	0.12	0.12	-	0.06
AC (mg/mL)	-	0.83	-	-	-	-
Citrate	-	-	-	-	✓	✓
Concentration for assays	0.53	0.22*	0.20*	0.66*	0.03*	0.16*

*(equalized at 0.03 Ag mg/mL)

between nanoparticles and solvents, and zeta potential (ZP) is a measurement of dispersion stability. Dispersions of nanoparticles with zeta potential (ZP) over 30 mV are more stable according to Koutsoukos et al. (2006), those nanocomposites with zeta potential between 20 and 30 mV may aggregate, and zeta potential under 20 mV may be considered more unstable dispersions.

—Antibacterial activity

Antibacterial activity was tested in liquid cultures by growth curves. This assay consisted in determining the growth of the bacteria E*scherichia coli* (*E. coli*) without (control) and with different amounts of nanocomposites. Absorbance was measured at 600 nm using a flourimeter POLARstar. 200 µl of *E. coli* inoculums at an optical density of 0.3 and different aliquots (4, 10, 20 and 40 µL) of the tested nanocomposites were employed to these assays. Table 1 shows the nanocomposites and their concentrations. The final nanocomposite concentration (Table 1) was calculated in base of the amount of silver nanoparticles present in each nanocomposite. In this way, the amount of silver nanoparticles has been equalized at 0.03 mg/mL (except TiO_2), so the concentrations of total nanocomposite vary between 0.03 mg/mL (Ag@cit nanoparticle) and 0.66 mg/mL (¼Ag/TiO_2 where the amount of Ag used in the synthesis process was lower and so the presence of TiO_2 is higher). The assays were carried out under continuous shaking at 37 ºC.

—Biocide assay on limestone of Utrera

Limestone slabs from Utrera's quarry (Seville, Spain) were selected for the assay of inhibition of biopatina formation because the use of this quarry is well-known employed in Sevillian historical buildings. Following the characterization made by Guerrero Montes (1990) for this limestone, it has a high content of quartz and fossils (2-5%) with a porous size between 0.1-1 µm. This limestone has medium-high porosity (9.6%) according to Ortiz et al. (2008). The size of the slabs was 1.5 x 1.5 x 0.5 cm. 200 µL of nanocomposites at the concentrations specified in the table 1 were deposited over the limestone slab surface. The concentrations employed were calculated equalizing the amount of AgNPs for each nanocomposite, except TiO_2.

Clorophytes coming from biopatinas of different Sevillian monuments were cultivated in a phosphate medium. Biopatina formations on stone were generated by immersion of the limestone slabs. The ambient conditions during the assay were room temperature and lighting with an incandescent lamp. Biopatina formations on stones were measured by a Colorimeter X-Rite SP20after 28 days of immersion and 5 days at room temperature for drying. The CIELab colour-system has been used in this assay, L* describe the brightness and a* and b* refer to the red-green and yellow-blue colour tonalities, respectively.

The Biopatina Formation Inhibition (BFI) was quantified in terms of total colour difference ($\Delta E^*_{BFI} = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})^{½}$), defined as the distance between the initial and final points in the CIELab Colour sphere during the processes of biobatina formation, where $\Delta L^* = L_{\text{after assay}} - L_{\text{before assay}}$, $\Delta a^* = a_{\text{after assay}} - a_{\text{before assay}}$ and $\Delta b^* = b_{\text{after assay}} - b_{\text{before assay}}$. *The results have been classified as optimal if colour cha*nge (BFI) is less that 5 (it could not been distinguished by naked eyes), intermediate in case of total colour change between 5-20, and negative if total color change is over 20.

Conservation treatments should not change the appearance of stones in cultural heritage. The total colour change (TCC) due to the application of nanocomposites and formation of biopatina has also been measured. Total colour change ($\Delta E^*_{TCC} = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})^{½}$), is defined as the distance between the initial and final points in the CIELab Colour sphere with and without treatment and biopatina formation, where $\Delta L^* = L^*_{\text{with treatment and biopatina}} - L^*_{\text{without treatment and biopatina}}$, $\Delta a^* = a^*_{\text{with treatment and biopatina}} - a^*_{\text{without treatment and biopatina}}$ and $\Delta b^* = b^*_{\text{with treatment and biopatina}} - b^*_{\text{without treatment and biopatina}}$. The optimal value of $\Delta E^*_{TCC} < 10$ described by Ortiz et al. (2013) for cleaning of stones were used as reference in this assay. These results have been classified as optimal if total colour change (TCC) is less that 10, intermediate in case of total colour change between 10-20, and negative if total color change is over 20.

Results and discussion

—Nanocomposites characterization

Raman spectra show the chemical composition of the different nanocomposites. The Raman spectra of the different pure compounds used in the synthesis have been studied to make the comparison with the Raman spectrum of the different nanocomposites synthesized. Figure 1(blue spectrum) shows the Raman scattering spectrum of the pure TiO_2, which bands are situated at 200, 400, 500 and 600 cm^{-1}. These peaks can be assigned to the typical molecular vibration mode of the TiO_2 in anatase phase (Xu et al. 2012). The TiO_2 band at 200 cm^{-1} meets with a typical band of the Ag, but the principal difference is that Ag band is more prominent. In the case of pure activated carbon, Figure 1 (brown spectrum) shows two prominent band at 1300 and 1600 cm^{-1}. The first nanocomposite studied was Ag/TiO_2/AC [Figure 1. purple spectrum]. The Raman spectrum of this nanocomposite shows the prominent silver band at 200 cm^{-1} while the TiO_2 (200, 400, 500 and 600 cm^{-1}) and AC (1300 and 1600 cm^{-1}) bands are more lightly, In the case of the Raman spectrum of Ag/TiO_2 nanocomposite [Figure 1. sky-blue spectrum], it can be observed the bands of the Ag and TiO_2 nanoparticles.

The principal different between the two synthesises employed in this research corresponds to the use of trisodium citrate as stabilizer of the silver nanoparticle. Figure 1 (green spectrum) shows the Raman spectrum

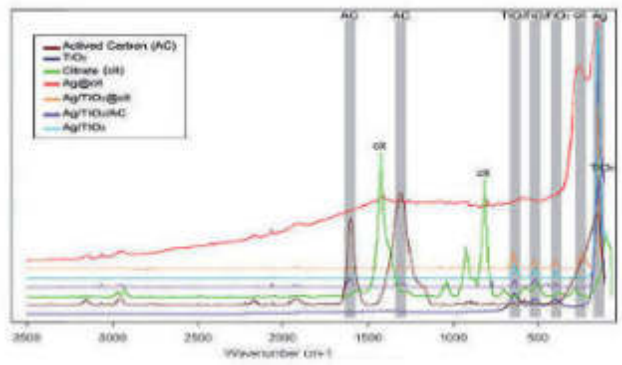

Figure 1.- Raman spectra: TiO_2, AC, Sodium citrate, Ag/TiO_2/CA, Ag/TiO_2, Ag@cit and Ag/TiO_2@cit.

of pure trisodium citrate with highlight bands at 250, 800 and 1500 cm^{-1}. However, the Raman spectrum of the Ag nanoparticle stabilized with citrate (Ag@cit) shows only a prominent citrate band at 250 cm^{-1} and the Ag band at 200 cm^{-1} [Figure 1.red spectrum]. Ag/TiO_2@cit nanocomposite [Figure 1. orange spectrum] shows the bands corresponding with Ag, TiO_2 and citrate.

Silver plasmon is a special property of AgNPs. The shape and amplitude of the silver plasmon determined by UV-Vis spectroscopy is a way to assess dispersion of nanocomposite size. Higher bandwidth implies particles with different sizes and less stability of dispersion.

Nanocomposites stabilized with citrate show a narrow bandwidth at 400 nm, result of their less particle size distribution (polydispersity). Nanocomposites without citrate show a displacement of the band. Their bandwidths are larger due to their less stability and the increase of polydispersity.

Table 2 shows a summary of the stability parameters of the nanocomposites synthesized in this research. Hydrodynamic diameter (HD) is closely related to the size of nanoparticles plus its interaction with solvent molecules. Nanocomposites stabilized with citrate show the lowest diameter and polydispersity, with sizes less than 45 nm. However, nanocomposites without citrate showed a higher polydispersity, and diameters with values higher than 100 nm.

Hydrodynamic diameters of the different nanocomposites have been classified according to the pore size of Utrera´s limestones [Table 2]. In consonance with this classification, Ag@cit and Ag/TiO_2@cit nanocomposites have the best penetration through the porous system due to the hydrodynamic diameters of these two nanocomposites are lower than 0.1 µm and the pore size is since 0.1 µm. The rest of nanocomposites with HD over 0.1 µm could block up porous systems, generating aggregates and stains on surfaces.

Zeta potential (ZP) of 30mV is taken as a line between stable and unstable dispersions by Koutsoukos et al. (2006). According with this rule, nanocomposites stabilized with citrate are the most stable, with zeta potential values around 30mV. This means that these nanocomposites are lower capacity to form aggregates, especially in the case of Ag@cit nanoparticles [Table 2]. Nanocomposites without citrate show values lower than 20 mV and are more instable.

In summary, nanocomposites stabilized with citrate are more stable and have a less hydrodynamic size. Their stability permits to apply and conserve them in aqueous solvent. The solution is easily re-dispersed with hand-

Table 2.- Raman spectra: TiO_2, AC, Sodium citrate, Ag/TiO_2/CA, Ag/TiO_2, Ag@cit and Ag/TiO_2@cit.

	Nanoparticles and Nanocomposites					
	TiO_2	Ag/TiO_2/AC	Ag/TiO_2	¼Ag/TiO_2	Ag@cit	Ag/TiO_2@cit
Hydrodynamic Diameter (HD)[1]	+	+	+	+	+ +	+ +
Zeta Potential (ZP)[2]	- -	- -	- -	- -	+	-
Biopatina Formation Inhibition (BFI)[3]	+	-	-	+ +	+	+ +
Total Colour Change (TCC)[4]	-	-	-	-	+	+ +

[1] According to porous limestone sizes. (-): HD > 1 µm; (+): 0.1 < HD < 1 µm; (+ +): HD < 0.1 µm.
[2] According to Koutsoukos et al. (2006). (- -): ZP < 20 mV; (-): 20 < ZP < 30 mV; (+): ZP > 30 mV.
[3] According to total colour change of biopatina growth (ΔE^*_{BFI}). (-): BFI > 20; (+): 20 > BFI > 5; (+ +): BFI < 5.
[4] According to total colour change of nanocomposites and biopatina growth (ΔE^*_{TCC}). (-): TCC > 20; (+): 20 > TCC > 10; (+ +): TCC < 10.

shaking. Moreover, their fewer hydrodynamic diameters (HD) may facilitate the penetration through stone porous system.

— *Antibacterial activity*

All nanocomposites tested caused a decrease of E. coli growth in comparison with control samples without nanocomposites (sky-blue bars) [Figure 2]. The higher inhibition was generally associated to higher nanocomposite concentration, except Ag/TiO_2@cit and TiO_2. The best result was obtained with 40 µL of ¼Ag/TiO_2 nanocomposite where we observed a 40% decrease in bacterial growth. In contrast to this, Ag@cit nanoparticle showed lowest inhibition effects, especially at 10 µL and 20 µL. For this reason, we can confirm that the combinations of Ag/TiO_2 have best biocide properties than silver or titanium dioxide nanoparticles separately, the mixture of these two nanoparticles improve the biocide properties of silver and the catalytic properties of titanium dioxide (Zhao et al., 2012 and La Russa et al., 2014).

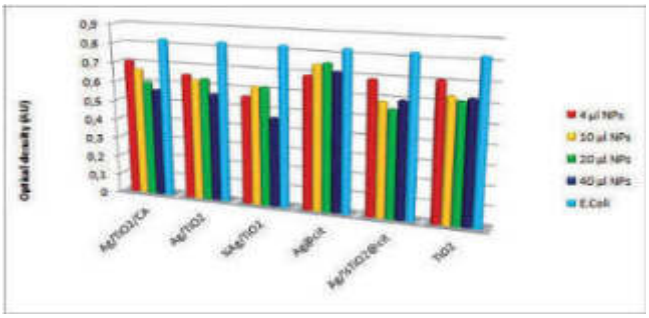

Figure 2.- E. Coli assays. Optical density at 7 h., when the stationary phase was initiated.

—*Biocide assays on limestone of Utrera.*

Biopatina Formation Inhibition (BFI) was estimated by comparison between surface colour before and after the trial. According to Prieto et al. (2004), this method is fast, easy and non destructive technique in comparison with Chlorophyll quantification or fluorescein diacetate hydrolysis. Moreover, this technique (ΔE^*) would allow us monitoring the biopatina inhibition on site.

All the nanocomposites generally allow us to reduce the biopatina formation, except in Ag/TiO_2/AC and Ag/TiO_2 [Table 02] where colour changes (ΔE^*_{BFI}) were over 20 (similar to control samples without nanocomposites). The colour change (ΔE^*_{BFI}) was below 5 in the slab with ¼Ag/TiO_2 and Ag/TiO_2@cit, so those nanocomposites showed the best biocide properties. It is important to note that the samples have been immersed in water during all the trial, generating optimal conditions for the growth of algae, but the stones in historical buildings are not immersed in water but subjected to frequent processes of hydration and drying. The Figure 3 shows slabs after assay and two slabs of control (d: with biopatina and e: untreated and unaltered sample). Biopatina was greenish [Figure 3.d], with the exception of the trials where the nanocomposites were applied and patina acquired orange colour due to the degradation of algal cells. Figures 3.a, b and c show the result of the assay in the slabs treated with the nanocomposites not stabilized with citrate. In this case, it can be observed as the algae colonies are degraded with the typical orange tone in the surface slabs while the Ag/TiO_2@cit nanocomposite [Figure 3.g] decrease the biopatina formation and the colour final of the slab is most similar to untreated and unaltered sample [Figure 03.e]. Total colour change (ΔE^*_{TCC}) shows the increment of colour caused by the treatment applied on the stone surface and the biopatina formation after the trial. This parameter tries to measure the applicability of these treatments for Cultural Heritage, so it takes in consideration the inhibition capacity of the different nanocomposites and the colour change generated by their applications. The best result was obtained for Ag/TiO2@cit nanocomposite. ($\Delta E^*_{TCC} < 10$) [Table 2]. In this case, although the comparison between the two better treatments (¼Ag/TiO_2 [Figure 3.c], Ag/TiO_2@cit [Figure 3.g]) allow us to corroborate the biopatina formation inhibition, the total colour change (ΔE^*_{TCC}) in the case of ¼Ag/TiO_2 is higher than 20 [Table 2] due to the darkening to the stone surface caused by the treatment. For this reason Ag/TiO_2@cit is the treatment recommended to use as biocide in Cultural Heritage, as it produce the best biocide effect with an admissible change of colour. Moreover, this Citrate-capped nanocomposite with TiO_2 (Ag/TiO_2@cit) showed the best efficiency because of lower concentration of this compound than nanocomposites without citrate was necessary for effective treatments [Table 1].

Figure 3.- Slabs after assay. (a) Ag/TiO_2/CA. (b) Ag/TiO_2. (c) ¼Ag/TiO_2. (d) Altered control slab. (e) Unaltered control slab. (f) Ag@cit. (g) Ag/TiO_2@cit. (h) TiO_2.

Conclusions

This preliminary evaluation of different Ag/TiO_2 nanocomposites showed good results as biocidal treatment. The mixtures of silver nanoparticles and titanium dioxide nanoparticles were more effective biocidal treatments than Ag or TiO_2 nanoparticles separately. The best results as restoration treatment were reported for nanocomposites stabilized with citrate because they have smaller particle size, are more stable colloids and exhibit excellent biocide properties inducing colour changes bellow 10%. Further studies are necessary in order to analyze different molar relation between Ag and TiO_2 in the protocol synthesis to establish the optimal treatment for stone on Cultural Heritage.

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The Loss of Oral Traditions in the Far East Russia: Future of the Community

Anastasiia Chuguevskaia

Abstract: This paper investigates the issues threatening the existence of oral traditions and expressions, a strong element of Intangible Cultural Heritage of indigenous nations in Russian Federation and discusses the consequences for the associated communities of such threats. Two of the major threats, rapid globalisation and modernisation of human life-style, have led to the distancing between generations, a phenomenon clearly evident in native settlements where younger generations are moving to urban areas and abandoning their native culture. This paper specifically focuses on the case of Evenks people of Russia, who represent one of the largest native minorities of the country. The Evenks were chosen to be a representation of the phenomenon due to the fact that the native community shows high concern for the issue of oral traditions endangerment and works on safeguarding it. The research used content analysis and netnography research to collect data from social media associated with Evenks and research articles on the issue to study the factors that affect the loss of oral traditions and the consequences for Evenks people of the loss of their oral heritage. It was found that topic of the endangerment of oral traditions among Evenks lacks the diversity of research, and does not receive enough support of legal protection of oral traditions and expressions. Nonetheless Evenks people show a great case of community empowerment through the process of creating programs for safeguarding their language and culture in the modern setting.

Key words: oral traditions, cultural heritage, loss of values.

La pérdida de tradiciones y expresiones orales entre las naciones indígenas de Extremo Oriente: consecuencias para la comunidad

Resumen: Este artículo investiga los problemas que amenazan la existencia de tradiciones y expresiones orales, un elemento fuerte del Patrimonio Cultural Inmaterial de las naciones indígenas en la Federación de Rusia y discute las consecuencias para las comunidades asociadas de tales amenazas. Dos de las principales amenazas, la rápida globalización y la modernización del estilo de vida humano, han llevado al distanciamiento entre generaciones, fenómeno que se manifiesta claramente en los asentamientos nativos donde las generaciones más jóvenes se desplazan a las zonas urbanas y abandonan su cultura nativa. Este artículo se centra específicamente en el caso de la gente de Rusia de los Evenks, quienes representan una de las minorías nativas más grandes del país. Los Evenks fueron elegidos como representación del fenómeno debido a que la comunidad nativa muestra gran preocupación por el tema de las tradiciones orales en peligro y trabaja en su salvaguardia. La investigación utilizó el análisis de contenido y la investigación de la netnografía para recopilar datos de medios sociales asociados con los Evenks y artículos de investigación sobre el tema para estudiar los factores que afectan a la pérdida de las tradiciones orales y las consecuencias para los pueblos de los Evenks de la pérdida de su patrimonio oral. Se encontró que el tema del peligro de las tradiciones orales entre los Evenks carece de la diversidad de la investigación y no recibe suficiente apoyo de la protección legal de las tradiciones y expresiones orales. Sin embargo los Evenks muestran un gran caso de empoderamiento de la comunidad a través del proceso de creación de programas para salvaguardar su idioma y cultura en el entorno moderno.

Palabras clave: tradiciones orales, patrimonio cultural, pérdida de valores.

Cultural Heritage

Intangible Cultural Heritage (ICH), as a part of Cultural Heritage, is a very sensitive subject as it is "important factor in maintaining cultural diversity in the face of growing globalization" (UNESCOb, 2011, p. 4). Oral tradition, have an important role in every culture, as it includes not only language, but also "spoken forms including proverbs, riddles, tales, nursery rhymes, legends, myths, epic songs and poems… and more" (UNESCOa, 2011, p. 4).

Oral traditions for indigenous people represent more than just spoken language; yet it is the factor that brings all oral traditions together and allows its transmission. Language builds the knowledge, defines the community structure and builds personality different from other native communities (Boroditsky, 2009). Unfortunately, established tradition and modern society often clash as a result of rapid development and changes. Leading to the shift in values, urbanization causes the movement of people and intermarriage among different native people

results in reduction of cultural populations; this leads to clash with national languages resulting in decay and a risk of extinction (Lewis, 2009). This phenomenon is very evident in the case of Evenks ethnic population, and therefore they were selected as the subject of this research.

The Evenks indigenous people represent the largest native population in Russia geographically (Syliandziga et al 2003) (see Figure1). Yet in the current decade sociologists and ethnologists define only around ten to thirteen thousand native speakers world-wide while the overall population is over double (Janhunen & Salminen, 1993; Lewis, 2009) and it keeps decreasing.

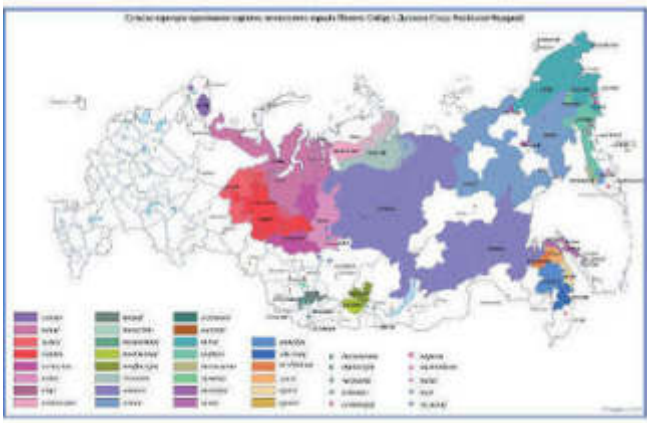

Figure 1.-The Territory of Modern Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation.

— The Importance of the Research

This research is essential, as culture and traditions are the foundation of human creativity and intelligence. Language enables ethnic groups to communicate information among each other and pass it on to future generations, without which people will lose their heritage. Therefore it must be safeguarded in order to ensure that future generations have opportunity to cherish the same experiences that past and present generations have now.

This research aims to 1) identify the factors that cause the native language to vanish; 2) determine what the effects are of the disappearance of language on the traditional way of life; 3) suggest possible solutions for how oral heritage can be safeguarded.

Literature review

— ICH

Cultural Heritage (CH) is defined as something of value, which communities want to pass to future generations and what brings a "sense of continuity" (Deacon et al 2004, p. 7). It demonstrates the diversity of nations and individuals; both tangible and intangible in form, it unifies a community. Unfortunately, ICH, unlike CH, is neither universal nor bounded by time, as it is a direct representation of the living traditions and practices of a community that change and evolve (UNESCOb, 2011). ICH conveys identity and uniqueness of the community, impacting the way individuals view their world.

—Concept of the Oral Traditions and Expressions

Oral traditions are defined as any spoken outlook passed from generation to generation from parents to their children. Language plays a critical part in keeping culture alive, as without oral expressions it would be impossible to transmit all the knowledge and wisdom that has been collected by previous generations. This also can lead to the distancing between generations and loss of connection to the past among younger people, as they are more oriented toward western cultures (Hieber, 2012).

At the moment, there are around 6,900 known languages in the world (Lewis, 2009). Over 3000 of these are endangered (see Figure 2). Russia alone accounts for 111 of the total endangered languages in the world (The Endangered Languages Project, 2016). With some forecasting, professionals predict that by the end of 21st century 50% (Nettle & Romaine, 2000) to 90% (Krauss, 1992) of all languages used today will be either endangered or extinct (see Appendix A).

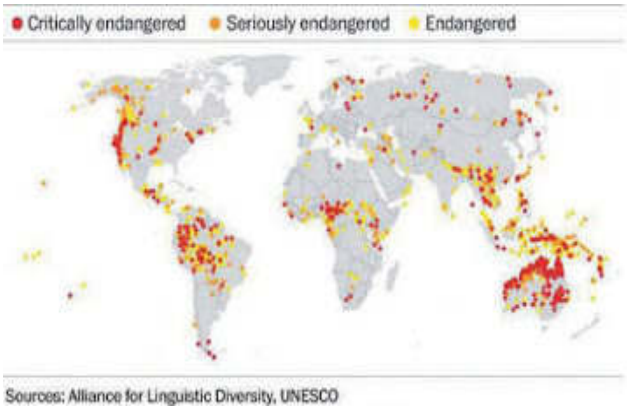

Figure 2.- Map of Endangered Languages in the World.

— Loss of Oral Traditions and Expressions

The endangerment of oral traditions are due to a variety of factors; among which, globalisation and urbanisation, environmental problems as well as the change in the setting of the place (UNESCOa, 2011; Hieber, 2012). Those factors force people to move to urban areas (Emirova, 2013; ICHCAP, 2016) and amalgamate in a new environment (Tygolykov, 1982), which results in decrease of native speakers. With separation and distancing of the native working population, the community is further reduced (Tygolykov, 1982). All these factors negatively impact the condition of the language itself.

— *Impact of the Loss of the Language*

In cases where language extinction is threatened, it results in eventual disappearance of the bond between the culture and the language of its speakers. Though, ICH does not include the grammatical structure of the language, with the loss of the language it is inevitable that the loss of oral expressions would soon follow (UNESCOa, 2011). Even though it is natural for languages and oral traditions to adapt to the community's ongoing changes, the disappearance of a language can have harmful effects on the community (Sallabank, 2010).

From the linguistic point of view, the shift that speakers have toward the wider used languages, leads to the generations that would not be aware of all the diversity of oral expressions that society has to offer.

•*Relationship between Endangered Language and Native People*

Languages mirror the society (Lupyan & Dale, 2010) and its relationship with nature. The oral expressions or terms used in everyday lives have cultural and environmental context specific to that language. When a community loses its language, its cultural identity could also be lost. Most of the cultural, spiritual, and intellectual life of a society is transmitted through language, and it is connected to the other ICH domains. Performing arts, festive events or even daily routines cannot fully function without language.

Methodology

The paper used an exploratory qualitative research method (Nargundkar, 2003). Document analysis and netnography were utilized in the collection of data, mostly with use of ethnographical approach for better understanding of Evenks' people lives and more in-depth insight knowledge on the case. It also produced richer data that otherwise would not be found through quantitative methods, due to limitations.

— *Document Analysis*

Content analysis is one of the most suitable research methods when it comes to study of ethnography and human communications: "Communication content is transformed through objective and systematic application of categorization rules into data" (Holsti, 1969). The paper included information from peer reviewed studies from Russian authors as well as public records (Appendix B). It served as a background and support for netnography, in order to build the base of trustworthiness among readers (Graneheim & Lundman, 2004).

— *Netnography*

Netnography, also known as "virtual ethnography" (Hine, 200, p. 257) can be defined as "a participant-observational research based on online fieldwork" (Kozinets, 2010, p. 66). Netnography was used to provide more primary data to support the topic and answer the research questions. With netnography, by using the wide range of online recourses that were provided for researcher (Bowler, 2010), several main types of resources were selected in order to have the best observational material. (Appendix B).

— *Analysis of Data*

The original language of the content used for analyse was Russian, as Evenks are native people of Russian Federation. Therefore, to present unbiased information to the reader, the double-blind translation method (Heath, 2005) was used to insure the accuracy of translation and trustworthiness of data.

The use of the "pattern based coding" allowed the author to cover more research ground in shorter time, as well as get larger amount of feedbacks from native people (See Table 2). Researcher was able to work through the patterns met in the content of the web-sites and from that developed structure that could satisfy the research discussion. As research had only focused on Evenks ethnic group, it is important to understand the limitations that affected the methodological design.

Findings and discussion

— *Evenks*

Territory of Russian Federation is a home to over 200 ethnic groups and almost 100 of them are representing local indigenous population (Central Intelligence Agency, 2016; Case 2). Each community has their own language and culture to represent and safeguard (see Table 1). For the present time the language of Evenks people is marked as "endangered" (Case 3.1, 3.4), and local dialects are already "possibly extinct" (Janhunen & Salminen, 1993, p. 1).

— *Findings*

It was possible to find some of the factors that affect the process of endangerment of languages and the oral traditions world-wide, in result the cause-effect relationship diagram was created (see Figure 3).

The research suggests that there are some affects that are mentioned more often than the others and that are correlated with other reasons for vanishing of the language.

Table 1.- Ethnolinguistic classification of Indigeneus Peoples of the North, Siberia and Far East.

Family of Languages	Language Group	The name of the people - their language (dialects)
Altai	Turkic	Dolgans - Sakha (Dolgan dialect) Tozhu tuvans - Tuvan (Todzha dialect) Tofalars - Tofalar Kumandy - Altai (Kumandin dialect) Teleuts - Altai (Teleut dialect) Shor – Shor (two dialects)
	Tungus-Manchu	Evenki - Evenki (three dialects) Evens - the Even (three dialects) Nanai - Nanai (several dialects and dialects) Ulchis - Ulchi Udege - Udeghe (three dialects) Orok - Orok Orochi - Orochi (three dialects) Negidal - Negidal (three dialects)
Ural-Yukagir	Ugrian	Khanty - Khanty (three dialects) Mansi - Mansi (several dialects)
	Samoyeds	Nenets - Nenets (several dialects and sub-dialects) Sami - Saami (four dialects) Selkup - Selkup (six dialects) Nganasans - Nganasan (several dialects) Enets - Enets (two dialects)
	Yukaghir	Yukaghir - Yukagir (two dialects)
Chukchi Kamchatka		Chukchi - Chuukese (two dialects) Chuvans - originally Yukagir Now Chukchi and Russian (Markov dialect) Koryak - Koryak (nine dialects) Itelmen - Itelmen
Eskimo		Eskimo - Eskimo (three dialects)

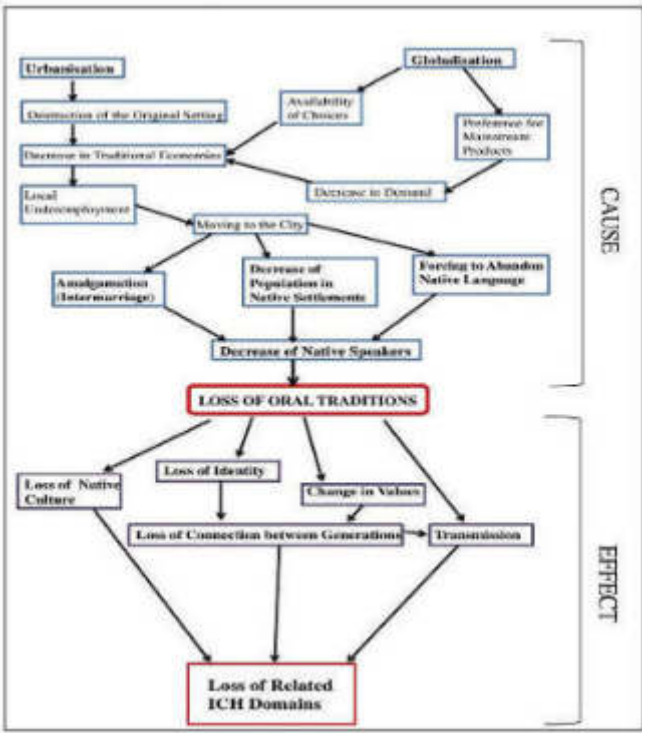

Figure 3.- Cause and Effect Relationship Diagram of Oral Traditions Endangerment

Table 2.- Categorisation of Common Terms Found Through Content Analyse and Netnography.

The Causes for Vanishing	Categories
Development of Neighbouring Regions	Globalisation
Globalisation	
Environmental Problems	
Urbanisation	
Decrease in Economy Support	Migration
Drop in Demands for Native Crafts	
Lack of Governmental	
Migration	
Modernisation	
Unemployment	
Moving to Urban Areas	
Abandoning of Native Language	Abandoning of Native Language
Amalgamation	
Bi/Tri Lingual System of Education	
Change in Traditional Way of Life	
Decrease in Population	
Health Issues	
Intermarriage	
Lack of Use of Language	

The most commonly used terms were categorised and included into the discussion (see Table 2). It also helped in defining important factors, as it clearly showed by the mentionings, what is considered important among native people and what people are really concerned about.

— *Discussion*

The most commonly mentioned causes for the endangerment of the oral traditions were globalization, migration to urban areas and abandoning of the language. [Table 2]

•*Globalisation*

The issue of globalisation is the most commonly mentioned factor that affects the loss of language. It is well-known outside Evenks community, as other indigenous people are also affected by this process. Three main factors were discovered that come from the globalisation, they are: development of neighbouring regions, environmental problems and urbanisation.

Globalisation is not something that can be easily stopped in the modern world. Globalisation and modernisation are the forces that despite helping the community do not pay much respect to minorities and their culture, and homogenies cultural groups. Therefore the local community sees it as a threat to their culture and the traditional way of life, as it brings change. In the discussions on forums, elders state "the longer civilization does not come to us, the better" (Case 3.4).

Local people acknowledge the globalisation and recognise its effect on their life. Community members participating in public forums like "Indigenous Russia", "Evenki", "RAIPON" talking about changed of their original way of life, most commonly how it affects their nomad life style. Having to settle and change their habits, leads to changing of the language, as there would be no need for the particular slang or words that they would use while moving around (Case 3.4). Among elders, the grandmothers are generally the carriers or oral traditions, which they would pass through story-telling to their grandchildren, yet now situation is changing. "They live in the city, and I am in the village" – comment one of the elders in the village (Case 4).

Urbanisation comes from development programs that were created by Russian government (Case 1.2, 1.3). This development changed the eco-system and the environmental situation of the region, resulting in environmental pollution and change in the original setting (Case 1.3). The consequence for native people was the decrease of pasture for reindeers, as well as the number of stock itself (reindeers are the main livestock for Evenks, as well as a mean of income, food and equipment supply) (Case 1.2, 1.3). Those factors resulted in decrease of economy and since it is harder to support the family, native people are forced to move to urbanized areas or bigger cities to find more stable and profitable job.

•*Migration*

The migration issue that affects locals came from several causes, like: drop in demands for native crafts, unemployment, lack of governmental support, decrease in economy and modernisation. All of those factors have resulted in the increasing migration wave.

As one of the Evenki teachers informed: "Why we do not know the language? Became too settled, having comfortable lives, to preserve the language, you also need to save the nomadic way of life" (Case 4).

The changes in economic situation and drop in demand for local crafts appeared due to the local economy not being able to compete with mess production and mainstream brands. With larger number of modern choices for people, as well as lack of support from the government, it is harder for people to take care of their homes and family (Case 1.5, 1.7). This makes local community to shift from local businesses and trades to more modern incomes. Modern technologies have also replaced the original tools (Case 3.3, 3.4), and while it is making the life easier it certainly has an impact on the language usage. Less and less they use Evenks language to explain the tools and materials, changing them to Russian or even English substitutes (Case 3.4).

People highlight that they have to abandon their nomad way of life and settle down, and even though it improves their life, it cuts them of from their roots. Slang what would be used by reindeer is now getting evaporated, as smaller amounts of people are using it, and there is no one to pass this knowledge to, as modern generations are not interested. Several speakers noted that "the preservation of reindeer herding is the basis of preserving the language, as children of reindeer herders are completely native Evenki language speakers" (Case 3.4). The migration causes the alienation of Evenks people and leads to abandoning of the language which is the direct cause for disappearing of the oral traditions.

•*Abandoning of Native Language*

The most direct and at the same time most challenging reasons for the endangerment of the language among Evenks have been referenced by both researchers and local people. Change in traditional way of life, amalgamation, bi/tri lingual system of education, lack of use of language, intermarriage; all result in decrease in population and therefore abandoning of native language.

When people amalgamate, they change their habits, their way of life; learn the language that people speak around them. The first shifts to another language took place during the Soviet Union, as native people had to learn Russian

language, in order to be able to work on factories and understand the majority of population. The director of the school says: "We speak both Russian and Buryat and Yakuts and Evenks [languages]" (Case 4).

Amalgamation process is happening as people move to more urbanised areas in order to be able to fit in a new way of life. One of the main consequences of amalgamation is intermarriage. Evenks often comment on a fact, that now most of them already have mixed ancestral roots. The teacher of Evenki language speaks "[My parents] automatically speak only in Russian, even among themselves. The language is preserved only among the old-timers" (Case 4).

The bi/tri lingual system of education that is common among native settlements might not be as useful, as it seems at first. While Russian based schools teach two languages: Russian and English, when it comes to native regions, students have to study two to four languages, depending on how many different native ethnics are living in this region. This of course gives a basic knowledge of a language, but sometimes it is not enough to be able fully express everything. "Teachers of the Evenki language are not prepared, we have textbooks…[but] they are very old. We … [use] different words, if you read something to old people, they do not always understand" (Case 4). The teacher later continues: "Evenki [language] none of our students know; teach them from scratch. In total teach four languages at school: Evenks, Russian, English and Yakut. All employees of our school speak Yakut. Evenki only know I and 2-3 employees" (Case 4).

In some cases even in families the language preservation is at risk: "In families Evenki language dies, even my own children say I did not teach them from childhood, and now they complain that they want to know their own language" (Case 4). The other problem faced by schools is the lack of findings from the government to support enough educational institutes, which results in decline of educational level (Case 4). The example can be the Yukaghir language that even though taught in several schools has only 20 native speakers (Case 3.2). This shows how the system that intended to help in safeguarding of the language has flaws; even though it is taught, it lacks the depth and meaning behind it.

•*Impacts*

The loss of native language has a great impact on not only native people but also the outsiders. It has been already mentioned above, that the loss of language and oral traditions leads to loss of other intangible heritage, like rituals, performing arts, social practices and even craftsmanship. By using old legends and spelling rituals, Evenks used this knowledge to conduct annual rituals, create the ornaments on products or clothes that would tell about their and their ancestors' lives (Case 3.4). Many other examples can be shown on how the language interconnect with the cultural heritage of Evenks, and with loss of only one element, all others would be affected. This in the end would cause the changes in the mind-set of people, change their values, and as a result the disappearance of the culture will take place.

The loss of culture would affect not only Evenks that would not be able to represent their culture anymore. This would also affect the country as a whole, as Evenks represent a great ethnical layer of Russian culture and history, and without it, Russian culture would suffer a loss of its wholeness.

—*Implications*

Even though the Evenks language is considered endangered, there is still hope for its safeguarding and passing to next generations, not only as a linguistic treasure, but also as a mean to bring the community together, a cultural core that passes values from generation to generation.

Local and regional non-profit organizations (NPO) as well as local community's head officers are taking measures to safeguard national cultures and with it the oral traditions (Case 1.1). The local community leaders together with regional governments are creating different programs and platforms, helping to safeguard oral traditions. The law "On nomadic schools" (Case 3.4) is one of these projects that can be used as an example. The other case that can be used is the Eskimos' ICH that was offered by local community to be included into the UNESCO Intangible Cultural Heritage List (Case 3.3), which gives hope for the Evenks people as well.

The rising interest in "the development of the social media in local language, textbooks and courses in local languages" (Case 3.4) also take place, which shows the support of local people towards their language, and their willingness to promote and distribute it among the population.

It can be seen that even though there are difficulties, the community members and the associations try their best in preserving the language, by implementing new courses as well as trying to push new legislations to the national level.

Conclusion

The objective of this research was to discover the reasons behind the disappearance of native language among native people of Russia on the example of Evenks people. The investigation tried not only to identify the reasons for disappearing, but also the consequences for community in case language is lost. It was found that there are changes that affect the language in Evenks settlements. These changes are taking place mainly because of the increasing influence of globalisation and modernisation. Although development cannot be stopped, smart development considering safeguarding of ICH can be implemented.

This paper had discovered that in this case when the language is endangered, people start to understand

the importance of the safeguarding the traditions, and understand the impact it will have if no actions taken. That is why there are more and more programs being established, and the local community government is trying to put legislations of guidelines for protection their language. Moreover this brings the hope that possibly people do understand, respect and love their culture and factors that makes them unique. There are programs and cultural exchanges; new school openings as well as new legislations being implemented that are committed to the protection of the language and also safeguarding of oral traditions.

The importance of this research lays in the understanding of substantial value of the culture on the world, its fragility and invisibility to an eye in everyday life, but without which people would lose their individuality and history. The famous proverb says "finders-keepers, losers-weepers". It perfectly describes the current situation where little by little people lose their traditions and individuality in the run for westernise mainstream trends that are pushed by modernisation and globalisation to masses. It is vital for people to understand the significance of their culture and try their best in its safeguarding to ensure that future progeny would be able to enjoy the fullness of experience that it can deliver. In other words, it is only up to the communities themselves to make sure that their cultures will live on and grow with every new generation. With this in mind, the raise of awareness is substantial for safeguarding of Intangible Cultural Heritage and particularly oral traditions and local languages.

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Appendix A.- "WAR OF WORDS" Table.

Appendix B.- Findings Data Collection List.

List of Resourses from Content Analyse:

- Case 1.1: Golovin, A. (2003). O Koncepcii Modeli Etnicheskoi (Nacionalnoi) Shkoli dlia Korennih Malochislennih Narodov Severa Rossii [The Concept Model of Ethnic (National) School for Indigenous People of Russina North].
- Case 1.2: Kolesnikova, L. K. (2003). Socialno-ecologicheskiw problemi Amyrskih Evenkov [Socio-Ecological problems of Amur Evenks].
- Case 1.3: Kozak, V. G. (2003). Ekologo-geograficheskaya harakteristika sredy prozhivaniya Evenkov amurskoy oblasti [Ecological and geographical characteristics of the living environment of Evenks in Amur Region].
- Case 1.4: Pilaeva, O. (2003). Ob Ischezaiycshem Iazike Amyrskih Evenkov [About vanishing languages of Amur Evenks].
- Case 1.5: Safronova, T. (2003). Socio-demographic and legal situation in the village Ivanovskoe of Seleindzinski District (1999-2000.).
- Case 1.6: Serebrennikov, V., & Syhomirov, G. (2003). Problems of preservation of traditional forms of nature use of indigenous peoples of the Amur in new socio-economic conditions.
- Case 1.7: Tygolykov, V. (1982). Evenki [Evenks]. In Ethnical History of the Peoples of North (pp. 129—154). Moscow: Nayka.
- Case 2: Government, R. (2010). Vsenorodnaia Perepis Naselenia [All-Russian population census]

List of Resourses from Netnography:

- Case 3.1: Evenki (VKontanke Community Group)
- Case 3.2: Indigenous Russia (Facebook Community Group)
- Case 3.3: Russian Association of Indigenous Peoples of the North, Siberia and Far East (RAIPON) (Official Website)
- Case 3.4: The indigenous peoples of the North, Siberia and Far East (Official Page)
- Case 4: Ria-Novosti (Ria-News)

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Behaviour of brick-NHL render systems in presence of NaCl solution

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Abstract: Double-layer renders were formulated for ensuring salt migration, ancient masonries conservation and environmental sustainability. Thus, natural hydraulic lime as binder and recycled aggregates from render wastes were selected. The properties were adjusted by adding an air-entraining agent in the inner layer and different percentages of water-repellent admixtures in the outer layer. The systems were applied on bricks and subjected to rising damp-evaporation cycles, for investigating their behaviour and properties in respect to NaCl migration. Mono-material prismatic render specimens were also studied. Water vapour permeability, capillary absorption, drying behaviour, compressive strength, mechanical resistance, conductivity and porosity of each formulation were evaluated. Good durability was observed whenever the render layers had different microstructure, either there was salts deposition within the lower layer,or if there was tefflorescences formation. If the layers had similar structure, deposition of salt at the brick-render interface occurred causing damages to the substrate.

Key words: Render, double-layer systems, salt transport, brick, rising damp.

Comportamiento de sistemas de revestimiento de ladrillos tipo NHL en presencia de soluciones de ClNa

Resumen: Se ha formulado una doble capa de revestimiento para garantizar la migración de las sales, la conservación de fábricas y mamposterías antiguas y la sostenibilidad del medio ambiente. De este modo, se seleccionó cal hidráulica natural y áridos reciclados de residuos de revestimientos. Además, se ajustaron y regularon las las propiedades mediante la adición de un agente aireante y de en la capa interna y de diferentes porcentajes de mezclas hidrorrepelentes en la capa externa. Los sistemas han sido aplicados sobre los ladrillos y sometidos a ciclos de humedad ascendente y de evaporación para investigar su comportamiento y propiedades respecto a la migración de ClNa. También se han estudiado especímenes prismáticos monomateriales de revestimiento. Para cada formulación se evaluaron la permeabilidad al vapor de agua, la absorción capilar, el comportamiento de secado, la resistencia a compresión, la conductividad y la porosidad. Cuando las capas del revestimiento presentan diferente microestructura se produce bien la deposición de sales en la capa inferior, bien transporte a la superficie y formación de eflorescencias, observando una buena durabilidad. Si las capas tienen estructura similar, se produce la deposición de sales en la interfaz ladrillo-mortero, originando daños al substrato.

Palabras clave: revestimientos, sistemas de doble capa, transporte de sales, ladrillos, humedad ascendente.

Introduction

In a marine environment, rendering systems may outstand hostile conditions due to marine spray and aerosol, and to capillary rise of water with a salinity of about 3% (Lubelli et al 2004). They are subjected to severe forms of degradation mainly due to the penetration of salt water, crystallization/dissolution cycles of salts and loss of mechanical strength due to the subsequent internal pressures (Fassina et al 2002; Lubelli et al 2004). In presence of rising damp of salt water the salt transport or deposition is regulated respectively by: migration of the solution inside the porous network from inland areas towards the outer ones, water evaporation and vapour diffusion through the outer layer. If the evaporation and vapour diffusion are slower than migration, the salt solution reaches the outer surface creating efflorescences with mainly an aesthetic damage. If the advection of salts is counterbalanced by evaporation within the material, internal salt crystallization occurs (sub-efflorescences). This causes internal stresses due to crystallization pressures, causing exfoliations and detachments of the surface layers. The moisture retention due to salt hygroscopicity contributes also to crystallization/dissolution cycles (Franzoni 2014).

Rendering systems may regulate water flow and salts transport within the masonry, thus tackling rising damp effects. The development of suitable mixtures

formulation is however complex since the substrate/plaster interactions are influenced by: relative pores structure and pores distribution, hydrophobic properties, plaster thickness, presence of several layers. Moreover, in the conservation field the compatibility of the rendering system with historical masonries is crucial, in particular in terms of mechanical and chemical compatibility, and stability overtime of the system.

In this work, the formulation of rendering systems based on natural hydraulic lime as binder is presented, aiming at obtaining a structure compatible with historical masonries (Lanas et al 2004). The systems, here proposed, are double layer render systems, admixed with air entraining agents in the first layer and water repellents admixtures in the outer layer for regulating the render structure and the water transport within the systems (Speri et al., in press, Falchi et al., 2015). The ecological sustainability of the render systems has been taken into account by using recycled crushed mortars as partial substitution of the aggregates in the internal layer (Raeis et al 2015; Silva et al 2016). For attesting the systems behaviour in presence of rising damp of salt water, the renders were applied on bricks that underwent absorption and drying cycles of a NaCl solution. Both singular render mixtures and systems constituted by a double render layer were studied and tested within our experimentation.

Materials and Methods

Red-fired bricks (San Marco Laterizi S.p.A., 25x12x3 cm) were chosen as substrate for the render application in order to simulate an historical masonry.

The first internal layer was constituted of natural hydraulic lime NHL3.5 supplied by MGN as binder, and limestone-siliceous sand partially substituted (1/3 by volume) by recycled old mortars with a size fraction of 0/5 mm as aggregate. The recycled aggregates were obtained by crushing old mortars made of limestone cement or natural hydraulic lime eventually admixed with calcium stearate as water-repellent. In addition sodium alkyl sulfonate was used as air entraining agent at 0.03% or 0.09% by weight on the binder weight. The first ratio is a percentage commonly used, whilst the second was selected as responsible for the formation of a macroporous structure. The second layer was obtained by mixing NHL 3.5, limestone-siliceous sand (size fraction 0/2 mm), and calcium stearate by SIGMA Aldrich, eventually added with a water repellent admixture at 0.3% or 0.5% by weight. In both the layers tap water was admixed till a good workability of the mixture was reached (slump diameter 17 cm).

Table 1 summarizes the systems composition that will be discussed in the present paper.

The system specimens preparation and exposure to salt solution transport was based on a protocol proposed within the COMPASS project (Wiffels and Lubelli 2006). The use of large specimens without lateral sealing ensured the mock-ups representativeness by simulating also the presence of corners in a building.

The mock-ups were made of full bricks, covered by a double layer of render obtained by mixing the binder with half the water and the air entraining agent, when present, at low speed (100 rpm) for 5 minutes. Then, the remaining water and the other materials were added and further mixed for 5 minutes. The first render layer was applied on moist bricks to form a layer 1 cm thick and patted in order to enhance the adhesion of the second layer. The specimens were cured for 12 hours at 95% relative humidity (RH) and 20°C before the application of a second layer of 0.5 cm thick smoothed with a trowel. Additional to these, prismatic specimens (4x4x4 cm and 5x5x2 cm) were produced of each separate render material. The double layer systems and the prismatic specimens were cured at 95% RH and 20°C for 28 days, then dried at room temperature till constant weight (55% RH, 23 °C). Three

Table 1.- Mixture compositions of the specimens.

Render system	First layer				Second layer		
			Type of recycled aggregate	Air entraining %			Water repellent%
C3_wr	NHL3.5 as Binder	2/3 of limestone-siliceous sand (size fraction 0/5 mm) + 1/3 of recycle aggragates	LImestone cement mortar	0.03%	NHL3.5 as binder	fine limestone-silecous sand (0/2 mm) as aggregate	0.5%
Ccast3_wr			LImestone cement + calcium stearate	0.03%			0.3%
C9_nwr			LImestone cement mortar	0.09%			0.0%
N9_nwr			natural hydraulic lime mortar	0.09%			0.0%
N9_wr				0.09%			0.3%
N3_wr				0.03%			0.5%
Ncast9_wr			natural hydraulic lime+calcium stearate	0.09%			0.3%

independent replicates were prepared for each mixture/ system.

The hardened double-layer systems underwent drying-wetting cycles by capillary rise of a 3% by weight NaCl solution, simulating the salinity of marine water. An absorption time of 24 hours was chosen to ensure specimens saturation also in presence of water repellent admixtures. The specimens were then removed from the container and placed at 65% RH and 23°C for 7 day drying, thus allowing the evaporation of about the 80% of the solution before the following cycle for avoiding excessive shrinkage and salt crystallization stress to the materials. In total, four cycles were performed without removing efflorescences or debris from the specimens surface.

After the salt cycles, the occurrence of visible damages and change in mass were determined. The presence of decay forms such as efflorescences, delamination, and disaggregation was recorded by photographic documentation and scans of the surfaces carried out at 1200dpi by a Epson perfection 3170 Photo Scanner.

The mono-material render specimens and the exposed double layer systems were tested in order to determine the physical properties that mostly influence the solution transport: capillary absorption according to NORMAL 11/85, drying behaviour (NORMAL 29/88) and water vapour permeability according to UNI EN:12086 (the permeability of the double layer systems was tested on the two layers once separated from the bricks).

The compressive strength was determined on cubic mono-material specimens samples (4x4x4 cm) according to UNI EN 1015-11. The double layers systems, too thin to be tested using the same approach, were investigated by using a Schmidt Hammer PT sclerometer for soft materials. Bodily detachments due to the strokes occurs whenever the render adhesion is poor, allowing to evaluate the hardness and the render adhesion to the bricks. Five hammer strokes at percussion energy 0.44J were carried out, followed by another five at 0.88J, to test both fragile or stronger render layers.

In order to highlight the salt transport behaviour, salt distribution profiles of the systems were obtained by cutting the layers in 4 slices parallel to the surface and by measuring the conductivity of each slice according to NORMAL 13/83 (EC-meter GLP31, Crison). The disruptive effect of salts on the render microstructure in the 0.06-20 µm range was estimated by mercury intrusion porosimetry (Pascal 120 and Pascal 240, Thermo Quest Instruments) according to NORMAL 4/80.

Results and Discussion

One replicate of N9_wr and of N3_wr detached bodily from the bricks before the exposure to absorption-drying cycles, pointing out insufficient starting adhesion, possibly caused by the use of NM as recycled aggregate.

Reoccurring patterns were observed after the exposure, such as: slight presence of salt efflorescence without substantial loss of material (Ccast3_wr, C9_nwr and Ncast9_wr); diffuse presence of salt efflorescence without erosion of the surface (N9_nwr); spalling and surface delamination (C3_wr); serious crumbling and/or erosion of the entire surface areas (N9_wr, and N3_wr) (Figure 1).

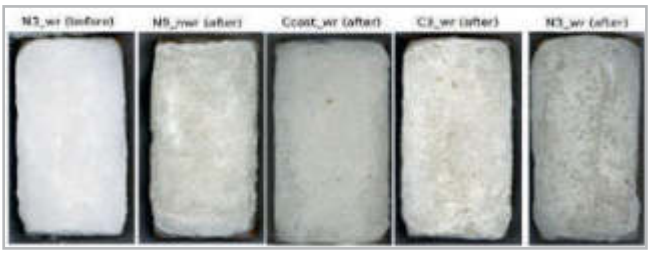

Figure 1.- Scans of some of the specimens before (b) and after (a) the crystallization cycles.

Table 2 and Figure 2 report the results regarding the water uptake behaviour obtained from the single mixtures (D=first layer; Up= external layer) and the double layer systems (DL) of the selected specimens. All samples tend to be almost completely saturated within the first 4 hours (120 $s^{1/2}$ in the figure 2) of exposure to rising water during the capillary absorption test.

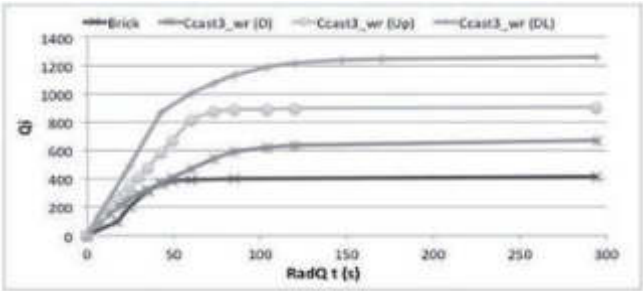

Figure 2.- Capillary water absorption of Ccast3_wr system, the single layer and the brick composing Ccast3_wr system.

The capillary absorption coefficient corresponds to the absorption speed and for mono-material specimens is easily evaluated as the slope of the first linear segment in the absorption curve (Qi vs √time). In the case of systems composed by brick, render D, and render Up, the individuation of the slope related only to the render layers is rather difficult to determinate. Figure 2 shows that the absorption of the double layer Ccast3_wr is not linear, but constitutes of segments with different slopes ascribable to the absorption of the brick (CA of single bricks =8,58 mg/ cm2s-1/2) or to the layers. For this reason, only the slope of the second linear segment was used to calculate the DLs coefficients reported in Table 2.

Table 2.- Capillary absorption coefficient CA, maximum water uptake Qi, drying coefficient Ang.Coeff, resistance to water vapour permeability μ, maximum compressive strength σ (D and Up) or sclerometric rebounds for strokes power of 0,88J (DL) of the specimens.

Render System		CA ($mg/cm^2s^{-1/2}$)		Qi max (%)		Ang.Coeff. ($mg\ s^{-1/2}$)		μ		σ (MPa) /Sclerometer	
		Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
C3_wr	D	14.4	0.8	13.7	0.4	-0.45	0.01	5.3	0.4	0.42	0.06
	Up	5.1	1.8	13.1	0.4	-0.38	0.02	9.23	0.7	1.63	1.46
	DL	4. 1	1.9	7.8	3.5	-0.03	0.01	8.5	4.0	23.7	6.3
Ccast3_wr	D	6.9	2.0	14.3	0.4	-0.60	0.01	7.0	1.7	0.88	0.19
	Up	12.7	1.4	15.5	1.6	-0.44	0.03	7.7	1.0	X	
	DL	3.6	0.3	14.3	X	-0.05	X	10.2	2.7	19.6	3.4
C9_nwr	D	7.7	0.3	12.9	0.1	-0.41	0.00	6.9	0.5	0.60	0.16
	Up	13.5	5.7	14.7	1.9	-0.44	0.03	8.3	1.7	2.29	0.20
	DL	1.9	1.7	6.3	5.9	-0.02	0.01	9.6	1.4	22.9	8.5
N9_nwr	D	18.3	2.1	16.5	0.3	-0.67	0.01	4.5	0.8	0.41	0.07
	Up	13.5	5.7	14.7	1.9	-0.39	0.06	8.3	1.7	2.29	0.2
	DL	3.8	0.4	6.8	1.5	-0.03	0.01	X		29.6	7.1
N9_wr	D	18.3	2.1	16.5	0.3	-0.67	0.01	4.5	0.8	0.41	0.07
	Up	15.8	1.0	16.3	0.1	-0.50	0.01	3.3	0.9	0.97	0.25
	DL	7.8	1.7	15.5	0.3	-0.06	0.01	6.0	1.6	25.3	5.1
N3_wr	D	18.8	3.3	17.5	0.2	-0.64	0.02	5.3	0.9	0.31	0.06
	Up	5.1	1.8	13.1	0.4	-0.38	0.02	9.3	0.7	1.63	1.46
	DL	8.9	0.3	15.7	X	-0.06	X	8.9	1.9	20.2	5.4
Ncast9_wr	D	6.7	0.3	12.6	0.3	-0.36	0.02	4.5	1.5	1.11	0.36
	Up	12.7	1.4	15.5	1.6	-0.44	0.03	7.7	1.0	X	
	DL	1.9	0.6	7.9	2.7	-0.03	0.01	12.4	0.5	34.6	4.4

An observed common trend is that the capillary absorption coefficient of DL is lower than D or Up, probably due to absorption of the render layers before the second linear segment. The absorption front is never parallel to the base but it curves on the corners, resulting in a simultaneous absorption by the brick and the renders at a certain time. Moreover, the differences in Qimax and CA could be related to different microstructure of mono-material specimens in comparison to double layer systems, possibly linked to moulding operations or application by trowel.

Despite the intrinsic difficulty to estimate the CA of DL and to compare this directly to the CA of Up or D, slower absorption rate occur whenever water repellent material is present, in particular in the first layer. The absorption capacity of double layer systems seems to depend mainly on the absorption capacity of the lower layer. Moreover, the water absorption speed do not depend on the total amount of water absorbed Qimax, which in turns seems to be correlated to the total open porosity and pore size distribution. (see also below and Table 3).

All the samples had shown quite similar drying behaviour (Ang. Coeff. in Table 2) which is significantly slower in the double layer systems in comparison to the single mixtures. Probably, the moist brick acts as a water reservoir slowing down the drying process. In the mono-material specimens most of the water evaporates in the first 24 hours, while the drying process takes more than a week for the double layer systems. Moreover, fast drying of the systems is observed whenever Qimax is higher. The presence of water repellents does not influence significantly the drying behaviour, which depends on the internal structure. The D layers usually show fast evaporation rates (with the exception of Ncast9_wr) probably due to a higher porosity.

When NHL is used as binder the permeability is in general high in comparison to cement based mortars, as confirmed also in this case. The permeability of the double layers system is similar to the one of the monolayer with higher μ, thus the less breathable layer prevent the water vapour flux. Outer layers (Up) in general are less permeable to water vapour in comparison to the internal layers (D), possibly due to their

relative porosity (Table 3). Ncast9_wr is the only exception with a lower permeability of the interior layer. Based on the results, the drying behaviour and the permeability seem to depend mainly on the structure and not on the possible presence of water-repellents.

Regarding the mechanical properties, in all systems the outer layers (Up) are more resistant in comparison to the inner ones (D), suggesting again that the Up layers may have a more compact and hard structure. Moreover, the resistance increases with the decrease of water repellent. In fact, among the systems studied, the Ncast9_wr (0.3% water repellent) shows the highest resistance to the sclerometer strokes, thanks probably to a good adhesion and compactness of the first layer, while N3_wr (0.5% water repellent) has low resistance and detach also by itself. The resistance of the double layer systems seems to be influenced mainly by the compression strength of the inner layer (D) and the bond between this layer and the brick.

In order to further investigate the water transport mechanisms, the physical properties were analysed in relations to their porosity and conductivity at the end of the cycles (see Table 3 and Figure 3).

Table 3.- Conductivity profile and the total porosity measured on the double layer detached from the brick after the cycles.

Render system	Nr. specimens detached before exposure	Conductivity profile (µs/cm) Int.—>ext.				Total Porosity % Int. —>ext.				Average pore radius (µm)			
		1st Layer mm		2nd Layer mm		1st Layer		2nd Layer		1st Layer		2nd Layer	
		0-4	5-9	10-12	13-15	Salty	Desalted	Salty	Desalted	Salty	Desalted	Salty	Desalted
C3_wr	-	96	98	127	145	38	38	30	29	1.32	1.00	0.44	0.29
C3cast _wr	-	120	100	148	109	43	38	29	29	1.24	0.95	0.28	0.33
C9_nwr	-	99	119	100	124	39	38	30	29	0.98	0.58	0.34	0.33
N9_nwr	-	148	138	127	134	31	32	27	30	0.42	0.34	0.31	0.25
N9_wr	1/3	77	83	138	151	36	38	26	30	0.71	0.67	0.36	0.25
N3_wr	1/3	139	81	79	174	41	45	26	29	2.30	1.37	0.39	0.41
N9cast _wr	-	88	149	242	139	32	37	29	31	0.88	0.49	0.25	0.24

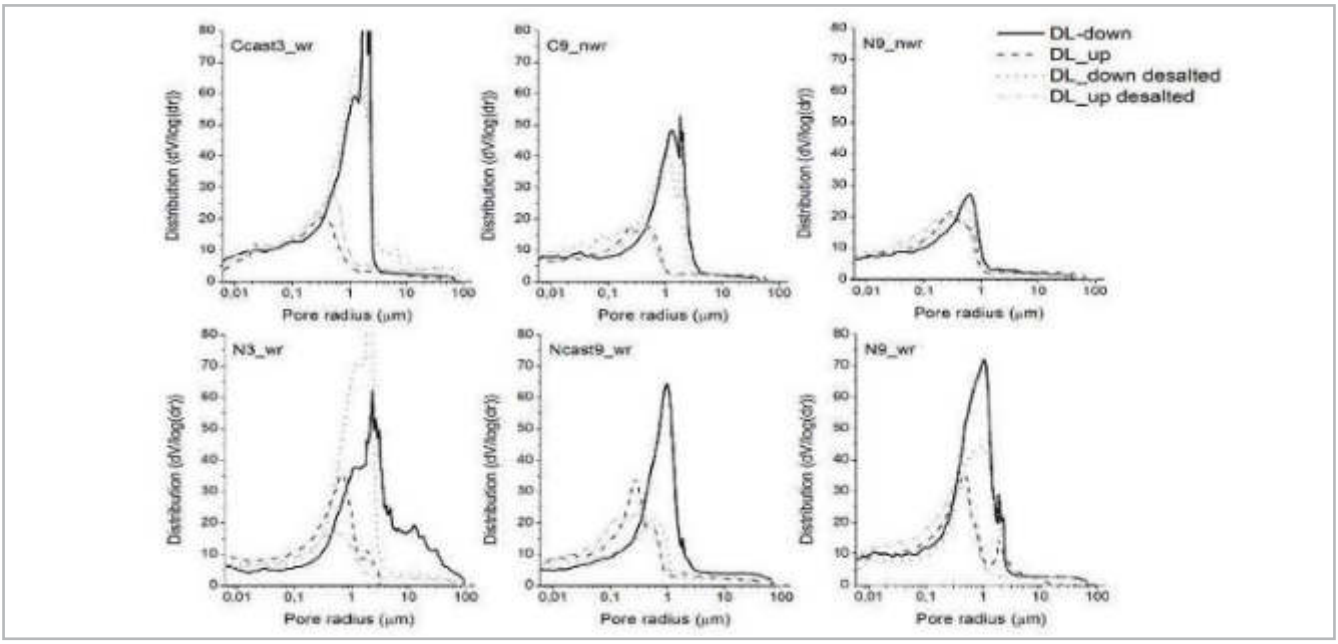

Figure 3.- Graphics of porosity radius vs distribution and of capillary absorption. C3_wr has similar structure as C9_nwr and N9_nwr as similar structure to Ncast9_wr.

In general, the lower layer has a greater porosity and higher average pore radius independently of the mixture used. Most of the specimens accumulate higher amount of salts in the upper layer or at the interface between the lower and upper layer.

In the N9_nwr series, conductivity profile shows a nearly uniform accumulation of salts in the double layer system. The total porosity of the inner layer is slightly higher explaining why the inner layer quickly absorbs a lot of water from the brick (Qi and CA values high), which is then carried outside by suction from the upper layer (slightly lower average radius pores).

In the Ccast3_wr series the lower layer has a much higher porosity than the outer one, characterized by smaller pores, resulting in a fast transport of water inside the upper layer with salt accumulation in the second one.

The C9_nwr and C3_wr show similar structure but opposite behaviour. In C9_nwr the outer layer absorbs the water quickly than the underlying layer thanks to the presence of smaller pores. On the contrary, the outer layer of the C3_wr series absorbs more slowly than the inner one because of the presence of water-repellent. In addition, the salt solution is drawn toward the outside thanks to the pore radius difference with no deposition of salts inside.

A greater porosity of the bottom layer is measured for Ncast9_wr series, moreover the presence of larger pores favors the accumulation of water and salts. The top layer with smaller pores absorbs water from the underlying layer (higher CA), while the different absorption speed promotes the deposition of salts at the interface.

The system N9_wr has a high porosity in the inner layer, with larger pores. The presence of small pores in the outer layer might be the cause of the high rate of absorption, probably for capillary suction, of the solution. Both layers have high vapor permeability and a fast drying resulting in salt accumulation over the surface.

In N3_wr the porosity of the inner layer is characterized mainly by the presence of large pores and is higher than the second layer. After desalination, there is an increase of small radius pores previously closed by salt accumulation. The low porosity and the high amount of water-repellent (0.5%) are most probably the reason for the low absorption rate and low permeability of the outer layer.

Conclusions

The results evidence that the use of recycled crushed mortars till 1/3 of aggregate allows to obtain resistant render systems, but that the correct dosage of water-repellent and air-entraining agents is fundamental. In particular, the higher percentage of air-entraining agent (0.09%) allows to obtain plasters with higher resistance to salt crystallization, whilst a higher percentage of water-repellent prevents the flow of saline solution, promoting internal salt deposition and detachments.

Based on the division proposed by Lubelli et al (2004), the studied systems can be divided as follow:

a)Salt-accumulating plasters (multilayer plaster systems with water-repellent external layer), such as Ccast3_wr and Ncast9_wr, allow the liquid solution to penetrate from the substrate, avoiding it to reach the outer surface. Salts crystallize in the plaster porous system thanks to an evaporation front located within the render.

b)Systems C3_wr, C9_nwr, N9_wr worked as salt – transporting renders. They transport the salt by advection towards the surface with the easy formation of efflorescences.. This behaviour is typical of permeable plasters.

c)Salt-blocking plasters avoid the liquid flux, water leaves the system only by evaporation, this may cause salt deposition at the interface plaster/substrate. This kind of behaviour was noticed for N3_wr leading to bodily detachments.

In general, a better resistance to salt crystallization and less degradation features were observed whenever the two render layers present different microstructure and permeability properties. Depending on the relative microstructure and water repellent properties, either there is deposition of salts within the lower layer or at the lower-upper layer interface (sacrificial renders), either with a rapid transport of salts to the surface with the formation of harmless efflorescences. When a similar structure of the two layers was observed, slow transport and deposition of salt at the brick-render interface was observed.

Future prospects foresee the application of the optimized system in meso-scale models and subsequently on real historical masonries.

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Born-digital art: documentation models as a conservation measure

Amelia Boogen Ybarra

Abstract: This article aims to present a revision of the existing documentation models for the conservation of digital and born-digital art.

It has been noted that most recognized projects, including latest ones, adjust to specific cases in order to meet the isolated needs of the born-digital art. However, models fitted to give general answers have not been found. It is imperative to revise documentation models for conservation means, due to soft- and hardware obsolescence. This is an opportunity to unify documentation and conservation aspects, which are not always reflected in them. Differing from traditional conservation procedures, often focused in keeping the work or document in its original condition, born-digital works have to be modified and altered regularly for their accessibility and intelligibility. Hence documentation plays an essential role.

Key words: born-digital art, digital art, analogical art, obsolescence, documentation models, conservation, software, hardware.

Born-digital art: modelos de documentación como medida de conservación

Resumen: El objetivo de este articulo es presentar una revisión de los modelos de documentación actuales dirigidos a la conservación de digital y born-digital art.

Del examen de los proyectos de referencia y de los modelos de documentación vigentes, se evidencia que los mayores problemas para la conservación radican en que los modelos se tienen que adaptar a cada caso específico, puesto que entraña una gran dificultad que adquieran un carácter de aplicación general. Debido a que no todos los modelos contemplan siempre la problemática de la obsolescencia de soft- y hardware así como la posibilidad de unir aspectos conservativos con documentales, queda evidenciada la necesidad de revisar y actualizar los modelos de documentación como medida de conservación.

Palabras clave: born-digital art, arte digital, arte analógico, obsolescencia, modelos de documentación, conservación, software, hardware.

Introduction

It is a fact that an iPhone bought only a few years ago and still working perfectly, today starts a mandatory obsolescence process. The Apple update iOS 8 cannot be installed on an iPhone 4, which means that the Apple developed device is going to stop being updated; in other words, Apple has decided it is about time you start thinking of replacing your smartphone.

One of the main aspects of the contemporary art is its closeness to life, including society and everyday elements. Art is highly influenced by the "digital era" we live in.

The cross between internet and computers (introduced for user level on the nineties for industrialized countries) and at present the Personal Digital Assistants PDA, (PALM, smartphone, tablet etc.) have made it possible that, on top of being an art generator tool, we take the artistic outlook towards a digital field.

We are facing new typologies linked to contemporary art:

- Digitalised art (works conceived analogical/ which were later digitalised).

- Born-digital art (since conception owes a digital existence).

- Analogical art (mixed works).

This new art, "born-digital" presents new goals and problems in relation to conservation.

The fast cycles of innovation and the short life of the technology deployed are in contradiction with durability. On top of the repairs of obsolete technology implied problem, as the difficulty to find replacements parts. In both a near and a distant future this situation will get worse.

Since the apparent infinite possibilities of "digital" have been considered as the solution for all "problems", most of all for archive, from analogical production.

It is important to distinguish between art conservation through digitalisation and digital art conservation, which is digitally codified and linked to digital procedures of born-digital art forms since its origin.

Not existing at present a documentation model which meets all the requirements for born-digital art preservation, different conservation strategies in the medium term are being combined and there are experiments trying to ensure the digital materials accessibility and recovery.

Most standardized documentation guidelines are requested in order to help in registering and archive in a sustainable and organized way the information gathered about the work.

Anyhow, a debate in the professional world is expected, to continue developing strategies to preserve the born-digital art for posterity and not only documentation about it to survive.

"*Are you born-digital? this will be the key question when it comes to preserve and maintain in the long term the art of our time.*"(Serexhe, 2013:13)

This is how Bernhard Serexhe starts his prologue on the last great Symposium publication about digital and born-digital art.

Most researchers used the term "MEDIA ART" until recently to refer to a diversity of artistic practices and works of art, which performance, was intrinsically linked to the use of accessible technologies, from the second half of the XX century.

This term is no longer useful since the born-digital art appearance.

Digitalized art, analogically developed and subsequently digitalized, does not need a program language application, unlike born-digital art.

From here on, we will speak about „born-digital-art" when we refer to digital born art.

Documentation of these works of art is a key element for its conservation and it has become the core of any conservation strategy and art preservation based in technology.

Methods and methodology

Since approximately 15 years ago, experts in the art field, research groups and different organizations, try to develop a documentation model that will consider all the distinctive features of the born-digital art, aiming to better its conservation.

What do we refer to with "document" a born-digital work? Documentation is the material that illustrates, shows, provides instructions or supply evidences of an activity, in relation with a work.

There are specific models designed to gather the required information for an accurate description. In order to keep the maintenance and care regulations and to order the work.

Some of the most pertinent aspects of documentation are the following:

Artist's intention and purposes (interviews); diagrams and technical details for the setting-up; details of the work's relocation; description of piece's behaviour; exact description; audio-visual interaction, whenever it is necessary and a description of the ideal spatial requirements.

Sources as reference publications, catalogues, migration options, updates and reviews can be useful for this issue. Most of them are developed from the "case study" and for this reason it becomes more difficult its applicability as a general rule.

The revision of the documentation models, aims to analyse the following problems to assess and how they could affect them:

- Technological obsolescence (deterioration of sensitive components; USB, CD...).

- Technological advance (new versions and software updating).

- Royalties and licences.

Conservation not only does not find its goal in digitalisation, it's just that conservation fights against its own means. In opposition to traditional conservation (guided to maintain work's or document's original condition), born-digital works have to be continuously modified and transformed so that they stay accessible and comprehensible. Documentation is one of the main foci. Digital continuous

intervention concerns not only the document but also its description and requires permanent financing.

There are four generalized (most commonly used) strategies in use: 1. Conservation of the hardware (spare parts store). 2. Migration (data transfer from one format to another). 3. Emulation (only "simulates" the original software behaviour). 4. Reinterpretation (It makes a data transfer from one storage medium to another).

Supporting devices are introduced: - by trying to conserve the largest number of models, copies and reparation pieces possible, to be able to emulate, transfer, migrate, etc., raising a kind of technology museum; - by establishing a "replication" in order to preserve digital online copies, in standard format; - by maintaining analogical items of any kind, that would impel to support them in time, such as paper, microforms, etc.: - by preserving digital archaeology which obliges us to wait for future casual selections.

Each strategy has difficulties and limitations of its own.

Migration, emulation, and reinterpretation count on 2 basic actions in relation to digital preservation that often go together: Medium Actualisation and Format Migration. We are also deep into a social phenomenon, which forces us to follow the dictates of the technological industry dynamic innovation, which is not interested in taking in account the related aspects of the developed products preservation.

Projects:

Projects have produced reference models for digital documentation.

We present some of the first documentation examples, which served to configure the documentation models we use nowadays.

The first initiative in the conservation field of Video art was launched in 1971. It is about EAI, Non_Profit_Organisation Electronic Art Intermix, which remains active.

Other ambitious projects such as OAIS, which is a reference storage model, is developed by the Consultative Committee for Space Data Systems (CCSDS), in order to provide an environment for the preservation standardization of all types of objects within the scientific range. OAIS was created aiming to be widely used for the long-term preservation of all types of objects not only digital ones. In 1999, from the New York Salomon Guggenheim Museum emerged an initiative for the Media Art and Performances conservation; the Variable Media Network. Matters in media Art; A common project from the New York MOMA, the San Francisco SFMOMA and the London TATE was born in 2003. The aim was to develop strategies for conservation and presentation contemporary art from that time, such as Video-, Film-, Audio- and systems with software base from those years: Matters in media Art collaborating towards the care of time-based media. PACKED (Centre for Expertise in Digital Heritage) is a Belgium Centre, which made the project "Obsolete Equipment", together with NIMk, (Netherlands media Art Institute, Amsterdam) about digital art conservation. The Symposium Modern Art, Who cares? was the first one to make an international call on concerns posed on contemporary art preservation, taking in account the digital art but not including at that moment born-digital art yet. Within the main results of the project we must mention the fulfilment of the International Symposium on Contemporary Art *Who Cares?* and the publishing of the book *Inside Installations* and of the documentary *Installation Art Who cares?*. Inside Installations (Preservation and presentation of Installation Art); This European research project was developed during the years 2004 to 2007. More than thirty complex installations were selected as study cases to be installed, researched and documented. The experiences shared by the associates resulted on them cooperating on the development of good practices about five research subjects; preservation strategies, the artists' involvement, documentation and storage strategies, theory and semantics, as well as the knowledge management and the information exchange. Managed by the Netherlands Institute for the Cultural Heritage (ICN), some of the participating organizations are the Tate, the Stedelijk Museum voor Actuele Kunst (SMAK) and the National Museum Art Centre Reina Sofía (MNCARS). Media Art net, a database organized by the Goethe-Institute and the Centre for Art and Media Karlsruhe (ZKM), born in association with a three volume print publication about history and aesthetics of electronic art. Rhizome ArtBase, established in 1999, is an online storage for new mediums with 2171 works of art, and it keeps growing. The ArtBase includes a wide range of projects of artists from all over the world who use materials such as the software, websites, motion images, games and browsers for aesthetics and for critical purposes. DOCAM; The project, "Documentation and Conservation of the Media Arts Heritage", comes up in 2005 from the Daniel Langlois Foundation for Art, Science, and Technology. They start International research alliances focusing their activities on works of digital, electronic and technologic art conservation, up till 2010. Virtueel Platform Research: Born-Digital Kunstwerken in Nederland, the scientific publication aims to analyse and report about the digital art conservation singularities in 2012. Digital art conservation: We found some information about the last great conservation project for Digital art, which took place in Germany and lasted three years. This project aimed on the first place to document and catalogue the Upper Rhine Valley digital art collections and on the second place to contribute on international debates about the digital art preservation. Berkeley Art Museum And Pacific Film Archive: The museum initiated a consortium with the aim of store, document and preserve media art, as well as to discuss strategies for digital art conservation. The Guggenheim Museum and the Franklin Furnace Archive are some of their associates for this project. IMAP: Independent Media Art Preservation (1999) is a service non-profitable organization committed to

preserve non-commercial electronic resources. IMAP offers an on-line resources guide for media art exhibit, collection and preservation, from their New York headquarters. ZKM: Zentrum für Kunst und Medientechnologie, since 1999, under professor Peter Weibel's direction, explores theory and practice of new resources and analyses critically, by means of different projects (study cases), the role that new art practices play in the information society. Netherlands Media Art Institute: from the beginning in 1992, as a Media Art preservation expert Centre, it develops new preservation methods and researches the video art, installations and performances preservation. Also INCCA, the International Network for the Conservation of Contemporary Art, which is a net of professionals related to modern and contemporary art preservation. It is formed with conservators, curators, scientists, art historians and researchers who share unpublished information from artists' archives via a database, have seen the light since then.

Documentation Models

Some of these documentation models present specific tools for technological art, some others have a holistic approach (properties which must be analysed as a whole), often related with efforts on the preservation, collection or cataloguing fields.

The most relevant documentation models, which therefore have been object of study on our research, are: the tools and models of the DOCAM; This documentation models, provides with a frame that enables us to organise the global information about a work, by concentration, categorization, and accessibility. VMN; The researches on the sphere of the Variable Media Network have enabled a concept of a methodology and the production of some tools serving to identify what is potentially variable in a work and what is not. QMV; Variable Media Questionnaire: Unique and unprecedented elaboration of a work documentation via an invitation (to an artist or to a person with an important experience with the matter work), to answer a number of questions about the work purposes. The documentation system MANS; Media Art Notation System: This is a concept mode with directions to distribute the work information, which is very influenced by the previous ones and by the CMCM (Capturing Unstable Media Conceptual Model), which offers a strict and articulated documentation structure. And the models of INSIDE INSTALLATIONS carried out the development of a documentation model and a method to document illumination, sound and movement. MATTERS IN MEDIA ART; it provides with preservation tools and museology resources for the technologic works.

The selection of documentation models is displayed in a way that can be understood how they affect one another.

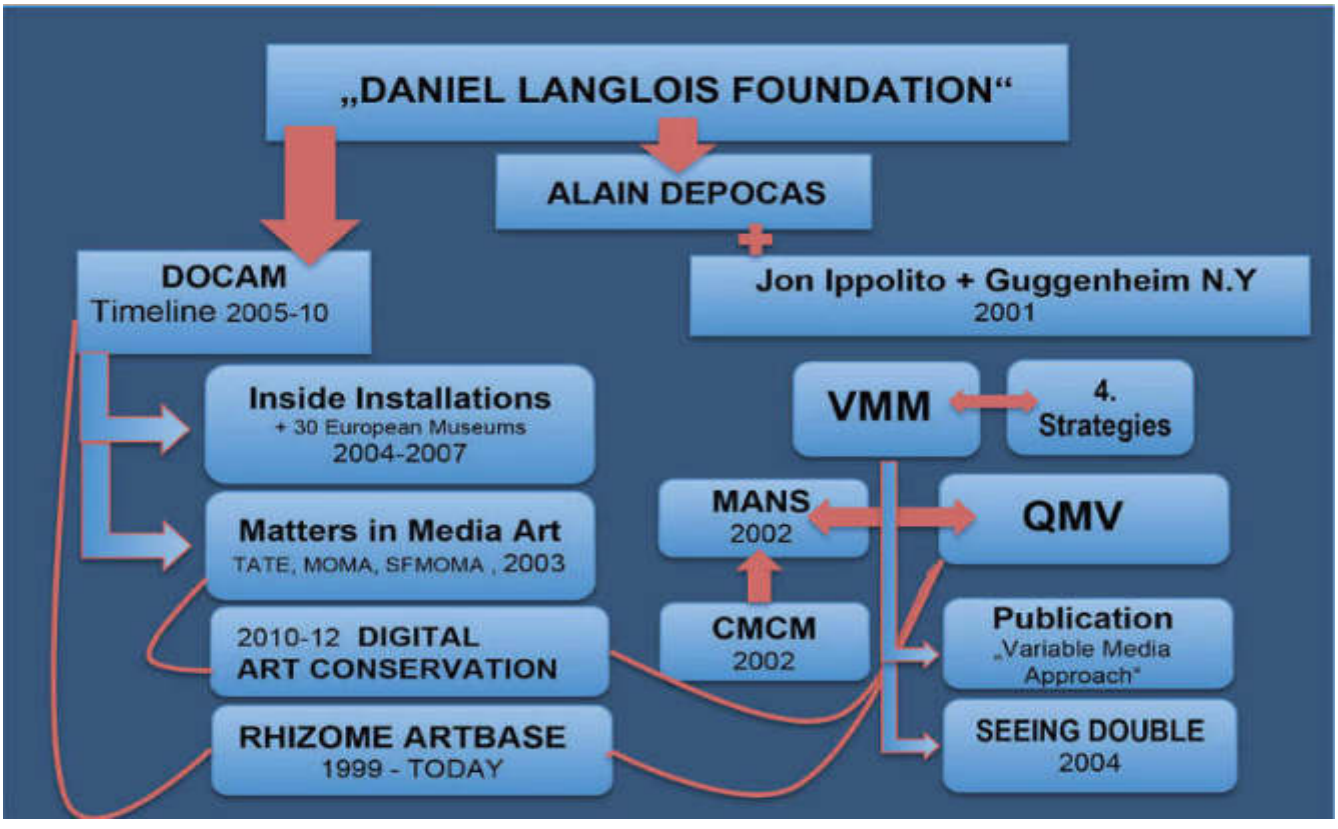

Figure 1.- Studied Documentation Models. Amelia Boogen©.

The Langlois Foundation plays an important role launching by means of Alain Depocas, (director of the Foundation Daniel Langlois Research and Documentation Centre; CR+D since 1999), the DOCAM project creation, under which, Depocas creates Timeline.

As such, he is responsible of the documentary collection, which includes the history, works and practices related with the media, electronic and digital Arts. He has also developed a database to manage the collection and other data within the CR+D scope of interest, such as the technologic art, and he is the Fundación Daniel Langlois website editor. Between the years 2005 and 2010 he has run an ambitious research project about documentation and conservation of the media art heritage (DOCAM), in which frame several tools and resources have been produced, as a chronologic line of technologies and a documentation model adapted to technological art.

The Variable Media Network (VMN) arises from the cooperation of Jon Ippolito and his New York Guggenheim Museum colleagues, together with the Foundation Daniel Langlois and they develop the Variable Media Questionnaire (VMQ).

They develop also a publication named "*Variable Media Approach; Permanence trough Change*" and organize in 2004 the exhibit "*Seeing Double; Emulation in Theory and Practice*".

Richard Rinehart creates the Media Art Notation System (MANS) and it is highly influenced by the Variable Media Questionnaire and by the Unstable Capture Media Concept Model (CMCM).

The Inside Installations documentation models are developed working 30 European Museums together, under the Netherlands Institute For Cultural Heritage (ICN) direction, in Amsterdam, and they take many references from the DOCAM model.

The models developed by Matters in Media Art, emerges from an European-United States cooperation, where the Tate Modern of London, the MOMA, the SFMOMA take part, as well as the project manager, the New Art Trust, developing quality tools by means of well known art experts cooperation.

Regarding the critical analysis of the revised projects and models we can confirm that de lack of applicability still exists. Conclusions evidenced that methodology constantly has to be modified to overcome the differences of each single case.

Two more projects develop new proposals of documentation models and solutions. They are Digital Art Conservation and data base ArtBase.

During the development of the project "Digital Art Conservation" (2010-2012) led by Bernhard Serexhe issues related to conservation of digital art were analysed from 2 points of view: one theoretical and one practical.

The theoretical standpoint settled the bases for the correct documentation of born-digital art, while the practical perspective helped to develop a new practical documentation model according to the analysed cases.

Guidelines from the reference models were applied into the production of one of their own and specific for born-digital art according to their study cases.

The data inclusion into the template to properly register the hard- and software features is one of his contributions to the born-digital art documentation.

The use of a free software (Open Source) distributed and developed over a XMind program (which is similar to Dropbox), allowed them to carry out an interactive, interdisciplinary and upgradeable archive work.

The Rhizome ArtBase data base lead by the curator Ben Fino Radin, is at the cutting edge of born-digital art data storage with preservation purposes.

They suggest universal access to their archive, as well as its active maintenance to boost its dissemination and the mitigation of obsolescence. The respect towards the artist's intention is a direct extension of the principal company values of ArtBase, to support and promote art that is engaged with the emerging technologies.

ArtBase highlights 3 important risks facing conservation; dispersion (data base and works located in more than one place or platform), data obsolescence (works that acquire contents from other sources have to perform the same changes and updating as the selected source) and physical degradation (degradation of any physical element holding digital information).

The source code preservation (the instructions a computer has to follow in order to run a software program) impels to constant recreation. The use of automatic scripts is added to their conservation methodology (to detect the links that are no-more working) and the crowdsourcing (collective work to detect failures caused by the users).

Conclusion

Despite all the group of researchers that work around the development of born-digital art conservation models effort, everything is pending of a greater international consensus.

It has been recognized that a major problem for conservation resides in having to adapt the documentation models to each specific case, as it entails a large difficulty for them to acquire a general guideline.

Additionally it can be remarked that not any documentation model proposes neither alternative, in relation to the obsolescence shown on the items (hard discs, DVD, USB...), in which the data obtained under their guidelines has been stored. Nor do they indicate what type of operating software system would be more appropriate.

We share the opinion that, the software's obsolescence solution could include the creation of a legal model supported by computer tools, to simplify the distribution and use of public domain contents.

We also want to advise that the "dispersal" ArtBase points out as one of the 3 threats for the conservation of born-digital art (it has implied the constant update to go along with the contemporary technologies, creating separate copies and leaving the original archive online untouched and reachable) can be related with the warning that copy and original are practically identical.

In the migration (data transfer from one format to another) of born-digital art in particular, it is necessary to make copies, modifying the originals partially or totally.

Therefore it is basic the agreement with the author to carry out these measures of conservation in order not to commit an offense.

In relation with intellectual property and licences framework, it must be noted that born-digital art more than any other artistic typology goes closely linked to the different legal aspects that concern them, like the intellectual property or the licences.

In the same way we consider that in order to reach the aforesaid sustainability, plans to reduce the creativity legal barriers should be continuing being developed by means of a new legislation and new technologies, facilitating the distribution and the use of contents for freeware (Freeware: it is understood the situation in which the art works, including computer programs, remain when the period of copyright protection expires).

In fact currently purchases are made based upon the format obsolescence -hardware and software – (Free software, is the name for the software that respects the freedom of all users that purchased the product, and therefore, authorise them to make any use of it) and the "rights" handed over or not to the institutions/collectors in order to be able to transform/update the work to ensure future accessibility.

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Degree in Fine Arts 1997 from the Basque Country University (UPV/EHU) where I specialised in in Conservation and restoration of Cultural Heritage having carried out since then this activity. Master Degree in Conservation and Exhibition of Contemporary Art (CYXAC). I received the award for the best student of Master 2014, UPV/EHU. I am currently a pre-doctoral fellow of the University of the Basque Country – UPV/EHU. From 2005 on I have coordinated it with teaching Arts and Ethics at the German School of Bilbao, -Deutsche Schule Bilbao- being head of arts department. I am also the coordinator of German as specific language (DFU) in the German School of Bilbao. Over these years I have continued my permanent formation in German, having achieved Certificate C2 from the Goethe Institute in Frankfurt as well as SEK II coalification in Arts, which permits me to examine German high school diploma (Abitur). Through my participation in a great number of restoration forum as GEIIC member and taking part in restoration projects with other companies I am continually on the job training.

Work experience: I have regularly collaborated with business of art restoration in Bilbao and Cantabria since 1999. This is how I have acquired knowledge in skills and specific treatment for modern and contemporary works of art, using equipment's of specialised technology as the suction plate and the realization of scientist analysis for the study of the works of art. All this work has allowed me to work as teaching assistant in several methodological courses, organised by the Institute of Cultural Heritage of Spain (IPCE) dependent on the Ministry. At present I accomplish the documentation of contemporary works of art as a preventive measure of conservation.

Ge-conservación
Conservação | Conservation

Conservation and restoration works of the Four Sewers Fountain in Daganzo (Madrid, Spain)

Vanesa García Alcocer, José Juste Ballesta, Elsa Soria Hernanz

Abstract: The paper's field focuses on the Restoration of the Four Sewers Fountain of Daganzo and the improvement of its immediate environment, linked to the Plan of Fountains and Historical Gardens of the Regional Government of Madrid.

Historically, this element has been a reference at a territorial level, being part of troughs net and cattle trails for livestock, besides urban scale, serving public utility and point of drinking water supplying for the village.

The intervention has had a dual purpose. On the one hand, monument's enhancement, recovering the original presence of the Fountain, altered after paving works of the square in 1985, which left it half-buried. On the other hand, recuperating the memory of the laundry, demolished on the same date, making it the main character of a new public space created around the pylon, which recovers its social role as meeting place for neighbors.

This process has benefited from a deep archival previous research; documentation, conservation and display of archaeological remains discovered; and a thorough restoration work to return its values to this Cultural Heritage Property.

Key words: Restoration, Conservation, Architecture, Fountain, Limestone, Daganzo, Madrid.

Obras de conservación y restauración de la Fuente de los Cuatro Caños en Dagando (Madrid, España)

Resumen: El ámbito de la comunicación se centra en la Restauración de la Fuente de los Cuatro Caños de Daganzo y el acondicionamiento de su entorno inmediato, que se engloba dentro del Plan de Fuentes y Jardines Históricos de la Comunidad de Madrid.

Históricamente, dicho elemento ha sido un referente tanto a nivel territorial –formando parte de la Red de abrevaderos y Vías Pecuarias para Ganado–, como a escala urbana, sirviendo de lavadero público y punto de abastecimiento de agua potable para la villa.

La intervención realizada ha tenido un doble propósito. Por una parte, la puesta en valor del monumento, recuperando la presencia original de la Fuente –alterada tras las obras de pavimentación de la plaza en 1985, que la dejaron semi-enterrada–. Por la otra, rescatar la memoria del lavadero –demolido en la misma fecha–, para hacerlo protagonista del nuevo espacio público creado alrededor del pilón, que recobra su función social como lugar de encuentro para los vecinos.

Este proceso ha contado con una profunda búsqueda archivística previa; con la documentación, conservación y muestra de los restos arqueológicos descubiertos; y con un minucioso trabajo de restauración para devolver sus valores a este Patrimonio Cultural Inmueble.

Palabras clave: Restauración, Conservación, Arquitectura, Fuente, Piedra caliza, Daganzo, Madrid.

Preamble

This paper provides information about the restoration and the process of improvement, enhancement and proposals done on the Four Sewers Fountain of Daganzo. As part of the *Plan of Historic Gardens and Fountains*, belonging to the Community of Madrid, this is one of the 583 fountains and 84 gardens (Aymerich 2012) listed.

The restoration is part of a collaboration program signed between the Technical University of Madrid and the Community of Madrid through its General Directorate of Cultural Heritage. This program eases the students from the Master of Conservation and Restoration of Architectural Heritage to get proffesional jobs in the historic heritage field, so to get further training and field experience.

The plan includes a close following from the General Directorate, that collaborates by connecting different agents such as these enthusiastic novel Architects with construction companies or experienced technical architects they invite to bid.

This double approach guarantees an appropriate final result of the works as it merges experience and know how together with eagerness dedication and the wish to implement the lessons learnt along the Master. Besides, the experience acquired by the new architects is a remarkable issue from several points of view: management, budgets and several Administrative levels: local, regional, and even state level in some cases.

Other plans under the direction of the Community of Madrid are working with this management model, too, such as the *Plan of Bridges* or the *Plan of Visitable Sites.* In other cases, the orders aim to focus on different tasks, not linked with heritage restoration only, but having to do with documentation, investigation, dissemination and cultural heritage of Madrid better knowledge; for instance: exhibitions, planimetries, historical or characterization studies, publications, preparation of museological installations, and more.

Historical-geographical context

To understand the restoration process done in 2015, a deeper description of the relevant role of water in the heritage of Daganzo is required.

— Territorial connection

The Henares valley, where the Four Sewers Fountain is located, is an area rich in groundwaters, and they have historically been used to hold human populations (Aymerich 2012).

At a territorial scale, this fountain is linked with the Via Pecuaria Galiana, as it belong to the Watering Places System, used for cattle; at a urban scale, it is a basic structural element of the development of the human settlements around (Lorenzo 2009).

— Historical evolution

It is a functional element that evolved in phases: two pylons were built at a first stage, one for population and one for animals. The later addition of a two-sink laundry downstream the original one server dor optimization of the water. Lastly, laundry labour conditions were improved by the addition of a shelter.

More than a pure utilitary construction, the Four Sewers fountain used to be a meeting point around the water supply: a symbolic and valuable resource that was an essential part in the daily living, so, this area was a hub for the community feelings and exchanges, a milestone with strong social interaction (Ruiz-Bedia 2011).

Early stage description

This part describes the stage of the fountain and its inmediate surroundings prior to the restoration labours [figure 1].

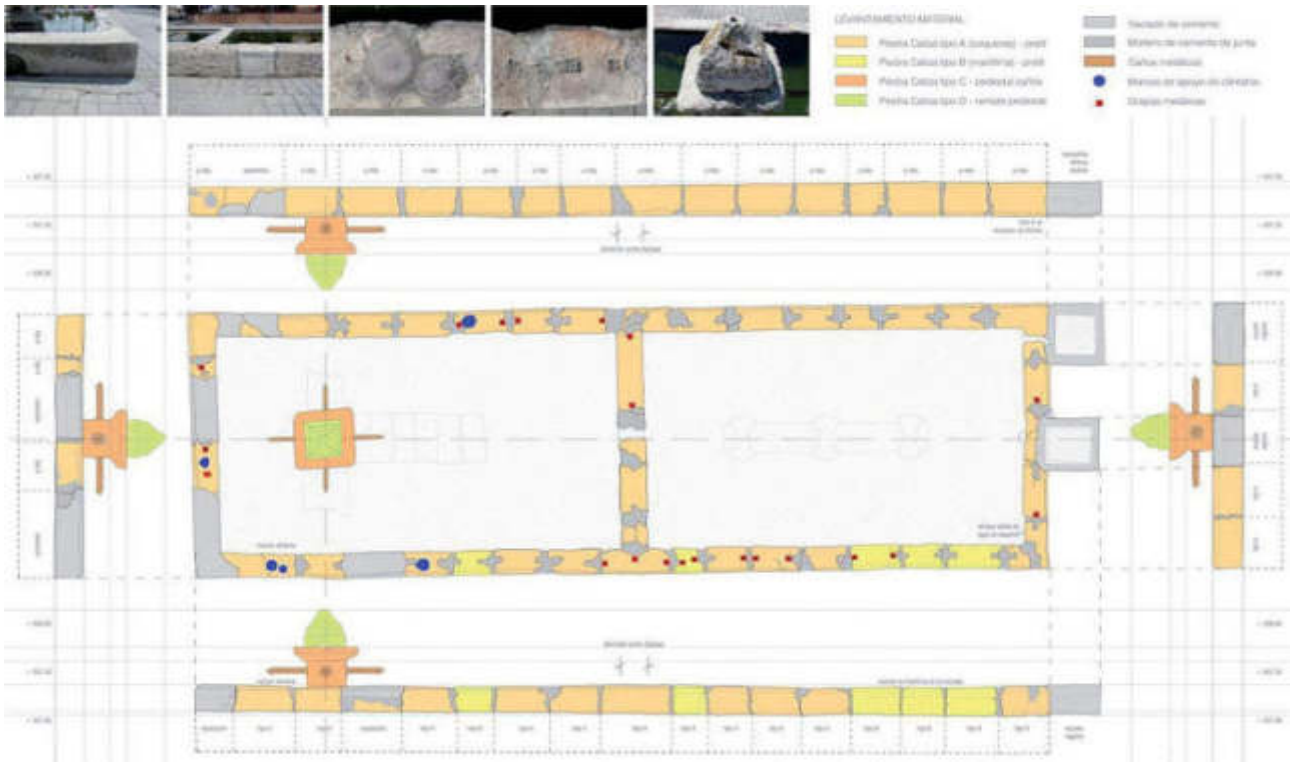

Figure 1.- Constructive analysis of the initial stage of the fountain (2013).

— *Geometric analysis*

The construction is made of limestone blocks, and it is composed by a central body with a square pedestal of 40 centimeters that holds a pyramidal shaped finishing piece on top. A long sewer emerges from every of its four sides, and they pour the water into a two sinks pylon. The perimeter of the parapet is 2.75 by 8.40 meters, made of limestone, too. The blocks used to build it are 26 cm width by 75 cm height and variable length, with chamfered corner edges.

The body used for laundry was placed towards it, inside a 9 x 6 m shelter made of masonry walls with a wooden structure gable roof. Both do not longer exist nowadays.

— *Constructive analysis*

- There are two limestone types: class A, wich is darker, with hollows and more abundant; and class B (pieces 09, 13, 17, 18 and 19), less frequent, of a lighter colour and a special texture got by small hammer blows, that are the ones suffering a more severe level of damages such as alterations, disgregations and efflorescences. Even though the reasons of the use of these two types are not clear, it seems the second type was used during a later restoration works, that consisted of a replacement of the original –but damaged– class A pieces by newer class B blocks.

- Pyramidal finishing element on top of the pedestal is a movable cover, for inspection of the inner water conduits, that may belong to the fountain from its very begginning or be part of a later addition. So, its top component, maybe a ball, is lost and left a hole only.

- The lead of seventeen staples remain in place, linking the top part of the parapet blocks.

- There are hystorical traces worth preserving, such as abrasing marks due to animals action while drinking, or due to ceramic jugs continuously placed towards the sewers during the refilling (Velasco 2007).

- Original water drainage went through a corner spillway, that is no longer used. Two newer spillways were added laterly: one is at a lower height so to connect to another close fountain prior to pour the water onto the stream; and another one connects to the local sewer system.

— *Pathological analysis*

Four main conlussions were obtained from the pathological studio:

- First of all, there was an incompatibility between the cement-based materials and the limestone ones, since cement is chemically attacked by the so abundant sulfates of limestones, which transform the cement soluble compounds into bigger crystals that break the inner structures and result into an brittle, whitish appearance and progressive cracking that decomposes it.

- The limestone carbonation process results in its dissolution. This stones are rocks composed of calcium carbonate ($CaCO_3$) and are impermeable and insoluble in water under normal conditions. However, if the water contains CO_2, this carbonic acid (H_2CO_3) attacks the limestone, forms calcium bicarbonate $Ca(CO_3)_2$ and decomposes the rock.

- The different types of limestone suffer different pathological processes: class A has hollows or cavities on its surface; class B pieces are affected by processes of desquamation; and the pyramidal stone of the top finishing is being attacked by orange lichens.

- The elevation that is more affected by filtration humidities is the North one, due to a constant leak and no direct sunlight. As a result, efflorescences and biological colonization appear. However, smaller leaks and abundant direct sunlight in the southern wall produce little and punctual efflorescences, so as widespread dirt.

Preliminary investigation

As part of the intervention methodology, a thorough preliminary investigation was carried out in order to establish the guidelines to use during the project. The main conclusions of these analysis are summarized below:

— *Historical documentation study*

Its origin is uncertain, although it could have been built between the late sixteenth century and the first decades of the eighteenth century. There are references on a water supply source dated 1579 (Ortega 1918) and in 1847 (Madoz 1845). In 1985, a refurbishment of the square around the fountain was done, and it consisted of a complete dismantling of it all and the demolition of the laundry area. A concrete slab was built below the fountain and the pavement around changed: a new level, 50 cm higher, left the fountain half-buried and it lost its proportions, so the parapet looked smaller. The result: an isolated area, almost non-accesible due to the continuous traffic around and the lack of use.

— *Petrological analysis*

Analysis and previous tests were conducted to find the leakages causes and to determine the actions to be taken. They consisted of: visual inspections, water absorption tests, infrared thermographies, petrographic analysis, ultrasonic surveys and surface hardness determination by rebound permeability measurements (Fort 2013). The results lead to agree on the good conservation of the limestone blocks, not as much of the mortar joints, that had to be replaced.

— Archaeological excavation

The archaeological excavation resulted into the discovering of important remnants of the old laundry brick construction, together with the original cobblestone boulder set around the pylon and the original slab foundation, made of stone (Mendoza 2014). So, team proceeded to study, document and integrate it in the restoration project [figure 2].

Figure 2.- Comparison between the archaeological excavation and the final restoration.

Purpose and objectives

There are three main purposes that guide the intervention: The first one is to recover the image and scale of the fountain, reverting the paving intervention in 1985 that left it half buried [figure 3]. Secondly, rescuing the memory of the demolished laundry by marking its footprint on the new pavement above the remains of the foundation found during archaelogical excavation. Finally, pylon and surroundings conditioning, so to get an accesible, agreable meeting point for the village citizens that comes back to its original function.

Therefore, intervention strategies were: reducing the ground level to its initial, lower level, that got the parapet and the pedestal of the sewers to go back to their original height; and generating a public square around the fountain and the laundy area.

The general criteria applied were:

- Compatibility between the old and the new through the remains reinterpretation.

- Integration: global unity as a whole, but interventions are differentiated in the detail scale.

- New elements are clearly separated from the remains by their modern design. Thus, the contributions can be easyly read.

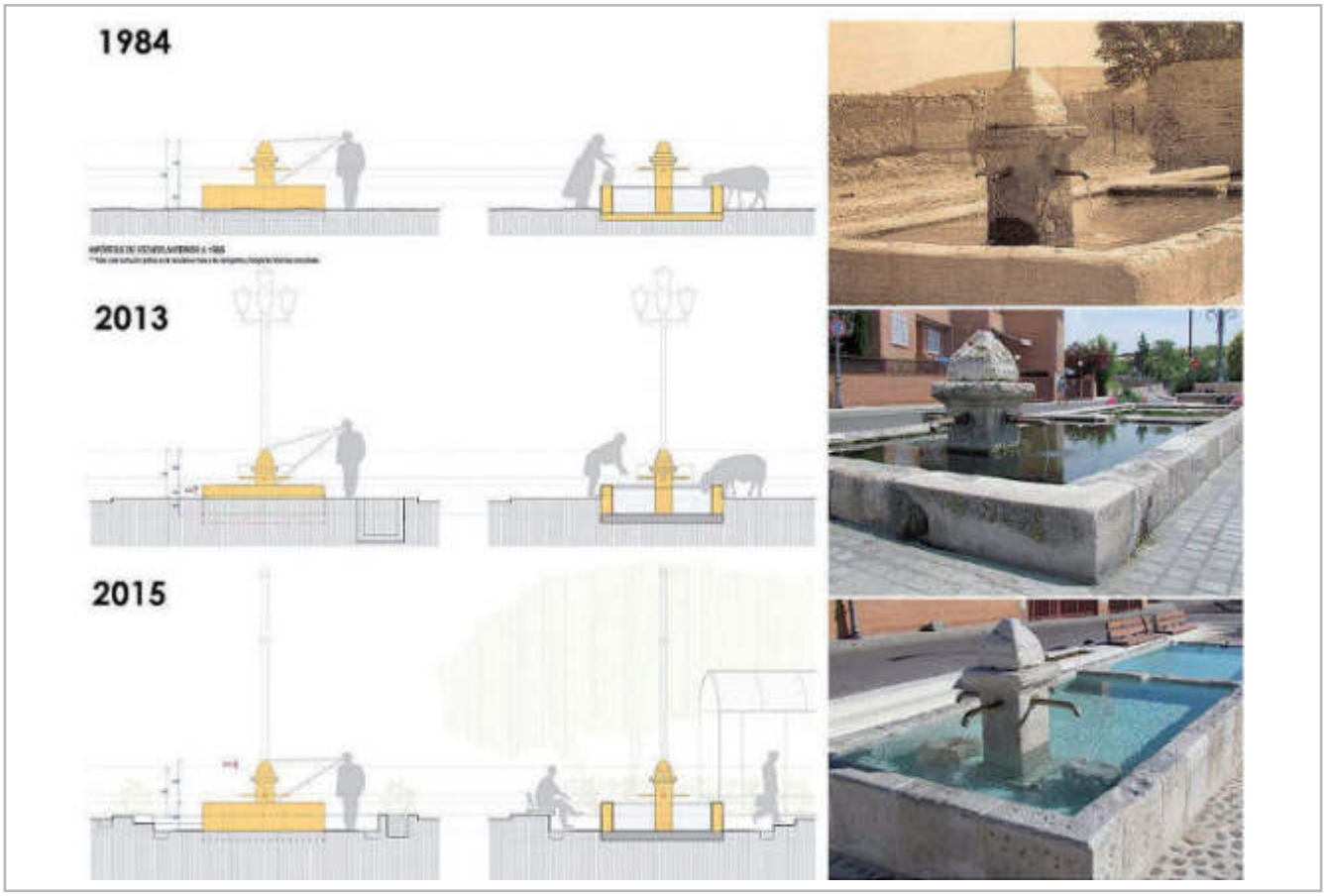

Figure 3.- Analysis of conditions into three periods: before 1985, from 1985 to 2015 and now.

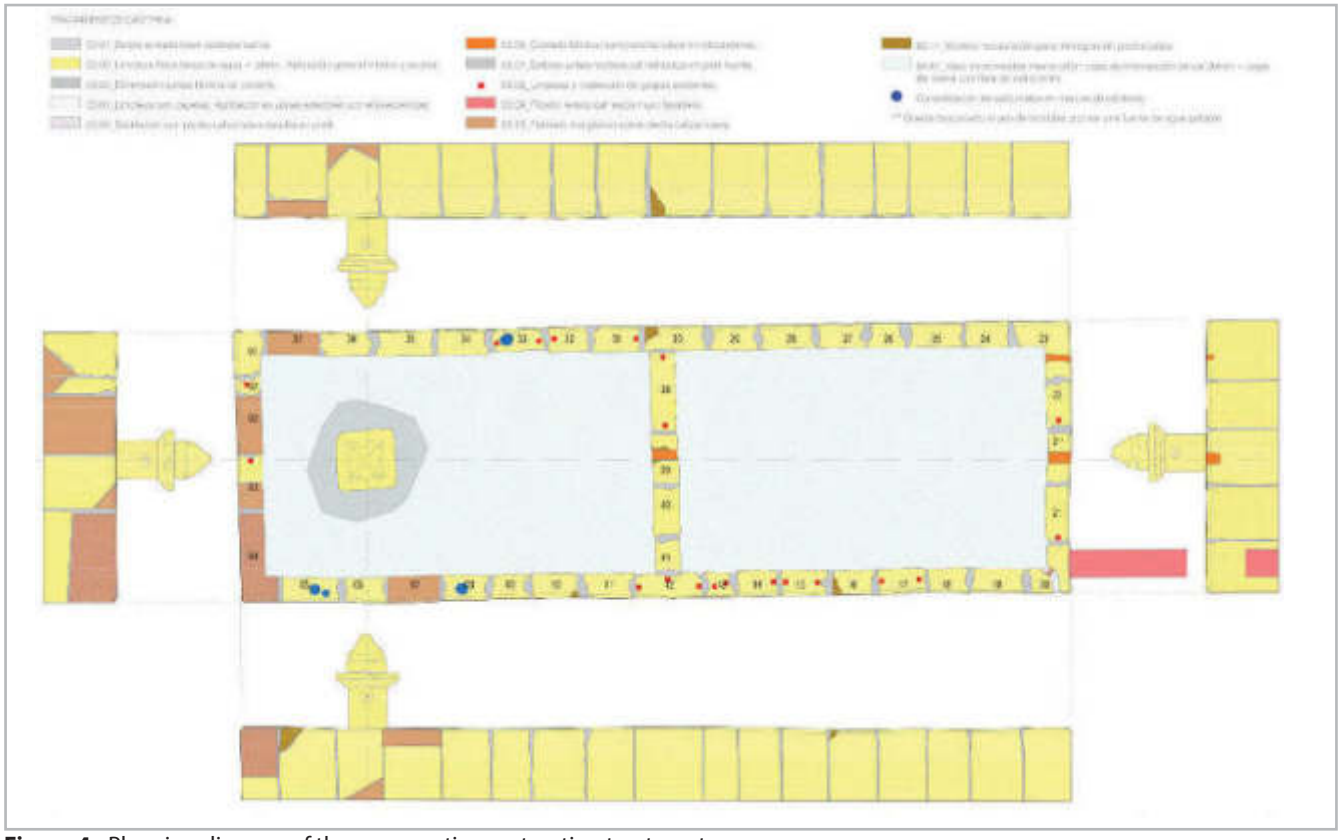

Figure 4.- Planning diagram of the conservation-restoration treatments.

- Integration of facilities on the ground and onto the perimeter wall, so to get a clean view of the historical object.

- Conservation and protection of the original remains.

- Proposal for future urban intervention, based on a partial pedestrianisation of the square to make it larger and reduce its exposed sides to traffic.

Conservation-restoration treatments

Aware of the importance of the fountain, the methodology considered its documentary, architectural and significan nature values. The role of the multidisciplinary team was crucial, as all actors intervented, decided and valued the different options and treatments to get to an agreement. All these treatments were tested in small parts of the fountain and valued together before its complete application. The most relevant restoration works were [figure 4]:

- Cleaning process main objective is the preservation of the good, in order to get a real view of current situation and prepare stone for the subsequent treatments.

Intervention process started with cleaning probes to support method election based on the premises exposed in the Project, as follows: that cleaning effect shall be slow enough to allow restoration staff to control its effects, that the method shall not generate dangerous by-product that could affect the stone; and that severe abrasions, microfractures or surface modifications shall not be produced.

Mechanic cleaning process consisting of white aluminium oxide micro-projection was finally chosen as the most appropriate method. The equipment used for this purpose was a mini-abrasion machine, model CTS Art 100, able to work at low or very low pressures so as to use a wide range of outlet nozzles, that were used according to the characteristics and thickness of the layer to be removed.

- Substituting cement for limestone and/or mortar [figure 5]. Once cleaning process was over, it was possible to check the state of old Portland mortar additions, in order to evaluate removal steps and techniques to use. This procedure consisted of mechanic manual elimination prior to its substitution, done using limestone pieces and lime mortar.

The material used for the purpose of the volumetric restoration was based on size and stresses to resist analysis. Hence, bigger volumes were substituted by limestone mortar prostheses and smaller ones were replaced by lime mortar reconstruction.

- Replacement of cement mortar joints. Traditional mortars are based on lime, but it has been continuously replaced by Portland mortars in recent interventions.

This is the case of the Four Sewers Fountain in Daganzo. The use of this new products has led to unfortunate consequences in the fountain preservation: first of all, Portland mortar is less porous, less elastic, harder, has a different thermal and mechanic behaviors; besides the high content of soluble salts that may crystallize in the stone material. Therefore, it was necessaty to remove it all and subtitute by lime mortars.

Figure 5.- Restoration details: substituting cement for limestone and pylon waterproofing; discovery of the primitive spillway corner; conservation and protection of the original remains; new sewers made of brass as per the primal design.

Figure 6.- image of the intervention in the Fountain Square (2015).

The new mortar to replace the cement-based one was made of lime as binder and river sand of different granulometry.

Plaster lime was chosen instead of hydrated lime in power due to a better cohesion of the mix and its adhesive capacity to the stony surfaces. Powder hydrated limes have a worse performance in terms of bonding capacity, due to preparation process: calcium hydroxide crystals are not correctly formed and carbonation process has already started in the storage bags (Fratini 2014).

- Pylon waterproofing. This is a major problem, frequently found in historical fountains. Some procedures prevail waterproofing against stone material preservation, and resisns are massive and indiscrimate applied on the stone, regardless impairments. In our case, a long term view led to plan a future reversibility of the treatment: final solution consisted of including a layer of intervention between the stone and the waterproofing, thus it can be easyly removed if required, without affections on the original stone.

The layer composition consists of aerial lime and marble powder plaster, left for weeks to make sure carbonation process was correct. Then, an acrylic primer (Acril 33) was applied for a double purpose: union layer and a reversibility guarantee thanks to its thermoplastic behavior. Lastly, waterproofing of the pylon was done by means of polyurethane resin (five layers) and two superficial layers of marble powder and limestone to get a similar surface appearance to the original fountain lime blocks.

Results of the intervention

Firstly, this intervention in the Four Sewers Fountain brings the original proportions back to its initial stage. The collective memory and social role of historical elements like the old laundry have been recovered, too.

What is more, thanks to the actions fostered by the General Directorate of Cultural Heritage of the Community of Madrid, this urban space has been regenerated: intervention treated the close environment, included new social uses and integrated new requirements such as urban facilities in a discrete way. To sum up, it got a full equiped and interesting social area around the fountain as prime character [figure 6].

Lastly, in order to bring the intervention close to citizens, an exhibition entitled "Fuentes de Daganzo, aguas con historia" was prepared by the architect V. García, the Daganzo City Council and the Daganzo Municipal Archive for dissemination purposes and in collaboration with the Community of Madrid, in the Culture House of Daganzo from the 4th to the 28th of February 2015.

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Nanostructured coatings for the protection of textiles and paper

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Abstract: Conservation environment with high humidity content or exposure to liquid water are directly linked to degradation of cellulosic materials, such as paper and fabrics. This research had as main objective the development of formulations based on two water-repellent products commercially available: a fluoroacrylic co-polymer and a polydimethylsiloxane. The purpose was to test their applicability to paper and textiles, both ancient and modern. Different analytical techniques have been used: FTIR-ATR spectroscopy, colorimetric analysis, observations by SEM-EDX and light microscopy, contact angle measurement and mechanical strength. Applications were carried out by spray and immersion achieving a systematization of the method and the choice of non-toxic solvents. Two of the four formulations tested were prepared with the addition also of silica nanoparticles. The results highlighted the compatibility and effectiveness of fluoroacrylic polymer with low nanosilica percentages applied by immersion.

Key words: textiles, paper, water repellence, protectives, coatings.

Revestimientos nanoestructurados para la protección de tejidos y papel

Resumen: Altos porcentajes de humedad o el contacto con el agua son las mayors causas de deterioro de los materiales celulósicos, como papel y tejidos. El objetivo principal de esta investigación es el desarrollo de film protectores en función de dos productos comerciales hidrófugos: un fluoruro de copolímero acrílico y un polidimetilsiloxano con la adición de nano-sílice. La finalidad es verificar la aplicabilidad sobre papeles y tejidos tanto antiguos como contemporáneos. Se han utilizado distintas técnicas analíticas: espectrofotómetro de infrarrojo FTIR con ATR, análisis colorimétrico, observación con microscopía óptica y electrónica, medida del ángulo de contacto y de la resistencia mecánica. Los productos se han aplicado por medio de spray o inmersión con adecuada sistematización del método y elección de disolventes a bajatoxicidad. Los resultados demuestran una buena compatibilidad y eficiencia de los productos fluoroacrilicos a bajo porcentaje de nano-sílice de inmersión.

Palabras clave: tejidos, papel, hidrorrepelencia, protectores, recubrimientos.

Introduction

High humidity or direct contact with water are the principal causes of degradation for cellulosic materials, as textiles and paper. Acid and basic hydrolysis are, in fact, promoted in presence of water, involving the breakage of the glycosidic bonds and resulting in deterioration of cellulose. Fibres swelling is another consequence of water exposure, which causes internal tensions. In addition, high relative humidity environments may promote also the development of microorganisms such as mildew and bacteria (Eastop and Timar-Balazsi 1998; Roberts 2006).

According to literature, many hydrophobic coatings have been proposed to protect textiles and paper from the action of water and several researches have been undertaken to find effective formulations. Carboxylate-alumoxanes sol-gel (Kiuberis and Tautkus 2005), titanium dioxide nanoparticles (Daoud et al 2005), modified copolymer lattices (Samyn et al. 2010) are only few examples among the many products proposed for the conservation of historical cellulosic materials.

In this research, four encouraging formulations based on water-repellent products present on the market were tested. The purpose was to examine their applicability for the conservation of specific cellulose substrates (paper and textiles) taking into consideration that in the field of Cultural Heritage conservation some necessary requirements have to be met, such as physico-chemical

and aesthetical compatibility of the treatments with the substrates (Pertegato 1993; Lorusso 1996). Four formulations have been investigated. Three of them were made of fluoroacrylic co-polymer diluted in ethanol, eventually added with hydrophobic silica nanoparticles; the fourth was based on a polydimethylsiloxane diluted in ethyl-acetate.

Methods & methodology

Cellulosic samples used during the experimentation were three types of paper and four textiles. They are described in detail in [table 1].

Four distinct formulations were developed to be applied on the samples; they are also illustrated in [table 1]. Considering environmental impact and consumers' health, two solvents were chosen for their low toxicity: ethanol and ethyl-acetate.

Aiming at comparing well-founded methods used so soon for textile and book preservation, both spray and immersion were performed to apply the formulations (Mazzon et al. , in press). A constant volume of 8ml of each formulation was sprayed with an airbrush on a set of 3 replicates of each substrate (5x5cm2), 4ml on one side and the rest on the other side. T4 and T5 specimens were sprayed only on the side which did not present the preparation layer. Immersion treatment implied the dipping of each sample for 30 seconds; the solution was replaced every six samples. Both the application methods foresaw a two-hour-curing phase at 60°C.

Aging tests were carried out to check the formulation stability. After being treated, a selection of specimens underwent artificial ageing. The test was performed by using solar lamps (500 hours at circa 8500 lux, 280-400nm) to monitor eventual polymer degradation.

To estimate the treatments' efficacy, specimens were examined by visual observation, optical and electron microscopy (DINO-Light Digital microscope; SEM JEOL JSM-6490LA), colorimetric analysis (Konika Minolta CM-2600d) (Feller 2001) and spectroscopic analysis (Thermo Nicolet FTIR with ATR Nicolet Nexus Smart Orbit, 4cm^{-1} resolution, 64 scans, 4000-400cm^{-1}). Physical properties' changes were estimated by wettability measurements (static contact angle by a Dataphysics Contact Angle System OCA15EC) and tensile strength assessment (Maximum Load and Young's Modulus values by uniaxial tensile tests on dog bone-shaped samples of 25mm length with an Instron3365 dual column extensimeter). In particular, the determination of the Maximum Load provides a measure of the force necessary to break the specimens. Young's Modulus measures, instead, the specimens' deformation, providing information on stiffness or flexibility: higher Young's Moduli correspond to higher stiffness. Hygroscopy behaviour was studied (NORMAL ISO 12571:2013) to analyse the moist retention capability of the fibres in different humidity conditions (RH 60% and 80%), while water vapour permeability (DIN52615, 1987) helped to establish whether permeability of samples was altered by treatments and whether a continuous moist-blocking film was present on the surfaces of treated samples.

Table 1.- Presentation of samples and formulations used during the research. Brief description and details are also reported.

Sample name	Description	Details
C1	Printed book paper "Del diritto internazionale. Lezioni"	Year: 1876 Bulk: 84.56gsm
C2	Printed book paper "Commentario del Codice e delle leggi di procedura civile"	Year: 1923 Bulk: 93.6gsm
C3	Common white printing paper	Year: 2015 Bulk: 76.12gsm
T3	Cellulosic row canvas	Threads/cm: 9
T4	Painting canvas covered with red handmade preparation layer	Threads/cm: 9
T5	Painting canvas covered with white industrial preparation layer	Threads/cm: 21
T7	Blue Cotton textile	Threads/cm: 27
Formulation name	**Description**	
F1	Fluoroacrylic co-polymer at 5.00%w in ethanol	
F2	Fluoroacrylic co-polymer at 4.87%$_w$ mixed with 0.13%$_w$ of hydrophobic fumed silica nanoparticles (Aerosil® R812 – BET surface area: 260 ± 30m^2/g), in ethanol	
F3	Fluoroacrylic co-polymer at 4.87%w mixed with 0.13%$_w$ of hydrophobic fumed silica nanoparticles (Aerosil® R812 – BET surface area: 260 ± 30m^2/g), in ethanol	
F4	Polydimethylsiloxane (PDMS – Sylgard® 184 Silicone Elastomer) at 5.00%w in ethyl-acetate	

Table 2.- Colour change ΔE*, product applied ΔM%, Contact angle [°], Vapour permeability [g/(s•m2)], Young's Modulus [MPa], Maximum Load [N], Hygroscopy at 60% and 80% RH values recorded for (U) untreated samples, samples treated by (S) spray and samples treated by (I) immersion. Here are reported the data of T3, T4, T5 and T7 textiles and C1, C2 and C3 papers, treated with F1, F2, F3 and F4 formulations.

Samples		ΔE*		ΔM [%]		Contact angle [°]			Vapour permeability [g/(s•m²)]			Young's Modulus [MPa]			Maximum Load [N]			Hygroscopy 60% RH [ΔM%]			Hygroscopy 80% RH [ΔM%]		
		S	I	S	I	U	S	I	U	S	I	U	S	I	U	S	I	U	S	I	U	S	I
T3	F1	2.6	5.9	10	8	0 ±0	143 ±9	145 ±5	582 ±50	522 ±9	606 ±24	464 ±58	397 ±91	371 ±13	107 ±22	91 ±15	111 ±16	1.2	0.7	1.5	1.9	4.5	5.3
	F2	2.6	5.0	7	12		140 ±4	140 ±7		481 ±6	566 ±9		377 ±66	324 ±18		92 ±13	105 ±6		0.6	0.5		1.0	1.5
	F3	3.8	7.0	15	13		139 ±6	140 ±3		478 ±5	558 ±8		356 ±86	339 ±54		96 ±19	111 ±16		0.6	1.0		1.3	5.1
	F4	5.7	3.9	5	6		136 ±6	142 ±6		503 ±31	577 ±19		230 ±48	255 ±54		28 ±9	43 ±8		0.9	1.2		4.8	4.7
T4	F1	2.8	4.0	2	2	131 ±8	132 ±5	134 ±6	341 ±59	279 ±22	238 ±29	188 ±10	195 ±18	113 ±21	34 ±4	29 ±2	41 ±3	0.3	0.3	0.5	2.0	2.0	2.2
	F2	3.5	2.0	2	2		133 ±7	131 ±8		284 ±15	244 ±21		136 ±22	216 ±34		36 ±6	37 ±4		0.1	0.5		1.6	2.2
	F3	9.1	8.8	5	2		122 ±5	124 ±5		268 ±6	229 ±7		140 ±24	134 ±22		37 ±9	33 ±6		0.2	0.5		2.1	2.5
	F4	8.7	9.5	1	1		129 ±7	137 ±6		307 ±32	283 ±44		120 ±27	179 ±64		32 ±4	33 ±4		0.6	0.5		2.1	1.9
T5	F1	1.0	1.4	7	5	129 ±5	143 ±8	136 ±5	288 ±29	253 ±16	261 ±39	196 ±25	161 ±16	173 ±9	41 ±1	45 ±3	47 ±3	1.1	0.5	1.2	4.2	3.5	4.2
	F2	2.1	1.5	9	6		136 ±5	140 ±3		261 ±5	236 ±16		157 ±11	151 ±16		41 ±0	41 ±3		0.6	0.2		3.8	3.1
	F3	3.9	1.3	17	5		132 ±6	140 ±1		254 ±2	223 ±6		167 ±6	174 ±8		45 ±2	45 ±3		0.4	1.2		3.6	4.4
	F4	2.9	2.4	9	2		143 ±4	147 ±4		241 ±23	306 ±20		191 ±10	173 ±32		39 ±1	39 ±7		0.6	0.9		3.8	4.2
C1	F1	2.5	10.7	16	10	129 ±6	127 ±8	130 ±8	578 ±17	513 ±9	519 ±36	713 ±83	389 ±55	429 ±61	2.0 ±0.1	43 ±5	43 ±3	0.7	0.5	1.2	2.8	4.4	4.9
	F2	3.6	3.3	24	11		131 ±8	137 ±6		529 ±5	489 ±7		418 ±85	388 ±50		43 ±5	44 ±5		0.5	0.5		3.7	4.1
	F3	9.4	8.9	35	12		133 ±10	140 ±7		523 ±5	485 ±11		363 ±26	420 ±50		42 ±4	46 ±3		0.4	1.4		4.3	5.2
	F4	24.0	8.0	14	7		138 ±7	138 ±6		533 ±15	510 ±32		362 ±37	366 ±32		29 ±4	36 ±2		0.8	1.2		4.5	5.0
	F1	4.8	1.3	30	11		126 ±2	126 ±6		281 ±19	303 ±37		1679 ±236	1378 ±74		7 ±2	5 ±3		0.5	0.5		3.0	3.2
	F2	0.9	3.2	39	10		122 ±5	128 ±3		315 ±48	382 ±24		5701 ±89	87 ±0.2		3 ±1	1 ±1		0.6	0.9		3.1	3.5
	F3	2.1	2.3	45	12		133 ±5	137 ±6		488 ±39	492 ±49		389 ±25	527 ±44		3.0 ±0.1	3 ±1		0.7	0.5		3.2	3.0
	F4	13.1	5.9	22	6		138 ±2	138 ±2		358 ±32	504 ±13		704 ±62	1062 ±254		4.0 ±0.1	5 ±1		0.2	0.6		2.3	2.5
C2	F1	3.4	1.6	21	7	122 ±4	117 ±2	123 ±2	496 ±30	229 ±6	318 ±19	1452 ±97	1146 ±134	1490 ±99	4 ±1	4 ±2	6 ±1	0.6	0.7	0.6	2.9	3.5	3.3
	F2	1.7	1.1	27	7		122 ±2	119 ±2		256 ±17	352 ±7		1289 ±162	1228 ±90		8 ±1	7.0 ±0.1		0.8	1.0		3.4	3.8
	F3	1.6	0.9	30	8		132 ±1	127 ±7		406 ±21	370 ±10		1359 ±199	1067 ±23		9 ±3	6 ±0.1		0.7	0.5		3.1	3.3
	F1	15.8	3.1	23	4		129 ±2	132 ±2		212 ±19	441 ±3		2949 ±238	1509 ±89		14 ±0.1	6 ±0.1		0.3	0.7		2.5	3.2
C3	F1	1.5	0.7	31	11	83 ±12	119 ±3	128 ±3	552 ±15	302 ±1	423 ±19	808 ±156	987 ±155	2531 ±192	3.0 ±0.1	6.0 ±0.1	14.0 ±0.1	0.9	0.9	0.5	4.6	4.8	4.2
	F2	1.2	0.6	32	10		122 ±3	126 ±1		408 ±17	437 ±17		669 ±35	2050 ±83		6.0 ±0.1	15 ±2		0.7	1.0		4.0	4.3
	F3	1.5	0.5	35	11		136 ±3	135 ±6		471 ±23	463 ±22		596 ±91	1952 ±331		5.0 ±0.1	13 ±2		0.8	0.6		4.2	4.1
	F4	1.8	1.6	29	6		133 ±2	135 ±2		383 ±23	520 ±16		1102 ±113	3318 ±229		5.0 ±0.1	15 ±1		0.4	0.9		3.6	4.7

Results & discussion

A selection of data is reported in [table 2], in order to easily compare the results obtained.

The overall percentage mass variation due to the products deposition range between 1%<Δm<45%. Despite the use of formulation at similar concentrations and preliminary trials conducted to ensure a similar deposition of products on the systems, spray and immersion methods did not reach the same quantity of products deposited. In particular, spray application often entailed slightly higher weight variations than immersion; this could be due to a partial evaporation/ loss of solvent during spraying and the deposition of a more concentrated product.

Generally, all the formulations caused an alteration to the appearance and colour variation of the surfaces, both when applied by spray and by immersion. Especially formulations F2 and F3, admixed respectively with 0.13%$_w$ and 0.25%$_w$ of nanosilica, caused white depositions; this phenomenon is clearly visible through digital microscope observations [figure 1]. The whitening observed when using F1, F2 or F3 is proportional to the quantity of nanosilica present in the formulation. This was evident in particular for the treatment F3, with a larger quantity of nanosilica, while F1 formulation always resulted in lower ΔE variation. Generally, a substantial ΔE variation resulted from F4 treatments, applied both by spray and immersion, primarily due to changes in colour lightness (-15.41<ΔL<-0.41).

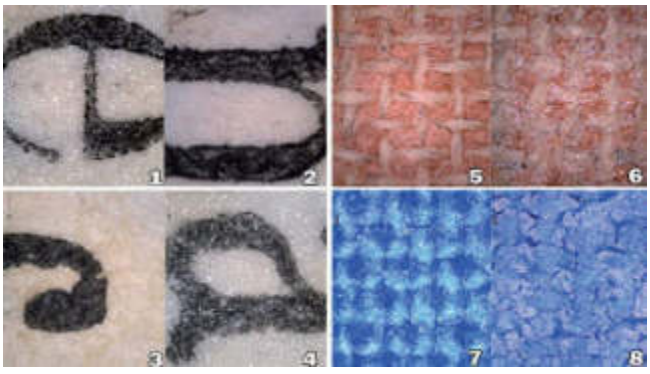

Figure 1.- Dino-Light microscope investigation of C2 substrates treated by spray with (1) F1 and (2) F2 formulations. C1 substrates treated with F3 formulation by (3) immersion and by (4) spray. T4 substrates treated by spray with (5) F2 and (6) F3 formulations. T7 substrates treated with F3 formulation by (7) immersion and by (8) spray.

SEM analysis of white paper (C3) and all textiles treated with formulation F3 highlighted that nanoparticles sprayed on the surface formed a fragile film, which tended to crack, possibly due to a partial lack of solvent (loss during spraying) and deposition of agglomerated polymer particle. Immersion application, instead, allowed to obtain treated samples with a morphology similar to the untreated ones [figure 2] by homogenously covering each fibre.

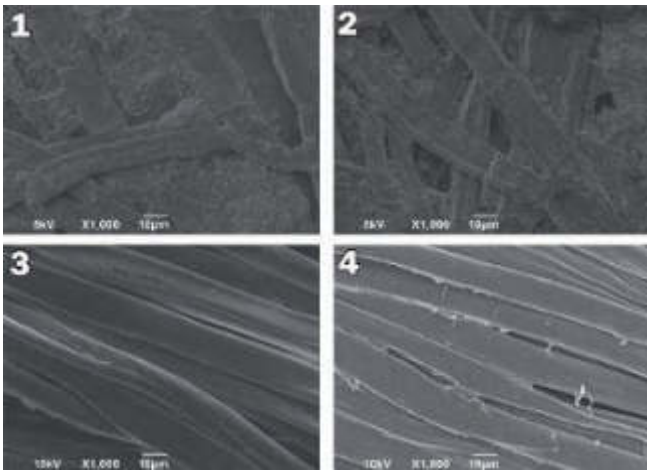

Figure 2.- SEM images of (1) untreated C3 paper, (2) the same C3 substrate treated by immersion with F1 formulation; (3) untreated textile T7 substrate, (4) the same T7 substrate treated by immersion with F1 formulation, Photographer: Simone Lauciello, IIT institute.

FTIR-ATR analysis was performed in order to evaluate possible reaction between substrates and products. The spectra showed the superimposition of characteristic absorption peaks of the cellulose specimens and of the formulations, without the presence of any extra-peak attributable to chemical reaction between substrates and products [figure 3].

Furthermore, the high contact angle values (between 115° and 147°), measured in order to test wettability, proved that each product contribute to reach excellent water-repellent

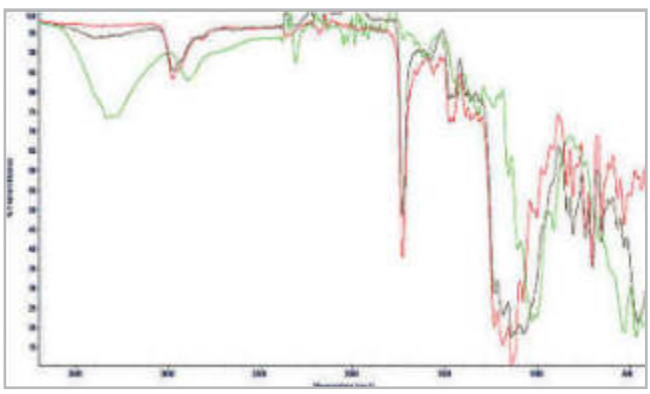

Figure 3.- FTIR-ATR spectra of (red) F1 formulation, (green) cellulosic substrate, (grey) cellulosic substrate treated with F1.

properties and decrease surface wettability; besides, the addition of nanosilica enhanced the water-repellence of the samples, especially on paper substrates. Treated samples probably present a nano-roughness causing the "lotus effect": the water drops tended to become spherical and to roll off even at low inclinations.

The Water Vapour Permeability (WVP) was not particularly affected by the application method chosen to treat textile samples, while immersion treatment lent paper samples a WVP closer to the untreated specimens in comparison to spray. Moderate WVP variations (around 15-20% for textiles and 20-30% for papers) were observed with the exception of spraying F1, F2 and F3 on specimen C2: WVP reductions between 30% and 60% were measured. WVP values close to the original ones suggested a homogeneous distribution of the products on each fibre with the formation of a thin and flexible coating structure without obstructing the natural pores between fibres and threads.

Hygroscopic tests, conducted at 60% or 80% RH, showed no significant weight growth of cellulose treated samples in comparison to the untreated samples, maintaining similar water retention properties and guaranteeing products compatibility. Treatments did not modify the process of samples to get into equilibrium with water vapour and this is a positive result, since the substrate was free to absorb and, most important, to release water vapour. A slight decrease in water vapour absorption may be an advantage to limit biological degradation and deterioration linked to hydrolysis.

As for paper specimens, mechanical tests demonstrated that treated samples generally gave analogous results for all formulations: higher values of Young's Modulus and slightly higher Maximum Load values indicating the formation of resistant but stiffer materials. It is important, however, to underline the high variability of Maximum Load values obtained for formulation F4, depending on the type of treated paper.

Instead, the textiles, after each treatment, always presented Young's Modulus decrease resulting in lower stiffness and probably a more flexible substrate; the Maximum Load remains similar. High standard deviations were measured probably due to intrinsic structural differences of the substrates.

After artificial ageing (500 hours at circa 8500 lux), the treated samples did not show any significant variation in wettability and chemical composition, as testified by contact angles and FTIR-ATR analysis. In fact, no new FT-IR peak related to functional groups were detected, even though signals already present before ageing seemed to show minimal intensity variations. This could be possibly due to minor breakage or the formation of new bonds, not easily quantifiable with this technique. After the exposure under UV light, colour measurements of treated surfaces were carried out together with measurements on untreated ones (used as reference). In [table 3] the mere contribution of UV radiation can be observed by comparing colour changes (ΔE^*), calculated with data collected before and after ageing,

of both untreated and treated specimens. As visible in [table 3], both yellowing of the treated and untreated specimens occurred, pointing out similar or even higher colour variation for the untreated ones. Due to their transparency, coating films did not entirely stop the UV radiations, resulting in a partial yellowing of the substrate. However, the yellowing observed on untreated specimens resulted slightly higher than on treated ones, thus suggesting the stability of the coatings under lamps radiation and a slight protection effect of the polymeric films with regards to UV radiation.

Positive results have been registered for contact angle on treated surfaces even after artificial ageing [table 3]. All values were higher than 90°, proving that UV radiations did not affect the water-repellence of the treatments. Slight decreases were generally observed for all the specimens, but water-repellence was definitely maintained.

Conclusions

Restoration products must follow precise requirements of chemical and physical compatibility with Cultural Heritage objects. This could be assessed by measuring, after the application, differences in colour, WVP, hygroscopicity, mechanical strength and through ageing test.

All formulations tested, applied both by spray and immersion, lead to water-repellent papers and textiles.

Samples		Colour change ΔE*				Contact angle [°]	
		Unir	S	Unir	I	S	I
T3	F1	4.8	4.7	6.2	8.8	137 ± 8	144 ± 8
	F2	5.0	1.2	5.1	6.7	133 ± 9	131 ± 6
	F3	3.1	5.5	7.5	7.3	139 ± 8	137 ± 8
	F4	5.5	4.3	7.5	6.5	143 ± 4	131 ± 10
T4	F1	6.2	5.6	14.1	9.7	131 ± 7	135 ± 4
	F2	10.1	6.2	9.2	7.5	129 ± 8	131 ± 6
	F3	6.2	1.1	11.0	8.6	125 ± 4	131 ± 6
	F4	10.2	7.0	8.7	8.3	134 ± 6	133 ± 7
T5	F1	8.5	7.5	7.7	8.9	124 ± 5	144 ± 4
	F2	8.0	6.9	10.8	12.0	132 ± 7	136 ± 4
	F3	9.6	7.8	11.5	10.1	135 ± 8	140 ± 4
	F4	10.4	9.7	12.3	13.8	145 ± 5	141 ± 4
T7	F1	5.0	3.2	4.6	4.6	135 ± 6	144 ± 5
	F2	1.2	2.2	1.6	1.2	139 ± 5	143 ± 5
	F3	4.2	2.5	4.8	4.0	139 ± 7	136 ± 5
	F4	4.7	5.3	6.3	7.1	147 ± 6	145 ± 5
C1	F1	1.1	1.1	0.9	0.9	111 ± 5	137 ± 3
	F2	2.7	1.8	2.1	3.8	117 ± 4	128 ± 3
	F3	3.2	3.1	7.6	10.1	121 ± 2	138 ± 3
	F4	1.2	6.9	4.8	7.3	129 ± 4	136 ± 5
C2	F1	1.4	0.9	2.0	0.9	112 ± 2	123 ± 3
	F2	0.7	1.7	1.0	1.0	117 ± 2	122 ± 5
	F3	0.7	0.7	1.0	0.5	137 ± 6	122 ± 2
	F4	1.8	2.8	0.5	0.8	124 ± 2	127 ± 5
C3	F1	16.0	16.1	16.9	17.9	108 ± 6	129 ± 4
	F2	16.0	16.0	15.7	17.7	117 ± 6	124 ± 4
	F3	17.1	16.1	16.4	18.2	123 ± 9	126 ± 6
	F4	17.4	22.2	17.2	19.2	127 ± 3	131 ± 3

Table 3.- Colour change [ΔE*] recorded after ageing (500 hours) for untreated and treated samples. Contact angle [°] recorded after ageing (500 hours) for treated samples both by (S) spray and (I) immersion. The data regarding T3, T4, T5 and T7 textiles and C1, C2 and C3 papers treated with F1, F2, F3 and F4 formulations are reported.

Among them, F1 and F2 reached a good compromise between effectiveness and compatibility requisites stated above. F3 also guaranteed positive values of WVP, mechanical strength and wettability, but the surface whitening of the samples, due to the high quantity of nanosilica, was not aesthetically acceptable, especially when applied by spray. Among all, it can be said that formulation F4 was the least effective because of the wide colour variation and a negative effect on WVP.

Structure or physico-chemical properties of the substrates did not affect the treatments application and their performances, encouraging their potential use for the conservation of paper and textile. However, a preliminary study of the artefacts and the development of *ad hoc* products is always fundamental.

Both spray and immersion application methods generally gave good results, even if spray left some small nanoparticles' agglomerates. It is suggested to immersion application whenever possible, while spray would be desirable in presence of canvas with a preparation layer or for breakable papers.

Some perspectives for future researches should be focus on: 1) improvement of the application methods to homogenize weight variations, focusing for example on the solvent concentration for spray application and verifying how much product is lost during the application phase; 2) bending tests of the treated samples, providing more information on the behaviour of the polymeric films; 3) testing the stability and the behaviour of these four formulations in presence of biological agents of deterioration; 4) further investigations of the coating microstructure, e.g. by SEM-EDX; 5) application on actual Cultural Heritage artworks, to verify whether the results are confirmed and to understand if new issues arise.

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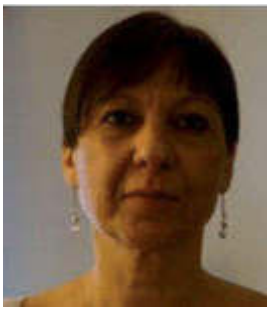

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Nopal mucilage as hydration agent for quicklime; extraction methods

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Abstract: The main objective of this research is to select an extraction method of nopal mucilage to be used as a hydration agent at a suitable concentration for slaking quicklime in order to obtain lime putties with better rheological and mechanical properties. An experimental phase was performed where different extraction methods to obtain nopal mucilage were tested. This made it possible to classify them into two groups: methods that require water to get the mucilage, and methods that obtain the mucilage directly from the plant. Galacturonic acid present in mucilage composition seemed to be the main cause of the chemical interaction between lime and mucilage. As a result, mucilage that presented the largest amount of galacturonic acid according to acid base titration curves was chosen as the best one to work with. It was concluded that the amount of galacturonic acid present in mucilage is not influenced by rising temperature and constant stirring during its extraction process, nor the nopal species or cladodes dimension. Furthermore, it was observed that mucilage viscosity obtained through the different extraction methods has a strong impact on the slaking process behavior and in the consistency of the resulting putties.

Key words: slaked lime putty, nopal mucilage, galacturonic acid, quicklime slaking process, acid base titrations, extraction methods.

El mucílago de nopal como agente de hidratación de cal aérea; métodos de extracción

Resumen: Esta investigación tiene por objeto la elección de un método de extracción de mucílago de nopal para emplear a este último como agente hidratador de cal para producir cal apagada que confiera mejores propiedades reológicas y mecánicas a las pastas de cal apagada. En esta etapa se desarrolló una fase experimental que incluyó distintos métodos de extracción de mucílago de nopal siendo posible clasificarlos en dos grupos: los que emplean agua en su procedimiento y aquellos que obtienen el mucílago directamente de la planta sin adicionar otra sustancia. El ácido galacturónico parece ser la sustancia responsable de la interacción química entre el mucílago y la cal, por lo tanto, el mucilago que presentó la mayor cantidad de ácido galacturonico de acuerdo a las curvas de valoración ácido base, fue elegido. Pudo concluirse que la cantidad de ácido galacturónico presente en el mucílago de nopal no está influenciada por factores de elevación de la temperatura y agitación durante el método de extracción, ni por la especie y el tamaño de sus cladodios. Adicionalmente fue observado que la viscosidad del mucílago obtenido de los diferentes métodos de extracción tiene un impacto importante en el comportamiento del proceso de hidratación de cal y en la consistencia de las pastas de cal.

Palabras clave: Pasta de cal hidratada, mucílago de nopal, ácido galacturónico, procesos de apagado de cal, titraciones ácido base, métodos de extracción.

Introduction

Since ancient times, a number of different cultures that use lime in construction have known the benefits of using additives in the formulation of mortars in order to improve the properties of this compound (Barba and Villaseñor, 2013). An ancient production process from a north Mayan region consisted of slaking quicklime using water combined with mucilage from different kinds of tree bark. This practice indicated that mucilage could probably improve lime mortar properties much more effectively from the quicklime slaking process (Carrascosa and Lorenzo, 2012). Nopal mucilage is one of the most affordable additives for Mexico, in economic and geographical terms. This additive has exhibited favorable behavior when employed in the formulation of paste and restoration mixtures (Bedolla, 2009). It is made up of a wide range of polysaccharides and other substances, like vitamins and hormones, and it has a high viscosity (Nazareno and Padrón, 2011).

As a result, a hypothesis was drawn: if it has been demonstrated that nopal mucilage improves lime mortar properties like resistance, viscosity and workability when it is used during mixture formulation, then it could also improve lime mortar behavior if it is used in an appropriate dilution instead of using only water to hydrate or slake quicklime.

Therefore, the main objective of this stage of the research is to select a method to extract nopal mucilage that could be used as a hydration agent of quicklime to improve the properties of this binder as slaked lime putty from its production, and not only during mortar or mixture formulation (Pérez et al., in press).

Methodology

During a first phase of experimentation performed with students of the Faculty of Chemistry at UNAM (National Autonomous University of Mexico), nopal mucilage seemed to interact strongly with cations such as calcium Ca+, and it has been reported that the chemical substance responsible for this is galacturonic acid. Consequently, it was hypothesized that this substance was the main cause of the chemical interaction between lime and mucilage and that it produced the desired results in lime mortars (Carmona, 2015). Therefore, it was considered that the mucilage that presented the largest amount of galacturonic acid in its composition would be the one that would display a better behavior in the lime hydration phase to produce slaked lime putty with better properties of application and resistance. The ultimate aim of the research was to develop an extraction method that would produce a greater volume of mucilage and facilitate the dynamics of the restoration work as much as possible.

Extraction methods were reproduced as described in investigations by various authors, and some adjustments were made based on experience.

The extraction methods tested were classified into two groups: the ones that need water to obtain the mucilage (constant ratio followed: 1:2, nopal: water by weight) [Figure 1a, b, c], and the ones that obtain the mucilage directly from the plant without any other substance [Figure 2a, b, c] [Table 1]. The resulting product from each method is considered as a 100% solution of mucilage.

Figure 1.- 1a, 1b, 1c: An example of extraction methods that need water to obtain the mucilage. 1a: Cladodes are chopped into small pieces, 1b: Cladodes are poured into water in a proportion of 1:2 (nopal : water in weight) for about 24 hours, 1c: Nopal mucilage is sieved through different sized meshes. Pérez et al., "The hydration of lime using nopal mucilage to optimize hydrated lime mortars for the conservation of built heritage". MNCARS, Madrid, Spain, in press.

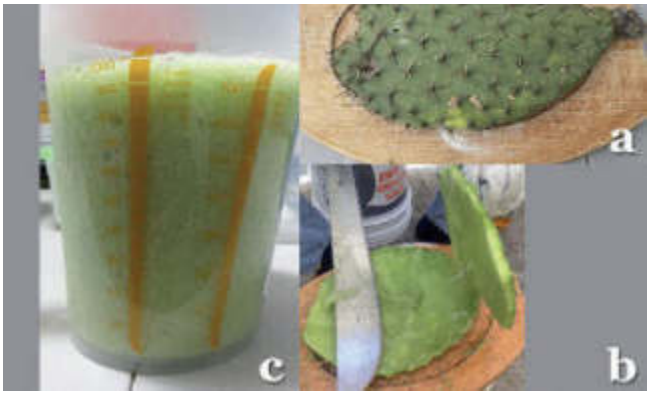

Figure 2.- 2a, 2b, 2c: An example of extraction methods that obtain nopal mucilage directly from the plant. 2a-2b: cladodes are cut halflenghtwise, 2c: Cladodes inner faces are scrapped in order to remove mucilage directly from the plant. Pérez et al., "The hydration of lime using nopal mucilage to optimize hydrated lime mortars for the conservation of built heritage". MNCARS, Madrid, Spain, in press.

Table 1.- Extraction methods of nopal mucilage. Pérez et al., "The hydration of lime using nopal mucilage to optimize hydrated lime mortars for the conservation of built heritage". MNCARS, Madrid, Spain, in press.

Methods of extraction of nopal mucilage								
Method No.	Species used	Elements removed	Cladodes cut	Proportion in weight nopal:water	Appliance used	Temperature (°C)	Stirring	Mesh aperture
Methods that use water in its procedure								
1	Tlaxcalancingo Puebla	Cutin, epidermis and spines	Chopped in pieces (2cm)	1:2	liquified	70-89	occasional	2mm-1mm-12-15µm
2	Tlaxcalancingo Puebla	Cutin, epidermis and spines	Chopped in pieces (2cm)	1:2	liquified	70-89	occasional	not meshed
3	Tlaxcalancingo Puebla	Cutin, epidermis and spines	Chopped in pieces (2cm)	1:2	/	/	/	2mm
4	Supermarket	Cutin, epidermis and spines	Chopped in pieces (2cm)	1:2	/	80	constantly for 30 minutes	/
5	Tetla Tlaxcala	Cutin, epidermis and spines	Chopped in pieces (2cm)	1:2	/	80	constantly for 30 minutes	/
Methods that acquire the mucilage directly from the cladode								
6	Tlaxcalancingo Puebla	Spines one by one	Cut half lenghtwise	/	/	/	/	/
7	Tecali Puebla	Spines one by one	Cut half lenghtwise	/	/	/	/	/
8	Tetla Tlaxcala	Spines one by one	Cut half lenghtwise	/	/	/	/	/
9	Tetla Tlaxcala	Spines one by one	Cut half lenghtwise	/	/	40-69	constantly for 30 minutes	/

The species that were tested with the different extraction methods included Opuntia ficus-indica cultivated species, indigenous to Tlaxcalancingo, Puebla, a wild species from Tecali, Puebla and Tetla, Tlaxcala, and finally species purchased in supermarkets in Puebla City.

In the first extraction methods tested, cladodes of a 40cm length x 25cm approximate width from Tlaxcalancingo, Puebla, were used. In this method the cutin, epidermis, and spines were removed using a knife. The cladodes were chopped into small pieces of about 2cm length, liquefied in a blender (Oster-BLSTMG-MR) for about 5 minutes, poured into water using a proportion of 1:2 (nopal:water in weight) and then the temperature of the mixture was increased to between 70°C and 80°C on a standard kitchen stove and measured using an industrial mercury thermometer (Alla France). A portion of the extract was passed through meshes of different sizes, 2mm, 1mm (method No.1), while another amount was left unsieved (method No. 2).

Method No. 3 was a variant of the previous two, where nopal from the same origin was chopped (cutin, epidermis and spines were previously removed), and left in water using a proportion of 1:2 in weight (nopal:water) for 24 hours at room temperature. This time, its extract was passed through a 2mm mesh because, in the previous method, a great amount of solution was held in the 1mm mesh.

Extraction method No. 4 included some cladodes obtained in a supermarket that were chopped into pieces of 2cm, poured into water in a proportion of 1:2 (nopal:water), and exposed to a temperature of 80°C on a standard kitchen stove while being stirred constantly by hand with a plastic spoon for 30 minutes.

Extraction method No. 5 was developed as a variant of extraction method No. 4 and involved nopal cladodes native to Tetla, Tlaxcala, of approximately 65cm length x 30cm width, since it had been noted that a larger amount of mucilage in liters was obtained from each cladode. The extract was subjected to a temperature of 80°C on a standard kitchen stove and was stirred constantly by hand with a plastic spoon over a period of 30 minutes.

A sixth extraction method was developed using Tlaxcalancingo cladodes. This method reproduced a traditional technique of Otomi ethnicity (this method was obtained by direct observation). It involved cutting the cladode in half lengthwise and scraping the inner faces using a knife in order to remove the mucilage directly from the plant without using water as a solvent. This extraction technique was replicated using native cladodes from Tecali, Puebla, (method No. 7) and Tetla, Tlaxcala, (method No. 8).

Method No. 9 arose as a variant of extraction method No. 8, where the product obtained with the original technique (method No. 6) was stirred constantly for 30 minutes using a plastic spoon and heated on a kitchen stove to 40 - 60 °C. An industrial mercury thermometer was used to measure the temperature (Alla France).

Subsequently, acid-base titrations were performed to 25 mL of extracts obtained from each method with gradual additions of 0.25 to 0.50 ml of sodium hydroxide 2 x 10-2 M and the support of a pH meter METROHM 620 for pH measurements reflecting the results in titration curves that led to partial conclusions about the presence of galacturonic acid. The greater the amount of sodium hydroxide needed to produce a significant increase in pH to basic values in each extract, the greater the amount of galacturonic acid it had.

Results & discussion

All the results were analyzed, and the two methods that displayed the greatest amount of galacturonic acid and the largest quantity of mucilage from each group of extraction methods were selected in order to create a graph and explain the criteria used to choose which one to work with. As shown in the graph [Figure 3a] from the group of extraction methods that use water in its procedure, No.1 and No. 4 reported the greatest amount of galacturonic acid, while No.6 and No.8 were selected from the group of methods that obtain the mucilage directly from the plant.

From the group of extraction methods that use water in its procedure, method No. 4, which involved an increase in temperature and constant stirring, reflected the highest amount of galacturonic acid in its composition. During titration process, the starting pH was 3.85 and relatively increased in values of 0.05 to basic standards every 0.25mL of sodium hydroxide added. A considerable increase of 0.30 in pH to basic values occurred after a concentration of 8.5mL of Sodium hydroxide had been added to the mucilage. Method No 1., which started with a pH of 4.2 and reported a slight increase in values of 0.05 every 0.25mL of sodium hydroxide added, until a significant increase of 0.10 in pH was reported when 8.00mL of sodium hydroxide was added to mucilage.

From extraction methods that obtain the mucilage directly from the plant, the mucilage obtained by method No. 6, which used cladodes from Tlaxcalancingo, Puebla, was shown to contain the greatest amount of galacturonic acid [Figure 3a]. The starting pH was 4.75 and there were small increases of 0.05 in pH every 0.25mL of sodium hydroxide added, but a more significant surge of 0.20 in pH to basic values took place when 16mL of sodium hydroxide was added. Method No. 8 seemed to contain less galacturonic acid than No. 6. It reported an initial pH of 4.85 and increases of 0.05 in pH every 0.25mL of sodium hydroxide added and a more significant increase of 0.20 at 14.25mL of sodium hydroxide present in the mucilage.

As explained previously, the greater the amount of sodium hydroxide needed to produce a significant increase in pH to basic values in each extract, the more galacturonic acid the mucilage contained. As a result, extraction method No. 4 from the group of extraction methods that use water in its procedure and method No. 6 from the group

of extraction methods that obtain the mucilage directly from the plant were chosen as the ones with the greatest amount of galacturonic acid in its mucilage.

The same graph [Figure 3b] also shows the volume of the mucilage produced in each method. Again, the two methods from each group of extraction methods that presented the largest amount of mucilaginous product were selected. As shown in the graph [Figure 3b], method No. 5 produced the greatest quantity of mucilage from the group of extraction methods that use water in its procedure, since each cladode indigenous to Tetla, Tlaxcala, of a 2.7kg average weight plus 5.4kg of water (following a constant ratio 1:2 nopal: water in weight) produced 6L of mucilage. In second place from the same group of extraction methods, No. 1 produced 4 L of mucilage from 1.76kg of nopal plus 3.52kg of water.

From the group of extraction methods that obtain the mucilage directly from the plant, methods No. 8 and No. 9 seemed to be the ones that produced the greatest amount (L) of this substance since 1.5L was obtained from each cladode of about 2.7kg from Tetla, Tlaxcala.

Not only is it worthy to choose an extraction method that produces mucilage with the greatest amount of galacturonic acid in its composition, but also a method that produces an abundant amount of the mucilaginous substance in liters in order to best facilitate the restoration

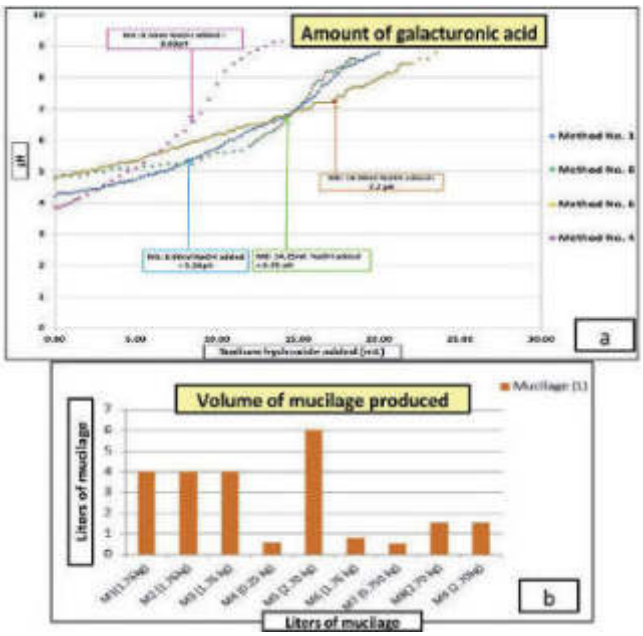

Figure 3.- 3a-3b: Amount of galacturonic acid in mucilage and volume of mucilage produced from the different extraction methods. 3a: The two methods that displayed the greatest amount of galacturonic acid from each group of extraction methods tested. 3b: The two methods that displayed the largest quantity of mucilage obtained from each group of extraction methods tested. Pérez et al. "The hydration of lime using nopal mucilage to optimize hydrated lime mortars for the conservation of built heritage". MNCARS, Madrid, Spain, in press.

activities at a construction site. Both factors were considered in order to select the best extraction method, but priority was given to the content of galacturonic acid.

After having analyzed the results, it was concluded that method No. 8, which belongs to the group of methods that obtain the mucilage directly from the plant, reported an abundant amount of galacturonic acid in its structure and produced a worthy volume of mucilage, so it was selected as the best to work with as a hydration agent for quicklime.

Slaking quicklime using mucilage

A first experimental phase was also developed for slaking quicklime (CaO) using the mucilage chosen (the one from method No.8).

In the traditional slaking quicklime process using only water as hydration agent, a sudden violent reaction is produced in which a sharp increase in temperature to between 90°C and 100°C takes place and the resulting putty shows a homogenous consistency.

In this experimental stage using mucilage solution as a hydration agent instead of only water, the temperature was measured with an industrial thermometer and consistency was evaluated by observation in order to compare both processes (the original one using only water as hydration agent and this investigation's suggested process: using mucilage solutions to slake quicklime) and their resulting lime putties.

To develop the experiment of the investigation plan, it was decided to begin with mucilage solutions in three different concentrations in water, 100%, 60% and 20%, as a first proposal using the selected mucilage.

To begin with the lime hydration or slaking process, a ratio of 1:3 was chosen (quicklime: mucilage solution in weight). The selected ratio was the one that proved to be appropriate according to experience because, as the authors mentioned, the amounts of water needed in theory to hydrate quicklime and to obtain slaked lime putties do not work in practice, and there is even the risk of drowning (Boynton, 1980; Bedolla, 2010).

The starting temperature of the quicklime slaking process did not go above 40°C in any of the three cases and the violent reaction took between 10 and 15 minutes to start. At the beginning, the process produced an agglutinate, yellowish sub product, which was stirred for 1 hour. According to Robert Boynton's investigation, the temperature reported might reflect a decrease in the surface area of the hydrated lime crystals and therefore a significant decrease in the rheological properties of the resulting slaked lime. In this time, the stirring of the sub product resulted in another high-viscosity sub product, of heterogeneous appearance which could not be handled as integral lime putty to produce a mortar. Once

the process finished and the final product cooled, this was left to rest on a 5-cm-thick mirror solution of nopal mucilage in water in order to protect the putties from the process of carbonation which takes place with the carbon dioxide in the air. Two months later, the final product was inspected and it was confirmed that it kept the same characteristics, like consistency and lumpy heterogeneous appearance, without improving its rheological properties after this time. From this procedure, it can be concluded that such a high viscosity of nopal mucilage as obtained though this extraction method did not allow the reaction to take place in an optimum way.

Consequently, the quicklime slaking process using mucilage was reproduced again but this time using mucilage extracted by method No.5 which uses water in its procedure and includes a rise in temperature and constant stirring as variables.

In the second experiment, the lime slaking process was carried out in a very similar way to the previous one, mucilage solutions in three different concentrations in water 100%, 60% and 20% were used as hydration agents with a proportion of 1:3, quicklime to hydration agent. This time the quicklime slaking process was also undertaken using water with no additions as a control test.

The exothermic reaction of the process occurred immediately. The whole procedure took approximately 2 hours. The 5-cm-thick nopal mucilage mirror was used again for the resulting putty from each process (20%, 60% and 100% mucilage solutions) and a water mirror of the same thickness for the slaking lime process, which used only water as hydration agent to prevent carbonation. The most violent reaction and the highest rise in temperature (105°C) during the slaking process was reported by the process that used only water as hydration agent, followed by the one that took place at 20%, mucilage solution, then 60% and finally 100%. All of them reached a temperature of between 90°C and 100°C. In this experimental phase, touch and sight reported the best consistency in the resulting putty in the nopal mucilage at 20%. In a subsequent phase, consistency will be evaluated using a Bostwick ZXCON consistometer.

Conclusions

Extraction methods which include water in the process offer the advantage of producing a larger amount of mucilaginous substance (as it is shown in the graph for method No. 5 the one that produced the largest volume of mucilage), but demand a period of at least 24 hours and report a lower amount of galacturonic acid than those that do not use water in its procedure. In contrast, extraction methods that obtain the mucilage directly from the cladode can reduce the production time and offer a higher content of galacturonic acid in its composition. However, the volume obtained is lower compared to the first group.
The rise in temperature and constant stirring during extraction processes are not related to the amount of galacturonic acid contained in the mucilage acquired since method No. 6, which does not include a rise in temperature and constant stirring, reported the greatest amount of this chemical substance from the second group of extraction methods.

The species that produced the largest amount of mucilage were the wild cladodes from Tetla, Tlaxcala, and Tecali, Puebla, in both groups of extraction methods.

Mucilage viscosity obtained through the extraction methods which do not use water in the process is so high that the reaction is very slow when it is used as a hydration agent of quicklime. This results in low quality slaked lime putties of heterogeneous consistency that are unsuitable for use as a binder in lime mortars. On the other hand, mucilage that includes water in its extraction process allowed an exothermic reaction to occur immediately during slaking lime process, reached a temperature of 100°C, and produced lime putties with better a consistency than the previous and will be used as binder for lime mortars in further experimental phases.

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Mundane beauty in art and architecture

Angela **Juarranz**

Abstract: In the twentieth century a specific kind of beauty emerged from art: the increased value of the mundane. Contemporary art shows that common situations have an aesthetic significance. But architecture does not pay any attention to this scope. What is more, it tries to deny it. Nor the design process nor the architectural photography show the presence of mundane things. Fortunately, we have some works to go in depth into this day-to-day issue. Let's analyze the photograph *Morning Cleaning, Mies van der Rohe Foundation, Barcelona,* (Jeff Wall, 1999), the intervention *Phantom, Mies as Rendered Society* (Andrés Jaque, 2012) and the film *Koolhaas Houselife* (Ila Bêka and Louise Lemoine, 2008). By considering the visual and spatial value of these cases, we reconsider them as an experimental space. What if architecture starts looking at its surroundings?

Key words: contemporary art, architecture, mundane, day-to-day, social.

Belleza de lo mundano en arte y arquitectura

Resumen: A lo largo del siglo XX ha emergido un tipo de belleza singular en el campo del arte: lo mundano. El arte contemporáneo muestra que los objetos y situaciones cotidianos tienen una trascendencia estética. Pero la arquitectura parece no prestar atención por estas cuestiones. Y lo que es más, las rechaza y evita. Ni el proceso de diseño ni las imágenes finales de la obra enseñan la presencia de lo mundano. Afortunadamente, hay ejemplos con los que investigar en la presencia de lo ordinario en arquitectura. Los ejemplos considerados son *Morning Cleaning, Mies van der Rohe Foundation, Barcelona* (Jeff Wall, 1999), la intervención *Phantom, Mies as Rendered Society* (Andrés Jaque, 2012) y el documental *Koolhaas Houselife* (Ila Bêka y Louise Lemoine, 2008). Examinar el valor visual y espacial de estas obras permite situar las cosas y acciones ordinarias como vía de experimentación y toma de nuevas posiciones. Es momento de que la arquitectura se replantee estos aspectos vivos propios de su entorno.

Palabras clave: arte contemporáneo, arquitectura, mundano, cotidiano, social.

Introduction

Although not easy to recognize at first sight, contemporary art depicts a key item that appears to be hidden in the modern architectural legacy. In the twentieth century a specific kind of beauty emerged from the mundane. Painting, sculpture, photography, and performance art show that common situations have an aesthetic significance. Also, we reach an experimental field by considering the visual, spatial and social value of these situations. But architecture does not look to pay any attention to this scope. What is more, it tries to deny it. Nor the design process nor the architectural photography show the presence of quotidian objects or daily tasks. So, what can architecture learn from contemporary art to get over the negation to this day-to-day context? Let's take a photograph, an installation and a film to go in depth into this question.

Morning Cleaning, Mies van der Rohe Foundation, Barcelona, a Jeff Wall's photograph, shows the interior of the German Pavilion, the iconic glass-walled building designed by Ludwig Mies van der Rohe for the 1929 International Exposition in Barcelona. Whilst the building's formal rigor and its opulent materials convey a sense of luxury, in the background, an attendant is in the process of cleaning. *Phantom, Mies as Rendered Society* (2012) is the installation produced by the architect Andrés Jaque in the German

Pavilion, as well as the previous work. It represented an inventory of the Pavilion's basic facts on a totally pragmatic basis: from materials, maintenance, and management to social and political issues. *Koolhaas Houselife* (2008), the last of the examples, is an Ila Bêka and Louise Lemoine's 58-minutes-long documentary. It presents a portrait of the *Maison à Bordeaux* (1994-1998), a country residence designed by Rem Koolhaas. The hero of the film is a housekeeper and as she starts bustling through the house, she animates her surroundings to perfection.

Each one of the cases shows an interpretation of an inner space. We need to delve into them, looking for the architect's objective, the user's experience, and the story of the work.

Morning cleaning

Jeff Wall (1946) is renowned for large-format photographs with subject matter that ranges mundane corners of the living and urban environment. *Morning Cleaning* is a cibachrome displayed as a transparency in a light box that measures over three and a half meters long by two meters high. It depicts the glamorous inner space of the pavilion in the bright light of the sunrise. One of the pavilion's cruciform-sectioned steel columns punctuates the composition slightly to the right. The room is closed off at the left by a freestanding wall of onyx doré with the splendid patterns of striations, divided into larger rectangles. At the rear, the main interior space is partly closed off by floor-to-ceiling glass panels, beyond which we see a reflecting pool. The Travertine marble floor of the main space extends past those panels to the edge of the pool. At the far side of the pool there rises abruptly a wall of Alpine Green marble, beyond the top of which we glimpse a band of tree branches and sky. *Der Morgen* (George Kolbe, 1925), a sculpture of a standing female nude with arms raised above her hands, rises on a pedestal from the pond. Six Mies' Barcelona chrome-and-leather couches sit at the two ends of a long black carpet, and two matching chairs sit just beyond the carpet. In the background of the image, in blue trousers, sandals, and a white T-shirt, a dark haired window cleaner bends at the waist over a large yellow bucket on wheels. His engrossment in his task leads the viewer to look at him and to the floor-to-ceiling glass panels blurred by the suds.

Mies' Pavilion was first constructed for the 1929 International Exposition held in Barcelona. It was disassembled at the conclusion of the exhibition, but reconstructed by Barcelona City Council in the 1980s because of its cultural and architectural significance. The building conveys a sense of luxury with the formal rigor and opulent materials. However, Jeff Wall pictures the Pavilion in a new but everyday stage. There is a primacy of aesthetic concerns, with notions of beauty, pleasure, and quality, while at the same time calling attention to the congruence with an art of the everyday. The image resembles very closely what occurs at the Pavilion and make visible an activity which is normally unseen and overlooked. Wall remarks "Baudelaire was right when he said that the most fascinating element is the common place". And: "The everyday, or the common place, is the most basic and the richest category. Although it seems familiar, it is always surprising and new" (Wall, 2001: 112).

Figure 1.- Jeff Wall. Morning Cleaning, Mies van der Rohe Foundation, Barcelona (1999). Transparency in lightbox, 187.0 x 351.0 cm Courtesy of the artist.

Phantom

Andrés Jaque (1971), the founder of the Office for Political Innovation, leads crucial debates for contemporary architecture. For example, *Ikea Disobedients* (2011) and *Superpowers of Ten* (2013) work on the assemblage of the diversity ordinary life is made of. In this case, *Phantom*, *Mies as Rendered Society's* intervention unmasks the German Pavilion. The research project describes it as a two-storey building with two inter-dependent notions of the political lie in dispute. The upper floor is physically transparent, but in order to provide an extraordinary experience of the everyday architecture it conceals the activities and pacts that take place there. The lower floor is opaque and it is the place where the experiments and conflicts which construct the Pavilion are confined. The basement is the place where spare parts, tools, and machines are stored to prevent us from seeing those objects around the building. Also, it is the place where derelict items are hidden from the experience of the visitors: faded red velvet curtains, worn-out white leather cushions from the Barcelona chairs and stools, and broken pieces of the Travertine slabs. At the end of the basement, there are a sink and a plastic round table where the staff dines together, and on the wall, some pinned photographs, portraits, exhibitions flyers and newspaper cut-outs. Their shared intimacy is visible in the basement, but leaves no trace on the floor above. The Pavilion operates together: "the exceptional emerges in the absence of the ordinary" (Jaque 2012: 3).

The 1986 reconstruction of the Pavilion faced the decision to incorporate this huge basement to make or not to make the staircase accessible for people. At the end, and with disabilities in accordance with current regulations, the architects in charge of the reconstruction decided that the only access would be via a dangerous and uncomfortable 63-cm wide spiral staircase. The concern was to preserve the original experience of the building as a reception space. The Pavilion was redesigned on the basis of criteria which had shifted from Modernist to Postmodernist, from formal approaches to mankind thoughts. As Jaque noticed, the hidden items are the architectural equivalents to the Oscar Wilde's *Portrait of Dorian Gray*. The dilapidated pieces of velvet, glass, or travertine are simultaneously hidden and preserved for the respect of what they once ideally represented. By having been part of the Pavilion's materiality, somehow it retains the essence of Mies' critical image. But while in aspects such us composition and materiality has been massively documented, its new conditions, like the basement, the cleaner task, and the ordinary life have remained a totally unseen and unstudied reality. Walter Lippmann's *The Phantom Public* (1925), the reference of the intervention's title, shows a civilization that is unable to be involved in the relational complexities of the societies. Jaque's intervention is about experiencing how it became part of the daily reality.

Koolhaas houselife

Koolhaas Houselife is one of the *Living Architecture* series, in which Bêka (1967) and Lemoine (1981) show a Pritzker Prize winner's building based on specific features, such as the purpose of the architect, the experience of the users or the confined stories. Their studies in architecture, art, and philosophy lead them to explore the building from other point of view to put into question its iconic image. In fact, the structure of the film is based in twenty-four chapters that allude to common elements of living architecture: staircase, light, leaks, among others. *Maison à Bordeaux* is a rectangular three-level flat-roofed private residence on a hill overlooking Bordeaux –already under the protection of *France's Caisse Nationale de Monuments Historiques*-. The lower level is a series of caverns caved out from the hill, designed for the most intimate life of the family; the ground floor is a glass room for living; and the upper floor is divided into a children's and parents area. The house was commissioned by Mister Lemoine, a newspaper editor who was paralyzed in an automobile accident. Because of the wheelchair, the hearth of the house is a 3x3.5-m elevator platform that moves freely between the three floors, becoming part of the living space, the kitchen, or the office space.

Guadalupe Acedo, the Lemoine's servant, makes her initial appearance in the movie's opening scene as she ascends with her cleaning equipment on the elevator accomplished to the Accelerationen waltz of Johann Strauss. Her non-stop, throw-away commentary is by turns gossipy, sagacious, and pragmatic while she remains self-effacing to their bizarre but essentially wonderful task. The second essential figure in the running of the house is the "house doc", the house doctor. He finds solutions to dysfunctions and deteriorations of all prototype mechanisms. Several scenes expose the deplorable physical condition of the building, which is falling apart after little more than a decade. Leaks degradation of the concrete core that holds up the house, blocked doors, and narrow corridors are far from the only problems.

Daily life

There are four facts we can go in depth to take them from art to architecture. First of all, those examples define the world as an ensemble of daily objects. They are focus on portraits, still life, nude, nightlife. Without pretension, yet full of precisely daily nature. Everything looks fresh, as if seen for the first time. Although the abstract appearance, there is no clear line between these situations and realistic ones. So, the quotidian world is accessible and valuable to art. They make all the cultural and aesthetic forces visible. They bring realistic and spatial scenes to mind. The artist and photographer are in close relationship to common things in common places, but also, for the same reason, with architecture.

To deep into this concept, the designers Naoto Fukasawa (1956) and Jasper Morrison (1959) take in account the value of the "Super Normal" (2007). That is something bases in the

prevailing scheme of common sense designs; a consciously designed normal above-and-beyond normal. Fukasawa admires "when viewing something with expectations of a new design, our negative first impression of "nothing much" or "just plain ordinary" shifts to "… but not bad at all" and supports the fun and pleasure of reconfirming what we would disregarded as "naff". In words of Morrison, the "Super Normal" object is the result of a long tradition of evolutionary advancement in the shape of everyday things, not attempting to break with the history of form but rather trying to summarize it, knowing its place in society (Morrison 2007: 21,29). "Super Normal" is concerned with the homely memorable elements of everyday life.

Also, some contemporary artists have worked on this issue: William Eggleston (1939), Stephen Shore (1947), and Wolfgang Tillmans (1968). Eggleston's *Democratic Forest* catalogue refers to a democracy of vision, through which he represents the most mundane subjects with the same complexity and significance as the most elevated. The images, made in the 1980s, travels from his familiar ground in Memphis and Tennessee to several American cities. Shore states: "I've left often like an explorer, and I'm interested in not just bringing my set of values and ideas to the rest of the country, but I'm also interested in seeing what's there". He remembers the Hamlet's words at Shakespeare's *The Death of Gonzalo* play: "the purpose of playing was and is, whose end, both at the first and now, was and is to hold, as 'twere, the mirror up to nature; to show virtue her own feature, scorn her own image, and the very age and body of the time his form and pressure" (Shore 2004: 183).

The inherent coolness of ordinary Tillmans' photography is taken to an extreme along with the apparent indifference to pictorial composition or techniques. In fact, the photographer affirms "That's how I want to convey my subject matter to the viewer. Not through the recognition of predetermined art historical/image categories but through enabling them to see with the immediacy that I felt in that situation" (Tillmans 2003: 303). In part, contemporary photographs of buildings come as quite as plain because they suddenly hide the underlying spatial theme, forgetting the living architecture. The photograph print of Tillmans absorbs all the architecture and all the life.

Day-to-day task

The presented works pay attention to the everyday task in domestic settings. In *Morning Cleaning*, the cleaner washing the windows represents many different notions of space. Its original subject is the maintenance of the transparency of glass architecture through the labor of cleaning, mainly cleaning the glass. This connects modernity and modern architecture with nature and household duties, since it is nature that makes glass dirty. While the building's formal rigour and rich materials carry the image of luxury, the cleaner calls the attention to the system necessary to maintain the architect's vision. On the other hand, it makes visible activities which are normally unseen or overlooked. Each picture is documentary in the sense that is exactly what we would need to do to keep the essence of the Mies' Pavilion; it is the openness to the daily architecture.

It is related to other Jeff Wall' pictures like *Volunteer* or *Housekeeping* (1996), where a man mops the floor of a drop-in centre kitchen and a chambermaid exits a pristine hotel room, respectively. Seventeenth-century Dutch paintings, like *Interior with Reading Woman and Sweeping Maia*, performed this field. The affinity between both paintings has been already studied (Städelches Kunstinstitut und Städtische Galerie, Frankfurt am Main, 2002). Wall states the interest in the complexity of the experience we must have every day in developing relationships with the past. This point of view brings to our mind the work of the sociologist and photographer Lewis Hine (1874-1940). Hine treated the dirty workspaces as a stage-set to see from the photographic peephole what is hidden to ordinary sight. Even, he used it as a tool for social reform by using them as instrumental in changing child labor laws in the United States.

Living architecture

About the spatial context of the contemporary art, the circle of peolple and experiences interposes itself much more forcefully that the landscape and architecture. The artist makes a space in which they can live by taking human stories and daily activities, and forgetting how intelligent and beautiful the structure is. While this might imply a certain clarity or honesty, the modernising impulse also homogenises, tending towards rationalised modular forms that often cut the ties between function and legibility.

Phantom and *Koolhaas Houselife* explores architecture from an unusual point of view. *Jaque* defines the Pavilion's basement as the mechanism whereby the traces of all the negotiations, experiments, and accidents that define the building are hidden from visitors and effectively rendered invisible. It is the place where a number of micro-stories around the building's existence, preservation, and performance are *black-boxed* (Jaque 2012: 8). It is not the visitor but the staff who truly know the complexity of the twofold Pavilion. Only they see the opposing but interconnected aspects of the building.

Bêka and Lemoine put into question the iconic building by the deconstruction and construction of daily life. Between changing the sheets and vacuuming the floor, we get onto the everyday reality. This house shows the existential ambiguity between effort and routine. Architects try to reconcile the utopian component of the modern house with the age-old habits: the rhetorical model of "life as it should be" and he wearied reality of "life as usual" (Fernandez-Galiano 1998:1). *Koolhaas Lifehouse* is the proof of the hard maintenance that the house needs due to the modern ideal. The *Museum Photographs* series of Thomas Struth (1954) brings living presences to the scene to compose a new life. Each to their photographs makes the person into a figure giving a renewed life to interiors which have been

corroded by the accidents of time. On the other hand, his work renders the experience, which is the encounter with various aspects of the outside world.

Social construction

The described works leave the realms of the symbolic to engage directly with social and political reality. They work the production of a situation, inventing the rules of a game, the scenario for a situation that affects a reality, a negotiation between the contingent and the necessary in architecture. The Pavilion's staff experiences the building as the confrontation between two ways of socializing daily life. The first is a self-referential architecture, fixed in its precious materiality and far from conflicts and contingences. The second is the one whose mutability makes possible the purity of the previous one. It is the socializing daily life.

The attention to the ordinary relation between constructed space and social and individual states has been developed by the artist Gregor Schneider (1969). *Hans ur in Rheydt* is the house where he lived for many years between the original walls and the newly constructed sections, describing double windows in front of a solid wall, moving wall sections and connecting narrow passage ways between rooms. He even changed and installed the house in different galleries and festivals. This is an artistic work of an architectural scale. He affirms the existing building, but only because of the connection with a deeper level that questions the existential possibility of dwelling by finding refuge in a house. With the change of location inside the house, it is visible the contradiction between the inconsequential ordinaries of a room and the uncanny foundations of domestic living. In the same sense, his contribution to the 2001 Venice Biennale defines a house's historical exterior and his private house: outer world versus the inner, the collective sphere versus the individual.

Streamside Day by the artist Pierre Huyghe (1962) works on the empowering of a community. A residential development was constructed in a forest on the Hudson River in New York State. The new residents were invited to an event to celebrate the birth of their community. That is how Huyghe invents a tradition for the new suburban settlements. The ceremony consists on a tree planting ceremony, speeches by local authorities, a barbecue, and so on. The work is the support of meetings, signs, and corporations. This event is a form of art that is able to modify the public space rather than just temporarily occupying it.

For all its sensuous and natural beauty, the described images are a laboratory test, a forensic exposure of a renewed way of architecture. The next step is to debate about how it can become part of a daily spatial perception.

On everyday architecture

It is important to consider how the sensibility in ordinary takes place in architecture. Robert Venturi, Scott Brown and Associates staged the exhibition 'Signs of Life: Symbols of the American City' at The Smithsonian Institution in Washington in 1976. The exhibition approached the American urban scene as a complex puzzle in need of decoding. In the gallery space various images were placed in relation to real objects (neon signs, furniture, pieces of architecture). Stephen Shore, who was then deep into his photography of vernacular towns and buildings, was commissioned to make the documents. Shore explains: '"The apparent is the bridge to the real. For many photographers, architecture serves this function. (…) A building also expresses the aesthetic parameters of its builder and its culture. This latter is the product of all the diverse elements that make up 'style': traditions, aspirations, conditioning, imagination, posturings, perceptions" (Shore 2008: 10). In the book *Learning from Las Vegas* (1972), Venturi concludes: "Learning from popular culture does not remove the architect from his or her status in high culture. But it may alter high culture to make it more sympathetic to current needs".

Due to their friendship, we can review the point of view of Jeff Wall and the architecture firm Herzog & de Meuron. Jacques Herzog once said that art is twenty years ahead of architecture. That means, in words of Jeff Wall, that if you want to experiment, it is easier if you are an artist than an architect, since an artist does not have to deal with all the practical constraints of architecture. So, architecture is never a free art. However, Herzog & de Meuron seems to play in an in-between space. In 1984, they designed *Lego House* as contribution to "L'architecture est un jeu… magnifique" (Centre Georges Pompidou, Paris, 1985). They show a view into and from one both specific and common room: the child's room. That is, the youth, the memories of day and night fantasies, of fear, sleep and eroticism. The atmosphere in these photographs is created by the chosen architectural elements: a wooden chair painted white, a shelf for the clothes, a desk, an open cupboard with the heart-like ornaments, a bed, the bedside lamp, the harmless ceiling map, its shadow on the nocturnal wallpaper. It is the image of a villa and the image of its architecture. Herzog & de Meuron's use of conventional, quotidian elements of architecture may even belong to the banal but, at the same time, shows a respectful appreciation toward them. Through the real materials, the language, the construction, and the tectonic composition they create connections to the users, the domestic surroundings, and the site's history (Herzog & de Meuron 2003: 219).

Three years after the *Koolhaas Lifehouse* documentary, Koolhaas published *Junkspace* (2002). The short essay makes architecture aware of the People's Architecture. Junkspace seems an aberration, but it is the essence, the main things. Elements such escalator, air-conditioning, sprinkler, fire shutter, sparkling infrastructures of light, LEDs, and video have truly revolutionized architecture, but all them are missed from the history books. Junkspace is everywhere, Junkspace is additive, layered, and lightweight, Junkspace knows all your emotions,

Junkspace is political, Junkspace pretends to unite, Junkspace creates communities (Koolhaas 2008: 182). However, when we think about space, we have only looked at its containers. As if space itself is invisible, all theory for the production of space is based on an obsessive preoccupation with substance.

Art and other practices are aware and face the proximity of everyday life. What if space started looking at People's Architecture? The thoughtful and playful narrative of all these works re-examines many important architectural concerns and that itself is definitely something worth holding on to.

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Financing Italy's Cultural Heritage Sites

Allison Suhan

Abstract: With fifty World Heritage sites, Italy is fiscally responsible for more World Heritage sites than any other country in the world. The country has seen many years of economic uncertainty, and the need for heritage site maintenance continues. In recent years, unique funding strategies such as fee structures, tax incentives, and public-private partnerships have been utilized to counteract the deteriorating culture budget and support Italy's architectural assets. Through case studies of World Heritage Sites in Italy, the research for this paper examined ways the country has balanced this monetary responsibility through these strategies. These projects are on-going and ever-changing, thus making them particularly relevant for the most current cases to explore. The research results in a recommendation of how to finance lesser-known sites and how the financing tools utilized in Italy can be applied elsewhere.

Key words: public-private partnerships, world heritage, Italy, conservation, restoration.

Financiación del Patrimonio Cultural de Italia

Resumen: Con cincuenta sitios declarados Patrimonio de la Humanidad, Italia es fiscalmente responsable de más sitios declarados Patrimonio de la Humanidad que cualquier otro país en el mundo. El país ha experimentado muchos años de incertidumbre económica, y la necesidad de mantenimiento de los sitios patrimoniales continúa. En los últimos años se han utilizado estrategias de financiación únicas, como estructuras de tarifas, incentivos fiscales y asociaciones público-privadas, para contrarrestar el deterioro del presupuesto cultural y apoyar los bienes arquitectónicos de Italia. A través de casos de estudio italianos catalogados como Patrimonio de la Humanidad, la investigación llevada a cabo en este artículo examina las formas en que el país ha equilibrado esta responsabilidad monetaria a través de estas estrategias. Estos proyectos están en curso y en constante cambio, por lo que son particularmente relevantes para explorar los casos más actuales. Este trabajo da como resultado una recomendación de cómo financiar sitios menos conocidos y cómo los instrumentos de financiación utilizados en Italia pueden aplicarse en otros lugares.

Palabras clave: aasociaciones público-privadas, Patrimonio de la Humanidad, Italia, conservación, restauración.

Introduction

Italy's management of heritage sites, and specifically its funding strategies, have been attracting media attention quite a bit in the last decade. From Nero's Dome crumbling to the ground, to Pompeii caving in, parts of the Trevi fountain deteriorating, and sites being closed indefinitely, Italy has sparked some attention with people questioning who is stepping in to help and how does Italy manage it all?

With 46 cultural World Heritage sites and four natural World Heritage sites, Italy is responsible for more World Heritage sites than any other country. This is only a fraction of the over 50,000 documented architectural assets that Italy recognizes and maintains (Compagna, 2013). Unfortunately, due to the economic state of Italy, the country has cut its culture budget by a third since 2010. With this decrease in funding and overwhelming responsibility to its sites, Italy needs to be evaluated by scholars in terms of its state role and diversified funding mechanisms such as private donations, fee structures, and public-private partnerships to counteract the deteriorating culture budget.

Methodology

Italy has seen many years of economic uncertainty, yet the need for heritage site maintenance continues. This continued fiscal responsibility is worthy of research in hopes that Italy's unique funding strategies such as private

donations, tax incentives, fee structures, and public-private partnerships to counteract the deteriorating culture budget can be an example for other nations facing or nearing similar economic issues.

I have gathered my information through literature reviews published in either Italian or English focused on Italian heritage sites, UNESCO sites, financing culture, visitor behavior, museum studies, tourism management, archaeology, and nonprofit funding. The literature consists of peer-reviewed journals, government documents, and conference papers. I have also gathered much of the case study information from newspapers and magazines since these are all projects that are in progress or recently completed and in current discussion. A less traditional way I gathered information on these case studies was through reputable social media accounts on Instagram, Twitter, and Facebook, as well as creating Google alerts with keywords related to my research and case studies. These resources allowed me to have consistent access to any updates on the projects or new Italian legislation related to cultural heritage. With the case studies and funding strategies organized in this research, future researchers and conservationists have a comprehensive evaluation of Italy and MiBACT's financing capabilities. As the case study projects continue to unfold in the future, this research can be built upon and enhanced by others.

The Role of the Italian Government

Italian cultural heritage is managed at a national level by the Ministry of Cultural Heritage and Activities and Tourism (also known as the Italian abbreviation MiBACT), which oversees heritage protection throughout the state. MiBACT operates at a local level through its organizational units known as *soprintendenze*, which manage cultural policies and work with local governments on issues related to conservation. Italy's economic and political issues have affected the *soprintendenze* and weakened their centralization within the state.

A series of Italian laws have recently been implemented to address its cultural heritage. In 2002, legislation was passed that enabled the sale of state-owned cultural property, under Law Jun 15, 2002, n. 112 Art. 7. "Patrimonio dello Stato S.p.a.". The legislation was passed as a way to authorize the liquidation of some of Italy's cultural properties to help reduce its oppressive public debt and allowed for the option to lease or sell art, historical monuments, and even natural resources (Benedikter, 2004). In the following year, several monuments were auctioned off to private investors (Waterhouse, 2009). In 2004, Italy passed the Code of Cultural Heritage and Landscape or "Codice Urbani." Since then, it has been modified by two other ministers in 2006 and 2008, resulting in a bipartisan endeavor towards culture (Council of Europe, 2015). The code essentially applied more stringent requirements to the privatization of public services in cultural heritage to prevent improper alienation of public property. This was, in part, a response to the public's disapproval to the selling of historic *palazzi* in 2003.

The government realized the gap in resources needed to maintain heritage sites and turned its attention to private donors by implementing what is known as the Culture Decree that was entered into effect as Law No. 106 in July 2014. The Culture Decree mandated the creation of a Strategic Plan for "Major Cultural Patrimony Projects" and appropriated funds for it in the sum of €5 million for 2014, €30 million for 2015, and €50 million for 2016 (Figueroa, 2014). Within the law lies the most attractive piece for private investors, known as the Art Bonus. It grants a tax credit of 65% of the contributions towards cultural heritage and tourism made in 2014 and 2015 and a credit of 50% of the contributions made toward the sector in 2016 (Foglia & d'Ayala Valva, 2014). These credits must be for financial contributions that aid in the maintenance, protection, and restoration of public heritage sites, or to support cultural institutions. In order for the government to accommodate these credits, the tax credit will be equally spread over three fiscal years. Furthermore, there is a tax credit cap depending on the contributor. Non-commercial entities as well as individuals cannot exceed 15% of their taxable income. For companies, the tax credit caps at 0.5% of their annual revenues. This law incentivizes companies to enter partnerships with MiBACT.

Private Individual Giving

Most sites of cultural significance around the world welcome private donations to support the site and its future. Italy is no different. These donations can help the site as well as directly involve visitors in its success. However, it is important to look at private individual giving in a cultural context.

In 2009, professors from the University of Torino and the University of Catania designed a survey that evaluated the motivations for Italians to donate to local sites of cultural significance. They first asked the individuals to state their willingness to donate to a cultural heritage institution in a neutral scenario. In the second set of questions, they asked if respondents would modify their first answer based on three new independent scenarios—tax rebates, reputational incentives, and transparency of the destination and the use of the funds given.

The result of the first question was that 32.7% of the respondents were willing to donate to a cultural heritage site. When given the second set of questions based on independent scenarios, transparency and accountability overwhelmingly attracted those surveyed who originally would not donate to a cultural heritage institution (see Table 1) (Bertacchini, 2010). This result makes sense culturally when one considers the Italian government and the history of corruption and the mafia that the country has lived with through its political history. Most recently, the deputy for the regional culture ministry for L'Aquila was

Table 1.- Donors' behavior according to the best choice variable with new contexts (Bertacchini, 2010).

Choice	Average Donation (in Euros)	Total Donors	% Initial Non-Donors in the group	Total Amount Donated (in Euros)
No Donation	0	473	100%	0
Fiscal Incentives 19%	68.12	32	56.25%	2,180
Fiscal Incentives 50%	146.40	166	36.75%	24,302
Reputational Incentives	542.62	16	31.25%	8,682
Transparency/Accountability	123.48	191	60.73%	23,585
Pure Prosocial	60.16	122	0%	7,340

arrested for corruption along with four other officials for alleged mishandling of restoration funds in June of 2014. In January of that same year, the vice-mayor of L'Aquila was forced to resign after being accused of bribery in exchange for building contracts (Nadeau, 2014).

Tax Incentives

The data displayed in Table 1 also notes fiscal incentives (tax credits) for donors to cultural heritage. Italian law at the time of the study allowed tax rebates for donations to cultural heritage at a rate of 19% of the amount donated (Bertacchini, 2010). The survey added an additional scenario of a hypothetical 50% tax rebate to understand how appealing tax incentives are to individuals which resulted in attracting 36.75% of the initial non-donors. This option received the second highest number of donors after those incentivized by transparency and accountability.

As discussed earlier, the Italian government has recently enacted a new tax credit policy. The Art Bonus that was recently enacted, should encourage private donations. According to the study, this should mean that there should be a 36.75% increase in private donations. As for corporate donations, this new tax policy should prove to be an incentive for increased partnerships and private donations.

Visitor Fees

Charging entrance fees to cultural heritage sites sparks debate across multiple disciplines. Depending on the type of site, for example a church, it may not be appropriate to charge a visitor fee. In other instances, requiring visitors to pay can help with costs and also regulate how many visitors are at a site at a time in order to better maintain the site. Recent studies of Italian state-run museums have found that revenue generated by ticket sales and additional services such as bookstores and gift shops only cover 12-15% of the overall operating costs of a site (Trupiano, 2005). In addition, MiBACT collects ticket proceeds and distributes them amongst all the heritage sites it oversees. Therefore, one site does not receive ticket revenue in proportion to its visitors. Furthermore, there are many sites that cannot implement visitor fees due to an inability to limit access, such as the Rialto Bridge in Venice. So while it may appear that the funds are distributed disproportionately, this system does allow for funds to reach sites that cannot regulate visitor fees.

Recently, the Italian government passed legislation to end the practice of allowing EU citizens ages 65 and over free admission to state-owned heritage sites including museums and galleries. This new legislation was implemented on July 1, 2014 and should aid in site funding through fee collection because age 65 and over EU citizens accounted for 26% of the visitors in 2013 (Hanley, 2014). While this is not a solution to tight funding at individual sites, it does demonstrate that the government is devoting attention to its visitor demographic and the impact they have on site revenue.

Public-Private Partnerships

The most promising strategy for heritage preservation in Italy is the concept of a public-private partnership funding maintenance and restoration of a site.

In order to create a partnership, the public sector, in this case the Italian government, initiates a request for proposals. This helps it gauge the private sector interest and the feasibility to secure the necessary funding. The government will then discuss the risks and responsibilities of each party as well as agree upon the expected benefits to each party. Once this has all been addressed, each entity signs a partnership contract and work can begin (Macdonald & Cheong, 2014). This relationship between public and private sectors has become the current trend in Italian restoration efforts. It has allowed for sites to receive assistance from the private sector without becoming privatized. A successful heritage preservation partnership agreement will ensure that public access as well as conservation practice standards are not sacrificed for the sake of financial assistance. There are growing numbers of notable partnerships in Italy that provide insight to scholars on how this concept is being implemented in reality.

The Colosseum

The Colosseum is a quintessential site for Italy. It receives over 8,000 visitors a day and while it brings in over €32 million a year through its entrance fees, the Colosseum is only allocated €500,000 of it from MiBACT to put toward maintenance (Xinhua, 2010). The remaining profits are disbursed to other cultural sites by MiBACT. While this nest egg of euros may be fine for small projects, it certainly cannot sustain all maintenance needs, much less a full restoration. In July of 2010, MiBACT announced that it was seeking sponsors for an extensive restoration of the Colosseum.

This is where luxury goods company Tod's comes in. Diego Della Valle, chief executive at Tod's, understands that if his company's pride comes from the 'Made in Italy' stamped on each product, then Italy's image must be maintained in order for him to succeed. This is why Tod's offered to fund a €25 million restoration of the Colosseum with the promise that it will be completed in three years (Nadeau, 2011). In return, Tod's has the rights to the Colosseum logo for fifteen years and can put its own logo on all Colosseum tickets (McKenna, 2012). The partnership between MiBACT and Tod's is an excellent example of how a public-private partnership can reap significant rewards for the site, the city, and the investor.

Trevi Fountain

Tod's initiative has sparked other partnerships between Italy's fashion industry and the state. Fendi agreed to a $2.93 million investment towards the Trevi Fountain in January of 2013. This is part of its larger "Fendi for Fountains" campaign that is committed to restoring Rome's fountains. While its mission is vague, the Trevi Fountain as well as the Le Quattro Fontane complex are their flagship projects for the campaign.

The Trevi Fountain celebrated its 250th anniversary in 2012 and has been inscribed on the World Heritage List since 1980 as part of the historic center of Rome. In recent years, the baroque façade began crumbling, with pieces even falling into the public right of way. In addition, weather issues resulted in parts of the façade becoming detached. Fendi's commitment to the fountain ensured the cleaning of the façade and statues, maintenance of the steel supports, the installation of new pumps and electric works, the replacement of the gilded Latin inscriptions, and waterproofing of the water basin (Johanson, 2013).

In return for the work completed on the Trevi Fountain, Fendi's logo was up during the restoration period, and, upon completion, a small plaque of appreciation for Fendi will be displayed for four years on the fountain (CNN Travel, 2013). The site's largest challenge was accommodating visitors during restoration. The fountain was drained and an elevated catwalk was installed to take visitors up close to the fountain's statues. Unfortunately, the tradition to toss a coin into the fountain upon visiting to ensure a return to Rome has proven an issue. Visitors have been throwing coins in close range to the statues from the catwalk and incidentally damaging the statues as well as hitting restoration workers. To alleviate this problem, MiBACT developed a mobile app for the Trevi Fountain, which contains historical information, restoration work updates, as well as a feature that allows visitors to virtually throw a coin into the fountain if within 100 meters of the site. MiBACT also installed a small temporary replica in front of the fountain filled with water to better articulate how the site normally appears to visitors.

Ironically, despite ongoing funding needed for this highly visited site, since 2006 any coins thrown into the fountain are collected and donated to Caritas, a Catholic charity which subsidizes a supermarket for Romans in need. An estimated €3,000 are thrown in to the fountain each day, collected nightly, and dispersed into Caritas' account (BBC News, 2006). While an excellent and noble use of funds, it can be argued that since 2006 an estimated €1.4 million has been thrown into the fountain. This could certainly benefit the historic fountain and ensure funding for a site which is free to the public.

Pompeii

Not all projects have easily found the funds needed to successfully continue. Lately, the most troublesome site for the country is the archaeological site of Pompeii. As the second most visited site in Italy and attracting 10,000 visitors per day, tourism demand is taking its toll on the site. This 66-hectare site has witnessed the culture budget crisis through reduction in its staffing as well as lack of restoration financing. In 1997 when the site was inscribed as a World Heritage site, there were 279 employees running the site. By 2013, there were only 197 due to tight budgets and retiring staff not being replaced (Euronews, 2013). That is a 30% cut in staffing at a site that is certainly in need of full staffing. Due to the lack of staff as well as minimal funds to keep up with restoration, there are currently only five individual sites open within Pompeii compared to 64 sites that were once open for visitors in 1956. Conservation efforts have been the primary need for the site. UNESCO reported 13 domus, or houses, at risk on the site and in 2010, a section known as the House of the Gladiators collapsed due to water infiltration, neglect, and poor restoration completed in the 1950s (Viggiano, 2011). This is only one of many houses within the complex that have collapsed or fallen into disrepair. At this point, the World Heritage Committee declared its deep concern for the site and urged the state to address the conditions that contributed to the collapse.

Coincidentally, Herculaneum, which is listed as part of Pompeii on the World Heritage list, played a significant role in the future of public-private partnerships. In 2004, the site partnered with the American-based Packard Humanities Institute (PHI) for support and PHI started small pilot projects at Herculaneum to better understand the overall project needs. After the pilot projects, PHI brought on the British School at Rome as a third sponsor for operational support. An innovative sponsorship agreement was drafted as a result and was the first site to utilize the new Codice Urbani legislation that allowed private partners to directly intervene on a public site to carry out conservation efforts at their own cost and management. This partnership paved the way for future public-private partnership models to exist at other publicly run heritage sites (Thompson, 2012). It has now been over ten years since this opening of legislation to private sponsorship at Pompeii. Hopefully management can refer back to its recent past and open its doors for private aid or risk further losing historic areas of Pompeii and being called out by the World Heritage Committee.

Recommendations

With the recent adoptions of increased tax credits, adjustments to visitor fees, and a focus on public-private partnerships, it seems that Italy is focused on improving its cultural heritage budget crisis while maintaining state ownership of sites. Public-private partnerships have been responsible for the latest large influx of funds, but there needs to be restraint to not begin the commodification of Italian culture that will lead to sites such as the "Fendi Fountain" or "Tod's Colosseum." These partnerships are a positive alternative to Italy's 2002 legislation that allows MiBACT to sell cultural properties. If MiBACT can continue to establish partnerships that prioritize the site over commodification, then this can be a successful option for heritage management funding.

While well-known sites are being financed and attracting public attention, what happens when all of the 'renowned' sites are claimed by private companies to sponsor? Will companies with a focus on corporate social responsibility look to sites less frequented by tourists and identified with Italian culture to invest their money? Italy cannot depend on these partnerships, but it can prepare a better system that utilizes these partnerships to ensure the viability of other equally important heritage sites.

One concept I have developed is 'Sister Sites'. For every public-private partnership that is established, a percentage of the funds will go towards a lesser-known heritage site in need of restoration. The corresponding site could be chosen from the list of sites curated through the Italian not-for-profit organization Fondo Ambiente Italiano (FAI). FAI began a program entitled 'I Luoghi del Cuore,' or 'Your Beloved Sites,' in which individual donors identify a building or site they appreciate and is in need of restoration. In the 'Sister Sites' concept, we can look at the Colosseum partnership as an example. Tod's would agree to fund the Colosseum restoration for €25 million and it would choose the percentage it would like to contribute to the Sister Site program. For this example, Tod's chooses to commit 2% of the funds to a Sister Site and would use FAI's curated list of sites voted for in 2014 to select a beneficiary. In this example, the Convent of the Capuchin Friars in Monterosso al Mare would be the recipient of the Sister Site funding since it received the highest percentage of votes in FAI's 2014 'I Luoghi del Cuore' program. With this Sister Sites program, the Convent would receive €500,000 that would otherwise be difficult to secure. There would be no guarantee that the percentage of funds given to the Sister Site would cover the total cost of work needed, but it would serve as assistance towards overall conservation financing needs. The Art Bonus would also make the contribution to the Sister Site even more attractive since the sponsor would receive a tax credit equal to 50%-60% of its contribution in the next two years. Of course the Sister Sites program would be folded into the partnership at the discretion of the private investor, but it would provide another site to demonstrate its philanthropic efforts.

Conclusion

Given the recent examples of investors coming forward in the name of Italy's cultural heritage, it seems that public-private partnerships are a strategy worth pursuing more diligently. With further research on the current projects initiated by the state jointly with private investors, there can be a more thoughtful evaluation of how effective these partnerships are. The newly enacted laws relating to the Art Bonus and the new admission fee regulation should be monitored as well, especially since the Art Bonus ends in 2016 and the rule of having aged 65 and over EU citizens pay full visitor fees has not been tested long. Researchers should be observant of any future legislation changes, if the Art Bonus will be reinstated after 2016, and the public response to these new laws.

These projects may be the beginning of a restoration renaissance for Italy and set an example for other countries facing austerity issues such as Greece, but this can only be done if there is transparency regarding the projects, their challenges, and the outcomes. Furthermore, the government must enact tax credits and set up a system that welcomes investment in cultural heritage as Italy has done. While Italy by no means has a perfect system or even a completed strategy, it does lead by example for other countries to learn from. With the revised tax credit policies, the establishment of successful public-private partnerships, and continual attention to the public and visitor behavior, Italy can regain financial stability for its rich cultural assets and invest in conserving heritage.

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The utility of the application of new three-dimensional technologies for the study and dissemination of heritage from a historical-technical perspective: case studies

Irene Ruiz Bazán, Gianluca Emilio Ennio Vita

Abstract: In this article we analyse the different applications of convergent photogrammetry in three different cases. In the first one, the application in the beginning of a restoration project of the Chapel of the Purification in the Church of the Carmine in Milan (Italy), where we will explain the usefulness of this technology. In the second case the utility of the three-dimensional reproduction made to the hidden murals at the Collegiate Church of Santa Maria in Daroca (Spain) for its diffusion and finally the application of this technique as a tool for communicating the results of research in projects. The confrontation of these cases in which the same technology is applied at various stages of the process of conservation and study of heritage, with distinctly different purposes, aims both to deepen their usefulness, such as delineating its limits and requirements

Key words: convergent photogrammetry, building restoration, 3D model, heritage research.

Utilidad y aplicación de las nuevas tecnologías tridimensional en el estudio y difusión del patrimonio desde una perspectiva histórico-técnica: casos de estudio

Resumen: En este artículo, analizamos las diferentes aplicaciones de la fotogrametría convergente en tres casos diferentes. En el primero, la aplicación de esta en fase de redacción de proyecto en la intervención de restauración de la capilla de la Purificación en la Iglesia del Carmine en Milán (Italia), dónde explicaremos las utilidad de estas restituciones. En el segundo caso se analizará la utilidad de la reproducción tridimensional realizada a las pinturas murales ocultas en la Colegiata de Santa María en Daroca (España) y por último se planteará la aplicación de esta técnica como instrumento de difusión de las investigaciones realizadas en proyectos de i+D+i. La confrontación de estos casos en los que la misma tecnología se aplica en diversos momentos del proceso de conservación y estudio del patrimonio, con fines claramente distintos, pretende tanto profundizar sobre su utilidad, como delinear sus límites y los requisitos que estas restituciones deberían satisfacer.

Palabras clave: fotogrametría convergente, restauración arquitectónica, modelo tridimensional, investigación en patrimonio.

Introduction

In recent years the field of cultural heritage has become one of the undisputed protagonists in the development of three-dimensional technology. Although this technology was not born for this application to heritage, its use in the field is demonstrably increasingly inescapable.

The use of three-dimensional technology for the reproduction and modelling of cultural heritage buildings is continually increasing. It is not far from reality to suggest that this technology will be used, in the very near future, in all conservation and restoration projects in Europe.

The advantage of this technology at all phases of conservation, development and diffusion of our cultural heritage is self-evident. In this article we present three different works employed as case studies to illustrate this situation, and consider the relevance of using new technologies and their relative usefulness at every phase of the conservation of heritage from a historical-technical perspective. We currently have access to very powerful technology that, most of the time, is not accompanied by the necessary theoretical and practical reflection on its use which would optimise its use and extend the possibilities it offers. We intend to bring to light the need for a critical analysis of its use which should precede any realisation.

We shall discuss shortly the diverse applications of three-dimensional techniques in different cases.

The confrontation of these cases with distinctly different purposes is intended to clarify and offer new perspectives on their usefulness, such as delineating the limits and requirements of the technology (Pérez Zapata, 2006).

The first case study is the Purification chapel of the church of Santa Maria del Carmine in Milan. It follows the model designed by Bramante and consists of a hemispherical dome supported by a drum sustained by pendentives. The decoration of the ceilings, columns and spandrels is both decorative and figurative; painted surfaces are primarily in the technique of fresco while decorating the high and bas-relief is plaster stucco with gold leaf. The decorative project responds to a unitary project attributed to the painter Giovanni Mauro della Rovere, "The Fiammenghino". The sponsor of the work is the parish in cooperation with Fondazione Cariplo funding.

The second case study is the Collegiate Church of St. Mary of the Body of Daroca Sponsored by the Fundación Campo de Daroca. It is, like most of our heritage, the result of several phases of construction at different periods.

The early church had a semi-circular apse facing east, which became a chapel during the Renaissance reform. The primitive apse remained hidden by a new vault.

During the restoration of the Collegiate church carried out in the nineties by architects Fernando Aguerri and Javier Ibargüen, an access was built through a metal staircase from behind the altarpiece of the new chapel, which allows access to this area. Due to the physical characteristics of the space, this access is too narrow and it is not possible to allow public access, therefore depriving visitors of the possibility of enjoying those mural paintings, about the existence of which, unless the guides offer precise indications, visitors remain unaware.

Finally, we present a case in which the application of technologies of three-dimensional reproduction has a strong educational and informative character which provides to the general public useful and comprehensible results of R + D+ I research, conducted with public funding. Those projects are: *Restoration and monumental reconstruction in Spain 1938-1958. The General Directorates of Fine Arts and Devastated Regions (Ref. HUM2007-62699)*, financed by the Ministerio de Ciencia e Innovación, and continued by the project *Monumental Restoration and Development in Spain 1959-1975*, (Ref. HAR2011-23918), financed by the Ministerio de Economía y Competitividad; and the last one, *Restoration architects in Spain during the Francoist regime. From the continuity of the 1933 law to the reception of the European theory*, Ref. HAR2015-68109-P (2015-2019), financed by the Ministerio de Economía y Competitividad, Secretaría de Estado de Investigación, Desarrollo e Innovación and FEDER founds. The principal researcher is María Pilar García Cuetos, an instructor at the University of Oviedo (Spain). These cases have been presented in the Congress Book of the "5th International Conference Youth in Conservation of Cultural Heritage YOCOCU 2016". Madrid: MNCARS, Ruiz Bazán and Vita (in press).

Methods & methodology

—Three-dimensional reproduction of the mural paintings of the chapel of the Purification in the church of Santa Maria del Carmine in Milan (Italy).

We have a case where the three-dimensional restitution is made in draft form using the technique of convergent photogrammetry (restitution of geometry by performing conventional photographs that are interpreted by a computer programme which also generates a three-dimensional model texture—mapping—applied to it) García León (2008). The preference for using this technique rather than others, such as a laser scanner, is because we are obtaining a map of faithful colours applied to a three-dimensional model which is essential for our purposes and the cameras of the scanner do not allow us to obtain a final quality result. Conventional digital photography applied in this system allows us to perform white balance, and all necessary corrections before making photographs, thus giving us a high quality texture.

Figure 1.- Orthophotograph made from the three-dimensional model of the dome of the Purification Chapel of the church of Santa Maria del Carmine in Milan, Italy.

The main advantage of this system lies in the possibility of obtaining a complete model of the interior of the architectural space which also reveals its physical characteristics and allows us to work in three dimensions to obtain all projections of space we need to develop plans, elevations and sections, damage maps, typological classifications and intervention proposals.

This ability to get as many orthophotographs (photographs that present an orthogonal projection without perspective effects) [figure 1] allows us to get a complete documentation of the place. Thus we can directly measure flat surfaces and get almost immediately the dimension of curves, such as vaults and domes, which allows a degree of accuracy that is almost impossible to date project measurements, especially when, as in the case we are presenting, we still do not have mounted scaffolding that can reach all points that need to be studied.

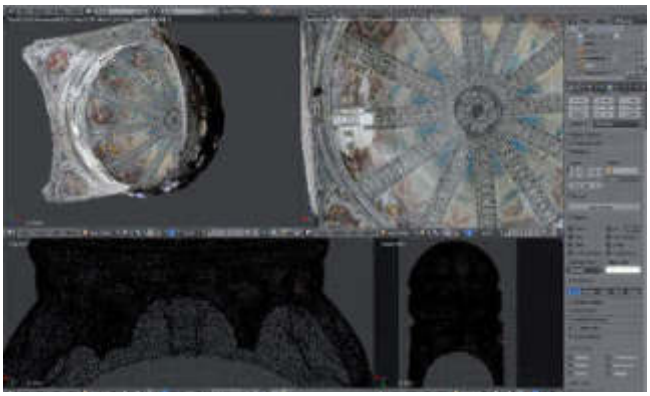

Figure 2.- Three-dimensional model of the dome mapped, shown inside the Blender 3d Open Source software. They are visible some parts deformed in the lower part of the dome. Given the complexity of the model and the presence of numerous points unreachable to the camera, it was necessary the realization of more models and the subsequent unification.

With this material, it is possible to create very accurate plans for the mapping of materials identification, damages, diseases and intervention proposals.

For this work we have used the photographs taken with a full frame sensor camera with 20.2 megapixels (Canon EOS 6D) and processed on a computer with Intel i7 processor and 32 GB of RAM supported by the graphics card Nvidia 3GB. The model obtained is suitable for the reproduction of mural paintings and the orthophotos obtained with the 3D model programme (Blender 3D) with the option to be printed at 300 ppi in A3.

Moreover, the realisation of a realistic three-dimensional model of the chapel can be extremely useful for the communication, perception and comprehension of issues related to the chapel and its paintings and sculptures for both visitors and researchers.

The possibility of viewing the model of the interior of the chapel with a realistic mapping of the paintings from an infinite quantity of points of view and with the full capacity of rotating and moving from bottom to top would be a stunning experience.

Proportions, relations between interior and exterior spaces, light and colours are perceived in a totally different way in comparison with a traditional representation, and also in comparison with the point of view that a visitor can have from the ground level.

Compared with the traditional way of representing ancient buildings, there are two great opportunities that this kind of representation can give to all of us. The first is the possibility of having a hyper-realistic mapping of the object. The surface of the model is no longer an abstraction, but is real (as real as a digital photo can be).

A very important fact is that the three-dimensional model is not realised starting from drawings and then painted, as in all previous physical or virtual traditional models [figure 2]. The model is extracted from photos, as is the mapping that creates the model. It is the paint that creates the volume and the virtual space. This changes not only the process but also the perception that we can have of an ancient building.

This fact is obviously incredibly important when we think about the model as a document for the future. In the case of future restorations or research, to have the possibility of knowing the exact appearance of the building 10, 50 or 100 years before, could be crucial.

The second opportunity is to have a model that you can navigate. Despite the fact that at the moment the technology to navigate inside a three-dimensional model is not suitable for all, we are sure that this will be part of the future of our heritage.

—Three dimensional model of the romanesque apse paintings in the Collegiate Church of Daroca (Spain).

In this case, the use of the technique of reproduction by convergent photogrammetry, using the same technology we have explained, is absolutely suitable for the reproduction of mural paintings and could be used for further study of these paintings or just to display to the general public. The advantage of this type of reproduction versus traditional photography is the fact that having all the documented space in a single file [figure 3] facilitates the understanding of the programme of mural painting and its context, and is extremely useful for paintings preserved *in situ*.

The three-dimensional reproduction in this case opens up new possibilities for the study and diffusion of these paintings; it is possible to have all the space documented and to browse inside, allowing one to zoom in on the areas to study in detail, with the only limit of accuracy being that which has been applied to make the model (the accuracy convergent photogrammetry is defined by the detail we can see graphically and is determined by the relationship between the pixel size, the distance at which the photography has been taken and the focal distance employed).

—Use of three-dimensional models for diffusion of the results of A R + D + I research

Finally, we present a case, recently approved in its third phase and not yet realised, in which the application of three-dimensional reproduction technologies has a strong didactic and divulgative character for communicating to the main public the results of the three research projects.

These projects are intended to contribute to "cover the patent historiographical deficiency in knowledge of the conservative, reconstructive and restorative activity under the Francoist period from the 1950s and over the decades of the 1960s and mid-1970s, which concludes with the

Figure 3.- Three-dimensional view of the mural paints of the Collegiate church of Daroca made by convergent photogrammetry.

death of General Franco" General Franco" (García Cuetos, 2013). The results of those researches have been collected in numerous publications, the most important of which are: *Restaurando la Memoria, España e Italia ante la recuperación monumental de posguerra (*García Cuetos, 2010) *and Historia, restauración y reconstrucción monumental en la posguerra Española (*García Cuetos, 2012). In addition to those books, numerous scientific articles and conference proceedings of congresses have been published, which are, however, directed to a specific public.

The results of these investigations have shed new light on the authenticity of the various phases of the monuments from which we have been able to establish broadly that many of the monuments restored during this period underwent profound changes. They underwent both additions and the removal of architectural elements under the guise of returning them to their "original" state, and intended as a glorious image of ancient Spain.

So, lots of information on what those buildings once looked like has been lost. Instead of this, there were created a number of new additions that could be termed "historically false" that today, due to lack of visual notoriety with which they were made, are difficult to understand (despite the principles of the Charter of Athens and the subsequent Historical Heritage Law promulgated in Spain in 1933 and applicable till the new one was made in 1985, which prohibited reconstructions and, only in the case of extreme necessity, allowed them with the condition that the additions made were always recognizable).

The three-dimensional model made with descriptive intent and not as a faithful reproduction of reality, will allow the different phases of construction and restoration to be distinguished, as well as the lost parts from both inside and outside of buildings to be virtually recreated, which in most cases belong to the baroque period. The appearance of the building during each historical phase will help to increase the knowledge and awareness of what happened during the study period. To carry out this work, we have the original plans on a scale of 1/50 and 1/100, the ancient photographs and the possibility of making a model using convergent photogrammetry of the building in which we add to or remove from a 3D model programme, such as Blender 3D, all the elements we need in order to clarify the different processes of the restoration. The development of these models becomes essential for communicating to the general public the results of this research because the vocabulary used in the written descriptions, specific to the field of art history, the restoration of monuments and architecture, is not easily understood by those who do not have specialised training. Moreover, three-dimensional objects are more easily understood because they don't require the effort of abstraction that a plant or section needs for its interpretation. That is why the realisation of these three-dimensional reproductions will culminate those investigations, which could be used for both informative panels or audiovisual media installed on the monument itself, as itinerant exhibitions or other communication systems capable of bringing to the public the results of the investigation.

Discussion

This article has sought to illustrate the practical use that today we can make of the technologies of restitution and three-dimensional reproduction, especially convergent photogrammetry, applied to the field of heritage management with different scopes: one before an intervention, one when the intervention has already been made several years ago but its results are hidden to the public, and finally when the aim is to communicate to the public the results of a historical research. We have seen how the time at which this technology is utilised changes its utility and its possibilities of being used. Thus, from a better and faster development of the restoration project, we can see the first uprising of these technologies. We have also seen their value as a documentation tool of the current status that could be replayed artificially if necessary. Once the three-dimensional model is complete it could become a very useful tool to facilitate accessibility of the results to the public and researchers who may need these models for consultation purposes. It is precisely this point, the accessibility of these models, which opens today a further discussion surrounding the application of these technologies. Thus, practically as noted above, a large number of the projects of a certain size that have been undertaken in Europe are documented using these techniques, but access to these models is still difficult and often impossible.

Conclusions

The first key issue is to establish a unified format for the three-dimensional models that allows for opening the file from standard programmes. We may establish parallelism between the swap file and pdf file (portable document format) the use of which today can be considered

universal, and so facilitating the use of these files for any researcher or user wanting to perform only consultation should be brought about so that anyone can open them without having to install a three-dimensional modelling programme. In this regard, it seems that the latest trends use a pdf format or 3D WebGL HTML5 accessible from an internet browser, although, as noted, there are so far no rules or protocol regarding the type of file to use to save these views, or on the characteristics they should have, such as the precision, scale of assessment, number of polygons, colour control, etc.

Beyond the problem of non-standardised and regulated formats, we find that there is no unified database in which we can place these models. In this field, it should be noted that 3D-ICONS, a European project, aims to digitalise a number of key pieces of architecture and archeology to provide three-dimensional models. Related to this project, Europeana, the European Union platform for cultural heritage, gives access to different types of content from diverse heritage institutions and CARARE, a network of "best practices", brings together agencies responsible for heritage management and heritage organisations, archaeological museums, research institutions and archives all over Europe to make digital content interoperable with Europeana.

Another remarkable project promoted by the European Commission in this regard is 3D-COFORM which aims to establish three-dimensional documentation as an affordable, practical and effective mechanism for the long-term documentation of tangible cultural heritage. In order to do so, 3D-COFORM proposes an ambitious programme of technical research, along with practical research in the market of three-dimensional views to inform and accelerate the deployment of the use of these technologies.

The implementation of these new technologies in heritage management tends to reach a horizon of extension for its use and standardisation of its formats, but at this moment, that purpose is still a desire and not a fact. At the moment these models are specific realisations, the application of which depends on the criterion of the different professionals of the entities in charge of our heritage. Therefore, there is so much work to be done before we can affirm that these new technologies are implemented properly in the management of our heritage. For now, we can affirm that, so far, its potential exceeds our ability to manage it, since we haven't been able to define standards that allow not just its application to a specific case—drafting project documentation parts, media material, etc.—but to for it to become part of all the processes involved in management. It should be useful from the first moment, facilitating a good conservation project till its last public release, always remaining available to those who could need the three-dimensional reproduction for their studies. If it constitutes an essential reference material, that can facilitate future interventions.

On the other hand, with the appropriate guidance of technicians and competent historians, another use for the development of these new technologies is to materialise or visualise hypotheses about the construction process of these historic buildings. So deep is the geometric knowledge that these technologies offer us, that the possibility exists to "undo the process" that led the monument back to its original state—checking measures, canons, etc.—to try to confirm some hypotheses. This, however, must be endorsed with studies in other disciplines, such as materials characterisation and particularly the great work of archival research and subsequent contrasts to the existing research, which are certainly fundamental to properly characterise the monument.

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Where is the authenticity of the contemporary art?

Carlota Santabárbara Morera

Abstract: In the contemporary art, the conservation of the original matter is not as important as the conservation of the authenticity of the work, because of this it is very important to know the artist and his work, to be able to conserve the most important values. In this process it is very important the documentation and the research. Therefore the criteria of restoration has changed, we can not conserve the patina of the contemporary art as a historic document, if this means the loss of the aesthetic value of the work. Nowadays the art is different, and therefore its conservation is different too.

Key words: conservation, matter, image, Contemporary Art.

¿Dónde está la autenticidad del arte contemporáneo?

Resumen: En el arte contemporáneo la conservación de la materia original no es tan importante como la conservación de la autenticidad de la obra, por ello es muy importante conocer al artista y su creación para poder conservar los valores más importantes. En este proceso es muy importante la documentación y la investigación. Por lo tanto los criterios de restauración han cambiado, ya no podemos conservar la pátina del arte contemporáneo como documento histórico si esto significa la pérdida de valor estético de la obra. El arte de hoy en día es diferente y por lo tanto su conservación también.

Palabras clave: conservación, materia, imagen, Arte Contemporáneo.

Introduction

Nowadays artists give more importance to other artistic values, not so much to physical aspects but to abstract concepts such as the content, message, the experimental creative process or the form itself, the design.

At first sight, it is stunning the restoration of contemporary art since its historical proximity should avoid it. However, we are in front of works that have been highly damaged and deteriorated in the last years, due in most cases to experimentation in the creative processes, the using of industrial materials whose aging was unknown and, above all, to the artists' disdain for the material development of their works.

In front of contemporary artists' attitude, today's theory of restoration is based, largely, on the ideas of Cesare Brandi (1906 Siena, 1988 Vignano). Art historian and restorer himself, he wrote *Theory of Restoration* (1963) where he summed up the basic ideas of his thought. For Brandi, restoration is defined as: "the methodological moment in which the work of art is appreciated in its material form and in its historic and aesthetic duality, with a view to transmitting it to the future" (Brandi, 1963).

From this definition it is understood that only the material the work of art is restored and this is prior in the restoration processes since it unites the historical and aesthetic instances. In the same way, Brandi holds that "the fact that the material may be the same is not enough to allow us to complete an unfinished or damaged building, because the historicity the material would acquire by means of the new use must not be taken backwards in time so as to avoid a historical as well as an aesthetic forgery from being created" (Brandi, 1963).

Today's theory of restoration is based on these ideas when stating that reintegration should be made with different materials to the original ones otherwise this new material apparently old should detract the historical value of the work of art.

In this way what Brandi does is to unify the two instances confronted throughout history, such as those defending the work of art as a historical document (Luca Beltrani) and those who consider it a merely aesthetic element (Viollet-le-Duc). Brandi defines every work as something unique and specific, naming it *Unicum*.

Discussion

The authenticity of the works of art was based on the matter in which it had been created because the work was identified with the finished physical object. But, nowadays it is different, the authenticity and the value of art is identified with many other values, especially when we are talking about digital art or new media (Adorno, 1975).

At this time, the matter does not matter as in the past, when the fetishism attitude towards the matter was because the authenticity of the piece identified with history of the matter, and was considered original for its uniqueness and exclusiveness.

Nowadays, this makes no sense because art has become immaterial Art forms, such as performance, installation, conceptual, digital and processual art. Then comes the rub: the need to rethink the theoretical foundations of the profession.

In many cases, Contemporary art is generated within technological contexts and its value has changed completely; it does not have a physical value anymore, it has become image, sensations and experiences. This is the case of the work Rain Room, (by random International, 2013), an installation of an electronic system that makes rain in a room, but with motion sensor that stop the rain over the person [figure 1].

To this respect we might point out the statements by the Italian theoretician and restorer Antonio Rava, who notes the fact that, in many cases, the artifact is not created by the artist's own hands, unlike conventional painting and sculpture, hence the necessity of new conservation practices which are still being under consideration nowadays, regarding the transmission of the artistic message to the future. And if, in order to transmit the original message, the substitution of elements is required, that would be a legitimate act as far as new information of the date of the change is provided.

The works of art today are created by a design and the artist does not make the work, it has been created based on a design that was generated by a software, the artist only decide how this should be done.

Figure 1.- *Rain Room* by Random International, 2013. Photo by the author.

This execution mode enables the creation of an object without "aura" (Walter Benjamin, 1936). The hand of the artist does no longer intervene in the process of making the piece of artwork, in this way, the piece are no longer "autographs", then, the authenticity reside in the idea, the intention or the experience created, but does not reside on the original matter (Althöfer, 1985).

The change in the definition of art has brought about the change in the importance of art matter. Actually, art is a different kind of communication. It is no longer a formal representation of reality, but it goes further, it transmits, communicates, provokes and, above all, creates experiences.

In the German theories we find that Hiltrud Schinzel, 2003, talks about recuperating the "*Kunstwollen*" (the artistic willpower), which had been previously exposed by Alois Riegl (1858—1905), and that surpasses the critique restoration. In the same way Edmund Husserl (1859—1938) in his phenomenology theory brings us closer to the experience, emotion and sensations that art has to offer, aiming to recover the intention of art, and rescuing the sentiment, the thought and the willpower, and also differentiating between authenticity and originality.

For this reason, we must be conscious of the immateriality of art, and how we should conserve the most important for the artist, maybe the intention, the idea, the design or the experience. Different values that must be considered because art is changing.

The contemporary art approach must be different. It is necessary to work in an interdisciplinary way to research about the new symbolic meaning of the artwork.

This assertion directly affects the criteria of restoration, because the image is an end in itself, independently of its matter.

It is very important to see how the symbolic value of the matter acquires greater significance, over all in Povera Art and in Ready Made. For example, *One Space, Four Places*, created by Tony Cragg at 1982, at the same time of artistic movements like Povera art, Land Art, Minimal Art or conceptual art. The same characteristic of all of them was, that the artistic object crossed borders of the traditional sculpture like a material work made by the artist like stone, wood, or bronze, but they should be air, water, feathers or land.

Tony Cragg first began working with synthetic materials, and other industrial materials. *One Space, Four Places* (1982) is one of this creative process where he used new materials, not only because their physical characteristics but also because their metaphysics qualities. Tony Cragg talks about a "meaning balloon". According to the artist, the stone, the wood and the bronze have a set of meanings underlying which aroused a great deal of poetic connotation [figure 2].

One Space, Four Places is made up of a lot of objects, pieces of brick, cardboard, plastic shampoo bottles, a soccer ball, a cylinder type Campingaz , a can of Coca-Cola, sponges,..., all of this like a metaphor of de degradation of the consumer society. In other words the work was made like a protest against a toxic waste in the river means that if part of the work is lost and a replacement is needed, it is very important to keep in mind that Cragg found all of the materials in the banks of the Rhin river at the beginning of the 80s, and if we want to guarantee the authenticity of the piece, it's necessary to repair it with parts belonging to the same period of time.

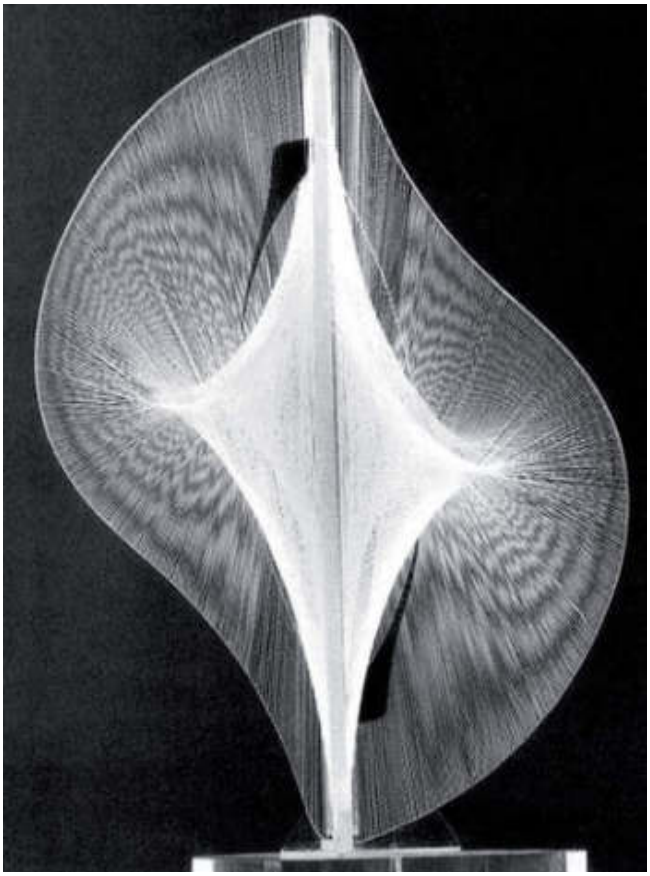

Figure 2.- *One Space, Four Places* by Naum Gabo. http://www.tate.org.uk/research/publications/tate-papers/08/naum-gabo-and-the-quandaries-of-the-replica (22-09-2016).

But, if the matter looses importance in relation to the image, arises the discussion about what is the difference between an original work and its copy.

Another concern in contemporary art preservation is the early decay of the plastic elements. Such is the case of the work *Linear Construction in Space nº 2* by Naum Gabo, in the Stedelijk Museum of Amsterdam, which is made up of nylon threads that became yellowish and broke, which force restorers to substitute them for new ones, since they are industrial materials. But, in this case, as in many others, we should ask ourselves if the complete material renovation of the work would affect its originality, and if we might appreciate a work by Naum Gabo as a work from the late 40s or, on the contrary, a present replica. Perhaps its originality does not longer lie on the constituting material but on its design. Where was the authenticity of the work? Maybe it is most important the image than the material from which it is made (Aben, 1975).

We have quite grown accustomed to the copy, and the perception of it as authentic. Indeed, the original work is often replaced by a copy without people even noticing. Such is the case of the copy of the sculpture of Michelangelo's David, which stands in the center of the city of Florence, and tourists take a lot of photos of the sculpture thinking that it's the original work, but really it is a copy of the original, which is preserved in the Academy.

The image of the art work is what remains. We don't care about the historical value of the material. It is on this point that alternative theories and new contributions to the history of restoration, specifically in the restoration of contemporary art, must be quoted. Among them, Theory of the Project by Francesco Lo Savio, an artistic theory contemporary to Brandi's, who places the importance of art in the idea and not in the material creation. Lo Savio claims that "The artist assumed the project in itself as the most significant part of the artistic process, an original and decisive act in the artistic creation, which is why he assigns the realization to others. For him, the physical production does not count since the work is already completed as a project, before formulating the idea, with all numbers and measures necessary to its possible production" (Righi, 1992).

Above all, in case of manufactured works. In such cases, the value of the artist's intentions is very important, as well as the value of the original object as a carrier of its originality. In relation to this, many examples can be found to demonstrate the importance of the aesthetic appearance, like the Alexander Calder's works, which were created with specific colours. For this reason the loss of uniformity is a big problem for the right

Figure 3.- *Carmen by* Alexander Calder. MNCARS. Photo: http://www.museoreinasofia.es/coleccion/obra/carmen (22-09-2016).

perception of them. Such as the work *Carmen*, placed at Museo Nacional Reina Sofia, or others works, like the one in National Gallery of Art, Washington, D.C. in both cases the works were restored replacing the original paint by a new layer of paint [figure 3].

The original paint was not respected, but the authentic image was recuperated. The "Patina" of this type of sculpture has no sense, because the most important is the appearance like a new work. It is important to remark that the manufacturing of these works is industrialized. It is possible to say that it is not a restoration, but a reparation.

In reference to the question about the importance of the traces of time over the artistic matter, the Italian philosopher Massimo Carboni said that works of art in ancient times were conceived as an unchanging object, which needed to be preserved and restored. However, nowadays, the transitoriness and the ephemeral are more important as artistic concepts (Carboni, 2013).

Beyond the importance of the matter of contemporary art, the second question is in relation to the image of the art over time, and how to conserve the original aspect of the works. This is the case of the artwork *Corner of fat* of Joseph Beuys, a German artist that does a work with a corner of fat in a cardboard box. When the work was exhibited in the Stediljk museum at 1977, the fat was beginning to rot away and also give off a bad smell. For this reason the museum decided to replace the corner of fat by another material more stable. But the artist few years later said that this work had lost the authenticity and its value. When the museum decided to change the original material, the work lost the symbolic meaning of the materia. It is about the importance of the conceptual meaning of the material, beyond the appearance (IJsbrand H., et al., 1999).

In the other hand, Heidegger suggests how aesthetic quality of art has an interesting relation with the social role of art and its meaning. This is the cornerstone of Heidegger's Theory of art. For this reason he considers the "Creative conservation" as the most important thing, which means that the conservation of heritage nowadays is the result of a creative process. That is possible only if Society makes a mental effort to understand the intention and memory of art. (Valentini, 2010:73)

In relation to the conservation of contemporary art, maybe we must admit that we have to conserve the change, like a methodology that also means dynamism in its own definition.

In that respect, we can talk about the work of Zoe Leonard, *Strange Fruit (for David)* which was gathered by the Museum of Philadelphia at 1998. It was an installation of 302 fruit peelings like bananas, oranges, lemons and peaches. [figure 4]

Figure 4.- *Zoe Leonard, Strange Fruit (for David).* Photo: https://imageobjecttext.com/tag/strange-fruit/(22-09-2016).

Paula Cooper, her art dealer propose stop the deterioration, but the artist didn't want. Zoe Leonard had created this work like a process of degradation until disappear. For this reason the work was lost and only we can conserve the documentation of the process like a performance (Rotaeche González de Ubieta, 2011).

"Conserving the change is maybe the biggest challenge for the contemporary art restorers." (Schinzel, 1979).

Conclusions

Contemporary art gives priority to the idea over the material aspect of the work of art, which decisively conditions contemporary art's restoration, leading internationally-reckoned restoration criteria into crisis. Therefore in the restoration of contemporary art the material is admitted to be replaced, whereas in old art

there is a sacred-like respect for it. This obsession for the material is a concept inherited from the Enlightment and Romanticism, historical movements which laid the basis of contemporary art collection and antiquarianism.

The conservation and restoration of the contemporary art is a change without an evident solution, despite the efforts, taken in that respect. What does exists, according to the German restorer Hisltrud Schnizel, is a methodology based on documentation, investigation and minimum intervention, aiming at the potential unity, but being aware that this does not longer lie in the physical object, but in the artist's idea or purpose (Santabárbara, in press).

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Stuttgart main station by Paul Bonatz: life of a monument

Letizia Musaio Somma

Abstract: The process of knowledge and protection of a monument building starts from the recognition of its value and is intended to keep it throughout its lifespan. When the feeling of self-identification with it by a whole community is added to its historic and architectural value, so as to turn it into a national symbol, the active conservation of a symbolic place over time becomes a fundamental commitment, and has to be adapted to the needs of contemporary life. This is the case of the Stuttgart main railway station, designed by the German architect Paul Bonatz in the early twentieth-century and consists of transit crossroads which have been in constant transformation, since its construction to the present day. It was the subject of extensive urban and architectural research, until defining a final hypothesis of transformation conscious and respectfulness of its existing use.

Key words: reuse, Stuttgart, railway station, infrastructural heritage, drawing, 3D reconstruction.

La estación principal de Stuttgart por Paul Bonatz: la vida de un monumento

Resumen: El proceso de conocimiento y la tutela de un edificio-monumento procede del reconocimiento de su valor y su finalidad es conservar este através de su uso. Cuando al valor histórico y arquitectónico se suma la conciencia de la identificación de toda una comunidad tanto que se transforma en símbolo de la ciudad, compromiso fundamental es la conservación activa de un lugar símbolo en el tiempo adaptándolo a las exigencias y a las necesidades de la contemporaneidad. Éste es el caso de la estación de tren principal de Stuttgart diseñada en la primera década del siglo XX por el arquitecto aleman Paul Bonatz, cruce de caminos de tránsito en continua transformación desde la época de su construcción hasta la actualidad. Ha sido objeto de estudio urbano y arquitectónico exhaustivo hasta llegar a una hipótesis de transformación y uso consciente y respetuoso de la situación existente

Palabras clave: reutilización, Stuttgart, estación de tren, patrimonio infraestructural, dibujo, reconstrucción 3D.

German architectural heritage

The study presented here is part of larger research on German architecture and its masters of the twentieth-century. These figures have often been poorly studied in their country due to possible ideological implications of their professional activity with the Nazi regime that had supported some major German architects. This widespread attitude has relegated into oblivion the important contribution to architecture that some of these architects made, as they were considered to be affiliated with the Nazi regime, even in cases where this was not possible due to chronological reasons. This is the case of the architect Paul Bonatz (1877-1956) who, with his production, made an important contribution to the architecture of the twentieth-century and whose main work, the main railway station of Stuttgart, has been analyzed. This work marks the transition from architecture presenting regional and romantic aspects to "Classic Modernism", a New Tradition, so as defined by Kenneth Frampton (Frampton 2008: 147), characterized by simple volumes, elementary parts with measured and austere language. At the time of the construction, the station was defined "historicist" with a negative connotation by radical architects of Modernism.

The history of the infrastructure

This was, in fact, the subject of a Master's degree thesis in architecture: it aimed to study this architecture under several aspects and explore its designer. The attention was directed towards the complete study of this building from

a historical, technological and design point of view, as well as rendering it in relief and drawing. The remarkable result of this architecture to become a symbolic monument for Germany consists in the capacity to put together several important architectural aspects.

Furthermore, Paul Bonatz, the designer of the railway station and several other works both in Germany and Turkey during the first half of the twentieth-century, has not been neglected. In order to acquire a thorough knowledge of his architectural theory we proceeded to the study of his architecture, especially in Germany and of those principles he expressed in his teaching period in the Stuttgart School, where he taught principles such as the importance of the role covered by drawing in architecture, keeping in line with the teachings he received by his master Theodor Fischer during his training in Munich (Bonatz 1950).

The research work about this issue was also stimulated by the events that affected the Stuttgart railway station in contemporary times. During the twenty-first-century, we witness the adaptation of the building to the new requirements related to high-speed transport: for this purpose a new project was carried out to transform the building by constructing a new underground station, close to the historic building, but rotating rail tracks perpendicular to their previous orientation. During the last decade the construction of this project, called "Stuttgart 21" (Roser 2008: 115), which is still in progress, has involved the partial demolition of the building designed by Bonatz. Because of the importance which the monument has today and the need to adapt it to high-speed transport, it was considered appropriate to envisage an intervention that should be respectful of the existing building, especially in light of its historical and architectural value.

Aims - Rebuilding a process for its enhancement

The main purpose of this research is to reconstruct a missing link in German and European architectural history of the twentieth-century, with the intent to define some principles for a new urban planning. Integrating the study of architecture and historical insight with the study of Bonatz, including his other works, allowed us to better understand the reasons behind the choices made in the project of the Stuttgart station. Such integration is also crucial for understanding the role of this infrastructure and to propose a reuse of the same architectural element even in the new changed historical conditions.

Many objectives are behind this research work. First of all, the enhancement of the heritage from the architectural, the monumental and social point of view, considered this not only for the city but also for the nation itself. In this regard, the starting point has been the reconstruction of the history of this architecture over time, through the various interventions and transformations that the station has experienced, even by its first designer. We can identify several phases in its history: from the first phase of the competition (1910) to the building process (1914-1928), from post-conflict reconstruction (1950-1957) to the current transformation.

The analysis focused on two main aspects of the station: the building itself, considered as an architectural gem and the relationship between the monument and the city, highly regarded since the conception of the first project. Our starting point was then the reconstruction of the city's history, through the various phases of its expansion, aimed at understanding the integrated features of the building within its urban context, such as position and orientation (Markelin and Müller 1991). In fact, the city of Stuttgart is in a natural basin surrounded by mountains and has privileged accessibility into the valley which is aligned with a large park and its path was chosen as the direction for the rail beam.

The resulting goal is precisely the analysis of urban elements which play a role in the creation of the relationship between the architecture and the city, such as roads, the turreted elements that act as landmarks and the public space. The research of these relationships is one of the objectives by Bonatz who aimed to follow, at least initially, urban planning as projected by Theodor Fischer which was one of the criteria of the competition (Bartl 1990: 289). He designed the station so as to have visual contact with the main city streets and also provided the design of the square outside the station and the building in front of it. As regards to the building itself, the integrated study of the Bonatz's mindset and its concrete construction in the monument, made it possible to grasp the theoretical evolution and architectural maturation of the architect throughout the years. These studies were conducted with the aim of bringing the building and its urban context back to its original integrity, albeit in digital form, so as to make the use and the preservation of memory possible. This is part of a proposed operation which aims to give new life to the building which is likely to be abandoned, stating the items to be preserved and new methods of use of the architecture.

Research methodology - Complex building in the stratified city

The methodological process we adopted began with the collection of bibliographic and archival data in major libraries in Stuttgart and Baden-Württemberg region, in order to gather the material needed for the historical reconstruction of the various stages in which the architectural and urban interventions can be divided. It consisted of the collection of texts by Bonatz on his main work and texts presented by other authors, sketches and design notes, official documents of the time of the competition and the construction of the building and proposals by other competitors. Original drawings produced by Bonatz were joined to this material pertaining to the building and the city, along with direct relief of the building on site. The large amount of information collected has made it possible to sketch a picture as complete as possible of the genesis and the planning stage, through to the construction of the station.

The next chronological sorting of found documents, relating both to the urban context (historical and urban planning maps) and to the building (competition and detail drawings), led to the accurate reconstruction of the choices at the origin of the project of the station and subsequent works. The great variety, even fragmentary, of the original drawings found was the basis for the reconstruction of each of the major historical phases of the building.

The urban analysis was performed and it has allowed us to understand the context in which the building arose and the choices made for its location and orientation, through the study of the city, according to different thematic layers extended to the entire town and then concentrated in the area around the station, such as monuments, public space, urban axes, poles and knots [figure 1].

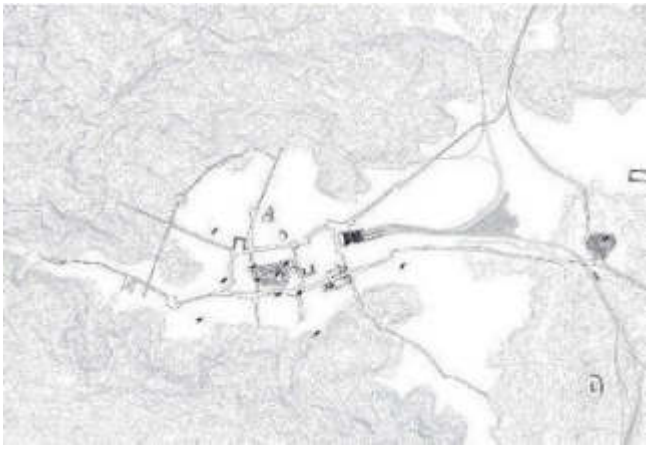

Figure 1.- Stuttgart: analysis of urban axes and monuments. Made by M. Balestra, M. Carbone, L. Fornarelli, F. Franciolapilla, L. Musaio Somma, A. R. Saponara, F. Strada.

The schematization of the context of the urban fabrics around the railway station has highlighted the features and mutually dependant relationship between the monument and the context itself and the reasons for the design choices. Even the historical study of the phases of the town's expansion has supplied an overview as complete as possible of the context in which the new building was inserted at the beginning of the twentieth-century. In fact, we succeeded in reconstructing the history of the railway in Stuttgart since its first appearance with a station building located near the old town, and later on expanding and changing according to new functional needs.

At the same time, a typological study on the building was conducted, placing it in relation to other more or less contemporary railway buildings, to highlight the common features and distinctive elements for railway architectures in the nineteenth-century. Stations in Frankfurt, Leipzig and Helsinki have been analyzed and compared with that of Stuttgart, thus verifying the existence of innovative elements, since the first project designed by Bonatz for the 1911 competition. These elements include the asymmetrical composition of the volumes, the balance between the masses, the tower on the side of a major road, which were quite set apart from the search for symmetry and hierarchy in the facades that were typical of the nineteenth-century (Voigt and May 2010: 37). The typological analysis was conducted focusing on the relationship between the building and the urban core on the basis of mutual interaction, on the study of facade elements such as entrances, towers and foreparts, the position of the side entrances and waiting gallery of travelers related to accesses and tracks room, on main and secondary axes, and the shape and type of roofing on the building and over the tracks.

Regarding the architecture of the building itself, it was necessary, for the purposes of its understanding, to develop a set of drawings on different scales, up to a detailed one, integrating the original iconic material available with the direct relief of the monument. This allowed us to fill in some gaps regarding the building parts which were not represented, partly because of the changes that occurred during construction. The drawings for each of the historical phases have become the basis for the reconstruction of materials and colors used, as well as a tool to investigate the different technological solutions choices over time [figure 2].

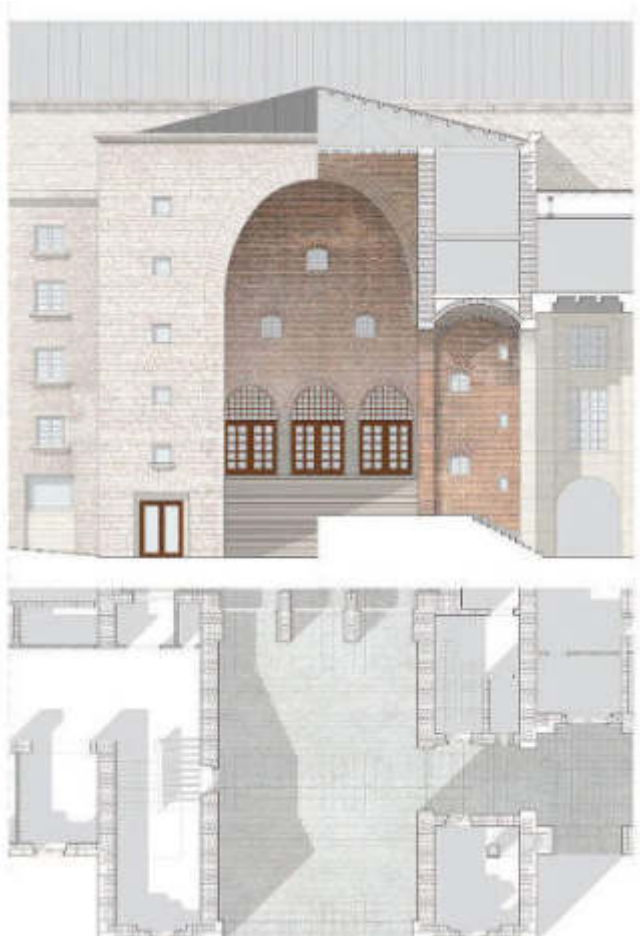

Figure 2.- Facade/section and plan of the small ticket hall (*Kleine Schalterhalle*) at the time of the first version of the building (1928). Made by M. Balestra, M. Carbone, L. Fornarelli, F. Franciolapilla, L. Musaio Somma, A. R. Saponara, F. Strada.

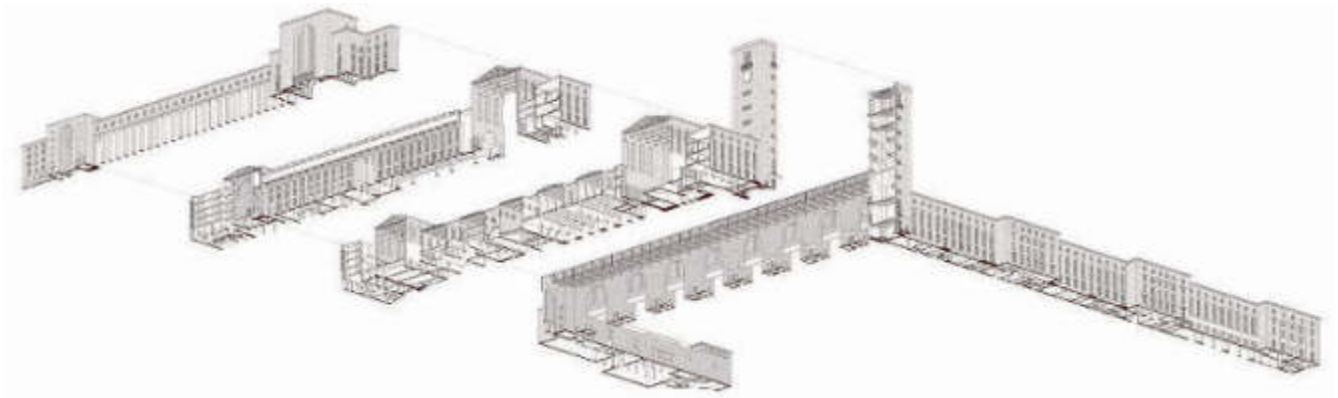

Figure 3.- Axonometric section of the railway building at the time of the first version of the building (1928). Made by M. Balestra, M. Carbone, L. Fornarelli, F. Franciolapilla, L. Musaio Somma, A. R. Saponara, F. Strada.

Figure 4.- New development plan for station area. Made by M. Balestra, M. Carbone, L. Fornarelli, F. Franciolapilla, L. Musaio Somma, A. R. Saponara, F. Strada.

Computer aided analysis of architectural drawings made it possible to complete the representation of details and to understand the relationships and ratios between the different parts of the building.

The last step of this long work of reconstruction was the development of a three-dimensional model for each of the major historical phases identified in the life of the building (first building and post-conflict reconstruction). Those models are intended to reconstruct not only the volumes of the station, including those no longer existing today, but also the internal space and the adopted technological details. This three-dimensional model is a valid tool to spread the knowledge of the monument [figure 3].

The study at different scales of representation, at urban, architectural and detailed level, allowed us to evaluate the complexity of the building and to analyze the characteristics in a timely manner. The study did not stop with historical reconstruction, but included contemporary events and projects.

The analysis of the modern project "Stuttgart 21" and the technical and functional reasons on which the new changes are based, were integrated into a new hypothesis of transformation which aims to give a new function or to restore the railway to the original artifact by Bonatz, so that it continues to be enjoyed by travelers and the local community, while contemplating the necessary changes to its technical and technological upgrading. As for the intervention in the neighborhood of the station, a residential settlement was planned in conformity with the natural and urban characteristics of the place, being a choice which further enhances the value of the place (genius loci) [figure 4].

Discussion of results - New life to the railway station

The results obtained with this research work are manifold and cover different aspects, all of them related to the possibilities of development of the cultural heritage, in this case linked to the world of infrastructure. The first objective achieved was the work of ordering and organizing all existing information on the matter, object of previous historical studies, but not of reconstruction and architectural exploration. Previous partial attempts at organizing information on the subject did not lead to a collection of graphs and historical data such as we obtained. Even the attempt to gather the body of drawings of the Stuttgart station was directed to the knowledge of the monument as complete as possible. These drawings were laying in German archives, available for consultation, but were not yet arranged into a systematic collection illustrating the various parts of the building in chronological order. The reconstruction of what was lost during the war or because of the contemporary transformation allows to preserve the memory and the architectural and building principles behind the project. The main result of the research we performed consists in the collection of a new corpus of drawings on a definite historical basis, to reconstruct the monument of Bonatz with all its characteristics, making it easy to understand its architectural and technological history.

Delving into the urban context, which was made possible through the study of archival documents, has highlighted the basic elements of the project and the importance they play in the current landscape and identifies the guidelines for the new design transformation.

Conclusion

The graphic and three-dimensional representation of the station form the base of a possible permanent exhibition inside the building, which would be useful to spread the knowledge of the architecture and to preserve its memory. This exhibit could take place in the spaces left free by the displacement of a part of the functions in the new underground station. It is a case of use in "infrastructure heritage" to be associated with an actual use with functions related to the scope rail, such as ticket offices and waiting rooms. There are several possible scenarios for the reuse of assets belonging to the "industrial heritage", all aimed at the reuse of places and spaces with a physical and symbolic value, which too often have been abandoned.

Outlook

This research has been the starting point for a study that I am conducting on the PhD course that I am undertaking which deals with the theme "The role of the railway in the development and transformation of the city". It is aimed at the knowledge of a framework of urban transformations related to railway buildings in historical and contemporary times, in order to identify guidelines for new urban transformations related to railway systems.

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Cultural and Arts Education - Project Benčić Youth Council

Natali Bosić, Ivana Golob Mihić

Abstract: This article will provide an overview of the local project with international support - Benčić Youth Council, which works to promote cultural and arts education for children and young people, creating a platform for participation in social change and connection with a wider socio-cultural environment (libraries, theatres, museums, cultural centres ...). The article will give the overview of theory and research findings concerned with culture and arts education that will in the second part be complemented with overview of Benčić Youth Councils practical experience, its emergence, local context and methodology of work.

Key words: Benčić Youth Council, culture and arts education, cultural heritage education, non-formal education, leisure time.

Educación cultural y artística - Proyecto Benčić Youth Council

Resumen: Este artículo presenta una visión de conjunto del proyecto Consejo Juvenil de Benčić, un proyecto local con apoyo internacional que persigue la promoción de la educación cultural y artística para niños y jóvenes, creando una plataforma para su participación en el cambio social y la conexión con un ambiente sociocultural más amplio (bibliotecas, teatros, museos, centros culturales…). El articulo muestra una visión global de la teoría y de los hallazgos de investigación relacionados con la educación cultural y artística, los cuales se complementarán, en la segunda parte, con el resumen de la experiencia práctica del Consejo Juvenil de Benčić, su aparición, contexto local y metodología de trabajo.

Palabras clave: Consejo Juvenil de Benčić, educación cultural y artística, educación sobre el patrimonio cultural, educación no formal, ocio.

Introduction

In the world of technology, computerization, industrialization and globalization, culture and arts education must gain as much space as possible in human life. Every man has a creative potential and considering that it is our duty to develop it and form it through education in order to enable the formation of a coherent personality in children and young people. Using and including local cultural resources, tangible and intangible heritage in education can help young people to strengthen their identity and social cohesion as well as develop intercultural understanding, respect for cultural diversity and culture of peace (United Nations Youth, 2013).

Cultural and artistic education should be an integral part of education programmes at the formal level, but in many countries, formal educational systems are still not given sufficient importance. This is where working with young people through non-formal and informal forms of education appears as a so-called corrective mechanism that compensates for what the formal system, because of its rigidity and inadequacy, is unable to offer to young people (Kovačić, Ćulum, 2015). In the context of culture and arts education, it is precisely the non-formal education programmes that can serve as means of bridging the gap between the separate spheres of education and arts and culture.

Arts and culture education

Vidulin-Orbanić (2008) recognizes four basic needs of young people in today's notion of leisure time: the need for

entertainment, the need for rest, the need for recreation and the need for cultural aspects of leisure time.

The cultural aspect of leisure time is probably the most important aspect in the context of education. Psychologists and anthropologists point to the need of culture and arts education from an early age and indicate its importance throughout the life of a person. They talk about the aesthetic nature of man as a reflection and manifestation of all other parts of human personality (Kermek, Sredanović, 1991). Culture is an area from which we can find out what young people really think, feel, value, hope for and what can be applied in their lives, language, music, fashion or idols. Therefore, by all accounts, the cultural aspect would need to have a central place in the research of leisure time because of it's extremely close relation with educational activities (Tomić-Koludrović and Leburić, 1999, Leburić and Relja, 1999, according to Vidulin-Orbanić, 2008). On the other side education can play a valuable role in "safeguarding" - *ensuring the viability of cultural heritage, including the identification, documentation, research, preservation, protection, promotion, enhancement, transmission* cultural heritage. (Convention for the Safeguarding of the Intangible Cultural Heritage, 2003).

There is an overwhelmingly low percentage of young people who spend their leisure time engaging in cultural and artistic activities. Why is that so? Young people need education about the culture of spending leisure time. It takes a new approach to artistic and cultural education. There must have been some examples of well-designed programmes for the implementation of this type of education, but it became apparent that the theoretical assumption is not sufficient for a necessary breakthrough in practice. It is necessary to start with the realization, which requires a range of components, from the involvement of the wider social environment, a specific place and time for performing the activities, equipment and most importantly, creating a network of various professional associates who will unite their expertise in various areas in order to offer adequate programmes.

Constant social changes and the emergence of new circumstances dictate the need to develop new and more effective approaches to education with the aim of facilitating the ongoing development of cognitive, social, emotional and work-action competencies of children and young people (Mikanović, 2015). It is precisely art that can serve as training grounds where children and youth can experience an active involvement in the experience, processes and the development of creativity.

Many researches have confirmed that the involvement of students in the artistic process and the inclusion of culture in education contributes to the development of a sense of creativity and initiative, fertile imagination, emotional intelligence and a moral "compass", a capacity for critical reflection, a sense of autonomy, and freedom of thought and action (UNESCO, 2006).

UNESCO's document, the Road Map for Arts Education (2006) brings recommendations for educators, parents, artists, school principals and educational institutions (UNESCO, 2006) and discusses the contribution of arts education to education and preparing young people to meet the challenges of the 21st century, describing it as a process that combines physical, intellectual and creative abilities and enables a more dynamic and fruitful relations between education, culture and art.

Nowadays, the transmission of cultural traditions and artistic practices within the family environment is becoming more difficult, especially in urban areas (UNESCO, 2006), and there is a need for creating educational platforms that will inhibit the creative potential of a modern child torn from the cultural tradition of their environment that used to be the main basis of education in former conditions of traditional education.

This paper will provide an overview of the local project with international support - Benčić Youth Council, which works to promote cultural and arts education for children and young people, creating a platform for participation in social change and connection with a wider socio-cultural environment.

The vision of work with youth in the Benčić Youth Council is very well described by the Costello Report, which states that the role of youth work is to empower young people and allow them to develop from a state of dependency in order to enable them to know, feel and believe that they have the ability to control and influence intentionally on what happens to them and their community (National Youth Policy Committee, 1984; according to Kovačić and Ćulum, 2015).

The mission of the Benčić Youth Council is cooperation and empowerment of children to learn, influence and create different forms of art and culture in their city. An important part of this process is the creation of opportunities for the expression of views, opinions and content produced by children.

Project in the making

Benčić Youth Council is a project that originated from good experiences and the artistic project *Preuzmimo* Benčić (Take Back Benčić), which used the former factory Rikard Benčić in Rijeka, Croatia, as a setting and a thematic background. Althea Thauberger, the Canadian artist and author of the artistic project, found the inspiration for her experimental film in the abandoned factory complex with history full of turmoil and changes.

To understand both projects it is necessary to know the context in which they developed. The city of Rijeka is the third biggest city in the Republic of Croatia and currently the biggest port. It has approximately 130.000 residents and it obtained the title of the European Capital of Culture for the year 2020 (www.rijeka2020.eu). Its advantageous geographical position on the seacoast but incised in the

Kvarner bay make it a safe port, close to central Europe, and provided Rijeka with the leading position in the 18th and 19th century for economic investments. That is why Rijeka became an industrial city, which influenced greatly on the urbanistic development, socio-economic picture and aesthetics of the city (Aničić, 2011).

The Rikard Benčić Factory, often called just "Benčić", was one of the biggest industrial complexes in the 18th and 19th century, and although it was not relevant in size in the 20th century, it still remained influential regarding its economic value. This complex was situated here in 1750 by the decision of the Queen Maria Theresa and her son Joseph II, rulers of Austro-Hungarian Monarchy of which the territory of Croatia was a part of, when they decided to start up the sugar refining business. They issued a tender for interested parties from Netherlands, Belgium and Great Britain, of which a Dutch company Proly and Arnoldt sent a bid and founded the Principal Commercial Company of Trieste and Rijeka. The sugar business grew quickly because the state ensured many benefits and tax releases. What remained of that era is the Sugar Palace, restored in 1875, that was used for administration and residence. The factory closed in 1814 after the production of sugar switched from sugar cane to sugar beet.

The complex did not remain empty after the factory had closed. First it was used as a state military base, and in 1851, again in accordance with state decision, a Tobacco Factory was founded and placed inside the complex. The complex still has the aesthetics and facilities that were built for the purpose of tobacco treatment and processing. The most important buildings constructed at the time were the T-object, which housed the Virginia cigar production plant, and H-object, which was used for warehousing and processing (Matejčić, 1988). A very important urbanistic change, for the factory and for the city, was the levelling of the shore in front of the factory, where a road was built first, and then the railroad with the main station. At the beginning of the 20th century, the factory was at its peak, but it was closed in 1944, after the economic crisis, wars and a few large strikes (Magaš, 2002).

After the foundation of the Socialist Federative Republic of Yugoslavia and the end of World War II, in 1947 to be precise, the process of reorganization of economy and industry in the state started (Dmitrović, 1997). One of the newly founded companies was Rikard Benčić, named after the folk hero born in Rijeka. The Rikard Benčić factory produced ship scuttles, skylights, gaskets, ship telegraphs, and other metal products (Bjelica 1988). The production grew almost until the end of the 1980s, when Yugoslavia was affected by an economic crisis and Croatia began with its secession from the confederation. During the entire time of its operation, the area of the factory was surrounded by a high wall and little was invested in infrastructure. The original purpose of the main buildings was changed. At the beginning of the Croatian War of Independence in 1991, the workers were laid off in stages, and finally the factory closed down permanently (Majer, Puhmajer, 2008).

Owing to its historical significance and value, the City of Rijeka bought the complex in 2000. Although at first its purpose was supposed to be touristic, the City decided to use it in order to solve the lack of space and inadequate spatial solutions of the several biggest cultural institutions in the city: the Museum of Modern and Contemporary Art, the City Museum of Rijeka and Rijeka City Library, by forming a museum quarter (Cuculić, 2015). Unfortunately, the plans were not realized due to political changes on the state and municipal level and the lack of financial means. The plan to apply for the European Union structural funds has been made, and the conversion of the Benčić complex is one of the strategic goals of the City of Rijeka Department of Culture, as well as the key point of the programme for the European Capital of Culture in 2020 (http://www.novilist.hr/Vijesti/Rijeka/Raspisani-natjecaji-za-projekte-kompleksa-Rikard-Bencic). The newest proposal to the projects, announced in the spring 2014, is the modification of the so called "brick" building (the former drier house of the Tobacco Factory) into a Children's House where the Rijeka City Library, the Art Cinema Croatia and the Rijeka Puppet Theatre (with several small partners) would organize programmes for children and youth. By allocating the brick building to all institutions but for a specific use, the City of Rijeka, in a way, required the institutions to collaborate and to have programmes adjusted to children and youth. In addition, they have set out the direction that they want to advocate – establishing institutions with programmes that educate the audience from an early age (http://www.rijeka.hr/GradskaKnjiznica).

All this was the inspiration for the artist Althea Thauberger, who decided to deal with seemingly complicated situation by involving more than 70 children from the age 6 to 13 from Rijeka area, to make an experimental documentary movie – explaining the development of the complex from their point of view, also involving the discussion about artist/worker position (Firth-Eagland, 2015). During the preparation, but also the filming, Natali Bosić and Ivana Golob Mihić, with more than 20 collaborators, organized workshops using various methods; applied theatre, dancing, storytelling, debate etc. In this way the children themselves, because they spent time in the space, created an emotional connection with the space and its history, as well as opinions about its future development, presented in dialogues in the film. The director took upon herself to create dynamics, rhythm, goals and general direction of the film.

Since this approach had such results, the Art Foundation Musagetes, that funded the artistic project, decided to continue and invest in a project that involved children and youth. The Musagetes is a Canadian foundation and it has a long term relationship with the city of Rijeka.

The name "Benčić Youth Council" came to be because of several reasons. "Benčić" as a location in the city is going to became very relevant for children and youth from the city of Rijeka, but it is also a place where the methodology was created. Naming the project after the fallen factory represents a hommage to industry that closed its doors and fellow citizens

that lived from it. This keeps alive the name that marked the city district for more than 150 years and aims to retain the memory of the space that hosted the project. A youth council represents a way for children and young people to express their opinion and influence decisions in their community. Youth councils can be established on different levels, local, regional, state or national, and can be tied to different entities, for example government, NGOs or schools. This project did not want to focus on the political aspect of a youth council, primarily on the candidacy and election process. The project wanted to keep the aspect of a youth council that considers, discusses and provides opinions on current issues, focusing on art and culture in the city of Rijeka. By giving children a voice and a way to reach the public, the children directly affect the cultural dynamics of their city and take on the role of its active participants, creators and commentators.

The project and its principles

Benčić Youth Council Project is a framework for non-formal and informal learning in culture and arts that balances research, work, play, and socializing. The project is funded by the Art Foundation Musagetes and supported by the Museum of Modern and Contemporary Art in Rijeka. It is designed for children and young people, developing their relationship with culture, cultural heritage, cultural production and cultural institutions in the city. As mentioned before, and recognized by UNESCO already in 1972 Convention concerning the Protection of the World Cultural and Natural Heritage and pointed out through the years (World Heritage Committee, 2002, 2007) the promotion and education about cultural heritage is the best way to preserve it for the future.

The main objective of this project is to bring culture and heritage closer to children and young people as future consumers and carriers of that culture. Benčić Youth Council is an opportunity for children and young people to learn more about the resources that are necessary for the production of the cultural content and to familiarize themselves with cultural institutions and venues. In addition, it is an opportunity for workers in culture and cultural spaces to adapt, learn to respond and design content suited for children – to encourage them to think about their programmes and policies that have to be adjusted accordingly. This project is designed for children and for cultural institutions so they would recognize the power and importance of children within the cultural dynamics of the city.

The mission of the Benčić Youth Council is cooperation with and empowerment of children to learn, influence and create different forms of art and culture in their city. An important part of this process is the creation of opportunities for the expression of views, opinions and content produced by children.

The project aims to be an example and inspire other cultural stakeholders to cooperate and network so they could offer children a stimulating and high quality educational programs in culture and the arts through their unity and synergy.

It includes organizing monthly workshops that cover a current topic from the cultural life of the city of Rijeka, the country or the world.
Categorization of topics we have covered so far:

—Cultural heritage (material and intangible heritage, cultural institutions);
—Performing arts (applied theatre, contemporary dance, circus);
—Visual arts (street art, painting, VJ, sculpture, new media);
—Cultural diversity (intercultural dialogue, international collaboration);
—Music (activist choir, jazz, recycled instruments).

Each month, the project gathers twenty children who participate free of charge in various group activities. The goal of the Council is to introduce children to various art forms, to include them in the operation of cultural institutions, but also to raise children's awareness about their hometown history, to strengthen their sense of belonging and caring for the past, as well as getting them to deliberate on their hometown's/county's future.

Benčić Youth Council's key principles are based on the social constructivist paradigm which maintains the social nature of knowledge and considers that knowledge is the result of social interaction and language usage, and thus is a shared, rather than an individual, experience (Prawatt & Floden, 1994).

According to Vygotsky (1978), social constructivism and sociocultural theories describe learning and development as being embedded within social events and occurring as a learner interacts with other people, objects, and events in the collaborative environment.

Although the methodology of the project is built on the foundations of social constructivism, it is important to note that it has not been taken and implemented as a previously existing model, but is rather a living organism that is constantly being evaluated and adapted to meet the needs of learners.

Key principles of the project can be summarised as:

Experiential learning is the principle that was first implemented in the project. Since this project aims to be a platform for non-formal and informal learning, the objective was to take children away from a formal classroom environment and atmosphere. The focus is on the participative approach – providing children with a chance to be in real life situations, so they can feel responsible and that their decisions and actions have an actual effect. By giving them practical work, they learn by doing. Reading a children's book by a Croatian author in the very library where it was written, looking at the original lock of the city gate from the 16th century or talking directly with a ship's captain in his quarters makes learning much easier.

Closely connected to this principle is the following one – **place based learning**. Although they overlap, the place based learning is accentuated because the tendency is not only to cover certain topic, but to spend time during the workshop on a location in the city that is closely connected to that same topic. This affects children but also the spaces that they visit. Visiting a ship that has strict security regulations, visiting a museum depot or a famous student club influenced the spaces and the people working there, opening them up for further collaboration. That brings us to the next key principle – **partnership**. To cover this wide range of topics it is essential to be willing to collaborate with different people, institutions and the NGO sector. Through the project, during two and a half years and 26 workshops, there have been more than 12 partner institutions and more than 40 associates, private persons and NGOs. With this the project encourages service learning and community engagement. By spending time with people and on site, children develop emotional connections – they develop the ability of **emotional learning**. This affects and strengthens their sense of belonging and identity. Furthermore, by nourishing reflective practice children are more empowered and confident in forming their opinions. All mentioned principles contribute to the last one – supporting and encouraging **children to become active citizens**. By targeting this project to children we are increasing the chances of having conscious adults in the future who will not be afraid to rethink, criticize, imagine and create. The project is creating opportunities that allow individuals to see themselves in the role of active agents, who play a significant role in improving their own lives and lives of others and art and culture is serving as a training ground where children and youth can experience active involvement in the experience, processes and the development of creativity.

Concluding remarks

The overview of theory and research findings concerned with culture and arts education provided in this article supports the belief that culture and arts education has an important role in developing social, personal and cognitive skills of children and young people. Regarding the emergence and methodology of work of the Benčić Youth Council, it complements the theoretical knowledge of cultural and artistic education through specific examples and locally grown experience that comes directly from practice. Cultural and artistic education has a powerful potential to promote change, but often lacks information about how it actually works in practice, especially in the non-formal sector. If we, cultural practitioners and educators, want to promote change and progress in the field of culture and art education, we need to share methods, models and practices. According to UNESCO's Recommendations for Educators, Parents, Artists, and Directors of Schools and Educational Institutions (UNESCO, 2006), by recognizing a value and documenting successful locally-developed, culturally-relevant culture and art education practices and projects, we create opportunities for future projects to replicate successful practices. With this article, Benčić Youth Council hopes to encourage other cultural stakeholders and practitioners to cooperate and network in order to create a database that will contain examples of local practices and models of cultural and artistic education from different countries so as to enable the transmission of knowledge and creation of better opportunities and environment for culture and arts education. The authors hope that the example of Benčić Youth Council practice can provides support for ongoing practice and future research in the field of culture and arts education.

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The palette of a 16th century Venetian artist: materials and methods of Giovanni da Mel

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Abstract: Giovanni da Mel (1480-1549) was an Italian Renaissance artist. He worked in the Veneto region and devoted himself to the fresco technique, in his family workshop. During the last part of his life, in the church of Trichiana (Belluno), he painted an altarpiece, which seems to be his only work on canvas.

Thanks to the collaboration between restorers and scientists, it was possible to explore in depth this peculiar painting. The imaging techniques helped in the identification of the artistic methodology, for example highlighting the use of engraving the preparation to draw (typical of the *fresco* technique). Then, the application of spot analysis allowed the identification of the artist's palette, revealing some peculiarities as the addition of a copper based pigment to the bone black, in order to dry the oil. The diagnostic techniques have fully characterized the altarpiece from a methodological and material point of view.

Key words: non-invasive diagnostics, integrated techniques, *in situ* analysis, Renaissance Italian art, artistic technique and materials.

La paleta de un artista veneciano del siglo XVI: materiales y métodos de Giovanni da Mel

Resumen: Giovanni da Mel (1480-1549) fue un artista del Renacimiento italiano que trabajó en la región del Veneto y se dedicó a la técnica del fresco en el taller de su familia. Durante la última parte de su vida, en la iglesia de Trichiana (Belluno), pintó la única obra sobre tela que se le atribuye.

Gracias a la colaboración entre restauradores y científicos, ha sido posible estudiar profundamente esta pintura peculiar. Las técnicas de imagen facilitaron la identificación de la metodología artística, por ejemplo resaltando el uso del grabado de la preparación para delinear el dibujo (típico de la técnica del fresco). Luego, la aplicación de análisis puntual permitió identificar la paleta del artista, revelando algunas características, desde la adición de un pigmento a base de cobre hasta el carbón animal (negro de hueso), para secar el óleo. Las técnicas diagnósticas caracterizaron completamente el retablo desde un punto de vista metodológica y de los materiales.

Palabras clave: diagnóstico no invasivo, técnicas integradas, análisis *in situ*, arte renacentista italiano, técnica y materiales artísticos.

Introduction

In the context of Italian art of the XVI century, Venice was one of the main centres that have been hotbed of master artists. Quite different was the situation at the borders of the Republic, especially near mountains, where the tradition and the contact with the countries beyond the Alps were stronger. However, the study of these small local realities is, nowadays, encouraged in order to know the connection with the main cities, also from the artistic point of view. The training of local artists, the origin of materials employed, the knowledge of other contemporary painters and their techniques are some examples of the main questions posed by art historians.

Giovanni Da Mel (ca. 1480-1549), with the brother Marco and the father Antonio, was an artist dedicated to the fresco technique. Many frescoes have been attributed to him and his family in the valleys of the left side of the Piave river (near Belluno). One example is the cycle of frescoes of the church of San Bartolomeo in Villapiana of Lentiai (Conte 1998). Always connected with the artistic movements in Venice, the peculiarity of Giovanni is that, in the last part of his life, he also painted on canvas, unlike his brother and his father. Up until now, the altarpiece in the church of Trichiana (Prealps of Belluno) is the only canvas attributed to Giovanni (1543). (Conte 1998) [Figure1].

Figure 1.- The Trichiana Altarpiece.

The Trichiana altarpiece (238 x 176 cm) represents Virgin Mary with the Child in throne between St. Bernard, St. Felix, St. Roch and St. Sebastian. In this painting, for the first time, Giovanni enclosed the representation within an architecture of the Renaissance. However, the structure of the painting seems to be more archaic than those represented on (Conte 1998).

The main question arisen by the art historians was if Giovanni simply employed the *fresco* materials (where possible) and related methodologies, or if he adopted any variation. Thanks to the large number of diagnostic techniques used, most of them non-invasive and portable, it was possible to characterize *in situ* both the materials and the artistic techniques of this work of art.

The painting has been analysed at the Restoration atelier "La Conservazione dell'arte" in Vittorio Veneto, while the University of Ferrara has performed all the imaging and spot analyses. Thanks to the collaboration between the Laboratory of Archaeometry (Department of Physics and Earth Science) and the Department of Chemistry, the results of non-invasive and *in situ* techniques have been completed with the microchemical analysis on few selected samples taken from the painting.

Materials and methods

Imaging techniques

The analysis of the painting started with the acquisition of the documentation and raking light photos, in order to highlight peculiarities of the painted surface. Then, the Infra-Red-Reflectography (IRR) has been performed using a Sony DSC-717 camera, operating in the range 950-1100 nm, and a Thorlabs DCC3240N in the range 1000-1100 nm.

As the displacement of the artwork to the Laboratories in Ferrara was precluded for its wide dimensions, the digital radiographies (RX) have been performed using a portable X-ray tube (EIS RX38: W anode). Some relevant details of the whole artwork have been acquired: the faces of the saints, the upper part of the Virgin Mary with the Child and some samples of the architectures. The digital X-ray detector is a Teledyne-DALSA Remote RadEye200, which is a 2D CMOS photodiode array, coupled with a Gd_2O_2S scintillator screen, composed by 1024 x 1000 pixels and with an active area of 98.4 x 96 mm. The digitization is performed at 12 bit/pixel. The radiographies have been acquired at 25 kV, 0.5 mA and 6 s.

UV fluorescence was also applied, in order to reveal the distribution of organic materials, such as varnish, and the presence of previous restorations.

Spot techniques

X-ray Fluorescence (XRF) and Spectrophotometry (SPF) spot techniques have been performed directly in situ at the restoration atelier by means of portable instrumentation. For XRF, a Bruker ARTAX 200 with Mo anode was employed, setting the X-ray tube at 25 kV and 1500 μA, using the collimator of 1 mm of diameter and acquiring the spectrum for 60 seconds. For SPF, the Konica Minolta CM2600d spectrophotometer, working in the range between 360 and 740 nm and integrating on a 3 mm area, was used.

In order to complete and fully understand the materials and the methodologies used by the artist, all results of the previous techniques have been compared with the analysis of 12 samples collected from representative areas of the painting: the leg of St. Sebastian, the green dress and the red mantle (2 samples) of St. Roch, the blue mantle of the Virgin Mary, the step of the throne, the grey and white dress of St. Felix, the brown dress and the foot of St. Bernard, the green and pink tiles of the floor.

All the samples, included in resin to obtain cross sections, have been observed by an optical microscope under visible and UV light at different magnification and photographed with a Canon EOS70D camera. The chemical elements, and hence the pigments, were characterized with the chemical microanalysis performed by the SEM Zeiss EVO MA 15 and SEM Zeiss EVO 40, both equipped with a X-ray Energy Dispersion detector (Oxford X-act), set at 20 kV, working under variable pressure conditions.

The organic compounds have been identified with specific spot tests. In particular, the fuchsin acid one to

Figure 2.- Details in Raking Light: a) second capital from the right, b) steps of the throne with the mantle of St. Roch, c) face of St. Felix.

reveal the protein-based binders and the saponification reaction with ammonia and hydrogen peroxide to detect oils.

Results and discussion

Imaging techniques gave many information about the executive procedure of Giovanni Da Mel on this painting. Starting from the simplest diagnostic, the raking light (see Figure 2), we can appreciate the use of engraving to depict all the architectures: from the arch and the pilasters (Fig. 2a) up to the steps of the throne (Fig. 2b). In Fig. 2c it is evident the use of a compass with a hard tip, that engraved the preparation layer, for the drawing of the halos. It is important to notice that engraving the surface to draw the architectures and, in general, the geometrical elements, is typical of the fresco technique. This suggests that the artist applied the lesson learned on frescoes to the canvas.

In Figure 3, the IRR of the steps of the throne and the mantle of St. Roch is reported. The comparison with the image in Figure 2b shows that the steps of the throne continue under the red mantle, thus indicating that Giovanni firstly depicted the architectures, then the human figures.

Figure 3.- Detail in IRR of the steps of the throne with the mantle of St. Roch.

Figure 4.- RX of the Virgin Mary with the Child.

The last elements sketched are the halos. In fact, in the RX of the Virgin Mary in Figure 4, as well as in the RX of the Saints, the sign of the compass to depict the halo does not continue under the faces. From the RX is also possible to notice that the details of the faces are not so evident, while the weft of the canvas is the main present element. This is due to a very thin pictorial layer, which is appreciable in raking light photos (Fig. 2) and in the cross sections, too [Figure 5a].

The IR-Reflectographies and the radiographies evidence no changes in the planning of the representation and no *pentimenti*, suggesting that Giovanni, in this work of art, was quite sure about the composition.

The UV fluorescence findings indicate that the old varnish is not uniform on the whole surface and reveal areas in which it has been absorbed by the painting. Furthermore, several small retouches are visible, mainly regarding St. Roch and St. Sebastian on the right side of the painting. The UV fluorescence also guided the selection of the point to be analysed with spot techniques, thus allowing to characterize

the original materials employed by the artist and to avoid the restoration ones.

To identify the artistic materials, more than one hundred points have been acquired by means of both XRF and SPF, in order to have representative examples for each colour used by the artist. The data obtained, as well as the microanalysis results of cross section probing, are reported in the Table 1.

Tabla 1.-Artistic materials: The technique that helped in the identification are marked with the X.

Colour/layer	Materials/pigments	XRF	SEM	Spot test
Preparation	Gypsum + Animal Glue	X	X	X
Imprimitura	White Lead	X	X	
White	White Lead	X	X	
Blue	Smalt	X	X	
Green	Copper Green	X	X	
	Green Earth	X		
Yellow	Lead–Tin Yellow	X		
	Yellow Ochre	X		
Brown	Brown Earth	X	X	
Red	Cinnabar	X	X	
	Red Earth	X	X	
	Red Lacquer		X	
	Minium	X	X	
Skin	White Lead + Cinnabar + Red Earth	X	X	
Black	Organic Black (bones black) + Copper Green	X	X	
Technique	Oil			X

Examining in depth some of the results reported in the table, the XRF firstly enhanced the presence of calcium and lead elements in all the points analysed, likely as components of the preparation. Indeed, in all the cross-sections the preparation and the *imprimitura* white layers are clearly distinguishable, separated by a thin fluorescent film evidenced in the optical microscope under UV light. SEM analysis on these areas revealed the presence of sulphur and calcium elements in the inner preparation layer, and the presence of lead in the *imprimitura*. The fuchsin acid test gave positive results only for the preparation and the intermediate thin film, while had no effect on the *imprimitura* and the outer pigmented layers. These findings suggest that the preparation is mainly composed by gypsum and animal glue, while the intermediate film corresponds to an additional glue layer (closure), very common in oil Renaissance paintings to prevent the absorption of oil in the preparation. On the contrary, the *imprimitura* is constituted by lead white. The positive response of the saponification spot test applied on some small fragments confirmed the use of an oil binder medium for the *imprimitura* and the painting layers.

Regarding the identification of pigments used, an interesting case regards the blue colour. As can be seen in Figure 1, the blue is evident for the dress of the Virgin Mary, but for the sky it can be confused with the grey of the architectures. The blue grains observed in the cross section were assigned to smalt, as can be inferred from the characteristic shape of slivers of glass (see Fig. 5a) and according to the XRF and SEM spectra that reveal the compresence of cobalt, silicon, potassium and typical trace elements such as arsenic and bismuth (Fig. 5b). Smalt is also present in the sky, but not in the grey architectures, even if their colours look very similar. The analysis of SPF spectra of the sky, exemplified in Figure 5c, highlighted a decrease of reflectance in the blue region, contributing to look as the grey of architectures. This is a natural ageing effect of smalt, as explained in Cianchetta et al. (2012).

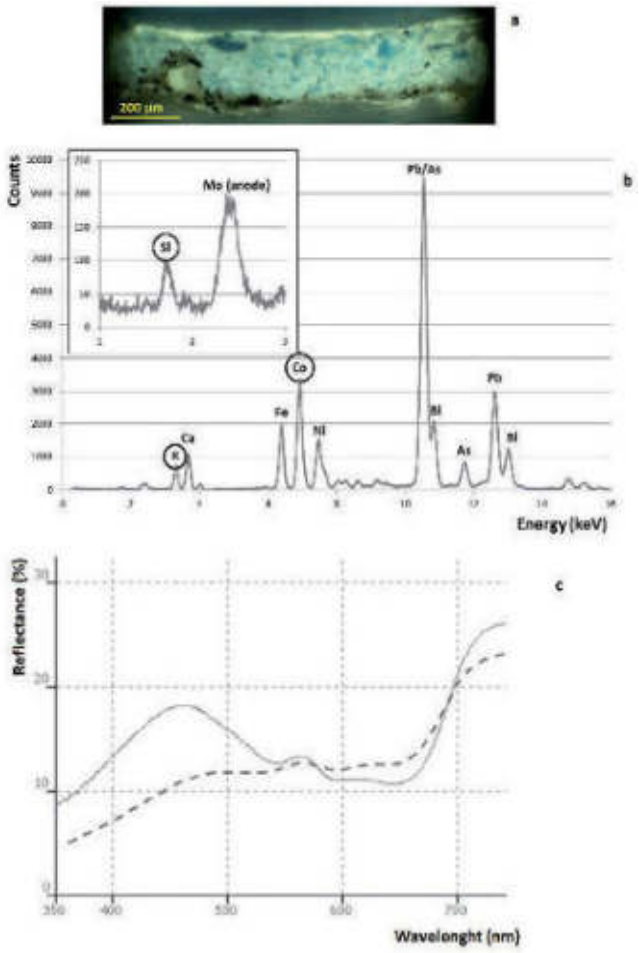

Figure 5.- a) cross section under UV light of the blue mantle of the Virgin Mary sample, b) XRF spectrum of the sky, c) SPF spectrum of the sky in broken line and FORS reference of smalt from http://fors.ifac.cnr.it.

The black pigments are largely used in the grey zones of the painting, as can be seen, for instance, in monumental architecture, on the throne, on the details of the dress of Saint Felix and the tights of Saint Roch. XRF spectra revealed in some cases the presence of phosphorus and calcium. The latter can also be associated to the gypsum in the preparation. No other elements related to inorganic black pigments were detected. The SEM analysis of some black grains confirmed the occurrence of both phosphorus and calcium, thus suggesting the presence of bone black, mainly composed by calcium phosphate. XRF spectra

highlighted the presence of copper in the darker areas, characterized by a higher amount of bone black. Even if it is well known that small amounts of a copper based pigment can be added in order to darken shades (Seccaroni and Moioli 2004), in the case of black pigments it should not be necessary. However, taking into account that carbon based blacks slow down the drying of oil media, it is necessary to add some driers (Berrie 2007). The copper salts are among the best driers for oils, in particular the verdigris (copper acetate), widely used in the past (Ashok 1993). Therefore, our hypothesis is that the artist mixed verdigris and bone black in order to enhance the drying of oil.

Furthermore, the SEM and XRF spectra reveal in all the grey areas the presence of various amounts of bone black mixed with other pigments. For instance, with iron based pigments like earths or with smalt, as in the darker areas of the dress of St. Felix, in the tights of St. Roch and in the throne.

Conclusion

The use of many scientific techniques, most of them non-invasive and portable, and the comparison between the data obtained, allowed to have a comprehensive knowledge of the artwork under analysis. The imaging techniques guided in understanding the artistic methodology and in the choice of relevant areas for spot techniques. The large number of data collected in the spot analyses have been compared and rationalized with the cross sections optical and microanalysis results.

In conclusion, the diagnostic techniques have fully characterized the Trichiana altarpiece, both from a methodological and a material point of view. Giovanni Da Mel, specialized in the fresco technique, tried to apply these knowledge in the only canvas attributed to him, for example in the use of engraving. Nevertheless, the materials employed are typical of that period and have been used skilfully.

This case study is part of a wider project concerning the characterization of the Da Mel's art technique. In this project, paintings on wood panel (Albertin et al. 2013) and frescoes have been studied too, with the support of scientific diagnostics.

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Ge-conservación
Conservação | Conservation

A wider study of contemporary art based on Mikel Diez Alaba´*s Mínimos series*

Irene Cárdaba-López, Iraia Anthonisen-Añabeitia

Abstract: This research is based on the work of the Basque contemporary artist Mikel Diez Alaba and his series called *Mínimos*, which gathers up to 144 small size pieces made out of acrylic paint applied on printed images. This collection was displayed on the Museum of Fine Arts of Bilbao during 2014.

The main objective of this paper is to reach a more integral conception of conservation –based on the latest theories regarding heritage-, focusing on material aspects and the conceptual characteristics of the artwork, alike. Thereby, the working method in *Mínimos* series has been analyzed, as well as the presence of elements linked to the natural heritage. All this, taken together allows the establishment of new strategies towards the conservation of contemporary artworks.

Key words: Conservation, contemporary art, cultural heritage, natural heritage, landscape.

Estudio integral de la obra contemporánea, el caso de la *serie Mínimos* de Mikel Diez Alaba

Resumen: La presente investigación se basa en la obra del artista contemporáneo vasco Mikel Díez Alaba y su serie denominada *Mínimos*, que reúne hasta 144 pequeñas obras realizadas con pintura acrílica aplicada sobre imágenes impresas. Esta colección se expuso en el Museo de Bellas Artes de Bilbao durante el 2014.

El objetivo principal de este artículo es alcanzar una concepción integral de la conservación- basada en las últimas teorías sobre patrimonio-, que abarque tanto los aspectos materiales como conceptuales de las obras de arte. Para ello, se ha analizado la metodología de trabajo empleada en la serie de los *Mínimos* y la presencia implícita de los elementos relacionados con el patrimonio natural. Todo ello en su conjunto permite establecer nuevas estrategias para la conservación de obras de arte contemporáneas.

Palabras clave: Conservación, arte contemporáneo, patrimonio cultural, patrimonio natural, paisaje.

Introduction

When studying contemporary art it is necessary to establish an appropriate strategy to consider the work as a whole, with the aim of reinforcing its value. Therefore it is necessary to take into account current tendencies regarding the conservation of the heritage around the world. This paper reflects on the big change that the conception of the term *heritage* has withstood. From the ancient conception of "Historic-artistic heritage" which is strictly linked to the materiality of an artwork, to the new conception of "Cultural Heritage", opened to both tangible and intangible values.

Throughout his career, Mikel Diez Alaba -who is considered one of the main figures in the Basque scene of the 70s- has always been closely connected to its surroundings, what has to be taken into account when conserving these artworks, as it will be discussed in section *Theoretical review about the artist*.

This research is focused on the production of Diez Alaba during his latest period, named Mínimos due to their small size. To accomplish this study, the artistic evolution of Diez Alaba was studied to give an overview of his work and to understand the development of the artist´s working method. Moreover, the artworks were analyzed both,

for their materiality and their intangible value. Finally, several reflections were made in order to reach an integral conservation plan considering the authenticity value of these artworks.

Several conservation concerns

Paint as a way of breathing, let the paint spread itself driven by the feelings and let the hand sway with the breeze. Paint to contain the beauty, because painting is created in a breath and can be enjoyed many times, to put on record that we have existed and add some mark of our own to the universe (Diez Alaba 2016). This statement, from Diez Alaba, evidences that in his artworks not only is relevant the material procedure but also the value of some other immaterial aspects.

The aim in *Mínimos* is to present the essence of Minorcan landscape: showing the calm and peacefulness inherent of the natural heritage of the island. The conservation of these artistic documents is necessary to preserve different types of heritage: the artistic and the natural.

These ideas fit together with current tendencies regarding the conservation of heritage around the world. In fact it is important to point out the big change that the conception of the term "heritage" has withstood. During the first decades of the 20th century this concept was restricted to artifacts coming from past centuries, for instance antiquities with aesthetic values and exceptional nature. This conception evolved from the late twenties towards a wider theory where not only the artistic objects are considered but also cultural expressions, nature and intangible goods such as traditions and memories, are taking into account. (Querol 2010:458).

The new terminology corresponds to a new cultural moment in which the materiality is not enough and it is necessary to strengthen the conception of a wider catalog of cultural heritage. In fact, now, the idea of heritage should testify society's traditions, customs and believes in a specific historical context, these are tangible and intangible aspects.

The present work is based on the latest theories of European charters and agreements, that is "The Nara Document of Authenticity" (Lemaire and Stovel 1994) and the "European Landscape Convention" European Landscape Convention 2000). The former, refers to the intangible heritage and the authenticity that should be considered an essential part of our culture. According to the seventh article of the charter, *all cultures and societies are rooted in the particular forms and means of tangible and intangible expression which constitute their heritage, and these should be respected*.

As stated in the European Landscape Convention, it is necessary to be *aware that the landscape contributes to the formation of local cultures and that it is a basic component of the European natural and cultural heritage, contributing to human well-being and consolidation of the European identity*. For this reason and *noting that developments in agriculture, forestry, industrial and mineral production techniques* (…) are in many cases accelerating the transformation of landscapes, there is a need to preserve the testimony of them considering every dimension of their value: tangible and intangible.

Under the light of these considerations our aim is to highlight the co-existence of distinct goods regarding to the same heritage in Diez Alaba's latest works: the Minorcan landscape itself, the intangible values (feelings, sensations, …) that are inherent to this space and the recording of such values in the *Mínimos* series. This way, we end up considering material and inmaterial goods as parts of the heritage that has to be conserved, also according to the most updated conservation criteria.

Methods and methodology: study of the artworks

In order to accomplish the main objective of this research, that is, to propose an integral conservation strategy, it is necessary to start giving an overview about the artist whose works are analyzed. After that, the research is focused on studying the concerning artworks, the *Mínimos* series. Finally, a detailed analysis of the paintings is described, evaluating their intangible value, up to the latest theories in conservation.

—Theoretical review about the artist

The artworks of Diez Alaba were studied from the very beginnings in order to give an overview of his work and to understand the development of his working method. The study is specially focused on the artist´s latest period, which gathers the artworks done while living in Minorca (Balearic Island).

Table1.- Former vs new conception of the term heritage.

	FORMER CONCEPTION	NEW CONCEPTION
	"Historic-artistic heritage"	"Cultural heritage"
VALUE	Dependent on the time factor, artistic value, subjective interpretation and uniqueness	Authenticity based on objective facts.
WHAT GATHERS?	Exceptional productions generally linked to the power (Elitist)	Cultural creations that testify society's traditions, customs and beliefs (Generalist)
WHAT PROTECTS?	Material elements (tangible)	Material and inmaterial elements (intangible)
	Produced by humans	Links nature and human trace (landscape)

Figure1.- Mikel Diez Alaba *Untitled*, oil on canvas, (1981).

Diez Alaba was born in Bilbao in 1947 and his career has been marked by evolution; there can be highly distinguished two stages in his development as an artist.

The first phase went on until 1978. In this period he was influenced by British figurative painters such as, Francis Bacon and David Hockney, which favored the creation of expressionist works with an abstract tendency and critical sense.

The complicated socio-political situation that characterized this period caused him a great anguish and led him to quit painting for a year. *Despair is absolute and I relieve it by painting. The need to paint didn´t allow me to think. I gave free rein to impulse, thus the canvas gradually filled up with life or death with hardly any time spare for reflection* (Diez Alaba 2016). This quotation reflects Diez Alaba´s feelings and describes the characteristics of those works perfectly.

The second phase in his career followed immediately; he moved to the countryside and took time to rethink about his career and personal worries. At the beginning of this new stage, he paints based on the influence of Chinese paintings and the working method of the old masters, while trying to reach the origin of the painting techniques [figure 1]. Focused on the nature, the landscape turns, from now on, to be the main character in his works.

In 1981 he moved to Alaior (Minorca), where his work gradually took on Mediterranean values, such as luminosity, sensuality, etc. interested in the power of evocation and suggestion of the landscape, which brought to him the strong impression of the light and colour of the Mediterranean, as stated by the artist in several interviews.

In the first paintings of this new period, everything seems to be in apparent disorder, where the natural elements are mixed "chaotically". Black is gone and colors are purer; as the artist indicated *Little by little, the space opens up, emptying, and at the same time the expression will be painted in a bid to recompose his own world*. Thereafter, the artist followed a more sensitive and harmonious tendency in which the most important fact is the process of self-enrichment.

At this point, Diez Alaba is focused on the process of both, the material aspects of the artwork and the relation with the surrounding that inspired the creation. On his landscapes, he recreates calm and peaceful spatial environments with luminous tones, inherent to the natural heritage of the island.

According to him, the value is the process; the work is the consequence of it: *I try to discover an approach through painting. Other conclusions are drawn after the work is finished. Intuition is fundamental and then reflection. You have to live with the forces of the universe for what you have to reconcile with living things, to take on movements and rhythms of nature* (Salaberri and Sáenz de Gorbea 2001).

—Study of the working methodology in Mínimos series

Several reflections were derived from the previous theoretical research and from the interview with the artist. Diez Alaba´s working method has changed over the years influenced by his surroundings; from realism and expressionism to abstraction- the works from the 80´s onwards-, from big formats to small ones, and from the social and political situation at the beginning of his career to the scenery and peacefulness, showing the closeness with his feelings more than ever.

In *Mínimos* series he paints abstract interpretations of Minorcan landscape through the artists´ eyes; sometimes appears the Mediterranean quietness but other shows its wildness.

This series look like fast sketches made during his trips around the island because of their small size- the artworks are about 6 x 9 cm-, but he produced them after reflecting about his feelings in those moments.

Figure 2.- Diez applying PVA on the substrates (left). A detail of the impastos in a Minimo (right).

As in his first landscapes based on old masters, he prepares carefully the substrates before painting. First, he manipulates the images he took during his outings using Photoshop: he removes the color almost completely and makes some other distortions on them. Then he prints the images on office paper and applies several layers of PVA in order to protect the inkjet pigment inks. When the adhesive dries, he paints acrylic impastos with precise brush-strokes helped by special Japanese brushes. [figure 2]

Mikel Diez Alaba evokes the landscapes from memory, although he uses printed images in the way that he has an image to start [figure 3], he paints inspired from the recall he has of the surrounding scenery. For that he uses a short colour palette, mainly based on blue, white, green, red and yellow, which are the colours directly related to the nature –sky, water, clouds, vegetation, sun- and their reflection on different surfaces. [figure 4]

—New insight into the analyses of the Mínimos series

The study of Diez Alaba's *Mínimos* was guided by the aforementioned principles, which drew the investigation to analyze the artworks on their whole: considering both the tangible heritage (the paintings) and the intangible one together at the same time. The connection between the artwork and the landscape is represented in the relation between the colour palette, the environment and the sensations collected by the artist during his journeys across the island, which are depicted in particular traces. Moreover, his paintings gather aspects of society's collective memory (intangible heritage), since they evoke the constructed ideas about the main characteristics of the island: calm, peacefulness, etc. Thus, according to the proposal approached in these lines, it is compulsory to be aware of the following: if those intangible aspects are not considered, the *Mínimos* series would be altered or damaged in some way, so the conservation strategy would be inappropriate.

Figure 3.- Photography of the landscape taken by the artist.

Figure 4.- Mikel Diez Alaba, title unknown, acrylic paint on printed image (2015).

In order to accomplish an appropriate integral conservation strategy , in this case, we should consider three distinct levels and stages on the artist's working method, every one of each draws its own value. It is necessary to preserve every agent that takes part on the complex production of his work:

1. Specific landscape. This is the natural scenery itself which experiences changes due to the pass of time and the human activity. These modifications of the landscape are regulated by the standards of UNESCO, in order to maintain the quality of life and the environmental characteristics of the island. It is compulsory to take into account the natural value of the landscapes which are protected by law and are the main subjects of the cultural heritage of the island.

In fact, Minorca is recognized as a natural biosphere reserve by the UNESCO organization, due to its rich and traditional rural countryside and the high compatibility achieved by the island between the development of economic activities and landscape conservation.

Minorca is a member of the Spanish Network of Biosphere Reserves and it is also object of the sustainability program developed by the Consell Insular of the island. The latter, was established in order to maintain the quality of life in this territory and the environmental standards which merited the declaration of UNESCO. Among them, to avoid any measure or intervention which pose a threat to the landscape of Minorca.

2. Photography of a specific landscape. It is the natural scenery captured in a specific moment. There is a need to conserve these images as to preserve both, the registration of the evolutionary landscape and the Diez Alaba's artistic view. In several cases, they are the proof of a frozen instant of the aforementioned nature. They are testimony of a concrete moment in a specific place of the landscape which will probably suffer uncountable changes as time goes by.

3. Artist's view of the landscape. The artwork represents a specific landscape (stage 1) through the memory of

the artist. It is necessary to preserve the artwork for its materiality but also for its immaterial values that represent the island. This corresponds to the highest level of abstraction both relating to the nature and the image. That is, on the one hand the conversion of the landscape into a memory inside the artist's mind. This could be considered an intangible good, part of the common imaginary.

On the other hand, there is a transfer of this memory into the work of art, through the use of painting materials. Here, the artist takes from the memory of these landscapes, the key elements that evoke its main values: quietness, peacefulness, and even the wildness in some cases – through the use of colours and abstract traces applied over the prints.

Despite the triple classification, it is no possible to have one without the other. This means, that to tackle the conservation of *Mínimos* series it is necessary to afford its comprehension from a wider point of view.

Conclusions

As the landscape and surroundings are protected by the autonomous community's regulations, Diez Alaba's *Mínimos* also deserve special attention. Not only given the fact of being an artistic production but also for being provided by the value of the social identity, which belongs to the heritage of the island. Moreover, the correlation between the materiality and the conceptual baggage associated to the landscape, characterize the authenticity of the artworks, as stated in Nara´s document. Therefore, it is safe to say that if we conserve the *Mínimos* series we are not only preserving their materiality but also the main natural good of a region, such as characteristics of a collective memory.

Taken together all the points detailed above, some general considerations are summarized:

- The need to establish an appropriate strategy for studying the works in their totality, so as to reach an integral conservation plan. Therefore, to study Diez Alaba´s *Mínimos* in their totality, it is important to understand their close relation with the Minorcan landscape (protected by law) but also the thoughts and personal condition of the artist, which are part of the inherent intangible values. Without them, the artworks fall into decay.

- The previous study of *Mínimos* may reinforce their value, according to the present theories in the heritage scope.

- The importance of breaking walls while trying to manage a more integral conception of the conservation of our heritage. Consequently, the importance of the implicit intangible values will provide a more integral conception of the conservation of our heritage, and as a consequence, a more accurate preservation proposal, exceeding the materiality of the object.

These proposals are the basis for every research regarding contemporary art, where the study of the ideas (through personal interviews with the artist, deep study about its production, multidisciplinary approach to the heritage, etc.) is vital for conserving the materiality of the artifacts. After all, we could end up highlighting that the proposal of a more integral conservation plan of an artwork, in which various agents are taking part, (the tangible and the intangible ones) all of them deserve the same degree of consideration. Thus, helping and raising the value of the artworks.

For this reason, this paper is the beginning of the research about *Mínimos* series, as a starting point for further essays that ensure the conservation of the artworks.

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Cultural management in the National Palace of Mexico: use and heritage conservation

Lilia Teresa Rivero Weber

Abstract: Conservation of Mexico National Palace is a complex labor, since implies the preservation, not only of the material aspects of the building and the objects contained within, but also all the immaterial values reflected on the walls of the structure that mirrors the historic continuity of Mexico and therefore part of the national identity. Due these conditions, National Palace is in our days the most emblematic and symbolical government building of the country.

In order to preserve the monument, a comprehensive conservation-cultural management program has been developed and implemented, considering operational aspects of the monument management, that is also part of the cultural infrastructure of Mexico City, since this historical complex attracts around 340 000 visitors each year.

In addition, among the Conservator´s Office strategy has been to promote collaboration between different actors involved with the use, operation and conservation of the monument, in which are included external governmental offices and academic institutions, both national and international. This collaborative approach has been crucial in order to implement the Management Program for the conservation of the monument.

Key words: Cultural Management, Preventive Conservation, Strategic Planning.

Gestión cultural en el Palacio Nacional de México: uso y conservación del patrimonio

Resumen: La conservación del Palacio Nacional de México representa una labor compleja, ya que no solo contempla los aspectos materiales del edificio y los objetos contenidos en éste, sino que también todos los aspectos inmateriales del inmueble y que muestran la continuidad histórica de México, y por lo tanto, del desarrollo de la identidad nacional. Dadas estas condiciones, Palacio Nacional es actualmente el inmueble gubernamental más emblemático en todo el país.

Para atender el monumento, fue necesario desarrollar un plan de manejo integral para la conservación del inmueble y la atención de las actividades culturales que atraen anualmente cerca de 320 000 visitantes; asimismo, se consideró la operación de las oficinas propias de la Secretaría de Hacienda y Crédito Público; así como las áreas Presidenciales que se encuentran también dentro del inmueble.

Por otra parte, la oficina de la Conservaduría de Palacio Nacional, ha promovido una colaboración trabajo coparticipado entre las distintas oficinas que se ven involucradas en el uso y operación del monumento, así como oficinas gubernamentales externas e instituciones académicas, tanto nacionales como internacionales. Este trabajo en realizado en co participación con los diversos actores involucrados, ha sido crucial para la óptima implementación del Plan Maestro para la conservación de Palacio Nacional.

Palabras clave: Gestión Cultural, Conservación Preventiva, Planeación Estratégica.

National Palace: Heart of the Nation

Mexico's National Palace is located in the Core Zone of the Historical Center of Mexico City, Site inscribed on the List of World Heritage in 1987, which comprises 1000 hectares corresponding to the geographical limits of the City since its foundation, in the XIV century until 1830 (Diario Oficial de la Federación, 1980). This area it's the most representative cultural evidence, not only of the city, but also reflects the entire country development. Therefore, National Palace conservation is essential to the permanence of national identity since the building, from its origins in the 16th century, hosted the main governmental functions, as today. Presidential Protocol areas, the Office of the Ministry of Finance, operate in conjunction with exhibitions and cultural areas, including archaeological observation ports (Castro, 2003). This results in an influx of nearly 320,000 visitors per year, a

daily dynamic, that generates an intense and constant use by different social sectors. Consequently, it is easy to understand why this monument is socially recognized as the Heart of the Nation.

Given the above, it was transcendental to elaborate an accurate diagnosis of the different uses of the monument, including conservation actions for the building and its collections, as well as planning and optimizing the needs of all the internal and external users. In this way, a comprehensive program of conservation, maintenance and monitoring that allows the coexistence of the monument and its role throughout the continuity of the history of the nation was implemented.

It's worth to say that the main challenge for the conservation of National Palace is given by its location: since it was built over the ruins of the palace of *Moctezuma Tlatoani* and the great *Mexica* ceremonial center, both built over *chinampas* ; which surrounding context was the ancient lake modified during prehispanic times to settle Mexico Tenochtitlan. Because of this, the monument was built on a highly compressible clay soil. Therefore its structure is affected by differential subsidence. Due to this, many of the actions focused on the conservation of National Palace involves monitoring the effects on the structural behavior and its interaction with local and regional soil subsidence.

Government complex since its origins

The National Palace of Mexico has been since its creation a palatial residence; under its foundations are vestiges of the houses built by the *Mexica tlatoani* Moctezuma. During the Spanish conquest, Hernán Cortes recognized in the palace its importance as part of the ceremonial center of the prehispanic city, so he asked for the property as payment for his services after the conquest. Afterwards, Cortes built his palace in a Castilian building style keeping the preexisting emplacement that mesoamerican gave to their buildings, according to the movement of the stars in order to reaffirm the Spanish domain. His son, Martin Cortes, sold the palace in 1562 to the Spanish Crown to be used for the Spanish Viceroy, his family and his court (Saucedo, 2015).

Over time, due mismanagement, lack of maintenance and natural disasters, National Palace was in serious risk: a fire in 1624, a flood that covered the entire city for more than two years; a mob, which angered by the high price of corn, destroyed the entire southwest area of the palace, a second fire in 1692, among other events that left their mark on its walls as a reminder of the consolidation of the country. However, modifications and restorations relived the iconic monument. In the middle of the XVIII century, neoclassicist architectural style made its mark in the expansion and reconstruction of the "Casa de Moneda" between 1779 and 1782 (Saucedo, 2015).

After nearly three centuries of being the Vice regal Palace, the nineteenth century saw the transformation of the Imperial Palace to become the current National Palace. First, during the War of Independence, the new ruling class chose to keep the State Powers in the same palace, so the first presidents lived and ruled from this site. Half a century later, when Maximilian of Hapsburg was proclaimed emperor of Mexico by the monarchist party and the support of Napoleon, he found the palace uninhabitable and infested with blood-sucking insects known as *chinches* (bedbugs), so he undertook a restoration in order to make it true imperial quarters (Valle-Arizpe, 1936). (UNESCO, 1982)

Upon the end of the short-lived government of Maximilian of Habsburg, President Benito Juárez decided to maintain the renovated rooms as areas of presidential protocol and moved his residential quarters to the north side on the Moneda Street. Near the end of convulsive XIX century, with the arrival of Porfirio Diaz to power, who ruled the country for 30 years, the National Palace experienced a significant improvement. The governmental activities were decentralized and, therefore, Ministries and employees moved into their own buildings, which stopped the palace from being the particular house of the presidents (Saucedo, 2015).

However, it did not stop being the government headquarters and symbol of national identity, since in 1896 the bell of Dolores, the same bell that served Miguel Hidalgo to call to the Independence of the Mexicans, was installed upon the central balcony of the Palace. Ever since, the "Grito" (shout) ceremony held every september 15, acquired its massive social proportion and became a dialogue between the President and the people who gather in the "Zocalo" square (Alcocer, 1985).

After the Mexican Revolution that began in 1910, towards the second decade of the XX century, the National Palace experienced a renewal that symbolically expressed the consolidation of the new political class, its institutional strength and its openness to the recent world artistic expressions that took nationalist traits. A team of architects and engineers added a third floor and redesigned its facade preserving some of the original architectural elements that since the XVI century gave its fortified character. Also, the courtyard of the Treasury was roofed and decorated with Art Deco motifs, along with an Italian mosaic floor and carved wooden furniture that served as the Treasury of the Federation, today transformed into a hall for official receptions (Castro, 2003).

By 1929, Diego Rivera began painting the spectacular murals that adorn the walls of the monumental staircase and the northern corridor of the second floor. The murals depict the epic of the Mexican people, using the symbols and episodes that show the history of our nation. In the 1970s, several works inside and outside the building have uncovered the remains of a courtyard of the XVI century and a prehispanic monolith of relevant archaeological importance. This

allowed a reassessment of the architectural complex that became the subject of study by archaeologists. In addition, it sparked the interest of architects and historians who contributed to the replacement of two elements that had been lost: The Chamber of Deputies, destroyed by a fire in 1872, which was rebuilt and opened to the public in 1972; and, in the central courtyard, a bronze fountain within a marble pile in whose top flutters a sculpture of a Pegasus (Saucedo, 2015).

Protection, conservation and restoration of cultural heritage

The main goal of the National Palace Conservator Office is founded on the objectives established by a presidential decree issued in 2013, which is "to protect, conserve, restore and reuse immovable and movable cultural heritage contained in the building" (DOF, 2013). Thus, based on the provisions of the national regulatory framework and in consideration of international recommendations, the Conservator Office seek to ensure optimal operation and use of National Palace, in addition to strengthening the positioning of its museum spaces according to international standards.

Figure 1.- Diego Rivera's Murals. One of the main sights for visitors at the inside of National Palace. DGCPN-SHCP. 2016.

Figure 2.- Main courtyard on National Palace. The Pegasus fountain in the center. DGCPN-SHCP. 2015.

In order to accomplish this goal, the team that collaborates in the Conservator Office has the vision to position National Palace as a comprehensive model to conservation of cultural heritage and social convergence, through cultural areas of first level, allowing Mexicans and visitors to enrich their knowledge and appreciate the historical and symbolic values of the monument. This is in synchrony to the Mexico's Declaration on Principles Governing the Cultural Policy, which states "sustainable development can only be achieved through the integration of the cultural factors within the strategies proposed for this; thus, those strategies should always consider the historical, social and cultural aspects of each society" (UNESCO, 1982). Therefore, the objectives of the Master Plan for the Conservation of National Palace, which is the fundamental methodological strategy of the Conservator Office, is divided into five strategic axes defined by themes:

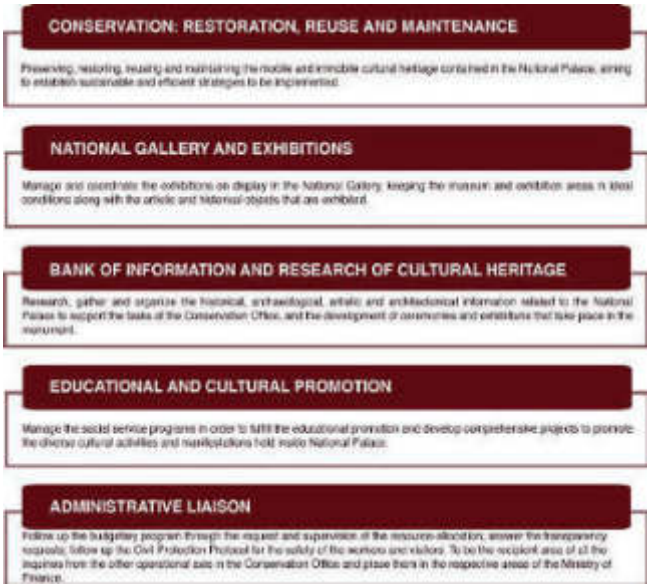

Figure 3.- Axes of Action of the Conservator Office of the National Palace. DGCPN-SHCP internal development.

These axes continuously and transversely implement diverse specific projects and programs to attend the monument, both in its conservation operational aspects.

1. Development of comprehensive conservation projects of cultural heritage contained in the National Palace, both immovable and movable.
2. Implementation of exhibitions in the Gallery of National Palace, which aim to show a comprehensive view of Mexican history in order to strengthen national identity.
3. Management for the cultural promotion and educational services of the various activities to be held in National Palace.
4. Coordination of integral projects for the diffusion of the diverse cultural activities and manifestations within the National Palace.

5. Research, registration and documentation of the cultural heritage contained in National Palace, both immovable and movable.

The optimum performance of these programs and actions, which are necessary for the conservation of the monument, are guaranteed by an Interagency Commission, which according to Presidential Decree, "has a permanent character, composed of representatives of several Secretaries of State, the Presidential Office and chaired by the Conservator (DOF, 2013). This Interagency Commission acts as a collegiate group to support and endorse the actions of the Conservation Office, as well as to request the implementation of specific conservation projects in the monument areas needed for the optimal use of the building.

On the other hand, this collegiate group, have endorsed the *Master Plan for the use and conservation of National Palace 2015-2018*, the essential document for the operation of the Conservator Office, that considers both the multidisciplinary approach along with strategic planning. In addition, this document considers the continuous monitoring and evaluation of National Palace, as part of a general and comprehensive diagnosis. The macro process approach consists of a methodology, which redefine, increases and exclude the information resulting from the continuous diagnosis of National Palace, in order to adapt the procedures and actions carried out in the conservation plans.

The actions of the Conservation Office are linked to the National Development Plan 2013-2018 in its guideline "Mexico Prospero", using the strategies for the development of sustainable tourism, which according to the World Tourism Organization, it must consider three aspects: economic growth, the inclusive and equitable development among residents, business and visitors, and, finally, environmental and cultural long-term preservation (OMT, 1995).

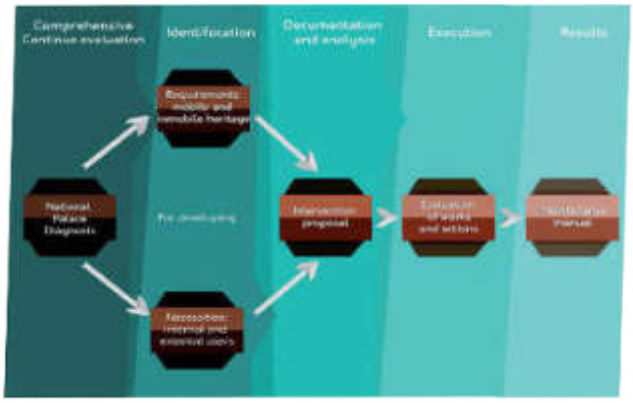

Figure 4.- Diagram of the proposed methodology "Continuing Comprehensive Assessment for the Diagnosis of Internal Development of National Palace. DGCPN-SHCP December 2015.

Figure 5.- Dissemination of cultural activities of the National Palace with visitors. DGCPN-SHCP. 2016.

In reference to the mentioned above, the National Development Plan states that it is necessary to "promote the care and conservation of cultural, historical and natural heritage of the country" in order to, according to the Norms of Quito, "turn tourism into a source of welfare (…), along with the necessity for the restoration and empowerment of cultural heritage to promote tourism, this meaning that investment of financial, human and material resources should be integrated into a regional economic development plan" (ICOMOS, 1967).

Transversal teamwork

Facing the challenges that implies the preservation, restoration and reuse of the National Palace, is a task that the Conservator Office could not achieve without the invaluable support of the different institutions that work collaboratively and co-shared with the Conservator Office: National Center for Conservation and Registration of Artistic Movable Heritage of the National Institute of Fine Arts (CENCROPAM-INBA for its acronym in Spanish); National Institute of Anthropology and History (INAH for its acronym in Spanish); Engineering Institute of the National Autonomous University of Mexico (II-UNAM for its acronym in Spanish), and the Ministry of Culture.

The large conservation projects are implemented through specialized outsourcing contractors, under several strict regulation systems, in order to ensure its proper implementation; these projects are mainly about structural safety given the circumstances of differential subsidence of the Historic Center of Mexico. Otherwise, minor conservation, maintenance and preventive procedures are done with the Conservation Office´s team along with the other maintenance offices of the Ministry of Finance.

In relation to the internal work of the Conservator Office, the main subject of this paper, various programs have been implemented for the conservation and protection

of the monument. Based on the document for heritage conservation, the Chart of Vantaa, established within the Rafael program of the European Commission in 2000, and also based on the *Master plan for the use and conservation of National Palace 2015-2018*, where each strategy corresponds to one line of action, the Conservator Office has proposed drawing up a Maintenance Manual for National Palace, in which the following characteristics are considered:

—*Leadership*. The Conservator Office team assume the leadership in the conservation of the cultural heritage contained in the National Palace.

—*Institutional Planning*. The Master Plan includes both, the direct actions for conservation and restoration, as well as preventive conservation in long-term institutional planning, using methodologies according to this concept.

—*Training*. All persons who are related on the care and maintenance of the cultural heritage contained in National Palace must be trained in the field of preventive conservation, according to their roles and responsibility.

— *Access to information*. All persons who are related to the care of the cultural heritage contained in National Palace must have access to archives and bibliography to obtain knowledge and international information on preventive conservation, according to their needs.

—*The role of the public*. People should know about the concept of preventive conservation and participate on its implementation and execution.

Looking ahead: prevent to preserve

The correct performance of all the personal involved in the conservation of the National Palace is crucial to achieve a good preventive program, in other words, those responsible for the conservation of heritage sites has to converge into a single line of work in order to achieve this purpose. This tasks have been achieved by the formation of trained personnel, who have been given the knowledge of methods and criteria that allow them to identify and prevent potential risks in the conservation of the cultural heritage in National Palace, at the same time they have been given the necessary tools for the proper monitoring and control of the monument. Thus, sustainable preventive conservation tools are established (Lopez Ruiz & Cuba Taboada, 2014).

Developing preventive conservation plans and sharing it with all the workers involved in the monument, will allow less restoration actions in the future and, thereby, the Conservator Office will achieve at National Palace a model of intervention that may lead to sustainable preventive conservation (ICCROM, 2000).

In this way, the main challenge has been met, since the Conservator Office prepared and dictated the first

Figure 6.- On site practice of the preventive conservation course. 36 workers participate in the active conservation of the cultural heritage in National Palace. DGCPN-SHCP. July 2016.

Preventive Conservation Course for 36 workers, all of them involved in the maintenance of the different areas of the National Palace, so that they are prepared with the knowledge, methods and criteria, and therefore, enabling them to identify and prevent potential risks in the conservation of the cultural heritage with the necessary tools for proper monitoring and control of the monument.

That is how the Conservator Office have generated organizational, procedural and maintenance manuals for the cultural property, in addition to catalogs of objects that are held in the building, along with the development of conservation courses and seminars with the main objective to contribute to academic activities related to the conservation of the cultural heritage.

Conclusions

Considering that National Palace it's a building in which the most of the political activity in the country is developed, the work of the Conservator Office must be a strategic conciliator, that is to say, to promote the collaborative and inclusive work, at any hierarchical level, of all the offices and actors that are involved in the conservation of the monument; this along with a continuous process of heritage appropriation and education about preventive conservation process. Only through this process the utmost goal will be achieved: the conservation of the most important monuments that conform the vast cultural heritage of Mexico.

Consequently, these actions will enable a harmonic and respectful work, because of the understanding of the complexity of the use and conservation of such important heritage site, and therefore, the balance of the necessities of the users along with the conservation requirements of the monument.

It's very important to understand that many of the deterioration process are consequence of the interaction of

the heritage and its use, and because of that, it is necessary to develop comprehensive preventive conservation strategies in wherein, by a systematic methodology for the assessment, identification, evaluation, and control of the agents that may deteriorate the building, objects and collections (that is to say, any cultural heritage), those risks of deterioration are minimized or eliminated by acting on the origins of these, that in most cases are a consequence of external factors on which the heritage is surrounded. In this way, the necessity of future major interventions, which could be more intrusive and expensive, can be avoided, and the conservation of the cultural heritage content in National Palace will be a strategy of continuous preventive actions.

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Alternative conservation methodologies: valorization and reuse of built heritage. Case study Exhacienda San Diego del Jaral, Mexico

Angélica González-Franco, Ricardo Muñoz

Abstract: Architectural conservation had its origins on the "monumental" perspective, founded on the restoration as the methodological approach. Although there are different conservation strategies, it is important to consider new proposals. The reuse of the built preexistences based on management plans, presents itself as an integrated strategy; where conservation, social welfare, environmental and economical sustainability converge by giving relevance to the existing architecture, located in the different urban environments regardless if it is a "monumental" or a minor architecture. The case study of the Exhacienda San Diego del Jaral is an example of the current conservation problem in Mexico: a vast amount of built heritage that due to the lack of human and financial resources is abandoned. They are not inserted in a comprehensive conservation strategy, where it should overcome the paradigm of the vision of the heritage as public expenditures and move it, to a useful model for economic development.

Key words: Reuse, Built Heritage, Sustainable Development, Environmental sustainability, Jaral de Berrios.

Metodologías alternativas de conservación: valorización y reutilización del patrimonio edificado. Caso de estudio de la Ex hacienda San Diego del Jaral, Méjico

Resumen: En la actualidad existen distintas estrategias para la conservación arquitectónica, mismas que han tenido sus orígenes en la perspectiva "monumental" y se han fundamentado en la metodología propia de la restauración, es importante considerar las propuestas actuales. La reutilización del patrimonio edificado, está fundamentada en los planes de manejo, se presenta como una estrategia integral, donde convergen la conservación, el bienestar social, la sustentabilidad ambiental y económica, para así poder brindarle pertinencia a la arquitectura existente ubicada en los distintos entornos urbanos, sin importar si ésta es "monumental" o contextual. El caso de estudio de la Ex hacienda de San Diego del Jaral, es un ejemplo de los actuales problemas de conservación en México: una vasta cantidad de patrimonio edificado que, debido a la falta de recursos humanos y financieros, se encuentran en abandono, ya que éste no se encuentra incluido dentro de una estrategia integral para la conservación, misma que busque romper los paradigmas de considerar a la conservación como un mero gasto público, para trasladarlo a un modelo de desarrollo económico.

Palabras clave: Reutilización, Patrimonio Edificado, Desarrollo sostenible, Sustentabilidad ambiental, Jaral de Berrios.

Introduction

The current theoretical and practical approaches around conservation are facing paradigmatic challenges in Mexico as well as in the entire world. Conservation needs to attend the physical problems on the objects that constitute a part of the heritage, as well as to understand the functions, uses and values that societies assign them, in order to determine the strategies to conserve them in the first place. In other words, it is necessary to consider that conservation does not pretend to freeze cultural heritage on a specific time, but is a methodology that adapts and modifies cultural expressions, either material or immaterial, according to the needs of a society that coexists with them. (Avrami & De la Torre, 2000). In this sense, the reuse of the built heritage is a comprehensive strategy for the conservation of any kind of architecture because it considers, not only the physical requirements for its conservation, but also the building´s users necessities. Besides, this proposal also considers the heritage approach by all the statements of current theories and the international recommendations in the discipline´s field.

The case study for the conservation of the Ex hacienda de San Diego del Jaral (located in Jaral de Berrios, San Felipe, Guanajuato), is the result of an academic work that considered as a starting point, not only by surveying the architectural complex and the understanding of the conservation theories and its processes, but also by questioning the process in which values are identified and assigned to both, material and immaterial, elements which conform the cultural heritage. This research was conducted from a mixed approach, which is the process that collects and analyzes qualitative and quantitative information simultaneously (Hernández et al, 2006), in order to obtain the interpretation, not only of the Exhacienda, but also of the urban context in which it is located. As a consequence, it also determines the contemporary challenges for the conservation of the built heritage in Mexico and how the reuse of these vast amounts of abandoned buildings could be a part of the answer.

Values: recognition and assignment

As a starting point of the analysis we considered necessary to establish a specific methodology for its valorization process, in the understanding that this process will uncover the material and immaterial significant characteristics of the building in order to assign them values. Since this process is fundamental to determine the conservation strategy of the architectural complex, it is possible to affirm that the very genesis of the conservation process of any cultural expression happens when an individual or social group assigns a value to it recognizing its characteristics. In other words, values are the qualities that give meaning to these cultural expressions, because they represent the identity of a society, both historical and current (Muñoz et al, 2015), and whose purpose is the satisfaction of the spiritual necessities for the contemporary society, that is to say, as Aloïs Riegl affirmed, "an object by itself is not valuable, but it is us, Modern individuals, who attribute value to it" (Riegl, 1987).

There are different nomenclature values indicated in many conservation texts such as the ones enlisted on the UNESCO Convention of 1972, or the others that some authors such as Riegl, Feilden and González-Varas have proposed. Nevertheless, it is very important to understand that the valuing process "depends on a subjective manifestation, that is to say, on the effects that a cultural expression (material or immaterial) causes on the subject, either in their sensory perception or in their spiritual awareness" (Riegl, 1987). Avrami & De la Torre confirms this idea by stating that, the values are identified and assigned because of multiple reasons such as religious, emotional, economic or political, and very recently due to environmental consciousness (Avrami & De la Torre, 2000). Therefore, we considered Riegl's statements appropriate for the Exhaciendas study because his categories help get a more objective analysis (given that they are based on a philosophical, sociological and art criticism perspective), which are divided in two categories: reminiscent (antiqueness, historical and intentional remembrance) and contemporary (instrumental and artistic).

Given the above, the understanding of the values of the Exhacienda helped determine the conservation strategy, in which in this particular case there were three within the framework of sustainable development: the reuse of the preexistence by the diversification of uses and activities, its restoration and the consideration of the architectural complex as a cultural tourism destination.

Alternative conservation strategies: the reuse of built heritage

In these early years of the 21st century it is important to review the main conservation strategies, not in order to question their approach or methodology, but to inquire how these strategies can be complemented by different (and even controversial) approaches in order to maintain the relevance and validity of built preexistences in a world context that changes more vertiginously than ever. These are the new paradigms that conservation faces and the reason to consider mixed comprehensive strategies (besides physical restoration) in which methodological tools are included to attend the requirements of the built preexistence as well as the necessities of society, environmental and economical sustainability.

In the last sense, the reuse of built preexistences does not represent a new approach. In fact, it is a practice that has been carrying on since the beginning of architecture itself. However, when this methodology is enriched with the theoretical and methodological foundations of conservation, the concept changes to a practice that considers not only the reuse, but also the heritage sense of the built architecture. In this way, this conservation strategy inserts itself in the field of contemporary architecture, were design proposal that will change the use of an built preexistence, in a way or other, is justified in the conditions of a specific historic context (Roberts, 2014). In other words, it represents a new approach in which an architectural object must be valued, analyzed and interpreted (because of its heritage condition which makes it a cultural resource) in order to propose, in addition to its conservation, its enhancement, complementation or modification to satisfy the necessities of a society.

Therefore, the action field of reuse as a conservation strategy, is not limited to monumental architecture, but to all kind of contextual architecture that gives form to urban settlements, so it gives functional, and therefore, social and economic relevance to built preexistences. Thus, three fundamental qualities of reuse may be enunciated:

First, as a strategy for conservation based on a reuse project which recognizes the values of the built preexistence, to have the possibility to respect its heritage character, by

the designation of new uses to a preexisting building. This entails the possibility of enhancing specific characters, in its aspects and elements, for example, its material characteristics that are valuable, while also minimizing others (Heritage Council of Victoria, 2013).

Soria states that the reuse of any built preexistence must have its origins in the valorization of its own characteristics, in such a way that the proposal for the reuse project functions as an integrator bond of the cultural manifestations, both historical and contemporary, which are contained in the same structure. In other words, the reuse project must conjugate two cultural expressions of a specific time and space in a single enhanced element, thereby enabling harmony, unity and emphasizing past and present virtues, not only typologically speaking, but constructively, technologically, socially and economically (Soria et al, 2007).

Consequently, the conservation of a specific heritage urban environment, is determined by the integration of contemporary architecture, on the understanding that "corresponds to the necessity of a society in order to retrieve and transmit part of its legacy through an architectural proposal" (Vázquez, 2009), which is less worried on the form design and more into the history research, methodology, programs, systems, materials and technology that will be used in the intervention. Therefore, the fundamental objective is the valorization of the preexistences through creative interventions based on the methodological work of scientific investigation, nullifying the destructive action of the speculating in developable land. Also, it is worth mentioning that many international recommendations such as Athens (1931), Venice (1964), Burra (1999), Zimbabwe (2003) and others charts have directly referred to the suitability of the reuse of built heritage as part of its conservation strategies, as long as it considers respecting the values contained in cultural objects.

Secondly, the reuse can be attributed as a change developer for social welfare, as a strategy to achieve economical sustainability, by the conservation of built architecture in site. Many beneficial conditions for the development of these locations are generated or given continuity. This is to say that, built heritage as a container of cultural values, encourages the formation of multiplier effects at micro and macro economy scale due to its conservation (Arriaga and González 2014). According to an "input-output analysis", it's possible to estimate that from economic investment in urban environments with heritage characteristics, positive effects are generated in the economy of those localities. This is because the built preexistences are inserted into different chains of economic values such as cultural, touristic, infrastructure, construction sectors and industries. However, is noteworthy to say that these chains of value do not operate individually, but are interconnected, since development corresponds to the unit of different conditions. In this case, built heritage is the center in which every economic activity is developed. (Avrami, 2016; Arriaga and González 2014).

Therefore, it would be appropriate to consider built heritage as a non-renewable cultural resource in order to link it to the development strategies that most of the times, only considers social, natural, human and financial aspects. This will allow the development of more comprehensive strategies for the sustainable development, the enhancement of society and the long-term conservation (Solis et al 2014).

Finally, on the understanding that every building in its design and construction represents an expenditure of energy in addition to material, human and financial resources, which are qualities that should be used by the current and future society. In this sense, the reuse is a strategy that decreases environmental degradation because it reconsiders the utility cycle of the preexisting architecture, presenting according to Cavieres & Pino, three fundamental opportunities for the environmental improvement: the recovery of areas, reducing the demand for natural resources and waste reduction (Cavieres and Pino 2011).

Case study: Exhacienda de Jaral de Berrios

At the center of the Mexican Bajio, north of the state of Guanajuato, the Exhacienda de San Diego del Jaral is located. It began operating in the middle of the seventeenth century and stopped in 1940, as an agro-industrial productive model. Since 1940's the Exhacienda has been abandoned, giving as a result its current deteriorated condition. Likewise, the uncertainty of a rightful legal owner is an unfavorable aspect for its conservation. This has not allowed the community to find themselves identified to the Exhaciendas ruins, causing indifference for its conservation. Furthermore, even though the Exhacienda is considered an agro-industrial heritage in Mexico, the regulator institutes for the cultural heritage in México doesn't legally protect the Exhacienda. It just allows it to be registered on Mexico´s list of built heritage (Muñoz et al 2015).

Jaral de Berrios, is located in a small rural town. Like other regional Exhaciendas it is immersed in a transformation moment, both at a social and infrastructure level. Social transformation has occurred due to the fact that local population has had the need to migrate to other urban centers in order to study and work. At an infrastructure level the changes involve the provision of non-existence infrastructure and networks which will transform the rural town of Jaral de Berrios to a more consolidated urban settlement [Figure 1]. These social contexts made us question if there is a comprehensive conservation strategy that would consider not only the attention of the requirements for the built heritage, but also the satisfaction of the community needs.

Figure 1.- Analysis of the urban morphology of Jaral de Berrios. GONZALEZ-FRANCO, A., MUÑOZ, R., (in press). *New visions for conservation in Mexico. Case study exhacienda de San Diego del Jaral*. In: Congress Book of the "5th International Conference Youth in Conservation of Cultural Heritage YOCOCU 2016". Madrid: MNCARS.

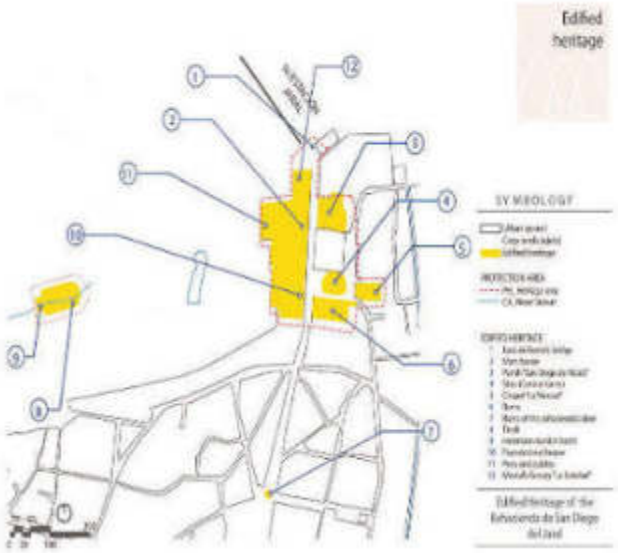

Figure 2.- Analysis of the built heritage of the Exhacienda de San Diego del Jaral. GONZALEZ-FRANCO, A., MUÑOZ, R., (in press). *New visions for conservation in Mexico. Case study exhacienda de San Diego del Jaral*. In: Congress Book of the "In 5th International Conference Youth in Conservation of Cultural Heritage YOCOCU 2016". Madrid: MNCARS.

The ruins of the Exhacienda are conformed by buildings that were used for housing, religious, productive and storage purposes [Figure 2]. These buildings are distributed at the north side of the community of Jaral de Berrios, which for this research were divided into five zones (Muñoz et al 2015):

• Houses and stables: conformed by the first main house of the XVIII century, and the actual main house of the XIX and XX centuries, their annexes, the cattle yard, stables and corrals located in the back part of the houses. [Figure 3]. This zone has an approximate area of 19,572.00 m^2.

• Public area: composed by the parish of San Diego de Alcala, the chapel of La Merced and the main square. The approximate area of the zone is about 13,600.00 m^2.

• Orchard: all the zone its integrated by 26 hectares, which are divided in a farmland, a Turkish bath, a panoptic tower and a water tank.

• Barns: this set is composed by two barns, five *silos*, one mill, an animal powered thresher and a pepper dryer. The approximate area is 6,000.00 m^2.

• The mezcal factory "La Soledad": is composed by three ovens, a *tahona*, a shredder, a room for distiller, two steam boilers and places for the aging of *mezcal*. The building area is around 2,045.00 m^2.

As mentioned earlier, the valorization process of the Exhacienda was fundamental for the development of the conservation proposals, because and according to Riegl's methodology, each building in the built complex present heritage characteristics. In this sense, we concluded that many reminiscent and contemporary values can be assigned to the Exhacienda, both for its material characteristics and its immaterial context, such as the important role of the Exhaciendas in the historical development of México.

In order to make a comprehensive valorization of the Exhacienda, it was necessary to divide the architectural complex into 6 categories:

1. Architectural layout that is the disposition of all the architectural elements and the relation between that determines the function.

2. Formal elements that is the geometry of the structure of the architectural complex.

3. Materialization that corresponds to the materials with which the architectural complex is built of.

4. Constructive systems and techniques that conform the architectural complex.

5. Ornaments and decorations in every formal element.

6. Natural landscape in which the Exhacienda is located.

With this categorization, we were able to assign values on a more objective way according to Rigel's categories. [Figure 4].

Figure 3.- Panoramic west-east view of the main plaza of the locality. It's possible to see the main house, the barns and part of the public area. GONZALEZ-FRANCO, A., MUÑOZ, R., (in press). *New visions for conservation in Mexico. Case study exhacienda de San Diego del Jaral*. In: Congress Book of the "5th International Conference Youth in Conservation of Cultural Heritage YOCOCU 2016". Madrid: MNCARS.

Figure 4.- Relationship between the valorization of the significant characteristics of the exhacienda and the conservation strategies due those values. Diagram: AGFH & RMN. (2016).

Discussions and conclusions

The conservation praxis needs a moment of reflection where as professionals on the field, we need to question ourselves in an objective manner: what's the ultimate reason for conservation? Are we moved only by the protectionist inertia of cultural objects, which undoubtedly are valuable and worthy of the deployment of resources and efforts for its conservation? Or, should we make a pause and consider the existence of an indissoluble binomial between these objects (in this particular discussion limited to the built heritage) and the uses and functions that societies assign them? In other words, we should understand that the built heritage must satisfy multiple social needs, so that in a reciprocal way society provides, although paradoxically, the requirements for the conservation of built heritage. This leads us to the understanding of the symbiotic relationship between the society and built heritage as long as the last one is in use.

The conservation methodology used on the analysis of the Exhacienda San Diego del Jaral aimed to be as objective as possible, due to the complexity of the problem and the many approaches that could be applied. Therefore, we followed a 4 steps process [Figure 5]. Starting by identifying the cultural object or expression in which the particular case was the Exhacienda. It was at this stage that the analysis of different characteristics and historical context took place. As a second step, the gathered information was processed with Rigel's categories of values in order to assign to each significant characteristic of the built preexistence, its proper value. This process allowed the objective characterization of

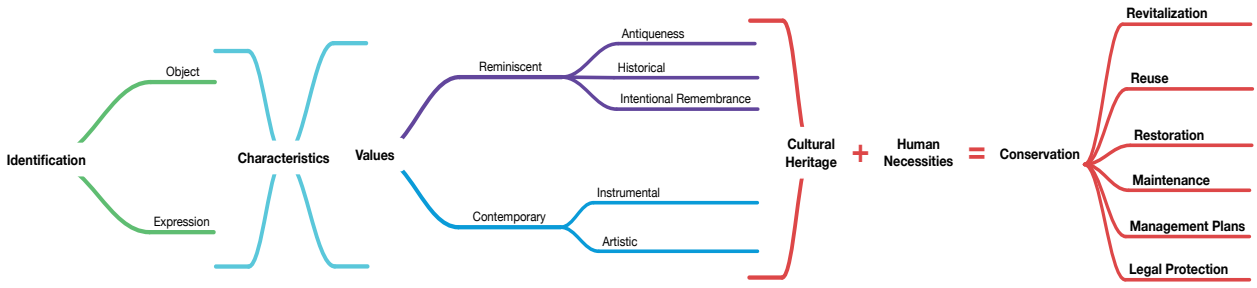

Figure 5.- followed in order to analyze, valorize, identify human necessities and proposal for comprehensive conservation. Diagram: AGFH & RMN. (2016).

the Exhacienda as part of the built heritage of Mexico. As a third step, with the conviction that we were working with an important heritage, the analysis of the social context took place in order to determine which human necessities were needed to be satisfied by the conservation of the Exhacienda. Finally, with all the data gathered the conservation strategy was developed and we considered not only the reuse of the Exhacienda for different kind of functions, but also the restoration of the most important characteristics, the maintenance of the recently construction of infrastructure (sewerage, roads, water and electrical supply) and the elaboration of a comprehensive management plan for the supervision in the development of all the conservation master plan.

The analysis above allows us, as conservation professionals, to expand our field of action with the simultaneous implementation of different conservation strategies. The case study of Mexico and the Exhacienda allow us to consider the use of the vast amount of built heritage in our country in many different fields, not limited only to cultural and touristic ends, but industrial, agricultural, educational, and many other social areas which need to be developed. In this way, the comprehensive conservation through reuse, restoration and maintenance, along with the control of management models and executive plans, could be the detonator for sustainable development for many rural localities.

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New insights for creative art processes. Collaboration and experimentation with contemporary artists

Eva Mariana Fuentes Duran, Rita Lucia Amor Garcia, Mª Pilar Soriano Sancho

Abstract: The artists' idea of exploration in new creative fields frequently triggers the collaboration between artists and other professionals. Understanding the experimentation which comes from it is the art restorers and specialists' main duty, as they are forced to establish new standards and increase their knowledge on the use of new materials. Consequently, the communication between artists and restorers is frequent nowadays in the form of interviews but also with practical collaborations. This paper tries to show how productive collaborations can be for artists during the creative process in terms of production and possibilities, and for restorers, because this would be the best way to learn about the art concept and its materiality, which will be helpful for the artwork's future conservation.

Key words: conservation, material experimentation, creative process, collaboration, contemporary artists.

Nuevas perspectivas en los procesos artísticos creativos. Colaboración y experimentación con artistas contemporáneos

Resumen: Las colaboraciones entre artistas y otros profesionales surgen frecuentemente por la tendencia de los primeros a explorar nuevos territorios creativos. La continua experimentación en la creación contemporánea determina la tarea de los restauradores –entre otros–, que se ven forzados a establecer nuevos criterios y a ampliar su campo de estudio a nuevos materiales. Como consecuencia, cada vez es más frecuente la comunicación entre artistas y restauradores, generalmente a través de entrevistas, pero, también, en colaboraciones entre ellos. En este artículo se pretende mostrar cómo de productivas pueden ser las colaboraciones durante el proceso creativo del artista, tanto para este, en términos de producción y ampliación de posibilidades; como para los conservadores-restauradores, en cuanto a conocer en profundidad el concepto de la obra y los procesos de creación del artista, lo que aportará una valiosa información para la futura conservación de la pieza.

Palabras clave: conservación, experimentación de materiales, proceso creativo, colaboración, artistas contemporáneos.

Introduction

The contemporary artist has, as one of its main character trails, the firm disbelief in the definition of the limits of Art. Since the beginning of the Avant-gardes in the second half of the 19th Century, the definition of Art has been subjected to the whims of those who called themselves artists. As a result, 'traditional' Art categories have become obsolete in defining the limits for contemporary artists. This can be seen in their experimentation with new materials, methods and techniques during the creative process.

The Spanish artists Patricia Gomez and Maria Jesus Gonzalez are a clear example of this evolution beyond the traditional art boundaries in their artwork since they started working together in 2002. Their artwork is site-specific in its conception, as it begins in abandoned places from where they aim to salvage the memory of those who inhabited the spaces.

The technique used by these two artists does not steer far from the idea of the traditional Italian detachment process of *strappo*, first used in the 18th Century. Their use of this centenary method applied to the reality of contemporary materials, presents a challenge to the current conservation methods. This example, that will be further developed in this article, shows the difficult task that art restorers face nowadays with artworks that have been created using heterogeneous materials of unknown composition or taken from outside the artistic range.

Figure 1.- Comparison between artists' detachment and *strappo*.

To understand Patricia and Maria Jesus' art practice, it is necessary to explain the differences between the traditional *strappo* and their method, which they have named 'stamp by detachment'. The *strappo* is a traditional technique used to preserve wall-paintings, consisting in using animal glue and cotton fabric with the purpose of separating the paint layer from the wall support (Soriano Sancho, 2006). In their adaptation of the technique, Patricia and Maria Jesus mainly use synthetic materials to get a copy, stamp or print – similar to engraving techniques – from those walls that are doomed to disappear (due to the precarious situation of the environments they work at). Combining diverse types of polyvinyl acetate and fabric with particular characteristics – depending on the result they want to get – they extract a representative image of a wall that tells a story.

Furthermore, with their 'stamp by detachment' method, the artists' intention and criteria differ from the restorer's. They do not pursue the loyal conservation of the current (art)work, because during their process they intend to create new artwork from the idea of memory.

Despite some subtleties between the two, the proximity of both processes is clear. Patricia and Maria Jesus find this proximity an enriching one, and they are very interested in understanding the conservation processes. It is thanks to this interest, that it has been possible to develop the interdisciplinary collaboration and study discussed in this paper.

The first collaboration between the artists and the restorers, started as a mere assistance to unload them from a big project. It was while this assistance was taking place, that the two approaches (the artists' and the restorers') blended and learnt from one another into what became a full collaborative proposal.

"*À tous les clandestins*" (To all the clandestins) is an art project about one of the immigration routes from Africa to Europe, developed in two Immigration Detention Centres in Mauritania and Fuerteventura (Gomez and Gonzalez, 2016). The cells in those two centres, currently laying unused, were covered in drawings and pieces of writing about the trip – dates, numbers, experiences, recommendations, dreams, etc. – from the people who temporarily were detained there. The artists were fascinated by those graphic demonstrations and they decided to keep the immigrants' memory alive by spreading their word and works outside the centres. The project posed a challenge for the artists twofold: in addition to the vast amount of references and writings on the walls in both centres, it soon became apparent that they were to face difficulties in the technical side, that were not going to be easy to solve by themselves.

Figure 2.- Walls at CIE Mauritania.

In April 2014, the artists welcomed the team of restorers into their practise, to assist on the technical aspects and lend a hand due to the size of the project. Within the first weeks of collaboration, as the artists' knowledge of the methods of restoration widened, – cleaning, and consolidation among others – they became more interested in the traditional technique of *strappo* and the possibilities of its application in their art practice. Furthermore, the restorers became more engaged in the creative process, enriching their knowledge in a way that would have never been possible in the conservation lab.

From then on, the two techniques – *strappo* and 'stamp by detachment' – were used simultaneously within the project. That brought an ongoing exchange of ideas and information that allowed the art production and the comprehension of the artists' creative practice.

Object and Method

During the collaboration in Patricia Gomez and Maria Jesus Gonzalez's project "*À tous les clandestins*", the restorer's objects and methodology evolved at the same speed as the artists' creative process.

Firstly, the main purpose of the collaboration was to assist the artists in any matter related to the use of materials and to provide answers to problems that might appear during the creative process. However, due to the rising duties of the restorers that took place during that first practical contact with the artists, the objectives became more ambitious. This way, in addition to the assistance, the restorers targeted their new purpose: to collect all the information available about the artists' processes, materials and concepts. This was an easy task as they worked closely with the artists, and helpful for the future conservation of their artworks. At the same time, the restorers had the opportunity to learn about their practical role in this kind of collaborations and identify both their responsibilities and limitations in the art production.

The methodology of the project evolved as the roles of both artists and restorers became more defined. In a first approach, the assistance of the restoration team was off-site, and merely one that could be defined as consultancy, mostly about materials, as they had done in all their past projects. As "*À tous les clandestins*" developed into a much ambitious proposal, one of the members of the restoration team relocated to Fuerteventura to help the artists on-site.

This on-site assistance developed into a close relationship between the two teams in which the artists decided to experiment with the original *strappo* technique as they learnt about the possibilities that restoration materials and techniques could give to their artistic practice without diminishing the relation of this new project to their catalogue of previous work.

After the completion of the detachments, the teams went back to the artists' studio to continue their investigation on how to transform the detachments that had been completed with the newly found technique into finalised art-pieces. This research was divided in two parts: a practical experimentation with new materials that could be compatible with both the *strappo* technique and the artists' requirements, and a study concerning their characteristics and properties. The specific methodologies carried out in each part and the materials used will be explained in detail in the following sections.

Practical Experimentation

The decision of using the *strappo* technique in this project increased the restorers' duties. This restoration system needs treatment following the detachment, which involves the application of a new support and the removal of all those natural materials used for the facing (this is a compulsory step in *strappo* detachments, preceded by treatment of the back, which will offer stability to the piece detached during its new life). The possibilities given by the treatment of the back – reinforcement – were numerous, for that reason, a practical research, parallel to the creative process, had to be organised.

The first aim of this practical experimentation was to get the better combination of support, adhesive and technique to get a cohesive appearance between the pieces obtained with the *strappo* technique, and those obtained via the artists' technique within the same project, which was the main objective of Patricia and Maria Jesus. Furthermore, and in order to achieve long-term conservation, the restoration team had to choose those materials that could guarantee the best stability over time.

The first phase of the practical experimentation comprised the selection of the fabrics and adhesives to be tested on specimens. These fabrics were a selection of five types of different nature but with a similar appearance of a thin net curtain. In terms of adhesives, three adhesives were considered: two vinyl adhesives used and well-known by the artists, and an acrylic resin, recommended by the restorers. The acrylic resin had similar properties to those adhesives used by the artists but with better conservative properties (Table 1).

Table 1.- Materials selected for First Stage experimentation.

Materials selected for First Stage			
ADHESIVES		FABRICS	
1	Plextol® B500	A	Nylon I
2	Vinavil® 69	B	Organza Silk
3	Rayt® Extra	C	Nylon II
		D	Polyester
		E	Silk II

Once all the fabrics had been pasted to the back side of the specimens, the facing removal was carried out, as this step was compulsory for the evaluation of the results. This step consisted on the removal of the animal glue and cotton fabrics used for the detachment applying wet cellulose poultice. The poultice was a combination of two fibres: Arbocel® BC1000 + Arbocel® BC200 (1:1) moistened in hot water. After the removal of the fabric, the results were presented to the artists.

Figure 3.- Specimen process example, First Stage. The same specimen at the beginning (left) and after pasting the polyester fabric with the adhesive Vinavil®69 (right). (Fuentes Duran et al, in press).

Four further stages followed the one just described. The aim of these was to learn more about the specific requirements of the detachments and, in constant exchange with the artists, reach a solution that would imitate the final appearance of the artworks done with their technique.

To understand this experimentation, it is necessary to go back to the dissimilarities between the results that both techniques offer. On the one hand, in the artists' own method, the materials used were a very thin synthetic fabric and polyvinyl acetate, which when dry, showed the image of the detachment from the front when fabric and adhesive became transparent – the layer acted as detachment facing and new support at the same time. On the other hand, the materials used for the *strappo* facing consisted in animal glue, gauze and cotton fabric, which needed to be removed after the reinforcement from the back – to be able to see what was detached – so the process did not finish after the detachment itself. Whilst the artists' technique showed the artwork from the obverse covered with a transparent layer, the *strappo* always had a support layer on its reverse.

This difference is key to understand the second stage of the process. Once the *strappo* detachments were fixed to their supports, there was a need to find a way to mimic the aesthetic qualities of the thin layer of gauze characteristic of the artists' technique. To achieve it, the restorers pasted a thin fabric on the obverse of two tests from the first stage. The fabric used was net curtain – Nylon II – and the adhesives were Plextol® B500 pure and Rayt® Extra (3 parts of adhesive every part of water).

After the results from the second stage were presented, the artists asked for the possibility of giving a mate aspect on the surfaces, so a third stage was developed based on the use of micronized silica that would be added to the adhesive to reduce any shine on the obverse. The micronized silica was mixed with Plextol® B500 – as this had been the most successful during the second stage – in different proportions.

Table 2.- Material tests: Stages 1-3.

	STAGE 1 (textile on reverse)	STAGE 2 (textile on obverse)	STAGE 3 (matte obverse)
	Textile + Adhesive	Nylon II + Adhesive	(Nylon II + Adhesive + Matting agent) (**)
1A	Nylon I + Plextol® B500	–	–
1B	Organza Silk + Plextol® B500	–	–
1C	Nylon II + Plextol® B500	Nylon II + Rayt® Extra	–
1D	Polyester + Plextol® B500	Nylon II + Plextol® B500	–
2A	Nylon I + Rayt® Extra	–	–
2B	Organza Silk + Rayt® Extra	–	–
2C	Nylon II + Rayt® Extra	–	Plextol® B500 (50%) + Silica: 2:1 / 1:1
2D	Polyester + Rayt® Extra	–	–
3A	Nylon I + Vinavil® 69	–	2x Plextol® B500 (50%) + Silica: 2:1 / 1:1
3B	Organza Silk + Vinavil® 69	–	Plextol® B500 (pure) + Silica: 3:1 / 2:1
3C	Nylon II + Vinavil® 69	–	–
3D	Polyester + Vinavil® 69	–	–
4	Silk II + Plextol® B500	–	–
5	Nylon II + Plextol® B500 (*)	–	–

(*) Differs from Test 1C in removal process of cement from reverse
(**) Used half of raw for each proportion

Following the idea of reproducing the artists' imagery, the fourth stage consisted in the removal of the reverse fabric after a new fabric had been pasted on the obverse. This was possible thanks to the use of different polarity adhesives, similar to chemical intervention layers (Regidor Ros, 2011:526). The reinforcement of the back had been done with a non-polar adhesive, and after the facing removal, a polar adhesive was glued to the new fabric on the front, allowing the removal of the back layer with a non-polar solvent without damaging the front one. The materials tested were Regalrez® 1094 in Ligroin (non-polar) with net curtain on the reverse, and Plextol® B500 (polar) with Nylon II for the obverse.

The fifth and last stage was based on some tests made in order to increase opacity in missing parts – where *strappo* had been unable to perform the detachment. The process was developed in a new specimen in which the reinforcement adhesive of the back was mixed with an inorganic aggregate. Plextol® B500, Nylon II and micronized silica were combined in different proportions with titanium powder as aggregate. The main purpose was to copy the colour and opacity of the background paint where the writings and drawing were located.

Theoretical Research

The restorers' duties in this art project ended with the theoretical study research made in support of the practical experimentations, in order to evaluate the materials tested from different perspectives. The process carried out to identify the compatibility between the

materials used, their adequacy regarding the artists' idea and the artwork's future conservation has been the following:

The first and most important aspects to be considered were the objectives and conditions proposed by the artists. Within this reality, there was also the concern for the issues regarding the artworks conservation, field of knowledge of the restorers. Both aspects were highly dependent on the following variables: the results sought, the properties of the materials found and used – and their analysis – and the vulnerability to alterations of the tests.

Secondly, this information was analysed and registered in order to determine the best way forward in the development of the project taking into account both the needs of the artists and the realities of the future life of the artworks. Accomplishing this valuation was the most complex aspect, partly because of the uncertainty of the project, and partly because of the duality of the criteria – artists' and restorers' – which would come into play at the same time.

The method used to face this problem was an adaptation of the process employed at Risk Assessment and Risk Management originally suggested by Robert Waller for the Preventive Conservation Plans (1994). This was adapted to the creative process, as it is showed in Table 3, which outlines the main ideas of the approach. It seems necessary to highlight that the process ended with the elaboration of a risks ranking that we hope will help in the decision making regarding the properties and alterations to be taken into account, based on their relevance.

Thirdly, once the most relevant properties and their relationship with the imposed conditions and objectives were established, the particular qualities of each material were compared (Fuentes Duran, 2015: 163-165, 170, 177). Through this method, there was an in-depth analysis of similar materials and a very specific determination of the suitability of one over another.

Table 3.- Risk Assessment system during creative processes.

Risk Assessment system during creative processes	
1 About the project	Get information on: • Materials • Objectives and artist's priorities (quantify importance) • Link purposes with material properties
2 Present risks	• Identification and selection of the most important ones • Causes and consequences
3 Analyse and quantify risks	• When could it happen? • Possible causes, process and effects • Influencing factors: - preventive facts, improvements - those which could worsen the situation • Risk quantification, depending on: - Probability - Consequences - Recoverability
4 Establish priorities	Ranking of risks

Results and Discussion

In the first stage, the practical research did not present remarkable differences between the visual aspect of the diverse combinations tested. However, despite the results of the organoleptic analysis being unremarkable, the following theoretical research showed clear choices for both the adhesive and the fabric.

During the theoretical study, the restauration team had determined that Plextol® B500 presented a better future conservation of the tests – in comparison to the vinyl adhesives proposed by the artists. Also, as far as the fabric was concerned, synthetic fabrics were recommended over natural ones, and the net curtain so-called Nylon II as the best option for the artists. Despite polyester fabrics showing slightly better characteristics for the restorers, the Nylon II was chosen because it adapted well and was well-known by the artists.

Following the theoretical study, and as previously determined in this article, an agreement was reached between the two teams, and the final materials were, the adhesive recommended by the restorers, Plextol® B500, and the Nylon II, which the artists knew and had used previously.

As for the results in second, third and fourth stages, the approach was that of analysing the tests as they came, and from them have a conversation with the artists, to agree on a next stage. The conclusions and findings of each one determined new corrections to be introduced in the next stages, in order to get the aesthetic form sought.

However, and as part of their creative process, the artists eventually decided to abandon the aim of mimicking their own technique as they became more and more interested in what they believed were the aesthetic characteristics of the original *strappo* detachments. Furthermore, the results given by Regalrez® 1094 in the fourth stage were unsatisfactory, presenting a lack of adherence that caused weakness in the artwork – in addition to the toxicity that Ligroin offered. Finally, the results given in the fifth stage were not aesthetically pleasing to the artists. This further reinforced their idea of going back to the results of the first stage to keep the appearance that *strappo* technique offered in the artworks.

Conclusions: understanding the importance of collaborations

The restorers' role in this collaboration has been much more significant and influential than first thought. From just being witnesses during the 'creative moment' alongside the artists, firstly as mere observers seeking information about their artwork, to a later much more active role, giving advice and solutions to new possibilities, the restorers have carried out an experimentation in order to obtain empirical results to be applied in a creative environment.

The theoretical analysis carried out by the restorers, was aimed at the artists, in order to give them different visual options. Restorers were, at the same time, doing their own research to be able to objectively expose why they believed some materials were more suitable than others.

All this work, in addition to the easing and accelerating of the artists' production, has increased the restorers' knowledge of these artworks, not only on their physical aspect, but also the conceptual one – meaning, values and artists' intention – and it adds a great value to the restorers' task.

Images are the authors' otherwise stated.

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Ge-conservación
Conservação | Conservation

The use of GIS for studying cultural heritage and historical urban landscape: the case of Perm and Usolie (Russia)

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Abstract: Perm and Usolie are cities in the territory of Perm region (Russia) which hold a rich cultural heritage. The historic urban planning of these cities is threatened due to anthropogenic and natural factors. Geographic Information Systems (GIS) are an excellent tool for operating archival geospatial sources, dating back to the 18th – beginning 20th centuries. With the cooperation of the Department of Ancient and Medieval History of Russia at Perm State Humanitarian Pedagogical University and the Department of Cartography and Geoinformatics at Perm State University, geospatial models that contain information of monuments of history, architecture and urban planning in according to the national cultural heritage register of Russia were developed. Processing of cartographic sources through GIS allowed visualizing the lost historical buildings and to combine information about all objects of cultural heritage. It provides the management of historical data in the preservation of cultural heritage and development of urban-planning regulations.

Key words: cultural heritage objects, GIS, geodatabase, cartographic sources.

El uso del SIG para estudiar el patrimonio cultural y el paisaje urbano histórico: el caso de Perm y Usolie (Rusia)

Resumen: Perm y Usolie son ciudades en el territorio de la región de Perm (Rusia), que posee un rico patrimonio cultural. Debido a factores antropogénicos y naturales, la planificación urbana histórica de estas ciudades y su patrimonio cultural se ven amenazados con una pérdida. Los sistemas de Información Geográfica (SIG) son una excelente herramienta para el tratamiento de las fuentes documentales geoespaciales, del siglo XVIII a principios del siglo XX. Se realizaron modelos geoinformáticos con la colaboración del departamento de Historia Antigua y Medieval Rusa de la Universidad Perm State Humanitarian Pedagogical University y el departamento de Cartografía y Geoinformática de la Perm State University. Estos modelos contienen información de monumentos históricos, arquitectura y planes urbanísticos de acuerdo con el Registro de Patrimonio Cultural de Rusia. El procesado de fuentes cartográficas a través de SIG ayuda a visualizar los edificios históricos perdidos y a combinar información sobre todos los objetos del patrimonio cultural. Proporciona el uso efectivo de datos históricos en la preservación del patrimonio cultural y la elaboración de planes urbanísticos.

Palabras clave: objetos del patrimonio cultural, SIG, geodatabase, fuentes cartográficas.

Introduction

Perm and Usolie are cities located on the Middle Urals (Russia, Perm region). The cities have rich historical and cultural heritage whose definition herein used of the Federal Law «On the objects of cultural heritage (monuments of culture and history)» (Law 73-FZ). According to this law, the objects of cultural heritage are «objects of immovable property ... were created as a result of historical events». These objects are valuable «from the point of view of history, archeology, architecture, urban planning, art, science and technology, aesthetic, ethnological or anthropological, social culture» and are evidence of epochs and civilizations, original sources of information about the culture origin and development.

Usolie was founded in 1606 as a village around new Stroganoffs salt production and received official status of the city in 1918 (after the nationalization of patrimonial estates). There are more than 40 objects of cultural heritage on the territory of the historical center of the city. Objects were built in a variety of architectural styles – from baroque to eclecticism. Due to the construction of the Kama hydroelectric station in the 1950s, the historic part of the city was flooded and buildings, which were built in the 18th – beginning 20th centuries, no longer

used in accordance with the original purpose. Presently the flooding part of the city is in the doldrums and in need of developing a strategy for the conservation/ restoration of cultural heritage. It must be highlighted that Usolie's cultural heritage was not the object of special investigations. Several times Usolie appeared in the catalogs of cultural heritage's objects of the Perm region. As a rule, such publications do not contain information about all Usolie monuments but only outstanding monuments of Baroque and Classicism, which received of the cultural heritage of Federal Importance (Shatrov 1976; Kiselev and Yakina 2011). The rest of monuments, which are important urban objects, unfairly remained outside researchers' field of attention. Vladimir Kostochkin (1988: 113-154) had been studying of the cultural heritage of the several historic settlements in the Urals. He had published a short essay about the history of Usolie in which he highlighted the events that influenced on the history of Usolie urban planning development (especially fires) and described outstanding architectural monuments of Usolie. Grigoriy Golovchanskiy is the first researcher who has been attempted to describe the urban development of Usolie in the context of the city's history from the foundation until 1917 (Golovchanskiy and Melnichuk 2005: 95-99, 150-159, 186-201).

The history of Perm began in 1723 when Egoshikhinskiy copper smelting plant was founded at the place of the modern city. Settlement around the copper plant was converted in the regional capital and renamed in 1781. Nowadays Perm is the center of the Perm region. There are more than 300 monuments and ensembles mostly dated to the pre-revolutionary period (before 1917) in Perm. During the last decades, the city center has been actively constructed, but the designers and developers do not always take into account the peculiarities of the historical urban development of the city, resulting in clashing elements appearing in the center of the city.

Researches devoted to Perm, primarily, highlighting the problems of the city foundation, urban planning and building development of the city. A soviet researcher of the Urals cities Leonid Iofa had concluded that Perm profitable «combines the water connection with the capital cities and closer the mining and metallurgical districts of the Urals», which determined the development of settlements (Iofa 1951: 235). Alexandr Terekhin has studied the formation of the architectural and historical environment of Perm and in consequence of archival research, revealed previously unknown city maps (Terekhin 1980). Presently, Pavel Korchagin has been researching the history and urban planning development of Yegoshikha-Perm. He underlined the need to create an archaeological map of the city at the level of the General Plan, the Project detailed planning or development separate quarters. It is based on the conclusion that «in the course of [archaeological] investigations revealed quite a number objects of the 18th century, with the result that appeared the prerequisites for georeferencing to modern topographic of maps the first centuries». (Korchagin et al 2000: 72). Perm historical and cultural heritage also appeared in the catalogs of cultural heritage's objects, but because of a large number of monuments, the information about them was presented very briefly (Shatrov 1976; Kiselev and Yakina 2011).

Further studying of the historical and cultural heritage of Usolie and Perm, including the use of digital documentation, is necessary for developing strategies for the conservation of cultural heritage in circumstances of urban planning development.

Methods and methodology

The principal sources for studying the historical and architectural environment of Perm and Usolie are maps and plans of the cities, therefore, geographic information systems (GIS) are an invaluable instrument for processing geospatial data. Using the opportunities GIS and geoinformation mapping allows to obtain a new product including new historical information in the processing of historical archive sources. GIS-technologies as part of GIS do not only allow to work with maps and text materials, but also visualize them in readable form.

Using GIS-technologies applied to the study of cultural heritage was formed as an interdisciplinary field of research. In the last decades, GIS is used as a tool for monitoring and management of cultural heritage for their protection. The group of researchers from the Cyprus University of Technology and the Institute for Mediterranean Studies using GIS as a non-destructive and cost-effective method to assess risks for cultural heritage in Paphos (Cyprus) for predicting the future development of the present hazards (Agapiou el at 2015: 230-239). The database, based on a Geographic Information System (GIS), was created by Spanish researchers. As a result, a catalog of traditional rural buildings in the province of Almeria (Andalusia, Spain) was compiled to facilitate the management of cultural heritage by public organizations or individuals for their reuse and restoration (Cano et al 2013: 34-47). In one of the chapters of «Visitor Management: Case Studies from World Heritage Sites» Katie Evans and Lindsay Fielding had discussed ways in which GIS might be used to achieve management objectives related to the protection of the Giza Plateau from the environmental damage caused by the development of tourism (Evans and Fielding 1998: 82-99). The research team from Jordan showed the results of a study carried out to evaluate the effect of the modern urbanization process in the degradation and loss heritage of the city of Irbid using spatial analysis through GIS (Al-Kheder et al 2009: 81-92).

Urban history is one of the most developed research directions with the use of GIS, besides many aspects of urban history are associated with cultural heritage. Anne Kelly Knowles has been allocated the application of GIS

in scientific practice in several areas, including empirical research on the history and to visualize past landscapes and the changing morphology of built environments (Knowles 2008: 8). Loren Siebert's historical GIS of Tokyo is a good example of studying urban history. In the result of research has been created of the digital atlas of the city, where the researcher presents various aspects of the city's history, including data on the physical landscape, administrative boundaries, information on the growth of the road and rail networks, information on land ownership, etcetera (Siebert 2000: 537-574).

As an example of the implementation of GIS-technologies for the study of cultural heritage it is worth to mention the only project of its kind in the region: «Historical and Cultural Heritage of Perm Region», which has been implemented by the Center for Geographic Information Systems and Technology and the Laboratory historical and political Informatics of PSU from 2013. The project provides an access to the data of cultural heritage and expects to use it for research projects without harming the physical integrity of the objects (Kornienko et al 2015: 124-132). The biggest advantage of the project «Historical and Cultural Heritage of Perm Region» that it includes information about almost all objects of cultural heritage of the region, is also its disadvantage because large amounts of information are difficult to work on the study of the local area. Due to the fact that in small area the region has a large number of monuments, some of them do not appear on the map of the project without any additional search in the database (Istoriko-kul'turnoe nasledie Permskogo kraya, 2013-2014).

Evgeniy Kolbovsky has formulated general principles of organization and technology of cultural landscapes' information support, which are relevant for the current research because created projects are associated with historical data (Kolbovsky et al 2012: 224-231). The present research was the implementation of the licensed software ArcGIS 10.2 (ESRI). For the correct work with spatial data needs a common coordinate system, accordingly, all historical maps were brought to coordinate system WGS 1984 Web Mercator Auxiliary Sphere. For the substrate used photographs of different spatial resolution: the territory of Usolie archives «PSU Space Monitoring Center»: LandSat (spatial resolution of 30 m, 2001), Spot-6 (natural colors, the spatial resolution of 1.6 m, 2014); Perm – WorldView-2 (spatial resolution of 0.5 m, 2010) and the base maps of resource ArcGIS Online.

The geospatial models - «Architectural and historical environment of Perm» and «Cultural and historical heritage of Usolie» - were created with the collaboration of the Department of Ancient and Medieval history of Russia at Perm State Humanitarian Pedagogical University and the Department of Cartography and Geoinformatics at Perm State University. At the same time, we had been working on the study of urban planning development of Usolie and Perm.

The developing of each geospatial model took place in several stages. First, the quality cartographic materials were selected and scanned. Cartographic and iconographic materials dated the 18th – beginning 20th centuries from the funds of national and regional archival repositories were used in the preparation of projects. Among which the Russian State Archive of Ancient Acts, the Russian State Historical Archive, the State Archive of the Sverdlovsk region, the State Archive of the Perm Region, History and Art Museum of Berezniki, the Solikamsk local history museum and Usolie historical and architectural museum. Methodological sides for the analysis of urban plans were developed by Pavel Korchagin (2006: 7-27).

The following stage was the georeferencing of each cartographic source to the modern topographic base and bringing them into a single coordinate system (WGS 1984 Web Mercator Auxiliary Sphere). The final stages of the work were the digitization of maps and plans and creation on their basis of the geodatabases. Creating the geodatabase is an important stage in the work because it allows you to work with large arrays of data. The geodatabase is necessary for structuring available positional and attribute data, which facilitates to work with them. Raster and vector map layers were attributed to positional information. In turn, the raster map layers were divided into cartographic materials and data of the Earth remote sensing, which were used as supporting material for digitization, georeferencing and identification of objects. Vector map layers represent digitized maps, which include the information of the following classes of objects recorded in the geodatabase:

- borders of the city and urban sprawl;
- existing brick and significant wooden buildings at the time of the map or plan;
- built-up and planned for building quarters;
- water bodies (rivers, streams, ponds);
- communication (roads, pipelines, tram and railway);
- infrastructure (bridges, dams, locations of fire hydrants, etc.).

Attribute data contains comprehensive information obtained from historical cartographic sources and represents tabular information, which is the basis of geographical objects, allowing to visualize and analyze data. Geodatabase allows creating attachments, which store the detailed information (non-geographic) about the objects of cultural heritage. By clicking on the object user can view necessary information in the pdf-document.

Results and discussion

The result of the investigation was the development of two geospatial models, which contain information about the planning and urban development of the Usolie and Perm in the 18th – beginning of the 20th century. In the attachments of geodatabases gathered information about

all the Perm and Usolie objects of cultural heritage, dated the 18th – beginning 20th centuries (Bushmakina et al, in press). The attachments include public information from the national cultural heritage register of Russia: the name of the object, its address, the date of construction, reconstruction and/or dates associated with historical events, the category of historical and cultural importance and type of cultural heritage's object. Moreover, the attachments represent archival and modern photographs of monuments, a suggestion of the architects or builders (if known), a brief historical information, architectural description of objects and drawing or building project [Figure 1].

Geodatabases allow storing the information in an orderly manner, to produce accounting and systematization of cultural heritage's objects and to implement spatial monitoring. It is possible to use query to search, do samplings on the set parameters and analyze the requested information, which is important in view of the annual change in the number of cultural heritage's objects under the government protection (annually in the Perm region, especially in Perm, several buildings are revealed as objects of cultural heritage, and some lost objects, which impossible to recover, removed from state accounting and government protection). These samplings can be helpful for research purposes or in the practical activities of the executive power authorized in the sphere of cultural heritage protection.

It is important to point out that GIS-technologies allow to study the heritage of cities in their integrity and diversity, not only the cultural heritage's objects, but also the historical and architectural environment: the existing system of verticals and spatial relations, the main streets and squares, the cultural landscape and the natural environment. Through the using archival maps and plans which were brought out to the modern topographic base, we have recreated the urban development of Perm [Figure 2] and Usolie [Figure 3]. Through the imposition of the archival cartographic sources, we have been able to identify new information which not shown in writing sources. We have recorded borders of the city and urban sprawl, network of water bodies, changes dimensions of existing buildings and add information about the history of the building of cultural heritage (monuments and ensembles).

Integration of historical maps and plans in GIS has allowed localizing the borders of the cities, historical building line of the 18th – beginning the 20th centuries, the density of development, highlighting the historical city center (in the case of Perm - the drift of the center) and separate functional zones, belonging residential estate. Correlation of archaeological data with historical maps makes it possible to analyze and confirm the accuracy of the information contained in archive documents.

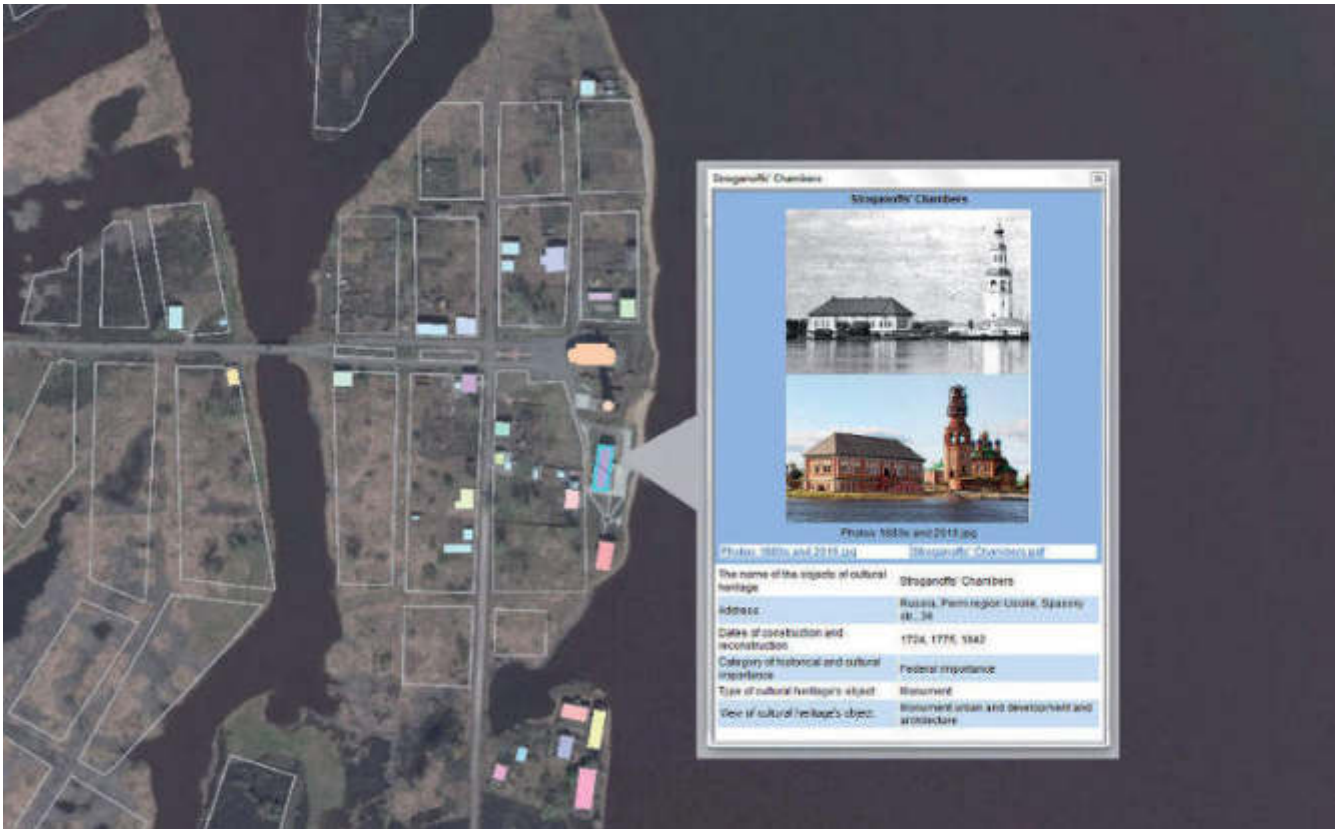

Figure 1.- Example of the attachment from geospatial model «Cultural and historical heritage of Usolie» (screenshot). Image owners – Maria K. Dmitrieva, Yuliya V. Bushmakina.

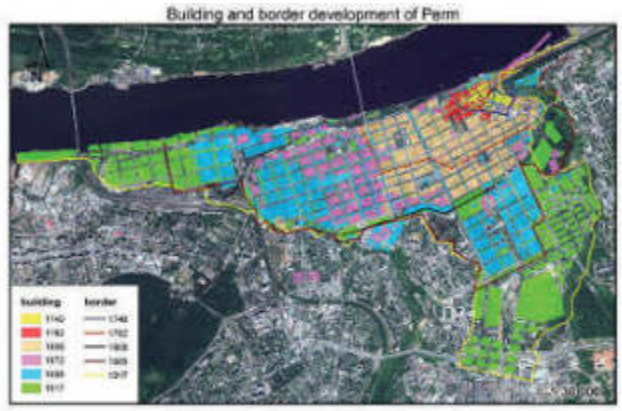

Figure 2.- Map of administrative boundary and quarterly network development in Perm. This figure was first published in 5th International Conference Youth in Conservation of Cultural Heritage YOCOCU 2016 Congress Book, published in relation of the conference YOCOCU 2016, organized by Museo Reina Sofía's Department of Conservation-Restoration, Fundación Museo Reina Sofía, YOCOCU (YOuth in COnservation of Cultural Heritage) Association and the Institute of Geosciences (CSIC-UCM), which took place from September 21th to 23th, 2016. Image owners – Maria V. Gogoleva, Polina A. Balyberdina.

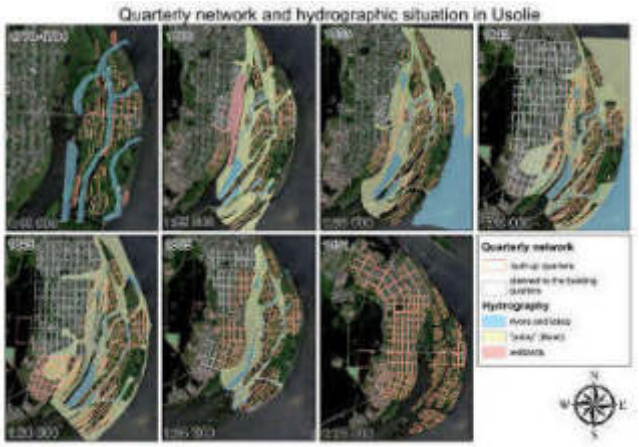

Figure 3.- Map of quarterly network reconstruction and hydrographic situation in Usolie in the 18th – the first half of the 20th century. Image owners – Maria K. Dmitrieva, Yuliya V. Bushmakina.

Correlation archival plans for «Project of quarters» and plans reflecting real urban development of the cities has provided an opportunity to identify divergences from the original plans (cemetery placement closer to the line of building) plans and the experience of failed planning decisions that eventually had to be rejected (the placement in Usolie of shops along the bridge and building quarters at flood). Availability of such information now helps to weed out failing urban planning and design decisions.

Moreover, through the use of GIS we have received qualitatively new information, especially in a changing cultural landscape because of the active channel processes and anthropogenic factors. For example, major of natural water bodies in Perm (except for the Kama river) are small (Egoshikha, Medvedka, Danilikha, Svetlaya), most of them were backfilled or enclosed in underground drainpipes. Mapping their channels would eliminate the technical excesses even at the design stage of buildings and constructions [Figure 4]. Integration archival maps and modern topographic proved useful for fixed changing coastline of the Kama and the location of the oxbow lakes in boundaries of Usolie by reason of channel processes before commissioning of the Kama hydroelectric station. Drawing of water and transport networks, communication networks, which appeared at the turn of the 19-20th centuries on the relief, demonstrates conditionality of their historical location. Finally, by means the archival cartographic sources are integrated to the modern topographic were refined construction periods, historical functions of many monuments of industrial architecture, including those from which only the foundations remain. Thus, the analysis plans of Perm and Usolie with application

Figure 4.- Bodies of water in Perm filled or enclosed in underground sewer. Image owners – Maria V. Gogoleva, Polina A. Balyberdina.

geoinformation methods has revealed features of the folding urban planning, define the boundaries of spread of building, identify patterns of folding of historical and architectural environment of the cities that will be useful for the study of the socio-economic subjects its history. Besides, the GIS-projects managed to bring together all information about the cultural heritage (monuments of history, architecture, and urban planning) of historical cities that allows implement spatial analysis and monitoring of cultural heritage, predict potential risks on the basis of the information included in the geodatabase. The application of digitized maps facilitates the use of historic cartographic sources in solving various historical and architectural problems of applied quality, given the plethora of information contained in archival maps and plans. Therefore, the use of GIS projects with drawings, photographs, and other historical data is valuable to the restoration monuments and conservation of the historic environment.

Conclusions

The GIS-technologies as a method of digital documentation are an excellent tool not only for visualization but also for studying cultural heritage and history of urban planning development, providing new opportunities for historical research. Using GIS for studying historical and cultural heritage provided an opportunity to confirm or refute the established historiography judgments concerning the

urban development of Usolie and Perm. The information obtained as a result of developing GIS project can be applied in practice. Digital data can be used to work with objects of cultural heritage (to carry out their spatial analysis, monitoring and accounting), in conducting archaeological research, the study and teaching of regional history. The correlation of geospatial models and modern buildings might be using in the development or correction of the urban-planning regulations.

The work on the projects for creation the architectural and historical models of cities Usolie and Perm will continue. It is planned to add in geospatial models data about the architectural environment of the 20th century given the development of Soviet construction, including information about the monuments of constructivism and Stalin's empire, the cultural heritage of the settlements included in Perm in this period.

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Ge-conservación
Conservação | Conservation

From the artwork to the "demo" artwork. Case Study on the conservation and degradation of new media artworks

Diego Mellado Martínez, Lino García Morales

Abstract: This paper describes the study case of the conservation of a new media artwork, *Cannula*, by Daniel Canogar (2016). This artwork combines and distorts videos downloaded from YouTube in order to create an oil-like live painting. Main new media conservation strategies are first introduced and discussed. Following, "re-creation" is presented as the best option to deal with the conservation of the elements that compose the artwork, such as its hardware –display, computer- and its software –custom made applications that combine and distort videos-. This paper focuses on a key element to the artwork that cannot be conserved by any of the exposed means: the Internet. YouTube is used to provide the videos to be used. If the service is not reachable –the connection is lost or YouTube is no longer available- the artwork will cease to exist as the artists conceived it. Storing in the memory of the computer the contents previously used provide a mean to re-use them if needed. In that case, the artwork will no longer be such –according to the artists, the live connection to the Internet defines the artwork- but a "demonstration". A self-documentation state defined as "demo", which, according to the authors, represents the closest possible experience to the original artwork.

Key words: New media art conservation, evolutionary conservation, re-creation, demo artwork, computer-based artwork conservation.

De la obra de arte a la 'demo-obra de arte'. Caso de estudio en la conservación y degradación de obras de arte de nuevos medios

Resumen: Este artículo muestra el caso de estudio de la conservación de una obra de arte de nuevos medios, *Cannula*, de Daniel Canogar (2016). Se comentan las principales estrategias para la conservación de arte de nuevos medios. Posteriormente, se presenta la "re-creación" como la mejor opción para lidiar con la conservación de los elementos que componen esta obra, tales como su hardware –pantalla, ordenador- como su software –una aplicación programadas que combinan y distorsionan videos - Pero este artículo quiere poner la atención en un elemento fundamental, que no puede ser conservado de ninguna de las maneras expuestas anteriormente: la Internet que proporciona los videos que la obra utilizará. Si esta conexión se pierde, la obra no puede existir tal y como el artista la concibió. Almacenar los contenidos previamente utilizados permitiría re-usarlos cuando no sea posible acceder a nuevos contenidos. En ese caso, la obra dejaría de ser tal y pasaría a ser una "demostración". Un estado de auto-documentación definida como "demo" que según los autores representaría la experiencia más cercana a la obra original posible.

Palabras clave: Conservación de arte de nuevos medios, conservación evolutiva, re-creación, obra demo, conservación de arte digital.

Introduction

Cannula is a digital artwork based on the execution of custom software on a computer. The output of this program is presented in a LCD display. Both the code, developed under C++ and the aesthetical characteristics of the display – frame width, resolution, size – are key factors of the artwork. The program uses those YouTube videos as a palette to create and abstract painting through an algorithm that, in real time, generates an abstract painting that is continuously changing and never repeating. The interaction with the artwork can be described as follows: the user/viewer inputs a search term (query) using a wireless keyboard. Then, the program looks for the YouTube's 100 most viewed videos matching that query and begins to download them. The moment the first video is downloaded, the previous images on LCD display are faded away and that first video is shown, distorted by the algorithm in such a way that resembles an oil-painting. As each of the following videos finish to download, they are added and combined to the composition (Figures 1 and 2).

Figure 1.- *Cannula*, showing the original content used to created an abstract image (by the authors).

Figure 2.- *Cannula*, showing the resulting abstract image (by the authors).

The conservation of this kind of works has been commonly addressed using the main new media and digital art conservation strategies - storage or substitution, migration emulation or re-interpretation - but according to the authors, they are not enough (Mellado Martínez& Garcia Morales, in press). The conservation of such a complex artwork must be considered from its very beginning –its production- in order to let the artwork "evolve" and change without modifying its nature. This is what "evolutionary conservation" means (Garcia 2016).

But this approach is not enough, at least for this particular case. The artworks is based on an online service - YouTube - whose continuity is not long term assured. Therefore, the loss of that service could jeopardize the integrity of the artwork. To avoid that loss, the contents used to generate the images –the sets of 100 videos downloaded after a query- are stored in the memory of the computer so they can be retrieved if the service is not available. Using previously downloaded contents do not represent the behavior conceived by the artist, although it is approved by him as a suitable alternative in case the service is down- Hence, the result cannot considered "the artwork". Instead, it can be understood as a demonstration of the artwork, a self-documentation on what the artwork was in a previous state that almost keeps the overall experience conceived by the artist.

It should be noted that one of the authors works in the Daniel Canogar's studio and assisted him as engineer in the whole process of production and preparation of the artwork for its future conservation. This allowed not only to obtain valuable information for this paper but, most important, to produce the artwork having in mind its future conservation

Methods and Methodology

New media artworks have become a conservation problem. Obsolescence and lack of resources can be named as part of the most difficult issues. Usually these problems are addressed as they happen, e.g. when component breaks down and a spare is needed or the software is running out of it expected behavior. What happens if one of those components, essential to the artwork, is no longer available? What happens if the artists did not have enough resources –e.g. time, money, knowledge- to present a final version of the artwork instead of a prototype? It is important to remember that "debugging" –i.e. a deep test of software looking for all its flaws- is a very resource-consuming and high profile task. In the case of *Cannula*, this debugging took even more resources than those used to achieve a prototype or beta version-. This is not unusual, since all the possible states that the software could reach have to be foreseen and considered, for example, what happens if the connection is suddenly lost. Correctly defining all the possible states the software can run into and addressing how the program should behave represents a very expensive task, resources wise.

To overcome new media art conservation, four approaches have been typically considered (Rinehart and Ippolito, 2014):

—*Storage/Substitution*

It considers storing spares of the components of the artwork for the future. For example, if an artwork includes a projector, storing spare lamps could be an option. A more advance version of this approach is refreshment, where elements are refreshed prior to their failure.

The main problem of this approach is that it does not solve the problem, but postpones it. It does not overcome obsolescence –spares will spire out at some point too- and requires both logical and physical space for storage.

—*Migration*

Migration considers moving, "migrating" the content form

an old media to a newer one in order to avoid obsolescence; for example, copying from VHS to DVD.

It could happen that, after several migrations, it becomes difficult to ensure that the quality of the content meets the required standards.

—Emulation

Emulation can be understood as a facsimile copy, where a new technology impersonates an old one. In a computer based artwork, for example, a modern computer with a new operative system (OS) could impersonate and old one, allowing an old piece software –based on an old OS- to run on a newer machine without changing that old program in any way. The main problem in emulation is that the experience of the artwork in a new device may be jeopardized

—Reinterpretation

Reinterpret means to create the artwork again under a different point of view, sacrificing some aspects in order to maintain the original spirit; for example, a Renaissance picture reinterpreted by a contemporary artist. The main problem of reinterpretation is how to assure that the original spirit of the artist is kept, especially when he or she is no longer available.

An additional approach can be considered, what Garcia (2016) defined as "re-creation". This approach aims to create again –re-create- the artwork without changing its essence, its symbolic value –what Garcia defines as symbol-object- but using different components to the originals, therefore, changing its support –what Garcia defines as system-object-. These new components will behave in the same way –or most similar possible- that the original. Somehow, it can be understood as a crossover between emulation and reinterpretation that allows the artwork to evolve in the future. Re-creation is a key element to understand what can be defined as "evolutionary conservation", this meaning an approach to conservation that allows the artwork "to change and evolve in order to stay the same" (Garcia 2016).

Evolutionary conservation is, according to the authors, a possible solution to new media art conservation problems. But it requires of a methodological approach in order the kept the artist intention. For example, it is necessary that the artists clearly state what defines both the system-object and the symbol-object. These definitions will allow the re-creation of the artwork in the future.

In this case, the system-object is a combination of software –the set of rules that generates the artwork- and hardware –the physical devices that present the result of the software-. Both of them need to be defined by the artist in order to allow its future evolution. Describing hardware is not a trivial task: not only all the parts must be listed and their features clearly stated, but also it has to be considered how future parts could impersonate old ones. In this case and for the shake of simplicity of this paper, the hardware needs to be fulfilled in the future can be summarized as "the set of elements that allows the software to be executed at 30 frames per second, generating 1920x1080 pixel resolution output on a 75" display, in portrait mode".

According to the experience of the authors, it is software that presents the greater problem. For it to be able to "evolve", it has to be described in such an abstract way that could be easily understood and implemented by other means, for example, using a different programming language. This description must include, again, all the consideration of the artists that allows the system-object to generate the symbol-object. For example, in this case, video content has to be retrieved from YouTube. Therefore, it has to be pointed out that software has to download contents from that site and no other.

Figure 3 is an example of how the authors propose describing the software. This diagram -which in computer science jargon is known as a "flow diagram"- represents how the software works. A piece of software is usually composed of several sub-processes, also known as "threads". In this case, for illustrative proposes, figure 3 represents only the main thread.

As it has been commented before, there is a fundamental aspect for the artwork that presents serious conservation problems. Since the videos used to create the abstract image are to be taken from a specific online server -YouTube - and not other, what would happen if that service were not available? In that case, the artwork as defined would cease to exist.

As a way to overcome this problem, it was decided to store in the hard drive of the computer a copy of the most recently downloaded videos. Then, if the service is not available, the software could use that copy of the videos to generate again the output image, using the same algorithm used when YouTube was available, as it was recently downloaded. This stored content will not be documentation on the artwork but the ingredient for the artwork to create a "documentation output" of itself. In this case, the documentation will not be shown in a different medium as pictures or video taken from e.g. a performance. It will be the same system-object, providing an experience of the symbol-object difficult to distinguish from the original one.

It can be questioned if this scenario where the program uses previously downloaded videos can still be considered as the artwork. Therefore, the authors propose the term of "demo-artwork" to describe the new object.

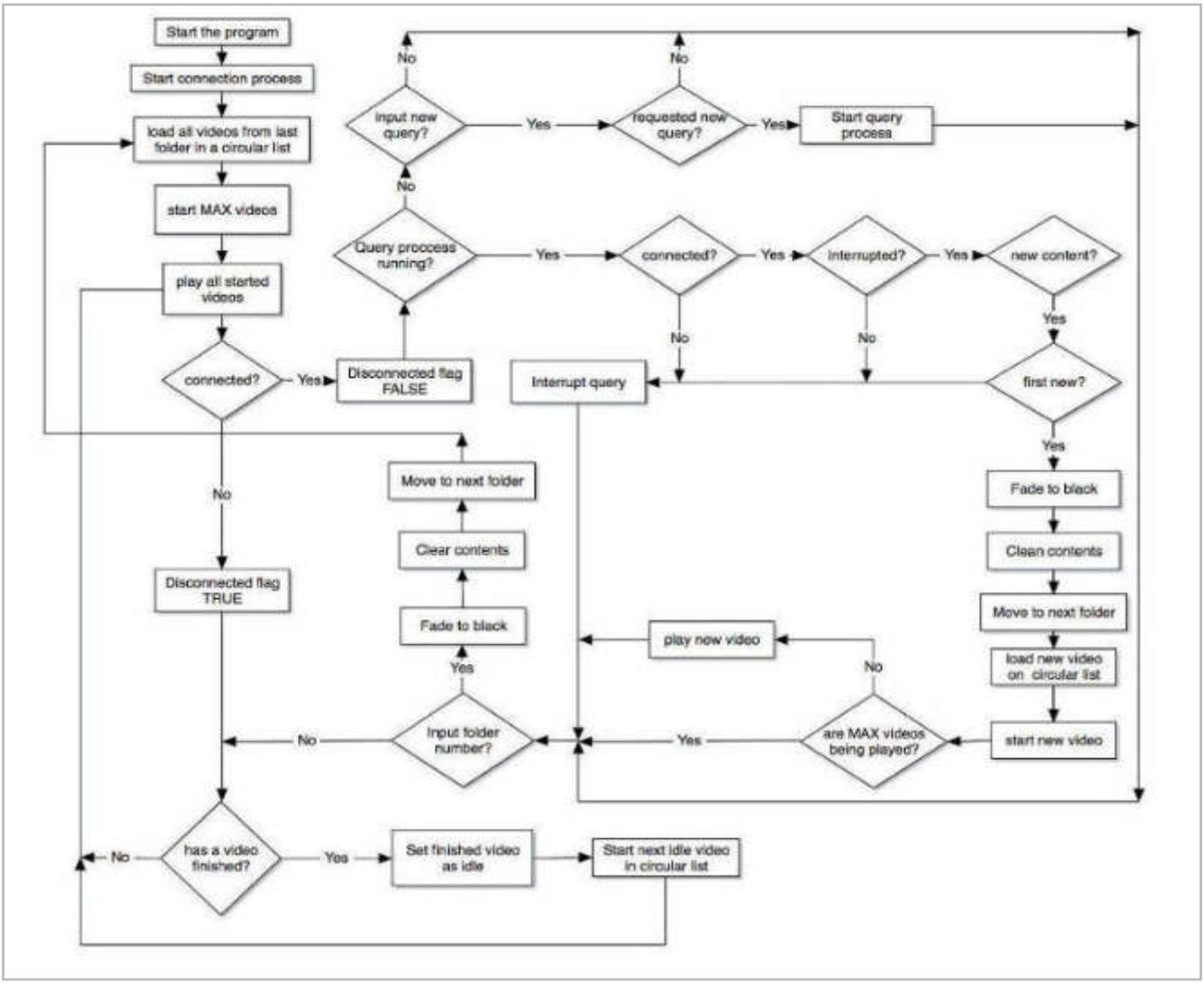

Figure 3.- Main process flow diagram (by the authors).

Results and Discussion

To allow future re-creation, all the previously shown considerations on hardware and software have to be presented and delivered. In this case, all are included in the manual of the artwork. For some time now, artist's studios have delivered manuals for their artworks which shown how to install the piece and how to turn it on and off. According to the authors, this is not enough. These manuals should include all the information needed to re-create the artwork, such as lists of parts, with its key features and flow diagrams for the software.

Gathering this information is not difficult when the conservation tasks are overcome from its very production, as in this case. When dealing with artworks already produced, these tasks, though not impossible, are harder to achieve. Classical restoration approach must always be kept on mind, but interviews with the producers of the artwork –in addition to the usual interviews to artists- and study of the source code of the artwork –which, according to the authors, must be delivered together with the artwork- should be part of the documentation gathered towards the artwork conservation. There will be cases when some –or all- of the information needed would be missing. In those cases, differences between recreation and reinterpretation may become blurry.

Still, a basic element, the access to YouTube, could fail. To avoid that, a demonstration mode is used. Immediately, a question arises: is this mode the actual artwork? The answer, according to the authors of this paper, is no. The artwork is defined as an interactive installation where users can request videos from YouTube in real live and that functionality is lost.

To overcome this problem, the authors propose the demo-mode, as degradation of the original artwork that would use videos requested in the past. This degraded version of the artwork can be seen as documentation of itself.

Conclusions

The "evolutionary conservation" paradigm has been implemented during the production of a specific artwork, allowing for its future preservation and conservation with a recreation approach. This approach cannot be considered as a definitive solution but an additional tool for new media art conservation.

In addition, a novel mode has been implemented to avoid the complete loss of the artwork in case that the service in which it relies shut down, the "demo mode" as a degradation of the artwork. There has been a lot of discussion about documentation as a preservation tool (Scholte & Wharton 2011) especially regarding performance documentation. Through a new approach, authors try to use the artwork interface to document the artwork itself. That documentation can be experienced through same interface of the actual artwork, even when the access to the resources needed to generate artwork is not available. In addition, that experience of the documentation is almost identical to the experience of the real artwork.

Finally, this paper wants to highlight the fact that producers and specially engineers should be taken into conservation teams. Not only for his or her deep knowledge of a technical matter –but for having developed what the art work calls new media. He or she is the ideal professional for restoration of these artworks.

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Current guidelines review for the preservation of plastics emitters of gaseous pollutants in Contemporary Art museums

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Abstract: Plastic contemporary artworks preservation is being a research object for the latter years. Even though so, gaseous pollutants emissions problem has not been studied in depth from the conservation-preservation field.

This article shows the results after the review on the most recent researches related to this problem. We also include the conclusions from the nineteen answers obtained from the surveys carried out in museums and institutions whose collections hold plastic made objects and pieces of art.

The data collection analysis brings to light the absence of specific protocols for plastic preservation, even more so if it is about those emitting gaseous pollutants.

Key words: plastic, modern materials, *malignant plastic*s, gaseous pollutants, preservation protocols, contemporary art.

Revisión de protocolos actuales para la conservación de plásticos emisores de contaminantes gaseosos en los museos de Arte Contemporáneo

Resumen: La conservación de obras de arte contemporáneo realizadas en plástico viene siendo objeto de investigaciones en los últimos años. Sin embargo, el problema de las emisiones de contaminantes gaseosos no ha sido estudiado en profundidad desde el campo de la conservación-restauración.

En este artículo presentamos los resultados obtenidos tras la revisión de las últimas investigaciones relacionadas con éste problema. También incorporamos las conclusiones extraídas de las diecinueve respuestas obtenidas de las encuestas realizadas a museos e instituciones, en cuyas colecciones albergan obras de arte y objetos realizados en plástico.

El análisis de la información recogida, pone de manifiesto la carencia de protocolos específicos para la conservación de plásticos, más aún si se tratan de los emisores de contaminantes gaseosos.

Palabras clave: plástico, materiales contemporáneos, plásticos contaminantes, contaminantes gaseosos , protocolos de conservación, arte contemporáneo.

Introduction

Plastics; we understand as such the combined natural polymers, semi-synthetic or synthetic, and their additives; were incorporated into the world of art at the beginning of the 20th Century. They keep growing in the design, and contemporary art collections. Thus, they signify a high percentage in the most relevant collections.

On the first decades plastics showed some instability, which forewarned a pressing need of research. Thus, from the first moment (90's), there were studies, related with conservation of contemporary art (Grattan 1993; Heuman 1995; Corzo 1999; Hummelen & Sillé 1999), within which plastic conservation was addressed. The specific ones for this material appeared by the end of the 20th Century (Blank 1990; Fenn 1995; Quye & Williamson 1999; Williams 2002; Oosten et al. 2002; Albus et al. 2007; Keneghan et al. 2008; Shashoua 2008b; Waentig 2008; Oosten 2011; Smithsonian Science 2012; Cadiñanos 2012; Lavédrine et al. 2012).

Time means a threat for these materials, and it has turned their conservation into a challenge; this domain is where this research takes place.

Plastics undergo irreversible deterioration processes with no treatment nowadays to guarantee their stability. As a consequence, preventative conservation is the only strategy to protect them. Therefore, it is required to have a specific conservation protocol to keep them in the best feasible condition.

Malignant plastics are those that when deteriorating, produce harmful emissions that may damage additional objects whether plastics or not (Williams 2002), and thus they become a new degenerating source.

Research in this area has begun but it is in an emerging state, since there are mainly specific study cases being addressed. It is difficult to find general examples that identify and describe plastics or analysis of the preservation condition of this material.

This article collects the following targets: review current research studies about the problematic on plastic made art pieces producing gaseous pollutants emissions; getting to know the protocols used for this material conservation in the contemporary art collections; show surveys efficiency as a tool for gathering unpublished information; critically analyse data obtained in order to know the deficiencies that may arise aiming to elaborate a protocol suggestion. Always within the scope of contemporary art preservation.

Methods & methodology

The research is structured in two parts: the study of the bibliographic sources and the inquiries.

The review has been done on the studies that refer design or contemporary art works with COVs emissions, since it has been noticed a lower number of those studies.

Surveys have two parts; a first one with the aim of knowing the existence of a specific protocol for plastics preservation. If there is one, a copy will be requested.

The second part (without protocol) consists of five questions directed to know each one of the values and standards used as preservation measures, and if they follow any external guideline.

The aforementioned enquires have been sent to fifty museums, both European and American, selected founded on: the importance of their collections, the larger presence of plastic-made works, or for being involved in projects related to this material preservation.

The last part of the methodology, consist in making the qualitative and quantitative analysis, where the conclusions have originate from.

Malignant Plastics

Polluting plastic's danger in Contemporary Art Collections is a problem that we only have elementary notions about, especially based on experience. There are seven research works (Fenn 1995; Keneghan & Quye 1999; Williams 2002; Shashoua 2008b; Kean 2009; Tsang et al. 2009; Lavédrine et al. 2012) that refer to the pollutant emissions from the artwork, but all of them only give an superficial overview of the problem. All seven studies warn us about the risk of gaseous pollutants emissions generated by specific types of plastics during their deterioration process, which may impact nearby pieces of work, both in exhibit or storage.

All of them also point at cellulose acetate, cellulose nitrate and Poly (vinyl chloride) as dangerous; five add polyurethane to this list; and two add rubber.

It is worth mentioning at this point, that there are also some research as The Museum Environment (Thomson 1978), *Airborne Pollutants in Museums, Galleries, and Archives: Risk Assessment and Control Strategies*(Tétreault 2003), *Monitoring for Gaseous Pollutants in Museum Environments*(Grzywacz 2006), among other, that refer to the pollutant emissions from other objects (showcases, container, etc.).

Consequently, it seems clear that all the artworks made by such five plastics need a specialized treatment that has to be taken in account when making a specific convention in order to preserve this material.

—*What are gaseous pollutant emissions by plastic?*

When plastics are exposed to sources of extrinsic deteriorating, such as light, ultraviolet radiation, temperature, humidity, oxygen and pollutants, chemistry reactions alter their qualities. When this happens, the appearance of degraded products released by the object often occurs, they agree with the migration of compounds added for their production and may be found in solid, liquid or gaseous state.

The appearance of deposits on plastic surfaces is generally due to plasticizer migrations, or occasionally due to fillers. When they are gaseous they may have characteristic odours, due to the unpredictable compounds' release (Balcar et al. 2012) .

These emissions may unleash or accelerate the ageing in other objects.

Consequently, some plastics are potentially dangerous, since these emissions may unleash or accelerate the ageing in other objects situated nearby.

—What do they emit?

It has also been detected which gases are sent out by these five plastic types. In this table the potentially dangerous plastics, and which are the most common gases they send out are pointed out (Lavédrine et al. 2012; Williams 2002).

Table 1.- Malignant plastics and their most usual emissions

Plastic	Gas emissions
Cellulose acetate	Acetic acid gas
Rubber, ebonite and vulcanite	Hydrogen sulphide and other sulphur containing gases
Cellulose nitrate	Acidic and oxidizing nitrogen oxide gases
Polyurethane	Nitrogenous organic gases
PVC	May produce hydrochloric acid gas under extreme conditions of moisture and light exposure

—How are they identified?

This identification may be done by different scientific analyses or by empiric analytic method. We find Condition Reports use the second one (Liébana, in press). Also, we notice that there is an important number of research describing which are the most typical odours released by each kind of plastic.

As example, we can find two samples of Condition Report specific for plastics including a section referring odors detected in the following books: "*Basic Condition Reporting. A Handbook*"(Demerouskas 1998, p.121) and "*Preservation of Plastic Artefacts in museum collections*"(Lavédrine et al. 2012, p.295).

It is worth mentioning at this point, that the odours are very subjective, therefore they will allow us to identify a threat in our collection, but by no means will determine a specific cause. Furthermore, there are gaseous pollutants odourless, so it could be given such a risk condition without being able to empirically perceive it at an early phase.

Potential casualties

Literature has also mentioned materials, which are susceptible to suffering damage due to these emissions. Six, out of seven works dealing with the problem, list the most potentially sensitive materials. All of them agree that, emissions affect the same plastics; five of them point out they are a potential risk for metals, two of them warn of the hazard meant for paper and Shashoua (2008) mentions how detrimental they can be for organic materials in general.

So, making a recompilation of yield results until now, we may conclude that the materials susceptible to these pollutants, are metals and organic materials

Figure 1.- Originally the work presented transparent plastic elements, now shows plastic decomposition signs, which cause deterioration processes on metallic parts. Portrait of Marcel Duchamp , Antoine Pevsner , 1926, Cellulose nitrate on copper with iron. Yale University Art Gallery Gift of Collection Société Anonyme.]

between which we may point at paper and plastics, more specifically fully vulcanised hard rubber (ebonite and vulcanite).

Plastic preservation at museums and institutions

In order to know whether there are or there are not protocols used for plastic conservation in the art conservation collections, fifty inquires have been sent to American and European collections with a result of nineteen answers, four of which did not answer to the second part.

The first part results reveal a lack of protocols supported by all nineteen of them.

The answers on the second part show heterogeneity on norms and parameters taken in account for physical plastic material preservation in each one of the collections. As opposed to decision making where a closer affinity of criteria may be observed.

Surveys section two. Standards; summary of findings.

Table 2.- * In rubber for exceptional cases. (Chart legend):
Guideline 1: Are the same parameters used for art works in good preservation condition as for those that have some type of damage?
Guideline 2: Are damage and pieces in good condition stored and exhibited together?
Guideline 3: Do you do any kind of maintenance (e.g. preventative cleaning) such as conservation measures?
Guideline 4: Is there any control of pollutant gas emissions?
Guideline 5: Personalized decision-making?

Institutions	Guideline 1	Guideline 2	Guideline 3	Guideline 4	Guideline 5
Kunststoff-museums-verein e. v.	N	N	-	-	-
Museum of design in plastic (modip)	Y	N	-	N	Y
SMK	Y	Y	-	N	Y
Tampere museum	-	Y	-	Y	-
Victoria & Albert museum	Y	N	-	N	-
Die neue sammlung -The international design museum	N*	Y	-	-	Y
Denver art museum	Y	Y	-	Y	Y
Moma	-	N	-	-	S
Pinacoteca do estado de São Paulo	Y	Y	-	N	Y
Centro andaluz de arte contemporáneo	Y	Y	-	N	Y
Centro atlántico de arte moderno	Y	Y	Y	N	Y
Guggenheim Bilbao	Y	-	-	Y	Y
Museo Vostell malpartida	Y	N	Y	N	Y
Museo artium	Y	-	Y	-	Y
Fundación gala salvador dalí	Y	N	Y	N	Y

In summary:

- Eleven museums set the environmental parameters according to the preservation condition of the piece of art, two don't, and two have not commented.

- Seven store or exhibit at the same time works in good conservation condition, and deteriorated ones, six don't do it, and two have decline any answer. It must be noted that, the vast majority who do not follow this norm, attribute it to space or curator problems.

- Four make some type of maintenance as a preservation measure, while all others have not answered that question. Only three museums make some type of gaseous pollutants emissions control, eight have confirmed they do not make any, and four have not answered. It must be noted that the three making some controls are all different; Tampere Museum uses an equipment that allows a gaseous pollutants general control in real time; Denver Art Museum make a periodical empiric control (smell) and the Guggenheim Bilbao uses AD-strips, thus it is only making a follow up of volatile organic acids.

- Finally all the Museums, that have answered, make their decisions individualized. We ignore the routine for the three that have not answered.

Information analysis: protocol-devising proposal

It is found out that there is no preservation protocol for plastic materials, which are considered indispensable. Shashoua confirms this fact in her recent article "A safe place. Store strategies for plastics" telling that "Since there are no international standards for storage environments for plastics, it is not uncommon for museums to apply those used to preserve both works of art on paper and other fragile organic materials".

Given the material characteristics and the detriment noticed along its lifetime, it is advisable to pay special attention to it, since the chemical deterioration may even cause its disappearance. On the other hand, it implies a potential risk for other works kept under the same place. Therefore, it is considered of paramount importance to elaborate an action protocol based on two crucial mainstays: material preservation and action guidelines. This protocol should enable us to regulate the steps to follow in a first decision-making.

—*Material preservation*

Plastic deterioration happens in two stages along its life: on its manufacture and on its "use". In this second phase it is constantly exposed to environmental factors. Prolonged exposures to light, heat, humidity, oxygen and pollutant gasses may visibly reduce its longevity (Shashoua 2008b).

Thereby, it must be estimated which are the best environmental values, both in storage and in exhibit, in order to develop a protocol. To achieve this target all deteriorating factors above mentioned have to be monitored.

So, materials preservation should consider the illumination parameters both in storage and in exhibit. Considering any type of light is detrimental for plastic stability, particularly if containing UV radiation; and the fact that hazard impacts are accumulative and therefore irreversible.

Accordingly, excluding light on storage areas and limiting it during exhibitions is recommended. As a consequence, it is recommended to restrict light in halls only when open to the public, considering that illumination must be artificial, free from UV radiations and limited to 50 lux.

Temperature is a key influence in deterioration processes, although it is proven that plastic tolerance range is quite wide.

One occurrence to bear in mind when talking about temperature is the day/night fluctuations, since not all collections are in a conditioned environment. It is proven to have a direct impact on its physical stability due to the relatively high thermal expansion coefficient this material has.

Temperature also has a major impact on chemical degradation processes, according to Michalski (2002)"Double the life for each five-degree drop, [...]", to this effect cold storage is considered a positive preservation measure. Nevertheless this system could lead to material damage as crackles or splits resulting from the cold-warm alternate processes. On account of this, an individual use must be determined, case by case, in order to assess its effectiveness. We also deem necessary further research aiming to reveal which measures have to be implemented to minimize the risk that adopting this system means nowadays.

Humidity is linked directly with all factors provoking HR fluctuations such as public attendance; so in exhibit periods it is recommended to keep it controlled by 40-50% and this way avoid certain plastics hydrolysing (Blank 1990; Keneghan & Quye 1999).

For cold storage this matter should be equally considered, since a maximum span of 6ºC - 10 ºC between plastic and container should not be surpassed to avoid condensation derived from the cooling process. Carrlee (2003) holds that keeping those parameters is crucial to avoid this process and suggests surrounding the work with an isolation material like polystyrene foam chips to achieve this.

Polymers are oxidized in all their life cycle phases - during manufacturing and processing, as well as during storage and use. Oxidation nevertheless, does not happen at the

same speed during all the polymer life stages (Shashoua 2008b).

This type of deterioration reduces plastic physical properties and changes its appearance. Most common symptoms are a decrease in malleability, strength and flexibility, as well as, discolouration, surface cracks and increase in porosity (*Ibid*.).

Aiming to slow down these modifications, systems like anoxia storages both in nitrogen atmosphere and in water, or placing oxygen absorbers in the packaging systems designed for this purpose, have been evaluated.

These methods nevertheless, require further investigation, since there are some knowledge gaps about some of them, which initially seem able to produce very interesting results.

Concerning oxygen absorbers, Ageless® is the right method for rubber preservation, since there are examples of its effectiveness, whereas it can be hazardous for all other plastics analysed here; AC, NC, PU, PVC since it produces a increase in HR in the packaging (Shashoua 1999).

RP-K® "absorber", yet lacking a deep study about its efficiency on "malignant plastics", is considered as an interesting option based on its efficiency for absorbing not only oxygen but other molecules, and unlike Ageless® keeps HR stable.

As for nitrogen atmosphere, although it may yield good results, its handling is more problematic since it may be hazardous for human beings, which complicates periodical artwork control. Accordingly, it is initially dismissed, although it could be considered in very specific cases.

We consider that underwater storage needs detailed examination enabling analysis of its pros and cons, Since no trials have been performed to proof the effectiveness of this approach, and although in principle exposes various risk, in rare instances rubber objects have been found submerged under water in surprisingly good condition (Grieve 2008).

As it is being considered along the full article, pollutants are a risk factor when preserving a plastic made artwork collection. Therefore, excluding them from their environment would be necessary for their right preservation.
It is recommended storing pieces of art in places as open as possible. If packaging is required, the materials used should be acid free, and adhesive labels should not be used at all.

As in the case of oxygen, we may also use absorbers to minimize the risk. These can be installed in the active filter system, in the storing area or inside the packaging material (Shashoua 2008a).

From existing scavengers, both activated carbon, as zeolites seem to report good results for certain plastics preservation. Although, this review also proves the need of studies in more depth that will enable to make the most out of those products.

Action criteria

The action guidelines in plastic preservation protocols must be focused on slowing deterioration, since up till now this cannot be stopped. There will be various deteriorating stages during its lifetime, being the reason why the steps to take will have to be necessarily different for each one.

As they are pieces of art, material preservation, must care also about conceptual conservation, for in case of extreme degradation, some questions should be answered as what measures to take, or if a replica would be acceptable between others.

The literature review on projects analysing most common plastics deteriorating sources and feasible solutions to inhibit them, shows that most of them focus on specific aspects, doing isolated researches, without taking in account plastic preservation general problems. From the review of fifteen studies only one of them (Shashoua 2008b) takes in account all aspects. Three of them (Blank 1990; Albus et al. 2007; Waentig 2008) although leaving out some, make also a global study quite complete. All others are centred in specific aspects.

Since the curator-contemporary art conservator aim is preserving the artist intention, stopping physical change, before taking action, we have to rely on a well-structured work methodology that may allow removing subjectivity from decision-making.

Conclusions

The literature review confirms that only seven research studies deal in a general way with the issue of gaseous pollutants, except Williams (2002) who does it in a specific way.

In the same way, they point at five plastics as dangerous because of their gaseous pollutants emissions: AC, NC, PVC, polyurethane and rubber. NOx, and acid, and sulfurous gases, are the most commonly expelled.

Condition Reports show that the empirical method is used only to detect gaseous pollutants, even though there are more reliable scientific methods, that not only detects gaseous pollutants emissions sooner, but also allows data records.

Surveys show some information that is not possible to obtain through bibliographic review, as it is the inexistence of specific protocols for plastic preservation.

They also confirm that scientific gas control is not generalized, aside from the exceptions aforementioned. This deficiency is related to budget matters, although some of the devices do not imply a high cost.

Finally, this research shows the lack of space and budget as decisive factors on decision making that negatively impact plastic preservation in collections. Nevertheless, a greater cooperation between museums curators, and researchers would significantly better the issue, since it would allow a deeper study for specific cases.

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Ge-conservación
Conservação | Conservation

Giancarlo de Carlo's University Colleges in Urbino. Studies and analysis for the Conservation Plan

Paola Borgarino

Abstract: The contribution presents part of activities that have been carried out for the preparation of the Conservation Plan of the Giancarlo De Carlo's University Colleges of Urbino, funded by the Getty Foundation within the "Keeping it Modern" program in 2015. Starting form a comprehensive evaluation and understanding of the values that are represented in the complex, the Conservation Plan aims at establishing a "sustainable" management strategy, which means finding a "point of balance" between conservation and change, between an important cultural value, which has led to an international recognition, and the demands of everyday management.

Within the Conservation Plan, specific guidelines for the preservation of modern materials and architectural elements and a schedule of interventions, preventive activities and controls are being developed. This paper presents the first steps of the research, the results already achieved and the themes currently being discussed.

Key words: conservation plan, modern heritage, preventive conservation, heritage preservation, condition assessment.

Las Residencias Universitarias de Giancarlo de Carlo en Urbino. Estudios y análisis para el Plan de Conservación

Resumen: Esta contribución presenta parte de las actividades que han sido llevadas a cabo para la preparación del Plan de Conservación de las Residencias Universitarias de Giancarlo de Carlo en Urbino, financiado en 2015 por la Fundación Getty dentro del programa "Keeping it Modern". El objetivo del Plan de Conservación es establecer una estrategia de gestión "sostenible", partiendo de una evaluación integral y la comprensión de los valores que el conjunto representa, lo que significa encontrar el "punto de equilibrio" entre renovación y conservación, entre el importante valor cultural que ha llevado a un reconocimiento internacional y las demandas de la gestión diaria.

Dentro del Plan de Conservación se están desarrollando recomendaciones específicas para la conservación de materiales y elementos arquitectónicos modernos y el calendario de intervenciones y actividades preventivas. Este artículo presenta los primeros estadios de la investigación, los resultados ya alcanzados y los temas que se están discutiendo actualmente.

Palabras clave: Plan de Conservación, patrimonio moderno, conservación preventiva, conservación del patrimonio, evaluación del estado de conservación.

Scope

—The University Colleges of Urbino

The University Colleges of Urbino, built by Giancarlo De Carlo between 1962 and 1983, are among the most significant and interesting architectural works of the post-war period. The Collegi are a huge construction, not far from the historic centre, where the Universities are located.

The complex covers over 62.000 square meters and consist of 5 "cores" (Colle, Aquilone, Serpentine, Tridente, Vela), each of which includes rooms (single or double rooms, with individual or shared bathrooms); "private" spaces used by small groups of students (kitchens, living rooms, terraces…); "public" spaces, with a specific function (classrooms, study rooms, a library, a canteen, indoor and outdoor theatres…) and spaces that are freely accessible and usable, such as the pathways and the common spaces.

Figure 1.- Aereal view. (Ph. Fulvio Palma).

The concept behind the project was incredibly modern: a university campus open to the city, provided with services and cultural activities, which citizens could access.

Nevertheless, these services have never been realized and the changes occurred in the last decades have led to a complete transformation of the requirements and needs.
Some demands for change are based on prescriptive requirements (an adequate compliance to the current standards in terms of safety and energy efficiency should be guaranteed as well as the accessibility for people with disabilities) whilst some changes are required to adapt the building to new necessities, habits and ways of life (e.g. as there is an increasing number of foreign students, part of the complex is used as a guesthouse).

In addition, the preservation of materials and architectural elements is an issue which needs to be addressed urgently; also taking into account that some improvements that should be introduced to ensure a greater durability.

— The Conservation Planning approach, concept and current applications at the international level.

The ICOMOS Madrid Document "Approaches For The Conservation of Twentieth-Century Architectural Heritage" (ICOMOS ISC20C 2011- 2014) is, at this moment, the main reference for the conservation of modern architecture. The Document stresses the need for a full understanding of the building that is the essential reference for all the decisions about the care and conservation of the authenticity and integrity. Materials, architectural elements, technical equipment, but also interiors, furniture and associated art works should be identified and assessed, as well as the context (landscape and urban setting) and the intangible meanings (e.g. the historic, social, scientific or spiritual value) of the site.

Conservation does not exclude change (which is an essential component for transmission to the future of a living heritage) but any transformation should be carefully weighted and based on appropriate management tools: a Conservation Plan should therefore be prepared before works start, to provide specific conservation policies to guide development and change.

The Conservation Plan has therefore been defined as: "a document which explains why a place is significant and how you will sustain that significance in any new use, alteration, repair or management (…) It is based on a very simple thinking process which starts with describing what is there, why it matters, what is happening to it and the principles by which you will manage it and then sets more detailed work programmes for maintenance, management, access, use or other issues" (HERITAGE LOTTERY FUND 2002).

The Conservation Plan fosters the change towards a "proactive" attitude, which requires conscious and careful evaluation, to prevent and control the impacts and includes a comprehensive study (historical research; analysis of the significance; condition assessment; analysis of the current and potential risks…) and sets the policies to conserve, manage and interpret the cultural significance identified in the site. The plan should also define the "limits of acceptable change", which means identify the significant parts of the heritage site, the areas where interventions are possible, the suitable uses and the conservation measures to be taken.

The Conservation Plan is a document rather new for southern Europe whilst it is quite diffused in the UK and in Australia, where that methodology was used for the first time and where there are already some important experiences on 20th Century architectural heritage (see the Sydney Opera House Conservation Plan, prepared for the first time in 1993 and revised several times since then; KERR 1993, 1999, 2003).

To test on a large scale the Conservation Planning approach for 20th Century architectural heritage the Getty Foundation launched in 2014 the "Keeping it modern" programme, an international grant initiative that supports the creation of conservation management plans that "guide long-term maintenance and conservation policies, the thorough investigation of building conditions, and the testing and analysis of modern materials" (http://www.getty.edu/foundation/initiatives/current/keeping_it_modern/). The program is part of the Conserving Modern Architecture Initiative (CMAI), a "comprehensive, long-term, and international program" whose goal is to advance the practice of conserving twentieth-century architecture, "through research and investigation, the development of practical conservation solutions, and the creation and distribution of information through training programs and publications" (http://www.getty.edu/conservation/our_projects/field_projects/cmai/) and is directed to important buildings of the 20th Century, that have the potential to serve as model at the international level.

Aims

—The aims of the Plan

The Conservation Plan of the University Colleges of Urbino is currently being drafted (the completion is scheduled for March 2017), with a grant from the "Keeping it Modern" program. With that grant the outstanding architectural significance of the complex is recognised at the international level, as well as its potential to be a reference for the conservation of modern materials and architectural elements. Preparing that Conservation Plan is a big challenge and a chance to discuss whether a value-oriented approach is viable, when dealing with a huge brutalist building, raw materials and elements that, at first glance, all look the same and have no specific qualities.

Starting form a comprehensive evaluation and understanding of the values that are represented in the complex (and that include the architectural significance, the social value, the connection with landscape and the historic city, and the different meaning experienced everyday by the over 1100 students and workers that live, study and meet in those spaces), the Conservation Plan will develop an overall management strategy which includes several aspects (conservation procedures and guidelines, identification of new functions and uses, energy efficiency - to improve the indoor comfort and reduce the operating costs, facilities, new connections with the city...). In that context, the specific issues of the site will be considered (as the size of the complex, the need of working without driving away the students and the accessibility problems, since a large part of the complex is not accessible by vehicles…).

—Conservation issues

The preservation of materials and architectural elements is a key point of the Conservation Plan.

The external facades of the complex are characterised by bricks and concrete, both used without plaster or other coating. From a conservative point of view, the fair-faced concrete slabs represent the main challenge.

In addition to the dimension of the elements (in some cases the thickness is less than 10 cm), that does not guarantee an adequate level of protection from the corrosion of the reinforcement, there are specific risk factors to be considered such as the different types of mix design, the environmental conditions (position, exposure, orientation), the quality of materials and construction; the surface treatments (some surfaces have been bush-hammered and this resulted in an increased porosity and, consequently, an increased vulnerability). Consequently, there are different levels of decay, ranging from a good state of repair to situations in which the corrosion of the reinforcement bars has already led to cracking, delamination, spalling, and to a significant loss of material. The conservation of the wooden windows and doors frames is a second important issue: all the elements are custom-designed and almost all of those in the common areas are unique pieces. Since most of them are exposed to the weather, without any protection, some of them have already been replaced using materials that are more durable and easy to maintain whilst others are rotten and damaged and are liable to be replaced in the next future.

Figure 2.- Collegio del Colle. View of walkways.

Figure 3.- Collegio dell'Aquilone. Façade.

Figure 4.- Collegio del Colle. Decay of the window frames.

Figure 5.- Collegio del Tridente. The windows of the rooms.

Research methodology

—Data collection and risk assessment

As first step of the preparation of the Conservation Plan, a comprehensive registry of the architectural elements has been developed for a complete description of the building. In that phase all the frames (doors, windows, roof lights, panels) and all the concrete elements have been identified with an alphanumeric code, classified and related to a state of conservation.

Than, starting from a detailed analysis of the architectural elements, hazardous situations, issues and predictable damages have been identified, considering the use of each element. For example, the windows of the rooms required a special attention, since they are likely to be used more often those in the common areas, are not repaired from the weather and have a significant influence in determining the interior comfort conditions. It should therefore be discussed whether a simple maintenance work can be proposed or the energy efficiency can be improved, and how.

As said before, the preservation of the concrete slabs is a major problem and it is essential to identify the areas that require urgent attention and where a repair is needed; the areas where a limited intervention is still possible; and the areas that are in a good state of repair and can be treated to prevent further damage. To identify the different materials and states of conservation a complete mapping of the main facades and a score evaluation of the external surfaces have been realized. The analysis has been integrated with the results from the diagnostic activities (carbonation depth analysis using phenolphthalein).

Starting from those maps, some areas for the pilot sites have been identified that are representative of the state of conservation of the concrete. Here, some promising conservation and repair techniques have been evaluated through several on- site tests, namely: protective treatments; to be applied on the concrete elements that are in a good state of conservation with preventive purposes; repair mortars; to repair the damages that has already occurred. Besides, for the areas that are "at risk" (because of the position, the shape of the elements, the material used…) or that are difficult to access for inspection and maintenance, "ad hoc" protection strategies, such ad flashings or protective coatings, are being studied.

The same approach was used for the doors and windows frames: over 4300 elements have been analysed and over 180 types have been identified. A score, ranging from 0 to 4 defines the state of conservation of each element of the complex.

All the data produced have been imported into special software (PlaNET Beni Architettonici) that have been expressly conceived for built heritage (BORGARINO, BENATTI, DELLA TORRE 2014) and that we are testing here for the first time on modern heritage.

The database has been organized taking into account and the size of the complex and the need to introduce as soon as possible a new management routine.

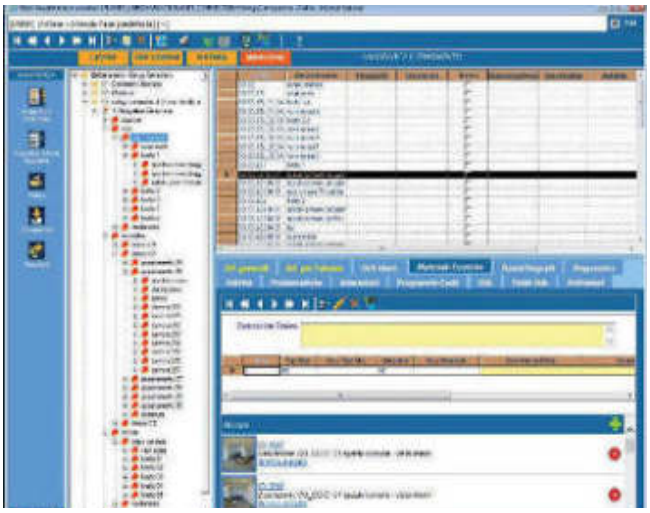

Figure 6.- PlaNET Beni Architettonici. Description of the complex and data storage.

Some support tools have been used to speed up the data entry, such as word lists and abaci (that can be selected through a drop-down menu) to describe materials, decays and surface textures and structured forms of data query for an easy identification of the emergencies and planning of the everyday activities.

Doors and windows frames can be easily arranged by type and state of repair and each element can be related to documents, descriptions and images.

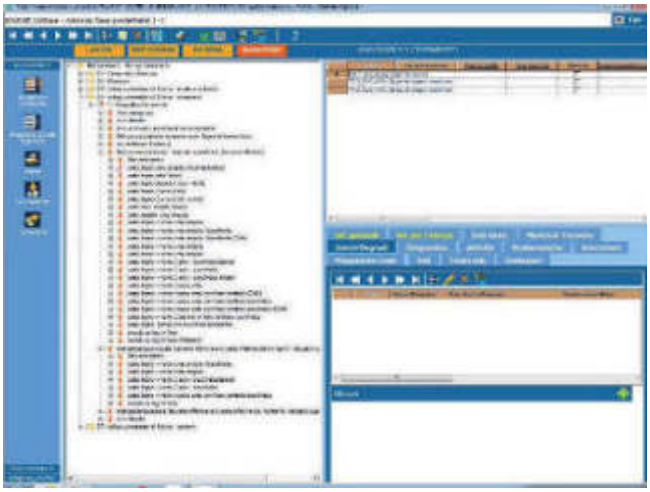

Figure 7.- PlaNET Beni Architettonici. Registry of the doors and windows frames.

The data collection will be incremented and updated over time, in subsequent studies and in the management routine. It is important that the site managers, that every day take care of the complex, have an active role in the implementation of the management routine, and the availability of updated, reliable and easily accessible data is therefore essential.

—*The "care program"*

The data collected in the first stage are being used to realize a "maintenance plan", defined "Care Program" to emphasize the priority that is given to prevention, controls and "soft "actions.

Within the "Care Program" conservation guidelines are being prepared for concrete elements and frames; the document will suggest repair techniques, conservation and preventive actions to be performed periodically (e.g. regular maintenance of wooden doors and windows, periodic renewal of the protective coating applied on concrete to ensure the conservation of the elements over time...).

Than, a schedule of activities will be established that includes: urgent maintenance works; limited repairs; preventive actions and controls to be performed periodically. Finally, a "user manual" addressed to the students will provide a presentation of the complex, precise instructions for a respectful use and forms for reporting anomalies, problems and maintenance needs.

Discussion

That plan is prepared by applying to the Conservation Plan the methodological approach established in the studies on preventive conservation (in the international context, see the UNESCO chair on Preventive Conservation, Monitoring and Maintenance of Monuments and Sites, established at the Catholic University of Leuven in March 2009 and recently confirmed until 2020 and the PRECOM3OS network), to include care into a comprehensive management strategy.

An effective conservation, based on prevention and daily maintenance can only be achieved through an integrated approach, knowledge-based and consistent with management and change.

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Ge-conservación
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Influence of inorganic and organic additives on spectrophotometry of lime mortars

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Abstract: Variation in colors in lime base mortars by adding materials like clay, manufacturing brick ash, quarry powder, and maize starch have been analyzed in this research. Such additions were compared with a sample mortar made only of sand and clay. In order to quantify the color, Chromatic coordinates, expressed in coordinates C.I.E. (L*, a* and b*) were measured. These analyses determine the median chromatic coordinates which are between red and yellow, maybe as orange. To design a mortar in that original color the measured values L*, a* and b* were taken into account. The present work shows the results of color of lime mortars which provides acceptable aesthetic results according to the original colors of the monuments that is intended to be restored but without diminishing the mechanical resistance of them.

Key words: Spectrophotometry, lime, mineral additions, mortars, restoration.

Influencia de aditivos orgánicos e inorgánicos en la espectrofotometría en morteros de cal

Resumen: En el presente trabajo se analizaron las variaciones de color de mezclas de mortero base cal con adiciones de materiales como: arcilla, ceniza de ladrillo, polvo de ignimbrita y fécula de maíz; comparando dichas adiciones con un mortero testigo de cal-arena. Para cuantificar el color, se midieron las coordenadas colorimétricas, expresadas en función de las coordenadas C.I.E. (L*, a* y b*). Estos estudios determinan las coordenadas cromáticas medias, que están en la gama de rojo-amarillo como es el naranja. En el diseño de un mortero con ese color original se tendrían que tener en cuenta los valores medidos de L*a*b*. El presente trabajo muestra los resultados de color del mortero base cal que proporciona resultados estéticos aceptables según los colores originales de los monumentos que se pretenden restaurar pero sin demérito de la resistencia mecánica de los mismos.

Palabras clave: Espectofotometría, cal, aditivos minerales, mortero, restauración.

Introduction

Gradual deterioration of the stone in historic monuments caused by physical, chemical, structural or anthropogenic agents, requires restoration procedures which part of them can consist on the application of binders or lime mortars not only for aesthetic purposes, but for protecting the exposed facades of the colonial architectural monuments built with ignimbrites stones from quarries of the surroundings. The first approach to conserve these monuments was to replace the damaged blocks but as the city grew and all the quarries around it were covered, it was not possible to find the same rock quality and worse, the active quarries were not enough appropriate to replace the blocks, so the best way in the meantime of finding new quarry stones for restoration works in monuments was to protect (cover) the non-sculpted facades. However, as the historic center of Morelia city – Mexico - is listed as UNESCO World Heritage Centre, there are rules according with restoration, specifically with color, than the mortars must comply. Morelia is also called the Pink City.

As it is widely known, lime mortars are not real hard building materials (Pozo, 2015; Grilo et al, 2014; Ventol à et al, 2011), therefore additions are considered to modify the mechanical, physical and aesthetic properties. Additions can be included as powder: the ones mentioned in this article, powder of the unaltered quarry stones, ash dust from the ovens in which bricks are fired, montmorillonite clays, and corn starch. Other additions can be incorporated in a liquid/semi-liquid state as milk, blood, oil, egg yolk and white, lard, cactus sap; and

fibbers for increasing flexural strength like cotton, wool, goat hair, chicken feathers. The powder additions can modify the color of mortars, and simultaneously they can also modify their mechanical properties, although this research only will refer to color as an aesthetical characteristic of its appearance.

The liquid additions modify the color of the lime mortars, but unfortunately towards a greenish tonality, and we were looking for pink color located between yellow and red axes, as indicated for the exposed ignimbrites taken from the colonial buildings (house of culture, Colegio San Nicolas). Then we decided to characterize the mortar color tending to pink, and fortunately the powder additions result in this aesthetic property. Of course the mortar color is not identical to the architectural patrimonial ignimbrites, the new restoration works must be noted (Stefanidou et al 2015).

The necessity to avoid or to minimize the visual impact of the protecting material during restoration requires the development of quantitative methods of color determination in this kind of material. The methods based on the visual comparison of colors (Esbert et al 1989:5-26; Tabasso 1992: 45-57) have been replaced by other methods based on spectrophotometry (Tabasso 1992: 45-57).

In the past it has been demonstrated the benefit that supposed the application of preventive measures that curb the deterioration of cultural inheritance; its preservation must be set as a main objective and search the measures necessary for the most suitable environmental conditions (Concha et al 2009), such as SO2 and particulate matter (PM), both mostly generated by fossil fuel combustion are the main causes of aesthetic and material deterioration on patrimony construction, particularly on carbonate materials (Bonazza et al 2005: 2607-2618; Grossi et al 2008: 143-160; Sablier and Garrigues 2014). In contaminated urban areas, the facades use to present black crusts on them, specially containing carbon and sulphur, gypsum, from the fossil fuels combustion by mobile vehicles (Bonazza et al 2005: 2607-2618; Grossi et al 2007: 117-130; Fronteau et al 2010: 25-34; Perez et al 2016). To preserve cultural inheritance it is a must trying to preserve the architectural monuments, but of course it could be a risk for the originality of the monument, as there is not a complete safe way to do conservation or restoration in Human Inheritance (Concha et al 2009).

The criteria to replace stones in a historic building should be based on geological, geotechnical and aesthetic parameters instead of visual methods, qualitative-subjective aspects or economical consideration (Taboada et al 1998:203-210; Dreesen and Dusar 2004: 273-287). When the original quarry stones are not in use any more it can commonly derive in an inadequate substitution, where a mosaic of original and substituted elements come together. This, not only provokes an unpleasant effect related to the change of color, but also, it does not comply international criteria for restoration and in force legislation, recommendations and guidelines related to national patrimony monuments (ICOMOS 1975; Llamas 2002; Prieto et al 2011).

Spectrophotometry measures the spectral reflectance of a material using certain directions and detection of fixed and unique lightness. Having such spectral reflectance and supposing a determined illuminant and observer colorimeter pattern, the color specification of the sample is eventually obtained. The International Commission of Illumination (CIE) recommends, that such color specification is tridimensional, being nowadays the space of color CIE 1976 (L*a*b*), usually designed as CIELAB (CIE 2014).

The purpose of spectrophotometry applied to works of art or to cultural patrimony, through spectrophotometric measurement, is to register, very precisely, the magnitudes that identify color attributes such as tone, clarity and saturation (Manlio 2005, 2015).

The chromatic reintegration materials have been very varied for some decades, but some novel materials have been used lately because of their workability, which carries an aesthetic function while integrating them in the original work (Lastras-Pérez et al 2011-2012). Some researches performed in Mexico have characterized mechanically and physically materials with varied organic and inorganic additives (Martínez-Molina et al 2010; Velazquez-Pérez 2015) with which prehistoric and colonial monuments were built (Sickels 1981-829; Magaloni 2008, Martinez et al 2008). It is necessary to determine the color variations which each additive confers to the mix because when using any mix for the restoration of monuments, we have to take into account the color of the restoration materials because they should not affect the historical monument aesthetically in a global set, such in a way to avoid a color loss. Therefore, the material used in chromatic reintegration should not loose its colorimetric properties showing a clear difference from the original material as a result of a wrong intervention (Lastras-Pérez et al 2011-2012).

In this study the result of a color analysis of lime mortars is shown. The study was done by adding organic or inorganic materials applied to walls as coatings, searching for a color that gives acceptable aesthetic results according to the original colors of architectural monuments to be restored, but preserving at the same time the mechanical resistance of mortars.

Methodology

This research started with previous studies on additives in different percentages [Velazquez-Perez 2015]. The additives were chosen according to their workability, adhesion, and the presence of cracks due to drying; as a result we study different additions - related to lime percentages weight: clay, 25%; quarry stone powder, 50%; brick ash, 50%; and corn starch, 2%. With the elaborated mixtures, brick walls were built and covered with these different mortars to evaluate their behavior and to measure the color of the dry mortars, comparing them through spectrophotometry, adhesion and carbonation depth tests, performed for both the control mixture and the modified mixtures.

—Mix Design

The materials used for this research were: Lerma River Sand: quality tests were carried out in accordance with current regulations. The sand material used was between sieves 4 to sieve 30, ASTM, the one that passes through sieve number 4, trying to reproduce the mix that is prepared to restore buildings in the State of Michoacán, Mexico. It is a silica sand. Water: tap water was used. Cementing material: Industrial lime from the Piedras de Lumbre stone quarry, in Jungapeo, Mexico, was used. Materials added as pigments: As said before, the powder additions came from ash of burnt wood in the manufacturing of handmade bricks, ignimbrite powder from the stone quarries surrounding Morelia, Mexico called Cointzio and "Jamaica", corn starch, and clay, the montmorillonite clay was classified as CL according to the Unified Soil Classification System (USCS). It also comes from the surroundings of Morelia, Mexico, sifting and adding them dry.

There is no a standardized method to design mortar mixes. For this work we used the weight ratio 1:2.5 for lime mortar, one portion of lime and two point five portions of sand. This proportion was suggested in previous works and widely used in restoration works (Arreola-Sanchez 2009, in press, Bedolla Arroyo 2010).

The amount of water used for the sample tests was selected according to fluidity tests of the cementing paste and the ones recommended in previous works [Martinez et al 2002, Bedolla et al 2008, 2010, Camacho 2001, Cortes 2002]. The amount of water fixed for the control mortar was 1:2. Besides, we did the fluidity test to learn about its workability.

The flow of mortars was determined by a table of flow, which is a circular metal plate that serves to expand a mortar cone through a number of falls given on the table frame according to ASTM-C- 311-04, which specifies that, for the design of mixtures, a fluidity of 110 ± 5% must be reached. This method is used to regulate the amount of water in the pastes and mortars that allows us to compare which additives demand more water compared to the control.

—Spectrophotometry

Spectrophotometry was performed on in situ dry mortars with a spectrophotometer (BLUE-NH300) with the BLUE-NH300 software. To quantify the color, we measured the chromatic C.I.E. parameters L*, a* and b*:) where L* represents the sample lightness, and a* and b* are the chromatic parameters, and they represent the chromatic scale from red to green and the chromatic scale from blue to yellow respectively, and the total color variation (dE*) with formula 1:

$$dE^*=\sqrt{(dL^2+da^2+db^2)}$$

Results and Discussion

— Workability of the Mixtures

In this study, proper physical appearance, color, texture, flexibility and also adequate workability were pursued, not being possible to fix a water proportion for all the mixtures. Therefore, the quantity of water was determined based on how easy to handle the mixture was according to restorers and masons' experience. We registered the fluidity of the mixture and the need of water for each mortar. The resultant fluidity was 99%. Based on this, we began to elaborate the mixes with different additives [table 1].

Table1.- Features fresh state and results of fluency.

Mix	Adding Percentage (%)	Nomen-clature	Physical behavior of fresh mortar	Relation A/C	Fluency
Control	0	Control	Mix presented good workability, no color, no odor, without bleeding and without contractions.	1.2	99%
Clay	25	ACA	Mixing very workable, is very adherent, manageable to flattened and specimens, presented Brown clear and odorless. No delays setting and presented the minimum bleeding.	1.2	86%
Quarry dust	50	PC	Mixing very workable, cohesive and manageable to flatten and specimens, presented pink clear and odorless. No delays setting and presented the minimum bleeding.	1.3	87%
Corn starch	2	ALM	Workable, manageable to make flattened mixture and specimens, presented white clean and odor-free. No delays setting and I present the minimum bleeding.	1.2	90%
Ash brick	50	CEL	Mixing very workable, adherent, manageable to flatten and specimens, presented grey clear and odorless. No delays setting and presented the minimum bleeding.	1.4	86%

From table 1 , we realize how all the additives used, were less workable than the sample mixture (sand and clay only) and two of them, quarry stone powder and ash from brick manufacturing, needed even more water than the control mixture (quarry stone dust and clay only). This may be due to the fineness of such materials with (sieved through a 0.0737 mm mesh), which would increase the superficial area and its need of water in the mixture. This fact favors the lime base mortars because when hardened are more porous than the control mortar and it favors the CO_2 flow through the mortar matrix which helps the mechanical work.

—*Spectrophotometry Test*

The color measurements were recorded on the covering mixes. The results are shown in figure 1 and table 2, where it is possible to observe that regarding the total color variation with respect to the control mortar, there was a great variation between the mixture with corn starch, being the closest to the control mixture (sand and clay only), outstanding with the highest value the mixture with ash from brick manufacturing. As for the results da* and db* we can observe that the values of the three mixtures are positive, which emphasizes that color is on the range of red-yellow. We can also observe this in the graphic that represents the Cartesian plane where all the values of the mixtures are on the first quadrant. On other hand, on the vertical axis to the right of the Cartesian plane of figure 2, we can see the change of lightness (dL*) because the farther it is from the control mixture (sand and clay only) (center of the vertical axis) the closer to black it is, as in the case of the ash from brick manufacturing.

Table 2.- Variation of chromatic parameters.

Sample name	Nomen-clature	L*	a*	b*	dL*	da*	db*	dE*
Clay	ACA	71.56	5.84	15.04	-8.46	3.86	8.56	12.64
Quarry dust	PC	67.96	9.48	9.29	-12.06	7.5	2.81	14.48
Corn starch	ALM	74.59	2.41	7.41	-5.43	0.43	0.93	5.53
Ash brick	CEL	62.09	3.61	9.94	-17.93	1.63	3.46	18.33
Contro (Only Lime mortar)	CON-TROL	80.02	1.98	6.48	0			
House of culture Almena	HCA	48.66	9.3	13.31	-31.36	7.32	6.83	32.92
House of culture Canaleta	HCC	47.94	7.17	9.48	-32.08	5.19	3	32.64
House of culture Canaleta	CNC	62.92	5.51	9.99	-17.1	3.53	3.51	17.81
Colegio San Nicolas Base of the column	CNB	53.67	3.89	9.09	-26.35	1.91	2.61	26.55

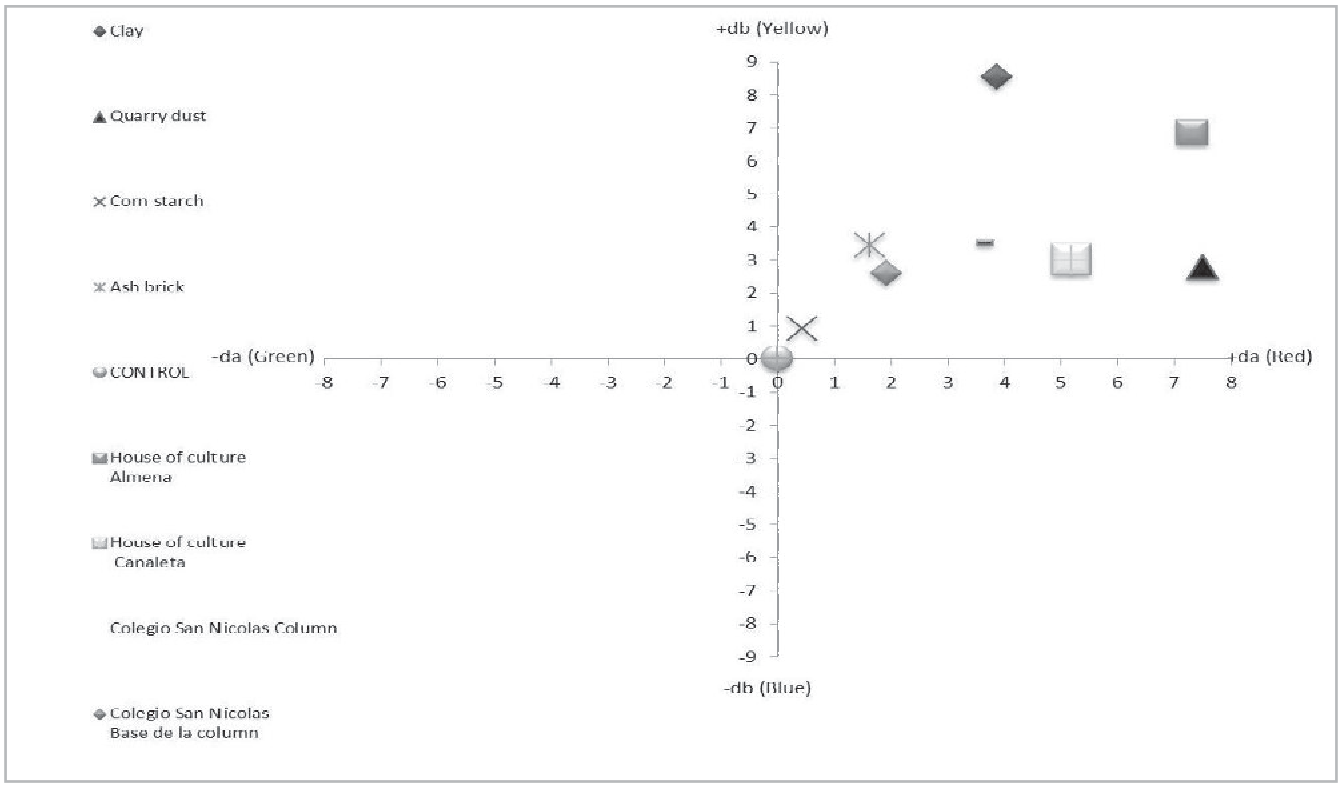

Figure1.- Color results of the studied mixtures.

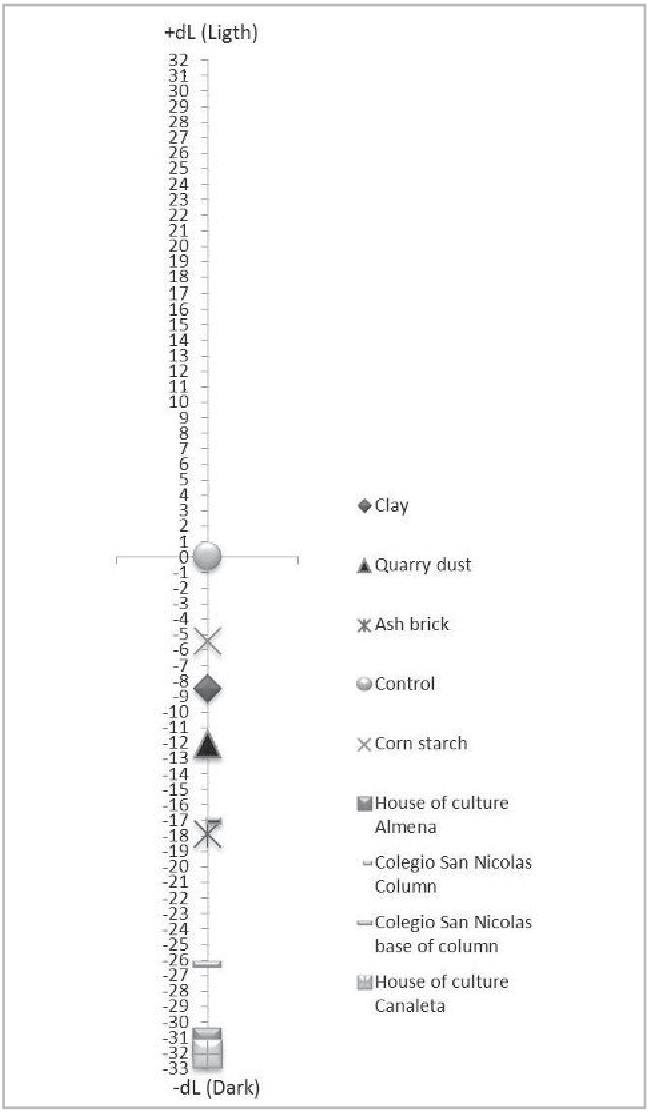

Figure 2.- Lightness variability.

Conclusion

According to the results of this research we may conclude that all the mixtures darken with respect to the control mixture, which is interesting because it offers a variety of colors that may be used in different zones of Mexico, such as Morelia, Puebla, Querétaro and Zacatecas. Being the colors very similar, it is relevant to mention that this is only part of a larger research. We continue looking for materials which compatible in color with the stones in historical monuments, carefully trying to find the most similar color and also similar to the materials employed with good mechanical characteristics and long durability.

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