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REHABEND 2016
Euro-American Congress

CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

Burgos (Spain) - May 24th-27th, 2016

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REHABEND 2016

CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

(6th REHABEND Congress)

Burgos (Spain), May 24th-27th, 2016

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6TH EURO-AMERICAN CONGRESS ON CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

REHABEND 2016

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The **Euro-American Congress REHABEND 2016** on **Construction Pathology, Rehabilitation Technology and Heritage Management** was carried out in **Burgos (Spain)**, in **May 2016**. The event was organized by fifteen organizations of **ten European and American countries**, and it was co-chaired by the **University of Cantabria**, through its Building Technology R&D Group (GTED-UC), and the **University of Burgos**.

REHABEND 2016 **continued the series of the five previous REHABEND international events**, which had been developed **since 2006 in different Spanish cities**. The previous one, in **2014**, was carried out in **Santander**. In 2014 edition, **more than 270 papers** by Professionals and Researchers of **17 countries** were presented and it became a conference of great interest according to the people who attended the congress.

Construction Pathology, Rehabilitation Technology and Heritage Management currently have great importance for construction sector. This prompted the organizers to propose the **technical event on these topics in Burgos** (a city with an impressive Gothic Cathedral of the 13th century declared World Heritage by UNESCO, and one of the strategic points of the Route of Santiago de Compostela). This event aimed to collect the **advances obtained in the last two years** in the **theoretical knowledge** and **practical realizations** carried out on the referred topics. The Congress met **around 300 technical contributions** coming from professionals, academics and specialists.

Based on previous experiences the Congress **was proposed once again in the Euro-American cultural space**. The **official languages** were **English**, **Italian**, **Portuguese** and **Spanish**. Organizers understand that technical articles and oral presentations, with the support of graphic material and schemes, may be understood by the people who take part in the congress, as it was evident in REHABEND 2014.

Under these premises and the successful previous editions, the Congress was sponsored by the **Government of Spain**, the **Government of Castilla-León**, the **Provincial Government of Burgos**, the **Municipality of Burgos**, the **Chamber of Commerce of Burgos**, **Mapei**, **Sika**, the **University of Cantabria** and the **University of Burgos**. In addition, several Universities, Technical and Professional Associations, Institutes, Foundations and Companies committed their **collaboration** in order to the success of this initiative.

REHABEND 2016 organizers would like to thank the multiple received supports: to the **Sponsor and Collaborating Entities**; to the **Scientific Committee Members** for their hard work in the revision of the different technical contributions, ensuring the required level of quality of an international event; to the **Speakers of the plenary sessions**; to the different **Speakers** for their relevant contributions and, in general, to the **people who will attend the congress** for the confidence shown in the event. Sincerely, many thanks to all.

Prof. Luis Villegas

Chairman of the REHABEND 2016 Congress
Full Professor of the University of Cantabria

Prof. Juan Manuel Manso

Chairman of the REHABEND 2016 Congress
Vice-Rector of Infrastructures and New Technologies and Professor of the University of Burgos

The University of Cantabria, through its Building Technology R&D Group (GTED-UC), was the promoter of the REHABEND Congresses on Construction Pathology, Rehabilitation Technology and Heritage Management.

The 1st REHABEND Congress was set in motion in Santander in November 2006. It became established in the 2nd (Santander, 2007), 3rd (Valencia, 2008), 4th (Bilbao, 2009) and 5th Congress (Santander, 2014), all of them carried out in Spanish cities. The ability to convene of the five perfomed editions was prominent, gathering an appreciable number of experts in the topics of the Congress. As a reference, in the 5th edition (REHABEND 2014) took part around 270 speakers from 17 Euro-American countries.

The 3rd edition of the Congress (REHABEND 2008) was organized together with the Construction Technologic Institute of the Valencian autonomous community (AIDICO), and the 4rd and 5th editions (REHABEND 2009 and 2014), in addition to AIDICO, the Congresses were co-organized with TECNALIA Research&Innovation. From the current 6th edition (REHABEND 2016) the congress is going to be co-organized by several entities from different Euro-American countries.

The covers and ISBN of the books corresponding to the performed congresses are attached below. The ISSN of the series of REHABEND books is 2386-8198.

REHABEND 2006 (Book of Papers)
ISBN: 978-84-690-5269-3 (several languages)

REHABEND 2007 (Book of Papers)
ISBN: 978-84-691-3612-6 (several languages)

REHABEND 2008 (Book of Papers)
ISBN: 978-84-692-5650-3 (several languages)

REHABEND 2009 (Book of Papers)
ISBN: 978-84-8873-404-4 (several languages)

REHABEND 2014 (Book of Abstracts)
ISBN: 978-84-606-6738-4 (in English)
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REHABEND 2014 (CD of Papers)
ISBN: 978-84-616-8863-0 (several languages)

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The Collaborating Entities have been presented grouped in countries, following an alphabetical order. As Collaborating Entities have been considered to all that have contributed with more than two accepted articles in the Congress, or that some of its members formed part of the International Scientific Committee of the Congress. Finally, in each country, the Collaborating Entities have been ordered according to the number of accepted articles.

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Portugal-Cadernosd'Obra Revista Científica Internacional de Construçao

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1.- PREVIOUS STUDIES	1.1.- Studies of conservation (historical, archaeological, etc.). 1.2.- Heritage and territory. 1.3.- Urban regeneration. 1.4.- Economical and financial policies. 1.5.- Processes of social participation and socio-cultural aspects in rehabilitation projects. 1.6.- Pathology in construction. 1.7.- Diagnostic techniques and structural assessment (no destructive testing, monitoring and numerical modeling). 1.8.- Guides and regulations.
2.-PROJECT	2.1.- Criteria theoretical of the intervention project. 2.2.- Traditional materials and construction methods. 2.3.- Applicable novelty products and new technologies. 2.4.- Sustainable design and energy efficiency.
3.-BUILDING INTERVENTION	3.1.- Intervention plans. 3.2.- Rehabilitation and durability. 3.3.- Reinforcement technologies. 3.4.- Restoration of artworks. 3.5.- Conservation of industrial heritage. 3.6.- Examples of intervention.
4.-MAINTENANCE	4.1.- Construction maintenance. 4.2.- Preventive conservation of built heritage.
5.- DIFFUSION AND PROMOTION	5.1.- Heritage and cultural tourism. 5.2.- Formation. 5.3.- New technologies applied to the heritage diffusion. 5.4.- Accessibility to cultural heritage. 5.5.- Working networks in the cultural heritage. 5.6.- Management of of built heritage.

ABSTRACTS OF THE CONGRESS

1.- PREVIOUS STUDIES

1.1.- Multidisciplinary studies (historical, archaeological, etc.).

1.2.- Heritage and territory.

1.3.- Urban regeneration.

1.4.- Economical and financial policies.

1.5.- Social participation processes and socio-cultural aspects in rehabilitation projects.

1.6.- Construction pathology.

1.7.- Diagnostic techniques and structural assessment (no destructive testing, monitoring and numerical modeling).

1.8.- Guides and regulations.

2.- PROJECT

2.1.- Theoretical criteria of the intervention project.

2.2.- Traditional materials and construction methods.

2.3.- Novelty products applicable and new technologies.

2.4.- Sustainable design and energy efficiency.

3.- BUILDING INTERVENTION

3.1.- Intervention plans.

3.2.- Rehabilitation and durability.

3.3.- Reinforcement technologies.

3.4.- Restoration of artworks.

3.5.- Conservation of industrial heritage.

3.6.- Examples of intervention.

4.- MAINTENANCE

4.1.- Construction maintenance.

4.2.- Preventive conservation of built heritage.

5.- DIFFUSION AND PROMOTION

5.1.- Heritage and cultural tourism.

5.2.- Teaching and training.

5.3.- New technologies applied to the heritage diffusion.

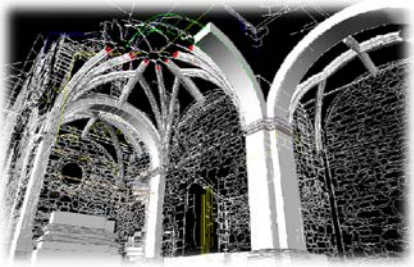
5.4.- Accessibility to cultural heritage.

5.6.- Built heritage management.

1.- PREVIOUS STUDIES








CODE 1.1.01

THE USE OF CATENARY ARCHES BY EIGTHEENTH MILITARY ENGINEERS

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KEYWORDS: Catenary arches, theory of the chain, gunpowder magazines, military engineers.

ABSTRACT

Catenary arches were used by Spanish modernist architects, whose main referent were Antonio Gaudí (1852-1926). The theory of the chain or *chaînette*, was raised by Robert Hooke (1676), and used by Christopher Wren in the Dome of Saint Paul (1675). The mathematical equation was formulated by David Gregory (1697) and after developed by James Stirling (1717).
The investigation studies the introduction of the concept of catenary in Spain through the projects of eighteenth century military engineers. Thus, the Academia de Matemáticas de Barcelona (1720) had as main reference the work of Bernard Forest de Bélidor, *La science des ingénieurs* (1729). This work was partially translated by John Müller (1699-1784) as *A treatise containing the elementary part of fortification, regular and irregular. For the use of the Royal academy of artillery at Woolwich* (1755), which also was translated in the Academia as *Tratado de fortificación, ó Arte de construir los edificios militares, y civiles* (1769).
In this context, several gunpowder magazines projects were found in the Archivo General de Simancas, where the concept of catenary vault is used. Between them, the projects of Miguel Marín in Tortosa (1731) and Barcelona (1731), and the project of Juan de la Feriére in A Coruña (1736). The evidences found reveal that, both the modern mechanics theory of British school and the construction of catenary arches –which was very important in Spanish modernist architecture of eighteenth century- were introduced in Spain in the first half of eighteenth century by Spanish borbonic military engineers. The paper establishes the theoretical framework to understand this kind of structures, and this knowledge is essential to assess them.

CODE 1.1.02

ITALIAN SOCIAL HOUSING OF AUTARKY PERIOD: THE CASE-STUDY OF THE BUILDINGS IN VIA FONTESECCO IN L'AQUILA

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KEYWORDS: Historic fabric, autarky, housing, types, construction techniques, materials.

ABSTRACT

As a result of the particular process of modernization developed in Italy, in the transition from the economic regime of corporations to autarky, the social house is apparently a simple building construction type, in which the processes of technical but also functional hybridization find space, offering new residential and distributive models according to the requirements of a more modern way of life.
Therefore, this paper will investigate an intervention of social housing built through a significant process of transformation of the historic tissue in the city of L'Aquila, in two phases, significantly placed before and at the start of the Second World War.
The houses of Via Fontesecco, realized by the "Istituto Fascista Autonomo Case Popolari", come within the framework of re-founding of the city, which Adelchi Serena had proposed with a programmatic deliberation in 1929 with three main directions in the field of housing, to define the new fronts of the route of the new Via Italo Balbo. The project is implemented through two consecutive batches: the first in 1938, the second by a proposal of 1941 and a subsequent of 1942.
It is interesting to re-read in the different projects developed, the typological and functional changes that in the same plan shape propose, by doubling the stairwell, a "minimum" housing-type model closer to the functionalist model developed for the storey-house.
At the same time, the current conditions of the buildings, severely affected by the earthquake of April 2009, unveil a building system in which it is possible to re-read the rules of the Autarky period mixed with the masonry construction techniques typical of the local tradition.
Therefore for the particular context investigated, the study of these heterogeneous building systems, in addition to marking a significant point in the history of "modern" Italian housing, becomes essential to evaluate the types of intervention to be carried out during the phase of reconstruction, in order to reach a re-functionalization responding to new patterns of use and new housing requirements.

CODE 1.1.03

PATRIMONIAL ASSETS VULNERABILITY AND URBAN SCALE SEISMIC RISK: CONCEPTUAL FRAMEWORK

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KEYWORDS: Patrimonial assets vulnerability, urban scale seismic risk.

ABSTRACT

The relevance of the cultural patrimony in the construction of local identity is evidenced through the tangible and intangible expressions in specific contexts and territories.

Seismic Risk evaluation generally considers the analysis of three key aspects; the seismic hazard, Vulnerability and Costs. Conventionally, the seismic vulnerability has been approached, in the context of seismic risk evaluation, as part of the material or structural predisposition of the building to suffer damage. Nevertheless, the study and evaluation of patrimonial architecture should embrace a larger scope of concerns. Vulnerability in the context of cultural patrimonial architecture should be also associated to morphological and urban qualities and their cultural context.

In this research, the conceptual argument of the relationship between patrimony, vulnerability and seismic risk is explained. The methodological structure of the study refers to the current seismic risk evaluation of Valdivia, Chile; Characterizes the territory´s history and its impact on physical vulnerability as much as its cultural identity, and identifies the basic parameters that define patrimonial vulnerability.

Results of this research suggest that its highly beneficial to consider the patrimonial aspect of architecture in the seismic risk evaluation. It is particularly relevant for constructions that have a high valorization from a disciplinary or socioeconomic perspective, and specially considering that even though there might be case studies with little technical value they may have a great cultural relevance in its social and historical context. This condition of cultural relevance and patrimonial significance may lead to a greater impact on the vulnerability evaluation, beyond the material or structural aspect, therefore may have a significant leverage on the three variable model of Seismic Risk evaluation.

CODE 1.1.05

THE KNOWLEDGE OF THE XYLOPHAGOUS AGENTS AND THE MEASURES OF PREVENTION IN THE CONSTRUCTION TREATISES OF THE 18th AND 19th CENTURIES

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KEYWORDS: Construction with wood, xylophagous agents, 18th and 19th centuries.

ABSTRACT

Madrid conserves an important group of residential buildings from the 18th and 19th centuries which were built without interior hydraulic facilities. Their structural framework is a mix of timber and masonry; many of the buildings are currently being restored in order to be adapted to the CTE, which specifies different problems. From the contemporary technical treatises, one can research the influence of knowledge about the durability of buildings as well as look for constructive solutions that eliminate harmful modifications compatible with the new technologies of the second half of the 19th century and the basic requests of the CTE. This letter examines knowledge of xylophagous agents of the 18th and 19th centuries, analyzing references to them in the technical bibliography from that time in relation to what naturalists also knew about them. From the beginning of the 19th century one can see, in zoological treatises, different descriptions, sometimes very detailed, of xylophagous insects (of the order Coleoptera) and their biology. However, in construction treatises they are not mentioned and they refer to the insects' effect as "corruption" in a generic sense, as they did in the 18th century. It is normal to find references to xylophagous agents in paragraphs listing trees whose wood is useful for building, or in ones dedicated to give constructive solutions to avoid said agents; solutions that, even in having an erroneous idea of the causes of wood degradation, are effective in minimizing the actions of xylophagous agents. In whatever case, this indicates constructive regulations of the structural systems of that time.

CODE 1.1.08

NEW ALPINE ARCHITECTURE IN ITALY: THE HOUSES OF THE ENI'S "CORTE DI CADORE" VILLAGE (1958-63)

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KEYWORDS: Construction History, building techniques, construction materials.

ABSTRACT

The study is part of a research on the evolution of construction techniques in the second part of the twentieth century in Italy, with the aim of identifying appropriate methods and techniques for the restoration of the Italian modern buildings.
The contribution proposes the study of the village to the ENI (Ente Nazionale Idrocarburti - National Hydrocarbons Authority) employees and their families, called "Corte di Cadore" and made near Borca di Cadore (in Northen Italy) by the architect Edoardo Gellner (1909 - 2004).
The project was commissioned by Enrico Mattei and it had no counterpart with other public and private European examples. Opened August 18, 1958, the village remained unfinished because of the untimely death of Mattei (1962).
Based on original documents kept in the Historical Archive of ENI and in the designer's archive, the study intends to focus on houses, that were an important opportunity to experiment new building systems, that proved efficient both technically and economically, and to face, from the design point of view, with a natural scenery of the most challenging. With the aim of starting an intense dialogue between natural and artificial materials the architect focused his attention on specific materials and building components, excluding advanced prefabrication techniques that would have possible applications also.
This experience, unique in its kind but underestimated, still remains an example of a modern interpretation of architecture, sensitive to the latest European and American experiences in the field of housing, and a model that, in the relationship with the environment, finds the reasons to experiment the potential of serial production too.
The essay will be concentrated on construction processes, on innovation in construction techniques and the interaction of construction, form and peculiarities of the building site. It will highlight the contradiction, typically Italian, on the use of industrialized processes.

CODE 1.1.12

THE RELIGIOUS ARCHITECTURE IN THE COLONIAL BRAZIL: THE STATE OF THE ART OF THE FRANCISCAN CONVENTS

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KEYWORDS: Religious architecture, brazil colonial, the franciscan convents.

ABSTRACT

This paper presents a review of the literature on the architecture built by the Franciscans during the colonial period in Brazil. It intends to confront studies on the convents built in the same period in the southeast of the country with the convents built in the Northeast, known as of the work of Germain Bazin "L'Architecture religieuse au Brésil coloniale" (1956-58, Brazilian version - 1983): as the Franciscan School in Northeast Brazil. These architectural complexes distinguished from the others, according to the renowned French historian of art, because they had specific characteristics such as the type and location of the cloisters, the atrium containing a colossal cross, the position of the churches of the Third Order in relation to the main churches, the kind of pediments and composition of the frontispieces of the main churches. The scarce literature on the convents of the Southeast of the country and some questions raised about these architectural complexes in relation to the Northeast in the Guzzo's dissertation "O Convento de São Boaventura de Macacu na Arquitetura Franciscana Brasileira (1999)" encouraged the review of the literature on the theme. Furthermore, the considerations presented in this paper, also results from the research that Guzzo is developing for her PhD project, whose subject matter is the composition of the facades of the principal churches of the Capuchin Franciscan convents erected during the period colonial. Historiography is dynamic and there is much to search about the Franciscan convents in Brazil. These architectural complexes are part of the Brazilian cultural heritage, thus the knowledge of this architecture is essential to its preservation.

CODE 1.1.13

THE ORDER OF ST. MICHAEL OF EGARA

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KEYWORDS: St. Michael of Egara, architecture, early middle ages, capital, orders.

ABSTRACT

The Episcopal See of Egara, formed by St. Mary's Cathedral, St. Michael's funerary building and St. Peter's church, is a monumental ensemble known for centuries and repeatedly studied from diverse approaches. However, research projects about the composition of the buildings are not known.
The aim of this paper about built heritage is to understand what were the architectural orders used in St. Michael.
The dome of St. Michael, in the central square, is supported by eight columns, four of larger diameter at the corners and four of smaller diameter in the center of the sides. The columns reused and from different buildings, have a base formed by torus and fillets of variable heights, according to the shaft to which they should adapt, shafts of different materials, and also different capitals, collected in ruins and some of them adapted to the narrow diameter of the columns. Above the structure of columns, each one topped by a stone element with the shape of an inverted truncated pyramid, eight stilted arches rest, supporting the dome.
Clarifying the origin or the references that led to employ four pendentives shaped as niches, which enable the central square to pass into the circular drum forming the base of the dome itself, has always been an impossible quest. Thus, in 1909, Josep Puig i Cadafalch described in this way the set of eight columns and capitals, and published a picture of St. Vitale inside of Giovanni Teresio Rivoira, linking the constructive solution used in St. Michael's dome with Ravenna's school.
St. Michael is the result of an architect's project. And to understand which rules were used in the configuration of St. Michael's architectural orders, we have measured the building [I], and we intend to study and compare, among others, the knowledge rooted in Roman architecture existing in those days, the constructive solutions used, and the different descriptions and graphical representations preserved from biblical texts.

CODE 1.1.15

BUILDINGS BECOMING ARCHITECTONIC HERITAGE. SOME RELEVANT ASPECTS ABOUT PROTECTION PROCESS IN CASTILLA Y LEÓN (SPAIN)

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KEYWORDS: Monument, declaration, protection, architectonic heritage, Castilla y León.

ABSTRACT

Castilla y León has a huge heritage knowledge. This is illustrated by the number of monuments, over one thousand. A building will be considered monument after an essential step: declaration. The designation involves the compliance of heritage law and new rights and duties. As a consequence, it affects conservation and rehabilitation of the building and owners; governments and citizens get new responsibilities.

The aim of this project is to present a study consisted of the analysis and the assessment of the protection process in this region of Spain, which is part of the dissertation called Impact of declarations of monuments: almost two centuries of immovable heritage protection in Castilla y León.

Mainly, it is a documental work whose methodology is based on studying public documents, rehabilitation projects, which have been added in order to remark the relationship between declaration and intervention, and fieldwork, finally, doing the classification of information according to several criteria. The advantage of researching from a global point of view is to give the same solutions to the same problems. This inductive method could be suitable for other monuments or group of them.

The results are related to historical periods, architectural typologies, artistic styles and geographical boundaries which is extremely useful, it offers information about the work done until now and it points out successes and mistakes. It is a good starting point to improve the protection of heritage due to an updated knowledge about state of the art.

CODE 1.1.16

HISTORICAL STONE QUARRY (EL FERRIOL STONE) OF STª MARIA DE ELCHE, PETROPHYSICAL AND PETROLOGICAL STUDY. EVALUATION OF ITS USE AS REPLACEMENT STONE

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KEYWORDS: Santa Maria Elche, El Ferriol stone, historical quarry, rock replacement, calcarenite.

ABSTRACT

The predominant building stone in the Basílica de Santa María in Elche is biocalcarenite, using different varieties in each of the two major construction phases. The rock under study is the more altered biocalcarenite used in the Capilla de la Comunión from XVIII century and with great architectural value. The historical investigations have brought to light a document of 1759 signed by one of the architects of the basilica where the number and format of the building blocks shown and where these materials must be removed. These unpublished data presented in this work.
In the region of Elche there is a place called El Ferriol whose rocks have been exploited as a building stone for centuries and different cultures. One of these quarries is dating from Iberian period. Samples were taken in three of the old quarries, located stratigraphically, and compared with the building. For this we have made a mineralogical, petrographic and petrophysical study. One of the quarries sampled corresponds to the aforementioned Iberian quarry, designed by a research team of archaeologists led by Pierre Roullar, where could have been extracted the stone used in the sculpture La Dama de Elche.
The biocalcarenite obtained from El Ferriol's quarry is similar to the Capilla de la Comunión, with a apparent density of about 1.8 g / cm^3, porosity of 20%, the coefficient of capillarity is 74 g / m^2 $S^{0.5}$ and compressive strength of 1.76 kN / cm^2.

CODE 1.1.17

RAMMED EARTH WALL WITH MASONRY COURSES IN THE REGION OF THE MORAÑA (ÁVILA-SPAIN) IN THE LATE MIDDLE AGES PERIOD

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KEYWORDS: Rammed earth with masonry courses, medieval architecture, construction technique, Heritage and territory, photogrammetry.

ABSTRACT

Within the history, earth has been used as a building material, mixed systems are vaguely documented in the region of Castilla y León, despite the use of earth being a fairly typical system in 'cultivated' architecture. The work focuses on rammed earth wall with masonry courses being the first system that evolves from the rammed earth wall. It has been used in late middle ages period in Spain, first in hispanomusulman territory and later in Christian territory.
The need for conservation and maintenance of this Heritage justifies the appropriateness of research techniques and construction procedures. The main objective of the study is to provide technical documentation, so far this is non-existent.
The study area focuses on the ancient region of Moraña (Ávila-Spain), because during the fieldwork it was detected that this is where the system was widely developed. Historically it linked to the Moorish construction way. The analysis methodology of the study consists of the construction, materials, elements and metrology and geology that composed the system. The capture and processing of data is done using techniques based on photogrammetry.
The results help to relate mixed rammed earth walls of the South Peninsula and the Toledo area with the Castellana area, and reflect the constructive evolution of the latter. It will also help gain a better understanding of this type of wall structures and increase working methods which will help their conservation, restoration and dissemination.

CODE 1.1.21

STATE OF CONSERVATION RESEARCH SURVEY OF THE REMAINING HALF-TIMBERED BUILDINGS IN PANAMBI / RS

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KEYWORDS: Half-timbered, survey, state of conservation.

ABSTRACT

The city Panambi / RS, Brazil is recognized for its diverse identities, stand out among them the reference as Machine City and for having been nominated Neu-Württemberg Colony, with its predominantly German settlement. It presents until nowadays remaining buildings in half-timbered style. The city has municipal legislation, which through the Master Plan provides strate-gies for the preservation and valuing of Heritage, however, there is no inventory record of build-ings half-timbered, as well as their state of conservation. Thus, this study aimed to investigate the properties with potential for preservation. It was possible to identify samples that make up a list of building of cultural historical interest, where the half-timbered style is present. Thus, they were categorized by their state of conservation, through the damage mapping method. The sur-vey processes, counted on the participation of the students of Technical Course in Buildings, of the Federal Institute Farroupilha Campus Panambi. The research studies phase counted on the participation of students, composing as a result a listing of the properties categorized in research and dialoguing with the legislation.

CODE 1.1.22

STORY ADDING IN ENSANCHE'S HISTORIC BUILDINGS OF BARCELONA: HISTORY, TYPOLOGY AND CONSTRUCTION

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KEYWORDS: Rehabilitation, Barcelona's Ensanche, Story adding.

ABSTRACT

Story adding in existing buildings is one of the most usual refurbishment actions when changes in urban ordinances allow a gain of height. In the context of Barcelona's Ensanche, its progressive densification comes as a result of changes in regulations which influenced the transformation of the historic district from the beginning of its construction in 1860. The constant changes in the regulations have allowed all over the years a progressive increase in height. The present paper studies the construction of the story adding in the historic buildings of Barcelona's Ensanche, since its origin to nowadays. The paper also presents and studies its typology, evolution and construction, focusing on the materials and technical solving of the contact with the existing building. A better knowledge on story adding typology and technology leads to a more objective assessment of its patrimonial values, giving, also, tools that can guide us towards more thorough interventions in the existing buildings.

CODE 1.1.24

METHODOLOGY AND PARTICULARITIES IN THE REDACTION OF THE HIGH COURT OF ZARAGOZA´S MASTER PLAN

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KEYWORDS: Master Plan, Zaragoza´s High Court, Luna´s Palace, Counts of Morata Palace, Giants Palace, Aragón´s High Court.

ABSTRACT

Mr. Pedro Martínez de Luna´s house, also known as “High Court Palace”, “Counts of Morata Palace”, “Luna´s Palace”, “Giants´ Palace”, and even “Royal Palace”, is placed in 1st. of Coso St. in Saragossa. It is one of the most beautiful and magnificient renaissance palaces of the XVI century in Aragon. It was declared as monument since 1931, and today it is the head office of the High Courts and Public Prosecution.

A new Master Plan was redacted recently for the palace, with the main purpose of its refurbishment. It is conformed as a complex and multidisciplinary document, attending to the exceptionallity of the historical-artistical circunstances of the monument. The Plan contains documentary and technical aspects to increase de knowledgement of the building, a functional study, and a frame in wich include all the future interventions.

The redaction of the Plan and the management of the huge documentation needed a specific methodology, because it is a building currently in use, and with series of particulatities. The method is based in a general structure that deals about the palace´s yesterday, today, and tomorrow, in other words, the antecedents, currently status, and future interventions wich will need to mantain its arhitectonical values.

This main structure is organized in eleven themathical dossiers, some of them are relative to each subject of study, and the others that establish relationships between them. Each dossier is understood in its own subject particularities, but in the overall vision of the rest too. We can outstand one of them, a particular Atlas of spaces, that allow us to have a complete and multipurpose interpretation of each palace´s room. The main purpose of this poliedric view is that the plan has to be a practical document, useful from small maintenance interventions to big future restoration operations.

CODE 1.1.26

OURO PRETO, RECORD OF A FORETOLD TRAGEDY IN A BRAZILIAN WORLD HERITAGE SITE: THE FIRES AT SÃO JOSÉ STREET, FORUM AND HOTEL PILÃO

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KEYWORDS: Fire, ouro preto, heritage.

ABSTRACT

By analyzing the period between 1937, year of creation of the National Historic and Artistic Heritage Services (SPHAN) and 2005, when the State of Minas Gerais - Brazil - Fire Department Standards for Heritage preservation were published (standards created specifically to protect cultural heritage from fires), it is possible to conclude that the city of Ouro Preto which is a national and world heritage site, suffered three fires of great proportions, taking into account social and cultural loses. These fires happened in the Forum in 1949, at São José Street reaching several mansions in 1977 and in Pilão Hotel located in the city's main square in 2003. This article aims at presenting how the population reacted to these fires and what the City Hall and the roles and responsibilities of the Cultural and Heritage Preservation Department. Thus it is expected a global awareness for fire prevention in cultural heritages in order to avoid that incidents like the ones that happened in Outo Preto/Brazil occur in other countries. The study was based on research conducted in several files, such as the Central Archives and the 13th Superintendent of IPHAN (National Historic and Artistic Heritage Institute), Ouro Preto Public Archives and Ouro Preto Public Library, as well as through bibliographic research and analysis of documents, administrative procedures, crafts, memos, reports, newspapers and photos. Throughout the article it is presented what the city of Ouro Preto learned with the fires and what has been done to prevent other fires such as these to happen.

CODE 1.1.27

THE PORTUGUESE URBANIZATION CARACTERISTICS AND ITS INFLUENCE IN BRAZILIAN CITIES FORMATION DURING THE IMPERIAL PERIOD: PETRÓPOLIS - RJ CITY CASE

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KEYWORDS: Cities formation, Imperial Brazil, urbanization model.

ABSTRACT

This article is a literature review on the Portuguese origin urban plans and its influence on the Brazilian cities formation during the imperial period. Several works dedicated to the subject are analyzed and among their authors we mention: Roberta Delson, Nestor Goulart Reis Filho, Walter Rossa, Beatriz Bueno and José Eduardo Horta Correia. Plans and policies developed by Major Koeler are analyzed in a second stage. He, who is a German military engineer, arrived in Brazil in 1828 to integrate the Foreign Corps and then after incorporated the Imperial Army Corps of Engineers. Thus, for over forty years, in the Emperor summer stay, the city became the Imperial Capital. Finally, a comparative study is developed between Portuguese urban plans and the plans of the city and policies elaborated by Major Koeler.

CODE 1.1.29

MASTER JUCA RESCUING THE STONEMASONRY ART IN MINAS GERAIS

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KEYWORDS: Stonemasonry, extension program, patrimony, master juca, Ouro Preto.

ABSTRACT

José Raimundo Pereira, also known as master Juca (1923-2006), has been considered the last master on stonemasonry from Minas Gerais - Brazil. He started his labor using the technique as an autodidact in this region during the 80's decade of the 20th century; working until his death, in 2006. He has created several pieces and conducted numerous restorations. He became the responsible for creating the Stonemasonry Extension Program at Universidade Federal de Ouro Preto in 2000. This extension program provided an interaction between this University and the community in Ouro Preto - MG through activities such as visits to historical monuments and offering practical classes directed to children, young people and adults. This paper aimed at showing the work and the socio-cultural actions performed by master Juca. We have tried to highlight his role towards the conservation of monuments and preservation of "how to do" of the stonework. The employed methodology through interviews about master Juca's life was very important, once he was a unique citizen who acted in the face of questions related to rescue an art that was already in extinction. The illustrations of some of his masterpieces highlight his relevance to the stonemasonry art in Brazil. By bringing master Juca's memory to the Stonemasonry Extension Program, we believe that we are contributing to the formation of a more acute awareness on history and daily life of other individuals who work with construction techniques in contemporary times.

CODE 1.1.30

PETROGRAPHIC STUDY OF IRON AGE POTTERY SAMPLES FROM ALTO DE LA GARMA HILLFORT (NORTH SPAIN): ASSESSMENT OF THE CALCITE DISSOLUTION CAUSED BY WEATHERING

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KEYWORDS: Iron age pottery, thin section, weathering, calcite dissolution.

ABSTRACT

La Garma archaeological complex (Omoño, Ribamontán al Monte, Spain) encompasses a number of important archaeological sites, allowing a reconstruction of human behaviour from the Lower Palaeolithic to the Middle Ages. One of them, the open-air site of Alto de La Garma, on top of the hill, provides valuable evidence of an early Iron Age settlement. The site is a hillfort which presents two phases of fortification. The earliest one was in the seventh century cal BC, and this followed by a second phase, probably in the sixth or the fifth centuries cal BC. The archaeological excavation at this site recorded the use of perishable materials in dwellings and fortifications, while important data on the subsistence strategy focused on cereals and cattle. The archaeological material is characterized by the importance of pottery which shows high morphological and decorative variability.

Optical microscopy is a common method to analyse and characterize the components of pottery. These studies are carried out with thin sections and are able to identify the components and the morphology of the aggregates, and determine the porosity and the different types of clay matrix. Moreover these studies are useful in order to distinguish the minerals which are formed in paragenesis with the clay from those which were added as temper in order to improve the properties of the pottery. The assessment of the pottery samples from Alto de La Garma has been carried out by means of sixteen thin sections which have been studied to identify the components, aggregate size, morphology, voids and textural relationships. The first results of the study have shown that eleven samples have lost the calcite crystals, and deduce that the samples have undergone intense weathering, resulting in the dissolution of this material component. This process is well-known at archaeological sites in the north of Spain. Nevertheless the other five samples preserve this mineralogy so the current research focuses on the determination and evaluation of additional variables which can participate in the process. Thus, this first approach has examined the relationship between the spatial distribution of the samples inside the site and the underlying geological units. The hillfort is located on top of a ridge whose geology consists of limestones interbedded with clay and sandstones.

CODE 1.1.33

OPTICAL MICROSCOPY STUDY OF CLAY PLASTER REMAINS FROM THE PRE-BELL BEAKER SITE (3RD MILLENIUM CAL BC) OF "EL CASETÓN DE LA ERA" (VILLALBA DE LOS ALCORES, VALLADOLID)

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KEYWORDS: Thin section, petrography, chalcolithic, settlement, clay plaster.

ABSTRACT

The archaeological site of "El Casetón de la Era" (Villalba de los Alcores, Valladolid) is a Chalcolithic Causewayed Enclosure placed at the north of the province of Valladolid (Castille and Leon, Spain). The site is one of the best examples of this chronology in the North Plateau. Three ditches and several pits have been identified, with a latter reoccupation dated in the Bronze Age. A notable amount of hardened clay fragments has been documented inside of several pits. These remains have been interpreted as remains of the clay plaster used as coating of the walls of the dwelling structures.

Thin sections and their study using a petrographic microscope have been one of the most common techniques used traditionally in the analysis of historic mortars. But they are less frequent for the study of the prehistoric building remains. That is, in the majority of cases, because of the poor entity of these remains. This analysis allows, not only the characterization of the clay matrix, the inclusions and their possible origin (natural or anthropic), but also diverse aspects of the technology used in the construction of these structures.

Seven thin sections have been studied, which belong to fragments with several differences between them. The aim of this sampling was to obtain the most complete overview. The preliminary results allow us to appreciate a relatively homogenous clay matrix, rich in oxides and quartz, and with the presence of limestone inclusions. The analysis highlights the presence of vegetal matter, belonging to the straw mixed with the clay, an essential element to avoid the emergence of cracks when the clay was dry. In addition, it has been also detected the presence of postdepositional alterations, such as calcareous recrystallizations.

CODE 1.1.35

INVENTORY AND CATALOGING OF GRAVES WITH ARCHITECTURAL-MONUMENTAL VALUE AT 30 DE MARZO CEMENTERY, SANTIAGO DE LOS CABALLEROS, (DOMINICA REPUBLIC)

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KEYWORDS: Funerary architecture, architectural heritage, nineteenth-century cemetery, patrimonial cemetery, Dominican architectural heritage.

ABSTRACT

Historical memory and, within it, the architectural heritage, is one of the most important cultural heritages of a town. Santiago de los Caballeros is the second largest city in the Dominican Republic, and it has historically been one of the most prosperous in the country. 30 de marzo Cementery is the oldest of the city and has real jewels of the local funeral architecture, samples of architectural styles from different periods, and types of burial. However, the total lack of information on the architectural and heritage assets that houses this nineteenth-century cemetery, compromises the safeguard of this cultural property. The main objective of this work is to research and develop a plan metric and photographic catalog of the main architectural and monumental value tombs as well as its stylistic and typological classification. Like many qualitative researches, in the process they were outlining other objectives, including the finding of urban plan metric of 30 de marzo Cementery for the location of the patrimony inventoried. A cabinet work was performed in order to build the theoretical framework, and an important field work, to make the urban plan metric, and photographic research of the cemetery, as well as each of the monumental tombs considered of architectural value. The final result is a catalog which are recorded on data sheets of the monumental tombs with architectural value as well as a map of the cemetery where their evolution and location of the graves are shown, sorted by styles and types. It is important to note that the research was funded by the Pontificia Universidad Catolica Madre y Maestra (PUCMM University) through its "Competitive Funds for Research Program" and executed in collaboration with architecture students from the same university, either as interns or enrolled in the “Theory of Architecture” course.

CODE 1.1.37

PRESERVATION AND USE OF SPACE IN A PROTECTED HEALTH INSTITUTION: REFLECTIONS ON GRAFFÉE E GUINLE HOSPITAL

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KEYWORDS: Cultural heritage preservation, buildings heritage, use of health spaces, Graffée e Guinle Hospital, Rio de Janeiro.

ABSTRACT

The use of space is a matter of great relevance to architecture itself and for architectural preservation, not only as the sole purpose of a building, but also as a reason for its conservation. In hospital architecture, in particular, the use of space and environmental functionality maintain a close relationship with the scientific and technological advances in medicine, usually implementing updates and adaptations of these areas to modern world demands, such as, the need for new equipment's installation necessary for increasingly medical specialties. An old and law protected hospital, such demands cannot always be met due to preservationist legislation details, which bring limitations to physical changes of the real estate affecting its use and functionality. This article claims to bring reflections on the relationship between the use of spaces and architectural preservation in health institutions, using as example the Graffée e Guinle University Hospital in Rio de Janeiro, a 1929 building protected by municipal law. This institution has been recently stigmatized among other factors, by its insertion in the public health system offering precariousness hospital care, teaching and research induced by insufficient financial and human resources, that has reached most of Brazilian university hospitals, as well as other situations concerning the management and the great demand of public health in Rio de Janeiro. From preliminary results, using a contemporary critical-conservative approach, we evaluate to what extent the preservation or degradation of this hospital was a result of the wrong use of spaces.

CODE 1.2.01

MANAGEMENT OF VISUAL IMPACT ON CULTURAL HERITAGE AND LANDSCAPE IN THE EIA. WIND FARM SAELICES AND ITS EFFECTS TO THE HERITAGE SITE OF UCLÉS AND THE SEGÓBRIGA ARCHAEOLOGICAL PARK (SPAIN)

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KEYWORDS: visual impact, cultural heritage, cultural landscape, wind farms, public participation.

ABSTRACT

Currently, there is a conflict between the expansion of the clean energy proportion and the value that society gives to heritage and landscape. After the Charter of Krakow and the European Landscape Convention (ELC), the landscape is understood as a heritage that serves the economic and cultural development of the populations, and public participation is necessary in their decision-making processes. In Spain, after State policies that encourage renewable energies (RE), there has been a proliferation of wind farms (WF), causing conflicts by the visual impact (VI) generated on the territory, landscape and cultural heritage. However, despite the existence of precedents on the topic, within the environmental impact assessment (EIA) it has not been achieved assess this impact well.
In this communication, lines of work in the EIA that could help make a better assessment of the VI generated by WF on cultural heritage are suggested. It presents the case study of WF Saelices, located in the vicinity of the Monumental Heritage (MH) of Ucles and the Segóbriga Archaeological Park (AP). Through a survey is analysed the assessment of affected population about these facilities. The results reflect the potential value of public participation in the EIA process for better assessment of heritage sites.

CODE 1.2.08

NEW DIGITAL MODELS FOR THE KNOWLEDGE OF THE LATE GOTHIC HERITAGE IN ANDALUSIA*

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* This research is linked to the R&D project (HAR2012-34571) "A Digital Information Model for the Knowledge and Management of Immovable Cultural Heritage" led by Francisco Pinto Puerto and funded by Spain's Ministry of Economy and Competitiveness

KEYWORDS: Heritage knowledge and management, digital model, geographic information system, graph, late gothic heritage.

ABSTRACT

This paper discusses the methodology used in "The Digital model of Andalusia's Late Gothic Heritage project" to develop new models of heritage interpretation through the application of GIS and Graph visualization - mathematical and computer models - to provide new perspectives to analyse the transformation of Andalusia's territory by considering social, political, economic and cultural evolutions. The relations between heritage with territory and society are the main elements of the complex system that shapes the heritage phenomenon. We argue that the heritage is conceived by a multitude of agents, movable and immovable elements, tangible and intangible.
Our goal is therefore to create new perspectives, with a transdisciplinary and multiscale approach of the Late Gothic Heritage that would provide an understanding of its components which interact with each other. The Late Gothic context was characterised by an intensive exchange of knowledge among professionals that produced numerous flows and transfers. All this movements also generated a multitude of variables - roads, materials transportations, transport, patronage, professionals, institutions, trips, meetings, etc. The production of the space itself, with all its entities, is the great laboratory of study.
This paper shows the methodology to create two different digital model – GIS and Graphs – which enable us to generate and achieve a more complete and flexible understanding about the Late Gothic phenomenon through a combined knowledge of space, time and agents.

CODE 1.2.09

SEVILLA SKIN. STRATUM OF COLOR AND LIGHT

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KEYWORDS: Litght, city, color, coatings, lime, pigments.

ABSTRACT

The light of Seville has a special luminosity transforming architecture. Its coatings reflect it, spread it, color it, shade it and modify the visual perception of space and color. Throughout the day, the light transforms the architecture and the city, changing the luminous intensity and different tonalities.
This research aims to analyze the layers of color and luminosity of traditional continuous coatings of lime -mortars, "jabelgas", limed and stuco-, and how they influence the design of architectural spaces. The study is specified in three sevillian buildings: Real Alcázar, Seville City Hall and Real Fábrica de Artillería. The remnants that remain is analyzed to investigate the original colors and its transformation from its origin to our days.
The methodology includes the historical study through iconography, photography, models and external sources. The strata study is also performed by colorimetry (CIE Lab) with determination of the L * a * b * coordinates, image analysis using the colorimetric study compared with the pattern of white barium sulfate and analysis compared with NCS color chart. The study was completed with the determination of the physicochemical properties of the coating materials: diffraction and fluorescence X-ray, infrared spectroscopy, optical microscopy and scanning electron microscopy.
In the conclusions, the results of the buildings colors that have kept through history and their material composition, are presented. They tell us of the building skin, its nature, its geometric attributes, their status as historical document, architectural fact and symbolic element. Knowledge of stratum help to preserve in architectural interventions, according to each case, the buildings skin in the city, safeguarding its authenticity.

CODE 1.2.10

SURVEY AND CHARACTERIZATION OF CORBELLED DOME ARCHITECTURE IN NORTHWESTERN PORTUGAL

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KEYWORDS: Corbelled dome, vernacular heritage, granite stone, laser scanning.

ABSTRACT

The act of overlaying stones to build masonry structures is one of mankind's most intuitive and resourceful achievements. Masonry buildings can be found all over the world, built with a wide diversity of materials and serving for all kind of purposes.
In rural northwestern Portugal, in a granitic highland landscape of scarce resources, for centuries, local farmers used masonry in order to make the territory suitable for farming. In their effort to increase production and, by doing so, to improve their living conditions, a specific mountain agro-pastoral system was developed. Supported by communitarian labour, this system was based on terrace farming and temporary mountain plateau settlements, called *brandas*, composed of granite corbelled dome buildings. In spite of its perfect adaptation to the harsh local conditions, this heritage's morphological and typological diversity and constructive inventiveness is endangered due to decades of rural exodus and, thus requiring urgent study and protection.
The research project aims to study this heritage from morphological, typological and constructive points of view, with the objective of proposing guidelines towards its preservation. To achieve the established goals, a four stage based methodology was established.
Literature review and fieldwork surveys were performed in the first stage, in order to identify possible case studies. In the second stage, an exhaustive geometrical survey and analysis of a case study was undertaken and complemented by physical and mechanical characterization of local granite. The third stage aims to do an overall structural safety evaluation of the corbelled domes, based on numerical analysis. In the final stage, consolidation and preservation guidelines to safeguard this architectural heritage will be proposed. This paper presents the results of the first stage, along with a glimpse of the second stage.

CODE 1.2.13

SUBJECTS AND INTENTIONALITIES: THE MUSEUM OF ASTRONOMY AND RELATED SCIENCES AND ITS REPRESENTATION IN THE CITY OF RIO DE JANEIRO

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KEYWORDS: Architecture, heritage, preservation, museums.

ABSTRACT

This study proposes to reflect on questions related to meanings, representations, subjects, and intentionalities observed in the process of the use of preserved historic buildings which currently house science museums. As a case study I will use the architectural and landscape complex situated in the Museum of Astronomy and Related Sciences. This complex is considered relevant historical and cultural heritage for the History of Science in Brazil, and the participation of the museum has an important repercussion in the area of scientific dissemination. The research aims to explore the process of reconversion and the qualities of the place in this context in which architecture has a significant role in the change of use and the requalification of the spaces of the museum. In this article, the architectural references of the architectural and landscape complex of the museum are analyzed and, based on photographs taken from a bird's eye view, some aspects of the urban transformation of the Imperial District of São Cristóvão are shown. The ongoing research intends to contribute to studies of the transformations of the use of historic buildings which house museums, based on connections linked to the historic constitution of the scientific institution in the architectural and landscape site in which they are located and in the context of the urban growth of the city of Rio de Janeiro.

CODE 1.2.18

THE SURVEY FOR THE MEMORY; THE DOCUMENTATION OF THE CHAPELS TO THE VIRGIN MARY IN THE LANDSCAPE OF BASILICATA

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KEYWORDS: Cultural heritage, documentation, survey.

ABSTRACT

Basilicata, region inhabited for thousands of years, is characterised by a comprehensive presence of many cultures in its land. Very interesting are the suburban chapels, often devoted to the Virgin Mary, that characterize the countryside of Basilicata. They had a great diffusion at the beginning of Middle Ages, and they were influenced by the country life and in many cases built close to ancient pagan sanctuaries devoted to female divinities related to the cycles of nature.
Small architectures with constructive and size affinity comparable with each other, become a chance for knowledge, where the survey design plays a central role to understand the complex dynamics of transformation that they had in centuries. The instruments of the survey help the architectural features of these small buildings to be transferred on the drawing sheet, allowing a comparison of types, especially by creating a first step to save their memory, a first step for their restoration and conservation.

CODE 1.3.01

HERITAGE, URBAN REGENERATION AND CLIMATE CHANGE ADAPTATION: CASE STUDIES IN CANTABRIA, SPAIN

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KEYWORDS: Urban planning, climate change adaptation, indicators, urban heritage, urban regeneration.

ABSTRACT

Urban planning in our cities has inherited schemes and management methods consistent with the processes of socio-economic evolution. In an overall review of European planning legislation, we can see therefore how a regulatory adaptation in the transformation processes is starting to incorporate the climate change phenomena.
The European Adaptation Strategy marks a turning point in the urban planning methodology. Following this guideline, the European Urban Agenda (in drafting phase) will interconnect the criteria of urban sustainability and climate change adaptation strategies for risk control. Consequently, we face a new stage where the risk control tasks, mitigation and adaptation measures must be incorporated in the urban plans of cities or sectors in cities from the beginning. In particular, some historic districts of our cities are highly vulnerable and need to be planned separately.
The aim of this paper is to identify appropriate indicators to establish management measures for historic urban centres in order to improve their resilience according to the European Strategy and the criteria for urban areas in the National Plan for Adaptation to Climate Change in Spain. Examples of integration of climate change adaptation in historic areas pointed out by UNESCO or the National Center for Preservation in the US.
The research focuses on the urban historic areas declared Assets of Cultural Interest under the legislation of Cantabria Regional Government. Usually, the most appropriate tool for these areas is the Special Plan so in addition, the application of these indicators in the planning process of the historic zones of Cantabria would ensure the maintenance of the cultural resources in order to face the adverse climatic effects under local change scenarios.

CODE 1.3.02

A MANAGEMENT MODEL FOR INTEGRATED URBAN REGENERATION: THE CASE OF THE HISTORICAL PORT CENTRE OF SANTANDER

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KEYWORDS: Urban planning, integrated urban regeneration, cultural ring.

ABSTRACT

Nowadays, there is a widespread consensus that sustainability needs to play a very important role in urban planning. Accordingly, interventions involving compact urban developments should be prioritized over new sprawl dynamics, so as to achieve more integrated and sustainable cities. In view of that, the Leipzig Charter on Sustainable European Cities (2007) and the Toledo Declaration on urban development (2010), introduce urban regeneration as a qualified form of intervention to solve current problems of deprived urban areas under a holistic view, considering physical, economic, social, cultural and environmental aspects.

In Santander's city centre, a group of isolated interventions are being developed using culture as a focal point. These interventions include rehabilitation of buildings and urban renewal (physical); attraction of new residents and promotion of public leisure areas (social); transformation and configuration of new commercial and leisure centres (economic); and creation or enlargement of public green areas and the city's opening to the sea (environmental).

The aim of this paper is to analyse whether the interventions implemented in Santander's city centre, which are not included in any institutional Integrated Urban Regeneration Plan, constitute in fact a regeneration process, i.e.: it follows specific methodologies aimed at articulating these actions and the financing procedures, with a common coordination, planning and management framework.

CODE 1.3.03

RURAL HISTORICAL TOWN OF CASTROJERIZ (BURGOS). PARADIGM OF CONFLUENCE BETWEEN INTEGRAL REHABILITATION AREA AND URBAN RENEWAL AREA

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KEYWORDS: Rehabilitation, urban renewal, regeneration, historic site, Castrojeriz.

ABSTRACT

The declaration Urban Renewal Area with the approval of the Governing Council of the Junta de Castilla y León dated April 16, 2015, is in this rural municipality, the regeneration of 65 dwellings and urbanization of the streets Marqués de Camarasa and General Aranda, in the vicinity of the Camino de Santiago. As it relates to equipment it is expected to rehabilitate the 'Casino', former municipally owned social club located in the Plaza Mayor. It is recalled that the center of Castrojeriz was the subject of a Comprehensive Rehabilitation Area previously operating in 132 homes. The overall planned investment amounts to 2,112,500 euros, of which the Junta de Castilla y León and the town of Castrojeriz contribute, each administration, 487,500 euros, the Ministry of Development 617,500 euros and 520,000 individuals. This Burgos´ village declared as an Historical Town, have come together two different urban figures of urban regeneration, an area of comprehensive rehabilitation as well as the recently approved Urban Renewal Area, each with a specific structure and execution. We compare the two performances by statistics on executions already made and its complement and definition with new actions planned, providing an enlightening insight on best in localities with these features regenerative future urban figures.

CODE 1.3.04

CITY AND THE HERITAGE

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KEYWORDS: Oikos, social unit, habitat, city.

ABSTRACT

The city is the greatest human invention Lewis Mumford (USA 1895/1990). Men joined their effort and developed through their avatars, from Catal Huyuk in Anatolia -Neolithic- to Buenos Aires-today.
Assuming that the city structure forms a succession of temporary layers that condense culture, memory, intelligence and materiality, on a hopeful time-space journey and vision through history we express the current city and the future are marked by its past. It is exciting to decipher its genetic laws and a great task for specialists, integrated into a common project to continue the great human invention without departing in dissociation factor citizens. In this context there are maintenance activities, replacements, inclusions and rehabilitation of old structures that rescue values associated with the contemporary.
Continuous and dynamic urban transformations do not always respect and include the city essence. The network of services, public transportation, vehicular traffic, real estate inserts, care of afforestation, changes in flooring of streets and sidewalks and carelessness of public space, are factors that must be made aware by all the urban users, both public and private.
The restored architectural heritage consolidates the redesign of the city with its values and essential functions. 4 cases in 2 sites of Buenos Aires illustrate the presentation from academic look.

CODE 1.3.05

THE SPANISH TOWN OF MELGAR DE FERNAMENTAL. A DIFFERENT VISION OF URBAN REGENERATION IN RURAL AREAS

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KEYWORDS: Urban renewal, rural population, rehabilitatiton.

ABSTRACT

The area on which said Urban Renewal Area with the approval of the Governing Council of the Junta de Castilla y León dated April 16, 2015, is bounded by the city center, historical buildings and shops of the town. The agreement calls for intervention in nine homes and the completion of the redevelopment of the Plaza Fernan Armentález and renewal of rough pavement Cabo Castilla Street and Plaza del Corro. Rehabilitation Center Multiple Chapel of Santa Ana uses is also contemplated. The overall investment is 382,500 euros, of which the Ministry of Development provides 110,700 euros, individuals a total of 100,800 euros and the Board and the City of Melgar de Fernamental a total of 85,500 euros each. In this area Melgar de Fernamental was performed between 2010 and 2014 in the rehabilitation of 191 homes through a Comprehensive Rehabilitation Area, being the urban renewal area under study, the continuity of that solution. The differences between these two different rehabilitation programs, urban renewal and regeneration are studied, and its implementation in the territory of action, comparing processes and actions.

CODE 1.3.08

VALORIZATION OF HISTORICAL HERITAGE TROUGHT LIGHTING: TAKING BACK THE NOCTURNAL HISTORICAL AMBIANCE OF THE ALFÂNDEGA SQUARE – PORTO ALEGRE/RS

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KEYWORDS: Historical cultural heritage, historic centers, public lighting.

ABSTRACT

The Alfândega Square and its surroundings, situated in the historic center of the city of Porto Alegre/RS, Brazil, are part of the city's origins. The city had its development deeply connected to the maritime function of this area. Located by the Guaiba River, the city used to be an outlet for the local agricultural production to other locations since 1772, creating the conditions for urban and harbor development. The Alfândega Square represents this time and its historical importance is related to the implementation of infrastructure systems that were essential to the city's development. Public lighting was one of the first implemented systems. In 1832, streetlights using whale oil were installed and, despite of their poor performance, a new relationship between the city and its nocturnal environment was established. Nowadays, even though it is possible to find some streetlight models that serve as a reminder of the old models, several other models are found, incompatible with the streetwalker relationship with the space. The buildings facades are completely illuminated by big spotlights that compete with the historical street furniture. The shadows don't stand out and the white light floods buildings and streets, hurting the nocturnal ambiance of the place. The goal of this paper is to present, trough contextualization and historic evolution, the importance of the Alfândega Square's area to the city's development, showing the role of public lighting in the process. The paper gives project guidelines for the Square's area, aiming to value its artistic and historical heritage. To recreate the historical ambiance of this part of the city means to take back part of the history, valuing the square space as a historical site and encouraging the population's feeling of belonging in that place, making the square a safer place at night and endorsing its nocturnal identity.

CODE 1.3.09

THE GRID AND THE SQUARE: TYPOLOGICAL VARIATIONS IN THE WEST OF SÃO PAULO STATE

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KEYWORDS: Patrimony, railway, grid, squares, typology.

ABSTRACT

From the late nineteenth century, two elements embodied the extensive occupation of territory in western São Paulo: the railroad and the grid, having coffee as main driver of this occupation. In the urban scale, the railway settled in the lower levels, near the waterways and flatter topography while the church, which even in the republican period occupied a prominent place, settled on the upper levels. It is natural to assume that the most representative buildings were concentrated in the vicinity and connections between these two elements. The squares, usually occupying a grid, were not oblivious to these elements, creating a relationship of complementarity, extension, autonomy, etc. While on the one hand the reconstruction of the design of squares, with their equipment, vegetation and paths, allowed us to check its details, however, it is its insertion on the grid which allowed us to understand these details on a larger scale and detect a typological variation across the comparative analysis. In this research were redesigned projects of 61 squares in 29 cities over four railway lines that propitiated the western occupation of the State of São Paulo: Paulista, Noroeste, Sorocabana and Araraquarense. The drawings were supported by iconographic, cartographic and textual research and make up a significant sampling to give subsidies to inventory preparations as well as intervention, conservation and restoration projects and public policy in urban and regional scale. This study was part of the research "Theoretical and technical knowledge on the configuration and reconfiguration of the cities formed with the opening of pioneering areas in the West of São Paulo State", conducted by the Thematic Project "Erudite knowledge and technical knowledge in the configuration and reconfiguration of the urban space: São Paulo State, nineteenth and twentieth centuries ", with support from the Research Foundation of São Paulo State (FAPESP).

CODE 1.3.10

"REGENERATION OR RELOCATION" A CRITICAL ANALYSIS AND AN ALTERNATIVE FOR SUSTAINABLE URBAN DEVELOPMENT IN ISTANBUL

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KEYWORDS: Urban regeneration, relocation, urban transformation, slum upgrading, sustainable urban development.

ABSTRACT

Under the brief title of "Regeneration or Relocation", this study faces as main objective a critical analysis of the contexts linked to a particular case, to interpret the nature of results and their relation with a sustainable urban development. The initial question is what sort of innovation could be best solution for a mega city in transformation, and questioning why is this regeneration process happening, as well as its' final effects on the space, and the society. The methodology is looking for alternatives of re-settlement and displacement, which focus on the projects for slum amelioration and urban renewal in historical neighborhoods. The added value is, to critically analyze the project done in the historic neighborhood of Istanbul regarding community benefits. Accordingly, this work focused on urban regeneration strategies in Istanbul and the social participation process, which involved socio-cultural aspects in the 'Sulukule Urban Regeneration Project', treating its' social impact as a study-case.

Istanbul is an urban mosaic, which consists of diverse architectural heritages, social ties, historical bounds, ethnic roots and cultural engagements. The Istanbul Metropolitan Municipality has proposed several developments in the last decade. Such attempts pursued strong impacts on the unique urban fabric of Istanbul, raising criticism from academic works and other authorities that could not find in these projects a fair a correlation of costs and benefits with the results achieved. The revitalization of the slum neighborhood and the projects applicability with respect to the community is not simple and substantive as it assumed: it is supposed to serve the people's capacity, wellbeing and development. Since respect for the existing social structure is one of the three pillars of any sustainable intervention (care for the environment, social benefits and economic viability), the renewal projects should serve its own community, caring for requirements to respect or to improve the urban fabric, but also the existing environment and life, including immediate context and existing social ties, which certainly, is not an easy task.

CODE 1.3.13

ARCHITECTURAL HERITAGE OF HISTORIC MEDITERRANEAN PORTS: A METHODOLOGY FOR VULNERABILITY ASSESSMENT

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KEYWORDS: Mediterranean ports, historic heritage, vulnerability.

ABSTRACT

The vulnerability of the historical maritime heritage is a research theme very widespread, because of the significant impacts of the modern- artificial and natural- world. In facts, on the one hand, technological innovations, transformation of spaces and progressive industrialization lead to obsolescence processes and abandonment of historical built heritage. On the other hand, disasters could represent hazard factors for coastal environment, particularly for architectural and cultural heritage. These issues take on even greater importance in specific exposed areas, such as ports, where transformations and innovations are rapid and, above all, the protection and preservation of historical heritage is critical.
The research work aims to analyse Mediterranean historical ports in order to develop a methodology for risk analysis that leads to the identification of strategies and guidelines for refurbishment and enhancement of architectural maritime heritage as well as for integration of the port-city system. The first step of the research has concerned the identification of categories and subcategories of historical port heritage, classified by typology and historical period, in order to understand specific criticalities and characteristics.
Specifically, the contribution will discuss and describe critical aspects of the preservation and enhancement of different typology of architectural and historical heritage of ports. Thus, in the view of the identification of hazard factors of port context and, then, of the risk analysis, it will be carried out a process methodology for the assessment of state of conservation and, therefore, vulnerability, considered in its broadest meaning: material-constructive, functional-managerial, and cultural-landscaping.

CODE 1.3.16

PLASTER AND STONE SURFACE RESTORATION OF ANCIENT CONVICINO (SASSO CAVEOSO IN MATERA-ITALY)

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KEYWORDS: Calcarenite, architectural heritage, degradation phenomena, conservative restoration.

ABSTRACT

The oldest part of the city of Matera, known as Sassi, is an architectural and urban complex consisting of built and carved out structures that stretches over a karst plateau, of which it seems to be a natural extension. The upper layer of the plateau is formed by calcarenite, a calcareous sedimentary rock of biochemical origin, improperly called tuff, characterized by the ease of extraction and processing which has determined its use as typical construction materials. The Sassi neighbourhood are UNESCO World Heritage since 1993. Moreover, the city of Matera has been chosen as European Capital of Culture for the year 2019 because of its unique architectural heritage that testifies the ability of humankind to dig shelters in the rock since prehistoric times. This paper illustrates a conservative restoration of a whole neighbourhood, currently abandoned and degraded, located in the Sasso Caveoso aimed at its rehabilitation as a tourist building. This neighbourhood develops along two different rocky planes with constructions facing to one side on a driveway and to other one on a series of small squares with walking surfaces following the trend of the underlying rupestrian houses roofing. Both carved out and built structures have affected by different forms of physical and chemical degradation phenomena, mainly due to capillary rise of water. Moreover, internal plasters performed in previous maintenance interventions with mortars based on cement are damaged by detachments caused by different thermal expansions between the masonry and the plaster and the presence of sulphate salts soluble as well. In this conservative restoration, binders based on natural lime were employed to obtain mortars or plaster compatible with the original materials and silicone acrylic resins were used as waterproofing. The severely affected ashlars were replaced by the rip-and-sew technique with calcarenitic blocks taken from a quarry located in close proximity to the City of Matera.

CODE 1.3.17

RISK ASSESSMENT: FIRST STEP TOWARDS URBAN REHABILITATION?

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KEYWORDS: Seismic vulnerability index, R/C buildings, damage mechanisms, damage scenarios.

ABSTRACT

The well-being and quality of life in old urban centres constitutes a dynamic goal, always influenced, by social and economic processes, evolution and urban growth and increasing demand over the existing building stock and urban infrastructure. In the scope of renewal and rehabilitation of old city centres, focusing on the physical building stock, the essential features, such as: structural safety and indoor comfort conditions in an equilibrated and sustainable manner, with the preservation and safeguarding cultural identity, is not merely a maintenance practice, but a fundamental valued action that creates opportunities and roots for successful urban management. Presently, many cities, throughout Europe are awakening to a culture of risk-integrated management and assessment, not only ate the city level, but at the regional scale. Risk management is a process that encloses a series of actions that support the implementation of measures that reduce the potential of loss in the sequence of a catastrophic event, for example, earthquake. However, vulnerability and risk assessment is a complex net of actions and strategic decisions on urban systems. Amongst many pursued objectives in the scope of urban planning and management, in particular for the case studies presented, risk assessment is approached in four fundamental domains: Earthquake and Structural Safety, Urban Fire, Comfort and well-being (climate change) and architectural and cultural safeguarding. At the urban scale and in the specific domain of structural safety, earthquake and fire vulnerability and risk, lead to severe consequences that are unfortunately part of the collective memory of communities. The consequences in the case of these events are motive for the strong valuing of prevention and preparedness strategies, mitigation and planning measures that reduce the physical, economical and social consequences and allow a continued actions of improvement, since a “zero” risk environment is impossible to attain. In respect to well-being and comfort conditions, the adaptability of the old building stock is a challenge in terms of new uses and functionality, proportionating improved thermal and acoustic conditions, promoting the longevity and maintenance, if in use. The cultural and architectural value of old urban centres of acknowledged heritage value, is not exclusively due to singular and monumental buildings, but also to old building aggregates. Moreover, rehabilitation and renewal actions only are consequential if taken at the building quarter or aggregate level, when in the case of the urban scale. Presently it is debated that urban rehabilitation, as a drive for the progressive improvement of living conditions of old buildings, safeguarding of cultural identity and sustainable development of old urban city centres. However, before intervening or defining retrofitting or refurbishment strategies for the building stock, the assessment of urban risks is crucial, formulating the question: is Risk Assessment, the first step for successful urban rehabilitation.

CODE 1.4.04

RISK ANALYSIS ON REAL ESTATE BUILD AND SELL DEVELOPMENTS

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KEYWORDS: Real estate investment, risk investment analysis.

ABSTRACT

The article discusses risks on real estate developments with focus in build and sell properties. For risk analysis, the key issues are: i. what is the meaning of risk of the investment, risks management and their mitigation; ii. management, economic and market environment risks, compatibles with monitoring procedures or not; iii. risk analysis through the measurement of the behaviour deviations impact on the investment quality. Following, using a prototype as example, we show how to build an impact analysis on the quality of the investment. Using this prototype, the objective is follow the main issues on modelling the investment in a simulation process. Complementary, as the prototype comprehends an image of a development in Brazilian market, enhances the major risk factors, which conducts to implementation of the most aggressive management controls and mitigation procedures. As it is a valid example of a development, the prototype allows the understanding of the impact of certain variables on investment actual quality, illustrating the critical ones and others that generate a weak impact, like the sales absorption before building.

CODE 1.4.05

PROPOSAL FOR APPLICATION OF COST-BENEFIT ANALYSIS (CBA) TO ARCHITECTURAL HERITAGE REHABILITATION PROJETS

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KEYWORDS: Cost-benefit analysis, rehabilitation, architectural heritage.

ABSTRACT

The decision to rehabilitate Architectural Heritage (AH) is complex, because the associated costs require different levels assessment, given their relevance to all stakeholders in decision-making, and are not always easily quantifiable. Following recent decisions of the European Union, it is urgent to carry studies to support AH rehabilitation. In this context, the use of methodologies based on Cost-benefit analysis (CBA) contributes positively to base decisions on AH rehabilitation investment projects. The purpose of a CBA is to evaluate if a project is feasible from the point of view of social welfare through the algebraic sum of their costs and benefits discounted over time.
The application of CBA to AH rehabilitation projects requires rigor and methodological consistency. This paper comprises a proposal for socio-economic evaluation of AH buildings rehabilitation projects based on CBA, which integrates the community policies and financial instruments. It aims to provide technical support and contribute to the reflection about co-financing rates modulation. It corresponds to a preliminary study about the subject. A research study is being developed in LNEC concerning the implementation of this methodology to support all stakeholders decision in AH rehabilitation projects.

CODE 1.4.06

ASSESSMENT AND RECOVERY OF HERITAGE BUILDING LUIS COUSIÑO, VALPARAÍSO, CHILE

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KEYWORDS: Assessment, heritage, rehabilitation, recovery.

ABSTRACT

This document treats the recovery and assessment of Luis Cousiño Heritage Building, located in Blanco No. 973 - 999 and Errazuriz Ave. in Valparaíso, built between 1881 and 1883. This building is protected by the Chilean Monuments Act No. 17,288, and to date of our analysis, it was completely abandoned and had been affected by fire.
In view of the conditions of the building, on July 1994, its owners requested for permission to demolish it in order to build a 15-level office tower. For this reason, Consejo de Monumentos Nacionales (National Monuments' Council) intervened, together with the local Municipality, in order to recover the building for its urbanistic and architectural characteristics, also for Valparaíso's history.
The edification was abandoned; being affected by several thefts and damage. Its current situation is ruinous, and several valuable elements from its original construction are missing, especially on its interior. Only its perimeter walls (157.64 line meters of facade with a height of 14m and wall width 0.8m) are standing.
The work done consisted on assessing the building's value on its current state, for its purchase by the Municipality, in order to allow for its recovery, according to the highest and optimal use of the asset, but taking into consideration its historical character and trying to avoid any effect on its original owners. Therefore, the work was centered in determining recovery costs, investment amortization and use proposals. Finally, after several years, they allowed for the recovery of the asset for educational use. The building was transformed into a center were different cultural and heritage activities occur. It also brought life to its surroundings, which were decayed at the moment of the assessment.
Finally, the evolution of the case, both in terms of heritage recovery and resources, is shown.

CODE 1.5.01

HERMITAGES AT BROTO VALLEY: A SOCIAL PROJECT FOR HERITAGE RECOVERY

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KEYWORDS: Social project, heritage, rehabilitation, hermitages.

ABSTRACT

The "Association of Friends of Broto Valley" is created In September 2010, as an initiative of retirees of Valley Broto (Huesca Pyrenees) to join efforts to restore the hermitage of Sant Clement, that was in a deplorable condition. It was consider the best way to achieve the objective: the celebration of the feast of Saint Clement, on 23 November, in the restored hermitage. And so, working together, and with some professional help, it was possible.
It was more than just a common association of the elderly, although almost all Broto retirees were its promoters. It was an association open to all people who feel identified with the people of Broto and its valley, regardless of age or place of residence. The name "Friends" that was chosen, synthesizes better than nothing: "associated Friends to preserve the heritage of the Valley of Broto, to improve the living conditions of their peoples and strengthen coexistence among its inhabitants and those who visit us."
The aims of the association are: the recovery and conservation of natural, artistic, cultural, anthropological and social heritage; the improvement of living conditions of the inhabitants of the valley; to seek the participation and involvement of other persons and entities; and foster unity in inhabitants of the valley and visitors.

CODE 1.5.03

THE VULNERABILITY DEMOGRAPHIC IN URBAN INTERVENTIONS IN HISTORIC CENTRES: THE CASE OF CARTAGENA

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KEYWORDS: Historical centres, social vulnerability.

ABSTRACT

The work is part of a line of research that is developing a model of assessment of intangible assets so complex as they are the historical centres. The model designed in four environments are taken into consideration: physical, social, economic, and institutional. Different international currents passed the importance of the social factor in the enhancement of historical centres. This enhancement is not achieved by incorporating only urban projects but also social and economic performances. Analysis of the influences between Mainland (historical centre) and content (residents) should be a priority point to avoid that our historic centres suffer processes of overcrowding or gentrification that block social diversity and value.
The objective of this study is to demonstrate the influence of policy interventions in historic centres on these environments socio-demographic profile. This is analyzed the influence that has had the urban intervention carried out on the Special Plan of reform inside (PERI) CA-4 of the historic centre of Cartagena on the social environment. The methodology followed is the socio-demographic characterization of this environment before and after the intervention, processing the data and comparing the intervention carried out in the 189-2 BA PERI of the eastern sector of the historic centre of Barcelona, in the District of Santa Caterina to have similar characteristics to the analyzed area.
The results demonstrate the influence in the revitalization of a historic urban intervention criteria have on the structure demographic. This highlights the need for principles that respect and improve the quality of life of the residents in the urban planning of these urban environments.

CODE 1.5.04

SOCIAL PARTICIPATION AND HERITAGE EDUCATION IN THE NECROPOLIS LA CALARILLA OF HORTUNAS, REQUENA (VALENCIA)

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KEYWORDS: Conservation, sustainability, social empowerment, social appropriation.

ABSTRACT

The recovery and conservation of local archaeological heritage by developing educational strategies increases awareness and active participation of the public. Heritage education is what helps strengthen social identities and contribute to the social appropriation of our cultural heritage. Is because of this that the archaeological necropolis of La Calerilla of Hortunas in Requena (Valencia) has developed a project for its social and sustainable enhancement supported by the Polytechnic University of Valencia and the local government of Requena. This methodology project includes a program of activities aimed at different audiences, classified in the three areas of education: formal education, where activities in High Schools and University are included; non-formal education, focusing on teaching and interaction in the Local Museum of Requena, where archaeological objects from the Calerilla are exhibited; and finally, informal education, where all events related to local archaeological heritage will be promoted through ICT. Thanks to this initiative we will be able to provide a closer and more human vision of our heritage that facilitates its understanding and contributes to its long-term preservation.

CODE 1.5.06

CAPACITY OF PUBLIC OPINION TO MODIFY INTERVENTION PROJECTS IN THE PROTECTED HISTORIC CENTRE OF CÁCERES

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KEYWORDS: Heritage, Project management, Public administration, Society.

ABSTRACT

The architectural interventions in heritage are often the object of criticism and controversy. In its development are involved multitude of diverse agents. Heritage is property of all citizens, not only those ones of the place but globally. These generalist parameters makes impossible to reach an agreement, and there may be dissatisfied parts with the intervention or arise controversies.
The case study was the socio-cultural development of two architectural projects that were overlapped in time, coinciding with the arrival of the crisis to the construction industry. They are focused on buildings with diverse protection levels in the historic centre of the city World Heritage Site of Cáceres (Spain). The capacity of society to modify projects was analyzed. As well the intervention of other agents was valued in their development through sectoral reports and diverse documents. It was noted that these entities, other than those related to technical development of the project, were the generators of significant changes in the formal, functional and aesthetic conception. So they also modified the relationship between these buildings and the historical landscape.
Projective processes of private and public promotion were studied, derived from direct order and open competition respectively, managed by architectural offices internationally renowned or local character. Among the analyzed real states there were buildings or elements from the XVth and XVIth century and historical false of the 60s and 80s of the last century, with different past and future uses. In these projective processes of intervention in buildings in a protected historical centre, it is concluded that the power of public opinion is able to alter the proposals initially submitted with different consequences depending on the particular casuistry.

CODE 1.5.11

HOUSING HABITABILITY: A DETERMINANT FACTOR OF HERITAGE MANAGEMENT IN ECUADOR. PRELIMINARY STUDIES FOR ITS COMPREHENSION

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KEYWORDS: Habitability, cultural heritage management, preliminary studies, field work, socio-economic needs.

ABSTRACT

The lack of social engagement negatively affects conservation of the built cultural heritage. As dwellings represent 75% of immovable heritage in Ecuador it is imperative to understand social needs and economic conditions of their residents in order to establish protection regulations and to manage these important resources. Traditional housing is one type of cultural heritage where the social and conservation needs strongly coexist and where proper management is critical for the benefit of both.
Therefore it is essential to understand the socio-economic-cultural needs, aspects and motivations of the inhabitants through preliminary analysis.
This paper presents results from one experience aimed towards measuring habitability in San Gabriel, a medium sized city of Ecuador. This study describes the field work results implemented to test previously analysed data, and the methodological approach that combined different socio-economic, geographical and participatory tools (interviews, observations, surveys) in order to improve heritage management with a mutual benefit for society and cultural heritage.

CODE 1.6.01

THE ROMANESQUE CHURCHES OF VALL D'ARÀN AND THEIR ANTIFUNICULAR SECTIONS

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KEYWORDS: Valle de Arán, geometric deformation, barrel vault, antifunicular sections, barrel pressure, romanesque construction.

ABSTRACT

The Aran Valley is located in the north face of Pirenees. Into this Valley there are some Romanesque churches, build between XIIth and XIIIth centuries, which present deformations upper to 10% from their original form. It is particularly interesting the church of Santa Maria d'Arties (XII-XIII),
Puig I Cadafalch (1908) points out that, the basilical floor plan church initially was covered by wooden roof truss. In the XIIIth century the use of wooden roof truss was replaced by the use of barrel vaults supported on non-monolithic circular section masonry columns.
The last years Santa Maria d'Artíes (s.XII-XIII) has been lay out through manual methods (2013-2015), topographic and photogrammetric systems (2013) and finally with the scan laser (2015) have been lay out the totality of church of Vall d'Aran. In some of perpendiculars sections have been seen antifuniculars forms, however it, the churches are in use. Into this article is justified these deformations and is analyzed the different interventions.

CODE 1.6.02

HISTORICAL ANALYSIS CONTRIBUTION OF THE STRUCTURAL AND TECHNICAL DIAGNOSIS OF HISTORIC BUILDING: THE CASE OF THE KETCHAWA MOSQUE-CATHEDRAL OF ALGIERS

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KEYWORDS: Mosque/cathedral, ottoman architecture, algiers, restoration, diagnosis.

ABSTRACT

The restoration of the mosque-cathedral of Ketchâwa is one of the most important projects undertaken within the framework of the protection plan of the Kasbah of Algiers.
Successively medieval mosque attested by the sources of the 16th century, then Othoman mosque at the 16th century rebuilt at the 18th century by the sovereign Hassan Pacha then Saint Philippe cathedral transformed during the French colonial period and finally again mosque of Ketchâwa after the endependence of Algeria, it carries in it the traces of a complex history whose keys of reading are in the Arab, Turkish and French archives.
The diagnosis of the actual position of conservation of the mosque developed within the framework of the project of urgent measures reveals many pathologies as well affecting its structure as its construction (architectonic materials and elements).
This present communication proposes to show the contribution of the historical readings connected on the building and instead of its construction in the evaluation and the understanding of pathologies which affect it.
It will initially be a question of explaining in what and how the disorders observed such as the subsidence, the instability of the central vault and the turns of bell-tower-minarets constituting the principal framework, the moisture of the walls, the deterioration and the corrosion of materials are in direct connection with various orographical and hydrological phenomena of the plate of establishment inherited the history, with hydraulic work of infrastructures undertaken at various periods of the evolution of the city, and finally with the cyclic seismic activity of the Algiers area. Then, it will be a question of showing the impact of the successive projects of construction, transformation and restoration readable through the stratigraphy of the building in the formation of various pathologies.

CODE 1.6.04

ASSESSMENT OF STRUCTURAL CONCRETE BUILDING OF THE YEAR 1920 USE OF HOTEL IN ARANDA DE DUERO (BURGOS) IN ARANDA DE DUERO (BURGOS)

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KEYWORDS: Structural assessment, structural inspection, intervention.

ABSTRACT

The building studied in this work is located in the San Francisco Street, in the Old Town of the city of Aranda de Duero (Burgos). Use before the housing reform was practiced, where the new intended use the hotel in the Services Sector
The evaluation and possible structural evaluation of an old building can lead us responsibility uncertainties involved, so you must use a reliable methodology to determine the real state of its supporting structure.
The Technical Code 2006, in its CTE-SE Structural Safety Annex E section: "Structural evaluation of an old building" two methods of quantitative or qualitative checking of the supporting elements of the building are collected.
In this work analyzes qualitatively the existing structure of the building by inspection, complemented by a quantitative study in order to obtain reliable information, carrying out forensic tests on the characteristics of existing concrete, and a recalculation of the structure with new charges resulting.
The final result of the study allowed to retain the original structure, timely reinforcing some of the pillars and incorporating a screed in the forged as a compression layer.

CODE 1.6.05

COATING BUILDING FAÇADE DETACHMENT: CASE STUDY

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KEYWORDS: Building façade; coating detachment; ceramic tile; natural stone.

ABSTRACT

The ceramic tile and natural stone detachment on the buildings facades are recurring cause of concern to users and building professionals, given the high potential exposure to accidents with possible injury or damage. The coatings detachment on facades are pathological manifestation observed with high frequency in the regular building construction process in Brazil, whose main sources are related to the use of inadequate materials and on site construction procedures, and the absence or poor design specifications. Within this context, this paper describes the case study analysis of the conditions on the facade with ceramic and stone coverings of residential building with 30 years old, identifying occurrences and assessing the situation of the coatings adhesion by carrying out the tests to percussion and adhesive strength. The methodology used to conduct the research included the following steps: information collectting, complimentary testing, diagnosis and prognosis of the situation and conduct definition. The results showed deficiency in adhesive strength at 57% of the tests performed on the façade; while the percussion test showed an average of 13% of boards inspected with hollow sound. It is believed, therefore, that the description of the diagnosis and the implementation of the resolution methodology of the pathological problems will contribute to the dissemination of knowledge, proposing alternatives for correcting conditions and stressing the need for adopting preventive measures in the design process and implementation of other similar buildings.

CODE 1.6.08

STATISTICAL DATA ANALYSIS OF PATHOLOGIES IN TRADITIONAL HERDING DOME CONSTRUCTIONS IN THE VALLEY OF ESGUEVA

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KEYWORDS: Dome constructions, dry stone masonry, trashumance, chozo, heritage conservation.

ABSTRACT

The Cañada Real Burgalesa (a crown drovers´ road in Burgos), through its course along the Valley of the River Esgueva, has caused the building of a great number of herding constructions intended for temporary accommodation during periods of transhumance. While this economic activity has virtually disappeared, those buildings still remain as heritage, dating back in time between 100 and 250 years. They share similar characteristics and have been subject to parallel external actions for the same time span, so that they have undergone common pathological processes.
This article is the result of a constructive and statistical data study conducted over a hundred dome constructions built with dry stones masonry, located in the Valley of the River Esgueva. Because of the constructive idiosyncrasies of the analyzed elements, the methodology was supported on field work and research on these heritage constructions. The result is the detection of the factors that affect the durability of these buildings, both constructive and structural as well as environmental, so that the conclusions can be transferred to particular cases for consolidation or recovery.

CODE 1.6.09

THE STRUCTURAL PROPERTIES OF EARLY CONCRETE STRUCTURES IN RELATION TO EARLY CONCRETE STANDARDS

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KEYWORDS: Early reinforced concrete, concrete core strength, standards, pathology, preliminary studies.

ABSTRACT

Reinforced concrete (RC) was introduced into Spain principally by French engineers in the late-nineteenth century. A number of regulations to standardize what was at that time an innovative new material were enacted in many countries throughout the first decade of the twentieth century. The inexistence of structural safety regulations in Spain up until 1939 and the obsolescence of the patent systems in the early decades of the twentieth century meant that the French and the German standards were the most widely used references for the design and calculation of concrete structures. This paper compares the results of studies on 22 structures built before the 1939 standard in the Basque Country (northern Spain) with the regulatory standards in use at that time. The test results on the reinforced concrete components and pathological processes of these structures yielded sufficient information to analyze their steel and concrete components, structural damage and mechanical properties. The results revealed a high degree of compliance with the first standards of the early twentieth century, thereby enriching our knowledge of the concrete properties and pathologies of those early concrete structures.

CODE 1.6.12

IDENTIFICATION OF MAIN PATHOLOGIES IN TABIQUE WALLS OF VISEU HISTORIC CENTRE

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KEYWORDS: Traditional construction techniques, inspection file, pathologies, tabique walls.

ABSTRACT

Based on a study conducted in the historic centre of Viseu (Portugal), this article proposes an analysis of the main existing pathologies in old buildings built with tabique walls. There is still little knowledge about this construction method, which justifies the need for a comprehensive study. Is therefore relevant answer some basic questions such as: Where are buildings with tabique walls located? Where in these same buildings were tabique elements applied? What type of materials were used? What are their main features? What are the most common pathologies? 5 blocks with different features were selected in the historic centre of Viseu, and an inspection program was conducted in 87 buildings, representing approximately 15% of existing buildings. The inspection form used was structured in order to include technical data about the buildings, following five main vectors: identification and architecture, structural solution, conservation status, type of use, and existing pathologies. About this last item, it was possible to collect information about the existing conditions inside and outside the building. The outer pathologies were characterized with parameters relating to the roof, exterior walls, and window frames, while the interior ones used parameters concerning the interior walls, floors and stair areas. The data collected on major pathologies in existing buildings will be presented. The inspection activities are essential at the planning stage of rehabilitation of old buildings and an indispensable tool for obtaining solutions to tangible and objective challenges faced by any technician related to this area of the building industry. The results of this research, as well as the knowledge derived from it, should be used in the rehabilitation process in the city of Viseu, as well as in other clusters with similar buildings, helping to preserve built heritage in an efficient and correct manner.

CODE 1.6.13

PATHOLOGY IDENTIFICATION OF HYSTORY MEXICAN MASONRY BRIDGES

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KEYWORDS: Pathology of masonry bridges, historic bridges characterization, masonry bridges identification.

ABSTRACT

Mexico has an important number of cities recognized by the UNESCO as World Heritage. Many of them, identified since the colony times, are churches, colonial buildings and highway bridges. In several areas of the country there are highway and railway bridges with an important historical value due to the construction technics and materials implemented in those days. In spite of their importance, very few efforts have been led to study the masonry historic bridges' origin and pathologies that eventually would conduct to a failure condition. The main objectives of this work are to study the masonry historic bridges, to characterize bridges pathologies, and to determine dynamic properties to identify subsequently damage mechanisms of this type of structures. Based on the information obtained from a survey, several rehabilitation alternative techniques are studied, in order to look for the appropriate conservation of the historic bridges. The methodology is presented through a case of study where is described the numerical methods implemented.

CODE 1.6.14

EVALUATION OF THE SEISMIC RESPONSE OF BRIDGES REINFORCED WITH REIFORCED CONCRETE JACKETS

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KEYWORDS: Pathology of RC bridges, columns reinforced, reinforced concrete jackets.

ABSTRACT

The bridges' columns are the structural elements that use to be the most damaged under the occurrence of earthquakes. These elements provide the stability to the structure, for what they must be rehabilitated and retrofitted frequently to fulfill any changes on the design code stipulations, as well as to fulfill the structural safety objectives defined on the original project. Along time ago, reinforced concrete (RC) jackets have been used as an attractive retrofit technique to provide strength and to improve the ductile behavior under seismic loads. Less efforts have been focused with the aim to quantify the jackets efficiency in reducing the bridges' seismic vulnerability. The present work studies bridges with typical geometry built with a RC substructure conformed by a single column. The study determines the effects of the RC jackets on the bridges' seismic vulnerability through fragility curves estimated with base on a parametric study that considers six retrofit cases, several seismic scenarios and four limit states of behavior. The results show that the inclusion of steel jackets increases the substructure's shear capacity and reduces de bridges' seismic vulnerability. In addition, the analysis of results let us infer the parameters that make more efficient the use of RC jackets in order to reduce the bridges' seismic vulnerability.

CODE 1.6.16

EXPERIMENTAL MODELLING OF THE PATHOLOGY THAT AFFECTS THE BURGOS CATHEDRAL "TRASALTAR":EXPANSION/BREAKNESS BY CHANGES IN HUMIDITY OF AIR IN PRESENCE OF MAGNESIUM SALTS

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KEYWORDS: Stone pathologies, expansion, extreme drying, magnesium salts, hygroscopic, shrinkage, dimensional change, piedra de Briviesca.

ABSTRACT

We study the dimensional changes produced in Paramo's limestone in its variety "Briviesca Stone"(stone in which"bajorrelieves of Trasaltar" were sculpted) when it gets contaminated with magnesium salts. Previously we duplicated the process of expansion and breakness(called EPS, spanish initials for "expansion by drying")when there is intrusion of liquid water. In this work we present the results of the duplication of the process only with changes in air humidity.
We use original stone of Trasaltar and also of the Claustro from Tudela's cathedral, architectural element built with the same stone as Trasaltar and affected with the same pathology. The samples, with the original contamination of the salts that appears in its architectural location, were monitorized in two perpendicular directions, with micrometers which its reading was in part manual and in part automatic(capture by computer)
Samples were first subjected to a slow drying process and after reaching extreme values of water loss, they were finally introduced in an atmosphere with conditions of 96 % of humidity.
During the drying process the sample reduced its dimensions in both directions but in the way of advances and setbacks. When introduced in humid atmosphere and after twelve hours there was an abrupt collapse of the sample with an important expansion(accompanied by microcracks) in the axis "Z" and a contraction and subsequent dilation (more moderate) in the axis "Z". The process was duplicated 100 hours later but with expansion in both axis.
This process of "expansion and breakness" was not able to be duplicated with "unaltered" quarry test tubes in spite of the exhaustive and careful work in order to obtain a stone with identical features as the Trasaltar. However part of the quarry test tubes were "oxidized" with ozone and in this concrete test tubes it was possible to duplicate the damage mecanism using a saline solution similar to the one extracted in the damaged Trasaltar.
The main conclusion is the knowledge and experimental duplication of the damage mecanisms and we end discussing the mecanisms that produce this pathology-greatly unknown- but in which the introduced experiments prove an important role of the changes in air humidity and organic matter of the stone.

CODE 1.6.17

PATHOLOGIES ON COATINGS OF CERAMIC FACADES

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KEYWORDS: Ceramic, facades, pathology

ABSTRACT

This paper discusses the different constituent layers of the ceramic cladding coatings, as well as the pathologies occurring in this type of buildings waterproofing, and a diagnostic methodology of this type of manifestation, for there to be a correct identification of the problem. The methodology is primarily based on analysis of documents; testing and identification of pathological manifestations.
The pathologies covered in this work are: efflorescence, cracks and detachment, the last one was present at the case study of a building located in Brasilia, the capital of Brazil. Primarily, there was a visit to evaluate the facade degradation, it was estimated the percentage of facade detachment through photogrammetry, the percentage increased after non-destructive testing of the ceramics through percussion, after the results of these evaluations, a few points were chosen to test the ceramic adhesion to the building, which made possible to identify the main cause of the detachment of this building facade.

CODE 1.6.20

STONE CLADDING FACADES. QUALITATIVE ANALYSIS OF CONSTRUCTIVE AND AESTHETIC DEGRADATION PROCESSES

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KEYWORDS: Oporto, 20th Century buildings, facades, stone cladding, aesthetic degradation.

ABSTRACT

In Portugal, the use of stone rainscreen cladding façade systems has increased substantially in recent decades, mainly from the 1990 enactment of thermal comfort legislation. This coating began to be seen as a qualitative enhancement solution in buildings of different functions, from public administration to housing developments.
The observation of that large production, with time passed serving as real test platform, allows the evaluation of its behaviour, from a constructive and aesthetic degradation point of view, with the verification of a large asymmetry apparently not related to the building age.
Thus, several questions arise, if the commonly accepted idea of long-term quality of these coatings would be correct; whether there are any combinations of characteristics that could alone be responsible for the appearance of certain anomalies; and, if these data could be included in the design phase, could it be a guarantee of a higher quality.
The aim of this work was to initiate the systematization of this initially intuitive analysis, departing from the treatment of an extended database of Oporto buildings, and then identifying and characterizing aspects that could influence the process of aging and decreased aesthetic qualities, such as: construction date, the type of stone used, thickness and geometry of the plates, its joints alignment or offset, support and restraint systems, type and thickness of thermal insulation, facades solar orientation, plates location in the facade, relationship with other elements and materials, shape of the building and its relationship with immediate surroundings (natural and built). For some parts of the city it was possible to make this assessment of the conservation status with a ten years interval (2005-2015).
The analysis allowed the identification of the persistence of certain anomalies in some specific conditions.

CODE 1.6.26

CHEMICAL ANALYSIS FOR DETERMINING THE PRESENCE OF MINERAL SALTS IN STEATITES (SOAPSTONES) USED IN CHURCHES OF THE CULTURAL HERITAGE, IN SÃO JOÃO DEL REI, MG, BRASIL

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KEYWORDS: Mineral salts, cultural heritage, stone material, churches, degradation.

ABSTRACT

The steatites or soapstone are very important rocks in buildings of historical heritage in Brazil. Stand out many works of the Baroque style in the cities of Minas Gerais. It is considered steatite as a compact rock, consisting mainly of the mineral talc, also contain other minerals. However, carbonates can reach high proportions. It appears as a rock low hardness. The use of this rock in the works of the equity is determined by the easy handling and finishing details. However, such use causes degradation of parts for large exposure to weather conditions. They observed several works of heritage made of steatite with severe damage by acid deposition and total or partial leaching. This research is focused on the qualitative chemical analysis to determine the presence of salts causing steatites damage caused by exposure to atmospheric pollution. It will be held technical visit churches, visual analysis, photographic detail and sample collection and thus future, suggest viable treatments with chemicals in order to slow down and / or stop the degradation, and promoting the longevity of historical heritage in the city of Sao Joao del Rei, MG, Brazil.

CODE 1.6.30

CRACKS IN MASONRY: CASE STUDY FORUM MUNICIPAL CARAÚBAS -RN CITY

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KEYWORDS: Buildings, pathological manifestation, fissure.

ABSTRACT

This work comes from the analysis and quantification of the occurrence of cracks in the Municipal Forum of Caraúbas (RN) - Brazil. The analysis came from the classification of its openness, activity, shape and direction, in order to record the possible causes. First, there was a metric survey of the building under study, to design the floor plan and then the photographic record, quantification and qualification of the cracks in every wall. Through the theoretical framework and a spreadsheet in Excel, cataloged up major cracks in the masonry. From the results obtained were verified fissruas due to: thermal movement, acting overloads, foundation settlements, hygroscopic movement, shrinkage and construction details. Finally, the results showed that the cracks caused by hygroscopic movement are predominant, with a high incidence of cracks in the wall 1, facade. It was observed also that the characteristics of that building an influence on the observed cracks.

CODE 1.6.31

PATHOLOGICAL STUDY OF FAÇADES IN THE HISTORIC CENTER OF BURGOS

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KEYWORDS: Pathology, rehabilitation, historic centres, building, façades.

ABSTRACT

Over recent years, historic Centres have been at the centre of much of the interest in building rehabilitation, in many cases driven by the Public Administrations, through various forms of subsidies and funding. However, those efforts have principally centred on recovery of the external aesthetic appearance, with no assessment of the underlying causes that provoke the deterioration of buildings, very often giving way to face-lift operations with immediate but hardly long-lasting results, given that the those same problems remain un resolved and will manifest themselves once again over time. In the present economic situation, the building sector is redirecting its efforts towards rehabilitation, which leads to the need to learn from past experience, in order to apply the lessons learnt in the future without repeating past mistakes. In this sense, a pathological study of buildings in the area circumscribed by the Special Plan for the Historic Centre of Burgos, more specifically in the first urban developments of the city along the northern bank of the River Arlanzón. On the basis of field work over the last three years, in-situ inspections have documented over 400 buildings, which comprise all of the buildings on that side of the river. They highlight the damage that was observed in a detailed way, through a collection of files that also include the statistical and the constructive data on each of the buildings in the study. This work allows a series of conclusions to be drawn that highlight the list of particular pathologies of certain building typologies, construction age, materials used, maintenance, layout and sunlight on buildings, as well as the rehabilitation criteria employed.

CODE 1.6.33

A CATALOGUE OF BUILDING PATHOLOGIES IN THE HISTORIC CENTRE OF GIJÓN (ASTURIAS)

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KEYWORDS: Pathology, rehabilitation, historic centres, building, façades.

ABSTRACT

In the present scenario of a globalized economic crisis and with particular impact in the building sector, the sector strives to find new niches in rehabilitation work, in which the question of restoring Historic Centres assumes special importance. Over the past few years, large amounts of both public and private resources have been directed at this activity. Traditionally, economic investment of this sort has been employed to recover the aesthetic appearance of the buildings, without conducting a more in-depth and global analysis of the pathologies that are affecting them. All of this leads to the urgent need to learn from past experience, so as not to repeat mistakes in the actions that are proposed for future interventions, all the more so in a context of economic crisis that obliges us to optimize the resources we employ, whether from public or from private sources. An exhaustive analysis is therefore necessary of the pathologies that affect the existing building stock, linking them to their possible causes, so as in that way to propose the most viable and effective solutions to them. To that end, a Catalogue of Building Pathologies in the Historic Centre of Gijón was conducted, centred on the Neighbourhood of Cimadevilla as its most representative zone. On the basis of field work in which approximately 140 from a total 180 buildings were catalogued, observations of deterioration and damage were documented, analyzing their causes and proposing solutions recorded in files that in addition incorporate statistical and construction data on each building. The information in these files permits a series of conclusions to be drawn that can serve as guidance for decision-making in the field of architectural rehabilitation.

CODE 1.6.34

CAPILLARY MOISTURE IN BRICK MASONRY WALLS AND THE EMPIRISM OF A SECULAR CONSTRUCTIVE TECHNIQUE

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KEYWORDS: Civil engineering, pathology, masonry, capillary moisture.

ABSTRACT

Masonry walls are rigid elements of a construction. Materials such as ceramic hollow facing bricks, ceramic solid bricks, concrete solid blocks, plaster, wood, stone, etc., consist in a set of the most commonly used materials in a building construction. The walls may be of a structural nature or simply for sealing, such as room compartmentalization elements. There are several studies on the most common pathologies in masonry, which represent not only a technological breakthrough in knowledge, but also possible solutions for these anomalies. Studies on capillary moisture, which is the most aggressive and most common type of pathology in masonry built on certain types of soils, have been carried out throughout the years; currently, its causes and the various harmful effects that this type of anomaly may have on masonry and buildings as a whole, are known - particularly in structural walls. Modern construction techniques, however, underestimate traditional techniques that eliminated these effects on constructions. Thus, this article lists some common pathologies related to moisture, presents some causes and effects, and also describes how the empiricism of a construction technique used in the past century may correspond to a definite technical solution for this pathology so common nowadays and that constitutes a chronic problem of high cost for building maintenance.

CODE 1.6.38

A STUDY OF BUILDING PATHOLOGIES IN THE HISTORIC CENTRE OF BILBAO

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KEYWORDS: Pathology, rehabilitation, historic centres, building, façades.

ABSTRACT

The prolonged situation of economic crisis and its special impact on the building sector has shifted attention in the sector to the rehabilitation and recovery of Historic Centers, in which a large amount of resources have been invested over recent years. Traditionally, this type of intervention has centered on the external appearance of the buildings, without conducting a more global and in-depth analysis of the pathologies that are affecting it. It is therefore necessary to learn from experience, so as not repeat the errors of the past in future actions, all the more so in a context of economic crisis that obliges us to optimize the resources, whether public or private, that are employed. To do so requires a detailed analysis of the pathologies that affect the existing building stock, situating them in relation to their possible causes, so as to propose more viable and appropriate solutions. For that purpose, in the framework of the Master's in Rehabilitation of the University of Burgos, documentation and diagnostic activities have been conducted over the past three years that have allowed us to ascertain the state of conservation and the possibilities for intervention in the Historic Centers of cities in the centre-north of Spain. As part of that work, a Compilation of Building Pathologies in Bilbao has been prepared, which is centred on the Seven Streets of the Historic Centre, the oldest zone and the original core of the city. As a result of field work in which all the buildings with pathologies are documented, deterioration and damage that are observed are summarized, analyzing their causes and proposing solutions. The information is recorded in files that also include statistical and construction-related data that can serve as the basis to guide decision-making in the field of architectural rehabilitation projects.

CODE 1.6.39

STUDY OF THE PATHOLOGIES AFFECTING BUILDINGS IN THE HISTORIC CENTRE OF PORTUGALETE

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KEYWORDS: Pathology, rehabilitation, historic centre, building, façades.

ABSTRACT

The prolonged situation of economic crisis and its special impact on the building sector has shifted attention in the sector to the rehabilitation and recovery of Historic Centers, in which a large amount of resources have been invested over recent years. Traditionally, this type of intervention has centered on the external appearance of the buildings, without conducting a more global and in-depth analysis of the pathologies that are affecting it. It is therefore necessary to learn from experience, so as not repeat the errors of the past in future actions, all the more so in a context of economic crisis that obliges us to optimize the resources, whether public or private, that are employed. To do so requires a detailed analysis of the pathologies that affect the existing building stock, situating them in relation to their possible causes, so as to propose more viable and appropriate solutions. For that purpose, in the framework of the Master's in Rehabilitation of the University of Burgos, documentation and diagnostic activities have been conducted over the past three years that have allowed us to ascertain the state of conservation and the possibilities for intervention in the Historic Centers of cities in the centre-north of Spain. As part of that work, a Compilation of Building Pathologies in Portugalete has been prepared. As a result of field work in which all the buildings with pathologies are documented, deterioration and damage that are observed are summarized, analyzing their causes and proposing solutions. The information is recorded in files that also include statistical and construction-related data that can serve as the basis to guide decision-making in the field of architectonic rehabilitation.

CODE 1.6.41

DETERMINATION AND STUDY OF RESIDUAL CAPACITY IN OLD BUILDINGS: CASE STUDY IN RABAT – MOROCCO

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KEYWORDS: Rehabilitation, raise of existing buildings, overload, reinforcement, lining posts.

ABSTRACT

Unlike restoration, rehabilitation of old buildings, by its definition, implies a change of destination and use of the building. But the change of destination involves renovation works and therefore different live loads and operating loads on the structure.
Indeed, the purpose of this article is to determine the influencing factors on the bearing capacity of old structures: reinforced concrete buildings (poles - beams structure) or masonry buildings (walls bearing structure and metal floor).
We will first propose an approach for building's diagnostic, especially as regards the frequency of the surveys to be carried out by structural element and defining the location and number of destructive surveys to be achieved in a building for a reliable simulation capacity.
In order to answer this issue, we will review the different diagnostic techniques and study their performance and their applicability in this particular case.
The example of this old building presents a case study of calculating the actual capacity of an old building in the historic center of Rabat. The building in question has structural pathologies. The aim of this study is to recalculate the building's capacity using the actual characteristics (reinforcing section, coating, concrete quality, masonry quality and the current operating loads based on the current building use) in order to determine the rate of the building's load.
To identify the supporting structure of the building, we conducted the survey of structural elements on site, which has identified the structural pathologies also. The diagnostic work, developed in this article, has confirmed the structural elements.

CODE 1.6.44

SOCIOECONOMIC ISSUES AND CONSTRUCTION PATHOLOGIES IN TIPICAL HOUSES OF THE HOUSING SOCIAL PROGRAM "MINHA CASA MINHA VIDA" (BRAZIL)

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KEYWORDS: Constructive pathologies, diagnoses engineering, social housing program.

ABSTRACT

Currently the Brazilian housing policy places in evidence the social issue of the civil construction. In is recent history, it is the first time that Brazil faces a so large housing program focused to lower financial income families. However, the quality and the suitability of the houses for their owners are not discussed enough in the Brazilian society. The present work deals with this issue observing and analyzing constructive anomalies, through a case study of a typical set of houses of the Brazilian housing program "Minha Casa, Minha Vida" ("My House, My Life"). In addition, a socioeconomic questionnaire was made and submitted to the social house owners. The main purpose of this practical study is to determine, through data, which are the main constructive problems in the houses. From these results, was made a brief analysis of the potential main causes and solutions, in order to identify if changes are necessary to improve the program. In conclusion, use of better materials and production of more adequate construction projects are issues that should be considered in the future to improve the program.

CODE 1.6.45

STUDY OF BUILDING PATHOLOGIES IN THE HISTORIC CENTRE OF SAN SEBASTIÁN

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KEYWORDS: Pathology, rehabilitation, historic centres, building, façades.

ABSTRACT

The prolonged situation of economic crisis and its special impact on the building sector has shifted attention in the sector to the rehabilitation and recovery of Historic Centers, in which a large amount of resources have been invested over recent years. Traditionally, this type of intervention has centered on the external appearance of the buildings, without conducting a more global and in-depth analysis of the pathologies that are affecting it. It is therefore necessary to learn from experience, so as not repeat the errors of the past in future actions, all the more so in a context of economic crisis that obliges us to optimize the resources, whether public or private, that are employed. To do so requires a detailed analysis of the pathologies that affect the existing building stock, situating them in relation to their possible causes, so as to propose more viable and appropriate solutions. For that purpose, in the framework of the Master's in Rehabilitation of the University of Burgos, documentation and diagnostic activities have been conducted over the past three years that have allowed us to ascertain the state of conservation and the possibilities for intervention in the Historic Centers of cities in the centre-north of Spain. As part of that work, a Compilation of Building Pathologies in the historic centre of San Sebastian has been prepared, which centres of the so-called Old Quarter as its most representative zone. On the basis of field work in which all the buildings with pathologies are documented, deterioration and damage that are observed are summarized, analyzing their causes and proposing solutions. The information is recorded in files that also include statistical and construction-related data that can serve as the basis to guide decision-making in the field of architectural rehabilitation.

CODE 1.6.46

DIFFERENTIAL SETTLEMENTS THAT CAN DE OBSERVED IN THE BUILDING OF CHRIST CHURCH, HISTORIC CENTER OF MEXICO CITY; DIAGNOSIS AND EVALUATION FOR ITS INTEGRAL RESTRUCTURATION

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KEYWORDS: Pathologies relating to differential settlements.

ABSTRACT

The subject of this presentation relates to the problem presented by the process of differential settlements that can be observed in the Anglican-Episcopal building of Christ Church (presently under the denomination of St. Juliana), which is located within Perimeter "B" of the Historic Center of Mexico City. Built in 1898 following the Gothic Style project by the english architect H.H.Simpson, but with mexican technology in use at the time, it is at present not in use after the collapse of its wooden roof, due to constant filtrations resulting from the deformations observed in the complex, caused by the settlements that can be observed in the site, which could be due to the previous existence of garbage or debris dumps dating probably from the XVIth or XVIIth centuries, as well as historic channels, the influence neighboring buildings, or a combination of all. In order to correctly understand the problem, a program of archaeological prospection will be required, in order to determine the characteristics of the existing foundations and of other probable previous structures, together with soil mechanics studies, due to the fact that that the subsoil is of an alluvial origin, in order to have the pertinent information with which the most appropiate rescue project might be reached for this monument, unique to the usual forms of mexican building Heritage.

CODE 1.6.48

THE ANTIQUE CLINIC PAVILION AT THE HEALTH COMPLEX IN FONTILLES, ALICANTE, SPAIN. HISTORICAL, STRUCTURAL AND PATHOLOGICAL ANALYSIS

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KEYWORDS: Fontilles, health complex, structural cataloguing, architectural evolution, pathology.

ABSTRACT

San Francisco de Borja Sanatorium in Fontilles is an architectural integrated medical complex for leprosy treatment, also known as Hansen's disease. It is located in Vall de Laguart, Alicante, in eastern Spain. More than 30 pavilions from different periods and styles of the 20th century make up this heritage health complex. According to the documentary heritage analysis, rural architectural techniques were used in the buildings. Most of construction raw materials came from the region, in addition to ceramics, tiles and bricks, produced in their own ceramic kiln.
This paper explains part of the works that are being undertaken within the research project "El Sanatorio de San Francisco de Borja de Fontilles. Modelo de análisis para la recuperación integral de instalaciones sanitarias de valor patrimonial", subsidised by the national program of research, development and innovation for the society challenges (Ref. HAR2013-42060-R).
The paper explains the methodology and research results about the current status analysis of the Antique Clinic Pavilion. This study aims to deepen knowledge of the history, constructive cataloguing, and current pathological condition of the building, which involves its waterlightness and structural stability.

CODE 1.6.54

NUMERICAL EVALUATION OF CLAY MASONRY PARTITION WALLS TO CRACK DUE TO STRUCTURAL DEFORMATIONS

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KEYWORDS: Structural movements, cracking; masonry partitions, numerical simulations.

ABSTRACT

Non-structural masonry walls are, in general, fragile systems with insufficient capacity to sustain thermal/moisture and structural movements, therefore presenting a high susceptibility to crack in serviceability conditions.
According to evidences taken from buildings in use in the last decades, this type of pathology has been occurring associated to structural movements, specially cracking in masonry partitions caused by the vertical deformations of reinforcement concrete structures. These deformations are caused by vertical loading and can be considerably aggravated by the long term/creep effects of concrete. If these structural deformations are not controlled, important loading/deformations can be imposed on more sensitive adjacent elements, such as non-structural masonry partition walls, and damage can occur.
Starting from the most common construction solutions used in Portuguese buildings, namely buildings built with reinforced concrete structures filled with lightweight clay masonry walls, this paper presents an advanced numerical study that demonstrates the susceptibility of clay masonry partition walls to crack due to vertical displacements of reinforced concrete structures. A tridimentional non-linear macro model of a masonry panel subjected to vertical displacements was calibrated through experimental data obtained from a flexural test performed on a lightweight clay masonry wall. This model was used to perform a parametric study of masonry panels in different conditions, such as panels with different height to length ratios, panels with openings, panels with different support conditions and panels made with stronger masonry.
From results obtained it was possible to verify that partition walls made with lightweight clay masonry presents a low deformation capability, since these walls are not able to sustain small vertical deflections without cracking. Moreover, the deflection control measures mentioned in design codes to avoid this type of damage in partition walls seem to be insufficient. Therefore, some constructive measures are suggested in this paper to prevent this type of pathology.

CODE 1.6.58

WATERPROOF BARRIERS IN 1940'S WITH DIATOMACEOUS EARTH

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KEYWORDS: Waterproofing barriers, diatomaceous earth, salts effects, traditional air lime mortars, cement mortars.

ABSTRACT

The introduction of diatomaceous earth in mortars for waterproofing barrier was implemented after 1945 in the central region of Portugal [1]. This region is characterized by traditional earthen architecture. The rising damp is one of the factors responsible for damages [2,3,4], even nowadays, in earthen heritage, mainly due to the effect of salts. During the 1940's diatomaceous earth was used in addition to cement mortar or air lime mortar to increase the supposed waterproof barrier capacity [1]. This apparent contradiction – the use of an absorbent material in the construction of a waterproof barrier – was prescribed by technicians who understood the need to control humidity in a region with a high phreatic level. The study of the effect of diatomaceous earth in mortars of the 1940's, its role in the improvement of waterproof barrier and control of salts progression, were the main objectives of this research.

In order to fulfil the proposed objective, buildings from the 1940-1956 periods were assessed and more than 725 architectural files of the Aveiro district archives were analysed. From this written sources was characterized the main compositions of joint mortars with diatomite.

To fulfil the goal, several mortar solutions samples were prepared based on the previously identified data and analysed at the laboratory using a number of different characterization techniques, namely, capillary measurements, mercury intrusion porosimetry measurements and other complementary tests.

The capillary tests, the NaCl and Na2SO4 tests show highly different results between the traditional air lime mortars and the cement mortars. Although, the air lime mortars are recognized more appropriated for rehabilitation interventions, the addition of diatomite does not surpass the defects. In opposition, the cement mortar shows less disaggregation effect on earthen bricks, despite less chemically compatibility.

CODE 1.6.60

REHABILITATION OF HISTORICAL BUILDING OF THE XX CENTURY IN PORTO ALEGRE-RS: IDENTIFICATION OF SALTS AND MATERIALS CHARACTERIZATION FOR COMPATIBILITY IN INTERVENTION

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KEYWORDS: Historical materials, characterization, efflorescence.

ABSTRACT

Porto Alegre (Southern Rio Grande do Sul, in Brazil) has a rich collection of historical buildings of the nineteenth century, early twentieth. Many remaining buildings of this period are protected by heritage preserve organs in several pre-established levels. This study presents an analysis related to a building of 1911, acquired by a private company, which intends to develop a rehabilitation project, preserving the original and usual features of this building. To contribute to the intervention project of the historic building, preliminary analyzes were developed in order to characterize the constituents of the original materials, especially masonry and stucco partition walls. This analyzes wants to indicate compatible materials for the restoration of deteriorated elements. The building remained for a prolonged period of time closed. Due to the absence of cover's elements, the humidity, mainly of infiltration from rain, and other sources, resulted in several pathological manifestations. One of the most important manifestations, verified visually, was the presence of efflorescence of different soluble salts. Samples were collected at different points for characterization analysis development and proportioning its chemical composition of the plaster/aggregate, as well as qualitative identification of the presence of soluble salts. There was a predominance of mortar lime-based and quartz coatings and bricklaying mortar. In the partition walls on the upper floor plaster, in addition to the lime-based coating, it was verified the presence of kaolinite and quartz inside the wall. The salts analysis confirmed the presence of sulfates, nitrates and chlorides in various parts in the first floor of the building.

CODE 1.6.62

DETERIORATION AND BREAKAGE OF PAVING STONES, SUBJECT TO HEAVY URBAN TRAFFIC

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KEYWORDS: Pavement, paving stones, pathology, breakage, deterioration.

ABSTRACT

In some cases, project errors constitute a high percentage of pathologies, that become evident prematurely in the use of the object constructed. The desired architectonic balance between the design, the technology and the use is disfigured when one of them fails. The study and diagnosis presented aims to demonstrate that an error in the project stage, as a consequence, leads to the failure of the following stages of execution and use.
This paper studies, analyses and draws conclusions based on a case of urban paving stone deterioration. Initially, it starts with the final design documentation, the changes “agreed” before the works, the analysis of the graphic and written documentation generated during the execution process, and finally, the first signs of deterioration and, as a consequence of all of this, the inevitable diagnosis.
It is from this point that the development and method of this documentary and field-work project is put forward, all with the aim of reaching conclusions to reorient the current situation towards a proposed solution that minimises the current maintenance costs. To do so, various proposals to rectify the problem are explained and analysed.
The results put forward aim to be the starting point for the technical solution for intervention.

CODE 1.6.63

PATHOLOGY IN FAÇADES BUILT WITH A BASE MADE WITH AUTOCLAVED AERATED CONCRETE BLOCKS AND A SINGLE LAYER MORTAR

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KEYWORDS: Pathology in façades, single layer mortar, Autoclaved aerated concrete, Elastic modulus.

ABSTRACT

The usage of autoclaved aerated concrete blocks to build detached houses presents many advantages over other similar materials. This kind of blocks present very low dimensional tolerances and great flatness, which confers the building a very homogeneous coating. On the other side, it is a very light material which allows an easy and comfortable handling. Finally, it presents very good thermal and acoustic characteristics. However, it presents a very high water absortion which implies the need of an outer finish that ensures impermeability. There are pathologies in façades built with a base made with autoclaved aerated concrete blocks and a single layer mortar as siding. The object of this research has been to be able to determine the causes that have brought about such pathology and be able to stablish a repair criteria. The methodology consisted in a first visual inspection, taking of samples on-site and further tests carried out in laboratory. Initially, the scope of the work was focused in determining the mechanical characteristics of both materials, and its contrast with its corresponding documents of technical approval and suitability for intended use. The results obtained proved the low resistance of the block and the root cause of the pathology. Another possible cause could be the difference between the elastic modulus of both materials.

CODE 1.6.64

INVESTIGATION ABOUT DE CAUSE OF COLLAPSE OF THE 4TH COMPARTMENT OF THE 3TH RESERVOIR OF CANAL DE ISABEL II IN MADRID, IN 1905

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KEYWORDS: Accident, collapse, vault, history.

ABSTRACT

This work contains the main results of an investigation carried out about the cause of the collapse of the 4th compartment of the 3th Reservoir of Canal de Isabel II in Madrid. It happened in 1905, on April 8th, being one of the most disastrous accidents occurred in the history of Spanish construction: 30 people died and 60 were injured. The design and construction supervision were carried out by D. José Eugenio Ribera, one of the main figures in Civil Engineering of our country, whose career could have been destroyed as a result of this accident. Since it occurred more than 100 years ago, the investigation started by compiling information about the structure`s design and construction, followed by reviewing the available information about the accident. With regard to the construction, it is interesting to point out its daring structural configuration. It covered a huge area of 74.000 m2 with a series of reinforced concrete vaults with a thickness of not more than 5 cm, a 6 m span and a rise of 1/10th. In turn, these vaults were supported by frames composed of very slender 0,25 m x 0,25 m columns with a height of 8 m. It is noteworthy that this took place in a time when the technology and knowledge about this "new" material was largely based on patents. In relation to the information about the collapse, its significance is shown by the important experts and lawyers that were involved in the trial and the subsequent administrative procedure. For example, Echegaray -the most important intellectual of that time- defended Ribera, Melquiades Álvarez –the future president of the Congress- was his lawyer, and General Marvá -who represented the important role of the military engineers in the introduction of reinforced concrete in our country-, led the Commission that was put in charge by the judge of the root cause analysis. In addition, the matter caught the interest of renowned foreigners like Dr. von Emperger or Hennebique and their opinions had a great influence. Nonetheless, this structural failure is unknown to most of today's engineers. However, what is most surprising are the different causes that were claimed to lie at the root of the disaster: material defects, construction flaws, errors in the design, load tests performed after the structure was finished, etc. The final cause that was put forth during the trial and in the following reports was attributed to the dilatation of the roof due to the high temperatures that spring, albeit the collapse occurred at 7 AM. Based on this information the structural behaviour of the roof has been analysed, which allowed identifying the causes that could have provoked the initial failure and those that could have led to the global collapse. Lessons have been learned from these results, which points out the relevance of history -and in particular, of examples gone wrong- for the continuous education that should exist in engineering.

CODE 1.6.65

A PROCEDURE TO ASSESS THE CRITICALITIES OF STRUCTURES BUILT IN ABSENCE OF EARTHQUAKE RESISTANT CRITERIA

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KEYWORDS: Building pathology, diagnostic techniques, decision support system, anti-seismic construction.

ABSTRACT

The building system is exposed, during its life, to a physiological decline process of the performance levels. In addition to the obsolescence due to natural aging, different obsolescence forms can be identified which do not have physical or mechanical origin but, in recent decades, are related to technological phenomena or regulatory requirements. Such obsolescence problems emerged because of the rapid national regulatory changes about earthquake resistant structures design also as a consequence of recent earthquakes.
This paper proposes a procedure (Decision Support System-DSS) devoted to determine the critical construction issues of reinforced concrete structures built in the period 1950-1980. Indeed, such buildings are realized in compliance with old anti-seismic laws, and present particular design and performance criticalities due also to incorrect execution method.
The DSS can be used by public and private companies in order to analyze the pathology of buildings at a large scale by using limited data and resources. During the definition phase of the diagnostic plan, the DSS provides the necessary steps to develop the preliminary knowledge framework. In particular, the procedure specifies the most effective diagnostic techniques and the operations to be performed during the knowledge path. The procedure is described by standard flowcharts, i.e., the activity diagrams of the Unified Modeling Language.
The proposed procedure is applied to a set of real case studies: among these, the school building "Cirielli" of Bari (Italy) is here presented in order to provide the systematic acquisition of a general cognitive framework for the characterization of materials and the subsequent structural analysis.

CODE 1.6.67

CATEGORIZATION OF FAULTS AND FAILURES IN CONCRETE STRUCTURES, ITS CAUSES AND MAGNITUDE OF AFFECTES

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KEYWORDS: Failures damaged structure, destructive and nondestructive testing, seismic wave reflection, freeze thaw cycles, alkali silica reactivity, durability and serviceability, pathology of materials, repairs and restoration.

ABSTRACT

The actual requirements in the practice of renovation and reconstruction, needs detailed analysis for the exact theory concerning the general causes and its effects on the materials of construction. In addition, this causes needs to be categorized and treated individually in order to be available in the literature of the theory of: Pathology of materials. This work was to analysis and classified the failure caused by many recognized effects upon buildings constructed with reinforced concrete or masonry bearings systems, and to be an attribute to the mentioned scientific line in the area of renovation, and reconstruction. The objects of the categorizing and analysis are the following causes:
1) Causes due to interior forces
2) Causes due to exterior forces
The result of research and the new theoretical information shows a significant process in the knowledge of serviceability, durability, strength and the age of construction materials especially the concrete.
Obtaining the correct information about the concrete, required a deep testing in which are destructive and nondestructive testing, these helps in getting a results to assist in the analysis of concrete failures, for putting up an adequate solution for its repairs.
Results obtained from the theoretical study and laboratory testing reveled significant information on concrete failures.

CODE 1.6.69

STUDY OF DEGRADATION IN BUILDING FAÇADES BY CLIMATIC AGENTS

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KEYWORDS: Degradation, service life, climatic agents, hygrothermal simulation.

ABSTRACT

Ceramic tiling applied to the façades has the function to protect the building from several intervening factors. Among these, it can be cited climatic agents such as wind-driven rain, solar radiation, wind, temperature, relative humidity, and others. In the context of Brasilia, Brazil, the façades of buildings have shown progressive degradation levels, and it reflect in the severity of anomalies, loss of functional capacity and service life of these elements. Thus, the purpose of this article is to study the degradation of façades by linking the occurrence of intensity of damage index to climatic agents using *WUFI® Pro 5.3* software. In Brasília-Brazil, two buildings were evaluated using methodology of quantification of anomalies applied by Silva (2014), through the association of damage occurrence to a function of building height, solar orientation, and age; with climatic agents: wind-driven rain, solar radiation, and temperature. The association of results has shown the values of wind-driven rain and solar radiation in North, East, West, and South. These factors can influence directly the high degradation index presented on the façades of the buildings studied. The most degraded façades (West and North) were mainly influenced by temperature gradient.

CODE 1.6.70

A CONTRIBUTION FOR THE PATHOLOGY STUDY OF EXTERIOR TABIQUE WALLS

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KEYWORDS: Pathologies, tabique walls, traditional construction, sustainable construction.

ABSTRACT

The tabique construction is a relevant part of the Portuguese heritage, in particular, in the North of Portugal. In general, a tabique construction is over one hundred years old and, most of them are still well preserved. This fact proves that this type of traditional building technique, which basically applies natural and local materials, is durable. It is important to refer that a tabique wall is built with a regular timber structure covered with an earth based mortar. Thus, in the Portuguese context, this type of wall is quite different of the other Portuguese traditional walls such as stone masonry, adobe and rammed earth walls. In addition, there is still a lack of technical information concerning tabique construction which may give guidance of adequate practise in maintenance, repairing and rehabilitation processes. This may justify the fact that demolition is unfortunately an option concerning tabique construction. Therefore, this research work intends to give a contribution in this area identifying the most current pathologies of tabique walls. A fieldwork has been carried out in order to survey this kind of pathologies. The obtained information allowed the knowledge of pathology phenomenon of exterior tabique walls. The identified pathologies are presented according to its severity in terms of the wall damage.

CODE 1.6.72

CATALOGING AND STATE OF PRESERVATION OF HYDRAULIC DEVICES IN EBRO RIVER PASSING THROUGH CANTABRIA

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KEYWORDS: Hydraulic devices, mills, inventory, state of preservation, lack of maintenance.

ABSTRACT

In this paper underlies two main objectives. The first objective is to make an inventory of different fluvial hydraulic devices of the Ebro River passing through Cantabria, Spain; and the second objective is to describe their current condition of preservation. In this regard, the pathological processes they have will be analysed.
The methodology combines field and office work. Therefore, after locating all the hydraulic devices (23 in total), they were visited and studied individually, with measurements and photographs of all the buildings and their most significant pathological processes. After recording all the referred wide information, a comprehensive work of reflection was developed with the objective of formulating general damage patterns in these 23 buildings. For that, it was necessary to identify the main pathological processes existing in this set of buildings. Besides, solutions to solve or mitigate them were proposed (they have not included in this paper for space reasons).
Finally, the authors also intended to warn about the lack of maintenance that have a significant number of these historical buildings. Despite of the fact that these historical constructions are not included in the official lists of protection given by the Administrations, they are silent witnesses of society's industrial development along the history. In this case, water mills and the traditional activities developed around them are part of our legacy but they are at risk of disappearing.

CODE 1.6.74

A STUDY OF BUILDING MATERIALS OF THE CATHEDRAL OF SANTO DOMINGO

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KEYWORDS: Deterioration, degradation, pathological processes, characterization of materials, Cathedral of Santo Domingo

ABSTRACT

All materials, including construction, suffer with time aging processes that occur as degradation and/or deterioration, especially those outside or in contact with the environment. The Cathedral of Santo Domingo, built between 1521 and 1541, has suffered in recent years a rapid deterioration and some degradation of building materials due to the influence of the local environment and with the aggravation of the Caribbean tropical climate in which it is located.
The purpose of this study was to diagnose the causes of accelerated deterioration and pathological processes in the construction materials to determine and identify effective and appropriate to increase the lifetime of the construction materials and reduce maintenance costs treatment.
The method proposed for the study consists of three stages: first, data collection, surveys visible changes (Mapping) and (visual) preliminary diagnosis; the second stage is the characterization of materials (chemical analysis, mineralogical, physical, mechanical, etc.), collecting data with specialized equipment and a definitive diagnosis; and the third stage is the design of treatments and procedures for intervention where the technical control and maintenance also comes back.
The studies and analysis of the Cathedral of Santo Domingo covered the entire exterior, from the facades to the vaults. The result of this work led to the characterization of materials used in the construction of the Cathedral, the identification of diseases and disorders as well as elements that produce it.

CODE 1.6.75

EVALUATION OF PATHOLOGICAL MANIFESTATIONS PRESENT IN FAÇADES PAINTS IN FLORIANOPOLIS CITY (BRAZIL)

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KEYWORDS: Pathological manifestation, paint, façade.

ABSTRACT

The pathological manifestations of façade painting has been common even in recently constructed buildings and is hindering the performance of this kind of finishing, widely used for its ease of application, reduced permeability of the substrate and decorative effect. In this paper are identified the origins of such manifestations as a rising from misunderstandings of the paint system specification, due to its low quality or by mixing different manufacturers; non conformities resulting from its application process, resulting from mortar renderings errors and other constructive devices or as resulting from inadequate performance of the inks. Through mutual comparison withBrazilian and foreign standards and quality of sectoral programs such damages are properly framed. Through case studies of various pathological manifestations the origins of these manifestations are characterized, considering as an aggravating marine and climatic influence of the city of Florianópolis (situated on the coast of southern Brazil). From the analysis and characterization of the pathological manifestations of painting is presented proposal for prevention and restoration and construction practices to reduce the incidence of such diseases. Finally, its presented a guide which aims to provide a technical decisión based process for those who specify the façade painting processes.

CODE 1.6.76

PATHOLOGICAL ANALYSIS OF MURAL PAINTINGS OF RAMON VASQUEZ IN THE CITY OF MEDELLIN COLOMBIA

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KEYWORDS: Mural painting, pathologies, conservation, Ramón Vásquez, figurative art.

ABSTRACT

In this research we propose and implement a methodology based on nine stages for the pathological analysis of 21 murals of the Maestro Ramon Vasquez in the city of Medellín. The methodology is based on the visual and photographic inspection of constructive and pictorial details in the murals, for a further characterization of the global state and the intervention or conservation needs of the mural. Among the main results, it was established that the predominant physical alteration in the paintings belonging to health, educational and patrimonial buildings correspond to cracking due to processes of shrinkage and plastic shrinkage suffered by the plaster base of the wall during the process of setting or possibly by excessive use of cement in the mortar mix. Besides cracks we found the existence of other minor physical alterations of such as detachments, soiling or wear contact and efflorescence's. By normalizing the painting area and counting the number of physical alterations present in each work a final assessment of the conservation status of the murals was developed and found that out of 23 mural units analyzed, 39,13% have a low level of deterioration, 30,43% a medium level and 30,43% a high level.

CODE 1.7.02

STRUCTURAL MODELING OF HISTORIC BUILDINGS: THE CHURCH OF STO. TOMÉ O NOVO DE MASIDE (OURENSE)

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KEYWORDS: Architectural heritage, structural modeling, masonry modeling.

ABSTRACT

For analysis of the built heritage buildings, is currently available powerful calculation methods. The most widely used of these is the finite element method, which provides power and reliability that make it the most widely used.
But when it comes to applying this method to the monumental buildings set of problems emerge when the calculation model is defined. This has caused serious malfunctions sometimes, since meaningless calculate very precisely a wrong model. In most cases it has been attempted to improve the model in their mathematical aspects by introducing nonlinear models or fracture models when the real problem is constructive peculiarities of the own building, if not inaccuracies or errors to the construction itself.
In our department we have performed several investigations to consider the constructive scheme in the construction of the calculation model, uniquely in modeling medieval walls of three components. However, on the occasion of a report which has asked us to assess the state of the church of Sto., Tomé O Novo in Maside, we have ascertained the presence of a very atypical construction system which has seriously affected the results of this evaluation.
The walls are made of two sheets of granite blocks of large dimensions but reduced thickness 33 ÷ 34 cm, that in the region are called perpiaños. They are separated by about 5 cm of empty space without any filling. These sheets are joined by some clearly visible transverse stones, by its smaller size. They are so separate that cannot guarantee a joint effort with minimal effectiveness. For this reason these stones are not considered in the calculation model or any of the checks carried out.
In the article the data acquisition and the various checks have been made are analyzed in order to adopt the most appropriate measures for the structural rehabilitation of the church. For this we have adopted a model calculation which takes into account the constructive peculiarities of the church, both in modeling the walls and the rest of the structural elements.

CODE 1.7.03

THE INFLUENCE OF THE EVOLUTION OF HERITAGE BUILDINGS IN STRUCTURAL AND PATHOLOGICAL ANALYSIS. THE CASE OF SAN PEDRO AD VÍNCULA CHURCH IN VALLECAS (MADRID)

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KEYWORDS: Construction, structural analysis, pathologies, vaults.

ABSTRACT

In the last few months, the survey, structural analysis and instrumentation works of *San Pedro ad Víncula Church* in the City of Vallecas (Madrid) have been performed.
The building showed several pathologies, mainly due to displacements and deformations of the structural elements. For this reason, the study focused on the structural analysis of the current state, with the aim of guaranteeing the stability of the complex and, if necessary, to define the interventions to be undertaken.
Among the works that have been performed in order to get to know the functioning of the structure, a historic study and a detailed constructive analysis have been included, as the building is a Site of Cultural Interest. Despite the scarcity of historical sources and, thus, the difficulty in stablishing a chronology, the geometrical survey and the analysis of the existing elements allowed us to establish a series of alterations that were performed on the church structure at different times.
The overall analysis of the data recovered from the previous analysis and the calculation of the existing structure allowed us to establish the main reasons for the apparition of the pathologies, which have a direct relation with some of the alterations of the structure that have been performed during the useful life of the building. This case highlights the importance of previous studies in every intervention of heritage buildings and, particularly, of having a deep knowledge of the constructive development.

CODE 1.7.04

RELIABILITY RATE ESTIMATION OF CONCRETE PILLARS IN EXISTING BUILDINGS THROUGH PROBABILISTIC METHODS IN A EXPLICIT WAY

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KEYWORDS: Structural verification, probabilistic methodology, reliability rate, failure probability.

ABSTRACT

The calculation methodology based in probabilism has been used along history in complex engineering projects, with examples such as risk evaluation methods in aeroplanes or in nuclear power stations. In building we use this methodology in a explicit way in our normatives, looking for the determinism convenience, the convenience of using what they tell us without knowing why and its origin, adding security coefficients that make ourselves feel optimistic in our calculations. But in few cases and without a solution to our question, we ask ourselves "and why this doesn't break down? That was the reason to do the structural verification. The probabilism try to give an answer to a more real structural verification and thus more secure.
The article presents a practical case of structural verification of concrete pillars in a refurbishment work, collecting the deterministic variables that the structure offers according to the geometry and its mechanical capacities obtained through tests, in another hand the probabilistic variables that focus in the uncertainty of the typical model and in the variable forces like service overloads, which have greatest uncertainty.
The result of this analysis offers the pillar relability rate to study, the probability of a failure in the structural element, collecting an useful methodology to the structural verification of elements subjected to bending-compression (pillars).

CODE 1.7.05

ANALYSIS OF RESISTANT BEHAVIOR OF VAULT EXTREMEÑAS UNDER DIFFERENT GEOMETRIC CONFIGURATIONS

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KEYWORDS: Vaults of spiral, structural behavior, self-supporting vault, brick building, rumble.

ABSTRACT

The Extremaduran vaults are located mainly in the area of Extremadura and Alentejo Portuguese and have been used until a few decades ago as usual structures in the houses of these areas, there are at present a large number of them.
Its main characteristics are that are built without centering, which is accomplished by be executed with a primer of spun conical-constructive, and that the key to the vault is at a higher altitude than the keys of the starts, which is called the rumble. This gives them a structural behavior that is intermediate between the domes and the vaults.
In this communication presents the study of these vaults with the objective of establishing a practical foundations to implement them in the evaluation in conservation work. To this end are set out in the first place the historical contextualization of these vaults, its geometric configuration, the materials which make them up, as well as the most common structural outline of its application in buildings housing. From this introductory framework is performed an analysis of the fundamental variables parametric: light, geometry of starts and rumble. The analysis allows to discriminate under what geometric configurations, you are vaults behave in linear elastic regime, and therefore, shall apply the conclusions obtained the parametric analysis, getting on the other hand those vaults in which the factory is in non-linear regime (cracking) and therefore for analysis shall be applied methods of calculation is not lienal.

CODE 1.7.06

GEOMETRIC ANALYSIS FOR STRUCTURAL EVALUATION. TLS VS OVERLAND PHOTOGRAMMETRY. APPLICATION TO MASONRY BRIDGE, (EX - 100 PK-8)

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KEYWORDS: Terrestrial laser scanner (TLS), terrestrial photogrammetry, documentation of the heritage, architectural uprisings, manufacture bridge.

ABSTRACT

The call Reverse Engineering, documentation of what has already been built, is a technique with a certain path. In part, in which to architectural uprisings refers, began being conducted by classical topography. With the arrival of the Terrestrial Photogrametría, this work was considerably revolutionised, allowing form three-dimensional models scaled with pairs of photographic images. In recent years the Terrestrial Photogrametría coexist together with the uprisings with Terrestrial Laser Scanner. In the field of research, both techniques are used equally, exist significant differences between them. Both with terrestrial Photogrametría as with Laser Scanner we arrived to obtain similar products although with various differences. One of the great differences that separate these two techniques lies in the initial investment, being the equipment of the Terrestrial Photogrametría considerably less expensive than the equipment necessary for lifting with Laser Scanner. Today, it has not been established a range of use argued that define which technique is most appropriate in according to which work or for according to what products. Analyzing this issue in depth we will see how with Laser Scanner are going to achieve better results in complex three-dimensional models, as well as a methodology of work more simple, on the other hand we will arrive to the conclusion that, for simple facades uprisings or three-dimensional models not very complex, the terrestrial photogrametría offers us a speedy, effective and economical. The study has been conducted having differentiated the use of these techniques in the fields of the Documentation of Heritage and work of technical uprisings. Applies particularly to the obtaining of the geometry of a manufacture bridge, as product required for subsequent structural assessment.

CODE 1.7.08

STUDY OF THE INFLUENCE OF THE FIBER DIRECTION IN THE ULTRASOUND WAVES' PROPAGATION RATE (FAKOPP) THROUGH STRUCTURAL TIMBER OF "PINUS RADIATA D. DON." AND "PINUS SYLVESTRIS L."

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KEYWORDS: Non destructive testing, NDT, ultrasound, Pinus Radiata, Pinus Silvestris.

ABSTRACT

The main objectives of this work are to develop a non-destructive ultrasonic wave propagation testing technique and the discussion on the results of coniferous sawnwood large structural cross sections. This research focuses on the application of non-destructive testing to real timber structures in order to evaluate their service quality (or state of degradation) and getting through a scientific and verifiable method to assess the mechanical properties of test specimens. Two species of specific wood (Pinus sylvestris L. and Pinus radiata D. Don) have been studied because of their widespread use in timber construction. We worked with a sound wave device by Fakopp Microsecondtimer © which is designed for reduced spaces so it can be used on site.
When testing a structure on site, it is common that the heads of the beams are inaccessible and it is likely that the measuring of wave propagation speed is indirect. Based on a series of laboratory tests with known angles, we measured how the speed of the waves changes in relation to the fiber direction angle. This paper presents a regression of empirical data that relates fiber angle to sonic wave propagation speed with a model of adjustment. We also propose the most homogenous and best angles for performing this test.

CODE 1.7.09

APPLICATION OF INTERFEROMETRY BASED ON RADAR (INSAR) TO DEFORMATION MONITORING FOR BUILDING HERITAGE

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KEYWORDS: Cultural heritage, settlement, deformation, DInSAR, GB-SAR.

ABSTRACT

As a clear future alternative for detection, analysis and monitoring of past and present deformation processes in building heritage (Ej.: churches and cathedrals; castles and walls; aqueducts and bridges; monumental and archaeological sites), this paper tries to show the potential of the technologies based on radar interferometry, both satellite (InSAR or DInSAR) and terrestrial (GB-SAR), used successfully in recent years for deformation monitoring in civil work projects, dams, geological risks and mining, as well as the real aperture radar (RAR), of higher accuracy in vibration assessment.
This novel technology provides sensible measures to millimeter to sub-millimeter precision movements through using interferometrical technique, a higher spatial resolution and, in the case of DInSAR, the possibility of accessing to files of images acquired from 1992. All these characteristics convert techniques based on radar interferometry on a powerful tool for deformation monitoring on regional (historical places) and local (monuments) scales.
Through several examples, this paper aims to show the advantages of these technologies as control and diagnosis deformation tools, as well as its potential applicability to the cultural heritage.

CODE 1.7.11

PHYSICAL AND MECHANICAL CHARACTERIZATION OF JOINT MORTAR APPLICABLE TO THE CONSERVATION OF TRADITIONAL BUILDING SYSTEMS IN URUGUAY

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KEYWORDS: Joint mortar, physical and mechanical characterization, conservation.

ABSTRACT

Building systems based on the use of ceramic masonry and lime mortars are very common in historic buildings of our national heritage still in service. Due to their age, which often exceeds 130 years, these denote the effects of deterioration caused by various pathological phenomena and natural aging, which alter their mechanical performance and durability. For these reasons, it is very common to carry out tasks of grouting and restitution of mortar, requiring the design of compatible blends with the laid down service conditions for the building and its current conservation status.
The selection of raw materials and the dosification of these mortars materials in our environment faces a knowledge gap regarding the physical and mechanical properties that can be achieved using different local raw materials. In that sense, this paper presents advances in laboratory characterization of different mortars usually applied in Uruguay using various local binding agents (regular cement, masonry cement and lime) under equivalent consistency, based on the information given in Constructive Memoirs of public bodies, in which the proportion of dry materials is stated, but notes indicating the water binder ratio are omitted.
Among the studied properties, consistency, water absorption coefficient, compressive strength, initial shear resistance, drying shrinkage, surface hardness by low impact rebound hammer and penetration resistance determined by Windsor Pin equipment, are included.
From the analysis of these results, it is expected to form a first base of experimental technical data concerning mortars applicable to intervention works of historical buildings and contribute in determining the correlation presenting the results of destructive and non-destructive techniques applied to these materials.

CODE 1.7.12

SUPPORT METHODOLOGY FOR THE INTERVENTION PROJECT IN THE BOURGEOIS HOUSES OF PORTO. AN EXPERIMENTAL AVALUATION

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KEYWORDS: Historical town, current buildings, preliminary studies, inspection and diagnosis.

ABSTRACT

The intervention in current buildings, located in historical towns, does not involve, in most cases, multidisciplinary teams or in-depth inspections, due to the obvious lack of economic resources for operations of this scale. Such fact can easily lead to inadequate options or even harmful actions for the preservation of the heritage existing values.
This framework established the scope of a research whose main objective was the design of a methodology to support the intervention project in the bourgeois houses of Porto, aiming at streamlining the whole process, from the inspection and diagnosis phases to the intervention solutions.
Based on the recommendations of international documents, as well as experiences that constitute examples of good practices, the methodology is structured around establishing analogies with the constructive model of these buildings. This is expected to streamline the characterization of the existing buildings and, consequently, the conduction of inspections, which can be particularly difficult to perform when the buildings are occupied.
It is then proposed, in this work, to test the performance of this methodology, restricted to the inspection and diagnosis phases, through its practical application to a concrete case study. The aim is thus to demonstrate that, by establishing analogies with the framework of the most common damages defined in the constructive model, it is possible to obtain, in a prompt and reliable manner, the characterization of the state of conservation of the concerned building.

CODE 1.7.13

VERTICAL SEISMIC BEHAVIOR FOR THE MORELIA CATHEDRAL IN MEXICO

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KEYWORDS: Cathedral, earthquake, macroelement, rígid elements, damage.

ABSTRACT

The present work shows an estimation of the seismic behavior for the Morelia Cathedral in Mexico considering both horizontal and vertical ground shaking components.
Evaluate the structural behavior for the naves of the Morelia cathedral considering several earthquake records involving the simultaneous effect of the horizontal and vertical acceleration components.
Definition of the seismic demand setting a set of earthquake records with a significative vertical component. Construction of bi-dimensional Rigid Element models for the macroelements that conform the three naves of the building. Non linear analysis considering exclusively as a first stage only the horizontal component and later perform the analysis acting simultaneously the horizontal and vertical component. Energy dissipation estimation and comparative analysis for the obtained values between the different performed analyses. Evaluation of the mechanisms and their damage degrees associated. Vulnerable zones detection.
The scope for the present work is centered in obtaining the seismic behavior of a heritage structure of large dimensions involving considering in addition to the horizontal acceleration the vertical as well in order to establish a first reference of the influence of the vertical acceleration in the performance of historical masonry structures conformed by three longitudinal naves.
The type frame macroelements suffer mainly traction damages unlike the located in the transept zone which suffer major shear damages due to its bigger stiffness on the lateral naves. On the other hand, the major damages for the longitudinal frames macroelements are centered in all the studied cases in the transept zone. In terms of the hysteretic dissipated energy for all cases it was increased when the vertical seismic component was acting. In summary for this particular case it can be conclude that the damage gets significantly increased when the vertical seismic component is simultaneously acting with the horizontal component of the shaking.

CODE 1.7.14

EVAPORATIVE BEHAVIOUR STUDY IN THE HERMIT HUMILLADERO BY HYGROTHERMAL SURVEY TECHNIQUES

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KEYWORDS: Historical buildings, moisture, hygrothermal inspection, monitoring, evaporation.

ABSTRACT

This paper reports the study combining a series of survey techniques to determine so called "*evaporative behavior*" of a building in response to moisture.
The study was conducted in the Hermit Humilladero (Ávila, 16th century). This building shows moisture-related decay, especially in areas that are buried under the street level.
The "*evaporative behaviour*" defines the response of a building in contact with moisture and it is conditioned by numerous variables (environmental, rainfalls, constructive features, materials, etc). The "evaporative behaviour" describes the flow of water through the walls due to evaporation: It is expected to quantify the magnitude of moisture affecting buildings, not as much by monitoring moisture within materials at a given time, but by monitoring the amount of moisture moving through the walls or floors. This approach is relatively novel, and it best describes the phenomenon of moisture transfer because it always refers to water movement.
Survey techniques included *hygrothermal inspection* to detect moisture focal points, wich allowed monitoring evaporation over time and correlation with rainfall and outdoors environment. These studies have been complemented with other Non Destructive Techniques such as Electrical Resistivity Tomography (ERT) or infrared thermography. Results were analyzed with graphic statistics. The combination of all these tests allowed a better characterization and understanding of wetting and drying cycles of the building.

CODE 1.7.17

DETECTION OF CONSTRUCTED CONCRETE PROBLEMS FROM IMAGE

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KEYWORDS: Diagnostic imaging, laser scanning, infrared image, problems in construction materials, concrete pathologies.

ABSTRACT

The paper describes the works carried out in order to detect problems (fissure, holes, marks,…) using images. The study was made in a concrete wall in the Vallès School of Architecture of the UPC.
The aim of the study is to obtain a graphic document of the wall that reflects these problems. Usually these pathologies have been detected from visual inspections, the field work is more time consuming, involves more travels to the place and the quantification is more complex. One option available is use geomatic tools, among which the processing and analysis of digital image from multiband images and intensity images collected from the use of a terrestrial laser scanner could be found. These tools have an advantage the do not use intrusive tools and so it prevents damage the object of study
The use of these digital images and their relationships from correlations established by GIS allows us make a graphic document with the information of the object state. Once validated the methodology that can be applied to other types of objects for detection and assessment of materials, defects or features of any constructive element. This way an operator can intervene in analyzed element to correct defects or act on its preservation with better security conditions.

CODE 1.7.18

DAMAGE IDENTIFICATION ON TRADITIONAL RESIDENTIAL BUILDING WITH MASONRY STRUCTURE BASED ON VIBRATION MEASUREMENTS

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KEYWORDS: Masonry, ambient vibration test, operational modal analysis, modal identification.

ABSTRACT

In Seville there are some common characteristics in the field of traditional residential building with masonry structure: the low bearing capacity of the soil, the poor design of the foundation (with similar dimensions for bearing and shear walls) and often poor connection between bearing and shear walls. Due to all these factors, it is common the occurrence of cracks at the junction between walls.
The dynamic characteristics of the buildings vary greatly with the emergence of such damages. The aim of the presented work is to define the range of dynamic results that may be expected for different geometry types within the field of study and to verify the theoretical influence of damage on the dynamic behavior of buildings, to check the possible use of simple dynamic tests in the diagnosis of this type of structures.
To this end, it has conducted a parametric study of the Sevillian building. They have been made about 350 finite element models in which the influence of each parameter and of each injury in the dynamic response of the structure has been studied.

CODE 1.7.20

MORPHOLOGICAL AND PHYSICAL-MECHANICAL STUDIES ON LIME MORTARS OF ARCHITECTURAL HERITAGE

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KEYWORDS: Lime mortars, characterization, non-destructive techniques, microstructural analysis.

ABSTRACT

The influence of lime mortar materials in the structural behavior of masonry ceramic building systems is as relevant as the influence of the bricks. Over the years, the mortars have shown their durability and quality. A general evaluation methodology for these ceramic masonry structures must therefore be based on the combined and integrated determination of its material constitution and its physical and mechanical properties which define its performance and durability. This leads to the determination of constituent's mineralogical composition, grain size, morphology of the composition, compressive strength, degree of internal cohesion and homogeneity, porosity, permeability and water absorption, among other properties.

In this paper we present a study on characterization of laboratory mortars with different compositions of lime and sand with varying dosages while analyzing the evolution over time of different morphological stages thereof, comparing with the results of joint mortars that belong to heritage buildings.

Techniques of scanning electron microscopy, microstructural analysis, X-ray diffraction for the qualitative evaluation of progressive mortars' carbonation by means of morphological observations and mineralogical analysis are applied. For physical and mechanical characterization in laboratory, non-destructive techniques like windsor pin and rebound hammer are presented as well as destructive techniques for determining compressive strength, shear strength linked to traditional masonry ceramic and retraction are considered.

With the results of characterization, we will contribute to the design of mortars compatible with existing structures and to establish the benefits and scope of some nondestructive techniques applied to determine relevant properties of masonry ceramic building systems.

CODE 1.7.21

DAMAGE ASSESSMENT FORM IN CULTURAL PROPERTY AFFECTED BY EARTHQUAKE

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KEYWORDS: Damage assessment, diagnostics tab, earthquake damage, seismic risk, "cultural heritage.

ABSTRACT

The training of technicians for the evaluation of damage to buildings undergoing emergency after an earthquake is part of the actions contemplated in the Special Plans of Civil Protection against seismic risk of some of the Autonomous Communities of the Spanish State . In the historical centers many of these buildings are cultural structures factory, where they can also find relevant real and even archaeological remains as part of its wall structures. In this context the chips damage assessment developed so far are designed to determine the habitability in the first days after an earthquake, regardless of cultural values that may be building.
A proposal tab is developed to address damage assessment in cultural property affected by earthquakes in emergency phase, posing a methodology that allows for the different technicians involved in the inspections have a unified approach to expedite the evaluation work each property damaged. This has been designed chips with established schemes to assist the assessor damage technical to understand the type and extent of damage present in both real estate and furniture. In the case of buildings, in addition to identifying data pertaining to the use and introduce emergency measures arising from possible collapse with focus on murals and archaeological remains.

CODE 1.7.22

CONTACTLESS GPR ADQUISITION SYSTEM FOR THE ANALYSIS OF CONSTRUCTIVE ELEMENTS OF THE CHURCH OF ST NICOLAS OF VALENCIA

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KEYWORDS: GPR, signal processing, synchronization contactless.

ABSTRACT

GPR technique is based on the transmission of radio frequency signals to the interior of the material to be inspected. Material heterogeneities (nails, humidity or changes in material) cause than some of the energy is reflected back to the surface generating a two dimensional image where the signal level is plotted versus linear antenna displacement and inspected depth.
The church of St. Nicholas is located in Valencia and is an example of Gothic building with baroque decoration. Although some of the frescoes of the church were restored in 1920 and currently is proceeding to its comprehensive restoration with the financial support of Hortensia Herrero Foundation. The use of non-destructive technique GPR is of interest because it allows the evaluation of the state of the components, without physical contact of the antenna, preserving most of the inspected item. Therefore, the absence of any physical contact between the antenna and the surface to be inspected, there is no synchronization between the movement of the antenna and the image obtained, making it impossible to measure accurately heterogeneities.
This paper presents the implementation of a contactless system for synchronization between the movement of the GPR antenna and measurement in order to obtain accurate and lifelike images. For this purpose, we have used inertial sensors, together with dimensional processing techniques, allowing reconstruction of the inspected item. The results are presented before and after the enhancement system for the detection of metallic elements embedded in the structure.
This paper describes the latest results that focus on monitoring the deck profile, detection of a hollow chamber and subsequent consolidation within one of the nerves and verification of performing reliable measurements are presented depths .

CODE 1.7.25

STUDIES FOR THE DETERMINATION OF BENDING STRENGTH OF PROJECT OF TIMBER ELEMENTS

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KEYWORDS: Design of timber structures; Method of the limit states, Strength efforts of project, Bending moments.

ABSTRACT

The Brasilian Code ABNT-NBR 7190/1997 – Design of Timber Structures – presents dimensioning procedures of timber structural elements for several types of solicitation efforts. Bending moments are treated by resistant stresses, based on method of the admissible stresses, which method is just in disusing. This work proposes an alternative design procedure of timber structural elements by considering strength efforts of project, in this case, bending strength of project. This proposal permits the automation of steps of the design procedure and a practical and logical use by the structural engineer. Numerical examples are carried out to evaluate the proposed procedure and to show the coherence regards the Method of the Limit States.

CODE 1.7.26

EVALUATION OF THE STRUCTURAL INTEGRITY OF A STRUCTURAL MASONRY PROJECT

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KEYWORDS: Structural calculations, NBR15812-1, United Service Limits, Collapse, structural Masonry.

ABSTRACT

The non-reinforced structural masonry system has been traditionally used on small constructions, such as houses and buildings up to eight floors. In these kinds of projects is recommended not to modify or remove any of the walls, or it might compromise the building stability and the safety of those around.
According to the inspection done at the C block building from 406 North in Brasília, it was observed that the residents of some apartments removed or modified walls without a previous analysis of the loads and the Service Limit State, causing the building to present some cracks that worried the residents later on.
According to NBR15812-1/2010, some calculations were made to verify slenderness, the active and resistant strains in order to analyze the displacements of slabs of each floor.
After this study, it was observed that there were no major changes in loads and the stresses acting did not exceed resistant strains.

CODE 1.7.29

BUILDING STRUCTURAL SECURITY VERIFICATION WITHIN EXPLICIT PROBABILISTIC METHOLOGIES. CONSIDERING THE SPATIAL AND TEMPORAL CHARACTER OF THE EFFORTS

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KEYWORDS: Building, structural verification, probabilistic methology, basic variables, reliability rate, failure probability.

ABSTRACT

The different national Normatives or Codes stipulate the structural security requirements in terms of reliability rates (β), or in the same way in terms of failure probability (fp). However these Normatives or Codes do not provide enough methodological information to allow a practical application for the estimation of those realiability rates. In particular, the hole of the basic variable could be divided into: a) Geometric variables; b) Variables of materials and strengths; c) Models uncertainties and d) Efforts variables. The latter have a clear spatial and temporal aleatory character that confers on them an ergodic significance.
On one hand, the article shows the ordered secuence of the structural verification, in building, of the probabilistic methology in a explicit way, proposing an organization chart of practical action, which target is the reliability rate estimation in service limit states of typical building structural elements. Therefore, proper aspects of these types of verifications are presented and discussed, such as simplified or approximate methods for the reliability rate collection. (Considerations about linearity of limit functions, basic variables independence, types of probability distributions or densities of those basic variables, etc.).
On the other hand, the distributions of the forces probabilities are analysed, making an special mention to forces of variable character, such as service overloads. This type of forces have significant uncertainty and its randomness is clearly spatial – temporal, so not only is interesting its knowledge about the intensity, but also the randomness about the spatial situation and its period or action or return duration. The article also anlyse the relation or combination of these variables within the remaining concomitant forces.

CODE 1.7.31

MONITORING OF THE ENVIRONMENTAL CONDITIONS OF THE SAINT NICOLAS CHURCH DURING ITS RESTORATION

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KEYWORDS: Monitoring, psychrometrics, air suspension particles, microorganisms.

ABSTRACT

A global intervention methodology is proposed here as a part of the wall paintings and ornamental coating restoration of the central vault of the *San Nicolas Obispo and San Pedro Martir* Church of Valencia. This intervention methodology includes the strict restorative intervention and the work on support, control and conservation guidelines.
This paper presents the used methodology and the first results of the environmental conditions monitoring. This includes thermo-hygrometric data, particulate matter data and the level of microorganisms present in the air.
A centralized control system with sensors combined temperature and ambient humidity and surface temperature located along the main vault and outside has been installed. This system allows annual observation of temperature and relative humidity variations in the different spaces of the church, as well as in the pictorial surfaces. The system allows the collection and transmission of data in real time.
At the same time, air pollutants and air microorganisms are sampled quarterly in order to determine seasonal variations in the inside environment of the church.
This research aims to characterize the evolution and trends of psychrometric parameters in the environment under study, and to correlate these data with the evolution of suspended particles and microbiological activity in the air.
This set of control systems allows on one hand the restoration monitoring, and on the other hand the realization of a preventive conservation strategy that will extend in time the results of this restoration.

CODE 1.7.32

STRUCTURAL ASSESSMENT AND RESTORATION OF AN ANCIENT EGYPTIAN TEMPLE

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KEYWORDS: Conservation, structural assessment, numerical modelling, stone masonry, strengthening.

ABSTRACT

This paper presents numerical modelling and structural analysis which were carried out as part of a major restoration project for Hibis Temple, an Ancient Egyptian stone temple located in El-Kharga Oasis in Egypt that dates 672 - 525 BC. The temple has suffered severe deterioration in addition to a big differential settlement under it,s foundation that caused tilting and serious cracking in several stone walls of the temple. The Egyptian Supreme Council of Antiquities performed a major salvation and restoration project which started with systematic investigation of the monument including historical, architectural and structural survey. Structural assessment was needed for proper diagnosis and safety evaluation of the temple, in order to suggest proper repair and strengthening interventions.

This paper outlines the condition assessment and structural strengthening measures carried out within the restoration project. Numerical modelling was made for the whole temple in its current condition using Finite Elements Method (FEM), and structural analysis was carried out due to the worst expected cases of loading .. Based on the outcome of the structural assessment study, necessary strengthening techniques were suggested complying with the international charters. At several locations, anchors were installed to enhance the stability and structural performance of the Hibis Temple.

CODE 1.7.33

NUMERICAL INVESTIGATION OF STRENGTHENED VAULTED MASONRY STRUCTURES

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KEYWORDS: Numerical modelling, nonlinear analysis, masonry, strengthening.

ABSTRACT

Unreinforced masonry arches and vaults are frequent in historic structures worldwide. Many of these structures are subject to deterioration and damage and need strengthening to maintain their stability and preserve the historic value. For design of structural interventions for these structures, analysis is needed to realistically estimate the stresses and deformations after strengthening.
The present paper addresses numerical modeling and nonlinear analysis of vaulted masonry vaults structures strengthened by different techniques. The numerical modeling by finite elements and the nonlinear analysis were carried out using commercial software ANSYS 12.0. The proposed model was applied to study the structural behavior of several brick masonry vaults strengthened by traditional techniques such as steel bars, ferro-cement and polymer mortar layers and also using externally bonded fiber-reinforced polymer (FRP) laminates; the analyzed vaults were previously tested in laboratory till failure. For all the studied vaults, the numerical results obtained using the proposed model were in good agreement with those obtained experimentally, which demonstrates the capability of the proposed modeling scheme to simulate efficiently the actual behavior of the strengthened vaults. Comparison of the different strengthening techniques regarding enhancement of the vaults capacity and stiffness showed that FRP overlays gave higher strengthening level where the failure load was double that of the unstrengthened vaults. The proposed modeling approach is thus considered a valid and practical tool for the design of strengthening interventions for contemporary or historic unreinforced masonry structures.

CODE 1.7.34

CHARACTERIZATION OF OLD RESISTANT MASONRY WALLS

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KEYWORDS: Mechanical tests, mechanical properties, resistant masonry walls, solid brick, lime mortar.

ABSTRACT

Masonry buildings in the city of Lisbon, representative of the Portuguese housing stock, are more vulnerable to seismic actions than reinforced concrete buildings built in the last decades. Despite all scientific advances, the need to develop further work in this area is fully justified taking into account that this problem involves risk to human lives. Also the growing interest in the preservation of the built heritage encourages the search of new rehabilitation solutions compatible with the original construction techniques of these buildings.

An ongoing study is focusing on a Portuguese building typology of the period between 1920 and 1940, known as “placa” buildings, whose seismic performance is deemed weak due to poor shear strength and ductility of the masonry walls, deficient interconnections between perpendicular walls and lack of integrity of the whole building.

This paper presents and discusses experimental results of various strength and deformation parameters of small wall samples, known as wallets, taken from buildings of the typology under study that were undergoing rehabilitation works. The mechanical tests will allow evaluating the behaviour of these walls for simple and combined actions, such as compression, diagonal compression and out-of-plane bending.

The mechanical characterization of these walls is a first step towards the assessment of the seismic performance of “placa” buildings before and after applying different wall strengthening solutions to be developed. The definition of such solutions and the respective application methodologies will follow the general principles for the conservation and rehabilitation of buildings, taking into account aspects such as the compatibility of materials, the feasibility and the sustainability of the solution, the degree of intrusiveness and the impact on the elements with potentially high cultural value.

CODE 1.7.36

SEISMIC VULNERABILITY ASSESSMENT OF A CULTURAL HERITAGE CASTLE

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KEYWORDS: Seismic, vulnerability, masonry, numerical modelling, kinematic analysis.

ABSTRACT

The 2009 *L'Aquila* earthquake and the 2011 *Emilia* earthquake caused widespread damage to the heritage masonry buildings showing the high vulnerability of the Italian historical monuments. In this context, the seismic vulnerability assessment is a relevant issue in order to preserve the historical identity of entire regions. In the present work the seismic vulnerability of a cultural heritage building has been investigated; the building is used as museum and it is located in the south of *Italy*. In particular, the seismic vulnerability of the *Castle of Manfredonia* has been analyzed. This study was conducted within a larger campaign (ARCUS) promoted by the *Italian Heritage Ministry* (MIBACT) in the entire Country. The main objective of this program consisted of individuating possible seismic fragilities in important heritage buildings used for public purposes. This would be the starting point for programming future interventions of strengthening and mitigation of the seismic vulnerability. The seismic assessment has been performed both in terms of local and global behaviour. The obtained results are reported and discussed in the paper; it can be emphasized, as the level of vulnerability is comparable when performing local and global analysis for the investigated case study.

CODE 1.7.38

DEVELOPMENT OF A METODOLOGY FOR THE SEISMIC VULNERABILITY ASSESSMENT OF EXISTING R/C BUILDINGS

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KEYWORDS: Seismic vulnerability index, R/C buildings, damage mechanisms, damage scenarios.

ABSTRACT

Recent earthquakes, all over the world have demonstrated that a large portion of existing reinforced concrete buildings exhibits high seismic vulnerability. The evaluation of the seismic vulnerability of reinforced concrete buildings is a challenge and allows the construction of damage and loss scenarios in case of a seismic event, supports the setting of the building rehabilitation strategies.
Thus, this paper aims to develop a simplified methodology for assessing the seismic vulnerability of reinforced concrete buildings, which is then applied to a group of 91 buildings affected by recent earthquakes with different macroseismic intensities. It is intended that this methodology may serve as a simplified tool for the seismic vulnerability assessment of R/C buildings, by means of the evaluation of 8 parameters that address aspects that can affect their seismic response.

CODE 1.7.43

BEHAVIOUR OF THE DOMES OF THE BONES CHAPEL DURING A LOAD TEST

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KEYWORDS: Load ter, dome, structural behaviour, monitoring.

ABSTRACT

The Bones Chapel is one of the most visited places in Portugal and is part of the São Francisco Church in Évora, Portugal. The Bones Chapel was built in the XVII century, with its interior walls and columns coated with bones and skulls. The domes were constructed with of clay bricks.
The static load test was performed to evaluate the structural response of a set of domes of the Bone Chapel along a gradual loading, aiming the total load of 350kg/m2. During the rehabilitationworks in the São Francisco, was included to change the top of the Bone Chapel to be used has a museum, with an imposition on contract that prior to the construction of the museum it would be necessary to perform a load test to evaluate the ability of the domed structure of the Bones Chapel to receive a dead load of 300kg/m2. The load test was displacement controlled, on several points of the loaded domes, and the possible cracks opening during the were evaluated. After the loading, all cargo was removed and evaluate the recovery of the deformations. The load was made using cement bags.
The test allowed to observe that the structure under study has a considerable stiffness and from the analysis of the test results it can be concluded that the structure has a good behavior for the loading levels that was imposed. Throughout the load test and at the end of it, it was not detected any changes in the structural shape and it was not observed the occurrence of new cracks.

CODE 1.7.44

PHYSICAL CONDITION OF THE BUILDING INVESTIGATION - METROPOLITAN CATHEDRAL OF ST SEBASTIAN, RIBEIRAO PRETO, BRAZIL

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KEYWORDS: Architectural heritage, conservation and preservation, planning rehabilitation.

ABSTRACT

This paper describes the ongoing investigation in the planning rehabilitation of the Cathedral of Sao Sebastiao, city of Ribeirao Preto, recognized as cultural heritage by the CONDEPHAAT (Brazil), contextualizing the currently practices, techniques and procedures of conservation and rehabilitation of architectural heritage in Brazil. The purpose of this diagnosis research to verify the physical condition of the building, so a detailed diagnosis based on historical research, inspection, monitoring and structural analysis was conducted to understand how to appropriate repair original damaged materials and restore features of this architectural heritage building. Through this diagnosis, it was observed that the focus of structural elements break, that shows major physical condition damage, are mainly located in the nave arcade, in the arches, in the nave dome cross and in the presbytery, and structural elements above the floor show signs of breakage and/or the breaks are directed to its base. Thus, the final diagnosis report concluded that there is differential settlement and the main structural disruption are resulting from excessive settlement because of changes in physical soil support capacity in foundation settlements. Thus, the excessive settlement is associated with water ingress into the foundation settlements, and these elements are shallow and supported by soil layers with less resistance to erosion and higher infiltration capacity, susceptible to any change in its original physical characteristics.

CODE 1.7.46

ONSITE INVESTIGATION AND DAMAGE ASSESSMENT OF ARTIFICIAL STONE STRUCTURAL COMPONENTS

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KEYWORDS: Onsite investigation, artificial stone components, damage assessment.

ABSTRACT

The assessment of structural concrete components relies on well-established non-destructive diagnostic techniques, within integrated and correlated testing programs, where destructive sampling might function just as limited calibration tool.
The investigation purpose, from characterization of physical-mechanical parameters to identification of the state of conservation, is crucial for historical buildings, where the requirement of low-invasive interventions should face the limited availability of data on construction materials and techniques and the evidence of physiologic and pathologic decay.
Particularly, the paper is going to discuss a non-destructive investigation procedure for reinforced concrete components with artificial stone cladding (lintels, jambs, parapets, brackets …) that feature several architectures of the early XX century with various solutions, in terms of mixtures, installation methods and decay patterns.
That procedure, comprising ultrasonic tests, locally related to magnetometer detection, radar scanning and video-endoscopy inspection is applied to the brackets on the facades of a representative case study, the social housing complex "Duca degli Abruzzi" (Bari, Italy), in order to detect the levels of damage and, thus, address practical guidelines for treatment and conservation.

CODE 1.7.47

REINFORCING OF ADOBE HOUSES IN SEISMIC AREAS

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KEYWORDS: Earthquake, adobe building, dynamic test, reinforcement.

ABSTRACT

The adobe houses construction in regions with high seismic hazard is unacceptable by modern engineering but it is a practice widespread in the constructions of spontaneous houses of social sectors with unsatisfied basic needs. This problem, although seen in cities of the province of San Juan, is recurrent in Andes regions of the Republic Argentina and several South American countries.
This paper presents the results obtained in dynamic tests on scale models of prototypes of houses of Adobe.
In order to improve seismic behavior, reinforcement techniques have been analyzed in order to choose which present best technical and economic conditions in the local context.
Due to the mechanical properties and local availability, were chosen wire mesh reinforcements formed by steel rods ADN42/50 of 4, 2 mm diameter and separated by a distance of 200 mm.
The construction of the models was conducted in the laboratory of the Earthquake Research Institute (IDIA) of the University National de San Juan (UNSJ) and for the implementation of the accelerations at the base used the vibrating table available in this institution.
They were built and tested two models in reduced scale (1:2). The first was built with adobe, without reinforcement, trying to emulate the standard construction techniques. The second consisted of a model, exactly like the first, reinforced with wire mesh coated with sand-cement mix.
The tests allow to observe significant improvements in the response of reinforced model that is evidenced by the level of damage reached and registered pattern of figuration.

CODE 1.7.48

ANALYSIS OF DAMAGE IN RAMMED EARTH STRUCTURES UNDER SEISMIC STRESS

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KEYWORDS: Rammed earth, seismic strength, nonlinear behaviour.

ABSTRACT

Analysis of damage and nonlinear behaviour of rammed earth constructions under seismic stress.
A large number of houses built with this material are located in seismically active areas so that knowledge of their behaviour under seismic stress becomes very important as a way to predict rupture and retrofitting which can be used on them to preserve it. It is therefore necessary to know the limit behaviour of these rammed earth structures under seismic forces and its correspondence with synthetic models, analyzed in our case using finite elements. Thus, reinforcement systems minimize the risk of these buildings would be able to be designed.
It has been undertaking a review and compilation of the rammed earth mechanical data existing in the literature. The material in linear and nonlinear regime has been mechanically characterized by incorporating laws of damage and fracture energy, that model a specimen subjected to seismic loads using finite elements.
It will be possible to relate the result obtained of the model tested by MEF analysis with the expected in a given structure. Besides it will be included the non-linearity of the material in their strength, adjusting the parameters related to damage models and fracture energy.
Behaviour laws used make the model weaken in the areas referred to by the effects of an earthquake. Thus, the implementation of certain strengthening or controlled weakening systems serve to dissipate energy and reduce the impact of the earthquake on the building.

CODE 1.7.49

STRUCTURAL ANALYSIS FOR AN HISTORICAL R.C. TALL BUILDING RESTORATION

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KEYWORDS: Tall building, structural analysis, restoration, historical building.

ABSTRACT

A detailed structural analysis (under seismic and wind loads) of an historical tall building in Milan is carried out in this paper. Galfa tower is one of the first tall building (109 m height) built in Italy during the ‘50 years. Nowadays, it is interested by an important restoration process involving also a change in its intended use (from office to luxury hotel and residences).
Several destructive, non-destructive and combined tests were performed in order to investigate the on-site characteristics of concrete. Moreover, additional mechanical and chemical tests on the steel reinforcement are performed too. Some finite elements models (FEMs) of the tower are implemented by using beam and plate elements and considering two different boundary conditions (fully constrained at foundation level and elastic soil support according to Winkler’s model). The interaction with the close existing lower buildings is considered as well.
In all of the FEM models of the tower, the materials characteristics are assigned on the basis of the statistical interpretation of the on-site test results. The seismic and wind loads are applied according to the Italian Design Code (NTC).
The structural safety verifications are carried out in terms of shear and combined compressive-bending actions, whereas further ductility verifications are conducted considering suitable nonlinear behaviours of concrete and steel rebars.

CODE 1.7.51

THE EFFECT OF GRAVITY ,GEOMETRY AND STIFFNESS OF NEARBY BUILDING IN THE FIELD OF TUNNELLING

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KEYWORDS: Interaction , gravity, tunnelling, numerical.

ABSTRACT

Due to the growth and development of populated urban areas, the economic one way to deal with traffic , creation of underground spaces, including the subway tunnels and underpass. Tunnel dug in the ground, causing changes in the stress field is level. And a displacement field around tunnel would create. In this case the adjacent buildings and structures will be affected by the effects of tunneling. As well as the movement and the results tension will be influenced by the characteristics of adjacent structures. The purpose of this paper is to examine the effects of adjacent structural characteristics such as hardness, geometry and weight in tunnel-structure interaction problem is nearby. Accordingly, sections drilled with the drilling of Tehran Metro (with a diameter of 8.85 meters) in the soil of the K3 station in 'Vali Asr' Street in Tehran, Using three-dimensional finite element code for linear elastic-plastic models are analyzed. The effects of various parameters such as hardness, weight, width, height of the building and out of the center tunnel were axis towards the building. The results show: increased stiffness and width of the building have a great impact in reducing the amount of displacement. The increase in weight, length and eccentricity important role in increasing the amount of displacement of axis tunnel showed.

CODE 1.7.52

PROPEDEUTICS, DIAGNOSIS AND THERAPEUTICS OF THE ROOF OF WOOD STRUCTURE OF A CONSTRUCTED ENVIRONMENT

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KEYWORDS: Pathologies in construction, wood, rehabilitation, propedeutics, therapeutic.

ABSTRACT

The purpose of this manuscript was to evaluate the structural integrity of Francisco Nunes Theater wood roof, located in the city of Belo Horizonte, MG, Brazil, and opened since 1950. For the assessment of this structure, "Arcos plans" hybrid consisted, the following stages were performed: propedeutics (inspection aiming general characterization), diagnosis (health state definition) and therapy (proper treatment). Different sources of damages were found, such as biotic (fungus e woodworm), abiotic (wood cracked, oxidation on connections) and structural (lack of lateral bracing, insufficient joint bolts, arches torsion, sway bracing without fixation, arches laminas damaged). Finally, it was proposed with details the measures that should be taken, such as constructive, structural, treatment and protection types of therapy, seeking the rehabilitation and integrity of the wood roof. The therapeutics suggested considered the structure performance and the elements design following the Brazilian Standard NBR 7190.

CODE 1.7.54

KINEMATIC ANALYSIS OF MASONRY STRUCTURES UNDER SEISMIC LOADS

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KEYWORDS: Earthquake, vulnerability, capacity-demand, mechanism, kinematic analysis.

ABSTRACT

Damage produced by earthquakes in masonry structures show several mechanisms.
They may form a part or the whole of a masonry wall. Most damage in local mechanisms are produced, due to the seismic action outside the plane of the wall, with respect to the whole structure behavior. Overturning or bending are a typical case. Various methods of limit analysis are collected at various standards and recommendations for the vulnerability assessment of masonry structures.
The study can be stated in terms of strength and in terms of displacement, in a Kinematic context demand-capacity. The article presents an example of vulnerability assessment of masonry facades against out-of-plane overturning in a height limited masonry building , of historical and rural centers, by using simplified models of limit analysis. ACL and ACLN abbreviations are used to designate linear and non linear kinematic analysis, respectively.

CODE 1.7.55

THE PERFORMANCE OF CONFINED MASONRY BUILDINGS IN THE 2014 CEPHALONIA EARTHQUAKES

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KEYWORDS: Confined masonry, FEM analysis, unreinforced masonry, linear analysis.

ABSTRACT

On August 1953 three strong earthquakes of magnitude ranging from 6.3 to 7.2 on the Richter Scale shook the Ionian Island of Cephalonia, Greece, and destroyed almost the entire building stock of the Island which consisted primarily of traditional unreinforced masonry houses. The authorities went on to restructuring of the building stock, based on a structural system most like what is known today as confined masonry. They designed about fourteen types of one- to two-storey buildings providing the engineers with detailed construction plans. These buildings are known as “Arogi” buildings (Arogi in Gr. meaning Aid). On the 24th of January and 3rd of February 2014, two earthquakes of magnitude 6.1 and 5.8 on the Richter scale, respectively, struck the island, causing significant soil damages, developing excessively high ground accelerations. Surprisingly, no damage was reported in this particular type of buildings. The seismic behavior of these buildings is examined through FEM linear analysis and it is compared to that of unreinforced masonry structures (URM). Computed results illustrate that the displacements of URM buildings would be about double the magnitudes observed in the corresponding “Arogi” ones, with the implication that the earthquake sequence of 2014 would have caused critical damage should the type of structure be of the URM type. Furthermore it is shown that when reinforced slabs are used to replace the timber roofs, the displacement is further reduced by 50%.

CODE 1.7.57

SEISMIC VULNERABILITY OF EDUCATIONAL BUILDINGS IN HIGH SEISMIC RISK AREA IN THE PROVINCE OF MENDOZA, ARGENTINA. A METHODOLOGICAL PROPOSAL

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KEYWORDS: Seismic vulnerability, qualitative method, educational buildings.

ABSTRACT

Is tried to offer an analysis of the qualitative method developed by the G.N.D.T. (Gruppo Nazionale per the Difensa dei Terremoti - Italy), together with other versions adapted to regional constructions of other countries and adapt it to the seismic-resistant security of educational buildings located in the province of Mendoza, Argentina. The objective is to provide a method of analysis of the seismic vulnerability that will prove to be agile, accurate and economically acceptable. The cluster in study is the region with the largest population density in the area with greatest seismic risk of the Argentina Republic. This zone has suffered destructive earthquakes of high magnitude in his short history. At the time of this study, there are more than 500 buildings of educational establishments. Many of these educational establishments dating back to times where compliance with earthquake resistant regulations were not required. The professionals in the field were using some of the prescriptions earthquake-resistant, according to the time for the implementation of these constructions that they were responding to the professional practice of the moment, without scientific basis or theoretical.
This is in contrast to proposals with work carried out in some buildings analyzed by other more sophisticated methodologies. This proposes that the resultant indicator it would serve to detect the possible pathological or structural problems. Then act quickly in the application of quantitative methods more accurate than can propose solutions in schools more vulnerable and avoid the huge socio - economic impact that could cause an earthquake of great magnitude. The conclusion opens us a panorama in which we must continue advancing to give better response to this problematics.

CODE 1.7.58

COMPARING STANDARDS VALUES TO REAL VALUES THROUGH AN INSTRUMENTED STRUCTURE

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KEYWORDS: Actions, structural instrumentation, structural evaluation, standards actions.

ABSTRACT

Normally, when a new structure project is planned, action standards must be considered. Based on these standards we can get the máximum loads and efforts than the structure must tolerate. At the same time, in case of refurbishment, despite of these rules must be also satisfied, different situations could appear, and in some situations limited loads could be tolerated. In these cases the structure must be clearly signalized with the máximum loads supported. In this paper a case study about a structural analysis of the bullring of Burgos (Spain) is prompted. The study is focused to obtain the real tolerated load level. The structure had been previously damaged because of its own age and the hard environment had been suffered. Fortunately, among last years some well-defined material investigations had been made. However, the objective in this case was to evaluate the structure not with the standards loads but the real ones. In order to do it, a certain number of control points were determined, and they were instrumented with straingauges. The instrumentation was evaluated among over 24 hour intervals to check different real load cases. Simultaneously with the data obtained through the instruments, the real loads were also measured, so we were able to know, at the same time, actions and the structural response to these actions. The structure had, also, a complicated structural behaviour because of their hyperestatic design, so thermal loads couldn't be considered. To investigate thermal effect, the structure was also analysed separated from others effects, among long time intervals.

CODE 1.7.61

STRUCTURAL ANALYSIS OF THE JURA CHAPEL OF THE SAN JUAN DE LOS CABALLEROS CHURCH (JEREZ DE LA FRONTERA, CÁDIZ)

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KEYWORDS: Structural analysis, finite element models, operational modal analysis, Jura Chapel.

ABSTRACT

This paper presents the structural analysis of the Jura Chapel (Fig. 1), a piece of heritage which dates from the sixteenth century and is located in the "San Juan de los Caballeros church" (Cádiz, Spain). In 2012, owing to the fact structural damages were detected in the dome of the chapel, a structural intervention began in order to recover its original aspect.
The structural assessment of the current state of the chapel is being done by means of updating of FE models using ambient vibration tests, a great tool for the update of numerical models. It is to be noted that one of the main difficulties that can be detected in a historical building structural analysis is the high level of uncertainty associated with many factors affecting the behaviour of the structure. Slight modifications of the mechanical properties of the structural materials, the soil-structure interaction or even the building construction process may be the cause of high changes between the results obtained from a numerical analysis and others estimated experimentally. In this sense, non-destructive techniques appears as a useful tool to provide information about the dynamic structural behaviour of the building. The modal properties provided by these techniques have already prove to be convenient to check and update numerical models. For this reason, some FE models and some dynamic in-situ tests have been done. As a result, a numerical model with similar dynamic behaviour than the observed in-situ has been achieved. This model has been used to evaluate the structural behaviour of the building.
A historical analysis of the chapel, the followed methodology and the obtained results are the goal of this paper.

CODE 1.7.62

DYNAMIC CHARACTERIZATION OF A HISTORICAL BUILDING BY USING OPERATIONAL MODAL ANALYSIS. SANTIAGO CHURCH (JEREZ DE LA FRONTERA)

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KEYWORDS: Operational modal analysis, non-destructive technique, Santiago Church.

ABSTRACT

In the last decades, Operational Modal Analysis (OMA) method has consolidated as a non-destructive technique that allows the experimental estimation of the modal parameters of a structure from measurements of its dynamic response to ambient vibration only. In recent years, many cases of application of ambient vibration tests can be found in historical buildings. Despite the fact that output-only modal tests are especially suitable for flexible systems, such as bell towers and minarets, several applications of OMA have already been performed in massive buildings. Due to the nature of historical buildings, the use of artificial elements such as impact hammers or shakers is usually not allowed and the tests are thus performed by using the ambient vibration survey technique. The main advantages of OMA are its low economic cost and the fact that excitation equipment is unnecessary.
This paper investigates the dynamic characteristics of the Santiago Church (Fig. 1), which dates from the fifteenth century and is located in Jerez de la Frontera (Cádiz, Spain). After performing several ambient vibration tests, six modes of vibration were obtained in a frequency range from 0 to 10 hertz. The goodness of the results obtained was evaluated by comparing the differences between the natural frequencies and modal displacements.
At the end, it is concluded the suitability of Operational Modal Analysis method as a non-destructive technique to characterise dynamically historical masonry buildings.

CODE 1.7.64

TEST METHOD FOR ASSESSING THE SUITABILITY OF A STONE TO BE USED IN A POOL AND AROUND

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KEYWORDS: Pool, visual properties, limestone, colour, wetting-drying cycles.

ABSTRACT

Natural stone installed in areas in contact with water such as pools is exposed to the action of chemical agents and processes related to water saturation and subsequent drying. Therefore, a progressive degradation of its visual appearance, changes to the mass and colour occurs. In order to assess the durability of natural stone in these conditions and, in the absence of an appropriate test standard for this particular use, we have developed an accelerated aging test that allows us to study the damage that the stone undergoes in a shorter time. For this purpose, an experimental procedure in two steps is described. The first step consists in simulating the interaction of pool water contact with a natural stone. The second one simulates the variations in the content of water in a pool, by alternating cycles of immersion in water and then drying at a controlled temperature. Water used in both experiments contains the chemical agent used to treat this water. The alteration of the natural stone is measured in a quantitatively form using properties such as colour and weight of the sample. Finally, the testing and the interpretation of results are added, and so the ability of a fossiliferous limestone to be exposed to environmental conditions in a pool.

CODE 1.7.66

DEVELOPMENT AND OPTIMIZATION OF MECHANICAL STRENGTH MODEL OF CEMENT-LATERITE-SAND SOLID SANDCRETE BLOCKS

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KEYWORDS: Sandcrete, pseudo-component, simplex-lattice, optimization,transformation matrix.

ABSTRACT

This investigation delves into the model development and optimization of the compressive strength of 67/33 laterite/sand solid sandcrete block. Laterite is a reddish soil layer often belying the top soil in many locations and further deeper in some areas. The study applies the Scheffe's optimization approach to obtain a mathematical model of the form $f(x_{i1},x_{i2},x_{i3,},x_{i4})$, where x_i are proportions of the concrete components, viz: cement, laterite, sand and water. Scheffe's experimental design techniques are followed to mould various solid block samples measuring 450mm x 225mm x 150mm and tested for 28 days strength. The task involved experimentation and design, applying the second order polynomial characterization process of the simplex lattice method. The experimental design model is $\hat{Y}_c = 2.06X_1 + 2.25X_2 + 2.13X_3 + 2.67X_4 - 0.77X_1X_2 - 0.71X_1X_3 - 2.70X_1X_4 + 1.58X_2X_3 - 1.97X_2X_4 - 1.61X_3X_4$. The model adequacy is checked using the control factors. Finally a software is prepared to handle the design computation process to take the desired property of the mix, and generate the optimal mix ratios.

CODE 1.7.67

NEW TECHNOLOGIES IN THE DOCUMENTATION PROCESS OF THE FACADE OF THE UNIVERSITY OF VALLADOLID

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KEYWORDS: Documentation process, lasser scanner, unmanned aerial vehicle (UAV), virtual model, built heritagel.

ABSTRACT

Nowadays, every intervention to preserve a historic structure depends on the development of preliminary studies from various fields of knowledge. The most relevant are those that condense the characteristics in terms of shape and architectural features, permitting a closer examination of a building's constructive and structural aspects.
In this regard, the process of restoring the façade of the most representative building of the University of Valladolid, originally laid out by Friar Pedro de la Visitación, has set in motion a process of documentation wherein new technologies have proven to be capable of generating descriptions that accurately represent the architectural asset in both shape and size. They are also a great starting point for assessing a structure's current condition, studying previous interventions and designing new intervention projects.
The façade documentation process was carried out using a hybrid method that included a 3D scanner and digital photogrammetry with images taken by means of UAVs (Unmanned Aerial Vehicles). In this process, programming a sequence of shots for both the scanner and the UAV was a mandatory and crucial step to guarantee that the whole façade was documented.
The virtual models yielded through data processing formed the basis for the development of a working base (field notes) for completing the analysis of the façade and collecting the information concerning its changes and condition.
In this way, the resulting 3D model not only provided a formal and highly precise description of the façade but also, by including the textures and colours of every surface and detail, served as an excellent reference source from which to propose project features as well as suggestions for care and conservation.

CODE 1.7.68

ANALYSIS OF THE RESULTS OF TESTS FOR DETERMINING THE WATER ABSORPTION BY MORTAR SPECIMENS OF THE 15801 STANDARD UNE

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KEYWORDS: Tests, mortar, masonry, conservation.

ABSTRACT

It is very common to find in masonries old pathologies due to the absorption of rain water or land. The actions to prevent or repair these pathologies are often focused on the brick. The problem is that the mortar, which is the other element used in the brickwork, is usually forgotten. In the case of old masonries, which were executed with very thick joints, they can represent almost two-fifths of the total volume. Related to capillary water absorption tests we have the "15801 UNE EN standard: Conservation of cultural heritage. Determination of water absorption by capillarity", which attempts to know the water that can rise by capillarity from a humid base that simulates the ground. During the realization of this test we have found data that shows that the water desorption processes of the specimens are very fast in the mortar. Therefore, depending on the specimen dimensions, different results could be obtained. For a better interpretation of these results, other essays, such as absorption and desorption tests with the same specimens have been carried out.

CODE 1.7.69

MONITORING OF THE WALLS OF AVILA

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KEYWORDS: Walls of Avila city, monitor, preventive conservation, heritage.

ABSTRACT

Continuing the integrated management plan of the walls of the city of Avila and knowledgeable of the problem of humidity and salts present within the walls, which causes the breakdown of traditional mortars with consequent loss of robustness of these, the city council of Ávila has counted with the collaboration of Telefonica and Santa Maria la Real Foundation of Historical Heritage to gain a real and scientific knowledge of the behaviour of the core of the wall and the manifestation of pathologies on the walls surface.
Accordingly, there has been, on one hand the monitoring of the walls and, secondly, a mineralogical analysis including, among others, samples of cuttings and waste obtained during installation in the dry drilling process at several depths and monitoring points.
The MHS system has been used to monitor of the walls, installing 4 sets of sensors distributed along the walls as follows: three of the groups have been selected based on humidity problems and the fourth has been selected as a reference group for others in an area with no apparent humidity problems.
Humidity, temperature and conductivity sensors have been installed, inside the walls at various depths and various environmental sensors have been placed on the exterior.
Based on the values provided by the sensors, together with the characterization of mineralogical phases of the salts and the determination of the concentration of the ions present in the walls surfaces, adequate interpretations of monitoring for optimum management of the wall have been established when the risk of damage by mobility and crystallization of the salt under the conditions of temperature and humidity increases.

CODE 1.7.71

IMPACT OF DUAL GAUGE RAILWAY TRACKS ON TRAFFIC LOAD INDUCED PERMANENT DEFORMATION OF LOW EMBANKMENTS

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KEYWORDS: Gauge conversion, permanent deformation, low embankment, sub-grade, stiffness.

ABSTRACT

There is a growing interest of many African countries to revamp their neglected and unsustainable railways to attract a transportation modal shift from the roads. In order to promote regional trade and transportation integration investors are faced with problems of *railway track gauge conversions* to match the needs of the rolling stock technology of the 21st century at the same time maintain business operations with the old rolling stock on the same track structure. The objective of the work documented in this paper was to numerically evaluate the impact of *track gauge conversions* on traffic load induced permanent deformation (PD) of low embankment on soft sub-grade. A method to predict the traffic load induced settlement of low embankment on soft sub-grade is proposed. Using the user-defined material subroutines (UMAT) in ABAQUS, a 2-D finite element (FE) model was formulated. These models are converted into a numerical formulation for implementation in FE analysis and the traffic load induced dynamic stress in the sub grade are calculated by using the multi-layer elastic theory. Then the plastic vertical strain in the sub-grade is calculated by an empirical equation, whose constants are related to the physical and mechanical properties of the sub-grade soil. The method was applied to analyze a 700m long section of a low embankment on the soft black cotton soil of Nakuru plains in Kenya using single and dual track gauge respectively. The corresponding results showed that the application of traffic loads on alternate rail tracks due to gauge conversions have a significant effect on the permanent deformation of the sub grade soil. The depth significantly influenced by traffic loading was found to be close to 6 m below the base of the embankment. The analysis also shows that increasing the thickness and *stiffness* of the sub grade is a very effective way of reducing the traffic load induced permanent deformation of soft sub grade soil. The proposed method can be used for settlement analysis on low embankments as well as a useful tool for making decisions on railway track gauge conversions.

CODE 1.7.72

INFRARED THERMOGRAPHY APPLICATIONS AS AN AUXILIAR TECHNIQUE FOR THE DIAGNOSIS OF DAMAGES IN BUILDINGS

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KEYWORDS: Infrared thermography; magnetic rebar detector; damage detection techniques.

ABSTRACT

This paper exposes a work where non-destructive techniques have been used to analyse households that show lesions in form of cracks and microcracks, in which the structural project of the building is unknown and where it is not possible to do test cores or probing holes, as the buildings were occupied houses.
Due to the constraints already specified, the technique of infrared thermography was chosen. This technology is based in the measurement of the radiation emitted by a body inside a specific range of wave lengths. The radiation that a body emits depends on its superficial temperature and on the emissivity of the material. The difference of radiation emitted is useful to identify different materials, thermal bridges and elements hidden behind the surfaces, as these are shown as areas of different radiation on the surface. Thermography is commonly used to detect moisture intrusion, but can be used as an auxiliary technique in the detection of cracks, poorly executed encounters, hidden damages, and others that can present the building.
In addition to both active and passive thermography, a magnetic rebar detector has been used to detect if the structural elements were reinforced. This type of equipment bases its functioning on the increase of the magnetic coupling when there is a metallic element inside the range of action of the sensor, which allows to locate metallic hidden elements in a non-destructive way.
These techniques could determine the constitution of load-bearing walls made of concrete blocks, the position of the structural elements of floors and roofs, as well as constructive encounters of the different parts of the structure. Parallel to the measurements made by the previous methods, the plot of the damages detected has been made.
Due to all the information collected, it was possible to determine the causes of the lesions that the buildings manifested, associated with small differential settlement of the foundation, deformation of slabs, hidden construction defects and thermal effects.

CODE 1.7.73

2015 NEPAL EARTHQUAKE: LESSONS LEARN FROM THE OBSERVED BUILDING BEHAVIOUR

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KEYWORDS: Seismic behaviour, Nepal earthquake, observations of collapsed structures, damages, survey report.

ABSTRACT

Following the April 25th Ghorka earthquake (Nepal), a research team from the University of Porto in collaboration with other international institutions from Portugal, United States of America, and Italy, formed a team to carry out a post-earthquake damage reconnaissance campaign. The Gorkha earthquake, with the magnitude of 7.8Mw, had its epicentre located in Lamjung, Ghorkha's district and caused approximately 9000 deaths and over 23000 injuries. In addition, thousands of buildings collapsed. On May 12th of 2015, an intense aftershock struck with a magnitude of 7.3Mw, which increased the previous number of deaths, injuries, and collapsed buildings. This paper summarizes the work done as part of reconnaissance campaign and it is divided into two main parts. The first part describes the reconnaissance mission that allowed for the characterization of the most common buildings typologies. In addition, an overview of the constructive practices adopted in Nepal as well as the Nepalese current Standards and Codes are presented. The second part provides a report and discussion of the damage observed during the reconnaissance activities, stressing the observed critical behaviours that could influence the response of structures located in other regions of the world. This paper reports on observed damage in more than 30 reinforced concrete buildings and several unreinforced masonry structures, schools, hospitals, and historical monuments.

CODE 1.7.74

DEVELOPMENT OF ELECTROMAGNETIC SENSORS FOR CORROSION ASSESSMENT OF REINFORCED CONCRETE STRUCTURES

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KEYWORDS: Reinforced concrete structures, non-destructive testing, corrosion assessment, Eddy current testing.

ABSTRACT

This paper describes the development and tests of ECT sensors, dedicated to identifying the existence of corrosion processes in reinforced concrete structures. The electromagnetic part of the sensor is an RLC series circuit, fed by a high-frequency electronic source. The inductive reactance of the sensor (L) is provided by a multi-turn coil, the capacitance (C) is an external arrangement of capacitors, and the resistance (R) is the sum of the coil resistance itself plus an external resistance. Three different prototypes were built. The presence of ferromagnetic bodies under the sensor disturbs the electromagnetic and consequently the inductive reactance. As the sensor is designed to operate near the resonance frequency, substantial change will occur in the measured voltage on the capacitor. This change of voltage is used to identify the presence, position, bar gauge and even corrosion processes in the elements of the armature of reinforced concrete structures. The paper presents the mathematical principles, electronic and electromagnetic developments, tests and analysis of the results.

CODE 1.7.75

EVALUATION OF THE CORROSION ON A MARINE STEEL SHEET-PILES BREAKWATER BY MEANS OF SYSTEMATIC THICKNESS MEASUREMENTS USING ULTRASONIC EQUIPMENT, OVER AND UNDER THE SEA

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KEYWORDS: Maritime works, steel Structures, corrosion, ultrasonic thickness measurements.

ABSTRACT

In Quepos, Pacific side of Costa Rica, it was constructed by 2010, the first phase of a marina, which has two mix breakwaters, both with rubblemound and circular cells of sheet piles, marine steel, ASTM A-690, filled with sand and gravel. Breakwaters are 956 meters long and consist of 25 circular cells from 12 to 18 meters in diameter, with interconnection arches.

The maintenance plan for the marina, considers tracking the corrosion experienced by the breakwater cells, and comparing the 'actual' against the expected corrosion rates, checking that the structural limits for the corrosion additional thickness are not exceeded, and programming countermeasures in case that are identified potential areas of accelerated corrosion.

Specific control sections, distributed along the breakwater, both internally and externally of the basin, (or inside the marina), were considered. In each section, thicknesses were measured every meter from the top of the steel cell to the seabed.

These measurements were made using ultrasonic equipment, with special underwater transducer, using a crew out of water, and divers in the submerged sections. Update annual campaigns measurements, are from 2011, 2012, 2013 and 2015.

With the measurements in the campaigns, it could be differentiated sectors of the breakwater, where the phenomenon of corrosion occurs with varied attack levels. Also, it was possible to estimate corrosion rates and useful lives, both general for structures, and specific for each level and section.

In turn, this allowed to identify maintenance priorities, defining possible sites where measures of corrosion protection should initiate, with barrier protection, or active or passive, cathodic protection systems, as well in general, to have confidence in the structural capacity and safety of the breakwater.

CODE 1.7.76

APPLICATION OF THE GROUND PENETRATING RADAR FOR ROAD INSPECTION AND SUBSOIL ANALYSIS: THE CASE OF THE SITEGI PROJECT

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KEYWORDS: Transport infrastructure, conservation, cracking, NDT techniques, GPR.

ABSTRACT

Transport infrastructure presents more demanding conservation and maintenance every day, especially under adverse economic situations, in which the maintenance of the active road heritage it is being prioritized against the construction of new infrastructure.
Since 2011, the Applied Geotechnologies Group of the University of Vigo, together with other remarkable civil engineering companies as EXTRACO, S.A. and Misturas, S.A., has developed the SITEGI project ("Technological Systems for Infrastructure Management"). It consists of a new inspection system that allows for making objectively decisions in the field of conservation. The system works collecting different road parameters with an integrated mobile unit of inspection, which is provided with high precision devices oriented to analyze these types of constructions. Within other integrated devices, there must be highlighted the laser mobile scanner (LiDAR) in addition to the perfilometer for superficial texture control in pavement, as well as the thermographic camera and the Ground Penetrating Radar (GPR) for the shallower inspection of the subsoil.
This work presents some of the GPR results obtained in the SITEGI project for two particular case studies: the inspection of cracking in pavement and the evaluation of filling in port zones. In both cases, the non-destructive GPR technique has proved to be a suitable method for quality control and maintenance.

CODE 1.7.78

PRELIMINARY STUDIES OF THE DIAGNOSTIC ON THE STRECH OF SAN BERNABÉ MEDIEVAL WALL, ZAMORA, SPAIN

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KEYWORDS: Wall, historical heritage, seismic refraction, electric log, laser scanner, loss of mass, sanding.

ABSTRACT

This stretch of the medieval walls of San Bernabe, belongs to the first walled enclosure of the city of Zamora in Spain. The use of seismic refraction techniques, geo-radar and CT scanning is widespread in previous nondestructive inspections of other listed buildings. The analysis of the images in the areas inspected with photogrammetry and 3D laser scanning supports the process of data collection and the wall's subsequent diagnosis. The data obtained by thermal imaging reveal that the stretch in question has some humidity in its backfill, which extends to the outside, and there is some crumbling of the stonework. These techniques have been developed in other fields unrelated to the assets that make up the Historical Heritage. This work aims to provide an example of the data collection to be taken into account prior to any diagnosis of a property and its subsequent intervention.

CODE 1.7.79

PRELIMINAR STUDY TO THE INTERVENTION ON THE 'LOS ARAGONENES' MILL IN MONACHIL, SPAIN

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KEYWORDS: Mechanical characterization, mixed masonry structures, cobblestone wall, lime mortar, brick.

ABSTRACT

This paper aims to present several complementary methods used to characterize, previously to the intervention project, the materials of the 'Los Aragoneses' mill located in Monachil, Southern Spain. The most part of the historical structures of the referred construction consist on mixed masonry structures, brickwork infilled by cobblestone wall, performed with lime mortars.
It will be done special emphasis on the tests developed to obtain information related to the mechanical behaviour of the masonry structures and their components.
The followed methodology consisted on a first onsite visit to identify the different constructive elements and the existing damage. After than this first approach to the building, and bearing in mind the existing economical resources to perform this starting phase of the study, it was defined a sampling campaign. Bricks, mortars and masonry specimens were taken from the building to subsequent testing on laboratory (physical-chemical-morphological-mechanical characterization tests). Besides, several non-minor destructive tests, N-MDT, such as flat jacks, ultrasounds, rebound hammer and penetrometer tests, were performed on site. Finally, although the fact that the results are not included in the paper, the structural performance of the building was evaluated, considering the estimated characteristics for the materials, with view of its refurbishment as Visitor Center associated to the network of Spanish National Parks.

CODE 1.8.02

PATOLOGHIC STUDIES MODEL FOCUSED ON LEARNED LESSONS

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KEYWORDS: Pathologic study, model, pathologic classification, analysis tools.

ABSTRACT

The topic explains a model to elaborate pathologic studies aimed at indicating principal damage causes, in addition it is universal and flexible, and its purpose is to turn resulting causes of the pathologic studies into learning, in order to spread this learning among students, designers, constructors, maintenance managers, manufacturers and researchers, so the can mitigate or avoid mistakes in future projects. In order to get the model, different methods and judgments found on data bases, manuals, books and articles from different countries; have been compared. The synthesis is "a model", and it includes: Support tools, stage processes to elaborate pathologic, intervention, assessment of intervention, and building maintenance studies; as well as the application of the technic of the learned lessons on every aforementioned phase; concluding with the use of a data base and knowledge diffusion.
While the model has been in development, the manufacturing technics and project managing has been evaluated, and the result was a pathology classification linked with a materials classification from Material Science and Engineering, technical pathology datasheet templates and laboratory tests datasheet templates, and format to elaborate pathology studies and causes analysis instructions.
It is worth mentioning that this research will present some examples about technical datasheet and results.
Finally, the model presented is an investigation in development and will be evaluated by specialists and users, so the debate and ideas contribution are opened in order to get a universal model that contributes with knowledge diffusion, and in this way to get a continuous improvement in designs, constructions, building maintenance, training, manufacturing and materials evolution.

CODE 1.8.04

THE HISTORIC GARDEN IN THE CONSERVATION CHARTERS: FROM THE ATHENS CHARTER (1931) TO THE FLORENCE CHARTER (1981)

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KEYWORDS: Conservation charters, ICOMOS-IFLA, historic gardens.

ABSTRACT

The international conservation charters are theoretical tools of worldwide reference, with no function of legislating on equity, but to provide background to the competent bodies to legislate. Their theoretical postulates should be understood at the time they were produced, and studying them, therefore, means understanding the evolution of the debate about the conservation issues. The purpose of this article is to trace the chronology of how the subject historic gardens has been treated since the first international conservation charter, the Athens Charter (1931), until the Florence Charter (1981), which was drawn up by the ICOMOS-IFLA, on the protection of historic gardens, to complement the Venice Charter (1964). The article highlights the recommendations and the selected texts for dissemination in the various symposiums organized by ICOMOS-IFLA since 1971 that subsidized the elaboration of the Florence Charter. The specific objective of this chronological route is to provide subsidies to critically evaluate the national conservation charters under the international discussion.

CODE 1.8.05

SUSTAINABILITY OBJECTIVES CONSIDERED BY THE SPANISH REGULATION IN THE DEVELOPMENT OF CONCRETE STRUCTURES

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KEYWORDS: Sustainability, structures, concrete, regulation.

ABSTRACT

How to value the contribution of the buildings to achieve of a more sustainable development is a fully valid question, sight the approximately 250 voluntary evaluation systems of sustainability for the buildings that exist in the world. Although the authors of annex 13 of the EHE-08 the structure has *"a relative influence on the final calculation of sustainability"*, the contribution that may represent the decisions about them has a particularly relevant because the volume of material in the entirety of the building. In the context of the IESEI project (investigation into efficient, earthquake resistant and intelligent in its life cycle) this communication analyzes the weight of the design, calculation and choice of materials, in the assessment of the contribution of the structure to the sustainability of the building, in the field of the Spanish current regulation. To get this objective, it values the character of the assessed decisions for the eleven sustainability criteria contemplated by the mentioned appendix and their weight in the final evaluation. The result is the identification of the most feasible decisions to influence the sustainability of the structure from design, calculation, execution and choice of the materials, within a system of assessment that reward the environmental aspects versus the socials and economics.

CODE 1.8.06

COMPARATIVE ANALYSIS OF THE DIFFERENT EXISTING FRP STRENGTHENING GUIDELINES. ASSESSMENT OF RESULTS OBTAINED BY SOFTWARE ORIENTED TO THE DESIGN OF FRP STRENGTHENINGS

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KEYWORDS: Structural strengthening, carbon fiber, CFRP, TR55, ACI440.2R-08.

ABSTRACT

Some techniques for the structural strengthening based on the use of composites began its development from the 80s, as substitution of traditional procedures based on plates of metallic nature.
Because of this, it became necessary to develop specific calculation models that could ensure the proper functioning of the strengthened member, taking into account the limits of the three intervening materials: concrete, steel and FRP.
The first codes were based on the adaptation of well-known, fully developed procedures (confining jackets with steel sheets and flexural reinforcements with steel plates) into this new technology. However, those incipient models had to be significantly supported by lab testing, which allowed the enhancement and debugging of the design processes.
Due to this, an important quantity of local design guidelines were released throughout different countries (Japan, USA, Netherlands, United Kingdom, Switzerland, Egypt, etc.) that, based on similar initial assumptions, started to develop into significantly different design approaches. Additionally, those guidelines were assuming the use of different reduction and/or correction factors in different ways, which means that, in practice, it becomes really complex to arrange comparisons among the results obtained.
Over the years it has been producing some convergence between design procedures, divided into those which follow ACI 318 and those supported by the Eurocode 2.
However, it has not been possible until the appearance of specific calculation tools for dimensioning FRP reinforcements to carry out a detailed benchmarking. The aim of the present paper is to compare the resulting solutions, according to the different FRP codes, comprising the results obtained either for a single section or for a structural member.

CODE 1.8.07

USE OF STRUCTURAL CALCULATION SOFTWARE FOR THE APPLICATION OF THE NEW GUIDELINES FOR THE DESIGN OF FRP STRENGTHENINGS: TR-55 AND EUROCODE 2

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KEYWORDS: Structural strengthening; carbon fiber; CFRP; TR55; Eurocode 2.

ABSTRACT

The first models for the design of FRP reinforcements were essentially carried out through testing. Therefore, these design models were based on a limited data, which leaded to a lack of real procedures for a significant number of assumptions.
The uncertainties regarding the ultimate performance of FRP systems were also solved with by employing safety coefficients and arbitrary limitations concerning the effective stresses. This led to models based on conservative and simplistic design procedures, initially based on modifications of existing design procedures for steel sheets or plates.
However, the pass of the years allowed multiplying the information available as a result of the constant development of new tests by the researchers. This permitted to know in detail the failure mechanisms of FRP, which resulted in a gradual reduction of those existing arbitrary limitations, but leading to much more detailed design processes that take into account all the possible mechanisms of collapse for the strengthened member.
Therefore, although current FRP design codes offer greater opportunities to the engineer, they have been oriented to significantly more complex design processes; hence the use of specific software tools in a considerable number of cases is consequently required.
A good example is the TR55 - *Design guidance for Strengthening concrete structures using fiber composite materials, 2012*, as an advance of the next calculation guides to come in the near future to Europe. This paper discusses the difficulties inherent in the new calculation methods, justifying the need for specific software for them.

CODE 1.8.08

FIRE SAFETY LABEL FOR BUILDINGS: A PROPOSAL

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KEYWORDS: safety, fire, label, buildings, prevention

ABSTRACT

This article objective is to present a proposal to create a fire safety label for buildings along the lines of the Brazilian program of energy efficiency labeling for buildings. It is intended to raise awareness and mobilize the population to the importance of fire prevention and contribute to a self-protection posture by the user of a given space. This article addresses some of the major risk assessment methods currently used, justifies the importance of implementing these labels to increase buildings safety against fires and reveals the necessary adjustments to its effectiveness.

2.- PROJECT

CODE 2.1.02

INTERVENTIONS ON THE ARCHITECTURAL HERITAGE IN NORTHERN CHILE AFTER THE 2005 EARTHQUAKE

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KEYWORDS: Earthquake, projects, intervention criteria, authenticity.

ABSTRACT

Earthquakes have been a constant issue in the Chilean history. The Chilean territory, which is part of the Pacific Ring of Fire, is one of the most seismically active zone in the Earth. Four seismic events over 7.5 Mw have been identified in the northern zone of Chile between 2005 and 2015, which severely local heritage in this zone. The damage includes important architecture such as Andean Churches, which can be identified through their singular attributes and the use of materials and techniques; characteristic of the locations and local communities, including rammed earth, adobe and stone masonry.

The research has raised mainly from practice rather than as formal study. Here, Northern Churches have special attention from both, authorities and experts. Based on a preliminary inventory that includes heritage value and level of damage, the Chilean State has funded the restoration of several cases.

The results of these interventions allow, a critical analysis including the criteria used in each of the projects that have been undertaken. Therefore, this analysis proposes a wider spectrum of possibilities with some extreme options such as the reconstruction of the original building and the final acceptance of the ruin. To what extreme are we capable of working without losing authenticity? And to what level the community opinion can change these criteria?

At last, do value and authenticity arise from form, location, space, constructive techniques, matter, or do they just arise from memory? Even though we are addressing a local problem some lessons learnt are possible to achieve, because the mere manner of dealing with it conform lessons that take universal character.

CODE 2.1.03

INTERVENTION IN RUINS: CONSERVATION, RECONSTRUCTION OR REUSE?

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KEYWORDS: Cultural heritage, ruins, design of intervention.

ABSTRACT

The intervention project considered cultural heritage ruins has been debated for long time. From the beginning of restoration theory, either by John Ruskin (1819-1900) who preached ruin stay, whether Viollet-Le-Duc (1814-1879) that regarded as the end of the monument, ready to be rebuilt or complemented by the principles he advocated by stylistic, this issue has been discussed in the bodies responsible for safeguarding the assets. The documents that follow these theorists, in general are against the reconstruction of the ruins. This theory has evolved over the years and today it values the question of authenticity, which is changeable and different in each country.
The purpose of this article is to discuss the case of interventions in the ruins of Brazilian historical buildings emphasizing the theoretical issues relevant to the subject. The topic will be discussed by presenting the treatment of interventions in Brazilian architectural about the preservation of the ruin, if its reuse, and the total reconstruction of the building. In the case of reconstructions, which values are crucial? These remain after the reconstruction?
The initiatives for the conservation of a cultural need much more than recognition of their cultural value. It is necessary that the people understand the value of the buildings and that enables conservation measures to perpetuate the memory of architectural history. This is the main contribution of this paper to present and discuss concepts and theories based on national practical examples.

CODE 2.1.05

INTERVENTION ON HISTORIC SITES: THE CASE STUDY OF CAMPINA GRANDE - PARAÍBA – BRAZIL

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KEYWORDS: Intervention, cultural heritage, Campina Grande-PB.

ABSTRACT

In May 2015 was inaugurated in Campina Grande, Paraiba - Brazil, a monument in honour of the 150 years of its political emancipation. The monument is located on the edge of the “Açude Velho” and the area is under public preservation laws due to its historical and environmental aspects. This article aims to analyse the impact of the building in the area, questioning the representativeness and historical authenticity of the monument, the violation of local law and the high cost of construction, which could have been used to preserve the local historical heritage, currently abandoned by those responsible for its preservation. The analysis is based on municipal legislation and general restoration theories such as the Nairobi Recommendation (1976), the “etropolis Charter (1987), a brazilian document that discusses about preservation and urban revitalization of historic places, and the Washington Charter, 1987, calling for the preservation of the values for the "historic character of the town or urban area and all those material and spiritual elements that express this character," especially "the relationship between the town or urban area and its surrounding setting, both natural and man-made". The insertion of contemporary architecture in historic sites must be done carefully, as this may interfere irreversibly on the site, changing the natural scale and the values related to the historic aspects of the space. The special case of this article, shows a design built arbitrarily without public consultation, using public money and disregarding the law for the area. We aim to contribute in the discussion of how to design for consolidated areas and its consequence to the preservation of cultural heritage.

CODE 2.1.07

THE INTERPRETATION IN THE CONTEMPORARY STRATEGY OF INTERVENTION ON HERITAGE: PINACOTECA DO ESTADO DE SÃO PAULO STUDY CASE

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KEYWORDS: Patrimony, intervention, interpretation, Pinacoteca do Estado de São Paulo.

ABSTRACT

There is not one single parameter that orientates the architectural interventions on historical heritage. As Ignasi Solà-Morales Rubió (1982) identified, the intervention is a free aesthetic operation, an activity of reflection, a form of *interpretation*. Regardless the way they are juxtaposed, the new and the antique architecture can no longer be read as independent – they are understood as a phenomenon in which is the past and the present are set together and that changes according to the values attributed to the antique and to the intervention intentions to reinforce or construct new senses. Consequently, acting on the pre-existing, the new architecture has a role of transforming experiences and meanings. To discuss the issue of contemporary architectural intervention in buildings and sites of historical value, the article deepens the understanding of the *intervention as interpretation* concept, unfolding Solà-Morales, reflecting on the possibilities to see this concept as a critical instrument in contemporaneity face to different project approaches. In light of this concept, it is selected one study case, the Pinacoteca do Estado de São Paulo, an intervention project of the architects Paulo Mendes da Rocha, Eduardo Colonelli and Wellington Torres, initiated in 1933, for the installation of an art museum on the antique Liceu de Artes e Ofícios, a neoclassic style building constructed from 1897 to 1900 by Ramos de Azevedo, in order to analyze the relations between past and present and how the contemporary operation interfered on the experience and meaning of the ancient architecture. It is possible to see that the adopted party induced changes in the way the internal and external spaces are perceived, in the symmetry of the neoclassical plant reading, in the building antiquity value evidence, in the constructive and tectonic aspects appreciation and in the spaces apprehension.

CODE 2.1.10

PERFORMANCE CRITERIA FOR THE POSSIBILITY OF RECOVERING THE FORGOTTEN CLOISTER OF SANTA MARÍA CATHEDRAL IN MURCIA

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KEYWORDS: Restoration criteria, intervention criteria, Murcia cathedral, cloister.

ABSTRACT

Santa María Cathedral of Murcia and the set of elements linked to it make a living work which transforms itself from its origin and still does today. The Cloister area has suffered the most relevant and, on the other hand, the most questionable transformations made in the XXth Century due to the necessity of a "change in use". Nowadays, there is the possibility of its recovery.
The current challenge is to answer the question of how to approach future restorations of this item, so altered from its original state, and also to identify which values will prevail in it, in order to determine significantly criteria and strategies of intervention.
Based on the finding of the preservation of many of the primitive structures, which could be rediscovered, it should also be taken into account the fact that transformations made in the last century, even assuming a great alteration of the original core, have gained the right to be preserved as the memory of history and culture of the past.
Therefore, it will be required the compilation and synthesis of all available information there is so far about this item. This should allow, first of all, a setting regarding its historical, architectural and constructive context and, secondly, the analysis, from its monumental condition, of three essential aspects: its condition as an architectonic object, as a historical document and as a significant item.
This is the only way to establish the criteria of performance in the cloister, from a Deep reflection on the knowledge of this area and its peculiarities. Given the above circumstances, we must find the best solution between recovery of elements of great architectural value that have been lost so far, and permanence of transformations already integrated into the identity of the monument.

CODE 2.2.01

CONSTRUCTIVE CHARACTERS OF THE WESTERN SICILIAN MASONRY IN THE XVIII AND XIX CENTURIES

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KEYWORDS: Masonry, constructive system, knowledge, Sicily.

ABSTRACT

The tradition of weight-bearing walls in the Western Sicily - mainly due to the frequent earthquakes occurring in Palermo between the XVIII-XIX centuries (the most destructive happened in 1726, 1751, and 1823) - imposed new types of masonry that, following the precepts of the rule of the art, suggested more stringent methods of well-construction, both in the choice of materials and in the adoption of novel constructive technologies.
The technical culture of that time was able to refile the constructive methods introducing appropriate improvements and experiments, which promoted the development of new knowledge (matter, materials, and constructive techniques), systems of consolidation and anti-seismic techniques, both for the introduction of new materials and in the identification of the most appropriate masonry.
The result is a compendium of noteworthy techniques that brilliantly solved the problems related to structural safety and seismic risk as well as helped the interaction between masonry, depending on types, and the other structural and not structural systems (floors, vaults, roofs, overhangs, ceilings, etc.) connected to it.
The aim of this work is analysing the consolidated construction practice – also through new documentary acquisitions – and discussing some cases of study, that identify some exempla that are notable for the originality and the experimentation of the final adopted solutions.
At the same time, we want to produce an atlas of traditional constructive techniques that may be extremely useful to scholars investigating the field of historical construction as well as to technicians and contractors working in restoration and structural reinforcements towards a respectful and compatible project of preservation.
Moreover, in comparison to the knowledge of construction rules handed by treaties and manuals, we want to transmit the building techniques of the Sicilian tradition, in order to properly report them in respect to a wider technical ambit, emphasizing also the specific characteristics and elements of originality that we have founded during our researches.

CODE 2.2.03

REVEALING MIRBAT'S TRADITIONAL DWELLING

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KEYWORDS: Mirbat, built cultural heritage, traditional housing, construction materials and methods.

ABSTRACT

Based in previous authors' research, this work interprets the results of the survey carried in the old area of Mirbat town (Sultanate of Oman), which is located on Indian Ocean coastline on the south of Arabian Peninsula. The history of Mirbat dates back to 4th millennium BC and the old town exhibits residential quarters with gorgeous traditional dwellings identified by their distinctive features of local Islamic style. The residences were erected at the beginning of 20th century by the local builders and with the employment of local materials and construction methods. Unfortunately, these traditional methods, which were passed down from one generation to another, were replaced by modern technologies. Motivated by the aim of understanding materials and techniques exemplifying local built culture, a survey through literature study, site examination, and interviews with local traditional builders was conducted. The scope of the research is the revelation of the built heritage of Mirbat as an example of inimitable architecture and people's culture wherein the results explore the local traditional dwelling, describe its materials and construction methods as well as building procedures.

CODE 2.2.07

COMPRESSED EARTH BLOCK STABILIZED WITH CEMENT AND ADDITION OF RESIDUAL SLUDGE OF WASTEWATER TREATMENT

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KEYWORDS: Earthen architecture and construction, compacted soil-cement, biosolids, compressed earth block.

ABSTRACT

The residual sludge generated in wastewater treatment is highly contaminated with pathogens so their disposal in water bodies or soil is highly damaging to the environment. However only a small part of this waste receives adequate allocation despite the Brazilian legislation be very restrictive in this regard. The housing deficit in Brazil is significant especially for social constructions, and is widely known that the construction sector is one of the sectors that impact more negatively the environment, because is notable the use of highly polluting materials. Among these building materials is possible to highlight ceramic bricks which consumes a lot of energy in the production process and also generate unwanted mineral waste. In this context as a contribution to the solution of these environmental problems, in this paper we studied the optimization of the addition of residual sludge in compacted soil cement without damaging their compressive strength and water absorption. In this study were experimented 3 percentages of sludge (4%, 9% and 14%) inserted in the soil cement (10% of cement), and materials without sludge (control). The results indicate that even with the inclusion of up to 14% sludge the resistance to compression of the soil-cement remained above the minimum required by the Brazilian standards (≥ 2.0 MPa), and the water absorption lower than the maximum allowed ($\leq 20\%$).Therefore from the standpoint of performance the proposal proved feasible. However from an economic point of view it may become infeasible because for this use the sludge must undergo a disinfection process with lime, drying and clod-crushing, resulting intensive work and high cost. Furthermore the consumed sludge volume is minimal considering the large daily production of waste. Therefore it would be advisable environmentally seek other suitable alternative, especially more economical to give an adequate final disposal to the sludge of sewage treatment plant.

CODE 2.2.11

EVALUATION OF FINISHING COAT SYSTEMS FOR OLD BUILDING RENDERS

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KEYWORDS: Wall coating; lime mortar; finishing coat; testing; water transport

ABSTRACT

The use of lime in construction dates back to thousands of years ago, having been a commonly used binder. Therefore, many old buildings still have masonry and wall coatings (plasters, renders and finishing coatings) made with lime. The renders and their finishing coatings are the constructive elements more exposed and thus, more subject to degradation. They are also decisive for the aesthetic appearance of the buildings. Hence, it is essential to deepen the knowledge about the efficiency of different coating systems for these walls, to ensure a good overall performance.
The present study aims to evaluate preliminarily the adequacy of some finishing wall coatings based on air lime for application on old walls, in comparison with finishing systems based on common paints. The influence that different types of wall finishing coatings may have on the performance of the wall is assessed taking into account observations and test results on laboratory specimens: visual appearance (in terms of cracking and surface texture), surface hardness, water capillarity, permeability to water vapor. The study highlights the technical and aesthetic advantages and disadvantages of the different systems and application modes analyzed.
It is concluded that the application of the same finishing coatings on the fresh mortar (medium moisture content) and on dry mortar (low moisture content) or the application of different finishing systems may give the final system a distinctive behavior regarding the water transport.
Some of the tested systems presented water vapor permeability much lower than others. Although the same systems also register low capilary coefficient, they are particularly not efficient for old walls with high moisture content, from cappilary rise or from other sources. The fact that systems with suplementary layers present faster drying and higher water vapor permeability need to be deeply studied.

CODE 2.2.14

ANALYSIS OF THE BOND BETWEEN FABRIC REINFORCED CEMENTITIOUS MORTAR (FRCM) STRENGTHENING SYSTEMS AND MASONRY

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KEYWORDS: Strengthening, masonry, FRCM, bond.

ABSTRACT

The structural performances of masonry elements strengthened with externally bonded composites, is strongly governed by the bond between the strengthening system and the masonry substrate; the failure of strengthened masonry usually takes place with loss of bonding at the interface strengthening system /masonry substrate.
Debonding has been widely studied in Fiber Reinforced Polymers (FRP) applied to concrete substrates but less in the case of masonry; very limited studies have been conducted to analyze the bond between Fiber Reinforced Cementitious Matrix (FRCM) strengthening systems and masonry.
Due to the growing use of FRCM as strengthening systems of masonry structures, mainly historical and monumental masonry buildings, the analysis of the FRCM/masonry bond is essential for a reliable design of strengthening systems.
In the present paper, results of an investigation, both experimental and theoretical, on bond between FRCM materials, made by Carbon fabric meshes embedded in a cement based matrix, and the masonry are presented and discussed.
A total of eighteen clay brick specimens strengthened with a single layer of Carbon FRCM, were tested under single face shear tests under the ambient temperature of *20°C*. In order to evaluate the influence of the bond length and to identify an effective anchorage length, different bond lengths (L_b*=150, 200, 250* and *300 mm*) of the C-FRCM reinforcement were considered. The width of reinforcement, b_f, was equal to *50 mm* for all tested specimens.
Results of the analysis, presented and discussed in the paper, make possible:

i) to determine the bond strength and the failure modes of the masonry strengthened by the FRCM system,
ii) to evaluate the influence of mechanical and geometrical parameters involved in the masonry/reinforcing system transfer mechanism on the local bond-slip law.

CODE 2.2.15

MORPHOLOGIC ADAPTATION AND BEHAVIOR OF PLASTER FOR THE RESTORATION OF ADOBE WALLS IN THE CITY OF LOJA, ECUADOR

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KEYWORDS: Cultural heritage, constructive technology, plaster.

ABSTRACT

During the process of restoration of adobe walls, the application of plaster or coating is common based on binders hydraulic; demonstrating soon cracks and landslides, which raises the question of quality of the plaster. Then arises the problem of proper dosage and application technique; In addition, the problem is aggravated due to lack of raw materials, quarrying and skilled craftsmanship.
The work focuses on the plaster for adobe walls, the objective is to determine the types of soils and dosages suitable for making plaster that guarantee the technical application in the restoration of adobe walls in the town of Loja, Ecuador. After the geological survey was selected five strategic locations within the urban limits of the city for the extraction of soil samples. On the basis of dosages used in previous restoration processes, arises produce soil samples identified 2 dosages based on land which are applied in adobe and the behavior is analyzed for 30 days to open space and covered space.
The results of morphological adaptation and behavior show that analyzing the 2 plasters based on land, on the experimentation of dosage with each of the five samples of soil, is detected that 3 dosages do not have suitable characteristics of behavior in the adobe, she is evidenced from small cracks to the total detachment of the plaster. However, 2 dosages present excellent results since cracks are not evident and it lacks of landslides.

CODE 2.2.16

TECHNOLOGY AND CONSERVATION OF IRON DOORWAYS AND RAILINGS IN BUILT HERITAGE: A CATALOGUE FOR EASTERN SICILY

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KEYWORDS: Wrought ironworks, eastern Sicily, conservation, construction history.

ABSTRACT

In the eclectic architecture of the late nineteenth century, a decisive role in the facades is taken from doorways, in turn framed by towering stone portals. These doorways are wooden, usually. In Eastern Sicily, and specifically in the area around the volcano Etna, the ongoing research investigates a particular local declination of this building component: the iron doorways. While the wrought iron gates are classified in large repertoires crossing time (from the XIV century at the beginning of XX) and space (all European countries and the United States), the iron doorways instead are much less frequent and quite not documented, both in magazines and in the manuals. Their spread in the historic center of Catania and in the foothill area, is justified in the prosperous industrial Catania of fin de siecle, when many foundries and blacksmith shops were operating here. This paper investigates the technological system adopted in iron doorways and on their conservation status, identifying constructive solutions and recurrent decay. The objective is that of a conscious conservation of these particular elements of buildings that avoids their replacement, often banal and inaccurate.
An even broader repertoire for formal solutions adopted is what interests the railings: the eighteenth-century types "petto d'oca" or "ventriera", to the elaborate panels in cast-iron, railings always complement the building facades through participation in the urban spectacle with which the Sicilian cities appeared in the eyes of admiring visitors. Even for the railings we investigated the procedures of building and assembly and present decay, to achieve a classification as a tool in preparation for intervention.

CODE 2.2.17

CHEMICAL AND PHYSICAL CHARACTERISATION OF THREE NHL 2 BINDERS AND THE RELATIONSHIP WITH THE MORTAR PROPERTIES

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KEYWORDS: Mortars for conservation, natural hydraulic lime, chemical and physical properties.

ABSTRACT

In conservation works, the physical properties of mortars, such as compressive strength and porosity, are by far the most important for compatibility with, and protection and durability of historic fabric. The classification of Natural Hydraulic Lime (NHL) binders by the EN 459-1, gives little information about these properties for mortars, due to the unrepresentative nature of the standard samples used to categorise these binders, especially after 28 days of aging. As a consequence, although important for quality assurance and consistency of binder production, the standard test tends not to reflect the performance of mortars as made and used on-site, since these use different aggregates and water/binder ratios.

In this work, three types of NHL 2 were analysed. These binders were characterised by means of X-ray diffraction and X-ray fluorescence. In addition to chemical tests, the surface area and bulk density data were also obtained. Mortar samples were manufactured using a sand aggregate which is appropriate for a conservation mortar with 1:2 ratio (binder:aggregate by volume). Sufficient water was added to produce a spread by flow table of 165±10 [mm]. The chemical and physical properties of the binders were related to the physical characteristics of the mortars.

The chemical and physical properties of different binders with the same NHL classification were found to vary greatly as did the properties of mortars at ages of 7, 14, 28, 90 and 180 days made with those binders. The need to develop a model to predict the performance of aged mortars based on the chemical and physical properties of the binders was identified.

CODE 2.2.22

EFFECT OF LIMESTONE AGGREGATE ON THE PROPERTIES OF NATURAL HYDRAULIC LIME MORTAR (NHL 5)

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KEYWORDS: Portland limestone aggregate; NHL 5; mechanical and hygric properties.

ABSTRACT

Although the properties of mortars depend mainly on the binder nature, the aggregate plays a role. There are contradictory reports on the effect of limestone aggregate on lime mortars, probably due to the use of different lime binders and the wide range of limestones used to manufacture aggregate. This paper studies the influence of Portland limestone aggregate on NHL5 mortars and compares them with siliceous aggregate mixes.

The aggregate's mineral composition (calcitic vs siliceous) does not affect the properties of NHL5 mortars to a great extent. The results suggest that the limestone aggregate mortars have a greater number of larger, active open pores, while the silica sand mortars include a greater number of fine, suction-active pores probably associated with the NHL5 binder. These would agree with the greater porosity and suction of the limestone aggregates, displaying porous surfaces and the smooth, impermeable surfaces of brittle fracture in the silica sand determined with SEM.

At low aggregate contents, the silica sand mortars are stronger in compression and flexion than the limestone sand mortars however, at greater aggregate contents, the limestone sand mortars are stronger. Some authors found a strength increase in lime mortar using limestone aggregate however, results are not comparable due to the use of different lime binders, limestone aggregate types and water/binder ratios. Rather, as the NHL5 includes significant clinkers, the results here are linked to PC research. As a result, the fine limestone aggregate powder probably provides a favourable surface for the nucleation and early growth of calcium silicate hydrate, enhancing hydration and strength development in the NHL5 paste. In addition, the coarser limestone aggregate, may enhance strength, by reaching a higher bond at the interfacial transition zone, due to the auspicious physical (texture), reactive nature and high suction of the limestone surfaces.

Both the siliceous and limestone aggregate mortars follow similar trends when increasing aggregate content: As the aggregate content increases, the compressive and flexural strengths drop however, porosity, water absorption and capillary suction increase. These effects are probably on account of the multiplication of interfaces or transition zones which are discontinuities in the structure of the composites.

CODE 2.2.23

EXPERIMENTAL ANALYSIS OF ADOBE-MUDBRICK AND BAMBOO PANELS: REVALUATION CASE OF ANCIENT CONSTRUCTIVE TECHNIQUES FROM SOUTH AMERICA

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KEYWORDS: Bamboo, anti-seismic strength, structural joints, traditional constructive techniques.

ABSTRACT

Bamboo and heart are traditionally used for construction in Latin America.
They present many advantages in the environment, technological and structural field, but they also have some disadvantages that can limit their diffusion.
The first technical problem regarded the question of structural union between bamboo poles.
Usually bamboo structural unions are made with nails and bolts. These elements break through the low cane thickness and cut the longitudinal fibers that give to bamboo his tensile strength. So this method reduces the bamboo resistance.
This research aims to realize a structural union that can guarantee a good resistance without breaking through bamboo cane. This union is made with lashings of ropes, a traditional technique of Eje Cafetero region, Colombia. To evaluate the structural union behaviour a bamboo structure was realized. It was constituted by two vertical columns and a horizontal beam. The beam was loaded along the center line with a concentrated load. During the test the displacements of all the elements were measured.
Then the research has investigated the possibility of applying an external bamboo reinforcement made with lashing of ropes to a mud-brick wall.
The study has evaluated the capability of bamboo reinforcement to contain the mud-brick wall in the case of horizontal stresses (like earthquakes).
The structure was stressed with a linear distributed load along the center line of the mud-brick panel, perpendicular to the wall plane. This stress state is similar to the conditions that can appear during a seismic event.
Due to the good results of experimental tests, conducted with 1:4 models in the laboratory, the solution has been applied to the prototype design of a low environmental and technological impact housing, that can guarantee an high structural safety level.

CODE 2.2.24

EXPERIMENTAL STUDY OF MECHANICAL AND PHYSICAL PERFORMANCE OF THERMAL MORTARS

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KEYWORDS: Performance, prototypes, tests, thermal mortars.

ABSTRACT

Mortars performance is studied in this paper through an experimental study applied on wall prototypes. Nine mortars were produced, with different compositions, by varying the aggregate (expanded cork, expanded clay, silica aerogel). All mortars show sufficient low thermal conductivity to be classified as thermal mortars according to the EN 998-1 standard. The following tests were carried out: bulk density, flow table workability, surface moisture, thermal conductivity, and pulse velocity; water permeability, adhesion test (pull-off), pendulum hammer and surface impact test (Martinet Baronnie). The mortars thermal behavior was also characterized through different rendering wall prototypes monitored with thermocouples, fluxmeters and thermohygrometers in a climate chamber with temperature control on one environment and with heat flux measurement.
This paper presents and discusses the mechanical and physical performance results of the applied thermal mortars on brick walls prototypes. This study is within the research project Nanorender PTDC/ECM/118262/2010 - Performance of silica aerogel-based renders.

CODE 2.2.26

THE REINFORCED CONCRETE AND THE HAPSBURG FORTRESSES: EXPERIMENTATION AND INNOVATION.

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KEYWORDS: Concrete, technological evolution, experimentation, innovation.

ABSTRACT

During the last decades of the 19th century, the volatile geopolitical configuration of Europe and changes in war tactics and weapons led to the construction of a new defence system. Forts, fortified roadblocks, infrastructure, trenches etc. were constructed in just a few years.
To abbreviate construction times, design and construction were standardised, in line with the concept of industrialisation gaining ground during the 19th century
The need to rapidly build strong new military structures led to heavy use of concrete. This stimulated experimentation to improve its composition by including siliceous, basaltic or granitic aggregate, accelerators, setting additives etc.. Systems were then studied to improve steel/concrete adherence, for example, by introducing hooks at the ends of the smooth bars.
Through reading military manuals and technical design documents for the construction of fortifications it means deduce the evolution process of the concrete and construction elements made of this material.

CODE 2.2.28

AN EXPERIMENTAL MODEL FOR REHABILITATION RENDERING MORTAR SUBMITTED TO RISING DAMP

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KEYWORDS: Rehabilitation, rendering mortar, rising damp, modeling.

ABSTRACT

This paper presents an experimental study to observe and modelling the rising damp of rendering mortars used to rehabilitate buildings. Cement-lime based mortars with different binder's composition and aggregates volume were proposed to explore several voids sizes variation on mortars. The mortars binders were composed by cement and three additions, such as hydrated lime, artificial hydraulic lime and quicklime paste. A rendering mortar mass proportions 1: 1: 6 (cement : lime : sand) was chosen as the reference mortar. In the other mixtures (1:0.33:3.7 - 1:1:7 - 1:4:14), here studied, the type of addition was varied to compose the following binders: cement + hydrated lime (CHA), cement + artificial hydraulic lime (CHB) and cement + quicklime paste (CV). The results of the wetted area by capillary water absorption of mortars on masonry panels were determined. From these correlations it was possible to build a mathematical water rising damp model and identify the mortars parameters that could be used to select a composition towards a good performance. The best performance was give by CHB mortar type and the mix proportions with higher aggregates/binders ratio. The results analysis had demonstrated that water rising damp can be modeled as masonry wet area which evolves logarithmically with time.

CODE 2.2.29

AN ASSESSMENT OF RAW MATERIALS FOR EARTH CONSTRUCTION IN COUNTY OFFALY, IRELAND

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KEYWORDS: Cement stabilisation, lime, plastic index, compressive strength, shear strength, shrinkage, grading.

ABSTRACT

This paper investigates the suitability of Irish soil for earth construction in Rhode, Co. Offaly, in an effort to provide sustainable construction alternatives to a currently unsustainable building sector of high energy demand and increasing CO2 and pollutant emission. The soil used to build a traditional earth farmhouse in Rhode was studied. The soil is too low in sand and too high in fines when compared to the optimal grading for soils for building. The liquid and plastic limits and the plastic index are lower than those considered optimal for unstabilised soils for rammed earth construction. The average linear shrinkage of the soil was lower than expected given the high amount of fines, but slightly higher than the maximum permissible values reported by some building standards. However, there was no visible cracking in any of the specimens. The low plasticity index and the low shrinkage determined suggest that, even though the soil is high in fines, these are mainly inert silts and perhaps clay minerals that do not swell.
Cement stabilisation increased the shear strength and cohesion of the soil more significantly than its compressive strength. The 15% cement stabilised earth reached the highest strength followed by the control samples which consisted of earth only however, the strength increase wasn't significant. The lime stabilisation, along with the 5% cement stabilisation caused strength loss. The drop in compressive strength and the low strength increase by the highest stabilisation are likely due to the high fine content of the soil raising the water demand and, consequently, not enough mixing water being present for hydration in the cement samples and carbonation in the lime earth soils during curing.

CODE 2.3.02

INCORPORATION OF STRAW AND RICE HUSK IN MORTARS: STUDY OF ITS BEHAVIOR

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KEYWORDS: Mortars, sustainable mortars, use of residues, straw and rice husk.

ABSTRACT

The cultivation of rice was introduced in Portugal during the reign of King Dinis, on the Lower Mondego, in Montemor-o-Velho area.
The Low Mondego still has, nowadays, a long tradition in the production of rice and associated industries, generating however, annually, a large amount of waste.
The provision of this and other types of waste that are of urban, agro-industrial or industrial origin, has worsened in the last decades, which has triggered a huge concern for its reuse.
In a constant demand for waste recycling some studies trying to analyse the feasibility of incorporating husk and rice straw in some constructive elements like blocks and lightweight concrete panels have been developed.
Due to the fact that shell / rice straw have a set of favourable characteristics such as low specific weight, low density, slow biodegradation and a composition rich in silica and fibres, the obtained elements have light weight, acoustic absorption and thermal insulation.
Aiming to reuse the waste from rice cultivation and trying to improve the thermal behaviour of mortars several compositions with introduction of straw and husk were characterized.
Due to the encouraging results founded we present, in this article, the characterization obtained.

CODE 2.3.03

DESALINATION OF HISTORICAL BUILDINGS AND ARCHAEOLOGICAL PIECES BY MEANS OF REDUCING BACTERIA

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KEYWORDS: Heritage conservation, desalination, soluble salts, salt crystallization, reducing bacteria.

ABSTRACT

Being the extraction of the soluble salts or desalination one of the main problems for heritage conservation and taken into account that multitude of methods to eliminate or diminish its presence have been developed along the last decades, this operation continues to be a not solved problem. This is due to little effectiveness or technical and/or economic unfeasibility of the actual methods, being limited to a merely superficial elimination, in case they provide certain degree of effectiveness.
This work is just a part of the bioremediation "BACTEROSAL" project whose main objective has been the development, validation and implementation of a novel technology, based on the use of new generation reducing bacteria, capable to effectively eliminate soluble salts inside historical building materials, sculptures and archaeological pieces.
Taken existing bacteria living normally in our surroundings (Ej.: ground and water), and after a sequential process of "screening", a set of powerfull sulphates and nitrates reducing bacterial with a high desalination power have been obtained in our laboratories, designing simultaneously cultures media properly adapted for their optimal development. The degree of effectiveness of "finalists" bacteria has been tested with different types of stony materials (sandstones, limestone and mortars) at different scales (samples→ ashlar → building), obtaining in the "in situ" tests effective desalinations 10-15 cm of depth, and reductions of soluble salts content around 70% in weight.

CODE 2.3.05

VIRTUAL PLATFORM FOR DESIGNING, PLANNING, CONTROL, INTERVENTION AND MAINTENANCE IN THE FIELD OF THE CULTURAL HERITAGE CONSERVATION- "PETROBIM"

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KEYWORDS: Cultural heritage, heritage management, 3D models, BIM, 3D graphics viewers.

ABSTRACT

From emblematic historical-artistic sites included in the World Heritage Sites by UNESCO to thousands of monuments all over the world, in their corresponding architectural projects, master plans, technical studies, memorandums, conservation plans, management and dissemination of cultural heritage, delineated graphical drawings or three-dimensional graphical archives (3D) provide very limited information respecting to their presentation, exploitation and graphic queries or data. In addition, the successive interventions works that take place through the years on a single monument, generate a large amount of information written and graphical documentation, printed or digital outputs, different file formats, all handled by different technicians over the years, make extremely difficult handling, storage, analysis and update.

In order to solve these problems arise PetroBIM, a virtual platform, created by means of own technology [WOB: "Walking On BIM"], based on a powerful but friendly management and consultation tool that allows to convert, designing, planning, control, intervention works and maintenance plans, the whole information linked to master plans, and conservation projects, from cultural heritage (all along the studies on a given monument), onto a live single 4D model, thanks to data base linked to BIM 3D models and a specific developed technological front-end display which allows to users, walking and interacting with the model, create virtual sections, update information and provide filters for previously loaded graphical and digital consultations.

CODE 2.3.11

SHOTCRETE IN REPAIR AND REHABILITATION PROJECTS

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KEYWORDS: Shotcrete, dry-mix process, wet-mix process, high performance shotcrete, seismic retrofit.

ABSTRACT

Shotcrete, also termed in Europe sprayed concrete, is a concrete pneumatically projected at high velocity onto a target surface. The material component of shotcrete is essentially concrete or sometimes mortar, but its technology is different from that of traditional concrete. In the over than100 years since the shotcrete process was developed, shotcrete has gradually played a valuable role in repair and rehabilitation projects mainly in the United States and North America. Compared to cast in place concrete, shotcrete is particularly advantageous in situations when formwork is cost prohibitive or impractical and where forms can be reduced or eliminated, access to the work area is difficult, thin layers or variable thicknesses are required or normal casting techniques cannot be employed. Moreover, the excellent bonding of shotcrete to surface of other damaged materials such as aging concrete, masonry surface, wood, steel structure is another useful property to perform effective and durable remedial work. The force of the impact of this pneumatically propelled material on the surface causes compaction of the shotcrete paste matrix into the fine surface irregularities and results in good adhesion to the surface. Properly applied shotcrete is nowadays a proven and durable repair material characterized by high strength, low absorption, good resistance to weathering and resistance to some forms of chemical attack. This paper describes the two techniques of shotcrete application, the dry-mix process and the wet-mix process, and presents the most recent advancements in the materials technology through which it is nowadays possible to use in rehabilitations and repairs high performance shotcrete, overcoming the drawbacks of conventional shotcrete. Between the over a hundred publications in the technical literature detailing shotcrete technology, the use of shotcrete in seismic retrofit in California has been chosen as case history example to illustrate the shotcrete evolution over the time and its peculiar strengths in repair and rehabilitation projects.

CODE 2.3.13

DRONES IN THE ARCHITECTURAL REHABILITATION. PREVENTIVE CONSERVATION IN EQUITY

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KEYWORDS: Drones, RPAS, inspection, preventive conservation, architectural rehabilitation.

ABSTRACT

Inspection and Maintenance must be the words par excellence related to the architectural rehabilitation. The premises that should exist in all actions concerning to rehabilitation should be twofold: prevention and diagnosis. It must be a priority in any historical monument or building an action plan for possible damages that appear throughout life. Technology has given us guidelines so that we can deal with a good inspection of our heritage, especially in areas of difficult access that can be more fragile by inclement weather or the proper orientation of the building. We believe that the methodology to be followed is that of the development of Flight Plans by technology RPAS or drones. The role of the application of drones in the Rehabilitation has several reasons. The first is the development of an Action Plan prevention, that is to say the development of technology frame recording maximum resolution and appreciating the existence of pathologies and study them retrospectively. Second, working with pictures from five to eight megapixels to visualize how far pathology reaches and being able to distinguish cracking, or even the collapse of the construction detail studied. And third and finally, developing thermographic studies to observe the appearance of damp in any constructive point and interpret their study to lead the result into a diagnosis and subsequent intervention evaluation. In short, we believe that technological advances with drones are the future in preventive conservation of all types of historical building but with more prominence in Monuments with high altitude, where there is no real view from ground level; this technology can give optimum results in order to improve maintenance and inspection of our heritage and thus develop a true diagnosis of the detected pathology.

CODE 2.3.15

COMPARATIVE ANALYSIS OF OXIDE CONTENT IN PORTLAND CEMENT AND SLUDGE FROM DRINKING WATER TREATMENT PLANTS

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KEYWORDS: Composition, XRF, sludge utilization, mortars, cement.

ABSTRACT

In order to mitigate the environmental impact caused by sludge dumping generated in water treatment processes, its use was sought in the development of building materials. This paper oxides concentrations in two types of sludge from drinking water treatment plants were determined and compared with concentrations thereof in portland type cement, this in order to assess the impact of concentrations of oxides in compressive strength of modified materials. These sludges were selected because previous research, in which the potential of use as raw material for the manufacture of mortars was determined, the strengths obtained ranged from 566 ± 29 psi and 1668 ± 29 psi.
Research development was conducted in four stages: 1. Sampling and sludge drying. 2. Analysis by X-ray fluorescence (XRF) of samples of the two types of sludge and cement. 3. Statistical analysis of results obtained by a t-test for the mean difference. 4. Discussion of results.
We conclude that there is statistically significant difference in concentrations of CaO, SiO2 and Al2O3 in sludge and Portland cement type.

CODE 2.3.18

EXPERIMENTAL STUDY ON USING BIODEPOSITION IN MORTAR SURFACES

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KEYWORDS: Biodeposition, consolidation, porosity reduction, bacteria, surface.

ABSTRACT

Biodeposition consists in the deposition of calcium carbonate produced by the biological activity of bacteria. This recent technique is been used mainly for treating construction materials such as stones and concrete, or for cementation of soils. This paper presents the main results from a study performed to investigate how biodeposition in mortar surfaces affects some properties relevant when this material is used in construction, such as permeability to water vapor, water absorption by capillary and surface roughness. The treated specimens were cured submerged in medium containing bacteria, urease enzyme and the feeding solution, while the untreated ones were cured submerged in tap water or adopting standard curing proceeding in a room with controlled relative humidity. Treatment efficiency was evaluated by comparing the results found for the treated and untreated samples. Data was interpreted considering pore size distribution and density in the hardened state. These preliminary results are very promising because they show improvements in the characteristics of mortars subjected to biological treatment, especially when using the enzyme isolated from the bacteria.

CODE 2.3.20

IS IT TIME FOR NEW APROACH ON HISTORIC BUILDING PRESERVATION OR CONSERVATION PROJECT?

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KEYWORDS: historic building, conservation project, database, knowledge management.

ABSTRACT

Historic building conservation projects are different than projects of new buildings. There are represent old and new, materials, technologies, and contain many information and knowledge. During the time of conservation unpredicted things had been discovered many times. Usually is not enough time to explore the building and the project represents risk to the owner and the contractor. If project managers be able avoid uncertainties, they need a mass of data, arising from the knowledge of the object, and to ensure that there are no errors in the functioning of the system. In the other hand, other managers (for example maintenance managers, etc.) also need a good knowledge of the buildings. In many countries collecting the data in not going on systematic way, but engineer's who reconstructing building whish more supports in first phase, when analysing the object. Information or knowledge about existing building could get find with allowing support technologies, like an artificial intelligence. Many countries in EU are not regulated their legislation with DIRECTIVE 2014/24/EU on public procurement yet. In this Directive »Member States for public works contracts and design contests may require the use of specific electronic tools, such as of Building Information Modelling (BIM) tools or similar«. With Directive investment get an opportunity to introduce BIM models also in reconstruction projects. In this paper presenting how we started to collected the data, exactly objects properties from specific buildings (Faculty of Civil Engineering and three others Faculties) in Maribor in Republic of Slovenia. We showing how databases could be applied to better use existing knowledge and experience in the new projects.

CODE 2.3.21

DESIGN OF AN ANCHORAGE SYSTEM FOR STONE CORNICES

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KEYWORDS: Stone cornice, individual anchorage, finite element method, destructive testing.

ABSTRACT

Cornices are pieces placed in almost all historical buildings. They are usually damaged by weathering, so they must be totally or partially substituted in many restoration works.
Cornices are usually composed by huge stone pieces, so they are heavy and hard-to-handle elements. This paper presents a new system to anchor stone cornices. The shape of the cornice is specially designed for being divided into pieces. These design solves the problem that implies the high weight of cornices. The anchorages can be place by only one person. The system can be used with different types of stone and with different measurements of cornices.
The description of the system, its design and its analytical and experimental analysis are the main goal of this paper.

CODE 2.3.22

MHS LAB, A LABORATORY FOR CULTURAL HERITAGE

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KEYWORDS: Monitorization, sensors, test, preventive conservation.

ABSTRACT

The development and implementation of the MHS Lab has been promoted by the Council of Culture and Tourism of Castilla and Leon, through the Santa Maria la Real Foundation, under the North Romanesque Intervention Plan and it is seen as an experimental space, oriented to applied research of the study of the behaviour of materials, products and processes in Cultural Heritage.
In this context, the chapel of Santa Maria de Canduela has become a Heritage laboratory, renovated and equipped with the infrastructure and equipment necessary to perform the tests. The solutions made to the challenges during the implementation of the laboratory have yielded a center for sustainable experiments and self-sufficient, from an energy standpoint, and capable of accommodating a wide variety of experiments.
The first experiments have been launched with the participation of the Conservation and Restoration of Cultural Heritage of Castilla and Leon Center and the College of the Preservation and Restoration of Cultural Property of the Community of Madrid. Monitoring and control of these experiments are based on the use of the MHS system as a tool specially adapted to the Cultural Heritage.

CODE 2.3.27

POLYMER SURFACE COATING FOR PLASTER MADE WITH LADLE FURNACE SLAG WASTES

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KEYWORDS: Plaster, slag, durability, coating, surface modification.

ABSTRACT

Gypsum is a binder material commonly used in masonry as a finish coating. The aim of this work is based on incorporate in plaster mortar as aggregate ladle furnace slag generated in steelmaking processes. On the other hand and with the intention of improving the resulting materials, this research analyzes the behavior of the modified surface with a protective polymer coating. It has been studied the reactivity of gypsum-slag interface in terms of morphology of gypsum crystals, the distribution of the polymer phase and the porosity of the material. The research carried out establishes that the porosity decreases with polymerization grade, but increases with the concentration of slag. Moreover, the variation in flexural and compressive strength and final physical properties are studied before and after treatment protector.

CODE 2.3.28

MORTARS DOSED WITH SLAG AGGREGATES FOR APPLICATION IN EDIFICATION AND RESTORATION

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KEYWORDS: Steelmaking slags, electric arc furnace slag EAFS, ladle furnace slag LFS, slag aggregate, masonry mortar.

ABSTRACT

The research developed in this work includes a study on the joint use of ladle furnace slag (LFS) and electric arc furnace slag (EAFS) in the manufacture of masonry mortars, for their use in construction and rehabilitation. A specific particle size aggregate is designed for all mixtures tested, so that the % of passes accumulated is the same in each of the sieves and that natural sand of reference mortar as well as designed sand from the partial substitution of the sand by steelmaking slags, present identical fineness modulus. The mortars obtained are characterized in fresh and hardened state following the test protocols of the applicable European regulations. The results obtained in mortars dosed with slag aggregates are compared with the properties of a reference mortar dosed with natural aggregates. From the comparative study it can be shown that steelmaking slags, ladle furnace slag (LFS) and electric arc furnace slag (EAFS), could be used as an alternative to natural aggregates in the manufacture of masonry mortars, making value an industrial waste landfilled with the consequent impact on the environment.

CODE 2.3.30

EARTHQUAKE SAFETY OF HISTORICAL URBAN FABRICS: A COMBINED APPROACH INCLUDING HUMAN BEHAVIOURAL ASPECTS

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KEYWORDS: Heritage preservations, earthquake risk assessment, evaluation for earthquake evacuation, exposure parameter investigation, evacuation simulation software.

ABSTRACT

The majority of Italian historical city centres is placed in earthquake prone regions. Their complex urban fabrics, ancient buildings heritage and high population densities imply a high importance of man-environment interactions while facing with risk reduction strategies: a "behavioural design" approach should be introduced. Historical buildings analyses and previsions of post-earthquake modifications should be combined to the "human" factor influence: a similar approach should efficiently provide evaluations about urban risk assessment, evacuation procedures management, interventions planning on critical heritage. This study is aimed at combining current methodologies to the "human" factors influence during both event and evacuation stages. A model for earthquake evacuation simulation is proposed. The prevision of building damages is proposed according to EMS and vulnerability studies; real earthquake evacuation are analysed in order to define evacuation behaviours and physical quantities in motion. A multi-agent architecture allows to trace man-environment interactions and individual's emergency choices, while the social force model describes people motion in the urban scenario towards safe areas. Software implementation is performed and initial tests (on an Italian historical centre) demonstrate the possibility to simulate the human behaviours (in both quantitative and qualitative ways) retrieved by empirical data. The model is proposed for evaluating probable pedestrians' choices in different scenarios, and checking solutions for reduction of interferences between human evacuation processes and built environment. Operative design strategies for interferences reduction could be proposed on model previsions: punctual interventions on particular buildings placed in strategic evacuation points can be evaluated in order to decrease the vulnerability of both historical buildings and historical urban fabric.

CODE 2.3.31

FRP CONFINEMENT OF STONE SPECIMENS AFTER HIGH TEMPERATURE EXPOSURE: EXPERIMENTAL TESTS

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KEYWORDS: FRP, confinement, stone, high temperature.

ABSTRACT

The behaviour of columns confined with Fibre Reinforced Polymer (FRP) composites has been studied extensively in recent years. Most research has focused on the performance of confined concrete but at the moment only a few investigations have been carried out about strengthening of stone or masonry elements. In this work the behaviour of San Julian's stone (a calcarenite widely used in most historic buildings from the city of Alicante, SE Spain) reinforced by FRP confinement after high temperature exposure is studied. A total of 36 cylindrical samples, with a diameter of 72 mm and 180 mm high, were prepared. The samples were heated in an oven to temperatures similar to those of a real fire and then cooled in two different ways: air cooled at laboratory temperature and water cooled by quick immersion in order to study the influence of the extinction method. Some samples were left unheated, as reference specimens. Two different FRP wrapping systems were used: carbon and glass unidirectional fibre fabric, embedded in epoxy resin. Results show a remarkable effectiveness of the FRP reinforcement, obtaining significant increases in strength and ductility in confinement elements compared to unreinforced samples.

CODE 2.3.33

INTEROPERABILITY BETWEEN BIM MODELS AND PRONIC APPLICATION: REHABILITATION OF A PUBLIC BUILDING

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KEYWORDS: BIM, ProNIC, rehabilitation, interoperability, information systems.

ABSTRACT

The use of information management systems allows the registration and storage of data throughout all phases of the construction life cycle, improving the quality, coherence and accessibility. It is unquestionable that BIM models (Building Information Modeling) are a reality to consider with extremely important contributions, not only for new constructions but also for the rehabilitation of the existing ones. The integration of BIM models with other information systems to support the construction process is important to spread their use. ProNIC (Portuguese abbreviation - Protocol for Standardization of Technical Building Information) provides an important contribution with technical and economic structured and standardized information. In addition, ProNIC is already developed to work in a collaborative environment for all stakeholders. This paper aims to present a methodology proposal for structuring the interoperability between information systems, with regard to the area of construction management, applied to BIM models in association with ProNIC for rehabilitation contracts. A case study corresponding to BIM and ProNIC implementation in the rehabilitation project of a building located in Lisbon metropolitan area with will be presented.

CODE 2.3.35

EXPERIMENTAL STUDY OF CONCRETE SELF-COMPACTING WITH RECYCLED AGGREGATES IN A COMPANY OF PRECAST, AN EXAMPLE OF SUSTAINABILITY

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KEYWORDS: Self-compacting concrete, recycled aggregates, sustainability, precast.

ABSTRACT

The purpose of this work is to determine the suitability of incorporating recycled aggregate from waste and rejections of his own material, self-compacting concrete in precast elements to add back to the production of new precast armed and prestressed.
To do a complete characterization of the new aggregate obtained is performed. Two dosages (HR-30 and HR-45) are designed using self-compacting concrete to encompass the full range of resistant prefabricated elements.
In the laboratory tests for determining their mechanical properties, later, are performed in a next phase, test their durability properties against.
The analysis is completed by checking on an industrial level aspects described above, including examining different precast concrete made with the object of this study and checking their behavior to bending, shear and deferred deformation.
The impact at the economic level which is the incorporation of new concrete with recycled aggregate concrete compared to the reference usually used is also considered.

CODE 2.3.36

RECYCLED CONCRETE PERFORMANCE IN AGGRESSIVE ENVIRONMENTS

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KEYWORDS: Concretes, recycled aggregate, performance, impermeability.

ABSTRACT

Durability is a key property in concrete structures due to the economic, safety and environmental impact of repair and maintenance operations undertaken during their service life. That is a particularly topical issue, given the efforts presently being deployed to develop concretes that include clay-based, construction and other types of industrial waste in their design. This study aimed to assess the performance of concrete in which part of the coarse aggregate was replaced with recycled ceramic waste. The first stage consisted in collecting and subsequently crushing the waste to the desired particle size. In the second, the physical, chemical and mechanical properties of the recycled coarse aggregate were determined and found to meet the requirements laid down in the existing legislation. Lastly, the concrete designed and manufactured with the recycled waste was tested for mechanical performance and impermeability to pressurised water. The findings showed that recycled aggregate is apt for use in the manufacture of sustainable and durable concretes.

CODE 2.3.37

DESIGN OF NEW CEMENTITIOUS MATRICES WITH GRANITE INDUSTRY WASTE

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KEYWORDS: Cements, performance, granite.

ABSTRACT

The Spanish region of Extremadura, the country's second largest producer of granite, holds a prominent position in the ornamental stone industry thanks to its geological characteristics and their exploitation. Granite quarrying and hewing entail the generation of large volumes of waste whose stockpiling in uncontrolled rubbish tips constitutes a significant environmental problem in the region. This study aimed to design new cementitious matrices by using different percentages of granite industry waste as an addition in the manufacture of new, more environmentally respectful cements. The waste was first characterised physically, chemically and microstructurally to assess its aptness for use in the cement industry. Those findings and the physical and mechanical characterisation of the cement matrices showed the new materials to be European standard EN 197-1-compliant in those respect and to exhibit no material physical or mechanical differences with conventional cement.

CODE 2.3.38

DESIGN OF NEW BLENDED CEMENTS WITH SANITARY WARE-BASED ADDITIONS

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KEYWORDS: Cements, additions, performance, clay-based sanitary ware.

ABSTRACT

Spain's clay-based industry, one of the country's most dynamic manufacturing businesses, is the world's largest producer of sanitary ware and second largest of tile. In light of end product requirements, this industry is characterised by the generation of factory rejects due to breakage, dimensional defects or firing flaws. This study explored the feasibility of reusing such solid waste as a pozzolan in the manufacture of ordinary grey cement to lower the consumption of natural resources and CO2 emissions. The waste collected was conditioned (reducing the particle size, drying...) in the laboratory, where it was characterised physically, chemically and microstructurally. The subsequent physical and mechanical characterisation of the new eco-efficient cements designed revealed that sanitary ware rejects can be used as additions in the cement industry.

CODE 2.3.39

REUSE OF UNBURNT CARBON FROM BIOMASS IN NEW CEMENT DESIGN

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KEYWORDS: Cements, properties, unburnt carbon.

ABSTRACT

In response to Spain's domestic energy problem, biomass plants have been established across the country in the last 10 years in an attempt to transform forest or crop waste into electric power via a more or less complex industrial process. Along with energy, the process generates a certain volume of waste (unburnt carbon and similar) that is presently sent to authorised waste management facilities for controlled stockpiling. This study explored the viability of reusing the unburnt carbon generated as a partial addition in cement manufacture, in keeping with European sustainability policies. The waste was collected and subsequently characterised physically, chemically and microstructurally to ascertain its possible applicability in the cement industry. That was followed by a study of the physical and mechanical properties of the new eco-efficient cements, whose performance was not found to be adversely affected by the inclusion of these new additions.

CODE 2.3.41

STUDY OF THE INFLUENCE OF THE RECYCLED AGGREGATE IN THE ACTIVATION ENERGY CALCULATED ACCORDING TO THE METHOD OF EQUIVALENT MORTAR OF THE ASTM

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KEYWORDS: Activation energy, recycled concrete aggregate, eco-concrete, mortar, maturity.

ABSTRACT

According to the ASTM C1074-11 Standard, the activation energy for the maturity method can be estimated using an "Equivalent mortar" in which the quantity of coarse aggregate is replaced with equivalent fine aggregate according to a relationship defined in the ASTM Standard. Therefore, according to this definition, the type of coarse aggregate does not have influence on the activation energy, so it could be deduced that the activation energy does not vary when replacing part of the coarse natural aggregate with coarse recycled aggregate. To analyse the possible influence of the percentage of recycled aggregate in the activation energy, it has been studied the activation energy of self-compacting concretes with coarse recycled concrete aggregate, using the equivalent mortar. In order to simulate the influence of the coarse recycled aggregate, it has been studied the equivalent mortars using fine recycled aggregate for the fraction of sand that corresponds to the coarse recycled aggregate according to the definition of equivalent mortar; calculating, for each dosage, the activation energy according to the method of the ASTM of the equivalent mortar and comparing the energies obtained. To complete this investigation, it has been studied the influence of fine recycled aggregate in the development of compressive strength of mortars, according to the curing temperature, with the aim of achieving a greater understanding of the influence of recycled aggregates in the maturity of concrete and in the development of the compressive strength in mortars.

CODE 2.3.42

USE OF FINE AND COARSE RECYCLED AGGEGATE FROM CONCRETE WASTE FOR THE FABRICATION OF PRESTRESSED PRE-SLABS

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KEYWORDS: Fine recycled aggregate, concrete recycled aggregate, prestressed, pre-slab, precast.

ABSTRACT

The present study analyses the feasibility of the simultaneous utilization of the fine and coarse fraction of a concrete recycled aggregate, from the crushing of discarded pieces in a precast facility, for the fabrication of prestressed pre-slabs. The replacement ratios of recycled aggregates were set to 0, 2, 4, 6, 8 and 10% of the total natural aggregate (fine and coarse) by recycled aggregate. The recycled aggregate was not subjected to any previous sieving process, every concrete mix was fitted according to the sieve size test in order to have a similar grain size distribution to the control concrete. For each of the mixes studied, the compressive strength is tested in 150 mm cubic samples and flexural tests are made in the prestressed pre-slabs, measuring the deflection in mid-span according to the applied force. The results obtained are satisfactory, since the mechanical behaviour is quite similar regardless of the replacement level.

CODE 2.3.43

A REVIEW OF THE DURABILITY ASPECTS FOR SELF-COMPACTING CONCRETE

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KEYWORDS: Self-compacting concrete, carbonation, chloride penetration, sulphate attack, frost durability and salt scaling, fire resistance.

ABSTRACT

This article presents a literature review concerning the durability of self-compacting concrete (SCC), making a comparison between this new type of concrete and the vibrated concrete (VC). The degradation mechanisms that have been considered are: carbonation, chloride penetration, sulphate attack, frost durability and salt scaling, and fire resistance. The carbonation of SCC is not significantly deviating from the carbonation of VC. Cyclic wetting and drying in a chloride containing solution shows significantly lower chloride diffusion in SCC in comparison with VC. The initiation time for sulphate attack is prolonged in SCC compared with an equivalent VC due to a denser microstructure in SCC. Frost action in combination with de-icing salts is leading to similar mass losses in SCC as in VC. SCC has a high probability of spalling when exposed to fire even in a dry environment, so precautions shall be taken when SCC shall be used in situations where no fire spalling is accepted.

CODE 2.3.45

PHASE CHANGE MATERIALS SOLUTIONS FOR REHABILITATION AND ENERGY EFFICIENCY

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KEYWORDS: Rehabilitation, energy efficiency, novelty products, phase change materials.

ABSTRACT

The high energy storage capacity per unit volume at a nearly constant temperature characterizes and distinguishes Phase Change Materials (PCM) from conventional building materials. In a given day, when the ambient temperature rises enough to reach the solid–liquid transition temperature, the PCM, incorporated in a construction element, changes from solid to liquid with endothermic behavior (latent heat) thus limiting the heat flow towards the interior of the building. On the other hand, upon an environmental temperature decrease, the PCM, that is now in the liquid state, may reach the liquid–solid transition temperature (melting temperature) again and shift to solid state, with energy liberation (exothermal process), thus delaying the cooling tendency inside the building. The permanence at a known melting temperature range will stabilize interior ambient temperatures thus influencing the thermal comfort sensation.
In this study we propose the use of PCM for energy rehabilitation of buildings. Exploring different methods of PCM incorporation in building materials and studying its efficiency.
This work consists on the study of the thermal behavior and energy consumption of a building when influenced by the incorporation of PCM. The case study is composed by the computer rooms located at the Faculty of Engineering of University of Porto – FEUP, with the reason of the need of an intervention in those spaces, whose temperature reaches high uncomfortable values during the summer. To accomplish this goal, the building will be numerically simulated through a calculation engine complemented with a user friendly graphical interface. The numerical simulation allows the recreation of various scenarios in the computer rooms with the purpose of understanding the reaction of PCM subjected to different environments.

CODE 2.3.46

STRUCTURAL BEHAVIOUR OF LIGHTWEIGHT COMPOSITE FLOOR WITH FIBER REINFORCEMENT

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KEYWORDS: Composite slab, lightweight concrete, m-k test, structural tests, numerical simulation.

ABSTRACT

The aim of this work is to study the structural behavior of composite slabs made up of steel sheet and lightweight concrete (LC), both experimental and numerical analyses.
On the one hand, structural behavior of composite slabs is studied using dynamic flexural tests. These laboratory tests provide flexural stress of the slabs studied, as well as the shear stress in the steel-concrete interface by means of m-k diagrams.
On the other hand, a finite element model (FEM) of one eighth of the slab was analyzed. This simplification was used due to the symmetry of the boundary conditions of the problem for load and geometry. Steel-concrete interface was simulated using frictional contact model with a frictional coefficient of 0.3. This coefficient of friction was obtained from pull-out preliminary experiments. Isotropic elastic mechanical properties of steel and LC was included in order to simulate their mechanical properties. The Young Modulus of concrete was used to determine vertical displacements as well as validate numerical results.
Finally, experimental results provide several conclusions. Firstly, structural behavior of composite slabs depends on concrete properties, steel deck geometry and their ribs, length of slab and service loads. Secondly, loads that LC composite slabs support are similar to supported loads by normal concrete (NC) composite slabs. In both cases, resistance to longitudinal shear forces are in good agreement. Third, numerical simulations developed in this study were compared to experimental tests. Some discrepancies are provided depending on the concrete stiffness and the geometry of the slabs.
In summary, this work shows the difficulties to simulate steel and concrete interaction in composite slabs. For this reason, different phenomena such as plasticity, crushing or cracking, and the use of crack initiators should be considered in order to improve future numerical models.

CODE 2.3.47

NANOLIME – POSSIBLE APPLICATIONS FOR THE CONSERVATION AND PROTECTION OF THE CULTURAL HERITAGE

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KEYWORDS: Nanolime, stone consolidation, render, silicic acid ester, CaLoSiL.

ABSTRACT

The conservation of stone, mortar, plaster and render, which are typical inorganic components, is a complex task requiring materials compatible both to the originally used components and already realised previous conservations. The number of available materials, however, is limited. Nanolime, a colloidal dispersion of calcium hydroxide nano-particles in alcohols, offers new possibilities for structural consolidation. Nanolime dispersions are available in concentrations between 5 g/L and 50 g/L. After evaporation of the alcohol, carbonation takes place by reaction with atmospheric carbon dioxide. The formed calcium carbonate particles form bridges between loose grains resulting in a significant increase of the mechanical strength. Nanolime dispersions offer a broad range of applications, also in combination with traditional stone consolidants such as silicic acid esters (SAE). When applied in a first step, the calcium hydroxide layers formed after evaporation act as adhesion promoter allowing the application of silicic acid esters also on materials which are incompatible to SAE.
It is well known that microbiological growth contributes not only to the aesthetic defacement of structural surfaces but can also result in serious damage to the materials and structures themselves. Sols containing stable dispersed nanolime particles in ethanol allow the removal of microbiological growth in an eco-friendly way by the dehydrating action of ethanol in combination with the creation of alkaline conditions by the lime particles. The small size of the lime particles guarantees deep penetration into infected zones.
The successful combination of nanolime dispersions with SAE could be shown by the restoration of the baroque marble statues “Dancing Faun” and “Bacchante” of the Royal Bath in Warsaw (Poland).

CODE 2.4.02

ENERGY EFFICIENCY WITH FPO HIGH REFLECTANCE MEMBRANES ON REHABILITATION ROOFS

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KEYWORDS: FPO membrane, SR (Solar Reflective), potential savings, carbon footprint, energy, sustainability.

ABSTRACT

Today, in waterproofing flat roofs we are accustomed to using bituminous or synthetic membranes with very dark colour.
The cover is one of the most affected parts of the building to sunlight, temperatures on the surface of the membranes in summer periods can reach up to 75 ° C temperature, with corresponding heat transfer into the building by increasing consumption frigories for cooling.
High reflectance membranes consist of a few based chemicals that increase the reflectivity of sunlight preventing membrane to reach high temperatures as with dark colors, saving energy in cooling the building treatment.
In this article I will present a study of energy efficiency that I will show the saving in kwh of a white cover high reflectance compared to a bituminous membrane and analyze a case in which a membrane has been replaced by a beige high reflectance white membrane, compare the annual savings.

CODE 2.4.06

REDUCTION IN ENERGY DEMAND OF EXISTING BUILDINGS. ANALYSIS CASE OF SPANISH BUILDING CODE FLEXIBILITY CRITERIA

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KEYWORDS: Energy efficiency, building performance, building regulation, refurbishment.

ABSTRACT

The Spanish Building Code (CTE) establishes the basic requirements that buildings must fulfill. The CTE DB-HE Basic Document "Energy Saving" has been recently updated, with new energy demand requirements for existing buildings refurbishment. When the afected área refurbished exceeds 25% of the total envelope area, the building energy demand must be lower than the reference building one. The energy demand requirements established in this way can make compliance difficult in certain cases where the refurbished area is just over 25%. The DB HE document includes application criteria, among which is a flexibility criterion that can be applied in certain cases, and allows adopt solutions to achieve the highest possible level of compliance with the established requirements.
The work presented includes the analysis of the building energy efficiency to a series of proposals for envelope improvement measures. These consist on a possible intervention on the opaque part of the envelope (facade, roof, ...) and the hollow part (windows).
The objectives pursued with this analysis is to determine the optimal measures for the building under study, based on the current state of the same, and the feasibility of compliance with the requirements set out in CTE DB HE1 for existing buildings refurbishment.
The methodology to be applied is based on the official verification tool of regulatory requirements set out in DB HE, Unified Tool Lider-Calener.
The scope of the study is to evaluate the optimal solution among all analyzed, exposing the results of the building energy demand and potential energy savings.

CODE 2.4.07

HIGH THERMAL MASS CONCRETE FACADES

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KEYWORDS: Thermal mass, energy efficiency, concrete, enclosure.

ABSTRACT

The enhancement of the building thermal mass is justified because of its ability to optimally use sources and sinks of heat. In many Spanish climatic areas the availability of solar radiation in winter and cool night temperatures during summer is enough to offset the losses of the building during the heating and the gains during the cooling period. In general, the effect of the building enclosure´s thermal inertia is not usually considered as a variable. In addition to the difficulty of modeling it for designers, calculation tools have not been sensitive to this parameter, and the knowledge of its benefits has not been adequately considered to date.
The article presents the results of SINHOR project. The main objective of the project was the development of an innovative design of a building enclosure for both, new construction and rehabilitation, that allow from the knowledge acquired during the analysis of the heating and cooling process of the concrete, maximize the energy benefit derived from the thermal mass of concrete.
The two types of solutions considered consist of a concrete inner leaf, which constitutes the heat storage element, and one intermediate sheet which includes a suite of fans that provide the flow allowing a forced convection that enables an optimally heat transmission between the elements.
Modeling and testing under real condition, with an analysis of key variables will be also presented in the paper.

CODE 2.4.08

METHODOLOGY TO APPLY SUSTAINABLE DEVELOPMENT PRESPECTIVE FOR CONSERVING HERITAGE

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KEYWORDS: Heritage, Sustainable development, local communities, cultural conservation, Economic development

ABSTRACT

Built cultural heritage plays an important role in the economic and social fabric of a city. Heritage can boost the local and national economy and create jobs by attracting tourists and investment, and providing leisure, recreation, and educational facilities. Although we lose our heritage due to economic and social aspects of the local people. This paper emphasizes the role of SD (sustainable development) in conserving cultural heritage and starts to set out a methodology considering the cultural heritage as a resource not a burden, by promoting a sense of ownership towards the monuments amongst the residents through transforming it into a communal resource that stakeholders benefit from and therefore conserve. This paper shows how can SD perspective be applied in heritage sites in developing countries by presenting a successful trial of an Egyptian non governmental organization (ATHAR LINA) which was similar to the Indian SD process and Darb al-Ahmar Urban Regeneration project that had been done by the Aga Khan historic cities program and by using the analytically compared methodology to reach the proposed methodology through the assessment of a real experiences led by nongovernmental organizations, it relied mainly on behavioral studies methods, including public participation and participative observation.

CODE 2.4.09

HEAT PUMPS AND RENEWABLE ENERGIES: MYTHS AND REALITIES ABOUT THEIR INTEGRATION IN BUILDINGS

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KEYWORDS: Renewable energy, heat pump, performance, carbon dioxide.

ABSTRACT

The history of renewable energy is not recent at all. However, its integration in buildings was not firmly promoted until the appearance over twenty years ago of the first European Directive related to energy efficiency and environmental protection, which had led to the current legal frame sensitized to energy sustainability and CO2 emissions. In Spain, the approval of the Building Technical Code in March 2.006 is considered as the first serious boost to the integration of renewable energy in buildings, as one of its aims is to reduce to sustainable limits the energy consumption in buildings and to get a portion of this consumption from renewable energy sources. To meet this goal it is commonly considered the use of the heat pump, which establishes the debate about whether it is a renewable energy source or not. In general, the origin of such a debate lies in the almost total ignorance of the principles governing the operation of a heat pump. This work presents in a practical way some objective criteria for estimating the seasonal average performance of the heat pump to determine to what extent it can be considered a renewable energy source and its influence in the fulfilment with current regulations concerning building. The methodology here presented, developed by the Diversification and Energy Saving Institute (IDAE), is then applied to different situations with different energy sources: Aerothermal, hydrothermal and geothermal energy. Finally, the results are analysed by simulation to test the impact of the heat pump in the energy rating of buildings.

CODE 2.4.11

THE INHERENT BARRIERS IN AIR TIGHTNESS ANALYSIS OF HERITAGE BUILDINGS

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KEYWORDS: Air tightness, air leakage, blower door test, heritage, on site testing.

ABSTRACT

The Energy Efficiency in buildings has been for years one of the most relevant lines of research. This goal is particularly challenging in the retrofit of historic buildings. In general, the main parameters involved in the passive behaviour of these buildings are two: heat losses and internal gains.
With regard to heat losses, they can be distinguished between the thermal losses through the envelope and the losses though the indoor air renovation. The design of the envelope has been significantly improved in recent years by the degree of thermal insulation and the implementation of shading control, but many historic buildings are protected by heritage regulations that reduce the possibilities of intervention. Considering these limitations, the heat losses related to air renovation are not sufficiently considered. The control of ventilation gains and losses can be one of the bigger improvement rates of the energy efficiency, especially in historic buildings.
Within the scope of ventilation, infiltration plays a major role in the building energy performance, but it also represents a relevant issue for user's thermal comfort and the indoor air quality. To characterize the features of building ventilation two main types of tests are employed: the tracer gases method and the fan pressurization method. This study refers to the fan pressurization method that is also known as the blower door test or BDT.
The present work shows the diverse complexity of particularities encountered during the determination of a campaign of 37 air tightness test conducted in historic buildings. The objective of the study is to define a methodology to anticipate and prevent the main problems that frequently arise when analyzing the air tightness of historic buildings. Additionally, some further improvements are given to fix some of problems that have been detected in the present Spanish and European regulation for BDT.
The study shows the main barriers detected and introduces a checklist as a simplified tool that aims to help the technician during the testing process. Aspects like the imprecise regulation, the difficulties in the preparation of the sample, the transportation of the equipment, the difficulties to perform large-scale trials, or the quantification of the level of air tightness for every part, among other many problems.

CODE 2.4.12

SENSITIVITY STUDY OF VENTILATION SYSTEMS PERFORMANCE OF RESIDENTIAL MULTIFAMILY BUILDINGS

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KEYWORDS: Dwellings, ventilation systems, simulation, air change rate, relative humidity.

ABSTRACT

Ventilation systems are of great importance in air conditioning energy use and defining the hygrothermal conditions and indoor air quality of buildings. It is absolutely necessary to ensure adequate levels of indoor air renewal.
Multifamily buildings in Portugal essentially use natural ventilation systems or mechanical or mixed extraction. However, it is difficult to conveniently assess the correspondence between the ventilation system installed and its ventilation rate.
In this article, through a simulation using the CONTAM software and based on experimental air permeability data from the ventilation devices, a sensitivity analysis is carried out by varying the most significant parameters in ventilation systems, such as pressure loss of the air inlets, air permeability of the window frames, and extraction flow rates in the kitchen. The annual simulation of air flows uses environmental conditions representative of the Portuguese continental climate (four cities) and the subdivision for heating and cooling seasons. It also involves the production of indoor pollutants (CO_2 and water vapour). The simulation provided the ventilation rates, the intake and exhaust air flows, the levels of pollutants at a given point or on average for a particular apartment type
The most significant conclusions of the simulations are: the low air permeability of the envelope leads to reductions in air change rate close to the limit set by regulation; continuous mechanical ventilation in the kitchen, an inlet grid in the kitchen, opening at the maximum flow rate, and closing the doors of service compartments significantly reduces the levels of pollutants.

CODE 2.4.13

AESTHETIC SUSTAINABILITY OF CONCRETE SURFACES

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KEYWORDS: Visual concrete, weathering, climatic conditions, design, photocatalysts.

ABSTRACT

Weathering of concrete surfaces is unavoidable. It consists on the changes generated by their interactions with the climate conditions they are surrounded.
Unacceptable weathering occurs when the changes in the appearance ravage the original design. Nevertheless, if the appropriate measures are adopted, weathering will not ravage but may even emphasize the desired visual aims.
The main causes of weathering are environmental pollution and rainwater washing of the surfaces, including runoff of the latter. Thus, the weathering process is influenced by the building geometry, the surfaces properties of the building and environmental conditions.
Weathering must be taken into account since the design first stages because of economic and environmental reasons, it is essential to foresee and to control rainwater flow and rainwater runoff.
In this paper are summarized the causes of aesthetic ravage of concrete surfaces, the variables that produce the ravage and the strategies aimed to foresee and avoid it. Moreover, a reference is made to self-cleaning and anti-pollution concretes that contain cements with photocatalysts.

CODE 2.4.14

COMPARATIVE ANALYSIS OF COST-EFFICIENT LEVELS OF INTERVENTION IN THE THERMAL ENVELOPE OF RESIDENTIAL BUILDINGS CONSTRUCTED IN SPAIN BETWEEN 1940-1980. APPLICATION TO LINEAR BLOCK TYPOLOGY AND CLIMATIC ZONES C, D, E

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KEYWORDS: Building typology, thermal envelope, energy demand, renovation scenarios, decision-making matrices, cost-efficiency.

ABSTRACT

In Spain, more than 46% of the housing stock corresponds to dwellings built between 1940 and 1980 that have a set of highly repetitive deficiencies, among which stands out the low performance of the thermal envelope. Most of these buildings are located in suburbs around large cities and have common building typologies. This allows the establishment of effective renovation strategies that have a high impact on achieving the H2020 environmental objectives.
This paper presents some of the results of one of the studied typologies of residential buildings in Pamplona (Spain), the linear block, which have been obtained within the research project prestaRener, "Performance-based design actuation protocol for buildings envelope rehabilitation". The similarity of the constructive characteristics of these buildings allows extrapolating the results to different cities in the same or different climatic zone.
The methodology which has been applied consists of: First, establishing the most representative typologies of these buildings, analyzing the constructive characteristics of the different parts of the envelope, and characterizing rehabilitation measures. Second, monitoring case studies to determine the actual performance of the envelope, and simulating different levels of intervention calculating the energy saving potential. Finally, assessing the cost-effectiveness of the different levels of intervention.
The results are presented in the form of matrices, which are a decision-making tool for selecting those interventions and investments that are efficient. Examples of heating demand reduction matrices of different renovation measures, as well as economic and cost-efficiency matrices are shown for one of the typologies studied in the aforementioned project (T1).

CODE 2.4.15

DESIGNING A SUSTAINABLE REGENERATION IN THE OUTSKIRT OF AGRIGENTO

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KEYWORDS: Building recovery, sustainable design, building regeneration.

ABSTRACT

This paper describes a case of building recovery and sustainable re-use in Sicily, that is the recovery of Villaseta. It is a very degraded neighborhood in the outskirts of Agrigento.
The main goal of the redevelopment project is therefore the rebuilding and the environmental regeneration of the neighborhood, using sustainable technologies and tools, with the construction of vegetable gardens and urban gardens, the production of renewable energy and the sustainable recovery of existing buildings. The eco-friendliness of the restoration project is therefore given by the use of garden roofs and vertical gardens. Villaseta will be a real "green lung" able to give greater environmental awareness and landscape to the city of Agrigento.

CODE 2.4.18

ENVELOPE CHARACTERISATION OF PORTUGUESE HOSPITALS IN ORDER TO DEFINE THEIR ENERGY RETROFIT

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KEYWORDS: Building envelope, shape factor, energy retrofit, health facilities

ABSTRACT

Improving energy efficiency through building retrofit is currently one of the main vectors found both in political and educational programs, in scientific investigation or as part of the projects for urban rehabilitation. Nevertheless, the actions actually undertaken are scarce and, sometimes, do not reflect these concerns.
Amongst the variety of factors that justify this discrepancy, the heterogeneity of the building stock is one of the most significant, ranging different construction periods, conservation states and purposes.
It is thus mandatory to establish guidelines towards smaller scales of intervention, covering groups of buildings that share similar characteristics and may get benefits from similar retrofit strategies.
The investigation work herein presented is based on the study of health facilities – with several dimensions – presently in operation in Portugal, built essentially in the second half of the 20th century, a period in which energy efficiency was not a priority and there was no national legislation regarding the energy performance of construction elements. Since the chosen sample frame comprises an extensive set of buildings, the first part of the work comprises the definition of general parameters that will allow a quick characterization of the building stock, the quantification of the improvement potential and will support the major strategic decisions referring to building retrofitting. The second part is dedicated to the construction of an analytical model with different depth of detail in accordance with the sample dimensions, representing the correct balance and proportion between the planning purposes and the realistic operational goals. Additionally, a hospital located in the central region of Portugal is presented as the first case study, covering the analysis of energy loss through the building envelope. This data will be further used to validate the model previously developed.

CODE 2.4.21

ENERGY EFFICIENCY IN BUILDING: ANALYSIS OF PROJECTS USING LED TECHNOLOGY

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KEYWORDS: Energy efficiency, environmental comfort and sustainability, lighting technology and LEDs.

ABSTRACT

LEDs (Light-Emitting Diode) have been used in numerous lighting design projects in different sectors, mainly because of the considerable advantages over conventional lamps. However, there are still some doubts about the technology itself and its operation, as well as questions about the exclusive LED use in any environment or retrofit in existing lighting systems. This article is about artificial lighting in commercial buildings. It presents a case study that aims at testing the efficiency and quality of light emitted by the LED lamps compared to fluorescent lamps. The investigation also verifies, on a percentage basis, the economy reached by the two lighting systems, their performance and the illuminance ratio of both fluorescent lamps and LEDs. The methodology seeks for answers about lighting systems that are able to meet technical and economic parameters. Our objective is to propose a qualitative and quantitative evaluation system to replace the existing system for LED lighting technology, using the following parameters: existing lighting, energy costs, the amount of light in the work plan, light quality, energy source lifetime, investment in technology, return on investment, reducing replacement and maintenance of lighting products, creating more sustainable enterprises.

CODE 2.4.22

USING THE PROJECT DESIGN FOR THE OPTIMIZATION OF ENERGY EFFICIENCY IN A POPULAR HOUSE LOCATED IN THE SUBTROPICAL CLIMATE

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KEYWORDS: Sustainability, lower environmental impact, energy efficiency, thermal performance, efficient popular house.

ABSTRACT

Aiming to seek solutions that might suit the sustainability in the socioeconomic context of low-income families, was built a prototype, known as Popular Efficiency House, which aims the study and application of techniques that provide a greater energy efficiency combined with a low constructive cost. The building was built at the Federal University of Santa Maria, located in the southern region of Brazil, where the climate is subtropical, with seasons well defined. The climate characteristics were reflected in the project design, both in relation to passive heating requirements such as cooling needs.

The performance of the envelopment was analyzed through the DesignBuilder software, being applied with a whole set of procedures and parameters stipulated by RTQ-R (technical regulation of quality for the level of energy efficiency of residential buildings) for the simulation method. Two simulations were made, one with the edification naturally ventilated and other with the edification artificially constrained. Through them, it was founded the indicators that determined the numerical equivalents, which defined the level of energy efficiency of the building, being awarded Level A for the most efficient building, and E for the least efficient.

The results show that a low-cost housing can have an excellent energy efficiency, as long as the design variables that affect its thermal and energy performance are considered in the project. It was observed that the design of the prototype privileged natural ventilation, through the chimney effect and through the cross ventilation that become possible due to the positioning of the openings. This strategic positioning, concurrently with the hermetic closure of the central rocker, provided passive heating during the winter, reducing the need for artificial air conditioning. Thus, through this study, it establishes a beacon that will direct the construction of a housing development in Santa Maria / RS, which will be held in partnership with the city government.

CODE 2.4.23

SCHOOL BUILDINGS REHABILITATION IN SOUTHERN EUROPEAN COUNTRIES – CASE STUDY

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KEYWORDS: School building, ventilation, temperature, relative humidity, carbon dioxide concentration.

ABSTRACT

Ensuring a proper indoor environmental quality (IEQ) in classrooms is crucial for the students' performance and well-being. Several studies indicate that academic achievements and students' health are linked to classrooms indoor conditions. Modern societies must, therefore, invest in the improvement of school buildings environment.
In Portugal, in the last years, large investments for school buildings rehabilitation were made. These interventions have been planned according to the most recent energy efficiency criteria, which resulted on the implementation of HVAC systems to control both the temperature and the indoor air quality. However, in situ measurements in service conditions revealed a quite different scenario from the one expected at the design stage. The main reason is related to financial incapacity of the school board to maintain and operate the HVAC systems.
This paper presents an alternative approach. Southern European climate allows using different ventilation systems, optimized for the occupants' comfort, with a strong natural component. Thus, demand controlled ventilation systems arise as a very interesting option since, in comparison with traditional HVAC systems, a decrease in both the initial investment and the operational costs is expected. An experimental demand controlled ventilation system was applied in a part of a school building and the indoor conditions were monitored during two months in both refurbished and non-refurbished classrooms. Air temperature, relative humidity and carbon dioxide concentration were measured. Occupants' perception of the indoor environment was also collected through a survey. This paper starts by describing the ventilation system and follows by presenting and describing the results of the monitoring campaign and of the survey.

CODE 2.4.24

MONITORING OF RESIDENTIAL BUILDINGS IN SOCIAL NEIGHBOURHOODS, WITH THE AIM OF IMPROVING THE ENERGY EFFICIENCY OF THE REHABILITATION MEASURES

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KEYWORDS: rehabilitation, monitoring, fan pressurization method, thermography, surveys.

ABSTRACT

The energy efficiency of building rehabilitation depends largely on the assumption of its current state. In residential buildings, this study is much more complicated, due to the existence of multiple occupants (landlords or tenants) with different patterns of use and that may have individually improved, throughout the life of the building , the envelope and/or the HVAC systems,. For this reason, data collection and monitoring of buildings is more difficult and at the same time more necessary in order to achieve more efficiency in rehabilitation measures. This article contains the methodology and experience in the monitoring of 24 residential buildings in Pamplona (Spain), built between 1940-1980 in social neighbourhoods. They were built before the first Spanish Energy Regulation, and they are therefore susceptible to energy rehabilitation for their poor constructive quality and their high energy consumption, bearing in mind the actual European Environmental Objectives. The methodology includes a constructive study of their current state, energy consumption data, Fan pressurization method, thermography, Heat Flow Meter Method, and comfort data, as well as surveys of use and thermal comfort, both in winter and in summer. The methodology must be adapted to the objectives of the study, have a low-impact on the occupants, and use "*low cost*" monitoring equipment, which allows us to get closer to reality and reduce the well-known "*Prebound Effect*", the difference between the energy actually consumed and the energy taken as starting point by the regulations. The more real data obtained from the current behavior of the building, the more efficient the rehabilitation measures will be.

CODE 2.4.26

ENERGY BEHAVIOUR OF THE TRADITIONAL ARCHITECTURE HOUSES IN CENTRAL SYSTEM AND ITS RELATIONSHIP WITH HUMAN THERMAL COMFORT. CASE STUDY: JERTE VALLEY (CÁCERES)

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KEYWORDS: Heritage rehabilitation, energy behaviour, efficiency design, traditional architecture, bioclimatic architecture.

ABSTRACT

The main objective of this article is to determine the energy behaviour and the human thermal comfort in the traditional architecture houses in Central System of Península Ibérica, characterized by continental climate in mid-mountain, in order to farther its conservation and right rehabilitation, through the case study of Jerte Valley.
Therefore, the wellness psicrometric diagrams has been studied in this specific region, as well as its characteristic metabolic activities, or clothing. Afterwards the geometry, construction, functionality of the building types have been determined, in order to simulate their thermal behaviour using energy software and measure heat exchange through the envelope, checking that these houses are bioclimatic constructions.
The results have been classified in two semesters. In the warm one, the flow comes into the house from the outside and goes down to the ground, like a heat sink. Thus, during the hottest week, with daily extreme outdoor conditions between 11-35°C and 80-40% of moisture (night-day), the temperature of the ground floor (which is in contact with the ground and whose walls are made of stone) is stabilized at about 20°C and 65% . The upper floor (with timber or stone walls) is between 22-25°C and 50%, which are comfortable conditions without external energy sources.
In the cold semester, the heat flows from the centre of the house to the entire building envelope. Thereby in the coldest week, with external temperatures between -5 to 10ºC and 95-75% of moisture (night-day), the temperature of the ground floor is stabilized at about 12°C (close to the ground temperature) and 55%, tempered conditions regarding the outer ones; even so the upper floor fluctuates from 5 to 11°C, the latest ones are low temperatures which will require an external energy contribution due to the light timber frame ventilated roof

CODE 2.4.28

COMPARISON OF THERMAL COMFORT AND ENERGY PERFORMANCE OF COURTYARD AND ATRIUM BUILDING TYPOLOGIES BY DIFFERENT CLIMATE ZONES

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KEYWORDS: Energy performance in buildings, courtyard building, building shape optimization, climatic comfort, CFD, fluent, thermal comfort.

ABSTRACT

The courtyard buildings, which we face either as a regulator of inter-building microclimate or as a climatic regulator at urban scale especially in hot climate regions, and which constitute one of the fundamental characteristic building styles of such climatic regions, should be applied in a form compatible with the features of the climatic region it is used. There is the need for a study that allows formation of a model toward determination of the optimum courtyard form and meeting the conditions of comfort by establishing an optimization model taking into consideration the climatic, meteorological differences for each climatic region the specific climatic region requires. The purpose of this study is to examine the energy efficiencies of the courtyard buildings used either as a micro climatic regulator in hot-dry climatic regions, or as a climatic regulator at urban scale, and to determine inter-building and courtyard comfort statuses, besides, to manifest different thermal behaviors of such buildings by estimating the same fully and accurately using real meteorological data under different design and climatic conditions with computer energy simulation on different courtyard form options put forth for different climatic regions, and thus to provide new information to designers at the process of putting forward the optimum courtyard form according to the characteristics and data of the specific climate for different climatic regions. By using the CFD program, this study has analyzed the thermal comfort statuses and energy performances of different courtyard shapes in inter-courtyard and building volumes that are discussed in hot-dry, hot-humid and cold climatic regions as well as the effect of the sunbeams received by the building surface and the daily solar movement on the thermal performance on the building. As a result of the entire analysis made for all building shapes, the obtained values were interpreted and the total energy performances were evaluated for each climatic region. In this study, the courtyard buildings will be assessed in terms of their thermal performances.

CODE 2.4.32

NEW SUSTAINABLE CONSTRUCTION SYSTEM WITH HEMP FIBER INSULATION

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KEYWORDS: Prefabricated building, energy efficiency, sustainability, full-scale experimentation, certification.

ABSTRACT

This paper presents the development of a new facade construction system based on sustainable core. As a result of the work done, a new prefabricated structural wood panel has been designed which includes among its components wood fiber and hemp as main insulation materials. The benefits of the solution, offering thermal inertia and regulating the internal moisture, combined with a breathable insulation, provide to the solution a very competitive behavior in relation to low energy embodied solutions.
Moreover, the main challenges faced in the development of the system are exposed, with regard both to the characterization of the product and the product certification, which represent a huge handicap when it comes to implementing the solution and marketing it.
Through full-scale experimentation developed, it will be obtained behavioral data of the panel that will validate the new system and allow characterizing the panel, in order to define its use and market the product.
Finally, to address this marketing stage successfully, a new product certification pathway has been defined, which aims to establish a precedent of success to promote the development of constructive solutions based on sustainable materials, overcoming the current existing barriers concerning to marketing and placing on the market of building systems based on sustainable materials.

CODE 2.4.34

SUSTAINABILITY ANALYSIS OF TABIQUE

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KEYWORDS: Sustainable building materials, life cycle assessment, thermal insulation, tabique construction.

ABSTRACT

The energy consumption in the world continues to increase and this fact contributes to rise pollution levels, environmental degradation and global greenhouse emissions. The construction sector is responsible for significant impacts on the environment as it consumes a lot of resources and also produces a lot of waste. One of the main objectives of the green construction is to reduce the environmental impacts by conserving and using resources more efficiently. This type of construction tends to apply natural raw materials. Tabique is a traditional Portuguese building technique applied until 20th century that use earth and wood as construction materials. This old buildings have high durability that requires maintenance and rehabilitation interventions. In this context, the aim of this study is to evaluate the environmental impact of tabique wall. The life cycle analysis is the tool used for the sustainability evaluation and it is carried out according to international standards ISO 14040/44. The adopted functional unit for these materials is the mass of the material required to provide a thermal resistance of 1 m2ºC/W. The calculation of the impacts is done with GaBi software and the CML 2001 impact category is used to define the Global Warming Potential of the study. The results revealed that most significant component of environmental impact of the tabique wall cocerning the category GWP is related with extraction of raw materials process and landfill.

CODE 2.4.38

CRITERIA FOR NZEBR TECHNOLOGIES AND SOLUTIONS

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KEYWORDS: Energy rehabilitation criteria, near zero energy buildings, packaged solutions, multifamily buildings.

ABSTRACT

IEE NeZeR-project (2014-2017) promotes the implementation and smart integration of Nearly Zero Energy Building Renovation (NZEBR) measures in the European renovation market by increasing knowledge of NZEBR concepts and benefits among institutional housing owners and in the whole building chain. This paper summarizes part of the results of the NEZER project focused on the development of energy efficient intervention packages for residential buildings under NZEB criteria.
Because of the high energy saving potential of the building stock constructed between 1960-1980, the project targets the renovation of multifamily blocks since they are the most representative ones and with higher replication potential.
Firstly, best available renovation solutions to reduce energy use and increase renewable energy sources share (RES) are gathered and analysed for optimal energy efficient renovation. Secondly, successful NZEBR best cases around Europe are presented to finally, design a NZEB renovation criteria for multifamily buildings. In order to reach energy saving objectives, packaged solutions for three renovation levels and four climatic zones have been defined.

CODE 2.4.40

APPLICATION OF A VENTILATED FAÇADE SOLUTION IN A REHABILITATION PROJECT AND MONITORING OF RESULTS: E2VENT SYSTEM IN THE MILITARY HOSPITAL OF BURGOS

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KEYWORDS: Rehabilitation, ventilated façades, monitoring, energy saving.

ABSTRACT

E2VENT is a project under development within the European Horizon2020 framework, the objective of which is the design of a energetically efficient system of ventilated façades for the rehabilitation of both residential and commercial buildings, based on intelligent heat recovery units that will be integrated into spaces in the ventilated façade. This system is intended to modernize the buildings, significantly reducing the final emissions of CO_2 and energy consumption. To do so, thermal and motion-detection sensors will be installed, which will monitor parameters in accordance with the needs of each building, resulting in increased user comfort and efficiency. E2VENT will initially be installed as a demonstration model in the rehabilitation of two buildings situated in Spain (Burgos) and Poland (Gdansk). The first of these is a building at the University of Burgos for teaching purposes and the second is a residential block. The heat recovery units, the number of photovoltaic cells and the thickness of the insulation layer will be adapted to each buildings, in order to achieve optimum functional operation and comfort.

CODE 2.4.41

SUPERINUSLATION SOLUTIONS FOR THE INTERNAL INSULATION IN ENERGY RETROFITTING

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KEYWORDS: Energy retrofitting, thermal insulation, experimentation, internal insulation systems.

ABSTRACT

Thermal insulation in buildings is getting more and more performing with modern energy efficiency regulations in developed countries. Not only insulation requirements are imposed to new-built buildings, but also to refurbishment activities of the existing building stock, where availability of space is often limited. These requirements lead to increased insulation thicknesses in building envelope constructions in modern days, leading to opportunities industries to develop integrated super insulation solutions, as internal insulation solutions. Materials such as Aerogels or Vacuum Insulation Panels (VIPs) allow for a substantial reduction of the required space.

However, the implementation of these materials at large scale requires of the development of construction systems to guarantee that the overall energy performance of these meets the possibilities of superinsulated materials. Research outcomes integrated in this paper provide solutions through the assessment of thermal bridge effects in light construction systems for VIPs and Aerogels, and full scale experimental campaigns conducted at the Kubik by Tecnalia test facility.

The outstanding results are that metallic profile systems should be avoided if these need to be laid across the insulation layer, as the overall heat transfer is increased by almost 40%, and that this issue can be reduced by incorporating nonmetallic plastic composite profiles in these systems, or by using systems where profiles are directly anchored at floor slabs. All this is demonstrated on full scale tests in which the overall energy performance of these systems is shown along with a relevant reduction in space requirements.

CODE 2.4.43

WEB-BASED TOOL FOR PRIORITIZATION OF AREAS FOR ENERGY EFFICIENCY INTERVENTIONS IN HISTORIC DISTRICTS

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KEYWORDS: Urban modelling, historic districts, CityGML, prioritization of areas, vulnerability map.

ABSTRACT

Decision making processes are about managing and exploiting the right information in the proper way. The decision making regarding improvements of the energy performance of historic urban districts (HUD) has to take into account information that is spatial, multiscalar and crossthematic. 3D Urban models can be used to support the decision making if the complex urban reality is abstracted into a manageable, accurate, coherent, comprehensible, predictive, and low cost model. However, the generation and management of this kind of urban models are time demanding and resource intensive. Moreover, if the proposed modelling strategy has to integrate energy planning and cultural conservation approaches, it is necessary to use a progressive and flexible information management strategy regarding the modelling that allows starting with a very low level of detail.
One of these strategies is to identify the most vulnerable areas, and based on that, the priority areas within the district; allowing to focus the decision making in these areas. The REACT Project ("Resilience, Accessibility and Sustainability for Historic Cities", partially funded within the INNPACTO programme) has developed a web based application backed by a multiscale model to support the identification of priority areas in a HUD for energy efficiency interventions. The application is based on a methodology that provides a vulnerability map using basic data, which has been obtained in an automatic or semi-automatic way. Those data regarding the vulnerability are weighted with the information regarding the density of those buildings obtaining an opportunity map or a priority map. This map highlights the priority areas, that is, the most vulnerable building blocks with the highest impact due to their density. In this way, and based on a low level of information, blocks or groups of buildings can be prioritized for energy interventions according to their conservation state, their energy performance and the concerns of the citizens.

CODE 2.4.44

METHODOLOGY FOR EVALUATING THE SUSTAINABILITY AND COST REGARDING SAFETY AND HEALTH IN BUILDING PROJECTS

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KEYWORDS: Construction, sustainability, health and safety, economy.

ABSTRACT

The current and future situation of the construction sector is marked by the EU´s firm commitment to sustainable construction, this is evidenced by the development of standards through CEN / TC 350 for evaluation taking into account two principles:

- Using a life cycle of the building approach.
- Sustainability is not only an environmental issue but also incorporates economic and social aspects.

Compliance with these sustainability goals, the current situation of our building stock and the economic reality of the sector, lead to invest the efforts in the refurbishment of buildings as a key factor in the economic recovery.
The construction sector has one of the highest accident rates, emphasizing the high mortality. In the rehabilitation works new risks, the so-called "emerging risks", are also identified which need to be planned at the design phase of the project.
Due to the failure of the public administration to reduce the accident rate through exclusively legislative and punitive measures, it has led to the exploration of other alternatives, mostly based on the analysis of the root causes of accidents and the integration of health and safety in the design phase.
It is in this sense that this model is presented, which follows the principles set by the European Community and develops a tool based on a decision-making by a method of multi-criteria analysis, structured hierarchically according to the four phases of the building life cycle: conception, construction, useful life and reintegration.
This tool allows to evaluate the feasibility of the project by obtaining a sustainability Safety and Health index ($S\&S_M$ index) moving on a 0.0-1.0 scale from low to high sustainability. Simultaneously, a health and safety cost index ($S\&S_C$ index), has been developed which economically quantifies the sustainability indices calculated.

CODE 2.4.46

EARTHQUAKE-RESISTANT INDUSTRIALIZED STRUCTURES BUILT INTEGRATED IN ENERGY EFFICIENCY BUILDING MODELS

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KEYWORDS: Structures; earthquake-resistant; industrialization; energy efficiency.

ABSTRACT

Earthquakes represent one of the natural danger with higher catastrophic damage average. This is due to socioeconomic losts caused in spite of the high knowledge about structural break down mechanisms of the constructions in the face of seismic activity. From the analysis of structural damages in buildings after an earthquake, most of the cases are mainly due to a bad seismic design of the building. Another nowadays social challenge, is to get energy efficiency constructions, that take advantage of natural resources, and reduce with his design the energy demand. In the present article, develops the design for the project of dry construction earthquake-resistant industrialized structural system, built in a modular building model with versatility of uses and energy efficiency, because of the implementation of passive and active strategies in the architectural design.

CODE 2.4.47

REHABILITATION CONSTRUCTION PROCESS FOLLOWING THE PASSIVHAUS STANDARD IN A PROTECTED (STRUCTURE) BUILDING

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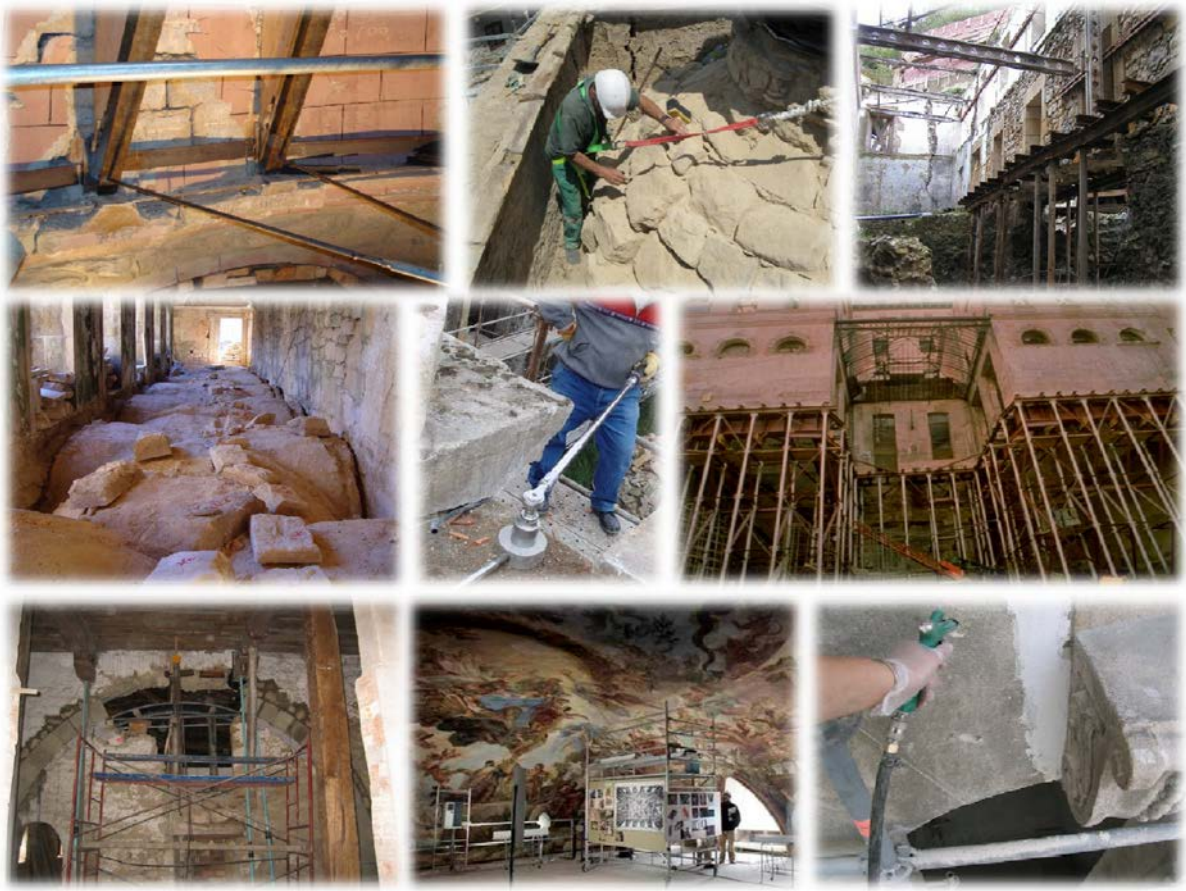
KEYWORDS: Rehabilitation, protected buildings, passivhaus, enerphit, energy efficiency, near-zero energy consumption, thermal insulation, air tightness.

ABSTRACT

Since the birth of humanity up until today, humankind has sought to protect itself from the inclemencies of the weather, finding shelter and protection from the cold and the heat by using energy. An energy dependence that has been spiralling upwards over recent decades to the point that in Spain, around 60% of building stock was constructed without any energy-efficiency criteria and 35% with very basic energy-efficiency criteria, following standards set in 1979. As few as 5% were constructed with CTE* the energy-efficiency of which falls short of European guidelines. Almost 10 million buildings do not comply with basic measures on energy savings. That is 10 million active buildings, which have not modernized their envelope and have excessive dependency on installations and energy: an energy that is obtained from fossil fuels and that is increasingly expensive, not only for the household pocket, but for the planet. In response to this, the passive house, known as passivhaus, is a construction standard that arose in Germany in the 1990s and that has extended across the world and is beginning to be seen as the strictest construction system on energy efficiency and the most highly valued within the construction sector. Its secret has been to combine a high level of indoor comfort with a very low level of energy consumption and a very reasonable economic price that compensates the difference in investment with regard to a normal building within a very short space of time. In addition, renewable energy sources can satisfy the low levels of energy that are required. The rehabilitation works on one of the buildings, with structural protection, of the old Military Hospital of Burgos, designated for teaching use for the University of Burgos, has been completed in accordance with the passivhaus standard. The constructive process of rehabilitation is described as well as the aspects taken into account to reach high energy-efficiency in a protected building.

3.- BUILDING INTERVENTION



CODE 3.1.02

PRONIC ON THE SCHOOLS REFURBISHMENT PROGRAM – CONTRIBUTIONS FOR THE CONSTRUCTION PROCESS IMPROVEMENT

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KEYWORDS: Construction management, public procurement code, refurbishment process, design stage, school complexes.

ABSTRACT

Portugal started during 2007 a major school refurbishment program. This endeavor had the initial goal of delivering more than 300 modernized complexes until the end of 2015. During the program, a new legal framework was published, introducing significant changes on the organization of the construction process, interaction between agents and requirements for the documents.
Parque Escolar, EPE administration, in order to follow these new regulations as good as possible and in order to improve the global quality and outputs of the projects set the adoption of standardized processes, namely through the use of ProNIC; that is the acronym for Construction Information Standardization Protocol. Its fundamental element is a breakdown structure for construction works (WBS-CW) that can be used to set standardized bill of quantities for technical design delivery. Other information elements such as specifications, cost scenarios and project structure are linked to it as well as functionalities. These promote a collaborative work space for the design development. During the implementation process, new functionalities were added following the legislation requirements and specific needs from the different construction agents, namely designers, work owner and supervision. The present paper aims to describe in detail this implementation experience, following two main lines. 1-The platform disclosure, its information elements and deliverables, as well as the constraints associated to the implementation on the practical situation. 2-The results and achievements, namely in terms of information management for the work owner and other benefits evidenced by the different construction agents. The conclusion discusses the advantages on the use of this platform throughout the construction process, not only for school buildings, but also in other operations and construction types, the integration possibilities with other tools and the framework with the methodologies used by the construction industry.

CODE 3.1.03

THE CONSERVATION OF MODERN RESIDENTIAL HERITAGE VERSUS PROBLEMS OF LIVABILITY AND USE: THE STATUS OF JOSEP LLUÍS SERT DWELLINGS IN MUNTANER STREET

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KEYWORDS: Modern Movement, residential architecture, rehabilitation, Josep Lluis Sert, Muntaner street apartments.

ABSTRACT

This paper examines one of the first works Josep Lluis Sert, Casa Lopez in Barcelona Muntaner Street. Sert is a leading figure of the first Spanish Modern Movement. Chairman of CIAM from 1947 until its dissolution in 1956, he went into exile of Spain after the end of the Spanish Civil War. He continued to work in USA and was professor at the universities of Yale and Cambridge.
Modern heritage conservation is a relatively recent debate, although there are already some examples of more or less successful interventions on a theoretical level, but more difficult to justify from the practical point successful and useful to their users.
If there are success stories of functional continuity or introducing new uses more compatible with conservation, in the case of residential architecture it is difficult to find similar cases in the manufacturing or public architecture. Virtually all housing interventions have musealized losing the condition for which they were built: Villa Saboye, Villa Tugendhat and the recent openings for views of the Cavrois or E-1027 Eileen Grey villas are a clear example. Identifying these problems and clashes between conservation and habitability, you raise methodologies may allow intervention to prevent the failure of an architecture without use.
The current condition of Muntaner building respect the original project is different. We may find the only house that has barely changed since the 30s, to the simple plants division in three of the original duplex with major changes in its interior layout. The visit and interview with some tenants and the study of historical interventions, some with a clear desire to preserve and others with more functional and economic finality, intends to focus the debate on the intervention in the architecture in order to find a methodology of intervention to the compatibility of architectural conservation with the needs and demands of today's habitability for residential use.

CODE 3.1.06

ROMAN CATHOLIC PLACE OF WORSHIP IN DANGER: THE CHANGES OF USE IN QUEBEC CAN INSPIRE BRAZIL?

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KEYWORDS: Quebec, Brazil, architectural reconversion, change of use, Roman catholic place of worship.

ABSTRACT

Last decades' statistics show a decrease in the number of people who claim to be Catholic in Brazil. In 1970, the percentage was 91.8% of the population; in 1991, that number dropped down to 83.3%; in 2010, it fell to 64.6%. This might explain the increase in the number of closed or underutilized Catholic churches. Many Brazilian Catholic churches are only used for special events such as weddings and baptisms, others are closed, with risk of collapse waiting for funds for its restoration. The province of Quebec, Canada, lived this decrease a few decades ago. The result was the closure of many places of worship and, then, there were many demolitions or changes of use of these buildings.

The aim of this paper is to analyze the case of change of use on the old church Sainte-Brigide-de-Kildare in Montreal, Quebec, Canada, understanding that this might be an alternative to the safeguarding of such Brazilian heritage. Initially, it will present the case of the church São João Batista dos Militares in Olinda, Pernambuco, Brazil, that despite the initiative of an organization linked to the preservation of heritage, was closed for years and ended up partially collapsing. Then, the paper analyzes the changes occurred in Quebec, showing the statistics in the religious composition of the population in recent decades, similar to Brazilian's changes, and its consequences on heritage. Finally, it will show a reconversion project in Montreal, demonstrating how different actors' participation and the emphasis on the social uses reinforced the community's equity ties with that building.

CODE 3.1.07

SEISMIC RETROFITING OF AN INDUSTRIAL MASONRY CHIMNEY WITH TRM

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KEYWORDS: TRM, masonry chimney, seismic retrofitting, fiber reinforcement, historic construction.

ABSTRACT

This paper presents a structural analysis of a masonry chimney which is being catalogued as local interest heritage construction. This analysis has been developed according the Eurocode 8 recommendations. The chimney, located in Alicante (Spain), is severely damaged, it shows several longitudinal cracks and mortar loss between bricks. In order to guarantee the structural safety under actual loads (self-weight and wind) and future and the seismic forces indicated by the Spanish Standards for this location, the chimney a structural retrofitting was developed with composite materials. This reinforcement comprised an internal textile reinforced mortar (TRM) layer with glass fiber mesh and cement matrix, and some local reinforcement with longitudinal carbon fiber bands. The study presented in this paper has two stages: First, numerical and experimental analyses of the original chimney, second, the design of the internal reinforcement scheme. The experimental text includes acceleration measures under ambient vibration for an operational modal analysis. Laboratory test for bricks and mortar to study the mineralogical composition and mechanical properties. The numerical analysis includes a preliminary pushover analysis before and after the reinforcement developed, and second, a linear response spectrum analysis to evaluate the structural stability under the seismic demand.

CODE 3.1.08

CLIMATE CHANGE RISK ASSESSMENT FOR THE HISTORIC CITY

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KEYWORDS: Historic city, resilience, climate change, risks assessment, vulnerability.

ABSTRACT

Cities accommodate around three quarters of the population, a share which is expected to increase in the next future, concentrate major economic and innovative assets and, for these reasons, are becoming the focus of the fight against climate change.
Historic centres are key pillars of their economy, contribute to welfare and quality of life and represent the expression of human culture. Impacts of climate change on historic cities are still uncertain, as they depend on the nature, specific characteristics, inherent vulnerability and geographical environment of the site. Historic cities are requested to adapt to climate change by developing resilient aptitudes to external attacks, such as extreme temperatures, precipitations, floods, landslides, storms and anthropogenic threats.
The combination of multi risk assessment and climatic projections is essential for the establishment of the vulnerability of these complex systems, in order to guarantee effective management and adaptation measures, both at urban and building level.
Conservation practices require for new holistic and adaptive strategies based on risks indicators with the objective of reducing losses and damages to cultural heritage towards new arising challenges. Aware of the increasing concern of climate change, this paper describes the on-going research activities on a comprehensive methodology for cultural heritage risk assessment for the subsequent implementation of solutions and strategies for the management, protection and adaptation of historic cities.

CODE 3.2.02

MICROPILES APPLICATION AS SOLUTION TO STRUCTURAL FAILURE CONCRETE PAVEMENTS CAUSED BY SOIL SETTLEMENT, COMMERCIAL BUILDINGS IN THE DISTRICT OF CHICLAYO – LAMBAYEQUE – PERÚ

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KEYWORDS: Resistance, pavement, compression, friction, concrete, micropile.

ABSTRACT

The project was to opt for a new technique in Peru; "Micropiles" that prevent the rapid structural failure in concrete pavements due to the settlement of foundation soil where efforts are transmitted to the structure, the main causes, bad compaction layers to each other and others. Conventionally this type of failure is solved, demolishing the pavement, removing the soil foundation, replacing and compacting again (emphasis in controlling compaction layers), proceeding to pour a new concrete pavement.
For the case in study, the structural failure was developed in a shopping mall in operation, and the previous constructive process may create stoppages and loss of daily sales. It is for this reason that we chose the application of micro-piles as a new alternative to support the concrete pavement, avoiding massive excavation and removal of soil, without stopping commercial activities.
The methodology is to determine the affected area, dividing repair sectors to minimize the cessation of activities.
We proceeded to the demolition of the pavement; and 3.5 diameter holes were made "in the collapsed zone with a depth varying between 3m and 5.50 m. Then proceed to place steel rods Ø = 1 "and Ø = 1 3/8" as the core to inject concrete fc = 210 kg / cm2 (Binding of concrete and steel forms the body of micropile).
Finally the new concrete pavement is built, which transmit the stresses to micropiles distributed in the affected area.
As a result; were constructed 54 concrete micropiles with fc = 210 kg / cm^2, of type I (frictional resistance t = 7.24 ton; compressive = 0.92 ton) and II (frictional resistance = 12.44 ton; compression = 1.23 ton).
The results demonstrate, that the micropile is a structural economic alternative for constructions, in which should not paralize their activities.

CODE 3.2.04

DURABILITY OF FLEXIBLE POLIOLEFINAS MEMBRANES (FPO) APPLIED IN BUILDING WATERPROOFING

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KEYWORDS: Membranas de FPO, propiedades, ensayos, durabilidad, envejecimiento artificial acelerado.

ABSTRACT

The durability of building materials is a key factor in assessing sustainability.
Today the use of FPO membranes in waterproofing roofs, especially flat roofs, has grown significantly. FPO sheets are actually the type of synthetic membrane most commonly used, being however, very long distance materials commonly known as bituminous membranes.
This article tries to explain the main characteristics of flexible FPO membranes used in waterproofing of buildings and his durability.
The work focuses on laboratory tests and field trials especially in works executed in Spain and the rest of Europe, with an age between 6-25 years.
The expected product life is generally calculated on the basis of data obtained through artificial accelerated aging in the laboratory, however verification of this estimate of useful life is possible only after many years, comparing the performance of materials in real applications.
Test obtained in laboratory against test membrane exhibits with different applications and durability will be compare.

CODE 3.2.06

PERFORMANCE OF WOOD IMPREGNATED WITH ALKOXYSILANES

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KEYWORDS: Wood, alkoxysilane, decay resistance, dimensional stability, fire.

ABSTRACT

The wood, very heterogeneous and complex material, changes its volume by water absorption or desorption causing swelling or shrinkage and also it can be degraded both by action of microorganisms and fire; the above-mentioned is a great inconvenient for most commercial uses.
Solid wood specimens of Araucaria angustifolia were impregnated with alkoxysilanes hydrolyzed and condensed "in situ" by the sol-gel process. Alkoxysilanes selected were aminopropyl methyldiethoxysilane and aminopropyl triethoxysilane; it was also used the aminopropyl methyldiethoxysilane/aminopropil triethoxysilane mixture in 50/50 w/w ratio. The pH was adjusted to alkaline value for controlling kinetic of hydrolysis and condensation reactions.
Impregnation process was carried out at 45–50 ºC in an autoclave, controlling the operating conditions for achieving different weight gains.
Unmodified and modified wood specimens were exposed to brown rot (Polyporus meliae) and white rot (Coriolus versicolor) under laboratory conditions.
The results indicate that the improved resistance to fungal exposure would be based on the wood chemical modification (the protection of cellulose caused by steric hindrance of ≡Si-O-Cellulose preventing the formation of enzyme-substrate complex). Moreover, the results also would be based on the enhanced dimensional stability of the treated wood; the quoted high dimensional stability, which limits the growth of the spores, is supported in the hydrophobicity generated by both the decreasing of the amount of polar hydroxyl groups and the partial occupation of pores with polysiloxanes.
Fire laboratory tests were carried out in Two-Foot Tunnel (flame spread index, panel consumption and smoke density) and in TGA detector (mass loss).
The performance can be explained according the reactivity of the alkoxides; the results indicate that as weight gain increase the performance of impregnants against fire also does.

CODE 3.2.09

RESTORATION OF SANT RAFAEL DOME. A PAVILION FROM THE HOSPITAL DE LA SANTA CREU I SANT PAU DE BARCELONA

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KEYWORDS: Restoration, modernist site, tile dome, FRG systems.

ABSTRACT

In the restoration process being carried out in recent years in the modernist Hospital de la Santa Creu i Sant Pau in Barcelona, we would like to highlight the works done in the Sant Rafael's pavilion dome. Basically because of how it has been raised with its enforcement procedure using a combination of traditional and new generation materials.
The modernist ground of the Hospital de la Santa Creu i Sant Pau in Barcelona is a unique building that was declared Historic Artistic Monument in 1978 and from 1997 its part of the UNESCO World Heritage.
The Sant Rafael building was one of the pavilions that best kept its original character, suffering few modifications, while the modernist ground was used for hospital use.
Keeping the most of the original features was one of the points that made the property decided to use this building as the perfect place for the promotional and institutional acts during the restoration process. This entailed the need for a detailed assessment of the conservation status.
In this evaluation process it was found that the old "day room" was one of the most damaged areas by the years. It consists of a two floor cylindrical volume topped by a double tile dome tightened by a metallic structural frame embedded in the different constructive elements.
As time goes by, the deficiency in the coating of the metal elements and the reduced maintenance works carried out during the last years, made those metal elements became rusted causing diseases in the recovering construction elements.
The restoration and consolidation process was divided in two phases:

- The first one: stabilization of the dome by a high ground provisional structure allowing public use of the ground floor with total safety for users.
- The second one: final restoration. In this process, the main point was the total substitution of the different damaged metal elements. These were changed for new ones with the same strength characteristics but with new and better treatment against rusting effects. It was necessary to devise an action procedure in which FRG systems for the provisional stabilization and definitive reinforcement were used.

CODE 3.2.10

CORROSION EVALUATION IN METAL REINFORCED MASONRY STRUCTURES WITH NON-DESTRUCTIVE ELECTROCHEMICAL TECHNIQUES

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KEYWORDS: Reinforcement masonry, monitoring corrosion, electrochemical techniques, material characterisation.

ABSTRACT

Although brick has been used since the earliest times, the knowledge about the behaviour of masonry is almost the least complete today. The vulnerability of old historical masonry buildings, both by the degradation of the materials themselves as by the different kinds of damage caused by agents outside the material itself, make it necessary to strengthen adequately these elements in order to achieve an improvement in the capacity in terms of strength and ductility. The election of the reinforcement system is a problem today as there must be analysed the different typologies to see which is most appropriate in each case and generate the least problems over time.
The corrosion of reinforcements has resulted to be one of the most frequent causes of their premature failures. Monitoring the corrosion rate, assuming the uniform corrosion and the loss in diameter decreases linear with the corrosion rate, allows calculating the remaining load carrying and the safety of the structure. The main investigation of corrosion researchers is detection and measuring of defects in the initial stage of corrosion process. Even though there are a few methods of measuring true, instantaneous rate of corrosion, based on electrochemical methods, no references about its application to masonry structures are found.
This paper proposes a new methodology to evaluate reinforced masonry structures advanced electrochemical techniques. These non-destructive techniques can be used as an efficient tool to contribute to the diagnosis of the conservation state of reinforced masonry wall and to monitor the restoration treatment.
The experimental work is carried out pioneering a study of the durability of these reinforcements through on site evaluation by non-destructive electrochemical techniques. Some preliminary results in the application of the proposed evaluation methodology to different masonry constructive systems are presented.

CODE 3.2.11

ENERGY REHABILITATION: ENERGY IMPROVEMENT OR ARCHITECTURAL IMPOVERISHMENT?

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KEYWORDS: Rehabilitation, energy, heritage, residential, building.

ABSTRACT

The beginning of the twenty-first century emerges as a unique opportunity to renew the residential building stock in Spain. Some circumstances focus on the construction sector, for the first time in history, intervening on the existing buildings more than constructing new ones. On the one hand, the historic need of acting in old buildings to improve their original characteristics. On the other hand, and as a result of the current economic situation, the improvement of these existing old buildings is seen as a possibility to reactivate the construction sector. But the main reason is the need for energy rehabilitation of these buildings. They do not have conditions to save the current energy demand. Therefore, there is a real need to intervene in the more than nine million existing residential buildings. Part of this intervention is now taking place with different results. The aim of this paper is to analyse how it has been made this intervention to date. For this study five cases of energy rehabilitation have been analysed near the city of San Sebastian. The selected buildings are part of a characteristic and representative building stock developed in the Basque Country in the 60s and the 70s.There is a clear risk that the energy improvement on existing buildings becomes a problem in the future. Now is the time to become aware of how we must act to achieve energy results, but without reducing the existing characteristics of the residential built heritage.

CODE 3.2.13

DIAGNOSIS OF A HISTORICAL RAMMED EARTH CONSTRUCTION: CASE OF MANUEL DE AGUIAR VALLIM'S RESIDENCE (BANANAL-SP, BRAZIL)

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KEYWORDS: Historical rammed earth construction, non-destructive tests, structural rehabilitation.

ABSTRACT

The residence of Manuel de Aguiar Vallim (an important coffee producer of 19th century) became an historic construction heritage during the 20th century. Nowadays this construction needs restorations: some parts of the structure are braced due to important damages observed. This paper presents a diagnosis of the construction, including damage statement and material characterization through visual recording, photographs, thermography, flatjack tests, collecting of compression specimens and density test. A report of the structural alterations was made and after analysis, it been clear that alterations made during the 20th century (more specifically the position and support of the roof truss) produced a modification of load transmission to the walls made of rammed earth. Analysis of rammed earth walls revealed that they can bear the roofing in so far as supporting points will be shifted and designed. An additional central steel structure is proposed to reduce roofing loads acting on rammed earth walls.

CODE 3.2.17

USE OF METAKAOLIN AND SUGAR CANE BAGASSE ASH AS SUBSTITUTES OF CEMENT IN MORTARS OF REHABILITATION

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KEYWORDS: Mortar, corrosion rate, pozzolans, polarization resistance.

ABSTRACT

The present study shows the results relating to the use of ash from sugarcane bagasse (CBC), blast furnace slag (EAH) and Metakaolin (MK) as a substitute for Portland cement (CP) in the preparation of mortars, in order to reduce the amount of cement, take advantage of the waste generated in agro-industrial processes in the region and assess their behavior in an aggressive medium for chlorides. The CBC was obtained from the sugar mill of Taretan, Michoacan, Mexico. It was sifted and used the material that passed through the ASTM 200 mesh. MK was used as it was obtained from the industrialized process. The EAH was obtained from the steel Arcelor Mittal. It was ground in a ball mill and was sifted, using to study the material that passed the ASTM No. 200 mesh. We used sand with graduation between the ASTM mesh No. 16 and ASTM No. 30. The specimens in which assessed the corrosion rate were corrugated steel bars grade 60 immersed in CP mortars with substitutions of 5%, 10%, 15%, 20% and 30% of CBC, EAH and MK. The techniques used for the assessment of the corrosion rate were the linear polarization resistance (Rpl) and electrochemical impedance spectroscopy (EIS). The specimens were subjected to an aggressive environment by chlorides in a solution with 3.5% NaCl in weight. In all tests the corrosion potential values were between - 600 mV and - 700mV, which indicates an active state of steel. The corrosion rates during the first two weeks were on the order of 0.001 to 0.015 mm per year for the bars at all replaced mortars. Higher corrosion rate readings were recorded for the replacement of EAH in 20% with initial values of 0.15 mm/year in the first weeks and 0.2 mm per year subsequently.

CODE 3.2.22

DURABILITY EVALUATION OF ADVANCED COMPOSITE TECHNOLOGIES FOR STRUCTURAL REHABILITATION

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KEYWORDS: Bond, durability, FRCM, FRP, inorganic, organic.

ABSTRACT

Externally bonded composite systems have become an attractive alternative to conventional methods for strengthening and rehabilitating the built infrastructure, particularly as applied reinforced concrete (RC) or masonry structures. Such systems can be classified based on the matrix, where the established technology uses organic-based matrices, known as fiber reinforced polymer (FRPs) composite systems, and novel alternatives use inorganic-based matrices, referred to as fabric reinforced cementitious matrix (FRCM) composites. Both types of systems rely on the bond between the composite and the substrate to transfer stresses through the matrix to the fiber/fabric. Bond is of critical importance in flexural strengthening applications, where delamination failure occurs between the substrate and system due to loss of bond. Although numerous research studies have demonstrated the effectiveness of externally bonded systems, the long-term performance with regards to the durability of the system remains a key concern to be addressed, to fully embrace such structural rehabilitations solutions.

The long-term study performance of composite systems under aggressive environments is partial and generally focused on mechanical properties only, where studies addressing the durability performance in terms of the tensile characteristics have shown that FRP systems exhibit a mechanical degradation, while FRCM systems remain relatively unchanged. However, evaluating the durability of the bond between the composite and substrate is a critical aspect, and limited information is available. To this end, this study experimentally evaluates the tensile and bond strength of different FRP and FRCM composite systems after aging in different environments and periods of exposure; including, 100 % relative humidity at 38°C, saltwater, and alkali solution (pH 9.5), representative of aggressive service environments.

CODE 3.2.23

ALKALI-SILICA REACTION RESISTANCE OF COAL BOTTOM ASH MORTARS FROM COAL THERMOELECTRIC POWER PLANTS

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KEYWORDS: Coal bottom ash, cement constituent, alkali-silica reaction, durability.

ABSTRACT

The beneficial effect of the cements with pozzolanic additions was observed in the first alkali-silica reaction, ASR, studies, in general, and with regard to the fly ash, in particular. The present study examines the effect of the bottom ash from a coal thermoelectric power plant used as main constituent of a common Portland cement on the mortars durability with regard to the effect of the alkali-silica reaction. Its performance is compared to that of fly ash mortars. Three cement types made of fly ash and bottom ash - CEM II/A-V, CEM II/B-V and CEM IV/A (V) – were prepared.
The CEM II/B-V presents an expansion slightly higher than that for the CEM IV/A (V) and very close to the limits for the ages of 14 and 28 days. At 90 days, CEM II/B-V cements exceed the expansion limit of 0.2%, but without reaching the expansion limit of 0.4%. Not significant differences were observed between the studied mixes of fly ash and bottom ash in CEM II/B-V cements. By contrary, all the mortars made with the CEM IV/A (V) cement are quite close the expansion limit of 0.2% at 90 days.
Therefore, it can be said that the more effective cements in the case of using potentially reactive aggregates are CEM IV/A (V) and CEM II/B-V. Also, CEM II/A-V have evidenced a better performance than CEM I 42.5 N at early age (14 days).

CODE 3.2.25

PHYSICAL-MECHANICAL BEHAVIOR OF PORTLAND CEMENT MORTAR WITH PARTIAL COAL SUBSTITUTIONS

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KEYWORDS: Durability, mortar, portland cement, replacement, coal.

ABSTRACT

This research analyzed the physical and mechanical characteristics of mortar of Portland cement, which was partially replaced by mineral coal (CM) powder, waste during the refinement of it to use it as a source of energy in the production of steel; this in order to determine if the CM increases the durability of concrete and knowing the feasibility of use of such waste in the manufacture of concrete or cement mortar. We characterized mixtures with partial replacements of CM, with respect to the weight of cement, 5, 10, 15, 20 and 30%. During its preparation were evaluated workability as well as normal consistency and setting cement time. The mechanical performance (compression, bending and tension) were determined at the age of 14, 28, 45, 90, 180 and 360 days; at the same time was performed the test of accelerated attack by sodium sulfate at the age of 90 days, in this test the samples were also analyzed with ultrasonic pulse velocity and electrical resistivity; and the effective porosity was quantified at the age of 900 days. Experimentation showed that CM does not significantly affect the mechanical resistance of the mixture and there was no change in effective porosity for replacements from 5 and 10% of CM; in addition, fresh admixtures presented more fluidity than indicated in the regular standards.

CODE 3.2.31

PROCEDURE TO DETERMINE ELASTIC MODULUS OF A ONE-COAT MORTAR

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KEYWORDS: One-coat render mortar, modulus of elasticity, dynamic test.

ABSTRACT

There are currently a large number of regulations to determine the mechanical characteristics of mortars used in construction, but there is no to establish what is its modulus of elasticity. The aim of the research was to establish a procedure which allows us to obtain the modulus of elasticity of a one-coat render mortar put in work. First, tests were performed on specimens manufactured in the laboratory, with different shapes and ages. They have been made trials to determine the static modulus of elasticity in compression and bending and dynamic modulus of elasticity longitudinal and transverse. They have also conducted tests to determine the compressive strength and bending strength of the mortar. Subsequently samples were taken "in situ" and proceeded to make the necessary tests to obtain such a modulus of elasticity. Results have been obtained from a wide and varied sample specimens of different shapes and ages.

CODE 3.3.01

STRENGTHENING METHODS FOR SHORT SPAN BRIDGES

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KEYWORDS: Bridges, strengthening, CFRP sheets, external post-tensioning.

ABSTRACT

The aim of the study is the assessment of the available methods for strengthening short span bridges, taking into account the technical efficiency, easy of construction and cost of implementation. The information derived from this study may serve as a guide for the designer during the rehabilitation of this type of bridges. The structural configuration is a concrete deck for two or four lanes, supported on concrete beams simple supported on masonry or concrete piers.
Firstly, the typical damage that has been observed in existent bridges is described, as well as the causes of damage. As a result of the increasing volume and weight of vehicles, many bridges do not conform to current design codes and have suffered deterioration or damage. In some structures visible cracks are present as a result of the low capacity of the structure leading to flexural or shear cracks which has impaired their structural behavior. Other damage could be present due to the poor quality of the construction materials, environmental conditions and the absence of an adequate maintenance program.
The most common strengthening techniques that are considered in the evaluation are the post-tensioning of beams, addition of bonded fiber carbon laminates, the use of new beams placed under the slab between the existing elements for load-sharing, and the jacketing of beams with reinforced concrete. The advantages and disadvantages of the adoption of these techniques are given as a conclusion of the assessment study.

CODE 3.3.02

ANALYSIS OF DIFFERENT TYPES OF CEMENTITIOUS-BASED COMPOSITES USED AS SHEAR STRENGTHENING SYSTEM FOR REINFORCED CONCRETE BEAMS

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KEYWORDS: Textile, shear, strengthening, experimental, analytical.

ABSTRACT

The global tendency to apply sustainable criteria in most of the productive fields and the limited durability and the pathologies that reinforced concrete elements suffer are aspects that explain the increasing necessity of strengthening this type of structures.
The evolution of strengthening techniques has consisted in the development of new technologies that ease the application of the solution and minimise the time structures are out of service. In this way, using composite materials in construction has represented a revolution in the strengthening of structures.
The textile-reinforced mortar (TRM) is a composite material that combines textiles, made of high strength tensile fibres, with cementitious matrix. A remarkable feature of this solution is that it does not require organic resins for its manufacturing and application, unlike the techniques as fibre-reinforced polymer (FRP).
The present work has consisted in the analysis of the mechanical and structural behaviour of reinforced concrete beams strengthened against shear stresses using different types of TRM. To fulfil this aim, an experimental campaign has been carried out. Nine reinforced concrete beams have been subjected to experimental tests, eight of them shear strengthened with four different combinations of textiles and mortars.
Using the experimental data, an analytical study has compared the ultimate capacity of the reinforcements with the predictions obtained from three analytical models included in design standards of FRP and TRM.
The results show that the strengthening system is able to increase an average of 33.7% the shear capacity of reinforced concrete beams. On the other hand, the results of analytical studies indicate that models adapted from FRP standards might show a better prediction capacity than the obtained with the code specifically developed for TRM reinforcements, which has performed significantly conservative.

CODE 3.3.03

EVALUATION OF ANCHORING STRATEGIES FOR IMPROVING THE EFFICIENCY OF FIBER REINFORCED POLYMERS (FRP) STRENGTHENING OF CONCRETE STRUCTURES

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KEYWORDS: Strengthening, anchors, fiber reinforced polymers, debonding, concrete.

ABSTRACT

Despite the progress made in recent years in the use of fiber reinforced polymers (FRPs) for the external strengthening of reinforced concrete structures, premature debonding and/or the lack of minimum bond length may result in the inefficient use of this technology or even in the impossibility to apply it. Therefore, to improve the efficiency and reliability of FRP strengthening systems, it is crucial to develop effective anchorage strategies to prevent or delay debonding failure. Even if many theoretical formulations have been developed to predict the bond strength between FRP laminates and concrete substrates, no design guidelines are presently available to quantify the beneficial effects of anchoring strategies such as transverse strips, Near-Surface-Mounted-Bars (NSMBs), and spikes on the bond strength. This paper presents the results of a series of bending tests carried out on ten reinforced concrete beams externally strengthened with FRP laminates. The main objective of these tests is to evaluate the improvements in the bending strength of the FRP strengthened beams provided by two different anchoring strategies: transverse strips and NSMBs. The experimental results seem confirming the efficiency of the transversal strips in increasing debonding strength while questioning the efficiency of the NSMBs anchors.

CODE 3.3.05

CRITERIA AND INTERVENTION TECHNIQUES FOR SEISMIC RESISTANT RECOVERY OF A RELIGIOUS ADOBE BUILDING

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KEYWORDS: Structural reinforcement, adobe masonry, architectural conservation.

ABSTRACT

The architectural heritage conservation, built with traditional adobes masonry techniques, presents significant difficulties where these buildings are located in seismic context such as Chile.
This article describes the criteria and intervention techniques that are designed for recovery earthquake resistant a religious set of colonial type that has been damaged with significant cracks and unaligned after the earthquake of 2010 and should be restored because it is a National Monuments. These interventions are designed taking into account the seismic behavior of the whole, which has been determined by the assessments made in the diagnostic pre and post-earthquake. These assessments demonstrate empirically the different resistance capacity of the building, varying in relation to their conservation and the existence of some reinforcement elements.
Interventions seek to recover those elements that have had a good performance against seismic thrusts and otherwise reinforcing the existing structure that has had less damage, mainly with wooden exoskeletons and geogrids, looking compatibilities between building systems.
More radically it has been rebuilt a pavilion, with the difficulty of complying a seismic regulations in a work that, for its historical value, must preserve the shape and traditional construction systems.
This project is an example of the intervention techniques that are being made in Chile taking into account the considerations of the new regulations for reinforcement and repairs of heritage structures in adobe.

CODE 3.3.09

SEISMIC UPGRADE OF MASONRY BUILDINGS BY USING INNOVATIVE ACTIVE FRP-TECHNIQUE

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KEYWORDS: FRP, vulnerability, masonry, kinematic analysis, strengthening.

ABSTRACT

Innovative materials such as Fiber Reinforced Polymer (*FRP*) have been widely used for the seismic upgrade and reparation for a couple of decades. This testifies the effectiveness of such techniques, especially when they apply to vulnerable masonry structures. In this study, the seismic upgrade of a large building, used as a theatre in the south of Italy, is illustrated. After a seismic analysis based on the study of the collapse mechanisms of the masonry walls, a strengthening program was individuated and successfully applied in-situ. The analysis was conducted with reference to the local mechanisms that can be activated by the seismic acceleration in the considered site. The kinematic analysis was performed as linear and non-linear. In the first case, the control parameter is represented by the minimum value of the seismic acceleration that can be supported by the excited sub-structure. When a non-linear analysis is implemented, the controlling parameter is the maximum displacement that guarantees the ultimate equilibrium configuration. It will be shown how the linear analysis may be more conservative with respect the non-linear one. Once the seismic vulnerability was quantified in terms of acceleration and displacement, an innovative strengthening system was designed. The seismic upgrade was evaluated by the comparison with respect the un-reinforced state of the construction. In order to avoid out of plain failure mechanisms, an active confinement was designed by using pre-tensioned carbon-aramid fiber wires, anchored trough steel plates to the masonry substrate. Four tensioned CFRP-AFRP (Carbon FRP – Aramid FRP) wires were placed along three sides of the building at different levels; each of them had a length of about *40* meters. The installation of the wires, the anchoring system and the tensioning procedure will be illustrated in the paper. The choice of composite materials allowed this type of innovative technique, by guaranteeing a high durability, speed of installation and safe operations in elevation. The conclusions will show how the designed strengthening technique is able to preserve the stability of the structure and improve its performance in case of seismic events, with no impact on the architectural aesthetics of the building. The intervention can also be considered removable according to the ISCARSAH's recommendations [1].

CODE 3.3.10

MECHANICAL BEHAVIOR OF MULTIPLE PLY FRCM (FABRIC REINFORCED CEMENTITIOUS MATRIX)

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KEYWORDS: FRCM, fabric reinforced cementitious matrix, strengthening and repair of concrete and masonry, mechanical behavior, multiple ply.

ABSTRACT

Fabric Reinforced Cementitious Matrix (FRCM) composite systems developed as an alternative to FRP, bonded externally for strengthening and repair of concrete and masonry structural elements are categorized as a thin reinforced cementitious products. They exhibit a strain hardening mechanical behavior commonly idealized as bilinear where the first segment represents the uncracked behavior and the second segment is the strain hardening effect of the fabric after formation of cracks producing a pseudo-ductile failure by slippage of the fabric. While mechanical characterization is performed on single ply tensile coupons, multiple ply behavior is not necessarily just a multiple of the first. Experiments on structural beam and slab reinforced with one and four ply FRCM have shown a difference in failure modes – fabric slippage for one ply, composite delamination for four ply. A study was performed using one, two, and four ply tensile coupons to investigate the behavior difference when multiple ply FRCM is used. Results indicate that there is interaction between the plies including deflection of the crack propagation path which can result in interlaminar separation. This effect starts to become evident with two plies and becomes the main failure mode with four plies. The efficacy of the material must be considered during design with multiple ply. The results of this study provide further understanding of the material and design considerations in its use for the rehabilitation of structures.

CODE 3.3.11

EVOLUTION OF FRCM STRENGTHENING SYSTEMS: FABRIC COATING BOND ENHANCED

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KEYWORDS: Bond, carbon fabric, FRCM, masonry, organic coating, strengthening.

ABSTRACT

Rehabilitation and strengthening of masonry and concrete structures with composite materials is nowadays a common practice allowing a viable and sustainable solution to engineers and architects by extending the life of structures. The use of dry or partially-impregnated fabrics made of carbon, aramid, glass or PBO yarns coupled with cementitious matrix (FRCM) offers advantages such as compatibility with the substrate and fire resistance, when compared to alternative organic based strengthening systems known as fiber reinforced polymers (FRP). Although FRCM systems have been successfully applied to masonry and concrete substrates, experimental studies have determined that loss of bond between the fabric and cementitious matrix interface is the primary mode of failure. The failure mode is cause due to the low impregnation between the cement-based matrix and the fabric reinforcement. This results in further slip of the inner fibers compared to the outer fibers of the roving, the so called 'telescopic failure effect'. Due to the benefits offered by FRCM systems, especially at it pertains to rehabilitating historic structures and maintaining structural integrity, it is anticipated that FRCM systems will evolve. The authors present an evolution of FRCM systems, by improving the mechanical bond at the interface between the fabric and the inorganic matrix, so as to improve the overall system effectiveness.
This study evaluates how different coating treatments applied to a carbon fabric, affects the bond behavior between fabric and mortar. The effectiveness of the selected coating treatments is evaluated experimentally by means of: i) tensile characterization, ii) shear-bond double-lap test. The bond enhancement treatments applied to the carbon fabric are coupled with different cementitious matrices, as well as with varying the levels of fabric pre-impregnation combined with quartz/silica based fine aggregates. Based on the evidence presented herein, a promising evolution of FRCM strengthening systems is proposed, where slight modifications to such systems can result in significant increases in overall FRCM effectiveness.

CODE 3.3.13

INFLUENCE OF INSTALLATION PARAMETERS ON EFFECTIVENESS OF CARBON SPIKE ANCHORS FOR CONCRETE RETROFITTING

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KEYWORDS: Structural reinforcement, fiber reinforced polymers FRP, anchorage systems.

ABSTRACT

The retrofitting of existing concrete structures with fibre-reinforced polymer (FRP) composites has widely been verified through experimental testing and has already been applied to structural members. However, the premature debonding of FRP from the substrate limits the technique effectiveness. In the last few years several anchorage systems have been developed in order to delay or to prevent debonding failure of FRP; the anchor under investigation herein is the embedded carbon fiber anchor, which has accurate compatibility and durability with concrete and FRP strengthening. The study of FRP anchors includes geometrical and installation parameters affecting the effectiveness of the anchorage system.

This paper reports a research conducted on FRP carbon fibre rolls embedded in concrete, studying parameters concerning drilling and installation of the anchors. The research is part of a larger investigation, and it consists on single-shear tests of the rolls without reinforcement, which allows to know the anchor behaviour without the influence of FRP strengthening. The variables considered are the installation of the anchors, including the drilling diameter, drilling depth and the dry or wet condition of the anchor installation. The variables affecting the concentration of stress in the bending region are also studied: dowel angle and bending radius. For this last parameter a specific tool has been designed, which allows controlling the bending radius of the concrete substrate. The research compares the effect of different anchor dowel angles, with and without special treatment of the edge, made with an specific tool in some cases and manually in others.

CODE 3.3.16

RETROFITTING IN RC BY FRCM SYSTEM. A CASE STUDY

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KEYWORDS: Retrofitting, renforced concrete, existing building, FRP, FRCM.

ABSTRACT

Fiber reinforced polymers (FRP) and Fiber reinforced cementitius matrix (FRCM) composite systems have shown great promise in structural rehabilitation and upgrade. The use of these composite materials is an excellent option for retrofitting because of their lightweight, high durability and high tensile strength. Today composite systems appear to be an appropriate way to increase the strength capacity of existing structures that are structurally unsatisfactory.
Researchers are working towards the introduction of FRP and FRCM design procedures for rehabilitation into standard codes of practice. To this aim, many papers addressing this application have been published too. They investigate behavioral aspects through several experimental works.
Moreover, several theoretical models have been proposed for predicting flexural and/or shear strength of beams and columns strengthened with FRP or FRCM systems.
But, in literature exists only a limited number of models that take in account the existing interaction among the different characteristics of solicitation.
In this paper, a procedure of design is presented, and it is based on the theory of the plasticity, for the reinforcement of RC beams, by use of FRP/FRCM systems. An example, about the strengthening in RC beams of a building of the years '20, in evident conditions of crisis for shear and bending moment, is illustrated.

CODE 3.3.18

OUT-OF-PLANE EXPERIMENTAL BEHAVIOR OF T-SHAPED FULL SCALE MASONRY WALL STRENGTHENED WITH COMPOSITE CONNECTIONS

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KEYWORDS: T-shaped masonry wall, out-of-plane mechanisms, masonry connections, composite system, CFRP pultruded tubes.

ABSTRACT

Masonry structures are commonly not in compliance with modern seismic design codes. The poor connection between orthogonal walls and between walls and floors may provide the local collapse of walls in case of seismic actions. Indeed, effective connections avoid out of plane collapses, which are the most common failure mode of existing masonry structures. The paper reports the results of an experimental program on T-shape full scale tuff masonry specimen, designed with poor connection between orthogonal walls and tested in the as-built and strengthened configurations with an innovative solution. Three tests were carried out on the specimen under monotonic and cyclic horizontal actions and constant vertical loads. The strengthening technique is based on the use of hollow CFRP pultruded tubes, wrapped with longitudinal and spiral stainless steel fabrics in order to increase the transverse strength of tubes and the bond between mortar and tubes. The experimental outcomes show that the proposal technique resulted effective to strongly increase the connection between orthogonal walls avoiding the premature out of plane collapse.

CODE 3.3.20

A SOLDIER-PILE STRUCTURE FOR ENVIRONMENTAL REHABILITATION OF ARCHAEOLOGICAL SITES IN THE MEDITERRANEAN PYRENEES

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KEYWORDS: Soldier-pile construction, building reinforcement technology, cultural heritage preservation, perception on historic structural engineering.

ABSTRACT

Soldier-pile design is useful for reinforcement, construction technology and environmental conservation of cultural heritage sites. From the years 1960 to 1996 ad hoc planning caused environmental negative impact on the archaeological site and historical buildings of Isil, Empúries-Pontós and Cadira del Bisbe. At that time the northeastern Iberian Peninsula went through a quick process of urbanization that also negatively affected forest and agricultural landscapes surrounding these sites. In this paper environmental impact assessment and problems is done through piles and lagging design specifications. Evidence will show how they work as corrective measures by constructing complex earth support systems. A historical report is given to support different kinds of perception users have on either modern concrete retaining walls or on he revival of traditional, wood frame and soldier-pier techniques. Timber and lumber systems, posts and earth retention walls work not only to repair but also facilitate inspection surveys, maintenance and monitoring of overseers working in damaged heritage and nature preservation sites.

CODE 3.3.23

REPAIR AND RETROFIT CRITERIA OF HIGHWAY BRIDGES

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KEYWORDS: Bridge pathologies, bridge vulnerability, retrofitting techniques, intervention criteria.

ABSTRACT

An important number of short and medium span bridges built before the 1980's decade are spread all over the world. A typical structural configuration of these bridges consists in a concrete deck on multiple simply supported precast girders. Most of them are RC structures designed with low seismic forces and out-of-date codes. Moreover, during their useful life several increments of dead and live load amplitudes are usually presented. Most countries have periodic inspection programs to evaluate, and based on the results, to decide rehabilitation actions for bridges. It is common to find pathologies that require detailed studies before deciding the type of intervention in each bridge or family of bridges. After selecting a group of bridges that need to be rehabilitated or retrofitted, the decision of the best technique and a prioritization process must be decided. This study aimed at analysing the most common bridge pathologies, rehabilitation and retrofit techniques, and discusses the most important parameters to be considered in a decision-making framework. Finally, the results of the vulnerability assessment of several bridges located in prone seismic areas and the retrofit alternatives are presented.

CODE 3.4.02

RESTORATION OF THE MAIN ALTAR OF CHURCH OF ST. MARY OF THE PRIORY

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KEYWORDS: Piranesi, restoration, conservation, history, stucco.

ABSTRACT

After 250 years from the intervention on Santa Maria del Priorato church started by Giovan Battista Piranesi in 1765, the military Order of Malta has undertaken the restoration of the important building. In May 2015, the conservation work of the altar designed by Piranesi, realized by the Roman sculptor Tommaso Righi and dedicated to S. Basilio, has been completed. The dedication recalled Knights of Malta's original church at Foro di Augusto, founded by basilian monks. In the altar project, Piranesi has used various decorative forms, as usual in his poetry, giving back to the ancient elements their meaning through fantasy. In 1828 the church was involved in a consolidation work by Giuseppe Valadier. Since that moment, the altar underwent ordinary maintenance interventions which, made with unsuitable materials and methods, caused deposits on the work surfaces, due to inappropriate whitewashing and painting application, according to the customs and the taste of time. This contribution aims to illustrate the altar restoration and the results of studies and multidisciplinary investigations on the work; on these basis the restoration interventions have been realized, allowing today a correct reading of surface colors and original patina of the altar.

CODE 3.5.01

CRANE CAROLA. AN INDUSTRIAL HERITAGE ICON OF BILBAO

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KEYWORDS: Industrial historical heritage, rehabilitation, gantry crane.

ABSTRACT

The crane 'Carola' is a shipyard crane of the type 'Electric Gantry Crane'. It was built between 1954 and 1957 by Talleres de Erandio following a request by Astilleros Euskalduna for shipbuilding.
This crane represented in the 1950s a great innovation for shipbuilding and the most powerful crane in the country at that time. It has a maximum height of 62 meters, a capacity of 30 tons, a minimum aperture of 10 meters and up to a radius of 25m at a speed of four meters per minute. The main elements of the crane are shown in the figure below.
After the Euskalduna shipyard ceased trading in 1984, the crane was subjected to severe deterioration due to lack of conservation and repeated looting.
In July 2000 the Provincial Council of Bizkaia began the restoration work to convert it into an industrial heritage element of Bilbao. Currently, the Bilbao River Maritime Museum, which manages the assets transferred by several Basque institutions, is exploring the possibility to convert the cabin and cockpit into a lookout.
In addition to the crane's history, this article will describe the functions that had the crane, its conservation and the study to condition the cabin and cockpit as a lookout.

CODE 3.5.03

DISUSED RAILWAY LINES. RECOVERY AND ENHANCEMENT

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KEYWORDS: Disused railways, recovery, enhancement, sustainable intervention, energy improvement.

ABSTRACT

In the hinterland of the South Italy there are many railway lines with related works of art and abandoned service buildings, sometimes forgotten. These railways come completely, tobepart of the industrial archaeological heritage, that you have to restore and enhance, as they represent the result of a process of change and a new way to "live" the territory. The paths, climbing through the mountains, engaged technicians and workers in impressive works of containment and consolidation, in addition were created works of art that are still, thanksto boldness, monumentality and insertion in the landscape, the most eloquent testimony of the technique applied in the beginning of the century for construction of railways. With this paper we want to show how the actions on individual railway lines may be different, but they all turned to the recovery and improvement of existing facilities providing in some cases, the conversion of railways (greenways) and service facilities (staging points, studies and multifunctional centers) and in other cases the reopening of the routes through policies of social, cultural and landscape regeneration.
We propose a methodology of approach to the problem of preservation of artifacts that mark the railway lines, which takes into account the difficulties of functional conversion of all buildings because of their structural fragilityand the inadequacy of the technological characteristics of the existing structures and therefore the need for intervention by a sustainable design closely related to their reuse and thereduction of energy consumption. The goal is to demonstrate how these small buildings, now considered outdated and obsolete, wrapped from decay and neglect, can become examples of architectural excellence and technological efficiency through sustainable design, which provides for measures compatible with the historic building technologies and, at the same time, directed to be self-sustaining from the energy point of view.

CODE 3.5.04

RAILWAY STATIONS IN THE SOUTH WEST OF COLOMBIA: MODEST HERITAGE AND TERRITORIAL VALUE

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KEYWORDS: Modest heritage, railway stations, industrial architecture.

ABSTRACT

This study looks at an example of the so-called modest heritage, giving importance to buildings as a complex and not just as a single building. This specific study looks at the complex of 47 railroad stations that were built in the southwest of Colombia in the first half of the twentieth century as part of the Pacific Railroad and have been declared Cultural Interest Heritage. While small in scale, these stations have an enormous symbolic importance as pieces in a system which strongly contributed to the establishment of the territory. The study analyzes the construction and implantation patterns of the buildings in the complex and evaluates the complex from various criteria including the importance of the surroundings and the landscape, the individual technical aspects and the affective connections of those living there.

CODE 3.5.05

AERIAL LIFT COMPLEX "CABLECARRIL CHILECITO – LA MEJICANA": A SCAR ON THE MOUNTAIN. PREVIOUS STUDIES FOR ITS INCLUSION ON THE ARGENTINA'S WORLD HERITAGE TENTATIVE LIST

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KEYWORDS: Industrial heritage, Geo-referenced survey, Cableway, gold mine, Chilecito.

ABSTRACT

The metalliferous riches of the West of La Rioja, Argentina, were exploited in a rudimentary manner (due to extreme environmental obstacles) until the early XX century. The railway construction in Chilecito by 1899 eased the transportation to Buenos Aires and Europe, though it could not cope with the topographical difficulties between the mines and Chilecito. For such purpose, a ropeway conveyor was built-an engineering feat, unique in the world due to its characteristics. It is a straight 35 km long aerial lift system that circumvents a 3,500 metre slope. The system comprises two steel cables (one stationary and one moving) suspended along 262 towers. Buckets and carriers transporting ore and all kinds of loads travelled on the cable up and down the mountain. 8 sections of the cable link 9 stations—some of which were equipped with steam engines to drive the system—as designed by Adolf Bleichert & Co. (Leipzig, Germany). The construction took place between 1901 and 1903.
This project will foster the valuing of the site in order to support its inclusion on the Argentina's World Heritage Tentative List.
The methodology comprises:

- Bibliographic and geographic data survey;
- Comparative analysis: originality, authenticity, integrity;
- Expeditions to develop georeferenced surveys of towers and stations.
- Interviews with competent informants;
- Systematization of graphic information (planimetric, photographic, audiovisual, and multimedia);

The project envisages the fostering of compromises between the citizens of Chilecito and their institutions in order to guarantee its protection as well as the report to support the nomination of this magnificent mining asset of the provincial mining history. This would help to culturally lessen the damages that its operation produced on the mountain.

CODE 3.5.08

REUSE OF INDUSTRIAL HERITAGE: THE CASE OF KURT TILE FACTORY IN TUZLA, ISTANBUL

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KEYWORDS: Industrial heritage, preservation, reuse, tile factory, Istanbul.

ABSTRACT

As cities are transforming, the issue of preserving and reusing industrial buildings is becoming an important part of the agenda of urban debate. For this reason, in this article, a less known tile factory in Istanbul Tuzla was selected as a case study. In this context, Kurt Tile Factory constructed in the first half of 20th century in Tuzla, Istanbul, Turkey is studied.

The production of brick and tiles in western standards had been realized in Ottoman territories in the last quarter of the 19th century. Unfortunately the brick making factories in Istanbul were demolished in the second half of the 20th century due to the urbanization problems. Therefore the Kurt Tile Factory which presents its architectural peculiarities such as furnaces, chimney, wooden pillars and roof structure is the only brick factory that exists today in Istanbul. The factory is not registered as a cultural asset by the national conservation board and is used as timber depot, cardboard and ship building factories in present. The area with its current industrial function and heritage creates a good potential to discuss problems, dilemmas and potential solutions about heritage.

In different European countries, it is observed that brick making factories are preserved as an industrial heritage and have museum functions where traditional brick manufacturing can also be seen. In this article, first of all, similar historic brick making factories preserved in Germany, Great Britain, Netherlands, Italy, and Greece will be studied. Current approaches to conservation, preservation and reuse will be studied over these examples. After this literature review, site-specific protection and reuse approaches will be studied over graduation studio works conducted at Yıldız Technical University on Kurt Tile Factory in 2014-2015 fall term. The article ends with drawing the contextual background and legal framework of a replicable example for industrial heritage in Turkey.

CODE 3.5.09

A PROPOSAL FOR THE REFURBISHMENT OF AN OLD INDUSTRIAL BUILDING - FÁBRICA VELHA IN COVILHÃ, PORTUGAL

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KEYWORDS: Industrial, culture, requalification, Covilhã.

ABSTRACT

This articles has the objective to proposal of a project to requalify an industrial building, which is situated near the Carpinteira river, Covilhã.
In Covilhã, we can find innumerous buildings of this kind, which with the passing of time, were abandoned. Due to these unfortunate circumstances, they must be requalified, giving way to new activities. The city has become increasingly less dynamitic and depopulated.
By requalifying and rehabilitating these buildings to give way to activities for the public, they become positive and attractive landmarks in the older side of town. The main objective of this project is to requalify the Fábrica Velha building, integrating a core of activities related with culture and art.
Yielding opportunities to receive musical events, expositions, theater, cinema and fashion. Having gone from being a survivor of its time to being a lasting presence in the cities life.
The importance of elaborating a project for the industrial heritage can be seen as fundamental for new politicians of a region or city, betting strongly on the requalification/revitalization. The requalification of these spaces contributes to a new urban and cultural regeneration. With the requalification of this building where art can be created and welcomed, giving in to the possibility of an impacto n the touristic development. Understanding the value of these buildings due to their location and urban scenery.

CODE 3.6.01

BIOREHABILITATION OF A FAMILY HOUSE BUILD WITH SAWN TIMBER LOAD BEARING WALLS

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KEYWORDS: Fungal decay, timber, rehabilitation, bioconstruction.

ABSTRACT

Today there is no doubt that rehabilitation and new construction projects, should always consider three key considerations: damage on the environment, social impact and economic sustainability.
In this context, both in the case of structural components such as coatings or finishes, it is obvious that the use of timber, in addition to its great mechanical performance, also leads to reduced environmental damage, especially when it comes from a forest area certified with chain of custody warranty.
Unfortunately the lack of knowledge about wood and its derivatives causes the appearance of damages and defects in buildings. Said problems range from small attacks of decay organisms, to more serious damages which sometimes even the habitability and the structural safety of the construction.
First of all, the paper aims to give an overview of the main pathological processes that often occur in houses built of wood; and then a structural and energetic rehabilitation performed on a timber frame family house, for which have been used exclusively Bioconstrucción techniques and criteria, is shown.

CODE 3.6.02

STRUCTURAL REHABILITATION OF THE HOTEL LUX, SINCE THE EVALUATION OF PROJECT TO THE REALITY OF EXECUTION; IMPACT ON COSTS AND PROFITABILITY

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KEYWORDS: Structural rehabilitation, pathology, reinforcement, intervention.

ABSTRACT

The aim of the paper is to highlight, through a practical case, an inherent problem for rehabilitation consisting of the impact on costs and profitability, the subsequent modifications from the initial phase of the project to the final reality of the execution, motivated by the impossibility of obtaining absolute certainty on pre existing building without incurring any cost overrun of studies and tests during the previous assessment.
The methodology used in this intervention of rehabilitation included a serious analyzing about technical feasibility and economic, of which were derived the importance of rigorous structural evaluation and proper diagnosis.
In the example shown, a residential building shaped in plan and elevation by an apparent symmetry, proceeded to the building assessment while it was being partially used by tenants. To do this experimental and analytical techniques were combined, seeking a limited but sufficient information using a statistical methodology inspection.
However, the successive appearance of singularities during the demolition process and execution of the area occupied until the last moment, in addition to a change of use decided by ownership on the fly, has forced the technical direction to progressively adapt to all discovered variations. Consequently this had an impact on the initially planned costs and undermining the expected profitability of the promotion.

CODE 3.6.03

STRUCTURAL REHABILITATION OF FORMER MILITARY HOSPITAL. VIGO (PONTEVEDRA)

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KEYWORDS: Rehabilitation structure, reinforcement, intervention.

ABSTRACT

The former military hospital of Vigo was incorporated into the Vigo-Redondela police station.
From 2006 to 2012 it proceeds to design and build a new police station in that land, having to join the old hospital to this project. Designed by the architectural team FQP-architects (Fraga, Quijada and Portolés).
The new use of the building made it difficult to maintain the existing structure thereof. The building also suffered a traumatic rehabilitation suffered by it in the 70s. So, the initial idea of the project, was to make a cutout full of it, building a new structure, independent of the facades of the old hospital, now called building C.
During the execution of the work, the option to keep the existing structure of the building arises, although it was necessary to resolve the inconsistency of the currently existing structure of the new use that went through the elimination of almost all interior pillars besides being necessary changes in the implementation of the stairways.
There were other problems. Apart from other buildings were already in operation. There was little time for execution of these works and there was little space for storage of materials.
The process consisted of an almost unique performance to replace the existing structure with a metal one. This operation was to be implemented virtually overnight because the building is located in the center of Vigo and needed the use of large do not support the daily urban city traffic mobile cranes.
This paper tries to show the process of design and installation of such a structure, a process that has several peculiarities worthy of mention.

CODE 3.6.07

INTERVENTION IN THE CHURCH OF THE VIRGIN OF THE HEALTH OF HONDÓN OF THE FRIARS, ALICANTE, (SPAIN)

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KEYWORDS: Architecture, restoration, church.

ABSTRACT

The Dominicans raised the current Virgin parish of the Health of Hondón de los Frailes in the 19th century, coming to the present day with few modifications. With the passage of time diverse structural hurts have produced to themselves for seat of the tower and the lack of tie perimetral, that demonstrate in drafts and cracks; the most important was separating the ship and the tower. The socle was presenting chipped caused by the water, specially in the right corner of the tower.
The interventions that have been realized were destined to assure the structural stability and to return the damaged elements, for it the project of restoration was gathering those necessary actions to re-wear the tower and to tie her in his perimeter to prevent it being from opened, sanear the whole front of the church and to repair it in the indicated zone, as well as the sealed one of the cracks and the treatments against the dampness.

CODE 3.6.08

REPAIR OF THE BUILDINGS OVER THE ROMAN THEATRE OF CADIZ AND ENHANCEMENT OF THEM

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KEYWORDS: Heritaje, archaeological excavations, archaeological conservation, grout injection, Roman Theatre of Cadiz.

ABSTRACT

The Roman Theatre of Cadiz (Spain) was built in the century I b. C. by Lucio Cornelio Balbo “the Minor”. It is the oldest Roman theatre in the Iberian Peninsula and the second one when looking at its dimensions. Balbo “the Minor” was a Roman consul who developed the city of Cadiz by the construction of many important buildings.
The most part of the Theatre is buried under “El Populo”. “El Populo” is an historical district of the city founded by the king Alfonso X in the century XIII. This area is the origin of the city of Cadiz. By this reason, it is heritage from the historic and artistic point of view. Due of the fact that some of the buildings over the Theatre are listed, they must be conserved and repaired. The remains of the Theatre must be restored too, and the archaeological excavations must continue too in order to undig the hidden remains. A structural intervention was concluded to be needed in order to guarantee the stability of the complex. This must be done without any damage to the remains of the Theatre.
The analysis of the remains of the Theatre and the buildings over it, and a revision of the available techniques for its conservation are the main target of this paper.

CODE 3.6.11

CONTEMPORARY ARCHITECTURE AND RESTORATION. TRIALS OF ARCHITECTURAL LANGUAGE IN THE REUSE OF FORTIFIED BUILDINGS

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KEYWORDS: Fortified buildings, conservation, reuse, integration, architectural language.

ABSTRACT

At the turn of the Twentieth and Twenty-First century, many restoration interventions interpret the theme of the addition – or the filling of the lacuna – not only as an answer to the conservation needs of the building, but also as a design opportunity in which metal structures become an instrument of the architectural syntax.
The use of building materials such as steel, Cor-Ten or titanium allows the development of additions/integrations that arise on the historical building as new stratigraphic layers, helping to realize a syntactic and formal distinguishability from the past.
Intervention practices based on the use of metal devices are clearly consistent with the statement taken from the Krakow Charter (2000): «If necessary, for a proper use of the building, completion of more extensive spatial and functional parts should reflect contemporary architecture». These elements/structures aspire to the maximum reversibility of the intervention, also helping to minimize the extension of the anchor points between old-structures and new integrations.
The paper analyses 5 interventions carried out on fortified buildings located in Italian territory between Trentino-Alto Adige region and Veneto region: the Juval castle (1997), the Tirol castel (2003), the Fürstenburg castel (1996-1999), the Firmian castel (2001-2006) and the scaliger castle in Ponti sul Mincio (2013-2015).
The contribution will highlight that the interventions carried out in historic sites by these techniques show clear formal similarities.
However, the outcomes of the interventions will be considered in terms of the inner coherence of the design choices, with particular attention in defining the construction details. In fact, the analysis of the working plan of each intervention – especially focused on the anchorage techniques used to connect the new insertions with the historical masonries – allows to underline significant mutual differences in the conservation of built heritage.

CODE 3.6.12

PROVISIONAL AND DEFINITIVE REINFORCEMENT OF AN 11-STOREY BUILDING AFTER A FIRE IN THE BASEMENT -1

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KEYWORDS: Explosion and building, on fire, building damaged by fire, reinforcement of burned out building.

ABSTRACT

In this paper the work carried out on a building consisting of 11 stories and two basements, located in Santander, after the fire caused by exploding fuel stored in one of the garages is collected.
The work ranges from visual inspections to determine whether the evacuation of residents was appropriate or not, the temporary reinforcement of the building, and finally the repair of the structural elements affected by the fire after the explosion.
The loads supported by the affected pillars as they were in the original plans were evaluated to define the provisional reinforcement of the building.
Regarding the repair of the affected structural elements, including pillars, abacuses and nerves of waffle slabs, tests were conducted to evaluate the residual strength capacity of the concrete pillars affected and those closest to the source of fire, as well as valves (yield strength and tensile strength), to achieve the necessary, adequate and accurate data to determine the structural safety of the affected area and, based on that information, to decide the most effective method of repair.

CODE 3.6.17

REHABILITATION OF A GLULAM COVER: PROJECT AND CONTRUCTION

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KEYWORDS: Structural rehabilitation, glulam, adhesive failure, numerical simulation, experimental tests.

ABSTRACT

This paper presents the rehabilitation of a glulam cover in Montevideo, Uruguay. The structure covers an area of 500 m^2 and consists of six main beams of 20 m long, straps and rafters made of Argentinian Paraná Pine (*Araucaria araucana*) glulam. No technical certificates of the used material are available. The cover was inspected at the end of 2013 and elements with structural damage were detected. The structural problem was caused by the failure of the adhesive-bonded joint in some finger-joints and layer unions, producing the tensile failure of some layers of two main beams. Other minor problems were detected, such as delamination and poor support condition of straps and rafter. As a solution to the identified pathologies it was proposed: the application of controlled upward deflections to the main beams of the structure, the subsequent reinforcing of them by through bolts along the edge and galvanized steel profiles in the tension face, the reinforcing of straps by galvanized steel sheets, and the modification of support conditions of rafters on straps. The stresses and strains caused after the failure of the main beams and expected at the end of the rehabilitation were estimated using a simplified model and a numerical simulation by the finite element method. During the rehabilitation process, applied forces and upward deflections were monitored by load cells and dial gauges. The results of the simplified model and the numerical simulation showed a very good approximation to the experimental measurements and allowed to adjust the values of the mechanical properties of the glulam. Finally, this paper presents some of the major challenges that arose during the rehabilitation, the actions taken to solve them, and the final state of the rehabilitated cover.

CODE 3.6.18

MURALS PAINTINGS OF THE SÃO DOMINGOS CHURCH IN ARAXÁ, MINAS GERAIS, BRAZIL: PATHOLOGY, DIAGNOSIS AND THE CONSERVATION PROCESS

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KEYWORDS: Murals paintings, pathology and diagnosis, conservation process, restoration process.

ABSTRACT

Much of the research in materials, traditional construction techniques and pathologies of cultural value in Minas Gerais are almost always concentrated on producing architectural and sculpture from the colonial period with emphasis on the baroque and rococo of the eighteenth and nineteenth centuries. However, from the twentieth century comes a large number of religious and civil buildings inspired by the neoclassical and eclecticism. So there has been a rich repertoire of ornaments in relief (stucco), hydraulic tiles, cast iron elements, and especially the murals executed by dry technique on the internal spaces of these buildings. This article presents the intervention process performed on the murals of the chapel-Mor of the Church of Santo Domingo, in Araxá, Minas Gerais - Brazil. Within this context, we present the methodology that includes contextual lifting steps, map damage and diagnosis and the definition of the conservation and restoration of interventions. The paintings, by Alberto Paulovich, were made in the decades from 1930 to 1940 and had a precarious state of conservation. The intervention process took place from January to June 2012 and achieved good results. Given the size of the collection and its complexity, required to coordinate actions and planned that would create dialogue among professionals directly involved and the technical decisions. Thus, it is believed to be contributing to the spread and the preservation of the memory and artistic and constructive identity of the local community.

CODE 3.6.19

PRESERVATION OF ARCHAEOLOGICAL AND URBAN HERITAGE THROUGH ARCHITECTURE. SAN MARTIN'S INTERVENTIONS IN THE CITY OF CARTAGENA (SPAIN)

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KEYWORDS: Pedro San Martin, archaeology, urban plan, Cartagena.

ABSTRACT

The methodology used for the enhancement of Heritage and Archaeological has commonly been its "display" either by large open digs or through transfer to purposely built museum spaces, while there have been high value alternative at the time they were developed and marked a before and after for managing the assets of a city.
One of these variants, perhaps the most prominent and yet unknown even today, is employed by Pedro A. San Martin Moro , architect, connoisseur of the city of Cartagena and its history, member of the Department of Fine Arts Ministry Culture and director of the Municipal Archaeological Museum of Cartagena, which develops a series of performances at multiple levels (architectural and urban), pursuing a central objective of the "Enhancement of the City as a whole" during the early second half of the twentieth century .
By using "jacketed piles and sand filling" in the excavation of plots to be built upon it proposes the preservation of sites in their original location creating an urban fabric in a lower layer to the existing urban fabric to ensure an alternative route by the underground Roman city, while trying with all means at its disposal and with the aid of the Law 16/1985 of June 25 Spanish Historical Heritag , which enhances the urbanistic Administration tools necessary to ensure the enhancement of Archaeological heritage.
Through the comparison of various actions, it can be noted how innovative approaches and architectural - urban construction systems are converted into referential architecture in patrimonial recovery for the development of the city and its future planning.

CODE 3.6.21

DURABILITY OF METAL STRUCTURES IN ANCIENT BUILDINGS: EXAMPLES OF EXHAUSTION OF SERVICELIFE AND INTERVENTION

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KEYWORDS: Metal structures, weldability, shoring; reinforcement, corrosion, differential aeration.

ABSTRACT

Most of the ancient buildings of the Spanish cities erected on the late nineteenth and early twentieth century were built with metal structure. Even on structures of inland cities exposed in a non aggressive environment there are pathologies due to corrosion of the metal structure. Usually these cases are associated with construction details that have not result completely appropriate for preventing moisture issues, such as the absence of correct coating of the steel structure or contact between steel and walls (metal joists with ceramic pieces between them, external brick walls close to steel columns supported on foundation...).
An incorrect maintenance of the buildings by the user entails the service life of some structural elements could decrease very fast. This is especially dangerous at points such as the above mentioned, which deterioration could not be noticed until it is too late.
In this article we show cases in which inappropriate maintenance has caused severe safety problems, complicating the further repair intervention. In ancient structures as cited above these interventions of shoring and reinforcement are further complicated if not weldable steel has been used the existing structure, aspect that in many cases is not considered.

CODE 3.6.22

TWO CASES OF EMERGENCY MEASURES: WHEN THE COMPLEXITY OF SHORING EXCEEDS IN THE SUBSEQUENT REINFORCEMENT

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KEYWORDS: Shoring, reinforcement, loads transmission, intervention.

ABSTRACT

When severe damage are detected in a structure is generated an alarm between the users and should to take emergency measures. Sometimes these urgent interventions make to take ineffective solutions of shoring.
To get that shoring be effective is essential, at least, to ensure at least two main aspects: it must carefully think of the trajectory that follow the loads from the existing structure to the elements of shoring, and the configuration of shoring should be designed to allow the execution of reinforcement.
As shown in real cases of intervention exposed, consisting in the reinforcing of steel columns close to collapse, the emergency shoring ready not ensure the correct transmission of loads mentioned (passing the risk of collapse of the columns to the beams of the building) neither allowed to tackle the reinforcement, so it was necessary to have another additional system of shoring that allowed removing the first with full guarantees before to drain and reinforce the structure.
The shoring should always be studied fully and carry out the supporting calculations and drawings of definition necessaries as is done with the final structures. Furthermore, in cases such as these, the complexity of shoring makes that the cost of these be greater than the cost of subsequent reinforcement.

CODE 3.6.23

TIME IN THE CULTURAL RESTORATION PROJECT OF THE FAÇADE OF THE CATHEDRAL OF PAMPLONA

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KEYWORDS: Conservation and restauration, cultural heritage, cultural project, Cathedral of Pamplona.

ABSTRACT

The restoration of the façade of the Cathedral of Pamplona (Spain) can be used to delve deeper into various aspects of time management in a restoration work. This Cultural Project has been carried out by introducing the value of the concept of time from different perspectives, both historical and current. In this sense, this restoration project constitutes a case of relevant study as a starting point to address a systematic reflection about time management around intervention in monuments, which appears necessary, and whose scope goes beyond this specific case.
It starts from the premise that every restoration project is: understanding and interpreting historical times; diagnosing and understanding the building degradation processes increased by over time; planning and management the project and consequent implementation; and transmitting those values that transcend the temporal dimension of any cultural property.
After analysis, it is possible to conclude that an optimization by incorporating other helpful actions within the time required for the proper development of a project, is more effective than an optimization of resources by reducing execution times. Activities related to research, communication and cultural advancement of heritage, have a greater effect on this cultural heritage to become appreciated by citizens.

CODE 3.6.25

REHABILITATION AND RESTORATION OF A HISTORIC ADOBE CHURCH

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KEYWORDS: Adobe, reinforcement, intervention, church, earthquake.

ABSTRACT

Historic adobe buildings are very often in Peru and actual building design code includes a seismic design but adobe buildings built prior to this code are still vulnerable to seismic damage and require rehabilitation and reinforcement. This paper shows the evaluation process for the structural intervention process accomplished on a historic adobe building. In this case, principles of conservation of heritage buildings limited the technical alternatives for seismic adaptation. Criteria applied for structural diagnosis of the building, considering stability as the key factor but also the structural configuration of the timber truss roof system and the weakness produced by humidity on foundations is described. In addition, analysis and selection process of final alternatives for reinforcement is presented. The 7.9 m high lateral adobe walls of the church was restored and strengthened. The three aspects of strengthening are: reinforcement of walls using a steel mesh, changing the roof while conserving the shape and increasing the section thick of the elements, and controlling wall moisture susceptibility problems by using a permeable protection of gravel stone. Since its rehabilitation, this church has successfully withstood more than 20 earthquakes with magnitudes from 4 to 6.

CODE 3.6.29

THE CERAMIC CONSERVATION WORKS IN THE GAUDÍ´S BUILDING "EL CAPRICHO" (COMILLAS) AFTER THE TWO RENOVATIONS

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KEYWORDS: Rehabilitation, conservation, ceramic, arts & crafts, modernist, Gaudí.

ABSTRACT

"El Capricho" is a work commissioned by Máximo Díaz de Quijano to the Architect Antonio Gaudí in 1883. It is located in the cantabrian village of Comillas. The building has been modified on two different occasions changing part of its structure. The first renovation took place in 1914 to convert a single man´s summer house into a suitable place for a large family. The second renovation was made by the architect Luís Castillo Arenal to turn the building into a restaurant. Both changes affected in a direct way to ceramic, one of the hallmarks of the building.
Ceramic plays a leading part in El Capricho. Gaudí tries to melt the building into the landscape in which it is located that's why he chooses this material. The influence of English art, especially the Arts Crafts movement, gives it such an importance that leads us to considerer this building as a clear evidence of the relationship between Gaudí and the international styles, providing a new approach to his work.
The goal of this research is to show a case of rehabilitation of a building paying particular attention to the ceramic and how it has been affected by the two renovations. We will go through the History of the building, its stylistic evolution and through both renovations to get to understand a building process which, due to the lack of documentation, we can only imagine.

CODE 3.6.30

AN EXAMPLE OF GOOD HERITAGE PRACTICE IN MODERN BUILDINGS CONSERVATION

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KEYWORDS: Conservation of modern architecture, intervention criteria, post-war architecture, Tavolara Pavilion.

ABSTRACT

Conservation of modern architecture poses great challenges to practitioners. In fact, it is not possible to apply established and codified theories and procedures, because of the innovative use of construction techniques and building materials. Every intervention need an ad hoc approach based on the peculiar features of that specific building. Therefore, every conservation project should be preceded by a "monographic" study of the building, depending on its relevance, but, unfortunately, this crucial phase is often disregarded. The paper will present the Tavolara Pavilion conservation as an example of a good heritage practice, thanks to a synergy between university and institutions.
The Pavilion, built in 1956 as a place for arts and crafts temporary exhibitions, was included in the DARC (Direction for contemporary art and architecture) list of the most representative Italian post-war architectures. In 2003, the Ministry of Heritage and Cultural Activities, by means of the Sassari department responsible for the environment and historical buildings, financed a study of the Pavilion, in order to elaborate a series of guidelines for the conservation project. The research, presented in the book "Il Padiglione dell'Artigianato a Sassari, architettura e conservazione" (The Arts and Crafts Pavilion in Sassari, architecture and conservation), was guided by professor Poretti of the University of Tor Vergata (Rome). The Sardinia Region prepared the preliminary project on the basis of this exhaustive survey and, following a public tender, the Pavilion was recently renovated.
In particular, the paper will examine the conservation project and techniques, which respected the identity of the building, focusing on how the procedure described influenced the positive results of the project.

CODE 3.6.31

THE 'CASARÃO' AMÁLIA NOLL: AN IMMIGRATION'S ARCHITECTONICAL MOSAIC IN SOUTH BRAZIL

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KEYWORDS: Heritage buildings, rehabilitation, imigration.

ABSTRACT

At the end of the XXI century, a big immigration phenomenon happened in the south of Brazil, when thousands of European decided to leave their native country to look for new and unexplored lands. The material and immaterial multicultural patrimony generated by them remains as history legacy from the European colonization (Portuguese, German and Italian), and many other ethnic groups developed and raised the people of Rio Grande do Sul. In these work we are going to deal particularly with the heritages from the peoples who debarked at Guimarães' harbor, in São Sebastião do Caí, Rio Grande do Sul, Brazil, that were spread out through communities as the Rio Branco road was opened. This road has an extension of 250 Kilometers moreover, nowadays, it passes through one of the most important industrial developed regions of Brazil. Even so, we can still find through this road many architectonic exemplars of the immigration period, as well as descendants residing on its banks.
The Casarão Amália Noll, in Feliz city, is one of these exemplars of the survival architecture from the past period. This building shows distinct steps and constructive techniques, furthermore we can identify in one single room the presence of the characteristics from the Portuguese, German and Italian architecture. In 2015, the construction finds itself in low state of preservation, when at the time begins the woks of cadastral surveys, diagnosis of pathologies and proposal of intervention.
The present article aim to show the proposed solutions for the first stage of architectonic intervention, in which we opted for the ruin stabilization and for the architectonic volumes restoration. At the new restored space will work a traditional German brewery, called Biergarten of Amália, beyond the museum of craft beer, immaterial heritage brought by the Germany people to the region.

CODE 3.6.34

THE REFURBISHMENT OF SINGLE PROPERTY UNITS WITHIN A BUILDING: STRATEGIES AND EXAMPLE OF INTERVENTION

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KEYWORDS: Building refurbishment, energy efficiency, building services integration, flexibility, thin insulation

ABSTRACT

The existing built heritage refurbishment is a relevant issue in pursuing the elimination of energy efficiency problems of the built environment, especially when it is characterized by low performance envelope and building services solutions. However, the intervention on a whole building is not always possible and often it is necessary to operate on individual property, that can change even the intended use, for example from housing to office. This involves the observance of today high performance standards, as well as the integration of more efficient systems in order to control and guarantee the indoor comfort conditions. The research focuses on these specific redevelopment projects that often encounter recurring issues, such as the impossibility to work on the building façades directly due to architectural constraints, as well as a limited storey height can restrict inevitably the range of choice of technical and building systems solutions, etc.
This paper presents a review on the main issues, constraints and strategies for the energy, architectural and performance refurbishment and upgrade of single units within existing buildings, and it shows their application in a significant case study where the most innovative technologies and technical solutions were used, providing at the same time the maximum building services and layout functional flexibility.

CODE 3.6.37

BEHAVIOUR AND DURABILITY OF "MIXED STRUCTURES" IN ARCHAEOLOGICAL AREAS. THE TEMPLE OF PYTHIAN APOLLO AT THE ACROPOLIS OF RHODES

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KEYWORDS: Anastylosis, archaeological remains, reinforced concrete, mixed structures, structural behaviour.

ABSTRACT

Since the beginning of the 20th century, reinforced concrete has had a widespread employment in the interventions of anastylosis of monuments in archaeological sites, as the new technique granted the reassembled ancient stones a new equilibrium. This practice has produced a broad scenario of "hybrid" monuments, i.e. "mixed structures", whose stability is guaranteed by the interaction between ancient and modern materials and construction techniques.
This paper presents the results of a PhD research that investigated some main issues related to the preservation of ancient ruins reassembled with reinforced concrete: re-thinking of their historical and cultural significance; testing the possibilities and limits in understanding their actual structural behaviour through the Building Science's structural models; proposing a possible approach in evaluating their structural safety.
Historical and current literature and in-situ inspections provided a picture of the widespread use of reinforced concrete in archaeological areas; references to the excavation campaigns and restoration works by Italian Archaeological Missions allowed interesting comparisons.
Then a case study has been chosen in order to focus on a specific "mixed structure", deepening and intertwining different disciplinary approaches: that is the Temple of Pythian Apollo at the Acropolis of Rhodes, partially re-erected between 1938 and 1940, where reinforced concrete has been extensively used and decay processes affecting materials and structural components have been observed.
With regard to the outcomes of the research, the importance of opting for the conservation of mixed structures as a document of our recent past is affirmed. At the same time, information from site surveys and archival records, compared to previous investigations and studies, highlighted the difficulty to describe realistically the behaviour of the considered structure drawing upon the current models offered by the Building Science. In order to hold together objectives of conservation and structural safety, a proposal of a new specific approach is outlined, referring to archaeological heritage areas and their "mixed structures".

CODE 3.6.38

INTEGRATED VALORIZATION OF CULTURAL HERITAGE. REUSE OF FORMER DOMINICAN MONASTERY IN ACIREALE (CT)

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KEYWORDS: Regeneration, sustainability, restoration project, technology, museum.

ABSTRACT

Nowadays, cities need environmental sustainability policies. Therefore, it's necessary to direct the management of the cultural heritage towards a development model that can trigger virtuous processes of urban, social, cultural and economic regeneration.
The driving forces of these processes could be precisely identified in historic buildings that often are neglected but in fact they are the real resource for the socio-economic and cultural revitalization of urban centres.
With this in mind, the restoration project of the former Dominican Monastery in Acireale has been addressed. The architectural complex contains a strong vocation to trigger a creative and cultural regeneration in the city centre. Thus, the new intended use of this monumental building for educational, cultural and museum centre has as its goal both to offer new spaces for the exhibition of movable cultural heritage and to provide a place for artistic creation dedicated to new generations.
The project aim is to mend the rift, in existence for over a decade, between the historic building and the town. In this regard, the hypothesis of reuse and the critical choices here presented, represent a means for the restoration of a historic building with strong identity characteristics as also related to cultural and social history of the town.
Finally, the comparison between different scientific expertises has allowed to develop a conscious and multifaceted design intervention respectful both of cultural value and vocation of the building, in terms of geometrical-spatial configuration, and, at the same time, able to express the needs of the contemporary society, declined in the social and environmental field.

CODE 3.6.40

DISUSE, HITS AND MISSES ON THE PRESERVATION OF THE FIRST WORK OF MODERN ARCHITECTURE IN BRAZIL

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KEYWORDS: Public policies of preservation, intervention and restoration of built heritage, preservation of modern architecture, brazilian modernist house.

ABSTRACT

This paper has as an object the residence from 1927 by the architect Gregori Warchavchic, of Ukrainian origin and Italian training, declared as Brazilian national heritage. The pioneer artifact was proposed as a manifest of esthetical change. Renovated by the architect himself in 1934, still for household use of his family, it approached even closer to the modernist paradigms, aligning itself with Le Corbusier's thinking.
Its integrity was threatened in the 1980s by the real estate market, when it received regional legal protection that it was later expanded to national legal protection.
Not being used by the family anymore, it was kept empty until the first decade of the present century, reaching and advanced stage of deterioration and ruining. Public management then promoted the intervention, still considering it an object of "renovation" instead of "restoration". Out of this process, an architectural project of intervention and conservative restoration aroused in my authorship, although without the definition of a program of utilization. The intervention execution aimed at keeping the integrity and authenticity of the property, even though it was not possible to define the technological adjustments for the change in utilization, and due to budget restraints, the execution focused only on the main built structure.
The limits of the property have expanded in its historical process, acquiring new contours: it constitutes today a public park instead of a private residential garden. Public management has changed, but the utilization of the property is still undecided and the construction faces a ruining state, jeopardizing the conservative restoration interventions that already took place.
It is objective of this paper to analyze all the historical process of this artifact, its management, intervention, rehabilitation and durability, under the conceptual, methodological and technological dimensions.
It is assumed that the correct use, which rehabilitates to life, is the most efficient factor of protection and preservation, ensuring its durability and material continuity from its pre-existence, its disuse (due to a non-definition of public policies) being the major factor for degradation, apart from conceptualizations, methodologies and technologies there applied.

CODE 3.6.41

CHALLENGES OF RESTORATION AND CONSERVATION AT THE STABLES OF MANGUINHOS HISTORICAL ARCHITECTURAL NUCLEUS, RIO DE JANEIRO, BRAZIL

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KEYWORDS: Cultural heritage, conservation, restoration, materials pathology, stables.

ABSTRACT

The intervention in the old Stables of the Oswaldo Cruz Foundation, located in Manguinhos, Rio de Janeiro, offers contributions to the field of conservation of cultural heritage. The restoration works taken forward – from the project through the completion of the restoration – resulted in the development of relevant practical and theoretical knowledge. This article aims to present this process as a methodological construction for the implementation of the intervention, which included different studies and research.

The Stables were built in 1904-1905. It is part of the Manguinhos Historical Architectural Nucleus, the pioneer group of buildings of the Oswaldo Cruz Foundation, an institution dedicated to promoting health and scientific knowledge in Brazil. The horses housed in this construction were originally used for the production of serum against bubonic plague. Conducted by the Department of Historic Heritage of Casa de Oswaldo Cruz, the intervention will be presented here in three parts: the improvement of knowledge concerning the building, which established some premises for the project; planning and execution of the work; and the implementation of actions for education and valorization of cultural heritage.

Several of the identified pathologies were related to the sealing problems at the roof and drainage system, which caused oxidation of iron elements and integrated assets, as the emergence of salt efflorescence on the facades. The project aimed to treat materials and causes of problems by organizing and integrating the various activities necessary for carrying out the procedures. A heritage education program was created. It included actions such as the establishment of a visitation program, which presented the unique features of the Stables and the restoration work to a diverse audience; motion registration of procedures and work steps; and the preparation of a special visual programming for the construction hoarding.

CODE 3.6.43

A RESTORATION AND STRENGTHENING OF THE FLOORS STRUCTURE IN THE "HOTEL-PARADOR SAN MARCOS", LEON (SPAIN)

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KEYWORDS: Heritage, building technology, reinforcing structures, steel structures.

ABSTRACT

Hostal-Parador "San Marcos" of the city of Leon has undergone several expansions and partial reforms in the last fifty years until a project of integral restoration of the complex of buildings was undertaken, with two successive extensions in 2010 and 2011. Modifications to the horizontal structure along the second half of the twentieth century consisted of forged metal beams and very poor fillers, such as ashes and light insulation panels. In the last planned reform it was intended to achieve, among other things, a greater bearing capacity of such slabs, by adding and properly connecting an upper slightly reinforced concrete slab. This is a simple and economical solution compared to other alternatives of more expensive reinforcement. In the absence of rules for composite structures in Spain, this paper presents the approach used to solve the problem, following the few prescriptions of EHE and classic criteria of strength of materials. Special attention is given to the definition of shear stresses in concrete and the connection with existing metallic beams.

CODE 3.6.45

CHAPEL OF THE HOLY CHALICE AND THE REHABILITATION AND EXPANSION OF THE CATHEDRAL MUSEUM OF VALENCIA

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KEYWORDS: Holy Chalice Chapel , rehabilitation techniques , Cathedral Museum , work rehabilitation , archaeological excavation.

ABSTRACT

The Valencia Cathedral is a building that has undergone many transformations throughout history. Currently being carried out the rehabilitation and expansion of the Valencia Cathedral Museum, started in November 2014. The main objective of the current phase is to give the museum a larger exhibition space to the extension of an upper floor and enabling a new plant in the basement, as a result of the important archaeological excavations being made to achieve, in many cases Roman levels.
The Museum building is attached to the Cathedral and has access to the Chapel of the Holy Grail. This chapel was exempt from the main building became part of the ensemble of the Cathedral 1496, so one of the clear aims of the project is to "liberate" constructive and visually the building of the Holy Grail, through materials and construction elements that meet the union of both buildings, so that generate the sensation in the viewer.
This article describes the works that are being carried out in this historic building, the solutions to technical problems, the criteria adopted against historical dilemmas, the materials used, as well as the techniques used: structural reinforcements, consolidations, cleanings and reproductions in masonry walls, arches and tracery.

CODE 3.6.46

REPAIR OF REINFORCED CONCRETE COLUMNS: DESIGN AND EXECUTION

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KEYWORDS: Reinforced concrete structures, structural maintenance, structural retrofitting, reinforced concrete columns repair.

ABSTRACT

Nowadays, there is an important number of buildings with structural problems in Spain. Among the reinforced concrete elements of a building, damages in columns are the most frequent and critical, due to their importance in the safety of the whole building. These problems are very common in buildings over 30 years old. Even though there are European regulations to indicate how to repair these damages, it is very frequent to repair them without any durability guarantee. Especially in small buildings, the repair consists in the use of commercial products without previous studies to determine the causes and the importance of the damages of the whole structure.
Nevertheless, it is necessary to perform a set of previous studies before repairing the damaged elements. From these studies it is possible to understand the causes of the damage and to assess the strength of the structure, to determine which repair or strengthening method to use. In this paper, a methodology applied to damaged RC columns in a basement of a building is presented.

4.- MAINTENANCE

4.1.- CONSTRUCTION MAINTENANCE.
4.2.- PREVENTIVE CONSERVATION OF BUILT HERITAGE.

CODE 4.1.01

FROM THE ROAD POINT OF VIEW: TEXTURE EMPIRICAL DECOMPOSITION TO PAVEMENT FRICTION

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KEYWORDS: Pavement friction, skid resistance, texture, circular texture meter, dynamic friction tester, Huang Hilbert transform, intrinsic mode functions, basic intrinsic mode functions, density, sharpness.

ABSTRACT

The paper presented here investigated the pavement friction-texture relationship, using a decomposition method of the pavement texture that is part of a new signal processing technique called “Hilbert-Huang Transform” to develop a texture parameters-friction relation. This method allows the empirical decomposition of the texture profile to a set of basic profiles in a limited number, called “Intrinsic Mode Functions” or IMFs. From the obtained IMFs, a set of four new functions called “Base Intrinsic Mode Functions,” or BIMFs, are introduced and are characterized from the density and sharpness of the peaks contained in the individual BIMFs. Then these two parameters are correlated with the pavement friction using different combinations. This procedure is applied to a set of texture and friction data measured through test roads in France. The textures and frictions are measured using, respectively, the Circular Texture Meter and the Dynamic Friction Tester in France and also on a number of test sites in the United States. The obtained results show a good correlation between some of the BIMF parameters (density and sharpness) to friction.

CODE 4.1.02

RISK ANALYSIS METHODOLOGY FOR BUILDING INSPECTION: TOOL FOR BUILT HERITAGE MAINTENANCE

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KEYWORDS: Civil engineering, risk analysis, building inspection, building maintenance.

ABSTRACT

The housing density in urban centres is a reality and it highlights the shortage of buildable areas, as well as the lack of care related to maintenance management of existing buildings, due to the absence of building maintenance and conservations plans. Because of that, there is a big incidence of building accidents caused by the negligence of managers and the lack of investment. The research has shown that, although building inspection is a consolidated building maintenance tool, most of the managers do not prepare their building maintenance plan, nor use building inspection as a tool, leading the buildings to the premature obsolescence of its elements and structures. The research calls attention to the building inspection technique that can be used to evaluate building maintenance and conservation. It is also a tool for analysis and investment planning based on actions to solve failures and anomalies that might come out during the building inspection. Those failures and anomalies are classified according to their degree of risk, determining the technical priorities of the investment adjustment in the maintenance plan. Aiming to collaborate in researches, the paper presents a risk analysis methodology which classifies inspect elements in a building, determining the priority order of services to be executed on a scale from (1) minimum risk to (5) imminent risk. The method can be a new consensus tool for building inspection practice, and it serves as a guideline for building maintenance interventions. It aims at the preservation of the buildings life spans and their increase, as well as their constructive elements.

CODE 4.1.04

THE IMPORTANCE OF PREVENTIVE MAINTENANCE FOR A GOOD PERFORMANCE OF A BUILDING

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KEYWORDS: Maintenance, performance, maintenance management, Technological Park UFRJ/Brazil.

ABSTRACT

The lack of proper maintenance in buildings is responsible for various anomalies, which can cause property and personal damage. These damages are significant and affect not only the owner, but also society in general, since it is the main cause of urban decay. To meet the expectations of users, it is important that the building provide appropriate conditions, presenting a good performance throughout its life spam, thus demonstrating the importance of the activities of conservation and maintenance of the built environment. The objective of this study was to analyze the maintenance management of the administration building at the Technological Park UFRJ/Brazil, trying to emphasize the relation between maintenance and good performance of the building and to demonstrate the need to develop a consistent maintenance system to achieve an efficient maintenance management. The study allowed to present strategies and possibilities of interventions, in addition to proposing the essential aspects for the development of a structured maintenance system. After reviewing the issue of building maintenance under the various perspectives presented, can be concluded the importance of planning a preventive building maintenance, according to standards, to achieve the level of performance expected for the building, besides being essential the search for tools and methods that can increase the efficiency of management. It is also pertinent to conclude that prevention is the most effective solution against the depreciation factors that affect a building, being the most economical viable, and ensuring other benefits for the building and its users, such as security, property valuation and attendance to the warranty period.

CODE 4.1.05

MANAGEMENT MODEL FOR BUILDINGS MAITENANCE

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KEYWORDS: Preventive maintenance, management, social housing.

ABSTRACT

Housing policy aiming the regeneration of out skirting areas, degraded residential zones and the refurbishment of urban areas have to be based on the Sustainable construction principles: durability, social cohesion, ecologic efficiency. Contrary to these principles has been registered lack of quality and durability in the constructed buildings that lead to early degradation and subsequent frequent maintenance, repair and refurbishment needs with high costs. So, the construction sector has been increasingly concerned about issues related to the durability and maintenance of buildings. Considering the importance of this issue in social, economic and environmental context, it was developed a model to implement preventive maintenance plans to be applied to the social housing stock managed by the municipal enterprise Domus Social, EM (in the city of Oporto). A sample of 27 buildings of two social neighbourhoods was analysed and inspected according a methodology and parameters that have been previously developed and established. The results of this site work were registered in inspection sheets and in anomalies reports, for each building. The conservation state of each one was also accessed through a methodology that has been developed and optimized by the work team. All the information collected and produced permitted to develop Preventive Maintenance Plans for each neighborhood integrating the maintenance costs estimation for the next 20 years of its service life.
The work undertaken in the scope of inspection and assessment of the conservation state of the buildings as well in the integrated management maintenance of the social housing neighborhoods is a fundamental tool for the decision-makers' support: management, planning and maintenance execution, to achieve an effective durability of the housing stock with high quality and low costs. This methodology can be applied to other typologies of housing.

CODE 4.1.06

THE STRUCTURE AS A LABORATORY: DIAGNOSIS OF CONCRETE DAMS

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KEYWORDS: Dams, diagnosis, damage, concrete, expansion.

ABSTRACT

Spain is a world referent in the field of concrete dams with more than 1200 dams constructed in its territory. The maintenance of these structures is crucial given their social, environmental and economic relevance. However, more than 50% of the Spanish dams are older than 40 years and, due to their ageing, some damages such as cracking, leaks or remaining movements may appear to influence their serviceability and safety. Any action to rehabilitate a dam should be proposed after a scientific diagnosis, which identifies the source of the damage and tries to understand the evolution of the degradation process. The aim of this paper is to present a methodology for the diagnosis of pathologies in concrete dams. Even though this methodology is based on the experience gained through the study of dams affected by expansive reactions, it is applicable to any typology of concrete dam and to any typology of damage. The methodology focuses on the analysis of the behavior of the dams and their auxiliary structures. This analysis is conducted with a transversal approach and at different stages. Furthermore, the methodology emphasizes the performance of “in situ” studies given that the dam is the best laboratory to determine the pathology. Besides the description of the stages considered in the methodology, the paper provides examples of its successful application to different Spanish dams affected by expansions.

CODE 4.1.08

MAINTENANCE AND CONSERVATION OF ROADS IN THE JUNGLE OF PERU

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KEYWORDS: Roads, concession, maintenance, preservation, pathology.

ABSTRACT

The research work was carried out in the city of Tarapoto, located in the region concerning the maintenance and upkeep of the roads in this important region, case Peruvian jungle the "Marginal de la Selva" (now President Belaunde Terry) the national system and others, such as "Marginal - Shapaja - Chazuta" departmental and neighborhood system production facilities, conducting a study on the road of the national system in the departments of San Martin and Amazonas, in a stretch of about 280 km of road asphalted, concessional condition which presents critical sections of maintenance and conservation, leaving perceive a sloppy pavement, unstable slopes, poor drainage, damaged walls, among others, with projection to suffer pathologies consideration.
The goals are intended to identify and describe the causes of inadequate maintenance and conservation, affecting their functioning and adequate service and propose alternatives to improve the maintenance.
The methodology allowed the verification in situ, in the rainy season to prove the worth of maintenance, raising visual and graphical information through video and photographs, crossing it with technical specifications and contrasting it with national road standards set by the regulator - Ministry of Transport and Communications- and verify the effectiveness of the concession.
The scope of work corresponds to the identification of the quality of maintenance and upkeep of the road concessional national system, which is supposed improvement work and almost permanent road maintenance are carried out in 2015.
The results indicated the malfunction of control parameters of quality established in the contract documents: pavement, artwork, storm drainage, slope stability, signage, environmental impact, determining the nonexistence of a competitive management of road maintenance allows the functionality of roads, requiring a rethinking in the concession.

CODE 4.2.01

BIOLOGICAL DETERIORATION CONTROL AS A KEY ELEMENT FOR PREVENTIVE CONSERVATION OF HISTORIC TIMBER STRUCTURES

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KEYWORDS: Preventive conservation, historic timber structures, fungi, insects, bacteria.

ABSTRACT

The maintenance system that has existed in the Kizhi museum since 1998 is based on preventive conservation principles. It pays much attention to the detection of initial stages of damage caused by fungi, insects and other biological agents. The related tasks are the elimination of infections and the generation of conditions unfavorable for the development of harmful agents.
This paper is based on long-term investigations of 82 historic timber structures from the 16th-19th cc. including the UNESCO site – the Kizhi architectural ensemble. All structures are log-frame structures built of Scots pine timber.
The paper presents a detailed description of the biological agents destroying timber structures in Northern Europe obtained within the framework of the projects supported by Russian Foundation for Basic Research grants ## 01-06-80405; 11-06-00165; 15-08-01893. Severe damage is mainly caused by brown-rot fungi and insects. The surfaces of structural elements exposed to environmental impact – roofs, passages, are colonized by lichens. Wooden elements functioning under anaerobic conditions (e.g. posts in the ground) have traces of bacterial deterioration.
Damages caused by biological agents are revealed through regular inspections. The important methods for their identification are acoustic detection, non-destructive methods and in situ procedure for evaluation of the xylolytic rate, which are described in this paper.
The obtained monitoring results serve as the basis for the maintenance plan. Elimination procedures – heat treatments with hot air and by microwaves, local treatments with chemicals, have become the first stage of the maintenance operations. At the second stage the conditions hindering the development of fungi and insects are created. They are: elimination of leakages and pathways of water sorption from the ground, improving microclimate conditions by additional aeration, and other measures.
The 18-years-long experience has proved that preventive conservation based on biodeterioration control is effective for the preservation of historic timber structures.

CODE 4.2.11

FIRE IN CULTURAL HERITAGE IN BRAZIL: PREVENTION SYSTEMS; LEGISLATION; AND THE ENVIRONMENT, SAFETY SYSTEM AND USERS INTERACTION

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KEYWORDS: Fire; prevention systems; cultural heritage; Fire Engineering.

ABSTRACT

Following the development in the cultural heritage, it is possible to observe that in the beginning, the view was restricted, only “material” values were considered in protection decisions and the responsibility of making just one field of knowledge formed basically by historians and architects. Throughout history, there was a need to expand the area of knowledge in order to devise more effective tools for preservation; then the humanistic and social aspects or "immaterial" values also started to be considered important in the decisions concerning preservation. With this in mind, other professional areas, such as economists, environmentalists and even the population became part of the decision making process in the field of cultural heritage, thus developing many tools for the protection of cultural property. Considering this brief history, it is observed that there is a clear need for interdisciplinary teams in the field of cultural heritage; therefore, should not Engineering, in its various forms (Fire, Structure, Electrical, Safety among others) also be part in decisions concerning cultural heritage? There is no point in applying conservation tools of cultural heritage if we do not pay attention to the impacts of climate change, possible disasters and accidents such as fires, which will be the focus in this article. It is important to create parameters and standards so there is no misguided actions when the safety measures against fire are design, risking damages in the property in case of fire or in the event system failure with this measures. Thus, this article aims at describing the role of engineering in the cultural heritage field, dealing in particular with Fire Engineering, Brazilian standards, aspects of fire prevention and the interaction between users of the protected environment and security systems.

CODE 4.2.12

DECAY OF BUILDING GRANITE AFTER SEVERAL CENTURIES EXPOSURE TO FIRE AND THE ENVIRONMENTAL ELEMENTS

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KEYWORDS: Granite; Conservation; Reconstruction; Restoration.

ABSTRACT

Most of the historical buildings of the north of Portugal are made of granite, so the subject of granite conservation arouses great interest amongst conservation professionals. The emphasis of this study is on granite buildings, in the architectural context, with an evaluation of the granite properties and an understanding of the mechanisms of stone decay. For this research were selected two monumental buildings.
Fire is a major threat to the cultural heritage built in stone and this study falls upon the damage that fire causes on a granite building, the early 18th c. Quinta do Covelo's Manor-house in Paranhos, near Oporto; it includes an experimental campaign on the building granite affected by fire action, like absorption, density, compressive strength and frost/thaw resistance tests. The granite blocks tend to chipping and cracking during cooling after an intense fire. The consequent severe cracking of the masonry and granite stonework, leads to water infiltration which accumulates in the nucleus of these structures, aggravating their decay.
The Church of São Domingos in Viana do Castelo is a 16th c. national monument, upon which is made the constructive characterization and evaluated its general state of conservation, suggesting possible solutions for intervention, given the criteria of authenticity, compatibility and reversibility inherent in conservation works of historical buildings. Further study of the granite rock of the main façade's Church was done, given the advanced state of decay. For this, rock's mineralogical characterization assays and two consolidant products (Tegovakon and Wacker OH) trials that provide relevant information to the rock consolidation proposition were performed.

5.- DIFFUSION AND PROMOTION

CODE 5.1.03

RESTORATION AND PRESERVATION WORKS ON THE HISTORIC ENSEMBLE OF SANTILLANA DEL MAR DURING THE FIRST DECADES OF THE XX CENTURY

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KEYWORDS: Restoration, preservation, tourism, cultural heritage, Santillana del Mar.

ABSTRACT

During the second half of the XIX century the village of Santillana del Mar was discovered by romantic travellers. Literary works, artistic guides, news and the discovery of the Altamira Cave in 1879, contributed to the knowledge of the historic ensemble. In the first decades of the XX century the process of heritage status began among the historic buildings and monuments. Santillana del Mar experienced a cultural revival due to the settlement of numerous aristocrats and intellectuals (Juan Antonio Güell, Count of Güell; Jacobo Fitz-James Stuart, Duke of Alba; Trinidad von Scholtz-Hermensdorff, Duchess of Parcent, among others) who promoted restoration works (in houses, palaces, The Merino and Don Borja towers and in the Collegiate church Santa Juliana), as well as urban improvements and cultural activities. Thanks to the great efforts undertaken by institutions and local figures, Santillana was transformed into a cultural and touristic icon in the region, playing a prominent role in this emerging cultural field in Spain.
The goal on this research has been to analyze the restoration works, urban improvements and all the initiatives that have been promoted for the knowledge, broadcasting and musealization of the historic ensemble. We verify that Santillana del Mar and his historical monuments turn into a consumer item in the first decades of the XX century, and how the tourism play an essential role for the restoration and preservation of the historic ensemble.

CODE 5.1.04

CULTURAL TOURISM THROUGH FIELD EXPERIENCE APPROACH

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KEYWORDS: Historical heritage infrastructure, Inka Road, research expedition, communication tools.

ABSTRACT

An exhibit about Inka Road or Qhapaq ñan (literally the Royal road) opened in June 2015 at Smithsonian Museum of the American Indian, Washington DC. This exhibit offers a wide breath of cultural knowledge and carefully describes many aspects related to the monumental Inka engineering achievements. Knowledge about the engineering aspects of the Inka road were obtained by reversing engineering segments of the 4,800 km route. Three expeditions into the high cordillera of Perú supported this work. Using satellite equipment research teams successfully broad cast back to the Smithsonian from the cordillera and provide visitors in Washington a live experience of the road's environment. The program replicated for the viewers an expedition walking the road and provide a deeper insight into many aspects of Inka engineering. This enriched experience provided knowledge for the exhibit and provide the bases for cultural tourism programs in the field. The expeditions were developed in a way that produced in its members and those at the Smithsonian an immersion cultural tourism experience. This paper present the features of a field experience approach for cultural tourism identified through analysis and discussion of these successful excursions and the exhibit in Washington. The approach replicates in some degree the research expedition and can serve as a model for cultural tourism programs of historical heritage infrastructure that are difficult to reach.

CODE 5.2.03

HIGHER-EDUCATION IN STRUCTURAL INSPECTION: THE EXPERIENCE OF ISEP (SCHOOL OF ENGINEERING, POLYTECHNIC OF PORTO, PORTUGAL)

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KEYWORDS: Inspection, rehabilitation, education, structures, ISEP.

ABSTRACT

The recent reorientation of the construction industry for the rehabilitation of existing structures requires the need to perform structural inspections.
This phase of inspection and diagnosis should precede any decisions on the rehabilitation of existing constructions, regardless of their typology.
Trained and qualified professionals in this work are required by the actual construction industry market.
Although specific courses on this topic are needed, they are not available on regular civil engineering courses in Portugal.
This paper presents the contribution of the School of Engineering (ISEP) of the Polytechnic of Porto (Portugal) in this area.
The main focus of specific formation in ISEP, within the area of inspection of civil engineering structures, is developed for masonry arch bridges, reinforced concrete structures, traditional masonry and timber buildings as well as for geotechnical structures.
Several case studies are carried out by Bachelor and Master's degree on Civil and Geotechnical Engineering, some of them included in Master dissertations as presented herein.
This article also emphasizes the extension to other adjacent themes allowed by the adopted methodology in ISEP.
Finally, the Post-Graduate Studies in Structural Inspection are presented in more detail, a recent and ambitious formative offer by ISEP.

CODE 5.2.04

KNOWLEDGE MULTIPLICATION OF THE CONSERVATION AREA, RESTORATION AND PRESERVATION

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KEYWORDS: cultural heritage education, restoration, Cuiabá.

ABSTRACT

This work refers to a short course conducted by the Superintendência Estadual do Instituto do Patrimônio Histórico e Artístico Nacional,in Mato Grosso, Brazil, in 2015. This activity reached professionals and students of architecture and engineering. The objective was the multiplication of knowledge in projects and works in historic buildings and, consequently, cultural heritage education. The proposal of the short course was to make students experience some activities in the field of conservation and preservation of historicals properties, reason for it was chosen a townhouse in the polygonal's inventory at the Cuiabá's historic center in progress of a structural stabilization project execution. The short course activities included both theoretical topics, such as theory of restoration, patrimonial charters, mapping of damage, and a practical part, which included visit to the building during construction and making adobe bricks in this local.

CODE 5.2.06

15 YEARS OF EXTENSION IN THE MINING ENGINEERING

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KEYWORDS: Patrimonial education, social responsability, student training, Ouro Preto.

ABSTRACT

The first extension program of the Departamento de Engenharia de Minas with the name of Stonemasonry Workshop based at the Universidade Federal de Ouro Preto (UFOP) looking for valuing the human being, approaching University and the community, and integrate knowledge. These activities are part of what has been highlighted in the National Education Plan 2011-2020 that calls attention to the universities on the role of extension. The Stonemasonry art was brought to the Departamento de Engenharia de Minas (Demin) through the hands of José Raimundo Pereira, also known as master Juca (1923-2006), one of last official master on stonemasonry from Minas Gerais - Brazil. The program completed 15 years in 2015. Over the years, the project has outlined as strategy: training undergraduate students, community's integration with the UFOP, research (historical and materials), the formation of new skilled workers and the preservation of heritage; directed to work with the methods of heritage education. In this period have been restored bridges, Fountains, Crosses and the Itabirito Train Station. Were produced 96 pieces of quartzite and 60 pieces of "canga" in the workshop and classes for training students of stonemasonry. Added to the results the formation of 11 carvers, 23 students of history, 33 works of independent research and 88 extension. The number of publications was significant: a book, three articles in periodicals, eight book chapters, sixty-seven articles published in national and international congress. Disclosure of art was also done through the permanent exhibition at the Museu de Ciência e Técnica da Escola de Minas, and itinerants in the Palacio das Artes in Uberaba and Coronel Xavier Chaves.

CODE 5.2.07

CULTURE, EDUCATION AND ART FOR CHILDREN: FORMATION OF CITIZENS

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KEYWORDS: Heritage education, social responsibility, training students, Ouro Preto.

ABSTRACT

The project since 14 years integrates academic community, professors, students and society through workshops of monumental art and weekly activities for teaching with children. In 2014, twenty students from three public schools of Ouro Preto, with an average age of 11 years old, were selected by their own institutions at the beginning of the school year to participate in the project. The activities were taught by students of History, Mining Engineering, Food Science and Technology. The classes were in the Department of mining engineering, at university of Ouro Preto at Tuesday and Thursday, with duration of 2 hours each. In addition to schools, the project aims to provide a children's contact with the unknown world of University and awaken in them the desire for knowledge construction. The project also offers to participants: school reinforcement, teaching reading, writing and interpretation, contributing to literacy and improvement in school performance. The interaction with students of public schools in the region back to the fore the various problems and solutions faced by educators and families. Such interaction exposes yet another difficulty faced in Brazilian education, but this time by members of the project. The results were: humanization of relations in academic areas, training of professionals with citizen awareness, improved school performance of children, dissemination material heritage of Ouro Preto.

CODE 5.2.08

ON SITE TRAINING CLASSES AS A TEACHING METHODOLOGY IN THE STUDY OF DAMAGE MECHANISMS IN STRUCTURES

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KEYWORDS: Teaching, Damage in structures, on-site training class, case study

ABSTRACT

The study of failures in real structures is very important for the training of experts in the field of structural engineering. On the one hand, it allows training experts in the fields of damage mechanisms and structural failures. On the other hand, it improves the design of new structures by learning from failures and it also lays the foundations of ethics in the structural engineering profession. In this paper, it is presented one of the teaching methods implemented in the School of Civil Engineering, Department of Construction Engineering at Universitat Politècnica de València. This method is based on the visit and analysis of one emblematic building of the city of Valencia, in order to analyse the damage of its structure. The failures observed “in situ” are linked to the theoretical concepts previously studied in the classroom. After the visit to the site, the students should write a report, where the observed damage is analysed, as well as their causes and possible evolution. Subsequently, in the classroom, it is prepared a discussion where the students explain each other’s their diverse points of view. The structure chosen as a case study is the Museum of Sciences Prince Felipe, which is a complex building where the students can study different damage mechanisms of a reinforced concrete structure.

CODE 5.2.09

A WEB APPLICATION FOR E-LEARNING TECHNIQUES OF CONSERVATION AND REHABILITATION IN ARCHITECTURAL HERITAGE

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KEYWORDS: Architectural cultural heritage, conservation, rehabilitation, e-Learning, semantic.

ABSTRACT

In this work, we present a specific software educative for e-learning of conservation and maintenance of Architectural Cultural Heritage. The huge extension of Cultural Heritage in danger shows the interest and the high potential impact of this Platform in regard to the initially remote learning and, after, in situ training for different stakeholders including Architecture students, technicians working in Conservation and Rehabilitation Tasks, and more generally, firms working in the construction sector. With this application, we intend to give support to the technicians and re-qualification workers as much as to entities which intervene in Architectural Cultural Heritage. By means a suggestions system, public and private entities can incorporate already performed experiences and additional contents. The incorporation of improved knowledge from use cases allows the reuse of labelled contents in a more general framework corresponding to a specific Ontology which has been developed for conservation and restoration tasks.

CODE 5.2.10

TEACHING AND TRAINING BIM IN AN ENGINEERING SCHOOL

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KEYWORDS: BIM concept, education, CAD, civil engineering.

ABSTRACT

The management of the totality of information concerning different phases of a building can be supported on a common environment. This concept is the basis of the technology Building Information Modelling (BIM). The text describes how the BIM concept has been introduced in the Department of Civil Engineering. The school itself has been promoting dissemination of BIM based on short training courses, seminars and technical sessions, involving credible designer offices and involving students in research projects, PhD thesis and MSc dissertations. The basic BIM technology must constitutes one of the essential tools in student's training, helping them, in the future, to facilitate their integration in a demanding and competitive work environment.

CODE 5.2.11

POPULAR BUILDERS PROGRAM SCHOOL: AN EXPERIENCE IN ACADEMIC EXTENSION DIRECTED AT THE TRAINING OF POPULAR SECTORS

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KEYWORDS: Popular builders, constructive deficiencies, academic extension and experience reconstruction

ABSTRACT

In the year 2010, in the Architecture School of Architecture and Urbanism Faculty of the Universidad Central de Venezuela, Popular Builders Program School (PBPS) was born with the purpose of attending to the constructive deficiency problems present in the housing located in the popular neighborhoods as consequence of the low technical preparation of his occupants, who built their own houses or their neighbors, without knowledge of the building codes applicable to their edification. This deficiency produces a set of pathologies that put at risk the stability and security of these housing and their inhabitants. The PBPS is an academic extension activity that through its professors provides the basic knowledge in masonry, plumbing and electricity to the inhabitants of the informal urban housing offering them the tools that propitiate individual and collective growth allowing them to correct the practices used in the construction of their houses. This work is a qualitative study of the analytic-descriptive type that presents the reconstruction of the first two experiences, done during the years 2010 and 2011, with the finality of showing the implementation process, present its results and extract learnings that allow the improvement and continuation of the program. The startup of the PBPS shows a new way to approach the academic extension by putting at the disposition of the less favored social groups the faculty resources and the university installations with the goal of overcoming their constructive deficiencies.

CODE 5.3.02

VIRTUALIZATION ARCHITECTURAL HERITAGE FALLEN. TOWER OF THE CHURCH OF SAN ESTEBAN IN VALDESPINA, PALENCIA

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KEYWORDS: Laser scanner, photogrammetry, RPAS, augmented reality, TIC, Romanesque Palencia, medieval towers.

ABSTRACT

The towers of the churches have an important role as the identifying element of our peoples and further define the skyline of the landscapes of Castilla (Spain). In late August 2012, the people of Valdespina (Palencia) was down a portion of the tower of the Church of San Esteban. Due to the state of ruin was left, the authorities were forced to demolish it completely, leaving only standing the lower body of the tower.
The objective of this work was to recover the visual image of the tower of the Church of San Esteban by digital virtualization, making a cheap safe virtual reconstruction for the building, and tight current broadcast standards and dissemination through ICT (Information and Communication Technologies), which facilitates dissemination and released to future generations what it was that architectural element disappeared.
It began making data collection by the party still standing. A laser scanner for the architectural element of a geometric pattern precision was used first. Then a ground and air high-resolution photoresist is performed by a RPAS (Remotely Piloted Aircraft Systems) in order to generate the actual texture of the stone walls by photogrammetry. Unifying the results of both processes, a 3D model with a geometric precision and high radiometric quality (texture color) was obtained.
After obtaining the model was implemented in augmented reality software, in which we introduce the geometric model parameters location and the identifying features of the church to function as a control target.
All this will allow any user to point the camera of your mobile device on the church of San Esteban, will be able to see the tower that once was there in real time.

CODE 5.3.10

AUGMENTED REALITY APPLICATIONS IN MANAGEMENT AND DIFFUSION OF HERITAGE

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KEYWORDS: Heritage, new technologies, augmented reality.

ABSTRACT

Given the lack of economic resources for the physical recovery of the lost heritage, a very interesting field, recently opened by some research groups, is the virtual reconstruction of buildings that have an heritage interest by computer graphics techniques and applications of computer-aided design. A step more in the use of new technologies in the management and diffusion of heritage is to complete the generation of virtual animations from the model generated with the virtual immersion those who wish to interact with the asset or liability, that is, enable interaction potential visitors of the original royal remains with the virtual model. For this novel techniques of "Augmented Reality" can be used.
Thus, using "Augmented Reality" applications (AR) we can visualize through a technological device widely used -smartphone, tablet, etc., a physical real-world environment whose elements are combined with virtual elements generated by computer to create a real-time mixed reality by adding virtual information to the existing physical information. Therefore, unlike the "Virtual Reality", where total immersion occurs in a completely unreal virtual world, "Augmented Reality" does not replace physical reality, but superimposes virtual information created through computer aided applications to the world real.
While the use of these "Augmented Reality" techniques can be applied to any heritage element, in our case apply to elements of industrial heritage, in particular to the study of water mills by modeling their missing components with 3D CAD techniques superimposing the virtual reconstruction of them with the physical reality of the remains that have endured over time.

CODE 5.4.02

SPATIAL ACCESSIBILITY IN SANTOS HISTORIC CENTER (BRAZIL): THE DIFFICULTIES FACED BY ELDERLY

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KEYWORDS: Historic places, spatial accessibility, accessible tourism.

ABSTRACT

Buildings and the central areas of historic towns were built in earlier periods to technical concepts and standards related to spatial accessibility. For this reason many of these sites have many obstacles that affect users with reduced mobility; in particular, the elderly. Face of this reality, this paper aims to present the spatial accessibility problems faced by older people with reduced mobility to visit the historical center of the Santos city, located in São Paulo, Brazil. The methodology used in this research consisted of exploratory visit, photographic survey and technical inventory developed from spatial accessibility indicators used to evaluate the environment quality, the comfort quality and safety quality. The results show the difficulties that elderly tourists can experience when visiting these places. The problems of spatial accessibility are related to spatial orientation, the displacement and the use of these places. They are the result not only by the date of construction of the buildings and their surroundings, but the lack of public policies that focus on spatial accessibility to tourist sites in Brazil. Spatial accessibility indicators used in this research can contribute to the development of a complete diagnosis of pedestrian infrastructure (sidewalks) and also for the formulation of programs, projects and municipal policies for the promotion of the spatial quality of the areas of interest.

CODE 5.4.03

SPATIAL ACCESSIBILITY IN THE HISTORICAL CENTER OF POÇOS DE CALDAS (BRAZIL)

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KEYWORDS: Historical center, spatial accessibility, accessible tourism.

ABSTRACT

This paper shows the evaluation of spatial accessibility in historic center of a Brazilian tourist town, located in Poços de Caldas, Minas Gerais State, Brazil. The tourist itinerary analyzed has composed of the most significant places of the city due to its historical, architectural and natural. The methodology consisted of documental research (laws concerning historical heritage, accessibility and technical standards), exploratory technical visit (through checklist, which identified the problems of accessibility through indicators about physics quality, comfort quality and safety quality) and photographic survey. The analysis of Brazilian laws and the laws of Poços de Caldas showed that lack guidelines for insertion of the theme accessibility in places of historical and tourist interest. The diagnosis showed that tourists with reduced mobility and physical disability (wheelchair users and the elderly) facing some problems to carry out the visits in the tourist-historical route analyzed. Among the problems identified include: i) Sidewalks; ii) signaling route; iii) external environments; iv) Access and exit buildings; v) internal circulation of buildings. The results show the difficulties that tourists who have some mobility restrictions (elderly, wheelchair) and visually impaired may experience when visiting the city. The accessibility problems are related to spatial orientation, followed by displacement of components and use. These problems are not due only for the period of its construction, but the lack of public policies that promote full accessibility to tourist areas of Brazil. Based on the problems presented in this research, the municipality can formulate and implement actions of short, medium and long term to make accessible tourist routes to all visitors.

CODE 5.4.05

308 SOUTH PARK SCHOOL IN BRASÍLIA: THE BRAZILIAN MODERN HERITAGE SITES ADAPTATION FOR UNIVERSAL ACCESSIBILITY

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KEYWORDS: Cultural Heritage; Modern Architecture; Brasilia; Accessibility; Authenticity.

ABSTRACT

Designed by José de Souza Reis, the 308 South Park School opened in 1958. It is an exemplar of modern architecture based on the Brazilian adaptation to the *Le Corbusier* principles. Devised by Lucio Costa as the basic element of the Pilot Plan, the neighborhood unit comprises four residential superblocks, church, school, social club, health center, kindergarten, library and movie theater. So, this school is part of the neighborhood unit, and it has three blocks (main, theater and art studios), swimming pools, playground, and sports courts. The educator Anísio Teixeira created this kind of school as part of his Educational Plan for Brasília. The school architecture is closely related to its educational plan and, as so, the architecture materializes the educational plan in the neighborhood unit. Many characteristics of the Brazilian modern architecture are found in this building: free plant, integration between indoors and outdoors, reinforced concrete construction technique, accessories for sun protection and ventilation as '*cobogós*', condensed plant, large spans, among others. The building was listed as Heritage Site by the local government in 2004. The Brazilian Federal Decree 5.296/2004 imposes adaptation for accessibility to public buildings. As school, its environment must be inclusive and as cultural heritage it must be preserved. So, the works to make it fit into the accessibility require care to avoid harming the principles of modern architecture and, thus, the authenticity. This paper aims at contributing to the discussion and study about the needs of adjustment for accessibility considering the restrictions imposed by the condition of Cultural Heritage Site. The "Matrix of Authenticity and Accessibility" applied at the school provided a complete information framework, disclosing needs and restrictions, guiding the interventions for universal access adaptations.

CODE 5.6.02

TOWARDS COMPLEX SYSTEMS TO MANAGE CULTURAL HERITAGE. THEORETICAL FRAMEWORK

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KEYWORDS: Cultural heritage, cultural policies, management, gobernance, sustainable development.

ABSTRACT

Cultural policies responsible for the protection of heritage assets are moving towards an organization of their management responding to new institutional models that abandon their executing and controlling nature to give way to another that is more coordinating and advisory, by establishing communication strategies that allow the incorporation of citizens, as subjects of cultural processes, into the planning of these.
This structural change in the management of cultural heritage is caused by the acknowledgment, both from international organizations and from states, of a new global ethic where cultural diversity has become the fourth pillar with which to support sustainable development - the others being economic, social and environmental pillars.
The broadening of the concept of heritage that has taken place over recent decades, and the necessary integration of heritage in its physical and social context, requires the restructuring of the mechanisms of management towards multilateral governance systems, where factors operate in a more complex network, characterized by the multiplicity of objectives, and where different levels of impact, from the global to the local, are integrated.
These circumstances draw a paradigm shift that affects the way of understanding heritage, its management, conservation and use, placing people at the core of its policies and projects.

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