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Euro-American Congress

CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

Caceres (Spain) - May 15th-18th, 2018

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REHABEND 2018

CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

(7th REHABEND Congress)

Caceres (Spain), May 15th-18th, 2018

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Avenue Los Castros s/n 39005 SANTANDER (SPAIN)
Tel: +34 942 201 738 (43) Fax: +34 942 201 747
E-mail: rehabend@unican.es
www.rehabend.unican.es

7TH EURO-AMERICAN CONGRESS ON CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

REHABEND 2018

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The **Euro-American Congress REHABEND 2018** on **Construction Pathology, Rehabilitation Technology and Heritage Management** was carried out in **Cáceres (Spain)**, in **May 2018**. The event was organized by twenty 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 Extremadura**.

REHABEND 2018 **continued the series of the six previous REHABEND international events**, which had been developed **since 2006 in different Spanish cities**. The previous one, in **2016**, was carried out in **Burgos**. In 2016 edition, **around than 310 papers** by Professionals and Researchers of more than **30 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 Caceres**, which old city has been declared a UNESCO World Heritage Site and is also on the 'Via de la Plata' path, the Silver Route, of the 'Camino de Santiago'. 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 more than **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 and 2016.

Under these premises and the successful previous editions, the Congress was sponsored by the **Government of Spain**, the **Government of Extremadura**, the **Provincial Government of Caceres**, the **Municipality of Caceres**, **Sika**, **HeidelbergCement**, **Portneo**, the **University of Cantabria** and the **University of Extremadura**. In addition, several Universities, Technical and Professional Associations, Institutes, Foundations and Companies committed their **collaboration** in order to the success of this initiative.

REHABEND 2018 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 **Keynote Speakers**; to the different **Speakers** for their relevant contributions and, in general, to the **people who attended the congress** for the confidence shown in the event. Sincerely, many thanks to all.

Prof. Luis Villegas
Chairman of the REHABEND 2018 Congress
Full Professor
University of Cantabria

Prof. César Medina
Chairman of the REHABEND 2018 Congress
Associate Professor
University of Extremadura

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), 5th (Santander, 2014) and 6th Congress (Burgos, 2016), all of them carried out in Spanish cities. The ability to convene of the six perfomed editions was prominent, gathering an appreciable number of experts in the topics of the Congress. As a reference, in the 6th edition (REHABEND 2016) took part around 310 speakers from more than 30 countries from all over the world.

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. Since the 6th edition (REHABEND 2016) the congress has been co-organized by several entities from different Euro-American countries.

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

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REHABEND 2007 (Book of Papers)
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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.

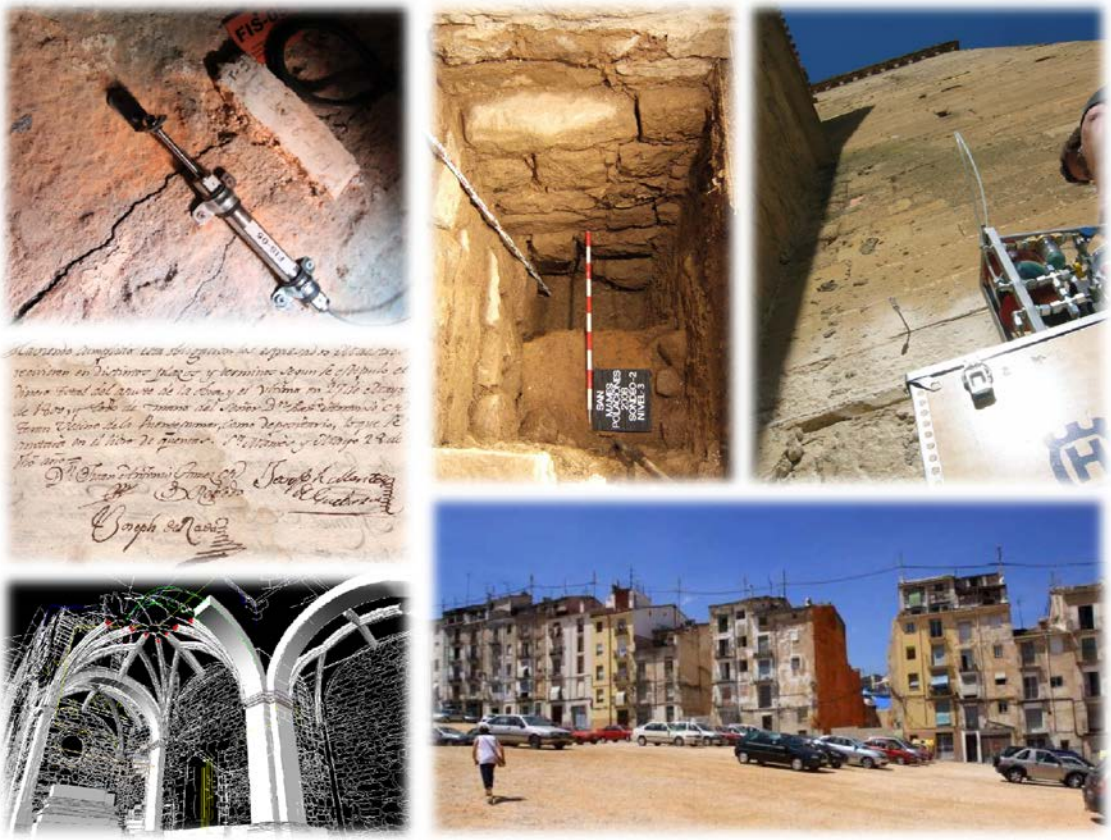
5.2.- Teaching and training.

5.3.- New technologies applied to the heritage diffusion.

5.4.- Accessibility to cultural heritage.

5.6.- Built heritage management.

1.- PREVIOUS STUDIES



CODE 30

ANALYSIS AND PROPOSAL OF RENOVATION CRITERIA AT THE BUILDING HEADQUARTER OF THE PUBLIC WORKS REGIONAL MINISTER IN CASTELLÓN (GAY AND JIMÉNEZ, 1962)

Martín Pachés, Alba[1]; Serrano Lanzarote, Begoña[2]; Fenollosa Forner, Ernesto[3]

1: Escuela Técnica Superior de Arquitectura
Universitat Politècnica de València
e-mail: albamar16@hotmail.com, web: http://www.upv.es
2: Departamento de Mecánica de los Medios Continuos y Teoría de Estructuras
Universitat Politècnica de València
e-mail: apserlan@mes.upv.es, web: http://www.upv.es/ficha-personal/apserlan
3: Departamento de Mecánica de los Medios Continuos y Teoría de Estructuras
Universitat Politècnica de València
e-mail: fenollo@mes.upv.es, web: http://www.upv.es/ficha-personal/efenollo

KEYWORDS: Renovation; heritage; modern movement; sustainability; Luis Gay.

ABSTRACT

The present text tries to highlight a building, exponent of the XX Century architecture in Castellón, current headquarters of the Valencian regional government, with competences in matters of housing, urbanism and public works. A tour is done on the different architectural projects, both the initials and those corresponding to subsequent renovations, accompanying the text with a review on the architects authors of the original project, Luis Gay y Luis Jiménez.
Various elements show the intention of taking as a reference the principles and resources of the Modern Movement: Various elements show the intention of taking as a reference the principles and resources of the Modern Movement: structural sincerity, the use of materials as an expressive element (especially rolled steel, glass and "gresite"), as well as the technology associated with them.
Information was provided regarding the different recognitions of its hetitage value (Docomomo Foundation and Catalog of Architectural Heritage of the City of Castellón), although it is not declared BIC or BRL.
The paper invites to the reflection on the criteria of intervention in the heritage of the XX Century, on the basis that these constructions must respond satisfactorily to a program of current needs and uses to keep them alive.
For this reason, an assessment study was performed about the conditioning needs in accordance with structural, functional, accessibility and energy efficiency requirements in its current state, as fundamental pillars to identify deficiencies, to propose improvements and, in this way, to guarantee their permanence through time and its heritage value.

CODE 32

NEW CONTRIBUTIONS TO THE STUDY OF THE HERMITAGES SETTING AROUND CÁCERES

Serrano Candela, Francisco

Extremadura University.
e-mail: estructu@unex.es, web: http://uexgica.blogspot.com.es/

KEYWORDS: Inventory; catalogue; hermitage; heritage; Cáceres.

ABSTRACT

The aim of this research work is to catalogue the scattered architectonic heritage composed of the existing hermitages and chapels in the municipality of Caceres following a specific methodology.
The methodology consists in creating an inventory and a catalogue of the buildings.
The results firstly secure an ordered relation of the hermitages around Caceres, to subsequently realise an analysis of each of them following the scheme: “Firmness, Utility, Beauty” enunciated by Vitruvius (construction, function and form).
Following the analysis of the catalogue of hermitages, the following conclusions are reached:
It is demonstrated that counting with an adequate catalogue of patrimonial elements scattered in the territory is possible.
The municipality of Caceres does not have such a catalogue.
The municipality of Caceres does not comply with Law 16/1985 of the 25th of June on the Spanish Historical Heritage.
The inventory and cataloguing must encompass the different fields of study (function, form and construction). Studies carried out from the perspective of isolated fields of study, which do not deal with essential aspects of the construction, or without graphical documentation such as maps, are inoperative for purposes of heritage management.
For the study of the architecture scattered in a territory it is fundamental to study the territory in context, because it defines the localisation and shapes the articulation of the architecture.

CODE 55

THE ORIENTATION OF THE ROMANESQUE CHURCHES OF VAL D'ARAN IN SPAIN (11TH-13TH CENTURIES)

Josep Lluis i Ginovart[1]; Mónica López Piquer[1]

School of Architecture Barcelona
Universitat Internacional de Catalunya
e-mail: mlopezp@uic.es, web: www.uic.es

KEYWORDS: Romanesque architecture; church orientation; christian religion; archaeostronomy; Valle de Aran.

ABSTRACT

In Val d'Aran there is a group of Romanesque churches built between the 11th and 13th centuries. These churches have been systematically studied through the massive data capture with a terrestrial laser scanner (TLS) in five study campaigns (2014-2015). The data obtained allow an accurate analysis from the geometrical point of view of these churches that have allowed to analyze the orientation from the approach to the Romanesque liturgies such us Gemma animae (c.1120) of Honorio de Autun, the Mitralis de Officio (1190) of Sicardo bishop of Cremona, the Rationale divinorum officiorum, (c.1150) of Jean Beleth and, finally, the Prochiron, vulgo rationale divinorum officiorum (1291) of Guillermo de Durando.

CODE 73

SANTO ANTÔNIO CONVENT IN IGARASSU, PE – REGISTER OF AN INTERVENTION

Guzzo, Ana Maria Moraes[*1]; Nóbrega, Claudia[2]

1: Doutoranda do Programa de Pós-Graduação em Arquitetura - PROARQ
Faculdade de Arquitetura e Urbanismo - FAU
Universidade Federal do Rio de Janeiro - UFRJ
anammguzzo@gmail.com , web: http://www.proarq.fau.ufrj.br
2: Doutor em Planejamento Urbano e Regional - IPPUR Programa de Pós-Graduação em Arquitetura - PROARQ – FAU - UFRJ
claudianobrega@gmail.com , web: http://www.proarq.fau.ufrj.br

KEYWORDS: Patrimony; restauration; franciscans; Convento de Santo Antônio em Igarassu.

ABSTRACT

This paper has as its theme the interventions carried out in Santo Antonio Convent in Iguarassu, in the State of Pernambuco (Brazil), which belongs to The Franciscan Order, according to the bibliographic and iconographic data gathering of the aforementioned convent, as of the decade of 1950. This decade is noted for a work campaign after the convent was recognized with the official national historic site status, in 1938, by the Instituto do Patrimônio Histórico e Artístico Nacional – IPHAN – founded in 1937, and it coincides with the visit paid to the Brazilian Franciscan convents by the Art historian Germain Bazin (1901 -1990), which resulted in his work "L`Architecture religieuse baroque au Brésil" (1956-58: Brazilian version – 1983), where the author dedicates one chapter to those monasteries. The case study of the Convent in Igarassu offers an opportunity to observe the practice and the fundamental theories of the restauration, according to the interventions performed. The evaluation was based on the textual and iconographic documents found in the archives of IPHAN in Rio de Janeiro and Pernambuco, complemented with field research. However, there are gaps in what refers to the registers of the interventions carried out. Thus, we aim to reinforce the need of the historic research as an instrument for the theoretical background of the restauration, and to draw attention to the importance of the register of the information about the occurrence of the works, aiding in the understanding of the essence of the asset to be preserved.

CODE 104

DONIBANE N134: HISTORICAL-CONSTRUCTIVE ANALYSIS OF LATE MEDIEVAL VILLAGE MANOR HOUSE IN PASAIA (GIPUZKOA - SPAIN)

Luengas-Carreño, Daniel[1]; Crespo de Antonio, Maite[1]; Sánchez-Beitia, Santiago[1]

1: ESMAARQ Research group
University of the Basque Country UPV/EHU
e-mail: daniel.luengas@ehu.eus ; maite.crespo@ehu.eus ; santiago.sanchez@ehu.eus

KEYWORDS: Late Medieval Seigniorial Residences; manor houses, palaces; medieval constructions; historical-constructive analysis.

ABSTRACT

The Manor Houses evolved during the Late Ages, adapting to the different historical periods and the needs of their owners. At the end of the fifteenth century, the prevailing residential model — the defensive Tower-House— was replaced by a more residential type of house. Unlike the rest of Manor Houses of these ages, the village manor houses were located in a single urban gothic plot, which greatly conditioned the interior distribution of these buildings. The house located in Donibane n134 is a good example of this typology, where the rooms had to be fitted in 11 x 39 gipuzkoan medieval elbows.
This work has aimed to analyze the historical-constructive evolution that has undergone this manor house. The building has been investigated through the historical-documentary analysis and the historical-constructive analysis, in order to determinate its original shape and constructive system. Four main construction phases have been detected: the original construction, the first modifications made between the sixteenth and nineteenth centuries, the reforms made during 1870-1976 and the consolidation works of the last decades.
It was possible to determine the original construction system, which was greatly transformed in successive reforms. The ground floor of the main façade was built using sandstone masonry blocks, while the upper two floors were constructed with wood and brick framing. Two stone overhangs were built on both sides of the main façade as an anti-fire measure. The side façades were made in poor quality sandstone masonry. Each floor had six beams arranged parallel to the main façade, which were embedded in the side walls. The original building had a gable roof, where the ridge beam was placed perpendicular to the façade.

CODE 126

CONSERVATION OF PREFABRICATED RESIDENTIAL HERITAGE OF THE CENTURY XX. JEAN PROUVÉ'S WORK

Bueno-Pozo, Verónica(*); Ramos-Carranza, Amadeo

Escuela Técnica Superior de Arquitectura. Universidad de Sevilla.
e-mail: vbuenopozo@gmail.com
e-mail: amadeo@us.es

KEYWORDS: Heritage of the century XX; prefabrication; Jean Prouvé; maintenance; pathologies prefabricated systems.

ABSTRACT

Jean Prouvé's Works form an essential reference in industrialised buildings in the twentieth century especially during the post-war period. With prefabricated architecture, Jean Prouvé further develops his thinking. He designs a great variety of structural systems which allow for producing many models. Some of them continue to be built nowadays and consequently, have been categorized as Asset of Cultural Interest. knowledge of his building solutions is limited, in spite of being considered one of the most innovative developments in that period. The materials which were used and his building methods enabled Jean Prouvé to have studied his residential prototypes in depth. These are considered of great significance in contemporary building.

In this communication, the design processes used by Jean Prouvé in his models will be revealed, allowing us to establish a research methodology prior to intervention in prefabricated and industrialized architecture, which is increasingly in demanded by society. Specific objectives are the contextualization of his residential work as a reference of the industrialized heritage; as well as the maintenance of such types of constructions, some of which despite having being considered as short or medium term solutions, have remained until the present day.

Therefore, particular emphasis is placed on Jean Prouvé's design methodology, on the fast and easy assembly that is carried out in his models. The fact that his works could be assembled by inexperienced workers and have been maintained through time reveals the precision in the design of the execution and in the structural maintenance. This, together with the fact that they are prefabricated structures, allows certain pathological lesions to be repaired easily, replacing the piece in question by another, thereby allowing permanence over time.

CODE 169

COMPARED ANALYSIS AS A CONSERVATION INSTRUMENT. THE CASE OF THE "MASSERIA DEL VETRANO" (ITALY)

Pagliuca, Antonello[1]; Trausi, Pier Pasquale[2]*.

1: University of Basilicata, School of Architecture
e-mail: antonello.pagliuca@unibas.it
2: University of Basilicata, School of Architecture
e-mail: p.p.trausi@gmail.com

KEYWORDS: Knowledge; conservation; typological analysis; compared analysis; built heritage.

ABSTRACT

The search of "Genius Loci" - that represent the "spirit of the place", a casket of all the information on a building - is the first step to project a recovery intervention on built heritage. Phenomenological research, focused on the study of the environment, of the identity relationship that the building has with the historical, social and cultural context, cannot be ignored by the application of a suitable scientific methodology, which is offered as a subsidy for the definition of the design and architectural choice.
The analysis of indirect sources (archivist and bibliographic, as well), becomes the first useful tool to define a precise understanding of the various evolutions of the building, reconstructing the constructive process in a clear and unambiguous way. However, due to the difficulty of obtaining historical documentation, direct analysis conducted in situ focus on the cognitive process and, along with a historical-constructive view, contributes to define an "architectural type"; it contains all the stylistic, technical and technological information, the information on construction features and on the materials of the building.
Therefore, to know this "type" becomes a starting point for a large-scale analysis that allows to examine the similar constructive and typological phenomena of the selected area, as a guide in support of the evolutionary reconstruction of the building and of the transformations that affected it during its life cycle.
This methodology finds its validation in the research for the historical-constructive events of the "Masseria di Santa Maria del Vetrano", built as the castle of the noble Passavante in 1093, to control the territory near the town of Matera (Italy); it becomes subsequently "masseria" at the nearby Benedictine monastery of "San Michele Arcangelo in Montescaglioso" (Italy) in 1119.
The research aims to propose a methodology of study and demonstrate how, by comparing the small historical documentation with a more significant constructive analysis "in situ" and with materials, it is possible to reconstruct the transformation phases of this important rural architecture, whose historical events rewrite the social and cultural context of a long-forgotten and abandoned Italian area. In other words, it want to provide the tools for defining a system that, by determining technological and functional elements, is able to minimize the risks of compromising historical artifacts and to ensure not only formal and morphological conservation, but also philological of the architecture.

CODE 172

THE INTERRELATION BETWEEN ARCHITECTURAL CONCEPTION AND STRUCTURE OF THE DOM BOSCO SANCTUARY THROUGH THE RECOUPERATION OF ITS DESIGN

Oliveira, Iberê P.[1]; Brandão, Jéssica[2]; Pantoja, João C.[3]*; Santoro, Aline M. C.[4]

1: Faculdade de Arquitetura e Urbanismo, Universidade de Brasília
e-mail: iberep@yahoo.com.br, web: http://www.ppgfau.unb.br/
2: Faculdade de Arquitetura e Urbanismo, Universidade de Brasília
e-mail: jessicaabrandao@gmail.com, web: http://www.ppgfau.unb.br/
3: Faculdade de Arquitetura e Urbanismo, Universidade de Brasília
e-mail: joaopantoja@gmail.com, web: http://www.ppgfau.unb.br/
4: Faculdade de Arquitetura e Urbanismo, Universidade de Brasília
e-mail: alinemcsantoro@gmail.com, web: http://www.ppgfau.unb.br/

KEYWORDS: Historical collection; sttructure architectural design; virtual modeling; apparent structure.

ABSTRACT

The Don Bosco Sanctuary was built in 1970, in the Pilot Plan of Brasília - DF. At present, no documentation of its design or constructive design, whether structural or architectural, is known. The present study aims to recover part of this collection that became a tourist reference for the Federal Capital, and consequently to make an analysis regarding the structural element as architectural composition. From on-site surveys it will be possible to identify and recover part of the collection of projects of the Don Bosco Sanctuary and also to compose a methodology of analysis of apparent internal and external structures that favors the understanding of the architectural conception. In order to achieve the objectives it was necessary to follow a survey and survey route where it was necessary to collect any and all existing information regarding the Don Bosco Sanctuary. From there it was possible to remake the structural and architectural plans of the sanctuary that later led to a virtual and physical modeling for a better understanding of the structural functioning. These projects will contribute to the secretariat of the Don Bosco Sanctuary for the recovery of its historical heritage. It can be seen that the structure was designed not only as a load sustainer but also as a functional and aesthetic part of the building.

CODE 177

THE SILVER ROAD THROUGH COLONIAL CHRONICLES. TOOLS FOR THE ANALYSIS AND ENHANCEMENT OF HISTORIC LANDSCAPE

Malvarez, María Florencia[1]

1: Dipartimento di Architettura e Studi Urbani
Politecnico di Milano
e-mail: mariaflorencia.malvarez@polimi.it

KEYWORDS: Historic trails; historic landscape; conservation.

ABSTRACT

The 'Camino Real de Potosí' – Royal Route of Potosí – (Bolivia) leading to the port of Arica (Chile) was used for the transportation of silver from Charcas' mines to the Pacific Ocean from the 16th century up to the late 18th century. The significant volume of trade for silver, mercury, exchange and basic consumer goods brought to the definition of a peculiar landscape along the historic trail, reflection of the colonial society of the studied period.
The article focuses on the study of a set of historical chronicles describing the landscape of the 'Ruta de la Plata' – Silver Route – emphasizing the sources' value as a knowledge tool of the historic landscape. The studied chronicles, selected for the richness of the description for the peripheral areas to the large urban centres, highlight the constant features and the transformation of the Andean landscape during the 17th century, characterised by the radical changes in social and economic structure. The proposed reading works towards the interpretation of a set of landscapes as human and productive settlements, and the philosophy of those, reflecting over the hybridization process, which opens the way to new products and cultural scenarios.
The present investigation contributes to the scientific community from a reinterpretation of a set of historical chronicles towards the identification of the systemic connection between places along the route and the description of the correspondent historical landscape. The study of the chronicles complemented, as part of a greater study, the analysis of other available sources: iconographic, cartographic, ethnographic and a field study survey. The interrelation of those allowed an historical "reconstruction" of the landscape system as well as an interpretative reading of heritage values based on the documental, architectural, urban and landscape relevance that justifies its preservation, enhancement and promotion.

CODE 202

ANTHROPIC TRANSFORMATIONS AND NATURAL DECAY IN URBAN HISTORIC AGGREGATES: ANALYSIS AND CRITERIA FOR CATANIA (ITALY)

Alessandro Lo Faro*; Angela Moschella; Angelo Salemi; Giulia Sanfilippo

1: University of Catania, Department of Civil Engineering and Architecture.
e-mail: alessandro.lofaro@darc.unict.it
e-mail: angela.moschella@darc.unict.it
e-mail: angelo.salemi@darc.unict.it
e-mail: giulia.sanfilippo@darc.unict.it

KEYWORDS: Catania; conservation; project; building facades; vulnerability.

ABSTRACT

Architectures those make up the historical cities are the result of the material culture of a community that has been able to express, in various ages, wise use of materials, artistic language, architectural composition and building typologies.
These architectures, observed in their diachronic development, have to be interpreted according to a synchronous reading, considering both the envelope, consisting of a surface that determines a language, degrades and transforms itself, both functional and structural components, which instead determine its typological-distributive, technological a structural features. This complexity suggests an interpretation of building blocks like macro architectural organisms (aggregate): they must be understood as a *whole* and not as a *total*.
The buildings in the down town of Catania (Italy) insist on a particularly layered fabric due not only to historical events, but above all to the numerous cataclysmic (lava eruptions and earthquake) that have fallen on it. In addition, changes in altimeter structures have been conditioned by the functional needs induced by mobility and public health.
The case study proposes an analysis of an urban aggregate in the city's eighteenth century soil, involved in the transformations (both formal and structural) determined by the *leveling plan* of 1862. The aim is to find a criterion, supported by interdisciplinary studies and procedures already being tested, to study and understand every aspect of the architectural vicissitudes that have brought the building to its present state of conservation. It intends to propose procedures for the correct intervention on the consolidated city, understood as a single body made up of related architectures. The adopted methodology foresees the reading of architectural, technological and structural characteristics of the study compartment and the understanding of the degradation phenomena.

CODE 216

THE BRICK BUILT FAÇADES OF TIERRA DE PINARES IN SEGOVIA. THE CASE OF PINARNEGRILLO

Gustavo Arcones-Pascual[1]; Santiago Bellido-Blanco[2]; David Villanueva-Valentín-Gamazo[3]; Alberto Arcones-Pascual[4]

1: Departamento de Enseñanzas Técnicas
Universidad Europea Miguel de Cervantes
e-mail: garcones@uemc.es
2: Departamento de Enseñanzas Técnicas
Universidad Europea Miguel de Cervantes
e-mail: sbellido@uemc.es
3: Departamento de Enseñanzas Técnicas
Universidad Europea Miguel de Cervantes
e-mail: dvillanueva@uemc.es
4: Alia Tasaciones S.A.
e-mail: a.arcones@aliatasaciones.com

KEYWORDS: Rural architecture; brickwork; building technique; facades, masonry.

ABSTRACT

The village of Pinarnegrillo in Segovia appears as a great example of a particular brick dwelling architecture made between the late nineteenth and early twentieth centuries, enhacing a domestic architecture by representative meanings in a rural environment. The Mudejar architecture present in Segovia in the XII and XIII centuries can contextualize the work of a group of local craftsmen that shows up through ornamental elements on the main façades, especially in cornices, imposts and lintels, exhibiting singular complex forms.
The present work is based in a registry and cataloguing of these singular façades, mainly found in the focus of Pinarnegrillo, into an area exposed to degradation of the urban patrimonial setting because of the substitution and modification of the built fabric. The adaptation of these residences because of reforms aimed at maintaining their use of primary or secondary housing is triggering the inclusion of new materials, different from their traditional constructive systems. It is urgent, therefore, the registration and constructive definition of them, necessary for the knowledge and the diffusion of this singular constructive display.

CODE 256

INTERWEAVING OF PRODUCTION PROCESS AND INDUSTRIAL ARCHITECTURE: EVOLUTION OF THE NUEVA CERÁMICA DE ORIO INDUSTRIAL COMPLEX

Otamendi-Irizar, Irati[1]

1: Department of Architecture
University of the Basque Country (UPV/EHU)
e-mail: irati.otamendi@ehu.eus

KEYWORDS: Industrial architecture in Gipuzkoa; Modern Movement; Luis Tolosa Amilibia; Nueva Cerámica de Orio; production process.

ABSTRACT

This paper presents a case study which represents a significant example of industrial development during the thirties in Spain, and more specifically, of the industry in Gipuzkoa which was developed in an uncentralized way spreading out from the river basins. The case in question is the "Nueva Cerámica de Orio" industrial complex, located in Orio, which is representative of the introduction and special presence of modern architecture in the industry of Gipuzkoa.
This architectural complex —now registered under the Monumental Complex category in the Basque Cultural Heritage Register and listed by Docomomo— has been the object of study of several publications. However, most of them have focused on studying the architectural aspects of the last refurbishing intervention carried out in the factory and clarifying its authorship.
In this regard, this work aims to study the evolution of this industrial complex, since its earliest days, in the 19th century, until today. For this purpose, both the architectural evolution and the production process have been taken into account. To this end, complementary tasks have been developed, such as fieldwork, documentary research and the historical-architectural analysis of the case study.
Both the evolutionary stages and their characteristics have been ascertained, as well as an approximation to the productive scheme housed in the complex. Thus, it has been corroborated that both the productive process and the requirement to maintain some preexisting elements have influenced architectural features. Furthermore, the business nature of this facility meant that architectural interventions had to subordinate to the premise of not stopping production. All these issues reflect common patterns and dynamics implemented in industrial architectures throughout Gipuzkoa; it can therefore be affirmed that the "Nueva Cerámica de Orio" industrial complex is a representative case of this context.

CODE 276

THE VIRTUAL RESTORATION ALLIED WITH SYSTEMATIZATION OF PROJECTS. CASE STUDY: SÃO FRANCISCO DE ASSIS HOSPITAL

Souza, Mariana[1]

1: Universidade Federal do Rio de Janeiro, PROARQ / Universidade Estácio de Sá
Faculdade de Arquitetura e Urbanismo.
e-mail: marivazcosta@gmail.com

KEYWORDS: Digital visualization; restoration project; systematization; virtual restoration; cultural heritage.

ABSTRACT

The main difference between the architecture project and the restoration project is that the second one works over the existing one that one intends to preserve because of its historical, artistic and / or cultural importance.
Even following a system of phases and stages in a restoration project, the final outcome of the restoration project and its impact on the monument, its surroundings and society, can hardly be predicted. This is mainly due to the fact that the design process and the discussions are restricted to a group of people.
The acceleration of growth from the second half of the twentieth century witnessed an unprecedented process of changes in the history of thought, technique and the arts. It can be said that Post-Modernity begins with the transition from industrial to post-industrial relations. Since the 1980s, a process of building a culture at the global level has been developed which, with the acceptance of all styles and aesthetics, aims to include all cultures as consumer markets.
Virtual reality made it possible to represent space in a trustworthy way, and the offices of architecture gave freedom of creation, allowing incremental innovations of representation of their projects. Landscapes, textures, colors, decoration, lighting, shadows, structures, everything can be simulated accurately.
However, it was only in 2000, in the Krakow Charter, that the first recommendations for the use of computing and digital tools in archaeological heritage were pointed out, establishing a more academic conduct of national and international research networks and a search for ethical search. Finally, a reflection paper from a seminar held at the British Academy in 2006 points out the guiding principles that will be implemented in 2009 in the Charter of London in 2012; followed by the Seville Principles in 2012.
These documents provided the development of scientific research in the field, of what we will call here, of virtual restoration and systematization of restoration projects, illustrated through the case study of the Hospital, São Francisco de Assis, one of the only examples of panoptic architecture in Brazil.

CODE 307

STRATIGRAPHY AND STRUCTURAL DECAY. THE CORNER TOWER OF A CASTRUM LOCATED AT THE BORDER OF THE CITY OF MODENA. 13TH CENTURY

Balboni, Laura[1]

1: Politecnico di Milano, Department of Architecture and Urban Studies
e-mail: laura.balboni@polimi.it

KEYWORDS: Structural analysis; building archaeology; diagnosis; construction techniques; tower; Modena.

ABSTRACT

This study aims to investigate the causes of the considerable structural decay of a 13th century tower located in the province of Modena (Italy), focusing on the information provided by a profound knowledge of its construction and transformation phases.
The building, defined a watchtower, is characterized by certain relevant aspects: it is, in fact, within the geographical area in question, one of the few, still-standing corner-towers which were part of a broader defence system of a fortified medieval town with origins dating back to the beginning of the 13th century. This singularity is reflected in the lesser-known constructive techniques of a building which is today, however, extremely transformed.
This multidisciplinary study wove together the survey of the geometries, the examination of archival sources, and, in particular, the building archaeology, identifying the sequence of construction events. For each of these, the materials and construction techniques used were investigated: from the perimeter defensive wall, which opened towards the town and was topped with swallow-tailed merlons, to the subsequent transformations and additional raisings realized in function of the various uses for which the tower was adapted over time, first as a dovecote tower and, in more recent times, as a dwelling. Furthermore, the buildings that were added over the centuries, and which have since been demolished, were identified. Lastly, the study was extended to include the broader defensive system of which the tower was a part. This helped determine the relationship with the peculiar geographical morphology of the surrounding area that today is widely compromised, recreating the geometry of the terreplein on which the tower was built, and the cross-section of the Castle ditches, today aggraded.
The results highlight an extensive patrimony of knowledge essential to interpret the crack pattern and deformations present as well as the tower's structural vulnerability, and to conducting any additional diagnostic evaluations necessary for strengthening interventions: e.g., the identification of building joints, often lacking toothing; of neighbouring masonry constructed using different materials and according to different geometries; of additional raised constructions and vaulted pushing structures completed over time paying little attention to the nature of the foundation terreplein or to other specific pre-existing conditions. While restoring the testimonial value of these elements (structural vulnerability as well as physical documentation on the building history), this study also specifies the limits of an intervention that would respect the tower requirements for protection.

CODE 371

THE PRACTICE OF THE MAINTENANCE OF BUILDINGS THROUGH THE ARCHITECTURE TREATIES AND CONSTRUCTION MANUALS OF MAJOR DISCLOSURE IN THE CITY OF PORTO

Teixeira, Joaquim[1]; Póvoas, Rui Fernandes[2]

1: Centro de Estudos de Arquitectura e Urbanismo
Faculdade de Arquitectura da Universidade do Porto
e-mail: jteixeira@arq.up.pt, web: http://ceau.arq.up.pt
2: Centro de Estudos de Arquitectura e Urbanismo
Faculdade de Arquitectura da Universidade do Porto
e-mail: rpovoas@arq.up.pt, web: http://ceau.arq.up.pt

KEYWORDS: Current architectural heritage; traditional construction; historical studies; technical literature; safeguard.

ABSTRACT

Nowadays, when the environmental cause is gaining, although gradually, more significance and importance in public opinion, the practice of building maintenance it is imposed as an activity to be favoured for a sustainable action. Simultaneously, the maintenance of old buildings represents the adequate way for the preservation of its cultural values, with a particular emphasis on the architectural and constructive ones.
When maintenance involves old buildings, it is highly consensual to deepen knowledge about history, from architecture to crafts, seeking to obtain important information, either to confront it to current scientific and technical knowledge or to launch new research tracks.
Therefore, the design of a manual for the maintenance and use of old and ordinary buildings cannot dispense the consulting of the historical and technical literature.
In the context of an investigation that has been developed for the design of a maintenance manual for the bourgeois house of Porto, a campaign was carried out to analyse the architectural treatises and manuals that had circulated during the period of great urban development of the city of Porto, in order to find useful information on this topic for the present days.
However, contrary to initial expectations, the documents consulted reveal very little about the practice of building maintenance. In fact, only the receipts included in the construction manuals can constitute a contribution to the current maintenance practice, taking into account the information they contain about the materials and techniques used in the past.

CODE 376

FROM PHOTOGRAMMETRIC SURVEY TO THE DIAGNOSIS OF MASONRY STRUCTURES

Guerra, Miriam[1]*; García, Julián

1: Universidad Politécnica de Madrid
e-mail: mgm19491@gmail.com
2: Universidad Politécnica de Madrid.
Departamento de Construcciones Arquitectónicas y su Control
e-mail: julian.garciam@upm.es

KEYWORDS: Photogrammetry; masonry structures; arches; orthophoto.

ABSTRACT

The accuracy of the new photogrammetric surveying systems, whose progressive improvement can be attributed both to the high resolution of modern cameras and to the recent development of sophisticated interpolation algorithms, allows collecting data not only of the general traces of the plant and the elevations of a building but, in addition, to know in detail the geometry of the pieces that compose it, and very specially of the elements that form its structure. This fact is of great interest in many fields, and especially in the field of masonry structures, since the stability analysis of these structures require (at least when local behaviour is intended to be incorporated into the study) of detailed information on the articulation of materials that compose them: bond materials, friction in contact areas or specific geometries of the contact surfaces.
This paper will discuss a specific case, that of the church of San Millán at Segovia, a building in which a complex photogrammetric survey has been used as a geometric basis for the analysis of the masonry structure. The different phases of the process will be studied, from the survey to the processes of geometric simplification necessary to be able to implement any type of structural analysis automatically, emphasizing on the operational facilities that this technique makes possible.

CODE 400

GEOLOGICAL AND GEOMORPHOLOGICAL STUDY OF THE HORNOS DE LA PEÑA CAVE (CANTABRIA, NORTHERN SPAIN)

Sánchez-Carro, Miguel[1]*; Bruschi, Viola[1]; Rivero, Olivia[2]

1: Universidad de Cantabria, The Cantabria International Institute for Prehistoric Research (Gobierno de Cantabria, Universidad de Cantabria y Santander) Civil Engineering School
e-mail: miguelangel.sanchez@unican.es, viola.bruschi@unican.es
2: Universidad de Salamanca, Depto. De Prehistoria, Historia Antigua y Arqueología. Facultad de Geografía e Historia
e-mail: oliviariver@hotmail.com

KEYWORDS: Geological and geomorphological studies; cave protection, speleothems mapping; Hornos de La Peña Cave; Spain.

ABSTRACT

Hornos de la Peña Cave is located in North Spain, near San Felices de Buelna Village in Cantabria Province. The cave was discovered in 1903 and since the beginning has been considered one of the most important sites of Palaeolithic rock art in the region. A rich ensemble of engravings dated between Aurignacian and Magdalenian periods was studied by Alcalde del Río and Breuil (1913). Nowadays, a team headed by O. Rivero has resume the study of the rock art and his context, both archaeological and geological.
Geological and geomorphological studies are excellent tools in order to preserve and protect caves because permit to outline the interaction between the different areas of the karstic system. Here we discuss the results of the information depicted by the geological and geomorphological mapping carried out inside and outside the cave. The external characterization shows a complex geological context defined by the presence of different geological units and their general arrangement. Regarding this, five geological units in the area surrounding the cave have been identified and characterized to know their main features and structural configuration. These units are dated as lower Cretaceous and consist of quarzitic sandstones, bioclastic limestones, sandstones with well-developed tabular bedding and a deposit of blocks and sands from Holocene.
Inside the cave, the geomorphological mapping focuses on the joint system, which permits us to define the karstic network and the main infiltration zones. Several families of discontinuities have been identified and characterized with the aim of obtain the relationship with the external context. Furthermore, a geomorphological mapping of the karstic deposits has been carried out in order to describe the different type of speleothems and their arrangement inside the cave.

CODE 498

EDIFICE MARTINELLI: CULTURAL HERITAGE IN SÃO PAULO, BRAZIL

Vieira Santos, Regina Helena[1]

Faculdade de Arquitetura e Urbanismo – Universidade de São Paulo (FAU-USP)
Dipartimento di Architettura – Università degli Studi di Firenze (DiDA-UniFI)
e-mail: rhvs@usp.br

KEYWORDS: Cultural heritage; architecture; preservation; conservation; restoration.

ABSTRACT

This work deals with a representative building of the urban history of the city of São Paulo. From the antecedents to its construction, the design (project), the implantation in the 1920s, the decay in the 1960s, the restoration in the 1970s to the present, the beginning of the twenty-first century. It is located in an area of the old city of São Paulo, Brazil, studied in the doctoral research.
The Martinelli building was built in the area that passed through the first modern urban intervention in the city that expropriated the primitive buildings, demolished them, for the extension of Rua São João. Consequence of the law promulgated in 1912, which determined the opening of Avenida São João. Important architects and engineers, practiced professional activity on occasion in the city, and designed the eclectic constructions of the 1920s.
The original documents, drawings and projects that are in the Historical Archive of São Paulo were the basis for writing this text, complemented by iconographic records found, the historical cartography studied and some laws of the occasion that allowed this urban work of great impact in the city.
This eclectic building reveals the influence of the law on the fabric and urban landscape. Among the documents investigated, it was possible to know the primary city, its transformations to become a great metropolis. The material reveals the existence of the protected cultural heritage and the inefficiency of the management of the urban instruments of the city of São Paulo in the preservation, in other words, the lack of public policy of preservation and conservation of the architectural assets. This material may be useful for future restoration of this building and mainly develop your conservation plan as a safeguard methodology to be used in many cases.

CODE 49

THE HISTORIC CITY IN THE CLIMATE CHANGE. MIVES METHODOLOGY APPROACH

Gandini, Alessandra[1*]; Garmendia, Leire[2]; San Mateos, Rosa[3]; Prieto, Iñaki[4]; San-José, José-Tomás[5]; Piñero, Ignacio[6]

1: Sustainable Construction Division, TECNALIA
e-mail: alessandra.gandini@tecnalia.com, web: http://www.tecnalia.com
2: Department of Mechanical Engineering, University of the Basque Country (UPV/EHU)
e-mail: leire.garmendia@ehu.es, web: http://www.ehu.es
3: Sustainable Construction Division, TECNALIA
e-mail: rosa.sanmateos@tecnalia.com, web: http://www.tecnalia.com
4: Sustainable Construction Division, TECNALIA
e-mail: inaki.prieto@tecnalia.com, web: http://www.tecnalia.com
5: Department of Metallurgical Engineering and Materials Science, University of the Basque Country (UPV/EHU)
e-mail: josetomas.sanjose@ehu.es, web: http://www.ehu.es
6: Sustainable Construction Division, TECNALIA
e-mail: ignacio.pinero@tecnalia.com, web: http://www.tecnalia.com

KEYWORDS: Climate change; cities; methodological approach; MIVES; categorization.

ABSTRACT

A large number of historic structures are over risks in cities due to weather patterns and global climate change: sea-level rise, increasing frequency of storms and other extreme precipitation events. Conservation of urban areas of historic value implies the management of these changes, by ensuring the protection of social values as well as the authenticity and integrity of heritage sites. Disaster risk reduction and adaptation to climate change should be seen as components of conservation, as they all share the objective of addressing the challenges of sustainable urban development.

This research presents a methodological approach (MIVES - Integrated Value Model for Sustainability Assessment) for vulnerability and risk assessment, supported by an information strategy and a multi-scale urban model, in order to provide decision-making with objective and justified prioritization. A decision tree is built as a basis for future developments in specific urban case studies, supplying in present work some partial discussion by delivering a balanced solution in terms of accurate results and data requirements, by using a categorization method for urban modelling. The information is organized and structured in hierarchical levels, permitting the comparison of building vulnerabilities and risks through the use of a unique index, thus facilitating the decision-making that is needed for the prioritization of efficient interventions.

CODE 148

TRADITIONAL BELL TOWERS AT RISK IN CASTILLA Y LEÓN. ANAMNESIS OF TWO EMBLEMATIC CASES

Salemi, Angelo[1*]; Mondello, Attilio[2]; Sánchez Rivera, José Ignacio[3]; Sáiz Virumbrales, Juan Luis[4]

1: Università degli Studi di Catania, Dipartimento di Ingegneria civile e Architettura (Italia).
e-mail: angelo.salemi@darc.unict.it, web: http://www.dicar.unict.it
2: Università degli Studi di Catania, Dipartimento di Ingegneria civile e Architettura (Italia).
e-mail: amondello@darc.unict.it, web: http://www.dicar.unict.it
3: Universidad de Valladolid, ETS Arquitectura, Departamento de Física Aplicada (España).
e-mail: jignacio@arq.uva.es, web: http://www.arq.uva.es
4: Arquitecto, Máster en Restauración y Conservación del Patrimonio (España).
e-mail: juanlsaiz@hotmail.com

KEYWORDS: Ruined buildings; religious architecture in the 16th century; traditional bell tower; historical building techniques; photogrammetric 3D survey.

ABSTRACT

The skyline of European historic centres has always been characterized by traditional bell towers. These buildings have an impressive verticality compared to the small planimetric dimensions. They are very significant symbols of the Hispanic landscape since the twelfth century. Castilla y León is scattered with small towns, almost completely depopulated now. In these villages, there are parish churches that once represented real administrative centres and important landmarks for the area. In many cases, these churches and their bell towers are in a serious state of neglect that caused their disappearance or partial collapses. This results in a considerable loss for European historic building heritage to be preserved and safeguarded necessarily.
A careful survey of these slender structures, with the help of digital photogrammetry techniques, allows the "stone document" to "tell" its state of conservation and its construction stages, if there are no adequate archival sources. This paper summarizes the results of the research carried out on the ruins of the Villaesper and Villacarralón bell towers, considered emblematic for the Valladolid area and never investigated previously. For each of them, traditional and photogrammetric surveys were conducted; this has allowed a careful anamnesis of the "corpus" of the building. We have analysed geometric configurations, materials, building techniques and different construction stages. We have obtained useful information about possible damage mechanisms that have caused the structural collapse and the still existing pathologies. This was also an opportunity to propose a virtual three-dimensional reconstruction to keep the memory alive, in the hope of desirable recovery actions by administrations to stimulate social and economic development.

CODE 170

THE TERRACED HOUSE IN THE HISTORICAL FABRIC OF MEDIEVAL ITALIAN CITIES: THE CASE STUDY OF IGLESIAS

Cuboni, Fausto[1]*; Brandinu, Laura[2]; Cannas, Leonardo G.F.[3]

1: University of Cagliari, Faculty of Architecture and Engineering, DICAAR
e-mail: f.cuboni@unica.it, web: http://dipartimenti.unica.it/ingegneriacivileambientaleearchitettura/
2: University of Cagliari, Faculty of Architecture and Engineering, DICAAR
e-mail: brandinu.laura@gmail.com, web: http://dipartimenti.unica.it/ingegneriacivileambientaleearchitettura/
3: University of Cagliari, Faculty of Architecture and Engineering, DICAAR
e-mail: leonardo.cannas@unica.it
web: http://dipartimenti.unica.it/ingegneriacivileambientaleearchitettura/

KEYWORDS: Terraced houses; medieval urban fabric; iglesias.

ABSTRACT

The terraced house is the urban elementary type par excellence, on the contrary of the court type, that is the most characteristic in rural centres. These two building types have originated most of the urban fabrics of the Mediterranean urban centres.
From the terraced type, building organisms have evolved, by means of successive cell duplicates and by merging different building units, giving rise to more complex multi-family organisms that compose the historical fabrics of our cities.
The historic center of Iglesias, a town in the southwestern region of Sardinia, is a fortified village with several examples of terraced type, originated in different periods under different domination and social contexts.
Although the theme of the terraced house and its evolution has already been studied by the Muratori's school considering other Italian historic centres, and in particular by Gianfranco Caniggia between the '70s and' 80s of the twentieth century, the Iglesias case study suggests new ideas of reflection for its peculiarity. This specificity represents a unique case in the Italian landscape, it can also be seen in Cagliari, a town which had the same rulers of Iglesias, and regarding Southern Europe, we can found it only in the regions around Porto (PT). This singularity is represented by the rotation of the layout of the roof ridges that are perpendicular to the road front. This affects both the urban landscape, in which the profiles of the urban blocks are marked by the succession of the roof gables, and the buildings construction, in which this different layering imposes peculiar solutions for the roofing.
The paper, considering the studies of other contexts in the Mediterranean area, seeks to investigate the causes and consequences of this constructive choice.

CODE 192

NATIONAL INVENTORY OF HISTORICAL QUARRIES ASSOCIATED WITH THE AQUITECTONIC HERITAGE. PROVINCE OF BADAJOZ

Fernández Suárez, Jorge[1]; Álvarez Areces, Enrique[1,2]; Baltuille Martín, Jose Manuel[1,2] y Martínez-Martínez, Javier[1]

1: Unit of Natural Stone and Monumental Heritage. Geological Survey of Spain.
e-mail: j.fernandez@igme.es; e.alvarez@igme.es; jm.baltuille@igme.es; javier.martinez@igme.es;
web: http://www.igme.com
2: CONSTRUROCK Network of Natural Stone and Architectural Heritage
web: http://www.igme.es/construrock/default.htm

KEYWORDS: Badajoz; monumental heritage; historic quarries; natural stone.

ABSTRACT

The framework for the present paper is the research project entitled "National Inventory of Historic Quarries associated with Architectural Heritage" (INCHaPA – Inventario Nacional de Canteras Históricas asociadas al Patrimonio Arquitectónico). This reseach project has been developed by the Geological Survey of Spain (IGME – Instituto Geológico y Minero de España). This work is focused in the location of the quarries or historical exploitation areas from where the stones were extracted for construction of the BIC (National Register of Historic Places), elements of defensive architecture included in the PNAD (National Plan for Defensive Architecture) and other elements of the rich architectural heritage of the province of Badajoz.

The main steps for the historic quarries location are: 1) the identification of the buildings rocks used in the architectural heritage; 2) consult of historic information; 3) rock sampling and rock characterization; and finally, 4) quarry location and addition to the national quarry database.

The localization of historical extractive areas is of great value. On the one hand, it enables the collection of original building stone for its characterization at laboratory and the evaluation of appropriate conservation treatments. On the other hand, it contributes with new and unpublished information extremely useful for other disciplines such as History, Archaeology, Geography, etc. All that lead to a better understanding of the built heritage and its relationship with the territory, contributing with a new perspective for its management and preservation.

Building rocks of 254 elements have been studied in the Badajoz province. 229 extractive areas related to these constructions have been identified and located.

The inventory and characterization of these historic quarries and extractive areas contributes to the recognition of these spaces as important cultural elements with remarkable scientific, cultural and educational interest. Due to these reasons, historic quarries and extractive areas should be protected under an appropriate legal figure.

CODE 193

NATIONAL INVENTORY OF HISTORICAL QUARRIES ASSOCIATED WITH THE AQUITECTONIC HERITAGE. PROVINCE OF CÁCERES

Álvarez Areces, Enrique[1,2]; Fernández Suárez, Jorge[1]; Baltuille Martín, Jose Manuel[1,2]; Martínez-Martínez, Javier[1]

1: Unit of Natural Stone and Monumental Heritage. Geological Survey of Spain.
e-mail: e.alvarez@igme.es; j.fernandez@igme.es, jm.baltuille@igme.es; javier.martinez@igme.es
web: http://www.igme.com
2: CONSTRUROCK Network of Natural Stone and Architectural Heritage
web: http://www.igme.es/construrock/default.htm

KEYWORDS: Cáceres; monumental heritage; historic quarries; natural stone.

ABSTRACT

Results showed in this paper belongs to the project entitled "National Inventory of Historic Quarries associated with Architectural Heritage" (INCHaPA – Inventario Nacional de Canteras Históricas asociadas al Patrimonio Arquitectónico), developed by the Geological Survey of Spain (IGME – Instituto Geológico y Minero de España) in collaboration with the Regional Goberment of Extremadura.. One of its main objectives is the characterization of the building stones used in the construction of the architectural heritage, as well as the location of the historic exploitation areas from where these materials have been extracted.

A total of 211 extractive areas (associated with 252 monuments) were located in the province of Caceres. Most of these extractive areas are developed on granite outcrops, but also other materials, such as quartzites, slates, marble or limestone, were exploited.

This project has a multidisciplinary sense, being necessary the use of tools from other disciplines such as Geology, Architecture, History, among others. In fact, in addition to the geological interest of historic quarries, their study is a fundamental starting point for defining ancient production centers of specialized building stones, as well as for studying the historical communication routes, or for known the organization and hierarchy of the mining work process and the stone trade.

Results from this paper, together with those obtained in the Badajoz province, offer a complete inventory of the historic quarries and historic extractive areas of the Extremadura Region (western of Spain). This research work provides an unpublished document for the study of the built heritage and its relationship with the territory, providing new perspectives for its analysis, management and conservation.

CODE 230

ANALYSIS OF THE PRESS BEAM MECHANISM IN THE UGARTE HAMLET IN ASTEASU (GIPUZKOA - SPAIN)

Crespo de Antonio, Maite[1]; Luengas-Carreño, Daniel[1]; Sánchez-Beitia, Santiago[1]

1: ESMAARQ Research group
University of the Basque Country UPV/EHU
e-mail: maite.crespo@ehu.eus; daniel.luengas@ehu.eus; santiago.sanchez@ehu.eus

KEYWORDS: Timber structures; Basque farmhouse; XVIth century; press beam; cider, lever.

ABSTRACT

The production of cider in Gipuzkoa was one of the main economical activities in this region during the XVIth century, along with the shipbuilding and whaling. Many Basque farmhouses (*caserío* in Spanish language or *baserri* in Basque language) produced large amounts of cider through a great power press. This press was known as *lagar* in Spanish or *dolare* in Basque.
Nowadays, there are many buildings with traces and clues of have being a press house in the past, but none has kept it in its entirety. The case of Igartubeiti, located in Ezkio (Gipuzkoa), is the most special as this press-house farm has been recovered and transformed by the Provincial Council into a museum, in order to ensure the transmission of this legacy to the new generations. This was an important project in order to spread the great magnitude of this type of hamlets had in the Gipuzkoan economy in the XVIth century.
This work analyzes the mechanism of the hypothetical great press in one case, Ugarte hamlet in Asteasu (Gipuzkoa). There are some clues indicating that this *caserío* used to press apples using this system. In a structural level, the movement of the great beam during pressing involved a dynamic load and a successive instability on the whole building.
Ugarte building was studied in the University Master in Rehabilitation, Restoration and Integral Management of the Built Heritage and Existing Constructions of the University of the Basque Country UPV/EHU. It is also part of one of the research lines of ESMAARQ Research group in the same university, at which belong the authors.

CODE 239

LA BAZANA AND VEGAVIANA, AND THE INFLUENCE OF VERNACULAR ARCHITECTURE ON THE ASPECTS OF SUSTAINABILITY OF THE SETTLEMENTS OF EXTREMADURA

Bote Alonso, Inmaculada[1]*; Sánchez Rivero, Mónica Victoria[2]; Montalbán Pozas, María Beatriz[3]

1: University of Extremadura
e-mail: ibotealo@alumnos.unex.es
2: University of Extremadura
e-mail: msanchezvj@alumnos.unex.es
3: University of Extremadura, School of Technology.
e-mail: bmpozas@unex.es

KEYWORDS: Settlement; sustainability; Extremadura; heritage.

ABSTRACT

The settlements of Extremadura, created by the National Institute of Colonization (INC), constitute a benchmark for implementation in the territory as well as sustainable rural architecture, either from the point of view of its architecture and urbanism or from the design of its activity and economic and social development as a productive city. In this sense, villages of architects so important both nationally and internationally, such as La Bazana by Alejandro de la Sota -located in Badajoz-, and Vegaviana by José Luis Fernández del Amo -located in Cáceres-, exemplify the sustainable in rural architectural heritage of Extremadura. Is in the design of the rural architecture of the architects of the INC where details and characteristics typical of the vernacular architecture of the area are often glimpsed. Therefore, the main objective of this article is to know if there was an influence of the vernacular architecture in the settlements of Extremadura in a general way, and more concretely in the settlements of La Bazana and Vegaviana, that influenced that today we would define as its own aspects of sustainability. The analysis is made from the study and comparison of vernacular characteristics of the populations of the areas in which the settlements of La Bazana and Vegaviana are located, and their subsequent comparison with the architectural and urban design of these villages. Subsequently, the relationship of this vernacular influence with the sustainable aspects of the villages is analyzed. As a main conclusion, we can establish that the vernacular architecture had a positive influence on the characteristics of the settlements of Extremadura, specifically in La Bazana and Vegaviana, which endow them with elements of sustainability from their design and conception.

CODE 250

CULTURAL LANDSCAPE OF LAS BEJERAS IN LARRAGA (NAVARRA). FIRST STEPS FOR CONSERVATION AND VALORIZATION

Torres Ramo, Joaquín[1]; Quintanilla Crespo, Verónica[2]

1: Department of Building Construction, Services and Structures
Universidad de Navarra
e-mail: jtorram@unav.edu, web: http://www.unav.edu/centro/saviarquitectura
2: Architect. Restoration and Conservation Specialist
Restauración de Patrimonio
e-mail: arquitectos@restauraciondepatrimonio.es, web: http://www.restuaraciondepatrimonio.es

KEYWORDS: Cultural landscape; conservation; territory; beehives; larraga.

ABSTRACT

The town of Larraga is located in the centre of Navarra (Spain), on the banks of the River Arga. It has been a town mainly dedicated to agricultural production, since ancient times. Some rural buildings disseminated throughout its territory stand out for their singularity among all the constructions with agricultural character. They are some related to beekeeping activity. These constructions integrate an entire system of buildings whose objectives are to lodge stable swarms of bees: bejeras (beehives), acclimatization cells or ventureros, wells and huts seek their accommodation in the territory, opening to the most favourable orientation. Its constructive characteristics are linked to the materials provided by the territory and traditional techniques, almost disappeared.
Nowadays, although beekeeping activity has almost disappeared in Larraga, but these vestiges have a great ethnographic and cultural interest. They constitute an element of identity of Larraga population, and they are a referent of an economy linked to the territory and its sustainability over time. Aware of the importance of its conservation, the City Council has begun a series of actions with the aim of preserving this rich and unique heritage, spreading it and making it known. This article exposes the conclusions of the work carried out so far for the conservation and enhancement of this heritage, as well as its future challenges.

CODE 257

ANALYSIS OF THE CHROMATIC IMAGE OF THE COMPOUND OF 127 HISTORICAL BUILDINGS IN CALLE DIDOUCHE MOURAD IN SKIKDA (ARGELIA)

Bosch, Montserrat[1]*; Marin, Oriol[1]; García, Nuria[1]; Navarro, Antonia[1]; Rosell, Joan Ramon[1]

1: UniversitatPolitècnica de Catalunya.
e-mail: montserrat.bosch@upc.edu, web: http:www.epseb.upc.edu
e-mail:oriol.marin@upc.edu; nuria.garcia.soto@upc.edu; antonia.navarro@upc.edu; joan.ramon.rosell@upc.edu

KEYWORDS: Town; historical centre; chromatic analysis; historical study; Mediterranean.

ABSTRACT

The towns in the Mediterranean basin show a past that may be red through their urban patterns and the surviving buildings. Those towns with a long history are converted into a palimpsest, on which different epochs superimpose and several buildings replace the obsolete ones, while others evolve and go under rehabilitations and great transformations in order to answer to new necessities.
This logic transformation of the town sometimes involves the loss of its heritage values, even more when occur historical events that contribute to modify the features of buildings due to cultural or identity reasons, due to the changes in the Government, to religious principles and to the imposition of new aesthetic styles. The façades of historical buildings are the most suffering parts and sometimes those that better reflect these incidents, which turn them into interesting documents for the analysis and the research.
The town of Skikda is located in the Mediterranean cost of Argelia and is a good example of a town with a more than 2'000 years long past, which has suffered different transformations until its consolidation as a port town with an intense social activity. The main artery in Skikda is the present Rua Didouche Mourad that cross the town from North to South on the path of the ancient road from Philippeville to Constantine.
The aim of this presentation is to show a studying methodology, starting from a multidisciplinary analysis of the historical compound of buildings that form the present Rua Didouche Mourad, to document scientifically the processes of transformation of this road and to elaborate hypothesis on its chromatic heritage. All the information was put at disposal of the local Administration and of the professionals charged to promote an intervention on Skikda's architectural heritage.

CODE 263

CONSERVATION OF THE BUILT HERITAGE: THE RECOVERY OF THE HISTORIC CENTERS OF THE CILENTO AND VALLO DI DIANO

Di Ruocco, Giacomo[1]*; Sicignano, Enrico[2]; Petti, Luigi[3]; Primicerio, Francesca[4]; Naddeo, Lucilla[5]

1: University of Salerno, Department of Civil Engineering
e-mail: gdiruocco@unisa.it, web: http://docenti.unisa.it/020080/home
2: University of Salerno, Department of Civil Engineering
e-mail: e.sicignano@unisa.it, web: http://docenti.unisa.it/001631/home
3: University of Salerno, Department of Civil Engineering
e-mail: petti@unisa.it, web: http://docenti.unisa.it/004657/home
4: University of Salerno, Department of Civil Engineering
e-mail: fprimicerio@unisa.it,
5: University of Salerno, Department of Civil Engineering
e-mail: molu-@hotmail.it,

KEYWORDS: Recovery; historical centres; sustainability; integrated conservation; urban regeneration; ecotourism; biodiversity.

ABSTRACT

In the Second World War, Italy was affected by a phenomenon of industrialization that influenced the development of many urban systems distributed predominantly in the major industrial poles and along the coastal areas of the Peninsula. Territories not affected by this process, the so-called "Internal Areas", have been progressively abandoned, a phenomenon that is still in progress, with a consequent strong economic downturn and a sharp reduction in the supply of essential services.
A recent analysis has shown that urban centers, predominantly smaller centers, included in these internal areas:
- they involve high social costs for the state they pay for the production and consumption processes currently in place. Among the most important issues are hydrogeological disruption, loss of biological diversity, degradation of human landscapes and loss of traditional knowledge;
- have little access to essential services such as health, education, mobility and virtual connectivity (Internet access), services that today in Europe identify the right of citizenship;
- they have enormous potential for economic development for the huge unused land capital (agroforestry systems, building capital, traditional knowledge).
In a broad sense, research seeks to identify a strategic approach aimed at the recovery and upgrading of smaller historical centers, including in the interior areas of Cilento and Vallo di Diano, in the province of Salerno. This approach moves from the need to identify the criticalities to be faced (lack of functions, equipment and services, hydrogeological vulnerability, seismic, etc.) and resources to be re-valued, namely the peculiarities of the material nature (environmental, geomorphological, typological, constructive) and intangible (local uses and traditions, enograstronomic, cultural, tourist potential, etc.). Specifically, in this contribution, the analytical approach to a case study is presented: the municipality of Ceraso, included in the "Cilento Interno" area. The approach concerned in particular the technological characterization of recurring building typologies, typical of the local construction tradition, with particular reference to the lithological characteristics and the seismic vulnerability of recurrent masonry.

CODE 271

RURAL ARCHITECTURE BETWEEN HISTORY, PRESERVATION AND REUSE. THE VILLAGE AND THE SILOS OF PIANO DEL COLLE IN BASILICATA

Guida, Antonella[1]*; Mecca, Ippolita[2]

1: University of Basilicata, Department of European and Mediterranean Cultures
e-mail: antonella.giuda@unibas.it, web: http:www.unibas.it
2: University of Basilicata, Department of European and Mediterranean Cultures
e-mail: imstudio@live.com, web: http:www.unibas.it

KEYWORDS: Knowledge; preservation; recovery; reuse; sustainability.

ABSTRACT

The rural landscape of Basilicata (South Italy) is characterized by the presence of widespread villages and architecture in where activities, crafts and manifestations of material, economic, social and spiritual life took place; to testify a "minor" cultural heritage. Residential architectures in these villages, largely abandoned, with the changing of social and working conditions have suffered marked transformations from the functional and distributive point of view, and if on the one hand, these conditions have changed the way in the other hand they have preserved them. Instead, the architectures, closely linked to productive activities (Silos, stables, ovens ...), once lost their original function, are in a state of degradation and desertion.
Same matter was touched to the village of Piano del Conte, built between 1920 and 1925 as a modern zootechnics and agricultural company and as a service center for peasant families, located in the nearby area; this village, in the 60s and 70s, was first depopulated and later suffered the transformation of its buildings.
The principle of research is the story of rural architectural heritage, the history of a community, which constitutes the memory of the site, identifies the local community and the territory and therefore its recovery and development are fundamental to preserving its identity and to set up new growth models.
Starting from a real case, the research provides cognitive supports of the complex and precious heritage of rural construction and directs the reuse and building renovation towards the problem of "reuse" and suitable destinations with the architectural, constructive artifacts features of buildings and with their surrounding landscaped.
The aim is to provide a methodology that, moving from technical discipline, proposes a concept of Rural Architectural Heritage recovery as knowledge, preservation, fruition and promotion, where maintenance works have to use design strategies and environmental technologies, to sustainability and material process.

CODE 336

PUBLIC BUILDINGS IN 19TH CENTURY ADANA PROVINCE

Umar, Nur[1]; Can, Cengiz[2]

1: Yıldız Technical University, Architecture Faculty, Restoration Department
e-mail: nur.umar@gmail.com
2: Yıldız Technical University, Architecture Faculty, Restoration Department

KEYWORDS: Adana; 19th century; public buildings; preservation.

ABSTRACT

This study is a summary of the ongoing doctoral thesis in Yildiz Technical University which aims to make an inventory of public buildings dated back to 19th century in the city of Adana-Turkey, document their current situation, evaluate their reuse and propose preservation approaches for them.
In the mid-19th century Ottoman State, there had been reforms in fields of law, military, finance, education and manufacture. As a result, the government redesigned the buildings of administration, education, medicine, transportation, manufacture. Unprecedented building types in the Ottoman style have emerged ensuring the integration of the western culture, instead of the Empire's dominant Classical Architectural style. Among these are the following building types; barracks, schools, government offices, prisons, post offices, hospitals, factories, railway stations, customhouses.
In 1860's, Egypt, India and Turkey was meeting the cotton demand of the world due to the outbreak of the American Civil War. The Cukurova Region including the city of Adana has gained global significance based on the amount of cotton production.
Adana, the largest city of the region turned out to be very prominent for the Ottoman State due to the increasing significance of Cukurova Region. As of this date, many investments and new public buildings have been constructed in the Adana city by the central government. In 1923, after the establishment of the current Republic, the names of some of these buildings were changed while the functions remained the same. Today, some building types have disappeared while others still exist. In this paper, inventory of the surviving buildings, their current status and actual functions will be evaluated and main preservation approaches will be proposed. Prime Ministry Ottoman Archive documents, annuals, national documentary archives, written materials on regions and settlements with map archives have been utilized during the research period.

CODE 363

THE CONSTRUCTION OF THE TRANSHUMANCE TERRITORY OF THE GERÊS-XURÉS: VERNACULAR HERITAGE IDENTIFICATION, ANALYSIS AND CHARACTERIZATION

Barroso, Carlos E.[1]; Barros, Fernando C.[2]; Riveiro, Belén[3], Oliveira, Daniel V.[4]; Ramos, Luís F.[5]; Lourenço, Paulo B.[6]; Vale, Clara Pimenta do[7]

1,4,5, 6: ISISE, University of Minho, School of Engineering
e-mail: arq.carlosbarroso@gmail.com, web: http://www.isise.net
e-mail: danvco@civil.uminho.pt, web: http://www.isise.net
e-mail: lramos@civil.uminho.pt, web: http://www.isise.net
2, 7: University of Porto, Faculty of Architecture
e-mail: fbarros@arq.up.pt, web: http://www.fa.up.pt
e-mail: clara_vale@arq.up.pt, web: http://www.fa.up.pt
3: University of Vigo, School of Mining Engineering
e-mail: belenriveiro@uvigo.es, web: http://webs.uvigo.es/geotech

KEYWORDS: Vernacular heritage; architecture; corbelled domes; granite; laser scanning.

ABSTRACT

In order to ensure survival, the rural populations of the Gerês-Xurés mountain range transboundary region developed, over centuries, a very specific system of vertical transhumance. Focus on making the most out of their natural landscape harsh conditions, human intervention shaped the territory, and gave birth to the existent and very authentic vernacular heritage, that has in the corbelled dome building technologies one of its most characteristic identity features.
In the pursuit of fertile land, villages were scattered in small and compact settlements, built at lower altitude and occupied all year long. The surrounding mountain's slopes were turned into farming terraces, and the high-altitude plateaus were for livestock and farming, thru temporary settlements built in corbelled dome structures. These vital points were interconnect by a dense network of paths and masonry walls. Although the resemblance between most of the region permanent settlements, the temporary nuclei, due to each mountain particular features, show a large morphological and functional diversity, from complex structures, like the *"brandas"* or the *"brandas e inverneiras"* system, to very simple pasture areas, like the *"currais"*. Understanding the high potential of this endanger vernacular heritage is a key point for its preservation, as well as its recognition by the scientific community and society in general. A previous study aimed at the *"brandas"* morphological and constructive characterization was presented at the Rehabend 2016. This follow-up study is focus on, in a first level, the identification and characterization of the general system main features, and, in a second level, the evaluation of this vernacular heritage main preservation threats. The research, based on case studies analysed thru fieldwork surveys, geometrical and constructive, and literature support, allowed to identify the main morphological and typological features related to the heritage elements that take part in this occupation system, and are discussed in this paper.

CODE 377

INQUIRY ON A CULTURAL LANDSCAPE. THE ARCHITECTURE OF TOBACCO DRYING IN THE CONFIGURATION OF THE TERRITORY

García Nofuentes, Juan Francisco[1]; Martínez Ramos e Iruela, Roser (corresponding)[2]; Herrera Cardenete, Emilio[3]; Martín Martín, Adelaida[4]

1: Departamento de Expresión Gráfica Arquitectónica y en la Ingeniería. Universidad de Granada.
e-mail: jnofuentes@ugr.es
2: Departamento de Construcciones Arquitectónicas. Universidad de Granada
e-mail: rosermartinez@ugr.es
3: Departamento de Construcciones Arquitectónicas. Universidad de Granada
e-mail: emilioh@ugr.es
4: Departamento de Construcciones Arquitectónicas. Universidad de Granada.
e-mail: adelaida@ugr.es

KEYWORDS: Cultural landscape; Vega de Granada; Tobacco curing houses; Industrial tobacco landscape.

ABSTRACT

The knowledge of the territory, implies the historical need of establishing a regulation that avoids both the dispersion of knowledge, and the adoption of radical postures during the its cognitive procedure. The realization of knowledge for the description and definition of a territorial system, has traditionally confronted the geographers and all the professionals involved in the study of the «place». The inquiry on this one, must be a scientific and non-artistic activity, so it should adopt the means to rigorously dominate the data obtained, defining the purpose in the selection and setting the research method, without curtailing a possible original interpretation, whenever it does not imply a deviation which contradicts the objective pursued.
In this context, human influence on the construction or the destruction of landscape is very difficult to delimit, since there is no established and unanimous recognized value system. This is the case of the «Vega de Granada», which does not recognize specific and systematic references for its delimitation. In this study and under the prism of the geographical knowledge formulated by Sauer, it is intended to establish the guidelines that define this region as a place which hosts a model of "cultural landscape", from the architectural identity of the singular industrial heritage inherited of «tobacco curing houses».

CODE 381

PHENOMENA OF TRANSORMATION OF THE HISTORICAL BUILDING BOX IN RURAL SARDINIA

Aru, Federico[1]

1: Università degli Studi di Cagliari
e-mail: aru.federico@gmail.co

KEYWORDS: Rural anthropization; rural landscape; transformation; tradition.

ABSTRACT

The last decades have seen the transformation of the relationship between necessity and form in the construction of the rural inhabited space. Economic and social transformations, technical and technological pluralities have altered this relationship, modifying the identities of places. If in line with tradition, this correlation can be interpreted as an equation, in which specific structures of anthropization were the result of specific needs of places, nowadays it is possible to read this relationship as an inequality where form dominates necessity, becoming autonomous. Inside the Sardinian rural village, the building box can be interpreted as a symptomatic element in which tradition has established its long-lasting characters and that today endures a deep transformation process, altering the consolidated historical meanings. Through an analysis of the transformation phenomena of the houses - particularly through the themes of contact and separation - the paper investigates on which components regulate the new relationship between necessity and form in the villages of rural Sardinia.

CODE 446

FROM ENGLAND TO THE URBAN STRUCTURE OF THE CITY OF A THOUSAND AND ONE COLUMN, AMBALEMA - TOLIMA

Espinosa Pasaje, Juan Carlos[1]*

1: Universidad de Ibagué.
e-mail: juan.espinosa@unibague.edu.co
web: https://www.unibague.edu.co/

KEYWORDS: Cultural Heritage; historic center AMBALEMA; urban structure.

ABSTRACT

This article will develop related issues with the presence of British people in the town of Ambalema, known as the city of the thousand and one columns, and the consequences of such permanence in the buildings that make up the cultural heritage in this city. Such information is part of the partial results of the research "Analysis and diagnosis of the current status of the Historical Center of Ambalema", which established the temporary line space of relevant facts and a physical-spatial inventory of 150 properties was made. This contribution is intended to demonstrate that four of the buildings (the tobacco factory, the English house, the tobacco factory ,"La Patria" and the Casona) that make up the "Campoalegre" sector, within the Historical Center of Ambalema, is the result of economic interests in an era of strategic relations between Colombia and England. Through a process of review and documentary analysis about the time of economic splendor of the Municipality, which coincides with the exploitation of tobacco, all the important social relationships made between England and Colombia can be understood in the XVIII century, and that led to the urban configuration. The main outcome of this article is that the Campoalegre sector in Ambalema does not belong to the colonial period, as it is currently known, but their urban configuration, in its beginnings, is a mixture between British and local features. In the future, such a consideration would be useful to rename the singular style of the Ambalema's historic heritage, from which can be concluded that the present sighting is a hybrid between the English and the Colombian culture.

CODE 454

WHEN AGRICULTURE RULES OVER THE TERRITORY: DRYSTONE WALLS

Gonçalves, Marta Marçal[1]*; Pérez Cano, María Teresa[2]; Rosendahl, Stefan[3]; Prates, Gonçalo[4]

1: Universidade do Algarve, Instituto Superior de Engenharia.
e-mail: mgoncal@ualg.pt, web: www.ualg.pt
2: Universidad de Sevilla, Escuela Técnica Superior de Arquitectura.
e-mail: tpcano@us.es, web: www.us.es
3: Universidade Lusófona de Humanidades e Tecnologias, ECATI.
e-mail: srosendahl56@gmail.com
4: e-mail: gprates@ualg.pt, web: www.ualg.pt

KEYWORDS: Drystone walls; territory; heritage; Cernache do Bonjardim.

ABSTRACT

The objectives of this paper are mainly the dissemination of knowledge about drystone walls, a "minor heritage", and the awareness of its importance in the territory characterization. These objectives are achieved when this theme is disclosed and explained. Heritage is protected and appreciated only if it is understood.
The expected practical impact is essentially related to the recognition of this type of heritage.
The main methodology consists of bibliographical and iconography collection, field surveys and exchange of ideas with the local people.
The approach is made from the point of view of how the practiced agriculture characterizes the territory, not only its structure, but is also necessary to know the local typologies of drystone walls to allow characterizing them.
Characteristics of drystone walls were discovered in this investigation, directly related to the territory where they are inserted.
The following limitations were found: the gradual replacement of drystone walls with masonry walls; changes in the type of agriculture; the difficulty of finding masters who have the know-how about drystone walls; the recognition of this heritage by the local population; and the gradual local population diminution.
Practical implications are an improved sense of belonging and identity as the knowledge and appreciation of this heritage increases the pride of the population. This was verified in the field surveys.
The originality of this paper is the object of study, the Parish of Cernache do Bonjardim, Portugal, since there are very few works about it, also with added value to dissemination of this type of heritage and its potential exploitation and protection by local population. It is possible to renew these walls' territory and use it for touristic, educational and cultural purposes, encouraging the local economy.

CODE 455

THE RECONFIGURATION OF THE WORLD HERITAGE CONSERVATION – BELEM (BRAZIL) AND OBSERVATIONS ABOUT COIMBRA (PORTUGAL)

Rodrigues Alves, Manoel[1]; Fonseca de Almeida, Maisa[2]

1: Instituto de Arquitetura e Urbanismo.
Universidade de São Paulo.
e-mail: mra@sc.usp.br, web: http://www.iau.usp.br
2: Instituto de Arquitetura e Urbanismo. Universidade de São Paulo.
Universidade de Araraquara.
e-mail: maisafonseca@usp.br, web: http://www.iau.usp.br

KEYWORDS: Urban space production; contemporary city; urban heritage; urban space patrimonialization processes; heritage and urban landscape.

ABSTRACT

Concerning the contemporary city urban space production process, mainly the culturalization of patrimonialization processes of historical ensembles and urban interventions, this research identifies a cultural process of resignification of the identity sense of the place and the site, because of this process, there is a deconstitution of the original cultural meaning characterized by the reduction of its symbolic values and the disarticulation of its urban context. This process, characterized by a culture mercantilization policies determined by the neoliberal urbanism logic of (re) production of the urban space, determines a distinct creation of territory and landscape process, we observe: the traditional urban fabrics context and identity dissolution; a low social participation of the local community in the decision making, against to some of the international patrimonial charts that seek to assist in the preservation of the socio-cultural aspects of the place. In this context, we realize that is necessary to observe and consider about urban interventions and the notion of heritage conservation (as heritage, history and memory elements of the city), this research allow us to question the conditions and singularities of patrimonialization processes that, on the one hand lead to the creation of simplified spaces of meaning and, on the other hand, the creation based on a thematized landscape from the reproduction of a history image. Therefore, it analyzes two recent processes of patrimonialization in urban buildings, one classified and the other still candidate for world heritage by UNESCO: University of Coimbra (Portugal) and Ver-o-Peso (Brazil), concentrating on the analysis of the Brazilian case. It is argued that both proposals, in greater or lesser dimension, promote the deconstruction of the meaning of urban fabrics as the resignification of their urban identity, thereby the city, and its landscape, urban and cultural elements, are renewed in an ennobled sense, thematized and disarticulated from its spatial and socio-cultural context.

CODE 464

REAPPRAISAL OF THE COLONIAL HOUSING IN LAMBAYEQUE: CONTRIBUTIONS FOR THE CURRENT ARCHITECTURE

Chirinos, Haydeé[1]*; Zárate, Eduardo[2]*

1: Universidad Nacional Pedro Ruiz Gallo. Lambayeque. Perú.
e-mail: haydeechc@yahoo.com
2: Universidad Nacional Pedro Ruiz Gallo. Lambayeque. Perú.
e-mail: ezaratea@gmail.com

KEYWORDS: Reappraisal; colonial housing; sustainable design.

ABSTRACT

This research is focused mainly on the study and the reappraisal of the cultural built heritage from a practical approach that contributes to the current architecture proposals. Its objective is the formulation of guidelines for the architectural design of sustainable housing in the Lambayecan coast, located in the north of Peru, based on the identification and revaluation of the concepts and criteria of environmental and constructive solutions that the architecture that was edified in the vice regal period in the place, has. To do this, the characterization of a selected sample of buildings was carried out, and through this analysis, the contributions proposed as design guidelines were determined. The results allow to conclude that these guidelines for housing design are focused on prioritizing the assessment of the climatic environment to properly implement the building, also considering recommendations for the specific design of various components, such as courtyards and fenestrations, which, together with the materials, are the aspects solved with skills and ability.
Finally, it is important to point out that this study contributes to the reappraisal of the cultural built heritage through its knowledge and analysis with simulation technologies, as well as helps to find solutions for the design problem, which currently have the existing housing in the place.

CODE 94

INFLUENCE OF ADMINISTRATION IN REHABILITATION IN THE OLD TOWN

Valverde Lorenzo, Luis Ramón[1]*; Díaz Sánchez, Marcos Antonio[2]

1: Doctor Arquitecto por la Universidad Politécnica de Madrid. Escuela Técnica Superior de Arquitectura
e-mail: luisvalverdearquitecto@gmail.com,
2: Doctor Arquitecto por laUniversidad de Extremadura, Escuela Politécnica.
e-mail: 927222732@telefonica.net,

KEYWORDS: Rehabilitation; administration; old town.

ABSTRACT

Plasencia, an eight-hundred-year-old city, situated in Cáceres province, is a monumental old town, wich is in a process of depopulation, the intervention of the Local Administration is very important to avoid its degradation.
With eight real rehabilitations of buildings of the Town, the work carried out by the Public Administration in each one of the interventions is analyzed, researching in every case the factors susceptible of improvement for later interventions.
The Administration has at the moment a great opportunity for its action to change the abandonment process such a significant part of its population, on the one hand as a regulator of the activity of rehabilitation and on the other hand as developer of the interventions in unique buildings of great importance within the city.
Of the interventions shown the following aspects are appreciated:
.- There are different interpretations of the rules of PERI according to the Municipality
.- The aggregation of plots prevents the programs of uses according to current legislation.
.- The fulfillment of the Rules prevents to maintain rationalist architectures.
.- The terms of administrative procedures discourage action.
.- There is no specific use prior to the rehabilitation of the property
.- Unpractical uses are posed before the investment and public function
.- Public spaces do not resurrect if the buildings that comprise it are dead
.- There are very different interpretations of the urban landscape in history.

CODE 182

INDICATORS FOR URBAN REGENERATION, A VISION FROM CLIMATE CHANGE ADAPTATION

García Sánchez, Francisco J.[1]; Ribalaygua Batalla, Cecilia[2]

1: EDUC, Doctoral School. Programa de Doctorado en Patrimonio Arquitectónico, Civil, Urbanístico y Rehabilitación de Construcciones Existentes
University of Cantabria / Universidad de Cantabria
e-mail: francisco-jose.garciasa@alumnos.unican.com, 15492garcia@coam.es web: http://www.unican.es
2: Department of Geography, Urban and Spatial Planning
University of Cantabria / Universidad de Cantabria
e-mail: cecilia.ribalaygua@unican.es, web: http://www.unican.es

KEYWORDS: Climate change adaptation; urban planning; indicators; monitoring and evaluation; sustainability.

ABSTRACT

Climate change impact will be particularly strong on historic centres of cities, where urban planning is a decisive tool for managing this phenomenon, ensuring the integration of sustainability criteria with mitigation and adaptation measures. There is considerable experience in introducing sustainability and mitigation indicators in urban planning, but there is a knowledge gap about the way adaptation parameters are incorporated. Adaptation is an iterative process that calls for close monitoring and regulation review in order to ensure its effectiveness. The variability in the climatic effects in the long term requires an increment in adaptation measures that are only controllable through adequate management of their evaluation. The definition of indicators could increase the resilience capacity in cities. If there are parameters in the planning process about green areas and public facilities, why not define specific adaptation parameters in urban planning?
The increase in risk due to new extreme events implies that those adaptation strategies that have been reflected in scientific literature for many years must now be incorporated in terms of urban planning legislation. In this context, a separation has been produced in the definition of those urban projects related to sustainable environment and those that are specific to strategies of mitigation and adaptation on historic centres. This work reviews the recent experience incorporating indicators and parameters in urban planning as adaptation policies in order to contribute to their integration in city planning, based on previous knowledge. The application of these indicators in different case studies allows us to verify how the sustainability parameters are valid when applying adaptation strategies.

CODE 244

ANALYSIS OF THE EFFECT OF 1755 EARTHQUAKE ON ALENTEJO REGION, PORTUGAL. LESSONS FOR PRESENT URBAN REGENERATION

Tavares, Alice[1]; Costa, Aníbal[2]

1: Universidade de Aveiro, RISCO, Departamento de Engenharia Civil.
e-mail: tavares.c.alice@ua.pt,
web: https://www.ua.pt/risco
2: e-mail: agc@ua.pt

KEYWORDS: 1755 Lisbon earthquake; urban regeneration; urban seismic resilience; Mercalli scale.

ABSTRACT

The analysis of documents and records from the post-earthquake period of 1755 in Lisbon, one of the largest seismic events in Europe, is still a very relevant source of data to better understand the effect of large seismic events and to support decisions at the level of urban management and territory. The present investigation analyzed more than 106 reports of 1756 and 1758 for the Alentejo region. The mapping of intensities according to the modified Mercalli Scale produced by the present investigation for the Alentejo region, with preponderance over the border areas of the Alto Alentejo, shows that there were areas of greater damage in 15 municipalities and reveal differences in relation to the Mapping of Isosssites of Portugal in the specific region and therefore should be areas with specific measures for seismic resilience. The study presents the main damages, in the most mentioned typologies of Churches, houses, walls, castles and convents. From the analysis of the data, it was concluded that the highest buildings (churches, walls, castles and convents) were the ones most affected by the earthquake of 1755 in the Alentejo, with special emphasis on the protruding volumes of the buildings. Therefore, the evaluation weighting of the building with these characteristics or with greater height or volumetric irregularity must be implemented. Special measures to improve the connections of singular elements to the building is a preventive action to be implemented. Measures to support the maintenance, conservation and rehabilitation of the old or pre-1980 building should be promoted, since one of the conclusions is that, regardless of the construction system, the good state of conservation of the buildings is crucial for a better performance in case of earthquake These measures should take into account the characteristics of the building, the social engagement and be included in the Areas of Urban Rehabilitation (ARU's).

CODE 269

PROPOSALS FOR THE RENEWAL OF THE INDUSTRIAL AREA INSIDE THE ANCIENT WALLS OF PORTOBUFFOLÈ, ITALY

Pietrogrande, Enrico[1]; Dalla Caneva, Alessandro

1: Dipartimento di Ingegneria Civile, Edile, Ambientale
Università di Padova
e-mail: enrico.pietrogrande@unipd.it, web: www.dicea.unipd.it
e-mail: alessandro.dallacaneva@dicea.unipd.it, www.dicea.unipd.it

KEYWORDS: Urban regeneration; urban analysis; memory; identity; public space.

ABSTRACT

Portobuffolé is a small, historic town in the Veneto region that is surrounded by the lush green countryside of north-eastern Italy. The paper concerns an area situated on the edge of the town, which adjoins the main piazza on one side and overlooks the rich vegetation outside the inhabited area on the other. A large factory is located in this area whose type, purpose and physical presence dramatically clashes with the town's characteristic urban fabric that dates back to the period between the Middle Ages and the eighteenth century. The factory was closed some time ago, further emphasising the urgent need to reconsider the area, with a view to making it more suitable for the context. It could serve as a bridge between the town and its surrounding nature, or it could restore the barrier previously formed by city walls that were demolished to make space for the factory. The paper refers to the municipality's considerations on the subject, and the impact it could have on the town's revitalisation. At present, the town is rarely visited by tourists and this is partly due to its decentralised position. The establishment of a new centre of attraction aimed at both residents and tourists could help address this issue. The paper includes the results of students' workshops developed in the framework of the courses on "Architectural and Urban Composition 2" taught on the master's degree in Architectural Engineering at the Department of Civil, Environmental and Architectural Engineering of the University of Padua, academic years 2015-16. The industrial area inside the walls is an opportunity to redesign the lost unity of this historic part of the town. Progressing from the study of how the area has evolved through time, students had to define new proposals for the area that involved testing new building types.

CODE 311

THE CAPIXABA AVENUE AS VECTOR OF TERRITORIAL STRUCTURATION

Pimentel, Viviane[1]*; Nogueira, Mauro[2]

1: FAESA/ES; PROARQ/UFRJ
pimentelvix@gmail.com
2: DPA/FAU/UFRJ
nogueira@studiomnn.com.br

KEYWORDS: Structural shafts, Downtown Vitoria/ES-Brasil, Capixaba Avenue, Jerônimo Monteiro Avenue.

ABSTRACT

This article proposes a reflection on the implementation of the Capixaba Avenue as a structuring element of the urban fabric in the historical center of Vitoria-ES/Brazil. At the beginning of the twentieth century, the modernization of the central areas translated the modernist spirit into Brazil. Under the influence of the urban reforms promoted by Haussmann in Paris, an inclusion of major avenues was a main option to reorder a road network and to restructure urban areas with still colonial characteristics. In Rio de Janeiro of Pereira Passos, the Central Avenue was configured as the structuring axis of the republican city after a significant part of the pre-existing urban fabric was destroyed. In Vitória-ES, Florentino Avidos continued with the reforms initiated by its predecessors, completing the opening of Avenida Capixaba in landfill areas on the sea. The opening of Avenida Capixaba, currently Jerônimo Monteiro Avenue, reached modernity's dream and provided the territorial growth for the areas northeast of the capital, in the region of beaches until then practically unoccupied. This paper intends to analyze the role played by the Capixaba Avenue as a vector of urban expansion in Vitoria, capital of the state of Espírito Santo. The methodology adopted consists of bibliographic and documentary research in primary sources, more specifically information contained in Government Reports, iconographic research in books and websites, comparative analysis with the opening process of Avenida Central, in Rio de Janeiro. As a result, it's possible to note that the opening of Avenida Capixaba is based on speeches and arguments that highlight the importance of the avenue as a vector to structure a territorial space.

CODE 420

FOR AN INTERVENTION MODEL IN HERITAGE - TWO CASE STUDIES

Feio, Olga[1]*; Álvares, Manuela[2]

1: DomusSocial, E. M.
e-mail: olfeio@domussocial.pt
2: DomusSocial, E. M.
e-mail: Manuela.alvares@domussocial.pt

KEYWORDS: Social regeneration; housing policies; public housing; heritage; rehabilitation.

ABSTRACT

DomusSocial is promoting urban and housing rehabilitation in the Historic Center of the city of Porto. The process began with some assets belonging to the former Comissariado para a Reabilitação Urbana da Área de Ribeira/Barredo (CRUARB) and the extinct Fundação para o Desenvolvimento da Zona Histórica do Porto (FDZHP), in an attempt to extend the spectrum of public housing policies regarding leasing programs on a supported income basis.
In a first phase, 17 buildings will be the subject of intervention giving rise to 11 different operations. These buildings were built between the XVIIIth and the beginning of the XXth century and have morpho-typological characteristics that we identify as the typical "Bourgeois House".
Two projects will be analyzed representing different realities due to their original condition: intervention in an isolated building and a joint intervention in a set of contiguous buildings.
It is intended through a comparative study of the operations in question to establish intervention parameters that will allow the definition of an intervention strategy for public housing heritage.

CODE 422

ARCHITECTURE AND THE DEVELOPMENT OF DOWNGRADED URBAN AREAS

Maria J., Żychowska[1]; Andrzej, Bialkiewicz[2]

1: Cracow University of Technology, Faculty of Architecture,
e-mail: pazychow@cyf-kr.edu.pl, web: http://www.pk.edu.pl
2: Cracow University of Technology, Faculty of Architecture,
e-mail: abialkiewicz@pk.edu.pl, web: http://www.pk.edu.pl

KEYWORDS: Architecture; function; museum; distinguishing; surroundings.

ABSTRACT

Architecture surrounds us daily. We notice low-rise buildings and high-rise buildings, big and small edifices but we hardly ever notice their design or beauty, not to mention their surroundings, the urban interior where they are situated. This also applies to contemporary architecture. The paper suggests focusing on objects that function as museums, especially modern art museums which become characteristic features in urban space and to which urban systems are subordinated, e.g. Frank Ghery's Bilbao centre.
This function has become important and distinct over the last two centuries. That is why it is placed in objects whose architecture is special: sometimes extravagant and often monumental in scale but always significant on an urban scale. It is because architecture is not only a costume or a shell enclosing any odd interior. It forms an integral part of the urban context which is an important pretext for making it happen. It is also a composition of volumes, their forms, functions, light, the idea contained within the entire object, and first of all, its subjective perception analysed in terms of directing public attention to particular objects with a view to making them distinct.
The paper presents an analysis of some examples of European museums of modern art – including some Polish ones – as significant architecture which is a key component on the scale of a city or its fragment. The aim is to stress the importance of the activities of local authorities and architects and the decisions they make for the development of downgraded urban areas.

CODE 440

PROPOSAL FOR THE RECOVERY OF THE SURROUNDINGS OF ZIRI WALL OF THE ALCAZABA IN ALBAYCIN GRANADA

Vallecillo Zorrilla, Ángel[1]; Vallecillo Capilla, Ángel[2*]; Serrano Garrido, Noemí[3]; Rodríguez Jerónimo, Gracia[4]

1: Investigador de la Universidad de Granada, Escuela Técnica Superior de Arquitectura.
e-mail: avallecillo@correo.ugr.es
2: Universidad de Granada, Departamento de Mecánica de Estructuras
e-mail: avc@ugr.es
3: Universidad de Granada.
e-mail: noemiserranogarrido@gmail.com
4: Universidad de Granada, Departamento de Mecánica de Estructuras.
e-mail: grodjer@ugr.es

KEYWORDS: Heritage; restoration; urban regeneration; urban vacuum; interventions close to BIC.

ABSTRACT

Albaicín is an important neighbourhood with a medieval origin and constitutes an emblematic location in Granada. It is located at the bottom of Cerro de San Miguel and built under the protection of the Alcazaba. It holds lots of significant places in its plan in which an empty urban area stands out from the rest. It is surrounded by the medieval wall of the old Alcazaba and the residential area of the neighbourhood between Puerta de Monaita and Arco de las Pesas.
It is a space without life that it is isolated from the city. This unused enclosure holds archaeological remains and an uncontrolled garden in which big trees, bushes and invasive species coexist. In addition, it is recognized for its high historic and landscape value thanks to the existence of the Almohade medieval wall (s.XII) and its proximity to buildings with a high patrimonial interest. Moreover, from this vantage visitors can enjoy magnificent views of the landscape of the city of Granada.
The aim of this proposal is to restore the place as a public garden, taking care of its initial patrimonial and landscape value. This is achievable by means of the integration of the garden in the urban planning through the connection with adjacent ways and the creation of internal routes to develop a relation between this area and other gardens and buildings included in the architectural heritage of the city. This work is focused on two more objectives. The first one is the elimination of recent constructions that turned into invasive for this area, taking advantage of the proximity with the garden “Carmen de las Maravillas. The second one is the proposal of a new building in this place to mitigate the lack of equipment in the neighbourhood.

CODE 478

RESIDENTIAL MODELS AND ENERGY OBSOLESCENCE IN THE FIRST SOCIAL HOUSING PROGRAM IN SPAIN. OPPORTUNITIES

Ponce Ortiz de I., Mercedes[1]; Galán Marín, Carmen[2]; Roa Fernández, Jorge[3]; López Martínez, José A.[4]; Rivera Gómez, Carlos A.[5]

1: Escuela Técnica Superior de Arquitectura, Universidad de Sevilla, España.
e-mail: mponce@us.es , web: http:www.etsa.us.es
2: Escuela Técnica Superior de Arquitectura, Universidad de Sevilla, España.
e-mail: cgalan@us.es , web: http:www.etsa.us.es
3: Escuela Técnica Superior de Arquitectura, Universidad de Sevilla, España.
e-mail: jro@us.es , web: http:www.etsa.us.es
4: Escuela Técnica Superior de Arquitectura, Universidad de Sevilla, España.
e-mail: jalopez@us.es , web: http:www.etsa.us.es
5: Escuela Técnica Superior de Arquitectura, Universidad de Sevilla, España.
e-mail: crivera@us.es , web: http:www.etsa.us.es

KEYWORDS: Housing; XX century construction; urban vulnerability; energy rehabilitation; energy efficiency criteria.

ABSTRACT

The second half of the twentieth century in Spain required a quick a response to the deficit of dwellings after the period of autarchy during Franco's dictatorship. This response was possible thanks to a large-scale approach to massive housing construction. This model required the definition of some minimums and put the focus in low-cost physical constructions and important payment facilities given to the purchasers.
In this context, the construction solutions provided are elementary, if not deficient, not contemplating the singularities of every project according to location, orientation, urban planning, or local resource possibilities for its execution. In this framework of the mid-twentieth century, the construction companies were nevertheless able to respond with some immediacy to the demand for housing in the terms established by the Ministry of Housing.
Some of the developments erected followed the new tendencies of the modern movement and today they are of cultural interest, with identification of levels of protection for their architectural intervention.
The resulting dwellings today present serious problems in terms of comfort conditions, habitability and energy efficiency, which demand urgent intervention.
In this work, we have identified the residential complexes built in Seville and a documentary review according the standards with which they were built, was done, in order to assess energy obsolescence and to establish energy rehabilitation criteria in accordance with current regulations.
The results obtained will allow the establishment of rehabilitation and energy efficiency criteria for this type of buildings, focused on the envelope, with a methodology that can be applied to other actions carried out in similar areas and adapted to the residential complexes built in Spain in the 1950s.

CODE 41

THE TECHNOLOGY APPLIED TO THE INSPECTION OF THE ARCHITECTURAL HERITAGE OF MACEIÓ COMMERCIAL CENTER - ALAGOAS

Calheiros, Karla Rachel Jarsen de Melo[1]; Farias, Daniel Gomes de Mello[2]

1: Arquiteta e Urbanista
Faculdade de Arquitetura e Urbanismo/Universidade Federal de Alagoas
e-mail: karlaarachel@hotmail.com, web: http://www.pagweb.com
2: Master's Degree in Computer Science
Federal University of Alagoas (UFAL), Brazil
LaCCAN (Laboratório de Computação Científica e Análise Numérica)
e-mail: danielmellofarias@gmail.com, web: http://www.pagweb.com

KEYWORDS: Architectural heritage, legislation, report.

ABSTRACT

This paper aims to investigate the publicity interventions in the architectural heritage located in state of Alagoas, the city Maceio, in the Preservation Sector (SPR-1), which has rules regarding the construction of the Special Preservation Zones (SPZs) established by Master Plan of Maceio in 2005. This research will investigate the possible failures of the Secretariat for Territorial Development and Environment (SEDET) regarding the supervision and enforcement of laws.
For development this work, the municipal legislation n. 4.545 / 1996 (General norms of protection to the patrimony or urban groups in which the SPZs is part), Law No. 3.538 / 1985 (Code of Postures of Maceio) and Municipal Law 4.954 of January 2000 were explored.
With the studies, it was observed the need to create a Cell Phone App, an instrument that could help society and the competent body to understand and care for the architectural of Maceio, how to encourage complaints, irregularities and possible failures of inspection of ads property located in the commercial Center of Maceio.

CODE 98

COST ESTIMATORS FOR RESTORATION WORKS. AN APPROACH TO THE INFLUENCE OF LOCALIZATION FACTORS

Díaz Sánchez, Marcos A.[1]; Valverde Lorenzo, Luis R.[2]; Rodríguez González, María A.[3]

1: Doctor arquitecto por la Universidad de Extremadura, Escuela Politécnica.
e-mail: 927222732@telefonica.net
2: Doctor arquitecto por la Universidad Politécnica de Madrid. Escuela Técnica Superior de Arquitectura.
e-mail: luisvalverdearquitecto@gmail.com
3: Doctora por la Universidad de Extremadura. Profesora titular Facultad de Ciencias.
e-mail: marodgon@unex.es

KEYWORDS: Buildings restorations cost; localization factor; budgetary deviation.

ABSTRACT

The financial crisis that is devastating Spain since 2008 has caused a relative increase in the renovation activity in comparison with the new building one. As a consequence, the public administrations have assembled financial measures in order to encourage the renovation sector since it is a dynamic factor for economy and employment. However, these measures lack effectiveness when the upwards deviations between the estimated cost of the works and the real one have been verified. This proves that the budget calculation methods which were relatively successful for new building, do not work as expected when applied to renovating an existing building.

This paper explores the factors that give rise to cost deviation in restoration projects, which is not only affected by the building-specific activities, but also by the great influence of the building's environment. This explains the lack of accuracy in the traditional budget calculation models when applied to renovation projects.

A thorough analysis of finished real restoration works of buildings in Caceres town has been carried out. The real budgets were known and they were made in a period of 10 years. This will allow the assessment of similarities and the detection of the different circumstances surrounding the works. These differences will explain the cost deviations in similar constructions works. As a result, we have achieved a mathematical model that reveals the influence of the different variables that clarify the final cost, and that arises as a powerful cost-control and initial budget deviation tool for restoration works.

CODE 140

POLICIES FOR ICONICITY AND THE SINGULAR BUILDINGS MERCHANDISING

Agudo Martínez, Andrés[2]; Vázquez Sánchez, Gloria[2]; Lucas Ruiz, Rafael[2]

1: TEP-951 ARHENE. Aprovechamiento de Residuos Industriales, de Construcción y/o Demolición para la Fabricación de Hormigón Estructural y No Estructural,
Dpto. Ingeniería Industrial e Ingeniería Civil. EPS Algeciras. Universidad de Cádiz.
e-mail: andresam@us.es
2: Universidad de Sevilla
e-mail: glovazsan@alum.us.es
3: TEP-172: Arquitectura: Diseño y Técnica (Arditec). Universidad de Sevilla.
e-mail: rlucas@us.es

KEYWORDS: Heritage; merchandise; singular buildings; costs.

ABSTRACT

In general the singular buildings, for his own nature, have to confront a superior Global Cost to those that we can consider to be ordinary or normal. The Global Cost (Cg), in agreement with the cost theory for Anticipation it will be composed by four addends: Cost of the area, honorary permission licenses and other previous costs (Cp), the Cost of investment or cost of construction of the building (Ci), the Cost of Operation which includes the maintenance, consumptions cleanliness and others relative to his useful life (Co), and finally the Cost of demolition and recycling of the building (Cr) up to returning the materials and the area, if necessary, to the original nature without any damage.
Our paper investigates on the Costs of Operation (Co) looking for formulae that allow to invert the process and therefore to transform them into positives, that is to say income. In general lines the income can be considered to be initially grouped in two big families: intangibles, by means of a politics of iconic buildings that turns the building into an image of guaranteeing and/or generating of income in the way of tourism or prestige and tangible, more immediate as the sale of tickets, products of merchandising, cinematographic concessions and image rights. Both strategies must be already contemplated in the functional program of the initial project and assumed by the social sectors and leaders of the affected environments.

CODE 179

METHODOLOGICAL EVALUATION FOR A PRE-FEASIBILITY ANALYSIS OF THE INTERVENTIONS OF RECOVERY AND UPGRADING OF THE BUILDINGS OF HISTORICAL CENTERS

D'Ambrosio, Roberta

Dipartimento di Ingegneria Civile
Università degli Studi di Salerno
e-mail: robertadambrosio@outlook.it

KEYWORDS: Retraining; conservation; reuse; evaluation; restoration.

ABSTRACT

Starting from a master's thesis in Building Engineering and Architecture on the Restoration of a disused building in the old town of Salerno, Palazzo San Massimo, it has been attempted to develop a methodological evaluation for a pre-feasibility analysis of the interventions of recovery and upgrading of the buildings of historical centers.
The restoration project, intended as a programming of interventions capable of preserving and transmitting an architectural good to future generations, seems to find in the "reuse" the key to solving the problems associated with the degradation of ancient monumental complexes and the social disadvantages typical of the ancients villages.
The difficulties encountered during the study, essentially related to the preliminary assessment of the costs of the recovery operation and, more generally, to the verification of the sustainability of the entire reuse project, have highlighted the impossibility of using a traditional approach based on estimation of the interventions. In fact, because of the degradation of the structure and the unavailability of funds for preliminary investigations, it was impossible to make timely surveys and analysis tools for which it was not possible to arrive at a reasonably acceptable estimate of the workings and thus of the intervention costs .
These difficulties have stimulated the setting up of a pre-assessment methodology of reuse projects based on an "ensamble" approach and some concepts derived from the quantitative methods that generally apply to the predictive analysis of massive "raw" data in heterogeneous and non-certified contexts (big data approach).
The results obtained are certainly promising and open interesting prospects for experimenting with the broader methodology as it would allow private administrations and private investors to obtain reasonably priced estimates for the prediction of retraining and retrieval strategies of the architectural heritage of ancient urban areas.

CODE 374

WALKING THROUGH THE CITY AGAINST THE EXPROPRIATION OF EXPERIENCE

Guerini F., Regis A.[1]

1: Universidade Estadual Paulista,
Faculdade de Arquitetura Artes e Comunicação, PPGARQ
e-mail: regis.guerinifilho@gmail.com
web: www.kaozmatron.blogspot.com

KEYWORDS: Modernity; alterity; wandering; urbanism; critic.

ABSTRACT

This article is a part of the author's masters research, and approaches the concept of errantology elaborated by Paola Jacques in his book Praise to the Wanderers. Wandering narratives are characterized by their resistance to the process of anesthetization and domestication of experience unleashed by the capitalist system.
The word alterity is formed by the junction of the Latin radical alter - other - with the suffix dade that indicates condition or state, that is, otherness can be defined as the experience of difference. This experience has been suffering constant attacks during modernity.
Wanderers are those who carry out urban wanderings, or rather, an erratic experience in cities that points to the experience of urban alterity. His narratives may be viewed as a critical possibility of insurgency against impoverishment / loss of experience, or in the contemporary city: the process of spectacularization. In this scenario, the wandering narratives presented in this article provide a critical arsenal for the understanding of contemporary cities and point to ideas and practices that serve to enhance more libertarian theoretical reflections and actions.

CODE 40

CONSEQUENCES OF THE INFORMAL APPROPRIATION OF MODEST ARCHITECTURAL HERITAGE IN COLOMBIA

Villegas, María Claudia[1]*

1: Pontificia Universidad Javeriana, Cali,
Department of Art, Architecture and Design
e-mail: mcvillegas@javerianacali.edu.co
web: http:www.javerianacali.edu.co

KEYWORDS: Modest heritage buildings; functional obsolescence; informal appropriation; Cauca Valley.

ABSTRACT

Most of the heritage buildings in Colombia considered as Assets of Cultural Interest of the Nation, are characterized by its modest architecture but its immense meaning in a past that defined the country's possibilities of progress, however in many cases its original use has been modified or in some cases has become obsolete. This obsolescence and abandonment of the building and its surroundings, generate a phenomenon of illegal appropriation by third parties for housing, single family or multifamily purposes, small businesses or even for criminal purposes such as the sale of narcotics and prostitution.
The analysis of 93 heritage buildings in the Cauca Valley based on a comparison method was made to determine the characterization and differences in the cases of; abandonment without appropriation, informal appropriation and formal appropriation for new uses.
The object of study is the set of buildings declared property of cultural interest (BIC) of the department of Valle del Cauca. For the study the buildings were divided into four groups according to the use for which they were built: (a) religious, (b) institutional, (c) housing, (d) railway. The result of this analysis tries to expose the consequences of the informal appropriation of the buildings belonging to the so call modest heritage buildings.
Elsewhere in Colombian territory similar goods are found under the same conditions, where the fundamental characteristic is the modesty of buildings in scale and magnitude. In some cases the consequences of this appropriation are very negative, they lead the building to greater deterioration.

CODE 122

SEVERAL FACTORS IN POPULAR HOUSING REHABILITATION IN HISTORICAL CENTERS OF CÁCERES PROVINCE

Sánchez, Javier[1]*

1: Arquitecto ETSAM. Master en Ingeniería y Arquitectura UEX.
e-mail: javierschez@gmail.com, web: http:www.sanchezterioarquitectos.com

KEYWORDS: Heritage; rural areas; architectural project; self-promotion.

ABSTRACT

The loss of inhabitants in small villages of Cáceres (Spain) province has been aggravated with the economic crisis arrival. This phenomenon generates an aged local population whose capacity to rehabilitate properties is reduced. Still, at present, the conservation and maintenance of the greater part of the inherited popular heritage depends largely in local people through specific actions.
In this paper, are studied several cases of rehabilitation of properties with different types of heritage value (buildings or elements from XV to XIX century), in protected historic centers of Cáceres province. It is based on several common parameters: the temporary environment coinciding with the economic crisis appearance (2007-2012), the social and cultural ambience of the local population, the ruinous states in which the buildings were previously to the intervention and the architects in charge of carriying out the projects and rehabilitation works. The other conditions are diverse, from the purely economic, to the education and taste of the promoters, going through the future use of buildings, the agents involved in each of the processes, the exact location of the properties and the historical heritage inheritances.
After analyzing the diverse results it is concluded that the local private promoter as a natural person is a key figure in any process of buildings rehabilitation with heritage value in the protected historic centers of Cáceres province, depending a priori on its sensitivity to the inherited property and its desire to recover their characteristic elements to achieve a respectful intervention with the built heritage.

CODE 240

ROOF TOP GARDENS AND REHABILITATION: PARTICIPATION AND COOPERATION PROCESSES BETWEEN UNIVERSITY AND ENTERPRISES

Bosch, Montserrat[1]*; Calvo, Lidia[2]; Boleda, M[3].; R. Cantalapiedra, Inmaculada[1]; Lacasta, Ana[1]

1: Universitat Politècnica de Catalunya Grupo de Investigación GICITED.
e-mail: montserrat.bosch@upc.edu , web:www.epseb.upc.edu
2: Eixverd. Universitat Pompeu Fabra UPF-Sostenible
e-mail: marti.boleda@upf.edu
e-mail: lidia@eixverd.cat
e-mail: inmaculada.rodriguez@upc.edu
e-mail: ana.maria.lacasta@upc.edu

KEYWORDS: Rehabilitation; green roofs; environmental impact; participation processes.

ABSTRACT

Rooftop gardens can bring interesting benefits to an existing building: improvements in the building's thermal response; acoustic properties; regulation of rainwater; in mid-city, they reduce the heat island effect; help to maintain biodiversity; and transform landscape elements into new spaces of coexistence and quality of life in the urban environment.
Many aspects of these solutions have already been extensively tested in laboratories, but there are few in situ experiments in which the performance of various proposals offered by the market can be observed in real conditions, such as those in the Mediterranean basin with abrupt temperature changes and intense, sporadic rains punctuated by seasons of drought.
In order to understand performance of rooftop gardens in real conditions of the Mediterranean climate, we carried out the experiment presented herein over the course of 18 months (February 2015 to mid-2017). We studied the behaviour of various rooftop garden solutions and converted the rooftop of an existing building into a living lab. We tested various different parameters and gained valuable information both for the research groups and the businesses that participated in the project.
The project also served to identify the barriers that still exist in society in regard to the implementation of green roofs as a rehabilitation strategy. Furthermore, we quantified several parameters (beyond the usual measures of thermal insulation) including surface temperature of various rooftop solutions using a thermographic camera; irrigation patterns; consumption and overload of water; performance of the garden layer; the management and maintenance of solutions; as well as the quantification of biodiversity and experiences with local fauna.

CODE 378

PARTICIPATORY INVENTORY OF QUILOMBO MESQUITA: HERITAGE EDUCATION FOR IDENTITY AND TERRITORIAL PRESERVATION

Paulino, Mariane[1]; Andrade, Liza[2]

1: Faculdade de Arquitetura e Urbanismo
Universidade de Brasília
e-mail: marianepaulino@hotmail.com
2: Faculdade de Arquitetura e Urbanismo
Universidade de Brasília
e-mail: lizamsa@gmail.com

KEYWORDS: Quilombo communities; traditional people; black heritage; participatory inventory.

ABSTRACT

The Remnant Quilombo Communities suffer social and cultural consequences of a secular invisibility process concerning the preservation of their memory, identity and territory, where the historical and socioeconomic context corroborate with a reality that stigmatizes and marginalizes this population. Given the construction and organization process of historical heritage in Brazil, there is a gap of recognition and safeguard in the sites and monuments related to this traditional people that contributes with a scenario of fragmentation of these reminiscences.

The object of study of this paper, Quilombo Mesquita is located in the state of Goiás, Brazil, obtained its certification as a remaining quilombola territory in 2006, however the titling process is not completed which contributes to the invasion and irregular occupation of this historical site. In the context of rural communities, the relationship with the territory consolidates social, labor, economic and cultural relations, where the relationship with the territory consolidates the memory and identity of this traditional people

Therefore, this work aims to present this community from historical process associating the construction of traditions and culture through its relationship with the territory - its knowledge and way of living. Involving members of the community as actors in this process intends to demonstrate the identification of cultural heritage based on the Participatory Inventory methodology (IPHAN) in order to generate subsidies for the construction of the heritage education process.

Thus, the main conclusion is the preservation of this traditional people heritage with social participation, through the identification of traditions and ways of living, is a process of valorization and cultural construction, strengthening the identity issues of these communities avoiding the fragmentation of intangible and tangible heritage and the territory, for an effective process of preservation and maintaining an alive heritage.

CODE 404

COLECTIVE INICIATIVE FOR FAÇADE CARACTERIZATION IN 500 BUILDINGS OF THE HISTORICAL CENTRE OF VISEU: COMMUNITY INVOLVEMENT, RESULTS AND PROSPECTS

Mendes Silva, José[1]; Pinto Mouraz, Catarina[2]; Sá, Carlos[3]; Bettencourt, António[4]

1: Departamento de Engenharia Civil; ADAI/LAETA, Association for the Development of Industrial Aerodynamics
Universidade de Coimbra
e-mail: raimundo@dec.uc.pt, web: http://www.uc.pt/fctuc/dec
2: Departamento de Engenharia Civil
Universidade de Coimbra
e-mail: catarinamouraz@hotmail.com, web: http://www.uc.pt/fctuc/dec
3: Instituto Pedro Nunes
Coimbra
e-mail: carlos--miguel@hotmail.com, web: http://www.ipn.pt
4: Departamento de Arquitetura
Universidade de Coimbra
e-mail: antonio.bettencourt@iol.pt, web: http://www.uc.pt/fctuc/darq

KEYWORDS: Rehabilitation; visual survey; conservation state; community involvement.

ABSTRACT

One of the main priorities of rehabilitation actions in historical city centres should be the preservation of the identity values that characterize those areas. Besides this, the community role in this process should not be neglected, since the main target of these interventions are the people that live in the historical centres and who should be the firsts to appraise these buildings and recognize them as their own. For this to happen, drawing society's attention for these matters and involving them in the decision process is paramount for the success of rehabilitation actions.
Taking this into account, an event of façade characterization was organised in November of 2016, taking place in the city of Viseu and regarding around 500 buildings of its' historical centre. A total of 180 students, teachers and technical experts, mainly in the areas of engineering and architecture, participated in this collective action. Around 30 national institutions were represented, including 10 Portuguese universities.
A detailed survey involving 200 topics was carried out with the purpose of characterizing the buildings' facades, which were photographed through the outside. This led to the development of a photographic database with more than 11.500 pictures.
Following this event, a specialized team contributed to the analysis of the conservation state of a smaller group of buildings (around 170), located in coherent urban areas inside the historical centre. The aim of this article is to present the context and goals of the event, as well as the methodology and tools developed for its accomplishment. The preliminary results regarding the constructive characterization and the conservation state of the buildings are also presented, as well as the prospects settled for future actions and remarks regarding the importance of these initiatives.

CODE 2

EVALUATION OF STRUCTURAL INJURIES IN HOUSES BY MOVEMENT IN MASS. CASE STUDY NEIGHBORHOOD "LA ESMERALDA" OF THE MUNICIPALITY OF AMAGÁ IN COLOMBIA

Ochoa-Botero, Juan Carlos[1]*; Carvajal, Henry[2]; Cañola, Hernán[3]

1: Universidad Nacional de Colombia, Facultad de Arquitectura, Escuela de Construcción
e-mail: jcochoa@unal.edu.co, web: http:www.unal.edu.co
2: Universidad Nacional de Colombia, Facultad de Arquitectura, Escuela de Construcción
e-mail: hhcarvajal@unal.edu.co, web: http:www.unal.edu.co
3: Colegio Mayor de Antioquia, Facultad de Arquitectura e Inteniería, Grupo de investigación Ambiente, Hábitat y Sostenibilidad
e-mail: Hernan.canola@colmayor.edu.co, web: : http:www.colmayor.edu.co

KEYWORDS: Cracks; subsidence; injuries in buildings; injuries in houses; Amagá Colombia.

ABSTRACT

This work shows the results of the evaluation of the structural injuries presented by the houses of the La Esmeralda neighborhood, located in the Municipality of Amagá (Colombia) by a mass movement of the land. The method used for the study included a historical component and a technical component. The first one looked for the antecedents of the problem from existing primary sources and the second focused on the description and analysis of the injuries in the dwellings. With the information obtained, a classification and qualification of the degree of affectation of the structure was made, which allowed for the sectorization of the areas of greater or lesser deterioration and to determine the tendency of the movement of the land. With this evaluation and the help of the geological, geotechnical, hydrological and hydraulic studies, the type of mass movement was determined.

CODE 8

PETRÓPOLIS NEGOTHIC CATHEDRAL DAMAGE SURVEY

Gaiofatto, Robson Luiz[1]; Machado, Erika Pereira[2]; Fachetti, Ana Kyzzy[3]

1: Civil Engineer
Catholic University of Petrópolis (UCP) / ENCOPETRO Structural Engineering
e-mail: rlgaiofatto@gmail.com, web: http://www.encopetroengenharia.com.br
2: Architect and Town Planner
Catholic University of Petrópolis (UCP)
e-mail: erika.pereira@ucp.br, web: http://www.ucp.br
3: Architect and Town Planner
Catholic University of Petrópolis (UCP)
e-mail: anakyzzy@gmail.com, web: http://www.ucp.br

KEYWORDS: Damage survey; built heritage; structural recovery; restoration; neogothic catedral.

ABSTRACT

The Cathedral of Petrópolis, Rio de Janeiro - Brazil, is a neogothic style building, built with the initiative of Princess Isabel in the reign of Dom Pedro II, in the 19th century. The temple had its conclusion, with the implantation of the metallic tower, in the middle of the XX century and was registered as a historical monument in 1980. It is an imposing construction, of great beauty and relevant for the history of Petropolis and Brazil. Due to lack of maintenance and inadequate interventions, it presents a series of pathologies that endanger its integrity. The construction is based on blocks of stone set on the ground, natural part, landfill part. The front underwent foundation repression during the great flood of 1988, that is partially stabilished but left to large crack in the building. The lower walls are of stone and the rest in massive clay masonry. The stones have infiltration stains, as well as the clay walls and exist too signs of leaching and carbonation. On the walls there are concrete shells forming vaults supported by central columns, covered by a high roof made of French clay tiles supported by a wooden structure, with several pieces in very poor condition. The main tower rests on a reinforced concrete base. Many of the galvanized steel sheets that make up the tower feature an advanced state of corrosion, as well as the reinforced concrete structures that make up the base. All the decorative elements in armed mortar that compose as neo-Gothic façades reveal damages, in some cases the sculptural piece is totally deteriorated. This paper seeks to describe a corrent damage survey, to present discussions about repair procedures, reinforcement and protection of the structure and decorative elements, aiming at a survival compatible with the importance of the historical monument.

CODE 17

THE INFLUENCE OF SALT CRYSTALLIZATION ON THE MICROSTRUCTURE AND THE THERMAL PROPERTIES OF RED CLAY BRICK

Koniorczyk, Marcin[1]; Bednarska, Dalia[2]*

1: Lodz University of Technology, Department of Building Physics and Building Materials,
Al. Politechniki 6, 90-924 Lodz, Poland
e-mail: marcin.koniorczyk@p.lodz.pl
2: Lodz University of Technology, Department of Building Physics and Building Materials,
Al. Politechniki 6, 90-924 Lodz, Poland
e-mail: dalia.bednarska@p.lodz.pl

KEYWORDS: Red clay brick; sodium sulfate crystallization; thermal conductivity coefficient; mercury intrusion porosimetry; microstructure degradation.

ABSTRACT

Water with dissolved contaminations is a frequent problem faced in building materials. This factor may cause significant degradation especially in case of porous materials. The paper presents the results of experiments concerning the influence of salt solution content on the microstructure and thermal properties of red clay brick. The inner structure of reference samples as well as the ones subjected to 5, 10 and 15 sodium sulfate crystallization cycles is analysed by means of mercury intrusion porosimetry (MIP). Moreover the relation between thermal conductivity coefficient of red clay brick and its salt solution content is investigated. The research is conducted using stationary technique for the dry specimens, as well as the ones containing 25%, 50%, 75% and 100% sodium sulfate solution. The results confirm the negative influence of salt solution content on thermal properties of brick, whereas data obtained by MIP method allows to assume that crystallization cycles have negligible influence on the brick microstructure.

CODE 23

INDOOR ENVIRONMENTAL QUALITY IN CHILD AND ELDERLY CARE CENTERS IN THE CITY OF VISEU - PORTUGAL

Pinto, M.[1]*, Freitas, V. P.[2], Infante, C.[3], Viegas, J.[4]

1: School of Technology & Management (ESTGV) - CONSTRUCT (LFC)
Campus de Repeses, 3504-510 Viseu, PORTUGAL
e-mail: mpinto@estv.ipv.pt
2: CONSTRUCT (LFC), Faculty of Engineering (FEUP), University of Porto
Rua Dr. Roberto Frias, 4200-465 Porto, PORTUGAL
e-mail: vpfreita@fe.up.pt
3: Master in Construction Engineering and Rehabilitation by the School of Technology & Management-ESTGV
e-mail: katarina.infante@gmail.com
4: National Laboratory for Civil Engineering (LNEC)
Av. do Brasil, 101, 1700-066 Lisboa, PORTUGAL
e-mail: jviegas@lnec.pt

KEYWORDS: Indoor Environmental Quality (IEQ), Indoor Air Quality (IAQ), Hygrothermal comfort, Ventilation Rate, Child Care Centers, Elderly Care Centers.

ABSTRACT

By assuming the importance of obtaining an appropriate quality of life inside buildings, the study of the IEQ plays a very significant challenge when analysed, especially in buildings that include a type of more sensitive and susceptible population, as is the case children and the elderly.
In order to maintain an adequate indoor environment for the occupants, with acceptable quality air levels and hygrothermal comfort, it is necessary to accomplish several requirements, for instance the limitation of the polluted values within the regulatory limits and the limitation of those parameters that influence the hygrothermal comfort conditions to ranges of regulated and recommended reference values.
This paper studies the indoor environment in compartments of buildings that includes child care centers and elderly care centers in the city of Viseu.
The study developed has the intention to characterize different selected rooms and the analysis of some environmental parameters, through its continuous records during two experimental campaigns. The continuous record focused on the following environmental parameters: air temperature, relative humidity, carbon dioxide concentration, total volatile organic compounds and ventilation rates. The results obtained are performed taking, also, into account the existing regulations and recommended limits, thereby enabling to evaluate the conditions IAQ and hygrothermal comfort present in many indoor selected for study.
For the several case studies were even evaluated the thermal comfort of the occupants, through the application of thermal comfort models.
Based on the conclusions of the experimental campaigns that were already developed, facing the hygrothermal comfort problems and the pollutants identified in the indoor spaces, were, also, proposed some recommendations, namely in the terms of air conditioning, ventilation and maintenance, in order to obtain a general best improvement of the IEQ.

CODE 39

HUMIDITY AS A CAUSE OF DEFECTS IN VARIOUS FAÇADE CLADDINGS

Pereira, Clara[1]*; de Brito, Jorge[2]; Silvestre, José D.[3]

1: CERIS-ICIST, Research Fellow, Department of Civil Engineering, Architecture and Georresources, Instituto Superior Técnico, Universidade de Lisboa
e-mail: clareira@sapo.pt
2: CERIS-ICIST, Full Professor, Department of Civil Engineering, Architecture and Georresources, Instituto Superior Técnico, Universidade de Lisboa
e-mail: jb@civil.ist.utl.pt
3: CERIS-ICIST, Assistant Professor, Department of Civil Engineering, Architecture and Georresources, Instituto Superior Técnico, Universidade de Lisboa
e-mail: jose.silvestre@tecnico.ulisboa.pt

KEYWORDS: Expert systems; cause; defect; façade claddings; humidity.

ABSTRACT

This paper analyses the effects of humidity on façade claddings based on six expert inspection systems that use the same methodology, developed at Instituto Superior Técnico (IST), Universidade de Lisboa (UL). These inspection systems are focused on adhesive ceramic tiling, natural stone claddings, wall renderings, painted rendered walls, External Thermal Insulation Composite System (ETICS) and architectural concrete surfaces. Each system was validated via an inspection program with a significant sample, whose statistical results on humidity-related causes are used in this paper. Moreover, the analysis compares the association considered in each system between humidity-causes and defects not humidity-related. This association was defined in correlation matrices. The main results reveal that painted rendered walls have the highest percentage of defects occurring as a probable consequence of humidity causes. Of those defects, “biological colonization” and “efflorescence” are the main two associated with humidity-related causes. The “accumulation of dirt and debris”, “colour changes” and “loss of cohesion/disaggregation and crumbling” were also found to be relevant consequences of humidity.

CODE 50

QUANTIFICATION OF COMPLAINTS DUE TO ISSUES CAUSED BY PATHOLOGICAL PROCESSES IN STRUCTURAL CONSTRUCTION UNITS IN BUILDINGS IN REGION OF EXTREMADURA

Carretero-Ayuso, Manuel J.*

Musaat Foundation and University of Extremadura
e-mail: carreteroayuso@yahoo.es

KEYWORDS: Anomalies; foundations; structure; complaints; Extremadura.

ABSTRACT

The construction sector in Spain is one of the ones leading to the most complaints caused by deficiencies and user dissatisfaction. The knowledge of the situations leading to the issues, as well as of their impact, is doubtless an important factor in trying to reduce analogous situations which may arise in the future.
This paper focuses on the study and quantification of the pathological processes found in Extremadura as relating to the foundations and structure of different buildings of this geographical area. A total of 108 anomalies were gleaned from the experts' reports part of court cases with known sentencing. The population targeted by the analysis corresponds to 100% of the data existing in the provinces of Badajoz and Cáceres for the years 2008 to 2013.
During the research, the different causes leading to said anomalies were analysed, with a total of 24 types of causes having been found, manifested in a total of 15 different construction elements (7 in the foundations and 8 in the structure).

CODE 61

CHARACTERIZATION OF THE MAIN ANOMALIES IN TIMBER EXTERNAL CLADDINGS. A CASE STUDY, THE CITY OF VALDIVIA, AUSTRAL REGION OF CHILE

Prieto, Andrés José[1]; Vásquez, Virginia[2]*; Horn, Andrés[2]; Silva, Ana[3]; Alejandre, Francisco Javier[1]; Macías-Bernal, Juan Manuel[1]

1: Universidad de Sevilla, ETSIE, Departamento Construcciones Arquitectónicas II
e-mail: ajprieto2201@gmail.com, e-mail: falejan@us.es, e-mail: jmmacias@us.es
2: Universidad Austral de Chile, Facultad de Arquitectura y Artes, Instituto de Arquitectura y Urbanismo
e-mail: vvasquez@uach.cl, e-mail: andres.horn@uach.cl
3: Universidade de Lisboa, CERIST-ICIST, Instituto Superior Técnico - IST
e-mail: anasilva931@msn.com

KEYWORDS: Historical buildings; timber claddings; anomalies; pathology; degradation.

ABSTRACT

During their life cycle, buildings and their components must fulfil a set of complex requirements, in terms of a minimum functional performance to ensure its serviceability. However, as soon as it is put into use, the buildings' tangible deterioration process begins. Buildings and, especially their facades, are the elements more exposed to external degradation agents, influencing the physical vulnerability of the building throughout its service life. The weak management of existing public funds for the conservation of real state requires a more rational approach to decision-making. In this way, periodic monitoring and maintenance of building coverings should be considered as an integral part of building management, especially in environments with high exposure to aggressive environmental agents that trigger biotic pathologies in coatings, which can be extend to the structure. This study identifies the main anomalies that can occur in facades with wood claddings, analysing the related causes and estimating the influence of pathological situations in their degradation. In this study, a first approximation was carried out, analysing a total of 50 wood coatings located in the city of Valdivia, southern region of Chile. The degradation conditions of the facades are evaluated through visual inspections. A statistical analysis of the resulting data was performed, providing relevant conclusions that could lead to actions to prevent the degradation of this type of coatings. The aim of this study is to give a first look at real estate, but also indicates that to consolidate the public space in question requires an integral and coordinated action between the central government of the country, regional and municipality, which until now has not happened. In this sense, this approach can be important in the implementation of programs of preventive conservation in groups of buildings with homogenous constructive characteristics.

CODE 70

GLOBAL INSPECTION, DIAGNOSIS AND REPAIR SYSTEM FOR BUILDINGS: MANAGING THE LEVEL OF DETAIL OF THE DEFECTS CLASSIFICATION

Pereira, Clara[1]; de Brito, Jorge[2]*; Silvestre, José D.[3]

1: CERIS-ICIST, Research Fellow, Department of Civil Engineering, Architecture and Georresources, Instituto Superior Técnico, Universidade de Lisboa
e-mail: clareira@sapo.pt
2: CERIS-ICIST, Full Professor, Department of Civil Engineering, Architecture and Georresources, Instituto Superior Técnico, Universidade de Lisboa
e-mail: jb@civil.ist.utl.pt
3: CERIS-ICIST, Assistant Professor, Department of Civil Engineering, Architecture and Georresources, Instituto Superior Técnico, Universidade de Lisboa
e-mail: jose.silvestre@tecnico.ulisboa.pt

KEYWORDS: Classification system; defects; expert-knowledge; inspection system; user-friendliness.

ABSTRACT

Inspection procedures are part of an adequate maintenance plan to extend the service life of buildings. They should follow a standardized and systemic methodology, such as the one developed at Instituto Superior Técnico (IST), Universidade de Lisboa (UL), in a set of individual inspection systems focused on single building elements or materials, such as natural stone claddings, window frames and claddings of pitched roofs. These systems were based on experience and on a literature survey, which supported a classification of defects, as well as other characterization parameters, that were validated through the field work. This set of inspection systems is a reliable basis to generate a global building inspection system, whose components should have a uniform level of detail. One of those components is a single classification of defects. The creation of that list of defects should be guided by specific criteria, considering not only the name of the defects, but also their definition within each partial inspection system. This unified list of defects should be concise, identifying visually detectable phenomena, and applicable to various building elements and materials. An excessively detailed list would not be pragmatic, but a list too simplified might not reflect the degradation specificity of each situation. It is expected that the proposed list of defects is a balanced commitment between detail and conciseness. The development, risks and strengths of this unique standardized tool to assist building inspection procedures are described in this paper.

CODE 78

PATHOLOGY OF CONTEMPORARY MASONRY STRUCTURES: A PRACTICAL CASE

Freire-Tellado, Manuel J.[1]; Muñiz Gómez, Santiago[2]

1: Dpto. Construcción y Estructuras Arquitectónicas, Civiles y Aeronáuticas, CEACA
E.T.S. Arquitectura. Universidade da Coruña.
e-mail: manuel.freire.tellado@udc.es
2: Dpto. Construcción y Estructuras Arquitectónicas, Civiles y Aeronáuticas, CEACA
E.T.S. Arquitectura. Universidade da Coruña.
e-mail: santiago@udc.es

KEYWORDS: Rehabilitation; building structures; building pathology; masonry.

ABSTRACT

This paper deals with a singular case of pathology of contemporary masonry structures, including its diagnosis and its repair works.
The appearance during the execution of the work of a group of injuries among which stood out a group of horizontal cracks in a building destined to a detached house caused the paralysis of the work and a judicial confrontation between the agents involved in the work in which one of the authors of these lines acted as a judicial expert. The judicial sentence assumed the arguments presented in our expert opinion and opened a process resulting in the order for the execution of the repair and the completion of the work.
The horizontal cracks referred to, whose description did not appear in any known treaty of pathology, were located halfway up the four corners of the upper floor of the building, rectangular in shape. This building had masonry structure made of concrete blocks and unidirectional reinforced concrete slabs, gable roof and 'cavity wall' type facade, with a inner bearing sheet made of concrete hollow blocks, and a double hollow brick exterior sheet, tied to the inner one by means of metallic keys.
Given the uniqueness of the cracks, the diagnosis was a meticulous work in which proceeded by discarding all possible causes to identify the determining cause, based on the appropriate numerical models. Before proceeding with the repair works, the building was controlled by means of plaster witnesses to contrast the hypothesis in which our expert opinion was based, evacuated with the haste imposed by the judicial authority. It was verified that indeed the cracks were not active. Once this fact was established, the repair was carried out without major problems. The delay in the completion of the work allowed the follow-up of the repair for almost two years.

CODE 86

SEISMIC BEHAVIOUR AND DAMAGE PROCESSES OF THE XX CENTURY SCHOOL BUILDINGS IN VALPARAISO, CHILE

Torres, Claudia[1]; Rojas, Pablo[2]

1: Universidad de Chile, Facultad de Arquitectura y Urbanismo.
e-mail: claudiatorres@uchilefau.cl,
web: http://academicos.uchilefau.cl/torres-gilles-claudia
2: parojjas@gmail.com

KEYWORDS: Architectural diagnosis; constructive pathologies; seismic behaviour; school architecture.

ABSTRACT

Most of the existing school building in Chile were built, as part of public policies for modernization of the State, between the 40s and 80s of the twentieth century. These buildings, have exceeded their useful life in more than 30 years, however, they continue to function as such, resisting constant earthquakes and environmental conditions, with minimal or no maintenance resources.
The architectural production of the public schools was carried out by the "Sociedad Constructora de Establecimientos Educacionales" during those years. They went from 1937 to 1985, the in charge of managing, designing, executing and maintaining these educational spaces. Of the works done by them, can distinguish two stages in architectural models; the first one, with singular buildings carried out in solid structures of concrete and reinforced brick masonry. The second stage of serial, modular and prefabricated works of steel and concrete. All buildings fulfilled seismic norms, existing since 1930 in our country.
We can see, that the construction of the first period have presented some structural damage of seismic origin and those of the second period an evident physical-chemical deterioration, according to the diversity of its components.
Based on this situation, the research is carried out comparing the behaviour of these premises, against the repeated seismic actions and the conditions of environmental deterioration. The failures, damages and harmful processes, were analysed, based on direct observation and non-invasive instrumental measurements.
In this instance, the results of the comparative analysis between 6 school building in the Valparaíso city are presented. They are located on the Pacific Ocean coast, and has suffered, at least 7 earthquakes 7.0 magnitude, and two 8.0.magnitude, since 1940 to date.
This research is funded by the National Fund for Scientific and Technological Development, FONDECYT.

CODE 93

BEHAVIOUR OF POLYOLEFIN WATERPROOFING MEMBRANES EXPOSED TO UV RADIATION IN THE IBERIAN PENINSULA

Teso Hernández, Javier[1]*; Rubio Encinas, Mª Jesús[2]; Rodríguez López, Fernando, Villanueva Llauradó, Paula[3]

1: Universidad Politécnica de Madrid, ETSICCP
e-mail: teso.javier@sika.es
2: Universidad Politécnica de Madrid
e-mail: mariajesus.rubio@upm.es
3: Universidad Politécnica de Madrid
e-mail: fernandeo.rodriguez@upm.es
4: Universidad Politécnica de Madrid
e-mail: p.v.llaurado@gmail.com

KEYWORDS: Waterproofing membranes; durability; UV radiation.

ABSTRACT

This paper presents results from real deck roofs with polyolefin waterproofing membranes in the Iberian Peninsula, after an exposure period ranging from 9 to 14 years; these exposure periods correspond to a minimum of 2207 hours exposure to sunlight (La Coruña) and a maximum of 3381 hours of exposure to sunlight (Seville). The aim was to investigate the degradation due to the UV radiation together with wetting-drying and freeze-thaw cycles in the actual conditions (as built). This constitutes a difference with respect to the most widely employed accelerated ageing tests, which cannot consider all the parameters affecting the degradation of the plastics. The results were obtained from 70x70 cm samples of each deck which were analysed in the laboratory. Five different environmental conditions were evaluated, corresponding to five different regions of the Peninsula. The samples were compared with non-aged products of the same characteristics. With the only exception of the samples collected in Seville, in which initial cracking patterns were observed, all the other membranes were found to be unaltered after the considered exposure period. It was concluded that the durability of the polyolefin membranes is adequate in terms of the UV radiation, which is one of the most important factors affecting deck roofs in Spain.

CODE 114

PROPER MEASURING OF THE MOISTURE CONTENT IN THE CONSTRUCTION OF TIMBER STRUCTURES

Lozano, Alfonso*; Lorenzo, David; Alonso, Mar; Álvarez, Felipe

1: University of Oviedo
alozano@uniovi.es, web: http://giconsime.grupos.uniovi.es
2: University of Santiago de Campostela
davidlorenzofouz@gmail.com
3. alonsonar@uniovi.es
4. felipe@constru.uniovi.es

KEYWORDS: Timber; moisture content; fungal decay; roof, colapse.

ABSTRACT

That wood is a material with a high durability is doubtless. However this feature is hugely influenced by water. In fact, when the moisture content of the timber element exceeds 20%, the wood is exposed to the attacks of xylophagous organisms, such us rot fungi and termites.
The risk of affection and the level of damage are increased with the moisture content until the Fiber Saturation Point (PSF). This parameter that slightly varies depending on the species, is always around 30%. From this value it is considered that new contributions of moisture will not vary the intensity of the attack.
Fortunately today the measurement of the moisture content in timber elements is carried out simply and reliably enough by means of xylohygrometers. Despite this, there are still a quite important number of failures in timber structures due to the lack of use of these devices; or by improper use of them.
The paper analyzes the collapse of a white oak wood roof structure after only two years since its assembly, due to the combination of a series of mistakes associated to the determination of the moisture content; in particular, the use of unsuitable equipment, omissions and inconsistencies in the test reports issued upon receipt of timber, the incorrect interpretation of these reports, and finally, errors in decision-making on the definition of protection treatment. The paper includes the use of destructive tests and NDTs, which were used to estimate the origin of the pathological process and the level of damage of the structure.

CODE 117

STUDY OF HAIL RAIN IMPACT ON FIBERCEMENT ON RESIDENTIAL COVERINGS WITH FIBER CEMENT TILE

Santos, Marcus D.F.[1]; Metz, Ana J.[2]; Policena, Ítalo[3]; Henn, Rafael F.[4]

1 UNISC, Santa Cruz do Sul, Brasil, marcus@mmcprojetos.com.br
2 UNISC, Santa Cruz do Sul, Brasil, anajuliametzz@gmail.com
3 UNISC, Santa Cruz do Sul, Brasil, italopolicena@unisc.br
[4] UNISC, Santa Cruz do Sul, Brasil, rafaelfh@unisc.br

KEYWORDS: Hail; performance; roof; fiber cement; project.

ABSTRACT

Coverage is the most exposed part of a building and also the one that suffers most from climate change and hail action. The southern region of Brazil is exposed annually to weather such as hail and wind, which causes the roofing and damaging of roofs of many homes. The most used tile in the South of Brazil is the one made of fiber cement, due to the low initial cost and because it's possible to find that tile in different dimensions. According to NBR 7196: 2014 [1], the tiles must withstand the action of wind and rain, in addition to bending stresses arising from their own weight.
According to SANTOS (2016) [2], hailstorms of about 50 mm in diameter are recorded in the southern region of the country, which is not consistent with the normative test of NBR 7581-2: 2012 [3], as well as NBR 15575-5 [4] because the diameter of the test ball required in both standards is only 25.4 mm (1 inch). In contrast, ASTM D 3746 [5] specifies in its hard body test the impact sphere shall be of ice, cast with the aid of a hail-throwing device, produced with compressed air, in addition to its size diameter of 50mm, thus reproducing the closest impact of the reality of heavy hail rainfall that occurs in the Southern Region of Brazil.
In order to prove that the tiles that are marketed in Brazil do not resist the hail rain of the southern region of the country, the mechanical strength of the fiber cement models of different thicknesses was studied, as well as a type of tile considered sustainable as regards rainfall of hail, mainly comparing the requirements of Brazilian standards in relation to international standards, in order to discuss the test that is being demanded by the standard of performance that is currently in effect for the entire national territory.

CODE 125

PATHOLOGIES IN SOCIAL HOUSING CONSTRUCTION - PROCESS FOR INTERVENTION PROJECT CASE STUDY: PEREIRÓ - PORTO

Ferreira, Diana D.[1]; Lanzinha, João C.G.[2]; Coelho, António B.[3]

1: Universidade da Beira Interior, Faculdade de Engenharia,
Dep. Engª Civil e Arquitectura
didiasferreira@gmail.com
2: C-MADE - Centre of Materials and Building Technologies
Universidade da Beira Interior, Faculdade de Engenharia,
Dep. Engª. Civil e Arquitectura
joao.lanzinha@ubi.pt
3: CITAD - Centro de Investigação em Território, Arquitectura e Design
Universidade da Beira Interior, Faculdade de Engenharia,
Dep. Engª. Civil e Arquitectura
abc.infohabitar@gmail.com

KEYWORDS: Social housing; construction; pathologies; rehabilitation; project.

ABSTRACT

Nowadays, it is important to raise awareness and influence our society to the rehabilitation practice of buildings once that are increasing the number of poorly maintained and unusable buildings, deteriorating the visual image of our cities. In this way, rehabilitation has been increasing value and interest in the way of revitalizing and improvement the aged houses construction in Portugal.
This paper presents as a contribution to the study of intervention concepts in social housing buildings, having as case of study the neighbourhood of Pereiró, it belongs to a master social housing plan "Plano de Salubrização das Ilhas do Porto" and "Plano de Melhoramentos" from 1956 to 1966, in the city of Oporto, Portugal.
In a first phase, this work makes a summary of the history, morphologic, social and constructive relationship in architecture of the neighbourhoods of social interest in Oporto developed up to the date of the study case, followed by an analysis of the building under study and surroundings.
In a second phase, the case study is exposed with the aim of the proposal of rehabilitation of the existing, facing the evaluation of the pathologies. It is made a technical inspection of the building and respective evaluation, evaluation of the thermal insulation quality and household surveys.
Knowing the main anomalies of the construction, it became possible to develop a rehabilitation solution focused in correcting them. With a diagnostic and a constructive framework done of the building and its surroundings, it improves not only the architectural space, but also, and mainly, the thermal quality of the construction and the convenience of the residents.

CODE 129

BIOLOGICAL CONTAMINATION OF CULTURAL HERITAGE

De Billerbeck, Virginia Gisel[1]*; Pages, Jacques[2]

1: ELIOS Cabinet conseil, 75015 Paris, France
e-mail: labo.elios@free.fr
2: BioDev'mlhl, 34610 Rosis, France
e-mail: biodev-mlhl@laposte.net, web: www.biodev-mlhl.org

KEYWORDS: biodeterioration; diagnosis; heritage monuments; cultural properties; data cartography.

ABSTRACT

This paper presents the problem of biological contamination of cultural heritage (historical buildings and cultural properties), and the methodological approach to determine the causes of the deterioration and to propose solutions. During the preliminary diagnostic phase, samples are taken in situ and biological analyses are carried out in the laboratory to identify those microorganisms which are responsible for the biodeteriorations. Concurrently, a measurement of the moisture at the surface of the materials makes it possible to know the environmental conditions inside the building. The data collected (biological, environmental, and sanitary conditions of furnishings) are spatially referenced in situ and then recorded on a cartographic layer. The map of the surface materials humidity is superimposed to the map of the biological contaminations, so as to visualize the risk zones to be controlled or treated. Three case studies are presented here to illustrate different agents of biodeteriorations: the colonisation of a church's stone façade (Notre-Dame-de-Pitié, France) by photosynthetic organisms (cyanobacteria, algae and lichens); the degradation of a parquet (Sainte-Hermine Church, France) by a formidable "dry rot" fungus; and the attack of wooden furniture (Saint-Bonaventure Church, France) by xylophagous insects and molds. Different treatments are proposed according to the biological organisms identified and the nature of the materials to be treated. Recommendations are made for preventive measures that are both simple and inexpensive, so as to avert biological contaminations.

CODE 143

MASONRY BRICK FAÇADES INTERVENTION

Echevarría, Luis[1]*; Gutiérrez, José Pedro[2]; Martínez, Sonia[3]; Carballosa, Pedro[4]; Piñeiro, Rafael[5]

Eduardo Torroja Institute for Construction Science. Spanish National Research Council (IETcc-CSIC)
web: http:www.ietcc.csic.es
1: l.echevarria@csic.es
2: jpgutierrez@ietcc.csic.es
3: soniamdm@ietcc.csic.es
4: carballosa@ietcc.csic,es
5: rpineiro@ietcc.csic.es

KEYWORDS: Masonry brick façade; pathology; reparation.

ABSTRACT

During the second half of the 20th century, a large number of buildings with a masonry fairface brick façade has been built. In spite of the huge accumulated experience over the years, pathology still appears in this types, moreover, this pathology is abundant and varied.
This paper presents the general pathology that affects this typology of façades, and presents the case of a singular brick façade, that appeared in a building built in the 50s of the 20th century. The façade of this building was completely rehabilitated in 2006, and several years later, some crackings that resulted in the fall of brick fragments of facade to the public highway appeared.
Several test were realized to determine the causes of the phenomenon. These tests included chemical physicist tests of the brick (to determine the chemical composition of the bricks and its degree of cooking, determination of its thermal dilation coefficient, etc.) and mechanical tests to determine its resistance and Young modulus. Apart from those, different numerical models were done in order to compare their results with those obtained in the mechanical tests.
Once the cause of the pathology was determined, several solutions of reparation and restitution were analyzed, and several tests were carried out in order to determine the optimum solution. To do so, individual pieces were tested, by doing several tests as rapid aging and a frost/thaw test. Lastly, several walls of low height were built with 3 proposed solutions. These walls were tested to compression to determine the ultimate load of the repaired system.
Due to the results obtained at the tests, it can be concluded that the three proposals of solutions are feasible, both economically and technically. The proposed solutions were used in the final reparation of the studied façade, depending on its adaptability to each zone.

ACKNOWLEDGE

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CODE 160

RESTORATION OF THE FACADES OF THE NATIONAL PALACE OF QUELUZ: INTERVENTION STRATEGY

Vaz Silva, Daniel[1]; Ferreira, Vanessa [2]; Marques, Carlos[3]*

Parques de Sintra – Monte da Lua, SA.
web: www.parquesdesintra.pt
1: daniel.silva@parquesdesintra.pt
2: vanessa.ferreira@parquesdesintra.pt
3: carlos.marques@parquesdesintra.pt

KEYWORDS: heritage; restoration; facades; lime mortars; pigments.

ABSTRACT

The restoration of the facades was part of a project for overall enhancement of the Palace of Queluz, the most important Portuguese baroque palace, started when the management of this national monument was entrusted, in 2012, to Parques de Sintra. The project was developed for both conservation and aesthetics purposes, to bring back the chromatic harmony and integrity of the exterior coatings. The walls of Palace, mostly built in the second half of the 18th century, had a great diversity of colours in the exterior renders, varying between the pink, the orange and the yellow, and between green and blue in the doors and windows, having lost the original colour and reliefs after several previous interventions. Laboratory analysis of samples of the original mortars confirmed that these were traditional lime-sand with a grey-blue pigment, confirming a watercolour drawing dated from 1836 which shows relief frames with panels of yellow colour over blue bases in some facings between doors. The limestones of Lioz and Ançã used in the decorative carvings were also in need of conservation for the cleaning of biological colonization, filling of gaps and repointing of joints. The prescriptions for the restoration of doors and windows followed specific rules regarding the type of timber and the extension and depth of the intervention. The work was carried out in order to recover, whenever possible, existing materials, reducing the replacement of elements and ensuring authenticity of the treated objects.
This paper presents the intervention strategy followed in all its extension, from the historical investigation and laboratory analyses to determine the original colours and decorative mouldings, through the survey of the state of conservation of all the facade elements, until the definition of the methodology of intervention and technical solutions, based on criteria such as the respect for authenticity and compatibility with pre-existing materials.

CODE 175

A PRELIMINARY INSPECTION MODEL FOR DEFECT DETECTION AT THE FACADES OF MODERN PERIOD BUILDINGS IN TURKEY

Ertemir, DilrubaYağmur[1]; Edis, Ecem[2]

1: Istanbul Technical University, Graduate School of Science, Engineering and Technology, Environmental Control and Building Technology Master's Programme
e-mail: dertemir@gmail.com
2: Istanbul Technical University, Faculty of Architecture, Department of Architecture
e-mail: ecem@itu.edu.tr

KEYWORDS: Facade defects; defect detection; modern architecture in Turkey; construction technology.

ABSTRACT

Buildings of modern movement, as a part of recent history, have become a subject of focus both in the world and in Turkey, in order to protect and preserve examples with heritage value. Additionally, studies on retrofitting them are also made, especially in relation with environmental sustainability concerns. In both cases, detection and diagnosis of the defects and failures occurring at these buildings is an important step to protect them, and improve their performances.
Building facade that is a part of building envelope is affected from exterior environmental factors such as wind, temperature changes or rain, and defects and failures may occur due to physical and chemical changes resulting from being exposed to location specific exterior conditions. The defects and failures observed may also vary depending on the technology used. Therefore, a master's study is being done on defect detection and diagnosis at the facades of Turkish modern movement buildings to prepare an inspection model.
In this paper, as a part of aforementioned study, preliminary outcomes based mainly on literature review are presented. In this respect, facade characteristics and technology of Turkish modern movement buildings, defects that may occur in one of the commonly observed technology, i.e. in rendered facades, and some of the available inspection methods to detect these defects are presented respectively. Finally, the preliminary inspection template generated is introduced briefly.

CODE 217

COMBINATION OF DIAGNOSIS TOOLS FOR A PROPER IDENTIFICATION OF MOISTURE PATOLOGIES IN MODERN RESIDENTIAL BUILDINGS

Hidalgo-Betanzos, Juan María[1]; Iribar-Solaberrieta, Eider[2]; Flores-Abascal, Iván[3]; Escudero-Revilla, César[4]*; Sala-Lizarraga, Jose María Pedro[5]

1: ENEDI group of Energy in Buildings, Department of Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: juanmaria.hidalgo@ehu.eus, web: http://www.ehu.eus/enedi
2: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: eider.iribar@ehu.eus
3: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: ivan.flores@ehu.eus
4: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: cesar.escudero@ehu.es
5: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: josemariapedro.sala@ehu.es

KEYWORDS: Construction pathologies; indoor air quality; Building monitoring; Infrared thermography; Interstitial condensations.

ABSTRACT

A study of moisture pathologies in a modern residential multifamily building is presented. The construction is located in northern Spain and it was built under the regulation NBE-CT of 1979. After the appearance of some moisture problems in the façades, three complementary studies were conducted to analyse the situation of the envelope and diagnose the best improvement possibilities.
The first study monitored the indoor conditions of temperature and humidity in the apartments with moisture issues in the walls. That way the occupancy, heating operation and natural ventilation were analysed during 40 winter days. The second study monitored the thermal envelope performance, measuring the heat flux and the inner and outer surface temperatures. This allowed to measure the real thermal insulation and thermal mass of the walls and thermal bridges effect in order to assess the risk of interstitial condensations under the real conditions of use. The third study consisted of an infrared thermographic survey, carried out from the outside and from the inside of the building. The irregularities detected with the IR study helped completing the assessment of the moisture problems.
This work demonstrates the importance of combining several diagnosis tools. The wrong interpretations which would have happened if the complementary studies wouldn't have been done, are exposed. This is a key aspect to diagnose building pathologies and improve the energy efficiency. The steps to find out the real causes are explained in detail. Finally, some technical solutions based on ventilation or thermal insulation enhancement are proposed, as different ways to reduce the high levels of relative humidity indoors and minimize the risk of condensations in the future.

CODE 218

PREDICTION OF IMPACT FORCE-TIME HISTORY IN SANDY SOILS

Ali, Adnan F.[1]*; Ahmed, Balqees A.[2]

1: University of Baghdad, Civil Engineering Department
e-mail: af_bas1@yahoo.com
2: University of Baghdad, Civil Engineering Department
e-mail: baahe777@gmail.com

KEYWORDS: Dry sand; impact; embedment; area of footing; force-time history.

ABSTRACT

A dynamic problem that is represented by impact acting on a soil medium (short-period dynamic load) is rather different from the case of impact acting on a structure such as a beam or a pile. In the case of a pile, the resulting impulsive wave as per Clough and Penzien (2003) shows a standard amplitude, shape, frequency, and duration. Therefore, the impulsive load wave is almost of an ideal shape. However, in the case of an impact load acting on a soil medium neither the shape nor the amplitude can be evaluated by any existing methodology. An experimental study on the behaviour of dry dense, medium, and loose sandy soils subjected to a single impulsive load is carried out. Sand models were tested under different impulsive energies caused by different falling masses from different heights. Tests were conducted using the falling weight deflectometer to provide the single pulse energy. The behaviour of sandy soils was evaluating using different parameters, these are; footing embedment depth, diameter of the impact footing, density of the sand medium and the applied energy. It was found that the amplitude of the resulting force-time history is a function of the degree of confinement on the footing, the embedment depth, footing area, density of soil in addition to the energy of impact (falling mass and height of fall). The shape of the impulsive wave was found to be, therefore, of mostly a single pulse; with or without a negative phase. Moreover, it could be of an ideal half sine wave or a part of half sine wave with a nonzero residual inelastic force (represented by the falling weight).

CODE 224

MONITORING, ANALYSIS AND PROPOSAL OF SOLUTIONS FOR CONDENSATIONS OR HUMIDITY PROBLEMS IN TRADITIONAL BUILDINGS

Ruiz de Vergara, Imanol[1]*; García, Carlos[2]; Sellens, Isabel[3]; Iribar, Eider[4]; Sala Jose María[5]

1: ENEDI group of Energy in Buildings, Department of Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: imanol.ruizdevergara@ehu.eus, web: http://www.ehu.eus/enedi
2: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: carlos.garciaga@ehu.eus
3: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: isabel.sellens@ehu.eus
4: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: eider.iribar@ehu.eus
5: ENEDI group, Dept. Thermal Engineering, University of the Basque Country UPV/EHU
e-mail: josemariapedro.sala@ehu.eus

KEYWORDS: Energy consumption; building monitoring; improvements after refurbishment; salubrity; surface condensations.

ABSTRACT

A case study of condensations in a 1970's residential building constructed with traditional construction materials in Vitoria-Gasteiz (northern Spain) is exposed. This pathology has adverse effects in the building such as the increase of the energy consumption and the health conditions in the interior of the dwellings become worse.
As a first step in the study, the interior conditions of the dwellings are monitored (interior air temperature, walls surface temperatures at different points and relative humidity) and a non-destructive test is carried out to determine the thermal resistance of the building envelope (façade). The temperature difference in each measurement point is analyzed and the possibility of condensations in each dwelling is determined.
To complete the study, WUFI® simulation software was used in order to analyze 2 different refurbishment solutions (ETICS and ventilated façade solution). Each refurbishment type is assessed in relation with the pathologies restoration and possible associated problems are exposed (appearance of interstitials condensations and / or molds).
The final results demonstrate that these refurbishment types do not only suppose well-known energy advantages (reduction and better use of it), but they also improve substantially the healthiness within dwellings, regarding the hygrothermal parameters.

CODE 226

STRUCTURAL DIAGNOSIS OF THE UNIVERSITY HOSPITAL HOSPITAL DE CLÍNICAS DR. MANUEL QUINTELA

Caro, Santina[1]; Pereyra, María Noel[2]; Leez, Álvaro[2]; Monfort, Christian[2]

1: Rectorado, Universidad de la República. 18 de julio 1824, 11.200, Montevideo, Uruguay.
e-mail: scaro@concepto.com.uy,
web: https://www.universidad.edu.uy
2: Departamento de Construcción del Instituto de Estructuras y
Transporte de Facultad de Ingeniería,
Universidad de la República. Julio Herrera y Reissig 565, Montevideo 11.300, Uruguay.
e-mail: construccion_iet@fing.edu.uy
web: https://www.fing.edu.uy/iet/departamentos/depto-de-construcción

KEYWORDS: Structural diagnosis; working methodology; pathologies.

ABSTRACT

The purpose of this study is to evaluate the condition of the building structure of the University Hospital ("Hospital de Clínicas Dr. Manuel Quintela"), in order to determine the possible use of the old building for the new hospital re-functionalization project. The building is considered one of the more emblematic constructions of Montevideo. It was constructed in 1923, it consists of 23-floor building, with a total constructed area of 110,000m2.
The main challenge of the work, was to respond to this problem in a short period of time. For this purpose, a methodology was developed which sought to identify:
i) The main pathologies and to associate them with their causes,
ii) Structurally compromised areas.
Based in the study of the existing documents of the building and in a walk through the different parts of the hospital, a workplan was determined. The first part of the work considers the future locations of some priority areas: Emergency, Surgical, Recovery Center and Cardiovascular Center (14.250 m2). Although the basement is not part of these areas, part of it was included in this stage of analysis because affectations in this level could condition the stability of the higher levels. In this areas it was done a systematical search of existing pathologies, they were included in the construction drawings, classified in a severity rank (in order to establish the possibility of their correction and / or repair), identifying their causes whenever possible.
The second stage of the study considered the areas not studied in the first stage and that could be structurally critical: the rest of basement, ground floor and roofs (16.000 m2).
In this way, analyzing the 27% of the surface, it was possible to carry out a structural diagnosis of the building, as well as determine the work required to rehabilitate it.

CODE 227

PATHOLOGIES IDENTIFCATION AND ANALYSIS OF CRISTO OBRERO CHURCH ENVELOPE, BUILT BY ELADIO DIESTE

Mussio, Gianella[1]; Castro, Magdalena[2]; Romay, Carola[3]

1: Architectural, Design and Urbanism University – Republic University
e-mail: gianellamussio@gmail.com.uy, web: http://www.fadu.edu.uy
2: Architectural, Design and Urbanism University – Republic University
e-mail: mmagcastro@gmail.com.uy, web: http://www.fadu.edu.uy
3: Architectural, Design and Urbanism University – Republic University
e-mail: cromay25@hotmail.com, web: http://www.fadu.edu.uy

KEYWORDS: Reinforced masonry; envelope pathologies; diagnosis.

ABSTRACT

The Cristo Obrero Church, located in Atlántida and built in 1958, is an exponent building that combines the use of reinforced masonry technology developed by the Uruguayan engineer Eladio Dieste and the sensibility in the expressive use of the brick in the materialization of a religious program.
The particular spatiality, the undulating envelope, the subtle use of the light, the bricks bonds and textures richness, as well as the use of an innovative structural and constructive system that makes an intensive use of local resources, are some of the outstanding values of this building declared in 1998 National Historical Monument, major recognition and heritage protection at the national level.
After almost sixty years built and in the framework of the development of a Conservation and Management Plan financed by Keeping It modern, a Getty Foundation initiative it has been possible to study and analyze the building from multiple disciplines in order to diagnose and propose actions for its conservation.
This article will expose the results achieved by a team of Architectural, Design and Urbanism University teachers that worked on identification, location, record and determination of the causes of the main pathologies affecting the building envelope.
This pathologies study is a preliminary step to carry out a diagnosis. It is also a tool to address, in a systematic way, the analysis of constructive problems affecting other buildings that make up the rich legacy from Eladio Dieste engineer.

CODE 237

FACADE RENDERING MORTARS, PATHOLOGIES AND PERFORMANCE EVALUATION

Vilató, Rolando R.[1]

1: School of Engineering
Mackenzie Presbyterian University
e-mail: rolandovilato@yahoo.com

KEYWORDS: Facade; rendering; construction pathology; performance.

ABSTRACT

The paper presents the most common pathological problems in facades rendered with mortar, investigated in a detailed review of several case studies in single storey, commercial and residential buildings. The examined construction systems are infilled frame with non-structural masonry and structural masonry. To comment on possible causes and prevention of these pathologies are referenced the design recommendations that should be followed in the detail of the facade rendering and the execution to increase durability. These recommendations are based on the actual standards in the Brazilian building code and several studies on buildings pathology. Finally there are related the performance criteria of the rendering, according to the Brazilian standards, and some types of test that can be performed in situ or in the laboratory, to evaluate different performance parameters of the rendered wall. As a result a "checklist" was developed that evaluates the main performance criteria of external renders to be considered to minimize the pathologies, that today are increasingly common, even with the large number of previous studies.

CODE 249

PREVIOUS STUDIES FOR THE RESTORATION OF THE TOWER OF SAN IGNACIO DE LOYOLA CHURCH IN GETXO (BISCAY)

Torres Ramo, Joaquín[1]; Quintanilla Crespo, Verónica[2]

1: Department of Building Construction, Services and Structures
Universidad de Navarra
e-mail: jtorram@unav.edu, web: http://www.unav.edu/centro/saviarquitectura
2: Architect. Restoration and Conservation Specialist
Restauración de Patrimonio
e-mail: arquitectos@restauraciondepatrimonio.es, web: http://www.restuaraciondepatrimonio.es

KEYWORDS: Restoration; heritage; previous studies; building pathology; saline environment; Getxo.

ABSTRACT

San Ignacio de Loyola Church was built in 1892 in a residential area near the harbour of Getxo (Biscay) in Spain. A bell tower is located in the western façade of the church. It was built in a sandstone masonry with local ashlars from Berango quarries. Despite being located inside the urban scene, the church presents a hard exposure to the sea, due to the topographic characteristics of the place. In spite of recent interventions (2004), the tower was showing considerable damages caused by evident processes of deterioration. The neighbours were alarmed when some fragments of corbel fell from the highest parts of the tower, impacting the pavement of the public square.
This article aims to expose the restoration process carried out during 2016-2017, starting from the previous studies of petrological characterization, damage analysis and identification of pathological processes. The article exposes the objectives, methodology and results of the restoration project and the conclusions drawn from the whole process.

CODE 278

THE VALIDITY OF THE CONSTRUCTIVE SOLUTIONS IN THE SOCIAL HOUSING OF THE '40S IN THE LIGHT OF THE SPANISH TECHNICAL CODE OF BUILDING: TERCIO Y TEROL NEIGHBORHOOD

Monjo, Juan[1]; Bustamante, Rosa[2]; Moya, Luis[3], Díaz, Elena[4]

1, 2, 3 y 4: Universidad Politécnica de Madrid, ETS de Arquitectura.
e-mail: juan.monjo@upm.es
e-mail: rosa.bustamante@upm.es
e-mail: lmoyago@gmail.com
e-mail: elena.diaz.santos.90@gmail.com

KEYWORDS: Constructive validity; constructive solution; social housing; twentieth century.

ABSTRACT

An analysis of the “Colonia de Tercio y Terol” (1940) of Madrid, an example of social housing of the first half of the 20th century, is made in terms of its structure, facade and roof from a constructive point of view, taking into account the requirements of the Spanish Technical Building Code (CTE). The analysis methodology is divided into:

a) Documentation of the original situation,
b) Verification of the CTE (Basic Documents SE Structural Safety and HS Health), and
c) Constructive pathology.

The analysis leads to the conclusion that obsolescence is relative and timely. It does not affect load-bearing structures, and as far as pitched roofs, we must indicate that the CTE is not very clear in the demands of that kind of covers. The analysis from the thermal point of view could introduce new parameters, which would condition more radically the possible obsolescence, if the requirements regarding the permissible transmittance of the envelope are not adopted and taking into account that “Tercio y Terol” is a homogeneous ensemble protected as a historical development

CODE 281

HERITAGE BUILDING. COMPREHENSIVE ASSESSMENT AFTER PARTIAL COLLAPSE OF THE STRUCTURE

Ulibarrie, Néstor[1]; Defagot, Carlos[2]; Yoris, Adrián[3]*; Ferreras, María Emilia[4]

1: Universidad Tecnológica Nacional, Facultad Regional Santa Fe,
Centro de Investigación y Desarrollo para la Construcción y la Vivienda.
e-mail: nulibarr@frsf.utn.edu.ar, web: http:cecovi.frsf.utn.edu.ar
2: Universidad Tecnológica Nacional, Facultad Regional Santa Fe,
Centro de Investigación y Desarrollo para la Construcción y la Vivienda.
e-mail: cdefagot@frsf.utn.edu.ar, web: http:cecovi.frsf.utn.edu.ar
3: Universidad Tecnológica Nacional, Facultad Regional Santa Fe,
Centro de Investigación y Desarrollo para la Construcción y la Vivienda.
e-mail: ayoris@frsf.utn.edu.ar, web: http:cecovi.frsf.utn.edu.ar
3: Universidad Tecnológica Nacional, Facultad Regional Santa Fe,
Centro de Investigación y Desarrollo para la Construcción y la Vivienda.
e-mail: emiferreras@yahoo.com.ar, web: http:cecovi.frsf.utn.edu.ar

KEYWORDS: Heritage; pathology; collapse; survey.

ABSTRACT

This article shows as a case of study a building at Santa Fe city (Argentine), cataloged as National Historical Monument. Its construction, with numerous interventions at different times, dates back more than two centuries. The functionality and physiognomy of the building have changed over time; having been used as dependencies of services, housing, government offices, until the present, where the Archive of Province Government was located.
Restoration and maintenance work was carried out periodically on the building, but these did not fully complete the requirements. Additionally the loads in the structures due to the destiny of the building, configures a picture of complex pathologies that seriously affect the construction.
At the beginning of 2017, part of the structure of a building mezzanine collapsed, leaving others part of structure with imminent risk. Consequently, a series of tasks that involved the survey of the main structural elements of walls, roofs and mezzanines; and a general survey of pathology indicators, classifying them according to their pattern, type or definition and magnitude were realized. Being the case, a construction with historical architectural value with a high degree of affectation, the interventions were minimized in extension and quantity.
A diagnosis of the current state of the structure, in order to provide elements, recommendations and suggestions to be taken into account in the design of the subsequent corrective actions, was elaborated from the analysis of the results obtained in the different stages of the assessment.

CODE 301

ASSESSMENT AND QUANTIFICATION OF PATHOLOGIES IN FACADE COVERINGS OF A FEDERAL DISTRICT BUILDING - LEM-UNB METHODOLOGY

Moreira, Bárbara[1], Castro, Eliane[2], Pantoja João[3]*

1: Universidade de Brasília, Brasília, Brasil,
e-mail: barbaraacmoreira@gmail.com
2: Universidade de Brasília, Brasília, Brasil,
e-mail: ekrausc16@gmail.com
3: Universidade de Brasília, Brasília, Brasil,
e-mail: joaocpantoja@gmail.com

KEYWORDS: Pathologies; facade; fail; detachment; displacement.

ABSTRACT

In order to have a good performance in the facades of the buildings it is necessary to make maintenance, guaranteeing the expected lifetime of the project. In this context, the importance of inspections for analysis and performance control and the need for periodicity of maintenance must be consider in order to avoid the appearance of pathological manifestations. To characterize and deal with these manifestations, there are methodologies of inspection and analysis, making possible the qualitative and quantitative evaluation of existing flaws. Considering the need for systematized inspections, the research sought in a very detailed way to apply the existing methodologies for the control and diagnosis of pathologies in facade cladding of a building in Águas Claras, Distrito Federal. The LEM-UnB methodology, modified by Roewer (2007), was used with the accomplishment of complementary tests. Percussion tests were done on facades B and C for the mapping of the detachments. As for the displacement, all the facades were analyzed visually, being the facade C the most affected. The complementary tests have confirmed the state of degradation seen in the inspections. There was failure of the coating by detachment and displacement, mostly located at the bonding and ceramic mortar interface, which may occur due to the poor quality of the material or the failure to perform. There was also the deficiency of horizontal joints of movement and absence of vertical joints of movement. The work met the case study objective, identifying and quantifying the pathological manifestations in facades of ceramic coating.

CODE 315

COMPARATIVE EVALUATION BETWEEN DIFFERENT METHODS OF PRELIMINARY BUILDING DAMAGE MEASUREMENT CAUSED BY THE INESTABILITIES OF A GYPSIFEROUS SLOPE IN FINESTRAT (ALICANTE – SPAIN)

Cano, Miguel[1]; Tomás, Roberto[2]; Tenza-Abril, Antonio J.[3]; Pastor, José L.[4]; Riquelme, Adrián[5]

1: Departamento de Ingeniería Civil
Universidad de Alicante
e-mail: miguel.cano@ua.es, web: http://personal.ua.es/es/miguel-cano
2: Departamento de Ingeniería Civil
Universidad de Alicante
e-mail: roberto.tomas@ua.es, web: http://personal.ua.es/es/roberto-tomas
3: Departamento de Ingeniería Civil
Universidad de Alicante
e-mail: ajt.abril@ua.es, web: http://personal.ua.es/es/ajt-abril
4: Departamento de Ingeniería Civil
Universidad de Alicante
e-mail: joseluis.pastor@ua.es
5: Departamento de Ingeniería Civil
Universidad de Alicante
e-mail: ariquelme@ua.es, web: http://personal.ua.es/es/ariquelme

KEYWORDS: Gypsiferous slope; instabilities; built heritage; damage recording schemes.

ABSTRACT

Urban areas show special vulnerability to the damages caused by slope instabilities. When people are settled down or infrastructures built on the top of slopes, this kind of instability increases the risk to suffer damages. Therefore, damage assessment caused by these instabilities is vital to understand the level of risk exposure. In addition to gaining a better knowledge of the influence of human beings' activities on slides, the study of the damages shown by the infrastructures on these areas can contribute to know the causes of the instabilities. Finestrat historic city centre (Alicante), placed on the crown of a gypsum Keuper slope, is one of the most visited tourist attractions of the Alicante province. The buildings located on the top of this slope show significant damages, cracks on walls and leaning structures that in some cases can affect the building stability. In this work, a preliminary classification of the building damage caused by slope instabilities is carried out applying simple methodologies from different authors. Data such as type of construction and building material, foundation type, architecture features and damaged shown by the building were collected by the work done on the ground. Finally, an analysis of the advantages and disadvantages of the different classifications which can be applied for this kind of works is done.

CODE 340

COMMERCIAL MASONRY MORTARS PERFORMANCE IN AGGRESSIVE SOLUTIONS

Menéndez, Esperanza[1], Argiz, Cristina[2], Sanjuán, Miguel Ángel[3]*

1: Instituto de Ciencias de la Construcción Eduardo Torroja (CSIC)
C/ Serrano Galvache, 4, 28033 Madrid, Spain
e-mail: emm@ietcc.csic.es, web: http://www.ietcc.es
2: E.T.S. Ingenieros de Caminos, Canales y Puertos. Universidad Politécnica de Madrid
C/ Profesor Aranguren, s/n, Ciudad Universitaria, 28040 Madrid, Spain.
e-mail: cg.argiz@upm.es; web: http://www.upm.es
3: Instituto Español del Cemento y sus Aplicaciones (IECA)
C/ José Abascal, 53, 28003 Madrid, Spain
e-mail: masanjuan@ieca.es, web: http://www.ieca.com

KEYWORDS: Edification pathology; durability; masonry mortars; efflorescence.

ABSTRACT

Four masonry mortars, two M5 and two M7.5 according to EN 998-2:2010, were subjected to nine aggressive solutions (NaCl -20g/l y 50g/l- Na_2SO_4 -20g/l y 50g/l-, sea water according to the American standard ASTM D665, K_2SO_4 -2,7g/l- Na_2SO_4 -1,8 g/l- NaCl -0,5 g/l- an a solution prepared mixing these three last ones) with the scope of assessing their resistance to efflorescence. All masonry mortars were factory produced mortars. They were immersed in the testing solutions and the time when the efflorescence occurs was recorded. Also, the affected area was calculated. The results were compared with those found in tap and distilled water where no efflorescence was detected. This fact evidences that the migration of internal mortar components to the surface of this porous material does not happen. By contrary, the most aggressive solutions have been those containing a high concentration of sodium sulfate, i.e. both solutions made of 20 and 50 g/l Na_2SO_4. The four mortars subjected to these solutions showed efflorescence after one day of testing and the affected area was found to be about 40 cm^2. Therefore, the essential process involves the ions migration from the aggressive solution to the porous mortar by absorption and diffusion. The mortar pore solution, with the ions now held in solution, migrates to the surface, then evaporates, leaving a coating of the precipitated ions in form of different salts.

CODE 358

INSPECTION AND CHARACTERIZATION OF THE WOODEN ROOF STRUCTURES OF THE HISTORICAL CENTER OF LEIRIA

Israel, Rúdi[1]; Gaspar, Florindo[2]; Veludo, João[3]

1: Departamento de Engenharia Civil
Instituto Politécnico de Leiria, ESTG
e-mail: 2140851@my.ipleiria.pt, web: https://www.ipleiria.pt/
2: Departamento de Engenharia Civil
Instituto Politécnico de Leiria, ESTG, CDRSP
e-mail: florindo.gaspar@ipleiria.pt, web: https://www.ipleiria.pt/
3: Departamento de Engenharia Civil
Instituto Politécnico de Leiria, ESTG, CERIS
e-mail: joao.veludo@ipleiria.pt, web: https://www.ipleiria.pt/

KEYWORDS: Inspection; wooden roofs; trusses; anomalies; conservation state.

ABSTRACT

Inspection, survey and characterization of wooden roof structures in old buildings is fundamental for planning and intervention for rehabilitation and reinforcement actions. The present work focuses on the Historic Center of Leiria (HCL), developing a diagnostic work, with the survey of the typologies of wood structures and evaluation of the conservation status of the roofs.
In first place a contextualisation of the area under study is made, followed by a synthesis of the types of wooden structures applied in old buildings, namely the trusses. A summary of the most common anomalies in wood structures and possible causes is also made.
Inspection data sheets adapted to the HCL were used to record the information collected during the inspection of the roofs that had the original wooden structure. In addition to the inspection, a photographic record, measurements and a geometric and structural survey of the wood structures were carried out, as well as the measurement of the water content.
The results of this work allowed to characterize the inspected roofs, with respect to their shape, constitution, geometry and pathologies, making an evaluation of their state of conservation, representative of the overall wooden roof structure of the HCL. The main types of structures used were identified as well as the materials, where maritime pine wood is dominant. In general, the roofs are in a very deteriorated and degraded state, emphasizing the importance of the intervention, inspection and maintenance of the roofs of the old HCL buildings.

CODE 405

SYSTEMATIC CHARACTERIZATION OF ROOFS IN THE HISTORICAL CENTER OF VISEU, WITH RESOURCE TO DRONES: ANALYTICAL CRITERIA AND RESULTS

Mendes da Silva, José[1]; Cunha, Inês[2]; Mouraz, Catarina[3]

1: LAETA_ADAI, Departamento de Engenharia Civil,
Universidade de Coimbra
e-mail: raimundo@dec.uc.pt, web: http://www.uc.pt/fctuc/dec
2: Departamento de Engenharia Civil,
Universidade de Coimbra
e-mail: maria.ines.cunha13@gmail.com, web: http://www.uc.pt/fctuc/dec
3: Departamento de Engenharia Civil,
Universidade de Coimbra
e-mail: catarinamouraz@hotmail.com, web: http://www.uc.pt/fctuc/dec

KEYWORDS: Urban regeneration; visual inspection; traditional roofs; state of conservation; inspection with drones

ABSTRACT

The degradation of sloped roofs is a major concern in older buildings because of the risk it poses, both in terms of structural safety and in terms of preserving all the underlying building elements and ensuring the health and comfort conditions for its inhabitants.
As a result of the natural aging of the roofs, the consequences of lack of maintenance and incidental and erroneous remedial actions, which often also conflict with the existing structure and its operation, threaten the identity of roofs and historic centers.
To define strategies and techniques of intervention, on an urban scale, on traditional roofs it is essential to know the different geometries, their unique points and their state of conservation.
In order to fulfill this objective, an inspection plan was defined as approximately 300 roofs in the historical center of the city of Viseu, with the use of "drones" and later data processing, developed using characterization and evaluation grids.
The study identifies typical situations and identities, unique situations and relevant architectural and patrimonial value, intervention and rehabilitation errors, as well as typical situations of deterioration.
The process involved a set of steps, such as the inspection program, the making of videos, the obtaining of fixed images, the creation of characterization grids, the classification of defects and, finally, the preliminary analysis of results, with a view to definition of a municipal intervention strategy, namely in the possible revision of the current regulation and in the definition of rehabilitation policies and incentives. This article will focus on the presentation of the constructive and architectural characteristics of the roofs as well as the analysis of their conservation status.

CODE 467

PATHOLOGICAL STUDY AT ENG. ELADIO DIESTE'S CRISTO OBRERO CHURCH, URUGUAY

Stela Sabalsagaray[1,a]; Carola Romay[1,b]; Alina Aulet[1,c]; Gianella Mussio[2,d]

1 Facultad de Ingeniería, Universidad de la República, Uruguay
2 Facultad de Arquitectura, Diseño y Urbanismo, Universidad de la República, Uruguay
[a]sabalsa@fing.edu.uy, [b]cromay25@hotmail.com, [c]aaulet@fing.edu.uy, [d]gianellamussio@gmail.com,

KEYWORDS: Cristo Obrero Church - Eng. Dieste; reinforced masonry; pathological damages.

ABSTRACT

Engineer Eladio Dieste was a relevant and eminent innovator in the field of engineering, national and international architecture, author of numerous industrial, cultural, religious, commercial and residential works, using a unique technology known as reinforced masonry. Using this technique, he led to maximum expression the characteristic materials of the Uruguayan construction, bricks, steel reinforcement and mortar cement, giving rise to structures and sinusoidal envelopes. By virtue of its singularity and relevance, various valuation, restoration and promotion initiatives are currently being carried out in Uruguay.
The Getty Foundation through its Keeping It Modern program in 2016 financed the Creation of a Conservation Management Plan and Administration System for Cristo Obrero Church, built by Engineer Eladio Dieste in 1958, currently declared a National Historic Monument. Teams belonging to different institutions and organizations participated in this project, forming a multidisciplinary team that carried out the metric building survey, characterization of materials (ceramics, mortars and reinforcements), studies of resistant evaluation, of damages, of the subsoil, historical, at an urban and sociocultural level. The obtained results represent a direct contribution for the conservation of the building as well as a relevant antecedent for the diagnosis and conservation of other important buildings of Dieste, whose work has recently been included in the World Heritage Tentative List of UNESCO.
An advance is exposed in the present article on the study of the damages that affect the ceramic pieces and the joint mortars (that eventually cover reinforcements) used in the Church.

CODE 473

2016 EARTHQUAKE IN ECUADOR: MISSION TECNALIA. TECHNICAL ASSISTANCE FOR EVALUATION OF DAMAGED BUILDINGS

Marcos, Ignacio[1]*; Díez Hernández, Jesús[2]; Lasarte, Natalia[3]; Gandini, Alessandra[4]; Garmendia, Leire[5]; Egiluz, Ziortza[6]; Piñero, Ignacio[7]; García Llona, Aratz[8]

1: Departamento de Ingeniería Mecánica, Universidad del País Vasco UPV/EHU
ignacio.marcos@ehu.eus
2: Fundación TECNALIA Research & Innovation
jesus.diez@tecnalia.com
3: Fundación TECNALIA Research & Innovation
natalia.lasarte@tecnalia.com
4: Fundación TECNALIA Research & Innovation
alessandra.gandini@tecnalia.com
5: Departamento de Ingeniería Mecánica, Universidad del País Vasco UPV/EHU
leire.garmendia@ehu.eus
6: Departamento de Ingeniería Mecánica, Universidad del País Vasco UPV/EHU
ziortza.egiluz@ehu.eus
7: Fundación TECNALIA Research & Innovation
ignacio.pinero@tecnalia.com
8: Fundación TECNALIA Research & Innovation
aratz.garcia@tecnalia.com

KEYWORDS: Earthquake; buildings; typology of damage; pathology; rehabilitation.

ABSTRACT

On April 16, 2016, at 7:00 pm, the land on the Ecuadorian coast trembled, leaving around 700 people dead and the neuralgic centers of several cities destroyed.
A message from Tecnalia Ecuador, and a quick response from Tecnalia Bilbao leads to the proposal to send, in a voluntary and altruistic way, a team of experts in structural pathology to ground zero for 15 days. Three weeks later the team takes land in Quito and puts itself at the disposal of the Ecuadorian Government to plan and coordinate the mission. In these works has collaborated professors of the University of The Basque Country.
Displaced to the zero zone of Manta and Portoviejo, two important cities of the most affected area, and accompanied by technicians from the Ministry of Development and Housing, the work of evaluating the condition of the buildings, investigating causes of damage and collapses, to identify the constructive errors were committed in order to prevent them in the reconstructions.
Basic and detailed inspections were carried out in a total of some 60 buildings, both official and private. The methodology to define the works was based on “detailed assessment sheets for buildings affected by earthquake”, in which, in addition to collecting the condition of the building, a chapter of recommendations for action is included.
In the article, in addition to explaining the scope of the mission, the effects of the earthquake on the structures, the most common failures and their relationship with the constructive systems used are also analyzed.

CODE 479

ANALYSIS OF THE ROTATING FOOTBRIDGE ALFONSO XIII OF ONDARROA

Piñero, Ignacio[1]; Marcos, Ignacio[2]; San Mateos, Rosa[3]; Garmendia, Leire[4]; Egiluz, Ziortza[5]

1: Fundación TECNALIA Research & Innovation
e-mail: ignacio.pinero@tecnalia.com
2: Departamento de Ingeniería Mecánica, Universidad del País Vasco UPV/EHU
e-mail: ignacio.marcos@ehu.eus
3: Fundación TECNALIA Research & Innovation
e-mail: rosa.sanmateos@tecnalia.com
5: Departamento de Ingeniería Mecánica, Universidad del País Vasco UPV/EHU
e-mail: leire.garmendia@ehu.eus
6: Departamento de Ingeniería Mecánica, Universidad del País Vasco UPV/EHU
e-mail: ziortza.egiluz@ehu.eus

KEYWORDS: Steel footbrigde; heritage; durability.

ABSTRACT

Alfonso XIII bride over the Artibai river is located in Ondarroa and it was built in 1925. This footbridge was also known as “beach´s bridge” by the locals and it was mandatory the payment of a toll in order to cross it.
The steel bridge makes the passage of ships compatible with the access to the beach, due to this, its rotating mechanism. The bridge had three-span rigidly connected part made of concrete, which do not exist nowadays, and a rotating steel span over the estuary. The movable section was composed of two identical rotating leaves supported by two piers. This movable leaves allowed the navigation on the river, wich was highly important at that time.
Over the years, several transformations have taken place on the walkway. For instance, the loss of the fixed section made of reinforced concrete and the electrical drives installed in 1931. Likewise, the closing of the two leaves due to the fact that it is not needed to be opened for maritime navigation, caused the disappearance of the toll hut and part of its mechanisms. This lack of functionality has caused a severe deterioration in the structure, which is inside the Basque Cultural Heritage.
The paper shows the uniqueness of the walkway, its current state of conservation and the previous studies carried out aimed at its rehabilitation, which are intended to be undertaken in the near future.

CODE 481

AN EXPERIMENTAL STUDY ON A FULL-SCALE MASONRY TIMBREL CROSS-VAULT SUBJECTED TO SETTLEMENT IN ONE OF ITS SUPPORTS

Juan J. Moragues[1]*; Benjamín Torres[2]; Pedro A. Calderón[3]; José M. Adam[4]; Teresa M. Pellicer[5]

1: ICITECH, Universitat Politècnica de València
e-mail: jmorague@upv.es, web: http://www.upv.es/entidades/ICITECH/
2: e-mail: bentorgo@upvnet.upv.es
3: e-mail: pcaldero@upv.es
4: e-mail: joadmar@upv.es
5: e-mail: tpa@upv.es

KEYWORDS: Vault; masonry; vulnerability; heritage; experimental testing.

ABSTRACT

The necessity of maintenance of the built Heritage is one of the biggest concerns of our society nowadays. Notwithstanding that some efforts have been made to preserve and maintain it, there is still much work to be done. Accidental actions and extreme events can cause the failures of the buildings, especially if they are masonry. That is the case of most of the Heritage buildings, whose structures can be very damaged by these events. For this reason, it is increasing the awareness of our society to protect these constructions against these actions. Regarding this concern, an experimental programme is being developed at the ICITECH (Universitat Politècnica de València). The SIMAX project studies the effect of the settlements, among other actions, in masonry structures. For that, a full-scale cross-vault has been tested in ICITECH laboratories. The tested vault is identical to the vault of the San Lorenzo de Castell de les Cabres church (Castellón, Spain). The approximate dimensions of the vault are 4*4 m. A settlement in one of the support of the vault has been simulated in order to characterize its behaviour. This paper shows the main preliminary results of the test.

CODE 482

ANALYSIS AND ACTIONS OF THE PATHOLOGIES PRODUCED IN THE CHURCH SANTIAGO APOSTOL SITA IN CASTRILLO DE MURCIA BELONGING TO THE HERITAGE HISTORIC OF CASTILLA Y LEÓN

Fiol, F.; Skaf M.; Ortega-López, V.; Fuente-Alonso, J.A.; Aragón, A.; Manso, J.M.

1: Universidad de Burgos, Escuela politécnica superior.
ffiol@ubu.es, mskaf@ubu.es, vortega@ubu.es, jafuente@ubu.es, aaragon@ubu.es, jmmanso@ubu.es

KEYWORDS: Pathology of the stone; pathology in the construction; preventive conservation of the built heritage; plans of intervention; stone tests.

ABSTRACT

The work carried out consists in the analysis of the existing pathologies in a building dedicated to the cult built from the end of the 15th century until the end of the 16th century located in "Castrillo de Murcia", province of Burgos (Spain).
In the present article the constructive history was studied through the analysis of different documents of historical archives, describing the constructive system used and its execution in time, as well as the material used for its construction. All this to finally determine the main causes of the deterioration of the stone that composes it, considering the environment of the building (climatology, geological formations, pedology, etc.).
To determine the pathological history, fieldwork was required, in which the fundamental physical and mechanical injuries per seat were documented. Likewise, characterization tests were carried out on the stone used in the construction, evaluating its alteration and degradation over time. The wooden structure of the existing roofs and roofs is also studied, observing a slight abiotic degradation.

CODE 499

MODELS OF PROPAGATION OF REINFORCED CONCRETE DETERIORATION

Carmen Andrade[1]

1: Centro Internacional de Métodos Numéricos en Ingenieria, CIMNE
UPC- Madrid
e-mail: candrade@cimne.upc.edu, web: http://www.cimne.es

KEYWORDS: Service life; corrosion; concrete deterioration; models, propagation.

ABSTRACT

Numerous existing structures located in marine environments manifest premature corrosion of reinforcement. Corrosion propagation modelling is necessary for the prediction of its performance and safety. In present paper the model proposed years ago is illustrated by means of the data collected in some reinforced concrete elements and specimens, with and without 3% admixed chlorides or carbonated, exposed to the Madrid atmosphere during more than 25 years. The instantaneous corrosion rate together with the associated parameters of corrosion potential and resistivity has been monitored periodically. The accumulated corrosion can be considered lineal as the climatic events repeat annually. In the paper is also presented the hydrothermal performance of concrete and its influence on the reinforcement corrosion process. The effect of temperature is double and in opposition because, on one hand it increases the corrosion rate in presence of capillary water but on the other hand, it induces its evaporation and increase in resistivity which decreases the corrosion rate. The evaporable water content of a concrete and not the relative humidity is what is directly related to the risk of deterioration reinforcement corrosion and therefore the most crucial effect is the direct exposition to rainfall or snow events.
Reinforced concrete may suffer rebar corrosion but also other types of attack to the material integrity. When these processes develop actively at significant rate, they usually manifest through cracking of concrete cover, expansions and efflorescences and they are named, for the sake of the service life calculation, as “propagation” periods. The most known generic model is that of reinforcement corrosion published by Tuutti with two time- phases: corrosion initiation and propagation, that is, during the penetration of aggressive substances no damage is produced until achieving the aggressive front the rebar level, where the oxides formed provoke the cracking of the cover. This result into a horizontal line regarding the damage level followed with a continuous increase when the external sign of deterioration are visible. The other most frequent attacks are: alkali-silica reaction or sulfate attack, acid or leaching by pure waters and frost attack. In present communication, although of complex mechanisms as corrosion is, it is shown that all these propagation periods can be linearized in order to be made “generic” and with the possibility to be considered too as a two-period service life model. Some examples are commented, in particular that of reinforcement corrosion which is modelled through a constant rate or with a bilinear trend.

CODE 19

COLLAPSE MECHANISM IN MASONRY WALLS THROUGH USING NUMERICAL CALCULATION: SHORING ON THE GROUND FLOOR

Calderón, Lucrecia[1]; Suarez, Sindy[2]

1: Departamento de Estructuras
Universidad Politécnica de Cataluña
e-mail: lucrecia.calderon@upc.edu
2: UAN Universidad Antonio Nariño
e-mail: sindysofia@uan.edu.com

KEYWORDS: Masonry; craking; arc; deformation; tension.

ABSTRACT

An important part of the Spanish built Park consists of load-bearing structures consisting of masonry that must be the opening of new hollows (shoring) that affect the whole.
The aim is to present the development of the different “cracking patterns” of walls with "shoring", i.e. the opening of new hollow with asymmetrical position on the ground floor, with the existence of one hollow in the top. For this, it has been necessary to establish some limitation requirements of the study, such as: only the action of gravity loads are considering, the wall is two floors and it is located inside the building, there is symmetry between the floor slabs that support both sides of it, and as important factor there are minimal edge beam.
The methodology used is based on "linear elastic" behavior according to other researchers and it is necessary to know the mechanical properties of the material. This has been proven by the study of simple models and real cases of collapsed buildings, and results have been quite accurate.
The cracking patterns that had been obtained are important in the rehabilitation field. They help the interpretation of their behavior in the wall. Not only locally, where we run the opening of a new hole, but as a whole; being able to predict the weak points and prevent future pathologies.

CODE 21

toGPRi: A PROCESSING AND VISUALIZATION TOOL FOR 3D-GPR DATA IN CULTURAL HERITAGE. APLICATION IN THE ROMAN SITE "AQUIS QUERQUENNIS" IN BANDE (OURENSE, SPAIN)

Sanjurjo-Pinto, Javier[1]; Solla Carracelas, Mercedes[2]; Puente Luna, Iván[3]; Prego Martínez, Francisco Javier[4]*

1: University of Vigo, School of Mining, Ph.D. Programme in Protection of the Cultural Heritage.
e-mail: jsanjurjo@jspinto.net; web: http://www.uvigo.gal
2: University of Vigo, Defense University Center, Spanish Naval Academy.
e-mail: merchisolla@cud.uvigo.es; web: https://cud.uvigo.es
3: University of Vigo, Defense University Center, Spanish Naval Academy
e-mail: ipuente@cud.uvigo.es; web: https://cud.uvigo.es
4: University of Vigo, School of Mining, Ph.D. Programme in Geotechnologies applied to Construction, Energy and Industry. R&D Departament at Extraco S.A. and Misturas S.A.
e-mail: i-d-i@extraco.es; web:http://www.extraco.es

KEYWORDS: Ground Penetrating Radar (GPR); laser scanner; archaeology; 3D representation; heritage, toGPRi.

ABSTRACT

The ground-penetrating radar (GPR) is a non-destructive geophysical method based on the emission of electromagnetic pulses into the ground by a transmitting antenna. It is one of the most utilized techniques for archaeological prospections since the early 90's of the XX century: it provides high-resolution images and even three-dimensional visualizations. However, there are very few commercial software for advanced 3D-data processing and visualization of these images. In this context, the aim of this work was to develop a free and open-source tool for GPR signal processing, named "toGPRI". It has been developed in GNU Octave programming language and it implements signal amplification and noise removal filters ("scattering") of the electromagnetic signal, allowing topographic corrections too. Regarding the 3D processing and visualization, this tool allows users to create 3D models and subsequent XY bi-dimensional images ("raster-layers" or "time-slices") in depth. It is also capable of creating overlayed images to connect signal reflections at different levels or depths, obtaining an approximate reconstruction of the occupied underground space. All these 3D images are also georeferenced, so they can be easily integrated into a Geographic Information System (GIS) environment, in order to perform a more successful territorial planning analysis in the area.
"toGPRi" has been field-tested, studying the Roman site "*Aquis Querquennis*" in Bande (Ourense Spain). A 3D-GPR data acquisition was carried out in the archaeological site, obtaining a 3D reconstruction of the archaeological site ground. It has revealed the existence of some buried structures, as the primitive barracks of the roman camp. A recent excavation conducted in the campaign of 2016 has confirmed such GPR interpretation.

CODE 22

STRUCTURAL BEHAVIOUR OF THE GOVERMENT BUILDING OF THE GENERAL ARCHIVE OF THE NATION OF MEXICO

Cruz, Claudia E.[1]; Peña, Fernando[1]; Chávez, Marcos M.[1]

1: Coordinación de Ingeniería Estructural
Instituto de Ingeniería, UNAM
e-mail: ccruzc@iingen.unam.mx; fpem@pumas.iingen.unam.mx; mchavezc@iingen.unam.mx

KEYWORDS: Lecumberri Palace; masonry; finite elements; seismic behaviour; differential settlements.

ABSTRACT

The study of the structural behaviour of the Government Building of the General Archive of the Nation is presented. This building has been placed in the Lecumberri Palace in Mexico City, a former prison that was inaugurated in 1900 and closed in 1976. After several remodelling works this building was inaugurated in 1982 as the governing body of the national archives.
The building is constituted by brick masonry with lime mortar. The building is founded on a deposit of high plasticity and very compressible clays that with the overexploitation of the aquifers cause the problem of regional settlements in the area.
For its study, a geometric and damages survey were conducted, as well as environmental vibration to know the dynamic properties and a finite element model were performed. In general, the structural assessment was found acceptable, the study shows its ability to withstand seismic actions in accordance with current Mexican building code, mainly due to the high density of walls that provide a greater stiffness. Therefore, the vibration period of this structure is very far from the dominant period of the soil. In conclusion, the critical condition of the building is the differential settlements, causing damage to the building.

CODE 44

ACOUSTIC TESTS USING ULTRASOUND ON MARBLE ELEMENTS OF THE ROMAN THEATRE OF MÉRIDA

Jiménez, Antonio[1]*; Pérez, M. Paz[2]; González-Mohino, Alberto[3]; Márquez, Juana[2]; Rufo, M. Montaña[1]; Rodríguez, Sara[2]; Paniagua, Jesús, M[1]; Marra, Ángel M.[1]; Álvarez, Mailen S.[1]

1: Grupo de Radiaciones no Ionizantes y de Inspección Ultrasónica
Universidad de Extremadura
e-mail: ajimenez@unex.es, web: https://www.unex.es/investigacion/grupos/grniiu
2: Consorcio Ciudad Monumental de Mérida
e-mail: marypaz@consorciomerida.org, web: http://www.consorciomerida.org
3: Departamento de Tecnología de los Alimentos, IPROCAR
Universidad de Extremadura
e-mail: albertogj@unex.es, web: http://www.unex.es

KEYWORDS: Roman Theatre of Mérida; ultrasound; marble; state of conservation.

ABSTRACT

The Roman Theatre of Mérida is considered one of the most emblematic monuments of the Spanish archaeological heritage. As such, it has been and continues to be the focus of numerous studies. In this work, we address the complex theme of the conservation of the building itself.
We present the results of a preliminary study aimed at evaluating the use of different acoustic techniques using ultrasound on marble elements, specifically on two cornices of scenic front with different state of deterioration. The ultrasonic inspection was carried out using two pairs of ultrasonic shear wave transducers (100 kHz and 500 kHz in frequencies each) in through-transmission mode, which allowed us to characterize both samples by: (a) Propagation velocities of shear and longitudinal waves. (b) The frequency distribution and (c) the attenuation of the transmitted waves in the specimens
As for the transmission velocity, the results obtained in the samples range from 2903 m/s to 5025 m/s for the longitudinal and from 1924 m/s to 2835 m/s for the transverse ones. The results are consistent, on the one hand, with the state of deterioration of the samples, in the sense that the most deteriorated specimen is also the one with the lowest velocity values, and on the other hand, with the measurement direction, since in a single specimen the horizontal direction presents in general greater values of velocity than the vertical, as it corresponds to the direction of preferential foliation of the marbles.
We observed a significant difference in the frequency values transmitted by the more and less deteriorated specimens and we detected a greater attenuation of the ultrasonic waves in the most deteriorated sample.
Taking everything into consideration, we deduce that the mentioned ultrasonic parameters are ideal when evaluating the state of conservation of a part.

CODE 64

GEOEMTRIC MODELING AS A STARTING POINT TO STRUCTURAL EVALUATION OF MASONRY ARCHS ANDVAULTS

Mencías-Carrizosa, David[1]*

1: Departamento de Construcción y Tecnología Arquitectónicas
Universidad Politécnica de Madrid
e-mail: dameca@gmail.com

KEYWORDS: Masonry; structural analysis; equilibrium; limit analysis; analytic geometry.

ABSTRACT

The geometric survey, the acquisition of the geometry and its subsequent modelling are the first steps that must be carried out prior to any intervention in an existing construction. The information encoded in the CAD models serves as a starting point for the realization of the structural evaluation, especially in historic masonry structures such as arches and vaults, where the weight of the structure is the most important vertical action to which the structure is subject. For this reason, the geometric information contained in the model serves both to determine the loads and to evaluate the structure itself, especially in those where these two properties are so closely linked. Modelling and representation techniques store analytical information obtained through either automatic or manual procedures, in digital sources, which will need to be interpreted in order to visualize and represent the construction under study. This article makes a tour of the most common techniques of survey, modelling and refining and its relationship with the overall structural evaluation of the structure, whether it is used as a support for subsequent structural modelling or by using the geometric model. In one case or another, the relevant information obtained from the survey will be different and the degree of precision and approximation to the real object will also be, so it must be in line with the structural analysis technique used.

CODE 124

A SIMPLE PROPOSAL FOR THE SEISMIC RISK ASSESSMENT OF WOODEN PATRIMONIAL STRUCTURES IN CHILE

Valdebenito, Galo[1]; Vásquez, Virginia[2]

1: RiNA Núcleo de Investigación en Riesgos Naturales y Antropogénicos en Chile, Facultad de Ciencias de la Ingeniería, Universidad Austral de Chile
e-mail: gvaldebe@uach.cl, web: http://www.rina.cl
2: RiNA Núcleo de Investigación en Riesgos Naturales y Antropogénicos en Chile, Facultad de Arquitectura y Artes, Universidad Austral de Chile
e-mail: vicky.vasquez@gmail.com, web: http://www.rina.cl

KEYWORDS: Seismic risk; wooden structures; patrimony; Chile.

ABSTRACT

The seismic risk assessment of patrimonial wooden structures constitutes a relevant issue not sufficiently considered in the current status of the seismic engineering community.
A simple proposal to evaluate the patrimonial seismic risk of wooden structures is presented, taking as study case the city of Valdivia, in southern Chile. The seismic risk is analyzed under three core aspects: vulnerability, hazard and architectural cost that considers the patrimonial variable.
The vulnerability assessment is considered by means of the vulnerability index method taking into considerations the most relevant parameters involved in wooden patrimonial structures. The seismic hazard considers both the uniform and local seismic conditions. The architectural cost considers the architectonic relevance, predominant styles, architectonic exposure and the territorial architectonic value.
Field measures were performed in order to obtain relevant information, taking as a study case the historic area in the city of Valdivia. Having defined the basic parameters, is created a computational platform, RIPAT, which calculates patrimonial risk, also establishing recommendations related to the intervention criterion.
As a result, the need to incorporate the patrimonial variable through the architectural assessment was found, generally becoming more significant than the other aspects. In these sense it´s important to understand that the seismic risk assessment of historic structures with the inclusion of the patrimonial variable is more than a structural or seismic evaluation only.

CODE 163

STRUCTURAL EVALUATION THROUGH MEF FOR THE STUDY OF PATHOLOGIES OF THE CHURCH OF SANTA ANA IN SEVILLE

Valseca, J.A.[1*]; Rodríguez-León, M.T.[2]; Compán Cardiel, Víctor Jesús[3]; Vázquez, Enrique[4]; Sánchez, J.[5]

1: Estructuras de Edificación e Ingeniería del Terreno
Universidad de Sevilla
e-mail: jav@us.es
2: Estructuras de Edificación e Ingeniería del Terreno
Universidad de Sevilla
e-mail: mtrl@us.es
3: Estructuras de Edificación e Ingeniería del Terreno
Universidad de Sevilla
e-mail: compan@us.es
4: Estructuras de Edificación e Ingeniería del Terreno
Universidad de Sevilla
e-mail: ev@us.es
5: Estructuras de Edificación e Ingeniería del Terreno
Universidad de Sevilla
e-mail: josess@us.es

KEYWORDS: Gothic-mudejar; masonry; vault geometry; MEF; modal analysis.

ABSTRACT

The socio-cultural circumstances in which the city of Seville was after the Reconquest will make the Church of Santa Ana the first to be built with a new plant and with a strong defensive character due to the sieges to which the city was subjected. The layout of a new plant, in the Gothic-Mudejar style, in addition to the defensive needs will necessitate that the cover of the Church must be resolved in a passable way in order to be able to defend itself from the continuous attacks, which made impossible its execution through the traditional system of par and knuckle that had been developing in the previous Parochial Churches in Córdoba.

The domed solution of the roofs, solved with brick and stone ribs, responds to a modulated plant distribution in which the lateral vaults are in a 10/7 relation (rods) with respect to the central one.

The works that we have been developing are mainly focused on the modelling of said geometries for their subsequent discretization and analysis by the Finite Element Method (MEF). For the generation of the geometry computer software modelling as CATIA or RHINOCEROS have been used for further processing and meshing through ANSYS ICEM CFD. The mesh has been made by shell elements for the complete model and solid elements for the more detailed analysis of a vault section and particularly the start of nerves.

The indicated computer models are analyzed in order to address the overall behavior and to identify the pathologies that are detected in some of the facings. Likewise, the modal analysis gives us information about the rigidities that certain elements contribute, such as the head and feet of the nave and the tower.

CODE 164

USE OF NON-DESTRUCTIVE TESTING TECHNIQUES GPR AND IRT IN THE ANALYSIS OF REINFORCED CONCRETE CORROSION: MILITARY BATTERY OF CABO UDRA

Vidal, Francisco Javier[1]*; Solla, Mercedes[2,4]; Lagüela, Susana[3,4]; Devesa, Rosa[2]

1: University of Vigo, PhD Program in Geotechnologies Applied to Construction, Energy and Industry, 36310 Vigo, Spain
e-mail: abadon13@hotmail.com
2: Defense University Center, Spanish Naval Academy, Plaza de España s/n, 36900 Marín, Spain
e-mail: merchisolla@cud.uvigo.es, e-mail: rosa.devesa.rey@cud.uvigo.es
3: University of Salamanca, Department of Cartographic and Terrain Engineering, Calle Hornos Caleros, 50. 05003 Ávila, Spain
e-mail: sulaguela@usal.es
4: University of Vigo, School of Mining, Applied Geotechnologies Research Group, Rúa Maxwell s/n, Campus Lagoas-Marcosende, 36310 Vigo, Spain
e-mail: merchisolla@cud.uvigo.es

KEYWORDS: NDT; georadar, infrared thermography; corrosion; reinforced concrete.

ABSTRACT

Reinforced concrete structures are fundamental elements in the support of buildings and other civil engineering constructions. One of the pathologies with most effect on reinforced concrete resistance is corrosion. Corrosion can influence reinforced concrete in three ways: concrete cracking, oxidation of steel or modify the adhesion of the steel-concrete system.
In order to evaluate corrosion, the use of complementary non-destructive techniques is proposed, given that they do not alter the reinforcement structure. This work shows the results obtained from the combination of the techniques of georadar (GPR) and infrared thermography (IRT), for the detection and evaluation of corrosion in reinforced concrete in a particular case of study: the Military Battery of Cabo Udra (Bueu, Pontevedra). The combination of both techniques allows identifying areas with different dielectric and thermal conductivities, respectively, in addition to internal conditions that affect the emissivity of the material externally.
The GPR study was carried out with a MALÅ ProEx system, using a 2.3 GHz antenna, with a depth of penetration of 40 cm and a spatial resolution of 1-2 cm. Six profiles of one meter have been acquired, with de-polarized configuration of the antenna and perpendicular direction to the length of the steel bars. The thermal analysis was performed with a NEC thermographic camera with an uncooled sensor, and the most representative temperature sample was between 21-22.5 ºC.
The images acquired show how the penetration capacity of the GPR signal and the reflection intensity (amplitude), decrease as the chloride and humidity contents increase, finally reaching total signal attenuation and its consequent total loss of information. With respect to infrared thermography, the detection of corroded areas and the presence of water that favors this phenomenon are possible, since both corroded materials and water have a different thermal conductivity and emissivity than no corroded elements.

CODE 188

CONSTRUCTIVE, MECHANICAL AND PHYSICAL CHARACTERIZATION OF GRANITE STONE MASONRY WALLS IN THE OLD URBAN CENTRE OF VISEU, PORTUGAL

Domingues, José C.[1]; Ferreira, Tiago M.[2*]; Negrão, João[3]; Vicente, Romeu[4]

1: Departamento de Engenharia Civil
Universidade de Coimbra
e-mail: jcarl.domingues@gmail.com
2: ISISE - Departamento de Engenharia Civil
Universidade do Minho
e-mail: tmferreira@civil.uminho.pt, web: http://tmferreira.weebly.com
3: Departamento de Engenharia Civil
Universidade de Coimbra
e-mail: jhnegrao@dec.uc.pt
4: RISCO - Departamento de Engenharia Civil
Universidade de Aveiro
e-mail: romvic@ua.pt

KEYWORDS: Old urban centre; granite masonry; mechanical characterization of stone masonry; in situ campaign; flat-jack testing.

ABSTRACT

Adequate constructive and mechanical characterization of stone masonry is an essential step in defining intervention strategies that might lead to the preservation of the buildings present in old urban centres, where stone masonry structures represent all, or at least the majority, of vertical resisting elements. Destructive testing is, in this context, not advisable, and the need arises for semi- or non-destructive procedures that allow obtaining, with the minimum damage, the data to be used in structural modelling for safety evaluation.

This paper presents and discusses the results obtained from an *in situ* test campaign conducted in the old urban centre of Viseu. This analysis intends to provide data that might help in the identification of typologies and in the estimate of mechanical properties of stone masonry walls in the old urban centre of Viseu, aiming at supporting the intervention in these buildings. Granite stone masonry walls of two different buildings were analysed and characterised considering their geometrical and material characteristics. Flat-jack testing technique was used to obtain resistance and deformability parameters to be used both in safety evaluation and intervention design.

CODE 189

PROPOSAL OF A NON-INVASIVE METHODOLOGY FOR THE CONSTRUCTIVE AND GEOMETRIC CHARACTERIZATION OF WATER DEPOSITS AND ALJIBES IN HISTORICAL BUILDINGS

Del Río Pérez, Luis Mariano[1*]; Rueda Márquez de la Plata, Adela[2]; Cruz Franco, Pablo Alejandro[3]; Martín García, Mª del Mar[4]

1: Department of Applied Physics. Polytechnic School
University of Extremadura. IP of the COMPHAS Research Group
e-mail: lmdelrio@unex.es
2: Architectural Expression Department. Polytechnic School
University of Extremadura. COMPHAS Research Group
e-mail: adelarm@unex.es
3: Construction Department. Polytechnic School
University of Extremadura. COMPHAS Research Group
e-mail: pablocruzfranco@unex.es
4: Polytechnic School. University of Extremadura
e-mail: mmartinzx@alumnos.unex.es

KEYWORDS: GPR; cultural heritage; cistern; non-invasive techniques; Cáceres.

ABSTRACT

The goal of this investigation is to show the methodology and the results obtained in the application of a non-invasive system for the geometric and constructive characterization of water tanks in historic buildings. For this, we used a georadar (GPR) as a prospecting technique in walls and floors, which allows to identify possible structures or hidden cavities. The equipment has different antennas that have made it possible to work at different depths and spatial resolutions.
The interpretation of the results is complicated, requiring an analysis and processing of the information, apart from extensive knowledge not only of the geo-detection but also of what we are looking for and how it behaves before this technique.
Methodologically, we proposed three study areas. The choice of them responds to their formal and constructive peculiarities. The first two zones have been used to "calibrate" and "analyze" the behavior of the different antennas before these architectural elements, checking the response of the different frequencies against different materials and geometries. These first two tanks or reservoirs have been restored by the work team and are also accessible, knowing both dimensions and the different materials that make them, an essential fact to be able to cross the data obtained with reality and be able to draw conclusions, enunciate a methodology and obtain a catalog of results that will serve other researchers.
In last and third place, the knowledge acquired is applied to a non-accessible cistern from which its formal characteristics, depth and materials can not be known, in order to be able to elaborate a non-invasive restitution by means of this technique. The selected building is the Ovando Palace, which, like many other buildings in the City of Cáceres, has a deposit located in the porticoed patio that articulates this Palace.

CODE 191

INSPECTION, DIAGNOSIS AND REHABILITATION PROPOSAL ON THE WOODEN BRIDGE INGENIERO CAPURRO DE DURAZNO (URUGUAY)

Vega, Abel[1]; Baño, Vanesa[2]; Cetrangolo, Gonzalo[2]; Domenech, Leandro[2]; Mazzey, Carlos[2]

1: Área de Tecnología, Construcción y Madera Estructural
Centro Tecnológico Forestal y de la Madera de Asturias (CETEMAS)
e-mail: avega@cetemas.es, web: http://www.cetemas.es
2: Instituto de Estructuras y Transporte, Facultad de Ingeniería,
Universidad de la República, Uruguay
e-mail: vanesab@fing.edu.uy, web: https://www.fing.edu.uy/iet
e-mail: gonzaloc@fing.edu.uy, web: https://www.fing.edu.uy/iet
e-mail: ldaguiar@fing.edu.uy, web: https://www.fing.edu.uy/iet
e-mail: cmazzey@fing.edu.uy, web: https://www.fing.edu.uy/iet

KEYWORDS: Structural diagnosis; wood structures; non-destructive test; rehabilitation.

ABSTRACT

The Capurro bridge, declared of Departmental Interest, dates back to 1903 and links the towns of Durazno and Santa Bernardina (department of Durazno, Uruguay). Its structure is made mainly of wood, and has the particularity of being a submersible bridge, spending several weeks a year below the level of the river. At the moment it has a pedestrian use and of passage of motorcycles, closed to the vehicular use, due to the bad state of conservation of part of its structural elements. The present article shows the work carried out in the bridge with the objective of making a structural diagnosis and propose the appropriate solutions for its rehabilitation or change of use, taking into account the priority in the use of wood as material for the structure and maintaining the typology of the original design. A visual inspection was carried out, element by element, identifying damages and pathologies. The visual inspection was complemented by the measurement of non-destructive sonic parameters to estimate the stiffness properties of the wood, the measurement of the moisture content of all the elements and the identification of the different reinforcement actions performed on the bridge during its life. Finally, different restoration scenarios were analyzed.

CODE 196

THE SANCTUARY OF SANTA MARIA DELLE GRAZIE AT FORNÒ: SURVEY OF STATIC AND DEGRADATION AND FEM STRUCTURAL ANALYSIS

Custodi, Alberto[1]*; Santopuoli, Nicola[2]

1: DICAM - Department of Civil, Chemical, Environmental, And Materials Engineering
University of Bologna
e-mail: alberto.custodi@unibo.it, web: https://www.unibo.it/sitoweb/alberto.custodi
2: Department of History, Representation and Restoration of Architecture
Sapienza University of Roma
e-mail: nicola.santopuoli@uniroma1.it, web: http://www.dsdra.it/drupaluni/santopuoli-nicola

KEYWORDS: FEM structural analysis; seismic analysis; guides and national regulations; historical masonry; the Sanctuary of Santa Maria delle Grazie at Fornò.

ABSTRACT

The Sanctuary of Santa Maria delle Grazie di Fornò, located in the Forlì countryside, is a unicum for size and shape as a building dedicated to Marian worship. It was constructed between 1450 and the early years of the sixteenth century. The Sanctuary externally consists of a circular masonry structure 15 m high and 33 m in diameter, with four semi-circular niches protruding to the outside; inside, a similar circular structure 20 meters high delimits a central area, covered by an octagonal dome. The space between the two circular structures is covered with a wooden roof resting on thirty-six main wooden beams. The current appearance is the result of changes and transformations that have occurred over time both for static necessities (stresses of the original annular vault) and changes related to epoch's style (the four semicircular niches realized in 1686), as well as for natural disasters (several historical earthquakes) and war damage (the demolition of the bell tower and part of the adjacent monastery in WWII). In-depth inquiries have been made on the building and its surroundings that have allowed an adequate assessment of the current conditions of degradation and damage, both for finishes and for structures. The curvilinear type of all masonry walls has motivated the study of the current structural capacities. Recently an entire laser survey was carried out, providing comprehensive measurements for reconstructing the Sanctuary's shape and overall size. After the laser survey, several structural analyses are executed, in particular under the foreseeable seismic action with the application of the Guidelines (2011) for the "Assessment and reduction of seismic risk of cultural heritage with regarding to the technical standards for construction in DM 14/01/2008". Lately it will possible to study the effect of the possible consolidation works.

CODE 201

VIABILITY OF COMPUTATIONAL ANALYSIS OF HYPERSPECTRAL IMAGES AS A NON-DESTRUCTIVE DIAGNOSTIC AND EVALUATION TECHNIQUE'

Pérez Utrero, Rosa M[1]; Martínez Corrales, Luis F [2]; Sánchez Fernández, Manuel[3]; Aguilar Mateos, Pedro L[4]*, Atkinson Gordo, Alan[5]; de Sanjosé Blasco., Jose J[6]

1,2,3,4,5,6 :Universidad de Extremadura, Escuela Politécnica Abstractde Cáceres
Group NEXUS (Ingeniería, Territorio y Patrimonio)
1: e-mail: rosapere@unex.es
2: e-mail: extremaduramineral@gmail.com
3: e-mail: msf@unex.es
4: e-mail: paguilar@unex.es
5: e-mail: atkinson@unex.es
6: e-mail: jjblasco@unex.es

KEYWORDS: Neural networks; hyperspectral images; cultural heritage; laser scanner.

ABSTRACT

The technology of digital image capture is undergoing constant development in both resolution and image quality. There is an inescapable need for this technology as a means to record and disseminate images of works of art and cultural heritage. The goal of this paper is to combine different non-destructive techniques including 3D digitalization using short-range laser scanner, commonly used in industry, hyperspectral images, widely used in remote sensing applications and scientific research and neural computing as a technique applicable to the treatment of hyperspectral images with a view to assessing cultural heritage sites (churches, bridges, palaces,…) and smaller cultural heritage features. The process included the collection of data by image capture using the hyperspectral camera through to the analysis of the resulting images using neural computing systems. The hyperspectral equipment is initially configured and calibrated using software that facilitates the capture of images of different materials under the same conditions of light and humidity, which are then analysed by neural computing through an MLP (Multi-Layer-Perceptron) supervised model. The applied methodology distinguishes between the same minerals extracted from different quarries, as well as the different materials used in restorations carried out at different times of the Temple of Diana, part of the Roman cultural heritage of the city of Merida. To complete the research, the images processed with metric information from LiDAR terrestrial sensors (terrestrial Laser Scanner, TLS) are fused to supply metric properties to the spectral information.

CODE 207

LOAD TESTS IN ANCIENT CONCRETE BRIDGES REPAIRED WITH LIMITED TRAFFIC LOADS

Aragón Torre, Ángel[1]*; Martínez Martínez, José Antonio[2]; García Castillo, Luis María[3]; Aragón Torre, Guillermo[4]

1: University of Burgos (Spain)
aragont@ubu.es
2: jamartinez@ubu.es
3: lmgcite@ubu.es
4: garagon@ubu.es

KEYWORDS: Actions; ancient concrete bridges; load test; rehabilitation; standards.

ABSTRACT

This study analyzes the constraints to be taken into account in the load test of an ancient reinforced concrete bridge, with functional limitation of loads by geometry, and traffic criterion. It is an old bridge of reinforced concrete of approximately 1950 composed by three isostatic spans of 9 meters length. The global width is limited to 5 meters, and it had just been rehabilitated, rather than demolished, with various reinforcement techniques, including those of carbon fibers. Considerations are made with old and modern regulations, both of actions to be considered in road bridges and in reinforced concrete standards. After that analysis a load test protocol is established and carried out. In the instrumentation, LVDTs were used to measure displacements (deflections), and also strain gauges to measure deformations (concrete and reinforcement materials). Finally, the obtained values were compared with the theoretical values. During the entire process of the load test, the different control parameters established in the protocol were validated.

CODE 232

DIAGNOSIS AND REHABILITATION METHODOLOGY IN BUILDINGS WITH FLOOR FRAMES MADE OF METALLIC PROFILES AND CONCRETE OR CERAMIC SLABS. HAVANA HISTORIC CENTRE CASE OF STUDY

Núñez Gallardo, María Victoria[1]*; Díaz Alemán, Frank[2]; Pérez Zuniga, Abel[3]*; Álvarez Rodríguez, Odalys[4]; García Cedeño, Ramón[5]

1: Stuniga, Bureau d'études
e-mail: vickyng8606@gmail.com
2: PLF Structural Engineers
e-mail: fdiaza80@gmail.com
3: Stuniga, Bureau d'études
e-mail: abelpzuniga@gmail.com
4 : Havana University of Technologies José Antonio Echeverría,
e-mail: oar@civil.cujae.edu.cu
5: Empresa de Proyectos de Arquitectura e Ingeniería de la Habana (EPROB)
e-mail: r.gacia84@gmail.com

KEYWORDS: Historic centres; diagnosis; pathology.

ABSTRACT

This structural typology of "floor frames made of metallic profiles and concrete or ceramic slabs" was wide spread in Cuba since the end of 19th century until the first decades of 20th century. The system is present in domestic and commercials buildings in the Havana Historical Centre. Overcharges, incorrect interventions and lack of maintenance have increased the deterioration degree of these buildings, in which the horizontal structure is the most damaged element.
Diagnosis and optimisation of future rehabilitation projects and economical savings supposes a highly social impact, benefit of life quality and also a positive effect in urban environment. This paper presents a structural characterization and diagnosis methodology, including non-destructive tests. A geo-referenced information system was used to determine the predominance of each typology in the Historical Centre, as well as past interventions and level of damage by area. The principal pathological processes are identified, associated with each frame component. Origen misconception and its influence in the damages are considered.

CODE 253

INFRARED THERMOGRAPHY APPLICATION TO IDENTIFY DAMAGE AND PATHOLOGIES IN WOODEN HISTORICAL CONSTRUCTIONS

Máximo, Marco Aurélio da Silva[1]*; Pantoja, João da Costa[2]

1: National Historical and Artistic Heritage Institute, IPHAN
Ministry of Culture of Brazil
e-mail: marco.aurelio.maximo@gmail.com, web: http:www.iphan.gov.br
2: Faculty of Architecture and Urbanism, FAU
University of Brasília, UnB
e-mail: joaocpantoja@gmail.com, web: http:www.unb.gov.br

KEYWORDS: Non-destructive testing; infrared thermography; wooden buildings pathologies; brazilian cultural heritage.

ABSTRACT

Infrared thermography represents the possibility of analysing building damages and pathologies in a non-destructive, fast and practical way. The purpose of this study was to evaluate damages and pathologies in wooden buildings using infrared thermography as an auxiliary technique. Brasília still presents some wooden constructions, remnants of the time of the construction of the capital. Some of these buildings passed through reconstruction works or had restoration works. This paper presents a case study of infrared thermography application on a historical building in Brasília: the Juscelino Kubitschek de Oliveira Hospital, that now is a museum called Museu Vivo da Memória Candanga. From thermographic records, it was possible to find out various damages and pathologies such as biotic problems, like fungus, woodworm and termites. It was possible to identify thermal behaviour from abiotic damages, such as wood cracked, and structural situations, like elements pieces damaged and moisture presence. Infrared thermography proved useful as an aid capable of providing information for the maintenance and conservation of the building, showing the thermal behaviour of wooden elements that can compromise the structure and building lifespan.

CODE 282

THE USE OF STRUCTURAL ASSESSMENT TECHNIQUES AND REINFORCEMENT TECHNOLOGIES FOR THE CONSERVATION OF THE BUILT HERITAGE: THE STRUCTURAL RESTORATION OF THE VISTABELLA CHURCH'S TOWER

Señís, Roger[1]; Llorens, Miquel[2]; Pavón, Susana[1]; Moreno, Benjamí[3]

1: Department of Architectural Technology (TA)
Polytechnic University of Catalonia (UPC - BarcelonaTech)
e-mail: roger.senis@upc.edu, susana.pavon@upc.edu
2: Department of Mechanical Engineering and Industrial Constructions (EMCI)
University of Girona
e-mail: miquel.llorens@udg.edu
3: Smart Structural Sensing Technologies, S.L. (3STECH)
e-mail: bmoreno@3stech.eu

KEYWORDS: Vistabella church; structural assessment; non-destructive technique; numerical modelling; strengthening technologies.

ABSTRACT

This paper presents the use of structural assessment techniques (Non-destructive testing and numerical modelling) and reinforcement technologies for the restoration of the Vistabella Church's Tower (La Secuita, Tarragona). The intervention was carried out due to evident construction pathologies that affected the resistant behaviour and stability of the steeple. The first step was to have the mechanical characteristics of the resistant elements that conform it. In this case, through the use of the Hole-drilling test such as Non-destructive techniques (NDTs), applied on four resistant ribs of brick masonry to establish the mechanical characteristics in combination with a numerical modelling with the objective of determining its structural behaviour and the evaluation of the steeple's structural damage of the building studied. This information was necessary to determine the reinforcement needed, according to the observed pathologies. In order to provide additional vertical load without substantively modifying the structural scheme, a solution based on external prestressed bars (strengthening technology), was implemented. The procedure and the results of the follow-up are described in detail, these being the objective of the paper.

CODE 283

SEISMIC VULNERABILITY OF EDUCATIONAL BUILDINGS USING A QUALITATIVE METHODOLOGY. CASES OF STUDIES

Pizarro, Nery[1], Tornello, Miguel.[2], Agüera, Nelson[3]

Centro Regional de Desarrollos Tecnológicos para la Construcción.
Universidad Tecnológica Nacional, Facultad Regional Mendoza, Argentina.
1: nery@frm.utn.edu.ar
2: mtornell@frm.utn.edu.ar
3: naguera@frm.utn.edu.ar

KEYWORDS: Seismic vulnerability; educational buildings; structural security; qualitative method.

ABSTRACT

Some of the problems facing the seismic regions of the world are the adequacy of the ancient buildings according to the new knowledge embodied in the current regulations. The first ones that should be intervened are those of great socio-economic impact and those needed to attend the post-earthquake emergency. One of them are educational establishments. The clúster of application are the schools located in the northwest zone of the province of Mendoza, Argentina, zone considered of high seismic risk. The ones built between the years 1950 and 1985. These were built under no regulations or under old regulations.
Those applies a method a qualitative method suitable to those developed by Benedetti and Petrinni for the "Gruppo Nazionale per la Difensa dei Terremoti" of Italy. The new methodology takes as a structural vertical seismic-resistant system to the masonry and incorporates the existence, in their work together, with the structures of reinforced concrete. It also makes the difference between the existence of the type of diaphragm, rigid or flexible.
The methodology has been adapted to make it simple and agile in its application and so identify, between the existences of a large number of schools, quickly to those with pathologies associated with your seismic-resistant safety.
This database will be able, in other instances, to apply quantitative, more sophisticated and precise methods to the most deficient structural systems v It will be possible to propose its repair, reinforcement, dissipators of energy or of seismic isolation. There is a possibility to recommend demolition.
The results of the first four evaluated buildings affirm that they are in conformity with the structural designs used in his epoch and with the regulations and the constructive practices to the moment of his construction.

CODE 287

EVALUATION OF REINFORCED CONCRETE BEAMS OF A BUILDING SITUATED IN THE HISTORICAL CENTER OF SÃO LUÍS – MA

Campos Costa, Elináí[1]; Lima Ribeiro, Diogo M[1]; Pereira-de-Oliveira, Luiz Antonio[2]

1: University CEUMA, São Luis, Brazil
e-mail: elinaicampos@hotmail.com; diogomlr@hotmail.com,
2: University CEUMA São Luis, Brazil/C_MADE Centre of Materials and Building Technologies, Covilhã, Portugal
e-mail: luiz.oliveira@ubi.pt

KEYWORDS: Corrosion; sea environment; steel reinforcement; concrete cover; mortar rendering.

ABSTRACT

Corrosion of steel reinforcement in advanced stages entails the risk of serious accidents. The environment where the structure is located can generate damages related to the physical and chemical conditions, independently of mechanical actions, that compromise the building structure durability. This paper goal is to investigate the causes of the reinforced concrete beams corrosion. These beams were built during a retrofit works of a historic building in the centre of the city of São Luís – State of Maranhão, in the northeast of Brazil. The building, located approximately 100 meters from the sea, is exposed to an aggressive environment, very influenced by saline mist. The beams were covered with a cement-based and clay mortars commonly used in historic buildings to preserve the architectural and constructive aspects. Covering samples from the lower, upper, and lateral beam faces together with reinforcement concrete covering layer were collected. Carbonation thickness of reinforcement covering (concrete + mortar) was determined by pH and phenolphthalein methods on collected samples. The MOHR method to quantify the chloride ions amount, present in the structure was also applied. Thus, it was possible to observe a total carbonation of the samples (concrete cover layer and mortars), showing total transparency during the application of phenolphthalein. An average content of 0.2% chloride, which is over the limit value of 0.14%, was detected. Therefore, the on-site analysis and laboratory tests allowed to conclude that concrete cover layer and mortars coatings qualities caused the beam steel reinforcement corrosion. Finally, it is interesting to remark that the existing steel reinforcement concrete cover layer is inferior to the minimum required in this environment by the standard norm.

CODE 288

ANALYSIS OF THE STRUCTURAL BEHAVIOR OF A MEXICAN COLONIAL CHURCH REINFORCED WITH CONCRETE

Beltrán, Diana[1]

1: Escuela Nacional de Conservación, Restauración y Museografía.
e-mail: dxbeltran@gmail.com

KEYWORDS: Intervention analysis; structural behavior; historic building; reinforcement; concrete.

ABSTRACT

This peaper deales with a comprehensive analysis of the conditions that influence the structural behavior of a historical construction that was reinforced with concrete. This analysis is focused on determinate how the intervention of the structure with concrete has changed the structural behavior of the church. The Santo Domingo's church is located in the historical Center of Mexico City. It is an eighteenth century building made with stone masonry and was reinforce with concrete in the mid-twentieth century. The study is based on the strategy of complementary analyses. Firstly, an analysis of the structure of the temple is performed, in which the historical, architectural and structural conditions are reviewed, as well as the current conditions that are evident through existing structural damage of the temple. From the historical and field surveys have been found that concrete was used at the foundation and at the dome; as well as in walls and the central vault. Second, a correlation between past and present conditions is made in order to determinate which effects are produced (directly or indirectly) by the inclusion of the concrete. The current deterioration in the temple is the result of a combination of several factors; the most important is the subsidence that affects the area of the city where the building is located.

CODE 303

STUDY OF THE BEHAVIOR OF THE MEXICO CITY CATHEDRAL THROUGH A THREE-DIMENSIONAL FINITE ELEMENT MODEL

Chávez, Marcos M.[1]; Basurto, Brianda[1]; Meli, Roberto[1]

1: Coordinación de Ingeniería Estructural
Instituto de Ingeniería, UNAM
e-mail: mchavezc@iingen.unam.mx; briankaleth@gmail.com; rmep@pumas.ii.unam.mx;

KEYWORDS: Masonry; finite element model; structural monitoring.

ABSTRACT

The Mexico City Cathedral is one of the most emblematic historical monument of the Colonial period. In 1987, it was classified as part of the World Heritage. From its constructive stage this structure has presented serious problems of differential settlements due mainly to the soft clayey soil where it is located and to which it was built on the remains of old constructions. These factors together with the excessive extraction of water from the subsoil have caused serious damage to the Cathedral. To try to understand their behavior and propose more efficient reinforcement measures, a series of simplified linear analyses have been carried out using finite element models, experimental tests and the installation of a continuous monitoring system. With the results of these tools was that in the decade of the 90s, an important program of rehabilitation and geometric correction was implemented over the Cathedral, managing to reduce the differential settlements and drifts of this structure. With the passage of time and with the development of high performance computing equipment, the three-dimensional model of the Mexico City Cathedral was created, trying to reproduce its original geometry and using an inelastic constitutive model of the materials. In this paper present the results of the modal analysis to determine its dynamic properties, as well as the calibration of these results using the dynamic properties obtained through the seismic instrumentation available to this building and previous environmental vibration tests. Similarities were found in the results even though the numerical model is the reproduction of the Cathedral without the absence of damage and repairs to which it has been subject during its period of life.

CODE 309

EXPERIMENTAL CHARACTERISATION OF WOOD FLOORS IN THE HISTORIC CENTER OF VISEU BASED ON LOAD TESTS

Raimundo, Ana[1]; Negrão, João[2]; Vicente, Romeu[3]*; Ferreira, Tiago[4]

1: Aluna de Mestrado, Departamento de Engenharia Civil da Universidade de Coimbra
e-mail: anaraimund@hotmail.com
2: Departamento de Engenharia Civil da Universidade de Coimbra
e-mail: jhnegrao@dec.uc.pt
3: RISCO, Departamento de Engenharia Civil da Universidade de Aveiro
e-mail: romvic@ua.pt
4: ISISE, Departamento de Engenharia Civil da Universidade do Minho
e-mail: tmferreira@ua.pt

KEYWORDS: Timber structure; timber floor; load test; Historical Centre of Viseu.

ABSTRACT

The Historical Centres own historical, cultural, architectural and constructive heritage that must be preserved. The aggregated value exceeds the sum of the individual values of monumental and/or classified buildings, hence all rehabilitation interventions on buildings of the area should be subjected to common basic principles. This study is part of a campaign of survey, protection and enhancement of the built heritage of the Historic Center of Viseu. Aiming at characterizing the wood floors of an old building, an experimental diagnostic and inspection campaign was carried out based on load tests. These tests consisted of vertical and punctual loading in the floor beams, considered to be a more adequate load type to these floors than the uniformly distributed load, generally used. The deformation of the directly loaded beam and the adjacent ones was measured. The results of this experimental campaign, and its treatment for the characterization of the floor beams, are presented in this paper. Finally, a brief presentation is carried out on the background concepts for the distribution system, in which the ongoing validation and numeric evaluation of the floor system is based.

CODE 314

STRUCTURAL SAFETY ANALYSIS OF THE AQUEDUCTS "COLL DE FOIX" AND "CAPDEVILA" OF THE CANAL OF ARAGON AND CATALONIA

de la Fuente, Albert[1]*; Alegre, Vicente[2]; Blanco, Ana[3]; Cavero, Teresa[4]; Quintilla, Roberto[5]

1: Universidad Politécnica de Cataluña (UPC), Escuela Técnica Superior de Ingenieros de Caminos
e-mail: albert.de.la.fuente@upc.edu, web: http://smartengineeringbcn.com/
2: COTCA, S.A.
e-mail: info@cotca.com, web: http://www.cotca.com/
3: Universidad Politécnica de Cataluña (UPC), Escuela Técnica Superior de Ingenieros de Caminos
e-mail: ana.blanco@upc.edu, web: http://smartengineeringbcn.com/
4:TRAGSA Empresa de Transformación Agraria, S.A.
e-mail: t.cavero.irure@gmail.com
5: Comunidad General de Regantes de Canal de Aragón y Cataluña
e-mail: roberto@cayc.es, web: http://www.cayc.es, Twitter:@cayc_es

KEYWORDS: Safety; maintenance; reinforced concrete; heritage.

ABSTRACT

The Canal of Aragon and Catalonia (CAC) irrigates 105,000 ha (131 irrigation user communities) and it is own by the "Confederacion Hidrográfica del Ebro" (River Ebro's Water Agency). The canal is 134 km long, running from Olvena, where water from the river Ésera is collected (Joaquin Costa reservoir in Huesca) to the river Segre (Lleida). The original designs date from the 18th century, when Charles III was King of Spain. At that moment, the main objective was to build an industrial and navigable canal. Its construction started later in 1896 under the supervision of the Civil Engineer Rogelio de Inchaurrandieta as an irrigation infrastructure.
The aqueducts are located between km 67 and 71 of the canal and were designed by the Civil Engineer Félix de los Ríos Martín in 1907. The cross-section of both aqueducts, Coll de Foix and Capedevila, was extended within the framework of the project by Fernando Hué Herrero in 1962 in order to reach design flows of 26.1 m3/s and 25.7 m3/s, respectively. The structural performance of the aqueducts has been satisfactory, nevertheless the hydraulic capacity has reduced over the years. As a result, the irrigation user communities have expressed the need to extend the cross-section of the aqueducts to meet the irrigation demands. Given the age of the structure and the different design considerations at the time, it is paramount to verify the structural reliability of the aqueducts in the new load configuration. Therefore, the objective of the paper is to present the structural safety analysis conducted and describe the new extended cross-section for both aqueducts (maintaining the original structural typology).

CODE 321

BUILDING DAMAGE ASSESSMENT IN AREAS AFFECTED BY LAND SUBSIDENCE TROUGH SAR INTEREFEROMETRY (INSAR)

Tomás, Roberto[1,2]; Sanabria, Margarita P.[2]; Herrera, Gerardo[2]; Cano, Miguel[1]

1: Departamento de Ingeniería Civil
Universidad de Alicante
e-mail: roberto.tomas@ua.es, web: https://web.ua.es/interes
2: Geohazards InSAR laboratory and Modelling Group
Instituto Geológico y Minero de España
e-mail: m.sanabria@igme.es, web: http://www.igme.es/InSARlab/

KEYWORDS: InSAR; damage assessment; monitoring; building; subsidence.

ABSTRACT

Land subsidence consists on the gradual sinking of ground surface due to different factors, which can be natural or caused by the impact of a wide variety of human activities. The settlements produced by land subsidence can affect the buildings, exceeding the allowable thresholds and generating a loss of functionality and different degrees of damage. Synthetic aperture radar interferometry (InSAR) techniques allow the measurement of the magnitude of the ground surface deformations from satellites that orbit hundreds of kilometres from the Earth with millimetre precision. Its application for monitoring land subsidence phenomena has experienced an exponential growing during last decades, consolidating as once of the most suitable techniques for the spatio-temporal study of this phenomena. Furthermore, the launch of high-resolution satellites as the CosmoSkyMed constellation or the TerraSAR-X satellite has improved the capacity of InSAR technique for monitoring buildings and other infrastructures. In this work a brief review of the InSAR technique and its applications for the remote evaluation of damage on buildings is performed. Moreover, a methodology for the evaluation of the serviceability limit states of the buildings is described trough some actual samples.

CODE 368

DETERMINING THE PATINA COLORS APPLIED UV-VIS-NIR SPECTROSCOPY AND MUNSELL SYSTEMS IN THE MAIN FAÇADE OF THE CATHEDRAL OF SANTO DOMINGO, DOMINICAN REPUBLIC

Flores Sasso, Virginia[1]; Ruiz Valero, Letzai[2]; Pérez Álvarez, Gloria[3]; Frutos Vázquez, Borja[4]; Prieto Vicioso, Esteban[5]; Martín-Consuegra, Fernando[6]

1: Pontificia Universidad Católica Madre y Maestra, Pucmm,
E-mail: vfloressasso@gmail.com
2: Pontificia Universidad Católica Madre y Maestra, Pucmm,
E-mail: l.ruiz@ce.pucmm.edu.do
3: Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc –CSIC),
E-mail: gperezaq@ietcc.csic.es
4: Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc –CSIC),
E-mail: borjafv@ietcc.csic.es
5: Universidad Nacional Pedro Henríquez Ureña,
E-mail: eprietovicioso@gmail.com
6: Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc –CSIC),
E-mail: martin-consuegra@ietcc.csic.es

KEYWORDS: Patina, UV-Vis-NIR Spectroscopy, Munsell Systems, Cathedral of Santo Domingo, Dominican Republic.

ABSTRACT

The main facade of the Cathedral of Santo Domingo, Primate of America, is the most important of the colonial architecture of the first half of the 16th century in America, which is built of coralina limestone. The color of its façade has been lost for various reasons, leaving only remains of the original patina that covered the stones, which had never been studied and valued until now. For this reason, the main objective of this research is to determine the color of the historical patina present in the main façade of the Cathedral of Santo Domingo by applying UV-Vis-NIR Spectroscopy and comparing the color with the Munsell Systems in dry and wet conditions. Two representative areas of the patina and one of the natural stone that served as reference were selected, all located in the right part of the main façade. The samples (CSD-S1) and (CSD-S2) correspond to the patina while the (CSD-S3) corresponds to the natural color of the stone.
The results with the UV-Vis-NIR Spectroscopy place all the values in the first upper right quadrant with values of a* and b* positive and luminosity greater than 50, consistent with the appearance of the material of the facade. With Munsell System, dry values showed that the CSD-1 sample is located at 7.5 YR 6/6, CSD-S2 at 5 YR 6/8 and CSD-S3 at 10 YR 7/4, and at wet values are: CSD-1 located at 7.5 YR 6/8, CSD-S2 at 5 YR 5/8 and CSD-S3 at 10 YR 6/6.

CODE 392

SLIGHTLY DESTRUCTIVE TECHNIQUE APPLIED TO DEDUCE STRESS STATES IN THE REHABILITATION PROCESS OF ANCIENT MASONRY STRUCTURES

Blanco, Haydee*; Boffill, Yosbel; Lombillo, Ignacio; Villegas, Luis

Grupo I+D GTED-UC (Grupo de Tecnología de la Edificación
Dpto. Ingeniería Estructural y Mecánica
Universidad de Cantabria
e-mails: haydee.blanco@unican.es, yosbel.boffill@unican.es, ignacio.lombillo@unican.es, luis.villegas@unican.es; web: www.gted.unican.es

KEYWORDS: Ancient masonry structure; mechanical characterization; flat-jack; stress level.

ABSTRACT

The rehabilitation of ancient buildings requires detailed knowledge of the mechanical characteristics and stress states of the structural elements, which play an important role in the intervention process. Sometimes, the estimation of the properties of the structure can be difficult due to multiple factors. Nevertheless, the non and slightly destructive tests can be used to estimate the structural characteristics with good precision at relatively low cost. Consequently, this article focuses on the determination of the service stresses in a masonry structure of a historic building, as well as the evaluation of the structural safety before the intervention process is carried out. A brief description of the analysis and the motivation of the research, the methodology adopted and its application to a case study, namely, the Modernist Church of the Seminario Mayor de Comillas, Spain, is provided. Finally, the evolution of the measurements recorded and the analysis of the results are detailed. The study enabled recommendations to be provided for the agents involved so as to guarantee the structural safety during the intervention process.

CODE 419

COMPARATIVE PERMEABILITY ANALYSIS OF STRAIGHT CONCRETE AND CONCRETE WITH ADDITION OF MICROSILICA AND METAKAOLIN

Torre, Ana[1]; Villavicencio, Andres[1]; Arrieta, Javier[1]

1: Laboratorio de Ensayo de Materiales (LEM), Universidad Nacional de Ingeniería, Lima, Perú.
e-mail: anatorre@uni.edu.pe

KEYWORDS: Microsilica; permeability; addition; durability; water pressure.

ABSTRACT

In the rate of deterioration of concrete, permeability is the parameter that directly influences, especially in situations where concrete is exposed to moisture. Currently there are no reference values that allow to know the degree of permeability of concrete with additions, which is known that improve by additions, such as microsilica (MS) and Metakaolin (MK). The purpose of the present work is to quantify the effect of small amounts of MS (5-10%) and MK (10-15%) on concrete permeability. The mixtures, which were use, correspond to w/c ratios of 0,40 to 0,60 and tests were carried out at 28 and 56 days. The permeability coefficient k was measured by applying a hydrostatic pressure difference between the two faces of the specimens. The flow of water passing through the specimens, or the depth of penetration in the material, was measured and the results show a significant reduction in k with MS and MK additions.For 10%MS the K parameter obtained was $0.95x10^{-13}$m/s ;in case of MK this Kvalue was $1.63x10^{-13}$m/s.

CODE 421

ASSESSMENT OF ADHESION OF THE WALLS COATING IN THE OLD SLAUGHTERHOUSE OF VIANA DO CASTELO, USING IN SITU PULL-OFF TESTS

Curado, António[1,2]*; Rodrigues, Sara[1]; Morais, Orlando[1]

1: Instituto Politécnico de Viana do Castelo, Avenida do Atlântico, 4900-348 Viana do Castelo, Portugal
e-mail: acurado@estg.ipvc.pt, web: http://www.ipvc.pt
2: CONSTRUCT-LFC, Faculty of Engineering (FEUP), University of Porto, Rua Dr. Roberto Frias s/n, 4200-465 Porto, Portugal

KEYWORDS: Refurbishment, retrofitting, pull-off tests, mortar, bonding coat.

ABSTRACT

The retrofitting project of the old municipal slaughterhouse of Viana do Castelo, a building with a high heritage value dated from the beginning of the 20th century, must preserve the impressive masonry façades made of granite stone.
In order to evaluate the adhesion tension of the mortar to the granite walls, a set of pull-off tests was carried out during the summer of 2017. During the experimental campaign, the mortar revealed to have no resistance. Failures occurred due to the mortar cracking leading to a set of bad results.
Due to the bad results, a new experimental campaign was developed to study four new façades render solutions, designed to improve the façades performance and afterwards to select the most adequate render, according to the experimental results. Two types of mortars layers were applied to the granite walls: a cement mortar, with and without a bonding coat, and a lime mortar, also with and without a bonding coat. These new rendering solutions were tested on façades with different orientation, in order to evaluate the influence on the results of the climatic agents.
The attained results allow us to conclude that the application of a previous bonding coat to the granite walls leads to higher values of the adhesion tension for the applied mortars solutions. The improvement due to the previous application of the bonding coat is valid both for lime and cement mortar. The application of a cement mortar over the bonding coat leads to 60% of the pull-off tests with results over 0.3MPa, value for adhesion resistance defined by the standards that frame the application of pull-off test. This coating solution seems to be the most adequate for retrofitting the granite walls.
Besides an adequate adherence to the substrate throughout their service life in order to protect the walls from the degradation agents to which they are subjected, coating mortars should also meet some other performance requirements, mainly to present a good plasticity, to increase the vapor permeability, to reduce effloresce and to avoid shrinkage and cracking due to effect of the climatic agents. The southern facade of the building, given its high exposure seems to be most relevant to study in order to define the most adequate rendering for retrofitting the façades of the building.

CODE 461

CHARACTERIZATION OF CLAY BRICKS APPLICABLE IN THE RESTORATION OF BRICK SKIN OF ARCHITECTURAL HERITAGE IN THE URUGUAY

Romay, Carola[1]; Rodríguez de Sensale, Gemma[2]

1: Facultad de Ingeniería, Universidad de la República, Uruguay
e-mail: cromay@fing.edu.uy
2: Facultad de Ingeniería, Universidad de la República, Uruguay
e-mail: gemma@fing.edu.uy

KEYWORDS: Clay bricks; characterization; restoration.

ABSTRACT

The use of exposed ceramic bricks in building's facades or roofs was a frequently used solution in the architecture of the 20th century in Uruguay. The unique characteristics of these clay units (color, texture and durability) are determinant aspects in the definition of the cultural and technological value of some buildings with heritage protection. Some of these buildings were designed by outstanding local architects, as J. Vilamajó, E. Leborgne, M. Payssé Reyes and R. Lorente; and engineers as E. Dieste, whose works have been recently inscribed in the tentative World Heritage List of UNESCO.
Working in these buildings to value and preservate them, currently demands the use of restitution piecies compatible with the original ones. This implies the need to initiate characterization studies comparing the original masonry units and those potentially available in the country in order to select the most suitable units to guarantee the conservation of these buildings.
This article presents the results reached in the characterization of different types of clay units produced nowadays in the country. The results are compared with the characteristics of units extracted from protected buildings in order to establish the degree of suitability of the first ones to replace the historical units. The properties studied are the mineralogical composition, capillary suction, permeability to high pressure water, absorption, efflorescences, color, superficial hardness, compressive strength and resistance to penetration.
These advances, in addition to contribute in the descision making about the suitability of the clay units studied for their particular use in the indicated buildings, encourages the creation of a technical data base of national ceramic products not yet available in our country.

CODE 474

MECHANICAL PROPERTIES IDENTIFICATION OF SAN CRISTOBAL STONE BY MEANS OF NON-DESTRUCTIVE TECHNIQUES

Baeza, Juan R.[1]; Compán, Víctor[2]*; Cámara, Margarita[3]; Pachón, Pablo[4]; Castillo López, Germán[5]

1: Department of Architectural Constructions II. University of Seville-Spain.
e-mail: jbaeza@us.es
2: Department of Building Structures and Geotechnical Engineering. University of Seville-Spain
e-mail: compan@us.es
3: e-mail: mcamara@us.es
4: e-mail: pachon@us.es
5: Department of Civil Engineering, Materials and Fabrication. University of Malaga-Spain.
e-mail: gcastillo@uma.es

KEYWORDS: Masonry historical construction; non-destructive technique; San Cristobal Stone; mechanical properties.

ABSTRACT

The stone from San Cristobal hill (El Puerto de Santa María, Cádiz-Spain) was used from the 15th to the 18th century in many of the monumental buildings in the Andalusian counties of Cadiz and Seville, such as Santiago Church and the Cathedral in Jerez de la Frontera-Cadiz or the City Council and the Cathedral in Seville.
The degradation that this sandstone presents in some important buildings of the Andalusian heritage causes concern for people who participate on their restoration and maintenance. The current low compression strength of this stone has caused important architectural and structural interventions.
One of the main characteristics of this stone is the great absorption capability. If this property is matched with atmospheric agents, the stone become softer and can easily decompose, causing important material and strength losses.
The aim of this paper is to contribute to the mechanical characterization of this stone using a geophysical method and analyzing the effect that humidity produces on its mechanical properties with deep interest. To develop this study, we count on a series of test pieces that belong to the Church of Santiago in Jerez de la Frontera. They have been extracted from columns in parallel to columns axis.

CODE 495

ASSESSMENT OF THE MECHANICAL PROPERTIES OF ANCIENT BRICKWORK WITH LIME MORTAR

Boffill, Yosbel[1]*; Blanco, Haydee[1]; Lombillo, Ignacio[1]; Villegas, Luis[1]; Sosa, Israel[2]

1: Grupo I+D GTED-UC (Grupo de Tecnología de la Edificación
Dpto. Ingeniería Estructural y Mecánica. Universidad de Cantabria
e-mails: yosbel.boffill@unican.es, haydee.blanco@unican.es, ignacio.lombillo@unican.es, luis.villegas@unican.es; web: www.gted.unican.es
2: LADICIM (Laboratorio de la División de Ciencia e Ingeniería de los Materiales)
Universidad de Cantabria. E.T.S. de Ingenieros de Caminos, Canales y Puertos
e-mail: israel.sosa@unican.es

KEYWORDS: Hydraulic lime mortars; Natural Hydraulic Lime (NHL 5) ; old brick masonry; prisms; physical and mechanical characterization; standards; ancient building.

ABSTRACT

Knowledge of the mechanical properties of masonry structures is essential in all interventions, whose characteristics are influenced by the properties of bricks and mortar. In consequence, this study addresses the mechanical behaviour of ancient brick masonry structures considering low-strength hydraulic lime mortars. For this, an experimental campaign was carried out for their mechanical characterization. The campaign includes the determination of the properties of the constituent materials over time: two types of old clay bricks obtained from demolition, and 2 types of mortar combined hydraulic lime (HL) with two kinds of sandy aggregates (limestone, L and siliceous, S). 71 prismatic specimens of 40x40x160 mm were made, and tested under bending and compression at 28, 91, 180 and 730 days of curing. Furthermore, the influence of the carbonation progress in these mortars was analysed. Additionally, two types of masonry specimens were constructed using the previously mentioned bricks and mortars. In consequence, six specimens were tested, three of each type. The paper includes a discussion on the ratio between the elastic modulus and the compressive strength of the masonry constituents and the comparison of these ratios with the ones suggested in design codes. A new source of data for the evaluation of the existing ancient structures was also obtained.

CODE 497

GEOMETRIC SURVEY, IN SITU MECHANICAL ANALYSIS AND STRUCTURAL BEHAVIOUR STUDY OF A 55M INDUSTRIAL BRICK CHIMNEY

Lombillo, Ignacio[1]*; Fraile, Paula[1]; Boffill, Yosbel[1]; Blanco, Haydee[1]; Sancibrián, Ramón[2]; Villegas, Luis[1]

1: Universidad de Cantabria, E.T.S. de Ingenieros de Caminos, C. y P. Grupo de Tecnología de la Edificación
e-mail: gted@unican.es, web: www.gted.unican.es
2: Universidad de Cantabria, E.T.S. de Ingenieros Industriales y de Telecomunicación
e-mail: ramon.sancibrian@unican.es

KEYWORDS: Industrial brick chimney; photogrammetry; laser scanner; flat-jack test; computational modelling.

ABSTRACT

Industrial brick chimneys are one of the most important symbols remaining from the industrial era. They were an essential elements, able to distribute the volatile combustion products at sufficient height, to reduce pollution on the ground. They also constituted landmarks of the industrial landscape of the time, serving in many cases as points of reference in the city. The existing difficulty of there being no functional use for the chimneys, once rehabilitated, should not be a reason for not keeping them. With this idea in mind, the article aims to develop the studies carried out in a 55m high industrial chimney.
After this introduction, the works conducive to obtaining the geometry of the construction are presented. For this, in addition to the desktop work developed for the location of the construction plans, a topographic survey with total station was carried out, and exterior geometry was obtained by architectural photogrammetry and 3d laser scanner. A mini-perforation was made at the base of the chimney to determine, through videoendoscopy, the internal morphology of the chimney. In order to mechanically analysis the exterior brickwork of the chimney, a double flat-jack test was carried out. Equally, a simple flat-jack test to estimate the stress level in a specific area of the construction was carried out. With the data obtained, a numerical model was developed, which was validated, considering the loads of the chimney´s own weight, the solar thermal action and the wind action on the day of the simple flat-jack test, taking as a calibration point the experimental stress obtained. Finally, by using this model, the chimney behaviour was checked against more extreme wind actions to analyse the safety of the structure.

CODE 57

REFLECTIONS ABOUT LEGAL DISPOSITIONS AND REGULATION IN SPAIN ON THE BUILDING REHABILITATION AND THE HERITAGE MANAGEMENT

Agudo Martínez, Andrés[1]; Castilla Guerra, Jerónimo[2]; Pedrera Zamorano, José Luis[3]

1: TEP-951 ARHENE. Aprovechamiento de Residuos Industriales, de Construcción y/o Demolición para la Fabricación e Hormigón Estructural y No Estructural, Dpto. Ingeniería Industrial e Ingeniería Civil. EPS Algeciras. Universidad de Cádiz. andresam@us.es, http://tep951.uca.es
2: TEP-951 ARHENE. Aprovechamiento de Residuos Industriales, de Construcción y/o Demolición para la Fabricación de Hormigón Estructural y No Estructural, Dpto. Ingeniería Industrial e Ingeniería Civil. EPS Algeciras. Universidad de Cádiz. jcguerra@us.es, http://tep951.uca.es
3: Departamento de Construcción. Escuela Universitaria Politécnica de Cáceres. Universidad de Extremadura.
jlpedrera@unex.es

KEYWORDS: Legislation; rehabilitation of buildings; management and heritage.

ABSTRACT

About 55 % of the Spanish built-up park is previous to the year 1980 and almost 21 % is older than 50 years. Is there sufficient the Technical Inspection of Buildings (ITE), as the only instrument that determines the degree of conservation of the real estate and allows to guarantee a worthy housing? How do the European requirements of the Package 20-20-20 “Energy and Climate Change” relative to the energy efficiency of the buildings apply in our country?
The UNESCO Conventions on the Protection of the Cultural and Natural World heritage (1972 and 2003) endorse the general applicable criteria for the management of the cultural heritage in the world; but, up to what point do they manage the generated tensions between the symbolic value and the capacity of generation of economic resources of the cultural heritage to mold these criteria? How is it the legislation in Spain in this regard?
With this work we try to offer an explanation on the current regulation, and to do a general reflection on his application, repercussion, excesses and lacks, its influence and its achievements.
In a descriptive phase a tidy and valued inventory is realized from the existing laws that can be applied to building rehabilitation and to the management of the heritage. In a posterior analytical phase, diverse practical cases are studied. In a third phase the results are classified and diagnosed and in a final and proposal phase, the application, impact, excesses and lacks of the legislation are measured and offers orientated to improving the legislative current area are raised.

CODE 275

LEGAL FRAMEWORK FOR URBAN REHABILITATION: DIAGNOSIS AND LEGISLATIVE RECOMMENDATIONS

Antunes, José[1]*; Mêda, Pedro[2]; Sousa, Hipólito[2], Moreira, Joaquim[2;] Pouseiro, Ana[1]; Antunes, Nuno[1]

1: OCB – Sociedade de Advogados
e-mail: oliveira.antunes@ocb.com.pt,
web: http://www.ocb.com.pt/
2: CONSTRUCT-GEQUALTEC, Construction Institute, Faculty of Engineering, Porto University
e-mail: pmeda@fe.up.pt;
e-mail: hipolito@fe.up.pt,
e-mail: jjm@fe.up.pt,
web: https://paginas.fe.up.pt/~icfeup/index.html

KEYWORDS: Systematization; simplification; streamlining; legal framework; standardization.

ABSTRACT

In the current legal framework, the urban renewal/refurbishment in Portugal, as most urban operations is governed by a set of laws, rules and regulations, making this subject a complex and stuffy legislative system. The compliance checking of the majority of the urban operations is mainly a bureaucratic process, in which it is almost always possible to find a legal or processual provision that is not being satisfied. The rehabilitation activity by individual and private companies is deeply limited, whether by the inefficient and bureaucratic control, whether due to the issue of prior binding opinions regarding the design by dozens of external entities in which the query is mandatory and are dependent of the central administration.

CODE 359

THE CONSERVATION OF HISTORIC BUILT HERITAGE IN EUROPE: REGULATIONS AND GUIDELINES IN ITALY AND ENGLAND

Marmo, Rossella[1*]; Pascale, Federica[2]; Coday, Alan[3]; Polverino, Francesco[4]

1: Università degli Studi di Napoli Federico II, Scuola Politecnica e delle Scienze di Base, Dipartimento di Ingegneria Civile, Edile e Ambientale
e-mail: rossella.marmo@unina.it
2: Anglia Ruskin University, Faculty of Science and Technology, Department of Engineering and the Built Environment e-mail: federica.pascale@anglia.ac.uk, web: http://www.anglia.ac.uk/science-and-technology/about/engineering-and-the-built-environment/our-staff/federica-pascale
3: Anglia Ruskin University, Faculty of Science and Technology, Department of Engineering and the Built Environment e-mail: alan.coday@anglia.ac.uk, web: http://www.anglia.ac.uk/science-and-technology/about/engineering-and-the-built-environment/our-staff/alan-coday
4: Università degli Studi di Napoli Federico II, Scuola Politecnica e delle Scienze di Base, Dipartimento di Ingegneria Civile, Edile e Ambientale
e-mail: francesco.polverino@unina.it, web: https://www.docenti.unina.it/francesco.polverino

KEYWORDS: Conservation; built heritage; regulations; Italy; England.

ABSTRACT

The management and conservation of cultural heritage, including architecture and urban sites, is a necessity and a duty of the modern world. The identity of European society is strongly linked to the architectural heritage, it represents an irreplaceable resource for its inhabitants, in terms of psychological, economic and social wellbeing. During the 20th century several international charters and conventions were adopted, developing and evolving conservation principles and methods. Meanwhile the object of the protection has changed, moving from the archaeological and artistic heritage to the historic towns, which require an integrated conservation in the society, in order to reconcile the urban renewal actions with the protection of historical and architectural values of each site. This means making delicate choices and difficult operations, which change from country to country depending on the attitude adopted regarding to the conservation. This work compares the legislative and political aspects on the theme of the architectural heritage management and conservation in Italy and England, in order to identify advantages and disadvantages of each approach and the lessons that can be drawn. Italy and England were chosen as case studies because they implement a profoundly different relationship between protection and utilization. The literature search carried out includes scientific articles, reports, laws and governmental and non-governmental guidelines. This research concludes that the relationship between protection and utilization depends on many factors: recognized values in the object of protection, affordability, rules and practices, limitations to the changes in legislation matter. The analysis of current attitudes about heritage built allows to understand the limits and potential of different approaches and the Italy and England are different in ideological, economical and methodological aspects, and therefore in the practical one.

2.- PROJECT

CODE 43

THE CRITERIA FOR HERITAGE RESTORATION DEFENDED BY THE ARCHITECT JUAN BAUTISTA LÁZARO AT THE END OF THE 19TH CENTURY

Diez, Jorge[1]*

1: UPM, ETSAM.
e-mail: jorge10@coal.es, web: www.saenzdemieraarquitectos.es

KEYWORDS: Nineteenth century; restoration; heritage; applied arts; Juan Bautista Lázaro.

ABSTRACT

Juan Bautista Lazaro is a little-known architect in the Spanish architectural scene. However, he is a very interesting figure due to his approach in 1880 to a new way to restore our Heritage that differed from the usual actions that were carried out in our country at that time. In opposition to the practice developed by the followers of the "restoration in style", Lázaro raised criteria closer to the conservationist principles.

This article aims to show the criteria to heritage restoration that this architect established, after the research that I have done about his print publications, projects and restoration works during the last years. All the documentation has been obtained from different archives and libraries of our country.

Lazaro was one of the most important architects of heritage restoration in Spain at the end of the 19th century not only because of his work in some of the most important buildings in Spain (the Cathedrals of Leon and Toledo, Santa Cristina de Lena, San Miguel de Escalada, Colegiata de Santillana del Mar…) but also because of his significant positions regarding the intervention in the architectural heritage: his respect for historical additions, his preference to avoid isolated monuments, his interest in structures and his desire to recover traditional crafts that were completely lost in Spain at that time.

CODE 97

TWENTY EIGHT PERCENT ESSAYING A CONVERSATIONAL MODEL

Urrutia, Daniella; Zurmendi, Constance

Proyect Departament
Fadu - Udelar
e-mail: estudiouzaa@gmail.com, web: http://www.estudiouzaa.wordpress.com
Poryect Departament
Fadu - Udelar
e-mail: estudiouzaa@gmail.com, web: http://www.estudiouzaa.wordpress.com

KEYWORDS: Heritage, Julio Vilamajo, Mesón de las Cañas, Villa Serrana, reconstruction.

ABSTRACT

Two looks on a piece, temporary constructions where the product is also reflection and reflection becomes product.
On the one hand, the visible work, the original project of Mesón de las Cañas (1947/1948) by Arq Julio Vilamajó and the process of project and execution of its reconstruction, shown in a chronological compilation that integrates graphics, photographs and texts over time (1947/2012) and on the other the invisible and possibly unfinished, unveiled through an invitation to the drift of project thinking, a look that oscillates between the analytic and the playful, the known and the unknown.
A conversational model is established as a mode, which allows to recognize in the habit of the question and in the exercise of doubt, a way of knowledge generation. The unknown begins in the plane pl3542, a sulphite drawn on both sides, a vertiginous change of scale and a note from the assistant to the master who initiates a continuous conversation in time. A dialogue that in its course finds resignifications.
Construction - reconstruction - product - reflection: they establish anarchic temporal relations that invest the current concept of time, that is, the idea of current time, as a linear, continuous, directed course where the time allowed is replaced by the undisciplined, that time model for which it is not contradictory to go simultaneously backwards and forwards. Practices that make the irreversible, reversible for a moment.
A graphic story that connects texts and images as a shared thought out loud.
The encounters with the building were, are and will be short essays, compose a notebook that allows to transform meanings, and are able to be ordered in memory time, technique, history, matter, landscape and its protagonists.
Each episode determines a position and detaches itself autonomous, shareable and reinterpretable.
A fragment that together with others will form lines still unpredictable, which will invite to continue building stable pieces ready to start again and propose again in the spiral of knowledge.

CODE 215

INTERVENTIONS IN TRADITIONAL ARCHITECTURE: VERNACULAR RUIN AS FORMWORK FOR THE CONTEMPORARY GRAFT

Ordóñez-Castañón, David[1]; de-los-Ojos-Moral, Jesús[2]

1: ETS de Arquitectura, Universidad del País Vasco UPV/EHU
e-mail: david.ordonez@ehu.eus
2: ETS de Arquitectura, Universidad de Valladolid
e-mail: jesusdelosojos@gmail.com

KEYWORDS: Traditional architecture; ruin; reutilization; contemporary graft.

ABSTRACT

The processes of depopulation and abandonment of the traditional agricultural activities experienced by many rural areas have led in recent decades to a situation of abandonment and defunctionalization of traditional architecture. However, the reoccupation of these ancient constructions is not simple, since they can not always satisfy the functional, technological and comfort demands that current lifestyles require. The inclusion of grafts of contemporary architecture is considered a way to adapt and, at the same time, preserve them.
Building new forms on the remains of old buildings is a question that has provoked intense debates since the nineteenth century, although mainly around the monumental ruin. The purpose of this article is to take up the reflection, now applied to the vernacular, through the analysis of a specific type of intervention on the ruin, called "The house within the house". We refer to those interventions that reuse the pre-existence as a container in which a new construction is introduced. The capsule is required to satisfy the current requirements of use and habitability. The previous wall, appropriately consolidated, remains as an enclosure that facilitates the integration of the new object in the environment and providing a several values associated with the memory of the place and the building. Between ruin and artifact arises a contrasting relationship, in terms of time, functional, material, technological,... Both identities converge symbiotically to generate a hybrid that reinterprets the values of the past but with a renewed projection for the future.
Several case studies are proposed: *Dovecote Studio* (Haworth Tompkins), *S(ch)austall Rehabilitation* (Naumann Architektur), *E/C House* (Sami Arquitectos), *House in Tebra* (Irisarri + Piñera), *Rifugio Paraloup* (D. Castellino, V. Cottino, G. Barberis, D. Regis), *Architectural archive* (Hugh Strange) and the *renovation of a historical farmstead in Schöneiche* (Alexander Palowski).

CODE 231

THE IMPORTANCE OF PREVIOUS DIAGNOSIS ACTIONS WITHIN MULTIPLE CRITERIA DECISION MAKING

Tavares, Alice[1]*; Costa, Aníbal[2]

1: Universidade de Aveiro, RISCO, Departamento de Engenharia Civil.
E-mail: tavares.c.alice@ua.pt, web: https://www.ua.pt/risco/
2: e-mail: agc@ua.pt

KEYWORDS: Multiple criteria decision making; AHP; diagnosis; cultural value; built heritage.

ABSTRACT

Multicriteria models within the Multiple Criteria Decision Making (MCDM) are set up with a complex multidisciplinary information framework that is provided by previous studies and analyzes, which for this purpose must be required in the context of the Inspection and Diagnostic Reports or Previous Reports. To better gauge the contribution of each expert, weighting weights are assigned to each criterion that will serve as a basis for analyzing alternatives to achieve the main objective, in a methodology that establish an hierarchy and constructs the decision, such as the AHP model. The quality of the final results depends on the compilation of adequate information and the previous in-depth knowledge of the built Heritage under analysis. This article intends to reflect on this process of using a multicriteria tool (MCDM), resorting as case studies areas of the historical center of Lisbon and Porto. From the study it was verified that for the rehabilitation processes with the maintenance of housing in the historical centers (without gentrification) the minimum intervention should be privileged. In this way it would be possible to establish good levels of functional compatibility, use and intervention costs, given the dimensional reality of housing, the costs and the average value of rents. Initiatives to promote urban rehabilitation for this purpose have in the MCDM important decision support tools.

CODE 337

DISSIPATIVE CROSS LAM ROOF STRUCTURE FOR SEISMIC RESTORATION OF HISTORICAL CHURCHES

Longarini, Nicola[1]; Crespi, Pietro[2]; Zucca, Marco[3]

1:Politecnico di Milano, Department of Architecture Built Environment and Construction Engineering
e-mail: nicola.longarini@polimi.it
2:Politecnico di Milano, Department of Architecture Built Environment and Construction Engineering
e-mail: pietro.crespi@polimi.it
3:Politecnico di Milano, Department of Architecture Built Environment and Construction Engineering e-e-mail: marco.zucca@polimi.it

KEYWORDS: Cross lam; historical building; seismic restoration; dissipative structures; nave transversal response.

ABSTRACT

In order to improve the nave transversal response of historical churches, a strategy basing on wooden roof strengthening aimed to obtain the global “box” building's behaviour should be pursued. For this strategy the wooden roof has to work as a dissipative diaphragm able to contain the out-of plane lateral walls mechanisms by allowing controlled rocking of the walls. Therefore, the roof has to reduce the in-plane shear transferred to the resistant transversal frames (or walls) by the dissipative behaviour of the steel connections. In this paper, the improvements due to the cross lam roof structure in the transversal nave response are pointed out with respect to several different solutions in terms of conservative restoration criteria. Moreover, the effects of the controlled lateral walls rocking obtained by cross lam panels are investigated for representative church configurations.
The effects of the cross lam roof-diaphragm in terms of controlled rocking are shown by performing nonlinear analyses on equivalent finite element models simulating the nave transversal response. Once evaluated the target seismic performance of the church, in terms of maximum drift allowed by the masonry walls, the in-plane shear acting on the cross lam panels are evaluated too.

CODE 367

ANALYTICAL STUDY ON THE EFFECTIVENESS OF THE FRCM-CONFINEMENT OF MASONRY COLUMNS

Balsamo, Alberto[1]; Cascardi, Alessio[2]*; Di Ludovico, Marco[3]; Aiello, Maria Antonietta[4]; Morandini, Giulio[5]

1: Università degli Studi di Napoli "Federico II", Dipartimento di Strutture per l'Ingegneria e l'Architettura
e-mail: albalsam@unina.it
2: Università del Salento, Dipartimento di Ingegneria dell'Innovazione
e-mail: alessio.cascardi@unisalento.it
3: Università degli Studi di Napoli "Federico II", Dipartimento di Strutture per l'Ingegneria e l'Architettura
e-mail: diludovi@unina.it
4: Università del Salento, Dipartimento di Ingegneria dell'Innovazione
e-mail: antonietta.aiello@unisalento.it
5: Mapei S.p.A. Structural Strengthening Line
e-mail: composite@mapei.it

KEYWORDS: FRCM; masonry; confinement; column; design-oriented model.

ABSTRACT

In order to improve the axial capacity of masonry columns, the confinement techniques allow restoring the structural safety without altering the architectural value, the shape and the weight of the member. Traditional techniques do not always meet these criteria, so the innovation of the FRP technique is suitable in overcoming these issues. The use of FRP is now consolidated and its design criteria are well-defined in the Italian CNR DT 200 / R1-2013. The criticalities of this reinforcement technique are mainly related to the compatibility of organic matrices with masonry, especially in the case of historical-monumental buildings. This led to the replacement of organic matrix with inorganic matrices, creating systems like the FRCMs (Fabric Reinforced Cementitious Mortars). Despite the high number of applications of this technique on masonry structures, there are still no guidelines that govern its design. Based on a database of experimental compression tests on masonry reinforcements reinforced with FRCM-systems, the article presents an analytical study for calibrating appropriate design formulations to be included in future regulatory codes on this topic.

CODE 411

DESIGN VARIABLES IN VENTILATED AIR CAVITIES FOR THE CONTROL OF RISING DAMP IN CULTURAL HERITAGE BUILDINGS

Gil-Muñoz, María Teresa[1]; Lasheras Merino, Félix[1]

1: Grupo de Investigación Análisis e Intervención en el Patrimonio Arquitectónico (AIPA)
Escuela Técnica Superior de Arquitectura (ETSAM)
Universidad Politécnica de Madrid (UPM)
e-mails: m.teresa.gil@gmail.com; felix.lasheras@upm.es

KEYWORDS: Ventilated air cavities; rising damp; built heritage; monitoring.

ABSTRACT

The goal of this communication is the description of the main design variables that determine the efficacy of ventilated air cavities, typically laid out close to the foundation or base of the walls in cultural heritage buildings, in order to eliminate capillary rising damp.
It is based on a methodology that has analyzed numerous projects and developed extensive field work in order to verify the performance of this type of constructive solutions. Both external and internal conditions of the cavities have been studied, as well as the environment of the building and the constructive characteristics of the foundation and the cavity. The real behavior of different types of cavities have been assessed through the collection “in situ” of the most relevant physical parameters of indoor air and the wall to which the chamber is attached.
The main results obtained are summarized here, and the design factors of these cavities that are more important for the mitigation of the damage caused by capillary rising damp are put forward and discussed.

CODE 11

COST AND PRODUCTIVITY ANALYSIS OF SELF-LEVELING UNDERLAYMENT COMPARED TO TRADITIONAL METHODS

Figliuzzi, Guilherme[1]; Vazquez, Elaine[2]; Nobrega, Justino[3]; dos Santos, João[4]; Alves, Lais[5]

1: Department of Civil Engineering
Federal Center of Technological Education Celso Suckow da Fonseca
e-mail: gui_figli@hotmail.com, web: http://www.cefet-rj.br
2: Department of Civil Construction
Federal University of Rio de Janeiro
e-mail: elainevazquez@poli.ufrj.br, web: http://www.ufrj.br
3: Department of Industrial Engineering / Department Post Graduate Studies on Safety Engineering
Veiga de Almeida University / Federal University of Rio de Janeiro
e-mail: stonob@gmail.com, web: http://www.ufrj.br
1: Department of Civil Engineering
Federal Center of Technological Education Celso Suckow da Fonseca
e-mail: paraduc@yahoo.com.br, web: http://www.cefet-rj.br
5: Department of Civil Engineering
Federal Center of Technological Education Celso Suckow da Fonseca
e-mail: lais.alves@cefet-rj.br, web: http://www.cefet-rj.br

KEYWORDS: Traditional levelling underlayment; self-levelling underlayment; cost; productivity.

ABSTRACT

Between 2005 and 2015, the Brazilian real estate market experienced strong growth, driven by the stable scenario of the Brazilian economy and policies to encourage real estate credit. With this demand, the companies of the sector sought to be more competitive in the market. One of the measures adopted is the search for more efficient executive processes. While the traditional manual methodology for underlayment predominates in the country's construction sites, a self-levelling underlayment presents a tendency towards mechanization of executive construction procedures. This paper aims to present a case study of a residential construction in Rio de Janeiro which used self-levelling underlayment technology. Comparisons regarding cost and productivity of both methodologies were made to evaluate the viability of the self-levelling underlayment in future construction sites. Data obtained from other constructions were used to estimate the productivity and cost of the traditional underlayment levelling. The results demonstrate that the use of self-levelling underlayment has potential to be widespread and used in the constructions in Brazil.

CODE 37

ANALYSIS OF THE CONSTRUCTION MATERIALS FOR THE FORT OF SAN FERNANDO (CARTAGENA DE INDIAS): 1753-1759

Galindo, Jorge[1]; Henao, Laura[2]; Fontás, Joan[3]

1: Escuela de Arquitectura y Urbanismo
Universidad Nacional de Colombia
e-mail: jagalindod@unal.edu.co
2: Mestrado Profissional em Conservaçao de Monumentos e Núcleos Históricos
MP-CECRE/UFBA, Salvador de Bahía, Brasil
e-mail: laurah-991@hotmail.com
3: Departamento de Arquitectura e Ingeniería de la Construcción
Universidad de Girona
e-mail: joan.fontas@udg.edu

KEYWORDS: Materials characterization; Antonio de Arévalo; fortifications.

ABSTRACT

Built between 1753 and 1756 under the direction of Spanish military engineer Antonio de Arévalo, the Fort of San Fernando de Bocachica is still one of the most interesting examples of Spanish military architecture in the Americas, not only for its layout (a horseshoe shape with a curved seafront façade and inward-facing bastions) but also for its particular technical/construction characteristics. The foundations (made from recycled materials taken from the old Fort of San Luis) were laid using wooden piles and ashlars on a sandy terrain and support walls made of brick and coralline limestone blocks. Lancet arches, in turn, support a flat roof that serves as an observation deck. Not without its pathogens and despite being severely threatened by human and natural influences, the fort still stands and remains in use today.

The purpose of this report is to provide a detailed account of the fort's construction materials through a study based on the analysis of the materials employed in its construction systems: woods, clay bricks, mortars made with lime and stones sourced from the sea, all through laboratory tests conducted through the assistance of the Federal University of Bahia (Brazil) and the National University of Colombia.

The results contribute in two ways: on the one hand, to understand the nature of the construction techniques used to select and prepare materials in the second half of the eighteenth century; and on the other, to provide the data required on the preparation of mortars and clays required when doing restoration work on the building. For example, the analysis of lime mortars used to bind bricks together reveals both their origin (sourced from quarries near the current site) and their pulverization and dosing methods when the mixtures were prepared. Likewise, the analyses detect the presence of pathogens that accelerate degradation processes.

It is an original and unprecedented study, pursued through an experimental methodology that also draws upon the history of construction as background in order to facilitate the analysis processes and the interpretation of the results obtained.

CODE 42

CHARACTERIZATION OF BRICK USED IN THE CATHEDRAL OF SANTO DOMINGO, PRIMATE OF AMERICA

Flores Sasso, Virginia[1]; Prieto Vicioso, Esteban[2]; García De Miguel, José María[3]

1: Pontificia Universidad Católica Madre y Maestra, Pucmm,
e-mail: vfloressasso@gmail.com
2: Universidad Nacional Pedro Henríquez Ureña,
e-mail: eprietovicioso@gmail.com
3: Cátedra UNESCO-ICOMOS (CNE) de Patrimonio,
e-mail: jomagar@iies.es

KEYWORDS: Brick; characterization; Cathedral of Santo Domingo.

ABSTRACT

In recent decades, the construction materials of historic buildings in the Dominican Republic show an accelerated and advanced deterioration. For this reason, the main objective of this research is to determine the physicochemical characteristics and mineralogical structure of the historic brick used in the Cathedral of Santo Domingo, Primada de América, built between 1521-1541. This has led to studies never before conducted in the country, taking advantage of scientific developments in recent years. In consequence the methods used to determine characteristics of the brick are: Petrographic Microscopy, X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Mercury Intrusion Porosimetry, Hygroscopicity or Pipette Test, Saturation test, Sclerometric analysis, infrared thermography, Colorimetry, salt and moisture estimates. At the conclusion, the minerals that made it up were obtained in a precise and quantifiable way, their chemical composition, resistance, porosity, water absorption capacity, as well as other physical characteristics. These results have been essential to your conservation and maintenance program.

CODE 102

EVALUATION OF THE CHROMATIC CHARACTERISTICS OF THE MURANO GLASS USED IN EXTERIOR COATINGS OF TRENCADÍS

Arias Holguín-Veras, Paloma M.[1]; Zamora i Mestre, Joan Lluís[2]

1: Programa de Doctorado Tecnología de la Arquitectura, de la Edificación y del Urbanismo
Universitat Politècnica de Catalunya
e-mail: paloma.arias@upc.edu
2: LiTA (Laboratori d'innovació i Tecnologia a l'Arquitectura)
Universitat Politècnica de Catalunya
e-mail: joan.lluis.zamora@upc.edu, web: http://www.lita.upc.edu

KEYWORDS: Color; murano glass; smalti; coatings; trencadís.

ABSTRACT

This research focuses on the analysis of the color homogeneity of Smalti type Murano glass pieces used for exterior tile coatings with trencadís technique, in which restoration work demands replacement of the glass tiles due to possible defects derived from exposure to atmospheric and environmental agents. For this, a color characterization of 48 Smalti samples, from the same manufacturer, was carried out using a portable spectrocolorimeter that allowed to make a catalog of the reference colors currently produced within the CIELCh color space, with the objective of evaluating the homogeneity of the colors of this handcrafted material. Subsequently, an analysis of the stability of these colors was performed based on a statistical comparison of the results obtained with the instrument and the color difference (ΔE94) was determined between the two faces of the glass sheet, to determine whether it was a factor to be considered at the time of the façade restoration. It is intended to continue this characterization and cataloging with a comparison of the values obtained with historical glasses. The present study provides a method of color analysis with a portable instrument that allows its subsequent use in situ in areas difficult to access, and a process for the categorization and identification of colors in non-industrialized materials.

CODE 116

COMPACTED SOIL-CEMENT: PROPOSED TEST METHODS FOR DOSAGE AND PHYSICAL AND MECHANICAL CHARACTERIZATION

Pinto, Eduardo da Silva[1]; Faria, Obede Borges[2]

1: PPGARQ/FAAC/UNESP - Bauru; SP, Brasil
e-mail: falecom_edu@hotmail.com
2: DEC/FEB/UNESP e PPGARQ/FAAC/UNESP - Bauru; SP, Brasil
e-mail: obede.faria@gmail.com,
web: http://www.faac.unesp.br/#!/pos-graduacao/mestrado-e-doutorado/arquitetura-e-urbanismo/

KEYWORDS: Earthen architecture and construction; rammed earth; soil-cement; physical and mechanical characterization.

ABSTRACT

In the present work are proposed test methods for physical and mechanical characterization of compacted soil-cement. To achieve this objective, a new mold model for the production of Ø 5cm x 10 cm specimens was proposed, replacing the mold adopted by the Brazilian standards, which recommend Ø10cm x 12.7cm specimens, making the tests more practical and reliable, in order to encourage the use of civil construction techniques that generate less negative environmental impacts. It is also proposed a metallic device for the diametrical compression tensile strength test, an important parameter for characterization of the material, which is not considered in Brazilian soil-cement standards. Tests were carried out using the proposed mold and device, as well as tests using the specimens produced with the current mold, to evaluate the proposed methods. With the results obtained, it is intended to open the discussion with other researchers, aiming at a future revision of Brazilian soil-cement standards, with the Brazilian Association of Technical Standards (ABNT). Some difficulties were found in the demoulding operation of the new specimens, however, the mold was corrected and the results obtained were promising, in terms of facilitating the process of physical and mechanical characterization of the material (with reduction of raw material consumption and of the time required for the specimens production) and to improve sampling, maintaining a level of reliability compatible with that obtained by current methods. From the point of view of the practical application of the obtained results, a soil-cement dosage curve was produced, with the purpose of guiding the choice of the minimum cement content, to reach a desired compression strength, or established by norm.

CODE 134

HIDRAULIC LIME CONCRETE FOR THEESTORATION OF SANT PERE'S CHURCH IN ROSSELLÓ (LLEIDA)

Rosell, Joan Ramon[1]; Ramírez-Casas, Judith[1]; Bedini, Sara[1]; Sala, Miquel Àngel[2]

1: Departamento de Tecnología de la Arquitectura, UPC
e-mail: joan.ramon.rosell@upc.edu.com
2: Arquitecto autor del proyecto; Departamento de Construcción, URV.

KEYWORDS: Rosselló's bell tower; lime concrete; hydraulic lime; water reducing additive; color pigments.

ABSTRACT

In January 2016, the bell tower of Sant Pere's church in Rosselló (a town 10 km away from Lleida) collapsed. The causes of the collapse, still undetermined, were probably due to the destabilization of one of the side walls of the bell tower itself. The church, built in the XVIII century, is the only one of the town and a restoration is urgently needed to recover the function of worship.
The project of restoration does not propose the reproduction of the original tower, but to built a structure that marks its silhouette. The designers decided to use materials compatible with the original one, specifically using lime as a binder.
The present study focuses on the investigation of an hydraulic lime concrete with specific initial features:

- a 90-day compressive strength of 10 MPa;
- reproduction of the color of the original stone of the front wall of the church;
- particular conditions of setting up.

The investigation was based on the existing bibliography and local materials, to develop an experimental campaign in the laboratory.
The results obtained satisfy the performances initially proposed and demonstrate the feasibility of using the lime concrete tested.
The construction work is currently being done with excellent results.

CODE 136

EXPERIMENTAL STUDY OF THE MECHANICAL BEHAVIOR OF BRICKS FROM 19TH AND 20TH CENTURIES BUILDINGS IN THE PROVINCE OF ZAMORA (SPAIN)

Ramos-Gavilán, Ana Belén[1]; Rodríguez-Esteban, María Ascensión[2a]; Antón-Iglesias, Mª Natividad[2b], Sáez-Pérez, Mª Paz[3]; Camino-Olea, Mª Soledad[4]; Caballero-Valdizán, Julen[2c]

1: Departamento de Ingeniería Mecánica. Universidad de Salamanca
e-mail: aramos@usal.es
2: Departamento de Construcción y Agronomía. Universidad de Salamanca
e-mail: (a) mare@usal.es; (b) nanton@usal.es; (c) zandival@msn.com
3: Departamento de Construcciones Arquitectónicas. Universidad de Granada
e-mail: mpsaez@ugr.es
4: Departamento de de Construcciones Arquitectónicas IT y MMC y TE. Universidad de Valladolid
e-mail: mcamino@arq.uva.es

KEYWORDS: Compressive strength; historic bricks; restoration and rehabilitation.

ABSTRACT

Interventions historic brick buildings require an exhaustive analysis of the current characteristics of the bricks, in order to establish the role that these elements maintain in the buildings. This study presents the result of an experimental analysis for the compressive strength of brick specimens extracted from different buildings built in the 19th and 20th centuries in the province of Zamora (Spain). specimens with very different characteristics are analysed, allowing comparisons between brickworks and manufacturing processes. The obtained resistance values are related to the result of a macroscopic and microscopic analysis of the material, which classifies the pieces into four groups, and to the results of the study of the density, absorption and open porosity of the samples. The compressive strength results show high variation between brick specimens and in-between the samples extracted from the same brick. A correlation between the of resistance and open porosity values, with less dispersion in the case of high sintering level is observed. Finally, the compliance with the current rules respect to their carrying capacity is checked.

CODE 151

BUILDING THE SPACE: VAULTS' GEOMETRY AND STEREOTOMY MATERIALS AND ARCHITECTURAL TECHNOLOGIES IN THE MEDITERRANEAN AREA

Campisi, Tiziana[1]; Saeli, Manfredi[2]*

1: University of Palermo, Polytechnic School, Department of Architecture (DARCH), Italy
e-mail: tiziana.campisi@unipa.it
2: University of Aveiro, Department of Materials and Ceramics Engineering, CICECO, Portugal
e-mail: manfredi.saeli@ua.pt

KEYWORDS: Constructive technology; stereotomy; vault; construction materials, Mediterranean.

ABSTRACT

In the history of construction, the erection of a vault has always been an architectural/engineering challenge. Such a structures, indeed, were able to cover large spaces with complex geometries and a high effort in design and construction. Often, beyond the successful examples, many failures occurred along with disastrous collapsing and changes of mind. In any case, the whole available apparatus of structural and technological knowledge was exploited, leaving a large space to imagination and experimentation. On the other side, consolidated structural and architectural schemes were often taken from the rule of the art or from manuals. Technological innovation were always merged with the science of construction, with design and drawing – of the whole structure as well as of meticulous illustrations – and with a wise usage of traditional local materials.
Stereotomy is the true heart of the vaulted construction. A precise science able to shape the constitutive material, the stone, with an absolute precision, useful not only to the statics of the system but also to the aesthetic output of the pushing structure. In this work many examples and constructive experiences are reported and compared. Furthermore, originalities and typologies are highlighted to show how the technical knowledge was highly transversal and shared, thanks to a large diffusion of ideas and artisans through the various countries.

CODE 171

BUILDING TECHNOLOGIES IN THE HISTORIC CENTRE OF IGLESIAS

Cannas, Leonardo G.F.[1]*; Brandinu, Laura[2]; Cuboni, Fausto[3]

1: University of Cagliari, Faculty of Architecture and Engineering, DICAAR
e-mail: leonardo.cannas@unica.it, web: http://dipartimenti.unica.it/ingegneriacivileambientaleearchitettura/
2: University of Cagliari, Faculty of Architecture and Engineering, DICAAR
e-mail: brandinu.laura@gmail.com
3: University of Cagliari, Faculty of Architecture and Engineering, DICAAR
e-mail: f.cuboni@unica.it

KEYWORDS: Industrial revolution; middle ages; iglesias; building technology

ABSTRACT

The historic centre of Iglesias, small town located few kilometres far from the coast in the south-west Sardinia, is an outstanding document with 800 years of history.
Its story is linked with the exploitation of mineral resources of the Sulcis sub-region. We know that Iglesias exists since Middle Ages when the earl Ugolino della Gherardesca invested in its development as a "garrison" of the area.
The building fabric is a palimpsest in which building types and technologies from various times coexist, those of the initial medieval phase and those of the more recent XIX – XX century urban transformations. These transformations were stimulated by the capitals and the intellectual resources that reunited in Iglesias for a new period of mineral resources exploitation.
Now the historic centre is affected by a political strategy that aims at improving the living conditions and, more generally, at the development of the city through the valorisation of its cultural identity. This strategy calls for the arrangement of the urban plans. Recently, in the framework of a collaboration between DICAAR and Iglesias municipality, our research group has been asked to analyse the historic building fabric as a preliminary study to support the definition of the operational aspects of the historic centre urban plan.
This paper describes the technological characteristics of the building fabric, in which local traditional building techniques, that belong to the pre-industrial economy, merged with technological innovations brought by the mining industry. These were used first for public and then for residential buildings.
This work will spread the knowledge about this human settlement, that is characterised by an unusual history and that is few investigated by the building technology point of view. This study will be useful for those that will work for its rehabilitation and for comparative analysis with other case studies.

CODE 176

FIRE BEHAVIOR OF COMPACTED EARTH BLOCKS

Soares, Edgar[1]; Lima, Diogo[2]; Ferreira, Débora[2]; Mesquita[2], Luís; Miranda, Tiago[1]; Leitão, Dinis[1]

1: University of Minho
e-mail: edgarsoares@civil.uminho.pt; tmiranda@civil.uminho.pt; dleitao@civil.uminho.pt
2: Polytechnic Institute of Bragança
e-mail: diogoopedroo@gmail.com; debora@ipb.pt; lmesquita@ipb.pt

KEYWORDS: CEB; Compacted earth block; resistance test fire.

ABSTRACT

The main concern of the fire regulation with the occurrence of fire is not related to the interest of preserving the patrimony, but rather to ensure that the structure remains with its preserved carrying capacity for a period of time considered sufficient to assure the total evacuation of people.
The work developed is about the safety of buildings in compacted earth blocks (CEB) when subjected to fire situations. The results of resistance achieved by the CEB during a fire and after being cooled are analysed with the main objective of increasing the knowledge and thus ensuring the safety of the property and mainly of the people.
It is also the objective of this work to understand the influence of the stabilizers, responsible for increasing the resistance of the CEB, through thermomechanical resistance tests in steady state. For this, 5 stabilizers mixtures using lime and cement were analysed, and different behaviour responses of the material subjected to the fire action were obtained. An analysis of the residual compression tests with the sample that attained the best performance is also performed.
The best performance was obtained for the composition with the highest amount of stabilizers, with 10% of lime and 10% of cement. However, the composition with 5.0% of lime and 7.5% of cement showed a resistance close to the previous one, this composition being a better choice due to the smaller amount of stabilizers, being more economical and more sustainable.

CODE 229

FATIGUE BEHAVIOR OF RECYCLED AGGREGATE MORTARS

Sainz-Aja, Jose A[1*]; Carrascal, Isidro A[1]; Polanco, Juan[1]; Sosa, Israel[1]; Thomas, Carlos[1]

1: LADICIM (Laboratorio de la División de Ciencia e Ingeniería de los Materiales), Universidad de Cantabria. E.T.S. de Ingenieros de Caminos, Canales y Puertos,
Avda. Los Castros 44, 39005 Santander, España
e-mail: sainzajaj@unican.es, web: http://www.ladicim.unican.es

KEYWORDS: Fatigue; mortars; locati; recycled aggregates.

ABSTRACT

In order to improve the quality of railway infrastructures and reduce maintenance costs, the replacement of traditional sleeper railways by concrete slab tracks system is proposed in this work. The use of recycled aggregate into the concrete should reduce the cost that this substitution implies. This recycled aggregate can be obtained directly crushing the elements removed from the traditional railway superstructure, specifically using the concrete sleepers and the ballast.
In a first phase, the fatigue behaviour of mortars using the recycled sands from both sleepers and ballast wastes were analysed. Miniature cylindrical specimens of 40 mm height and 20 mm diameter prepared with recycled and natural siliceous sands, using the same grading have been manufactured: old sleeper concrete, ballast and standard silica sand. The method followed in order to analyse the fatigue behaviour was the accelerated LOCATI method.

CODE 264

THE AMAZON REGIONAL ARCHITECTURE OF MILTON MONTE: KALUME RESIDENCE

Maciel, Patrícia de Lima[1]; Tavares, Rui[2]

1: Faculdade de Arquitetura, Universidade do Porto
e-mail: patyarquitetura@yahoo.com.br ,
2: Centro de Estudos de Arquitetura e Urbanismo, Faculdade de Arquitetura, Universidade do Porto
e-mail: rtavares@arq.up.pt

KEYWORDS: Architecture; amazon; belém; milton monte.

ABSTRACT

Architecture based on modernism's precept in Brazil reached world recognition mostly by the hands and work of Oscar Niemeyer. The construction of a Brazilian architectonic identity is quite noticeable in the work of this architect, which is permeated with environmental considerations. Grounded on the consolidation of these precepts in the process of project creation, though late in North Brazil, two professionals came to be in the limelight, who are responsible for the reconception of modern Brazilian architecture when environmental conditionings in the region are taken under consideration; Severiano Porto (1930 -), headed in Manaus (AM) and Milton Monte (1929 – 2012) based in Belém (PA), this being the object of the PhD thesis. It can be said, summarily charactering Milton Monte's work, that his architectural proposals aimed at understanding and adequately responding to specific climatic demands in the Amazon; nevertheless, much of his work reveals traces, structural solutions and architectonic elements and regional construction methods. By successfully applying such characteristics to his designs, Monte was able to directly influence both the method of project conception as well as future architects in the field. Thus, the same way Niemeyer made his the international style criteria and gave it Brazilian culture characteristics, so does Monte provide the architecture in Belém with an equatorial aura by interlacing the modern with the regional.
Many particularities inherent to the work of the architect are condensed in the object which is suggested for the article referring to an architectural and constructive study on the Unifamily Housing Kalume, an award winning project in which Monte used, apart from armed mortar on the floor, the bent eaves, a devise of the architect's creation; the topic – Project: traditional materials and construction methods – allowed a theoretical study on modernism in Brazil, the adaptations of the concept to the region, was developed; also a photographic, documental and project collection was made in the private heritage of the architect. This theoretical and documental search supported the comprehension of Milton Monte's significant contribution to the building of a more modern and regional climate adequate Belém.

CODE 285

LABORATORY STUDY ON THE BEHAVIOR OF LATERALLY LOADED ADOBE WALLS

Weldon, Brad[1]*; Bandini, Paola[2]; McGinnis, Michael[3]; Dávila, Eduardo[4]; Garcia Vera, Diego[5]

1: New Mexico State University, Department of Civil Engineering
e-mail: bweldon@nmsu.edu , web: http:www.ce.nmsu.edu
2: New Mexico State University, Department of Civil Engineering
e-mail: paola@nmsu.edu , web: http:www.ce.nmsu.edu
3: University of Texas at Tyler, Department of Civil Engineering
e-mail: MMcGinnis@uttyler.edu , web: https://www.uttyler.edu/ce/
4: New Mexico State University, Department of Civil Engineering
e-mail: davila88@nmsu.edu , web: http:www.ce.nmsu.edu
3: New Mexico State University, Department of Civil Engineering
e-mail: diego_gv@nmsu.edu , web: http:www.ce.nmsu.edu

KEYWORDS: Adobe; moisture; mud brick; experimental testing.

ABSTRACT

Adobe is a traditional construction technique used throughout the world. It requires low-energy and produces minimal waste material among many advantages. Adobe can be found in historic and new construction throughout the world, many in earthquake prone regions. Due to their substantial mass and low tensile capacity, adobe structures are particularly susceptible to the effects of seismic forces. In addition, adobe is often affected by moisture that penetrates from the ground or through the plaster. This paper describes the preliminary findings of an experimental program to investigate the effect of moisture content on the lateral resistance of adobe walls. Lateral load tests were conducted on small-scale adobe walls with variable moisture contents to evaluate the effect of moisture near the foundation-wall interface. In addition to variable moisture contents, different foundation types (i.e., traditional versus modern) were used to evaluate their effect on the wall performance. It was observed that a slight increase in moisture content of the adobe has a significant effect on the wall's strength characteristics. The wall behaviors were evaluated and compared. Finally, bio-inspired concepts are introduced for improved sustainability and resilience of adobe construction.

CODE 290

CONSTRUCTION MATERIALS IN THE HISTORIC CITY: IDENTIFICATION, VALUATION AND CONSERVATION. THE CASE OF CUENCA, ECUADOR

Aguirre Ullauri, María del Cisne[1]; Sanz Arauz, David[2]; Vela Cossío, Fernando[3]

1: Programa de Doctorado en Patrimonio Arquitectónico. Universidad Politécnica de Madrid – Proyecto Los materiales en el estudio histórico – constructivo – ambiental de los conjuntos históricos. El caso de Cuenca. Universidad Católica de Cuenca
e-mail: cisne2222@hotmail.com, maguirreu@ucacue.edu.ec
2: Grupo de Investigación: Análisis e Intervención en Patrimonio Arquitectónico. Departamento de Construcción y Tecnologías Arquitectónicas. Universidad Politécnica de Madrid
e-mail: david.sanz.arauz@upm.es
3: Departamento de Composición Arquitectónica. Universidad Politécnica de Madrid
e-mail: fernando.vela@upm.es

KEYWORDS: Historic materials; assessment of incidence factors; heritage conservation; Cuenca.

ABSTRACT

The construction characteristics of architecture in the city of Cuenca (Ecuador), in accordance with the representative time periods of its cultural, political, economic and social transformation, have permanently defined the nature of the areas, zones, sectors and/or neighborhoods that constitute the city; even so, the recurrent use of certain local materials exposes both the attachment and availability to these materials; be it the case of andesite, brick, or travertine, but also other materials like mud - in the form of adobe, bahareque (wattle and daub), plaster and paint – which delineate the architectural identity of the city.
From recognition of this situation, the details of its architectural condition (type of element, location, general characteristics of shape and material appearance) are collected and documented in file records, as part of a preliminary characterization based on observation and field inspection applied to the French Neoclassical building facades, as it represents a temporary synthesis of the integral transformation of architectural work in Cuenca.
Under this perspective, the identification of the historical uses of these materials, and the estimation of the risk to which they are exposed nowadays in such conditions implies an approximation towards the hierarchical implementation of mitigation measures of the incidence factors, as well as the treatment of pathological lesions, in accordance with the patrimonial valuation of the buildings or urban areas in which they are located, as well as the intrinsic material characteristics. For this purpose, application of the ABC Method, which in conjunction with the Leopold Matrix, defines the methodological guidelines that enables the analysis, as well as the determination of complementary fields of study, such as the characterization of materials, the prediction of scenarios, and the orientation of corrective and preventive public conservation policies.

CODE 320

THE STELLAR-SHAPED FORTIFICATION OF NICOSIA (CYPRUS)

Bernardo, Graziella[1]; Palmero Iglesias, Luis Manuel[2]; Geratzioti, Maria[3]

1: Department of European and Mediterranean Cultures
University of Basilicata
e-mail: graziella.bernardo@unibas.it, web: http://www.unibas.it
2: Group or Department Second Author
Polytechnic University of Valencia
e-mail: lpalmero@csa.upv.es, web: http://www.pagweb.com
3: School of Engineering
University of Basilicata
e-mail: maria.geratzioti@gmail.com, web: http://www.unibas.it

KEYWORDS: Military architectural heritage; circular stellar plan; heart shaped bastion; calcarenite; joints mortar.

ABSTRACT

Between the end of the fifteenth and the beginning of the sixteenth century, military architecture underwent significant transformations. The use of the artillery and the progress of sciences occurred during the Renaissance period led to the introduction of new architectural forms and the consequent adoption of new building technologies. The main innovations were the replacement of the medieval squared towers with circular corner bastions, the lowering of the height of the fort constructions and the increase of the thickness of the defensive walls. The fortified walls of the city of Nicosia, built by the Venetians at the end of the sixteenth century, are to be considered among the first examples of the new way of constructing polygonal fortresses according to the changed requirements of the art of war. In 1570, the Venetians demolished and rebuild the medieval walls of the city in only eight months under the threat of the imminent invasion of the Ottomans. The new walls were designed by the Italian military engineer Giorgio Savorgnano according to the Renaissance ideal city with a stellar shape circumscribed in a circumference of a diameter of 7 km interrupted at regular intervals of 260 meters by eleven heart shaped bastions of the same size and form, outlining a regular hendecagon with eleven sides and eleven angles. The adoption of the circular lines of the walls and the shape at the heart of the ramparts provided a greater resistance to the fortification than those of the medieval type with squared lines, which made corner areas of the weakness points of the fortification. In spite of the numerous and bloody conflicts that have marked the history of Cyprus, the Venetian walls of Nicosia have been preserved until today and can be counted among the most beautiful monuments of the worldwide military architectural heritage. This work illustrates the preliminary experimental results of a research activity aimed at the study of construction technologies used by the Venetians for the construction of Nicosia fortress and at the characterization of the original materials, whose knowledge is a prerequisite for the design of restorations and maintenance of the architectural heritage.

CODE 334

THE INFLUENCE OF THE PUNTO AND THE RETUMBO IN THE VAULTED SYSTEM EXTREMADURA SABOVEX

Cortés Pérez, Juan Pedro[1]; Reyes Rodríguez, Antonio Manuel[2]; Matías Sánchez, Agustín[3]

1: Grupo de Investigación NEXUS
Universidad de Extremadura
e-mail: jpcortes@unex.es
2: Universidad de Extremadura
e-mail: amreyes@unex.es
3: Universidad de Extremadura
e-mail: amatias@unex.es

KEYWORDS: Extremadura vault; punto; retumbo; structural behavior.

ABSTRACT

The Extremadura vaulted system is made up of the extreme vault and the walls on which it rests. It is a typical typology Extremadura (Spain), the Alentejo (Portugal) and bordering areas, which has been used in the construction of houses and buildings until the early seventies of the last century.
The extreme vaults are like the vaults of edge, but in which the central key of the vault is higher than the keys of the arches of the arrangements in the walls. The difference between both dimensions is called rumble. Another important geometric variable in the behavior of the system is the point, which is the arrow of the elliptical arc of the arrangements of the vault. Therefore, a difference of the firearms that are the result of the intersection of two cylinders, these two are the intersection of two toroid of a wide radius.
To carry out an analysis and evaluation of the structural system, within an intervention that is increasingly common, it is essential to know the most important variables that condition their behavior. This is what is conducting a study of the structural behavior of the system, which is analyzing the most important variables, both geometric and mechanical.
Within this study, a parametric analysis of the geometric variables has been carried out in which up to 648 configurations of vaults and walls have been studied. In this communication the works carried out are exposed, describing the geometric variables that influence the behavior of SABOVEX. After a sensitivity analysis, the most influential variables, to finally present the parametric analysis of how to influence the light, the point and the return in the deformable and resistant behavior of SABOVEX.

CODE 341

ECOLOGICAL BLOCKS OF SOIL-CEMENT WITH INCORPORATION OF WASTES

Ferreira, Débora[1]*; Luso, Eduarda[1]; Cruz, Maria[1]

1: Instituto Politécnico de Bragança, Escola Superior de Tecnologia e Gestão de Bragança
debora@ipb.pt, eduarda@ipb.pt, lurdes@ipb.pt

KEYWORDS: Soil-cement blocks; ecologic; wastes.

ABSTRACT

This paper aims the revision of work already carried out on soil-cement blocks with incorporation of waste, which it´s the basis of VALORCOMP project and which intends to characterize ecological blocks resulting from a homogeneous and compacted mixture of soil, cement and water in suitable proportions, cured without heating.
Soil is an abundant raw material, recyclable and reusable, non-combustible, non-toxic, with significant thermal behaviour and without too expensive transformation processes, which allows selecting this material as a major possibility for sustainable construction. The limitations of soil as a construction material, in particular its mechanical behaviour and its susceptibility in the presence of water, can be minimized through soil stabilization processes. In the composition of the blocks, the soil is the major element and the cement is added in various proportions functioning as a binder since it is responsible for the mechanical strength properties of the final product. With wastes incorporation, mechanical, physical and thermal properties change. Laboratory tests in order to evaluate the potential use of the wastes in blocks composition, it´s essential.
The main organic wastes found in the research were eggshells or ashes, rice husk, malt bagasse, sugar cane, boiler ash, waste paper industry, wood and organic waste deposited in landfills. The best results in terms of overall performance were achieved with eggshells or ashes, rice husk, banana bagasse and organic residues, which allows verifying that this alternative of reuse for the wastes, besides the environmental advantages also allows a low costs associated with landfills.

CODE 373

TYPOLOGY, CONSTRUCTIVE TECHNIQUES AND MATERIALS COLONIAL LIGHTHOUSES IN ALGERIA

Karima, Amari[1]*; Amina, Abdessemed-Foufa[2]

1: University of Blida 01, Institute of architecture and town planning
e-mail: amarikarima11@gmail.com
2: University of Blida 01, institute of architecture and town planning
e-mail: aafoufa@gmail.com

KEYWORDS: Coastal lighthouses; masonry; architectural typology; constructive typology.

ABSTRACT

Each intervention on the built heritage requires, before moving to operational in situ, a fundamental step of knowledge and analysis of all the historical, architectural, constructive, structural and architectonic aspects of the latter because of their sensitivity, complexity and the values it possesses. Indeed, in the framework of the preservation of ancient buildings located on the Algerian coast, the rehabilitation of colonial coastal lighthouses needs in-depth knowledge of their architectural typologies, materials and constructive techniques.

The colonial coastal lighthouses in Algeria constitute a very interesting patrimonial richness dating back more than a century and a half and represent a variety of architectural and constructive typologies of the late 19th century and early 20th century, due firstly to the chronology of their construction where the first lighthouse was built in 1861 and the last in 1954, secondly, to their geographical location which is different either on land (on cape), on islets or on isolated islands at sea , And finally, to their tower, which is the remarkable and highest element in a lighthouse, whose forms, heights, and locations in relation to the building vary from one lighthouse to another; Which one finds either the tower in the middle of the building, or the tower attached to the building or the independent tower.

Our presentation will focus on all the constructive typologies of these buildings in stone masonry, which we find structures with stone and other with cut stone coated or apparent size with the blocks of stone for the corner chaining And the framing of openings. And also on architectural typologies that encompass a category where the lighthouse building is alone and another one whose lighthouse forms an ensemble with ancillary buildings with or without garden.

CODE 379

FERNAND POUILLON DESIGN: COMBINATION BETWEEN TRADITIONAL KNOWLEDGE AND CONSTRUCTIVE INNOVATION

Mohammedi, Louiza[1]*; Abdessemed Foufa, Amina[2]; Cheikh Zouaoui, Mustapha[3]

1: Laboratory "Environment and Technology for Architecture and Cultural Heritage" Lab ETAP. Institute of Architecture and Urban planning (I.A.U), University of "Saad Dahleb" Blida 1 Algeria,
e-mail: louizamohammedi@yahoo.fr
2: Laboratory "Environment and Technology for Architecture and Cultural Heritage" Lab ETAP. Institute of Architecture and Urban Planning (I.A.U), University of "Saad Dahleb" Blida 1 Algeria,
e-mail: aafoufa@gmail.com
3: Laboratory "Environment and Technology for Architecture and Cultural Heritage" Lab ETAP. Institute of Architecture and Urban Planning (I.A.U), University of "Saad Dahleb" Blida 1 Algeria,
e-mail: czmustapha@yahoo.fr

KEYWORDS: Fernand pouillon; stone masonry; traditional materials; construction methods.

ABSTRACT

During the decade preceding the independence of Algeria, the French architect Fernand Pouillon marked the Algerian context by many architectural projects. With deficiency in residences, the needs for re-housing the Moslem community of the shantytowns as well as the urgency to build in quantity, quickly and at lower cost, were the conditions to satisfy immediately.
However, at that time both cement and steel were insufficient, and to find materials of replacement constitutes a major task. In this respect, Pouillon conceived and implemented material diversity as well as constructive modes in stone masonry in its projects. This alternative, allows cost effective constructions with a better quality and resistance. Indeed, contrary to the "HLM" constructions of the time, which were built expensive and within long times, Pouillon was able to maintain not only the costs and the deadlines but also the quality and the comfort of the inhabitants.
The choice of the "prefabricated stone" of Paul Marcerou, gives place to several modes of implementation and is accompanied by complementary technical research that Pouillon tested in the whole of Tourette in Marseilles, then continues with the 200 residences of Aix in Provence, and finally the Algerian operations.
The scope of the present research is the revelation of the built heritage of Fernand Pouillon in Algeria. Based on the work of preceding researchers as well as on some in-situ investigations, this research is thus a contribution to rediscover the traditional materials and innovating construction methods, implemented by this architect.

CODE 387

MINERAL BASED WHATERPROFFING TEST

Wallace, Tenório[1]; Rafael, Aragão[2]; Angélia, Faddoul[3]

1: IESPLAN – INSTITUTO DE ENSINO SUPERIOR PLANALTO.
e-mail: tenorio@grupoaeronet.com.br, web: http:www.iesplan.br
e-mail: contato.rafaeldias@gmail.com, web: http:www.iesplan.br
e-mail: angeliasf@uol.com.br, web: http:www.iesplan.br

KEYWORDS: Specimen, additives, waterproofing, mineral, concrete, break.

ABSTRACT

This article presents some of the main results of laboratory tests done with additives waterproofing agents based on minerals applied to concrete and having, among other properties, the ability to make it waterproof. The waterproofing capacity of the concrete was tested when receiving this additive in its trace, as well as its resistance compared to the concrete of trace standard (without additive), through the breaking of cylindrical specimens. Comparatives of guarantees, durability and its own resistance. In addition to the trait suggested by the manufacturer of the product, several other traits were tested so that it could be observed as the ratio between the quantity and water-cement factor, influence the strength of the concrete as well as its waterproofing. A major joint effort of the technical society (research entities, universities, manufacturers of materials, construction companies, developers, entities representative of consumers and representatives of public authorities) is being provide a level of performance compatible with the required concrete structures.

CODE 388

BUILT VERNACULAR HERITAGE IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT GOALS: A RATIONALE FOR ENGAGING HERITAGE PARADIGM INTO CLIMATE ACTIONS'

Olukoya Obafemi A.P[1]

1: Faculty of Architecture, Civil Engineering and Urban Planning, International Graduate School: Heritage Studies PhD Program, Brandenburg Technical University, Cottbus-Senftenberg, Germany.
e-mail: olukoyaobafemi@yahoo.com, web: http://www.-tu.de

KEYWORDS: Built vernacular heritage; building envelop; environmental sustainability; goal 13.

ABSTRACT

Achieving the sustainable development target is not plausible through only technological perspectives, especially in the building sector, it requires the incorporation of multiple paradigms. Through the continued affinity for technological solutions, the sector has demonstrated a sustained undermining of the stability of the planet and unsustainable usage of earth's resources. Suffice it to state that, on the other hand, built vernacular heritage has demonstrated varied layers of lessons in these contexts. However, these lessons fell victim to alternative engineering safety paradigm offered by modern building construction. In this vein, this paper argues that while it is necessarily true that built vernacular heritage lacks engineering compliance, the amalgamation of its age-long sustainability lessons with minimal contemporary engineering solutions could provide alternatives to the challenges of greenhouse gas emission and unsustainable use of earth's resources in the building sector. To validate this position, therefore, this paper conducts a comparative analysis of a built vernacular heritage and a modern building in the context of the building envelop and carbon footprints, with the aim of demonstrating the values of built vernacular heritage in the context of Sustainable Development Goal (SDG) 13. Conclusively, this paper posits that, imbued with the values from the past, built vernacular heritage is a finite and non-renewable environmental resource which needs to be sustained for the benefit of future generations.

CODE 393

INFLUENCE OF THE SUBSTRATE PREPARATION ON THE ADHESION OF MORTAR ON CERAMIC BRICKS

Costa e Silva, Angelo Just da[1]; Azevedo, Antonio Augusto Costa de[2]*; Souza, Marcelo Tavares Gomes de[3]

1: Universidade Católica de Pernambuco
e-mail: angelo@tecomat.com.br
2: Instituto Federal de Ciências de Educação e Tecnologia de Pernambuco
e-mail: antonioaugustoca@hotmail.com
3: Instituto Federal de Ciências de Educação e Tecnologia de Pernambuco
e-mail: marcelomtgs@gmail.com

KEYWORDS: Adhesion; mortar; roughcast.

ABSTRACT

The present work analyzes the influence of the substrate preparation on the adhesion of mortar, especially the preparation of the roughcast, simulating situations that occur on site. The study was carried out from field tests and include the preparation of samples in 5 different conditions (reference: no preparation of the substrate, substrate surface moistened with water, moistened with lime solution, with roughcast, roughcast with lime solution). The substrate was made of ceramic bricks on which industrial cementitious coating mortar was applied. After 28 days, adhesion strength tests were performed, in accordace with NBR 13528 (2010). The results show the influence of the substrate treatment on the adhesion, especially in the case using roughcast with lime solution, instead of the substrate surface moistened with water (adhesion increase of approximately 30%). This is an alternative of simple implementation and low cost.

CODE 475

ACTIVITY OF FLY ASHES FROM WASTE INCINERATORS AND THE SUGAR INDUSTRY IN LIME MORTARS AND PASTES

Lima Figueiredo, Radson[1]*; Pavía, Sara[2]

1: Trinity College Dublin, School of Engineering, Department of Civil, Structural and Environmental Engineering
e-mail: limafigr@tcd.ie
2: Trinity College Dublin, School of Engineering, Department of Civil, Structural and Environmental Engineering
e-mail: pavias@icd.ie

KEYWORDS: Fly ash; pozzolanic activity; hydrated lime; lime mortar.

ABSTRACT

Fly ashes (FAs), generated as by-products, can be active in the presence of lime generating cementing hydrates through pozzolanic reaction. These can enhance the strength of hydrated-lime mortars still preserving their physical and chemical compatibility with traditional and historic masonry.
This paper assesses the properties and reactivity of FAs from different sources in order to evaluate their potential as pozzolanic additions in lime mortars.
The results evidenced that the incinerator and sugar bagasse ashes studied are reactive and combine substantial lime. All ashes significantly increased the flexural strength of hydrated lime alone and only one of the incinerator ashes lowered the compressive strength of the lime at 90 days. The significant strength increase is probably due to the generation of pozzolanic cements and to the increase in nucleation sites for C-S-H precipitation.
The gas adsorption measurements indicate that the specific surface areas of the ashes range between 4.50 and 5.27 m^2/g. Values greater than those typical of other pozzolanic additions such as GGBS and PFA, however, lower than RHA or MS.
The finest (incinerator) ash (IFA2) which also has the greatest specific surface area and the highest calcium content, shows the greatest activity with the mechanical test however disagreeing with the chemical test. The compressive strength reactivity rating follows the trend of the BET results where the most reactive ash is IFA 2, followed by IFA 3 and finally IFA 1.
The ashes consist of a mix of irregular porous and vitreous particles. The chemical composition and the presence of cubic crystals suggest the presence of halite (NaCl) in the incinerator ashes which can adversely impact material durability. The mineral composition evidenced the presence of silicates, oxides, carbonates and salt minerals.

CODE 496

NATURAL HYDRAULIC LIME MORTAR INJECTIONS IN THE STONE WALLS OF THE SANTA MARÍA OF VITORIA-GASTEIZ CATHEDRAL

Estívariz Martínez, Mª Esperanza[1]; Cámara Muñoz, Leandro[2]

1: Building Engineer, Fundación Catedral Santa María
e-mail: esperanza@catedralvitoria.eus, web: www.catedralvitoria.eus
2: Architect, Fundación Catedral Santa María
e-mail: lcamara@catedralvitoria.eus, web: www.catedralvitoria.eus

KEYWORDS: Cathedral; natural hydraulic lime; injections; mortar; consolidation.

ABSTRACT

The injection aim has been the inner consolidation of the stone walls which remained an incorrect present state, in order to improve this way their behaviour and strengthening them without hardening. This natural lime mortar injection in the Santa María cathedral stone walls was preceded with imperative studies based on the cathedral structure behaviour and the utmost necessity of repair it. Once the injection decision was taken, those surveys have been following two main different ways, the proper material selection and the application techniques on site. It was decided that the injections were made of medium strength features natural hydraulic lime and low grading aggregates, providing a high fluent mortar obtained by means of additives. For he on site performance, surveys have been focused on what pressure the material should be injected into, the dumping rhythm not only in time but also in volume, the wall penetration extent and the minimization of the produced damage because of the necessary perforations for the injections. All this tasks do not complete the studies on lime injection for the stone walls consolidation, it is essential to do a pursuit routine, by means of monitoring, on the movements of the injected elements thus the evolution and time stability could be observed.

CODE 3

CONCRETE STRUCTURES TREATED WITH MIGRATORY CORROSION INHIBITORS. EFFICIENCY MONITORING IN PROJECTS

Suárez, Javier*; Borralleras, Pere; Sánchez, Guillermo

1: BASF CONSTRUCTION CHEMICALS, S.L.
e-mail: javier.suarez@basf.com, web: https://www.master-builders-solutions.basf.es
2: e-mail: pere.borralleras@basf.com
3: e-mail: guillermo.s.sanchez@basf.com

KEYWORDS: Concrete; protection; corrosion; inhibitor; migratory.

ABSTRACT

There are products on the market known as migratory corrosion inhibitor agents (ICM), which are characterized by their ability to move through the porosity of the hardened concrete and to place in the reinforcement zone, drastically reducing the corrosion intensity and thus preventing pathological phenomena related to the corrosion of the reinforcement in the structures of reinforced concrete. Migratory corrosion inhibitors are liquid products that are applied directly to the surface of hardened concrete and must be able to migrate to the reinforcement zone. This mechanism has aroused much scepticism in engineers and architects, which has entailed the limited use of these technologies.

BASF Construction Chemicals, with its migratory corrosion inhibitor agent, has carried out an intense monitoring of its effectiveness in a real project, the Miró Foundation of Barcelona, where the application of the inhibitor was made in 2005 and measures have been taken of monitoring in 2007, 2013, and 2015, by the “Instituto de Ciencias de la Construcción Eduardo Torroja”, obtaining spectacular results even under adverse conditions of carbonation, after ten years since the application.

Once the effectiveness of the product has been demonstrated in real cases, the use of proven corrosion inhibition agents (ICM) opens new possibilities in repair techniques and in its design and design, and represents a unique opportunity for preventive interventions.

CODE 38

STRUCTURAL IMPROVEMENTS IN MORTARS AND CONCRETES FOR THEIR APPLICATION IN THE REINFORCEMENT OF HISTORICAL STRUCTURES

Durán, Luís[1*]; Fortea, Manuel[2]

1: Grupo de Investigación en Construcciones Arquitectónicas. GICA
Universidad de Extremadura
estudiolduran@mail.com
2: Grupo de Investigación en Construcciones Arquitectónicas. GICA
Universidad de Extremadura
fortea@unex.es

KEYWORDS: Lime, fiber, cork, ductility, vaults, earthquake.

ABSTRACT

With the discovery and subsequent development of portland cement, in the restoration of traditional structures there has been a tendency to use cement mortars in a systematic way. However, damage to the masonry and factories in general has been repeatedly reported due to the incompatibility of this cement with the materials of the old buildings.
The most recent restoration works have studied and reproduced lime mortars used in antiquity because they are considered more suitable for compatibility between materials, non-chemical aggression to stone and structural ceramics, and in order to avoid excessive stiffness in the breast of the constructive elements. But there are no studies on its structural safety.
It is possible to improve the design of the mortars and concretes for the historical structures with aggregates of controlled granulometry and that in turn decrease the mass for a better structural behavior of the historical structures especially before seismic actions (as they can be the vaults before an earthquake to make them compatible with the elements to be restored), with the inclusion of granulated cork (recycled, surplus of other processes) and adding polypropylene fibers.
The study confirms that it is possible to obtain a mortar and concrete that applied to the factories, it achieves a greater physical, chemical and mechanical compatibility with the structures of the historic buildings. A better structural behavior, more ductile and less rigid, has been demostrated, lacking "brittle breakage".
The use of hydraulic lime for the restoration of the patrimony and in particular to improve the behavior of the structures of historic buildings in certain accidental situations such as the earthquake is a clear innovation because it is this material improved with fibers and cork the ideal to assume this structural role.

CODE 53

BEHAVIOR TO RESONANT FATIGUE IN COMPRESSION OF RECYCLED CONCRETE FOR STRUCTURAL USE

Yoris, Adrián[1]; Thomas, Carlos[1]; Medina, César[2]; Polanco, Juan A.[1]; Sánchez de Rojas, María Isabel[3]; Frias, Moises[3]; Cantero, Blas[2]

1: LADICIM (Laboratory of Materials Science and Engineering), University of Cantabria,
E.T.S. de Ingenieros de Caminos, Canales y Puertos, Av/Los Castros 44, 39005 Santander, Spain.
e-mail: carlos.thomas@unican.es
2: University of Extremadura, UEX-CSIC Partnering Unit, School of Civil Engineering,
Avda. de la Universidad, s/n, 10071 Cáceres, Spain.
3: Eduardo Torroja Institute for Construction Science – CSIC, C/Serrano Galvache 4, 28033 Madrid, Spain.

KEYWORDS: Recycled concrete; fatigue; resonance; Locati.

ABSTRACT

In the present work, the physical and mechanical properties of different types of concretes made with commercial cement and with natural and recycled coarse aggregates are evaluated. For this purpose, cylindrical specimens with different dosages were made: a standard concrete with commercial cement and natural aggregates, and two concretes with commercial cement and recycled aggregates with 25% and 50% replacement.
The density, porosity, absorption, resistance to simple compression, modulus of elasticity and behavior to resonant fatigue in compression were determined from the processed concretes. To carry out this last test, the Locati methodology was applied, for which 6 steps of 1·105 cycles each were configured, with a single minimum voltage and an increasing maximum voltage for each of the steps.
The results obtained show that there is a significant loss of load capacity in all the concretes evaluated, regardless of their type. On the other hand, a high loss of rigidity is observed in the standard concrete, while in the concretes with recycled aggregates said loss is significantly lower

CODE 54

RADIOLOGICAL PROTECTION CONCRETE BEHAVIOR AGAINST HIGH TEMPERATURES

Tamayo, Pablo[1]; Thomas, Carlos[1]*; Setién, Jesús[1]; Polanco, Juan A.[1]; Ferreño, Diego[1]; Rico, Jokin[2]; Ballester, Francisco[2]

1: LADICIM (Laboratory of Materials Science and Engineering), University of Cantabria. E.T.S. de Ingenieros de Caminos, Canales y Puertos, Av/Los Castros 44, 39005 Santander, Spain
e-mail: pablo.tamayo@unican.es
2: GITECO (Grupo de Ingeneiería de la Edificación), University of Cantabria. E.T.S. de Ingenieros de Caminos, Canales y Puertos, Av/Los Castros 44, 39005 Santander, Spain.
e-mail: jokin.rico@unican.es

KEYWORDS: Radiological protection; high density concrete; radiation absortion.

ABSTRACT

In the present study, the main results of the characterization of the components of a structural concrete for protection against ionizing radiation from radiological installations are presented.
Those radiological equipments are placed in several kind of facilities, from radiotherapy or nuclear medicine installations to industries for materials production, or nuclear power generation plants, all of them with stringent security requirements, specially in terms of protection against radioactive release. Therefore, they must be built with suitable construction materials, among which structural concrete is one of the most important.
Its design parameters are not set to obtain a high-performance concrete, but a very high-density one, whose total aggregate fraction is composed only by magnetite aggregate (90% ferrous-ferric oxide). The use of this kind of high-density aggregates may provide a concrete with a low thickness of the half-value layer. This allows higher attenuation of electromagnetic ionizing radiation and, at the same time, the use of smaller concrete thicknesses.
The study also proposes the use of a water/cement ratio of 0.59, attending to a compromise solution between the overall density of the concrete and its resistance, and the establishment of mix proportions with three aggregate sizes (0/2, 0/8, 0/20) and Portlad cement CEM I.
On the basis of this, this concrete characterization requires a study on its mechanical behavior under high temperatures, by mean of tests that emulate the thermal effects radiation and extreme temperature gradients would cause in case of accident. The physical-mechanical behavior of the concrete after exposure to aggressive external agents is also investigated, in order to quantify its life expectance. This characterization is accomplished with those tests dictated by the standards.
The obtained results show the feasibility of obtaining a suitable structural concrete with high density and a suitable behavior that allows its application in radiological installations, guaranteeing its effectiveness against high temperature shocks.

CODE 115

SUITABILITY OF STRUCTURAL MEMBRANES FOR THE REFURBISHMENT OF HISTORICAL BUILDINGS AND PRESERVATION OF ARCHAEOLOGICAL SITES

Llorens Duran, José Ignacio de

Building Technology Department
Barcelona School of Architecture. Technical University of Catalonia (UPC)
e-mail: ignasi.llorens@upc.edu,
web: http://sites.upc.es/~www-ca1/cat/recerca/tensilestruc/portada.html

KEYWORDS: Structural membranes; textile roofs; tensile structures; ETFE.

ABSTRACT

Through the analysis of 80 interventions in buildings and urban spaces of the historical heritage belonging to 24 countries, it has been established that structural membranes (both fibre-based and ETFE films) are suitable for refurbishment when protection, extension of the covered areas or courtyards are needed, because they are able to satisfy the principles of restoration of the architectural heritage formulated by the International Council on Monuments and Sites.
Three intervention strategies have been identified. The first strategy does not alter significantly the architectural character of the building or its constructive integrity. The second strategy adopts a different approach but maintains a dialogue in such a way that the coherence of the whole is maintained. On the other hand, the third strategy introduces a totally new concept by juxtaposing an outstanding new shape, which could be an appropriate choice if the context lacks character or definition.
On special occasions, the preservation of the external image of the building is added to the aforementioned principles. It is a requirement that considerably affects the design. It is also noticeable the suitability of membranes to cover large areas on existing stadiums and arenas because this capability is based on the lightness, translucency and compatibility of the intervention that does not alter the basic outlines and preserves the architectural character being easily differentiated and in some cases, easily removed. The same features are convenient for the protection of ruins and archaeological areas that require minimal and reversible interventions.
The concepts involved are illustrated with examples taken from the author's own experience and most of the projects on which the research is based are available at:
http://sites.upc.es/~www-ca1/cat/recerca/tensilestruc/REFURBISHMENT_web.pdf (24/10/2017).

CODE 225

DURABILITY ANALYSIS OF RECYCLED AGGREGATE MORTARS

Sainz-Aja, Jose A[1*].; Carrascal, Isidro A[1].; Polanco, Juan[1]; Sosa, Israel[1]; Thomas, Carlos[1]; Ana Cimentada[1]; Amilcar Abel Ramos Santos[1]

1: LADICIM (Laboratorio de la División de Ciencia e Ingeniería de los Materiales), Universidad de Cantabria. E.T.S. de Ingenieros de Caminos, Canales y Puertos,
Avda. Los Castros 44, 39005 Santander, España
e-mail: sainzajaj@unican.es, web: http://www.ladicim.unican.es

KEYWORDS: Durability; mortars; recycled aggregates.

ABSTRACT

In order to improve the quality of railway infrastructures and reduce maintenance costs, the replacement of traditional sleeper railways by concrete slab tracks system is proposed in this work. The use of recycled aggregate into the concrete should reduce the cost that this substitution implies. This recycled aggregate can be obtained directly crushing the elements removed from the traditional railway superstructure, specifically using the concrete sleepers and the ballast.
To evaluate the quality of the sands from both sleepers and ballast wastes, the durability of mortars was analysed, as well as with siliceous natural aggregate sand. In order to evaluate the behaviour to aging, humidity-dryness cycles tests have been performed. The humidity-dryness cycle test was performed using three different types of fluids: distilled water, seawater and water with sulphates.
To quantify the durability of mortars with each type of aggregate measurements of the mass of the specimens have been performed, both dry and saturated and it has been analysed the microstructure after the exposition to each aggressive agent.

CODE 247

CHARACTERIZATION OF SELF-COMPACTING MORTARS WITH ADITTION OF PERLITE POWDER AND LIMESTONE POWDER

Cortez, Franco[1]; Artigas, Veronica[2]

1: Facultad de Ingeniería
Universidad Nacional de Salta, Argentina
e-mail: franco6cortez@gmail.com
2: Facultad de Ingeniería
Universidad Nacional de Salta, Argentina
e-mail: veronicaartigas6@gmail.com

KEYWORDS: Mortars; self-compacting; perlite; limestone filler.

ABSTRACT

The benefits of limestone filler as partial replacement of portland cement are very well known, increases the resistance at early ages and improves the viscosity in mortars and self-compacting concretes. On the other hand, fine ground and unexpanded perlite has not been studied in depth as addition in mortars and concretes. However, its high silicon and aluminum oxides content can increase the strength of concrete at late ages. It is therefore that many mixes was proposed, replacing cement with perlite powder (PP) and limestone filler (LSF) in several proportions until 50% by mass. Rheological properties were evaluated by V-funnel and Slump flow tests. Flexural and compression strength was evaluated in prismatic samples of 40x40x160mm at 1, 3, 7, 28 and 90 days. The results have been used for the evaluation of the combination of these materials that offer a better performance for a self-compacting mortar in the fresh as hardened state.

CODE 330

RESEARCHES ON THE BEHAVIOR OF THE CONCRETE WITH INCORPORATION OF INDUSTRIAL RESIDUES TOWARDS THE ATTAINMENT OF A SUSTAINABLE MATERIAL

Parrón Rubio, Mª Eugenia[1]; Agudo Martínez, Andrés [2]; Rubio Cintas, Mª Dolores[3]; Contreras de Villar, Francisco[4]

1: TEP-951 ARHENE. Aprovechamiento de Residuos Industriales, de Construcción y/o Demolición para la Fabricación de Hormigón Estructural y No Estructural,
Dpto. Ingeniería Industrial e Ingeniería Civil. EPS Algeciras. Universidad de Cádiz
mariaeugenia.parron@uca.es; andresam@us.es , mariadolores.rubio@uca.es, francisco.contreras@uca.es,
http://tep951.uca.es

KEYWORDS: Residues proceeding from the metallurgy; concrete; sustainability.

ABSTRACT

The general consumption of concrete is way over any another material of engineering. The speed of depletion of the natural resources associated with this consumption is evident. One of the main problems of the steel industry related to the manufacture of steel, are the secondary products that are produced, causing over the past few years news types of industrial residues that depending on the sustainability of the environment, are re-used or well-treated. This work proposes the analysis of the resistant behavior of residues in test tubes of concrete, like the powders of smoke proceeding from ovens of electrical arch, when the melting of the materials takes is produced.
It is tried by this work to contribute to the evaluation of the behavior of these materials, characterising its properties. Its durability or aptitude to support, during the useful life for it has been projected to, the physical and chemical conditions to which it is exposed, and that would manage to cause its degradation as consequence of different effects from the considered charges and solicitations in the structural analysis.
The aim is to analyze the concentration of industrial residues as concrete component promoting economic and environmental improvements. What interests us is the knowledge of the Carbon footprint and the Water footprint of the products, which are the indicators of the largest use and founded on the concept of Analysis of the Life Cycle (ACV) in agreement to international ISO procedure [1,2 and 3], and as such, they need experiences and relevant conclusions to complete their research.

CODE 372

COMPARATIVE ANALYSIS OF DIFFERENT LASER SCANNING DATA IN 3D DOCUMENTATION AND MODELING OF BUILDING HERITAGE

Gonçalves, Luisa M. S. [1]; Gaspar, Florindo[2]; Gonçalves, Alexandrino[3]

1: Departamento de Engenharia Civil
Instituto Politécnico de Leiria, ESTG, INESC Coimbra
e-mail: luisa.goncalves@ipleiria.pt, web: https://www.ipleiria.pt/
2: Departamento de Engenharia Civil
Instituto Politécnico de Leiria, ESTG, CDRSP
e-mail: florindo.gaspar@ipleiria.pt, web: https://www.ipleiria.pt/
3: Departamento de Engenharia Informática
Instituto Politécnico de Leiria, ESTG, CIIC
e-mail: alex@ipleiria.pt, web: https://www.ipleiria.pt/

KEYWORDS: Terrestrial laser scanning, heritage, 3D modelling, accuracy.

ABSTRACT

The application of Laser scanning, has introduced significant changes in 3D data acquisition process and in contrast to the “classical” manual data acquisition techniques, such as terrestrial surveying and analytical photogrammetry, these automatic recording methods allow an automated dense and accurate sampling of the object surface within a short time.
Due to the development of this technology and also to the fact that precision and measurement volume requirements are very diverse, one laser scanner is not normally enough to cover all the applications in cultural heritage. Thus, the study of the performance and results accuracy of different types of equipment in a variety of scenarios is important to assess their capabilities against different objectives and needs in terms of cultural heritage.
In this paper we present the results of a comparative analysis of 3D data collected with three types of Laser Scanning equipment and respective fusion, used in the survey of the Founder´s Chapel of Santa Maria da Vitória Monastery, also known as Batalha´s Monastery. The Laser scanning systems used measure the time lag between the emission of a laser beam and the detection of its backscattered echo using different forms of measurement such as, round-trip time measurements, phase based ranging and triangulating laser scanner measurements. The data was collected with equivalent capture conditions. This work is part of the project entitled “Monumental Polychromy: Revealing Medieval Colours at Batalha” which aims to recreate the three-dimensional original polychromy of the Founder´s Chapel of Santa Maria da Vitória Monastery, Portugal.

CODE 383

DEVELOPMENT OF FUNCTIONAL MATERIALS BASED ON ENCAPSULATION TECHNIQUES TO OBTAIN BASE LIME MORTAR PRODUCTS WITH BIOCIDAL ACTIVITY FOR THE REHABILITATION OF HISTORICAL HERITAGE

Lloris, José Manuel[1]*; Sanchez, Marilo[1]; Calero, Pilar[1]; Pastor, Adrián[2]; Cruz-Yusta, Manuel[2]; Pavlovic, Ivana[2]; Sánchez, Luis[2]; Marmol, Isabel[3]; Pedrajas, Josefina[4]

1: Fundación CIAC Centro de Innovación Andaluz para la Construcción Sostenible.
E-mail: gerencia@fciac.es, web: http:www.fciac.es
2: Universidad de Córdoba, Departamento de Química Inorgánica
e-mail: luis-sanchez@uco.es
3: Grupo Puma,
e-mail: imarmol@grupopuma.com,
4: Alsens Tech.
E
e-mail: tecnico@alsenstech.com,

KEYWORDS: Heritage rehabilitation, lime mortars, biocidal activity, encapsulation, controlled release.

ABSTRACT

Much of the cultural heritage such as monuments, facades and sculptures, is made with stones of different nature, or mortars of plaster and lime. The great variety of materials and execution techniques employed implies that the alterations they suffer are very heterogeneous and complex. The alteration and deterioration processes are produced by the natural aging process of the materials, or induced by external agents. In recent years, the deterioration of historical and cultural heritage assets has been accelerated by the increase in pollution and the absence of preventive conservation systems. One of the most important deteriorations at present is due to the proliferation of microorganisms. Among the conservation treatments we can find biological control through biocides, cleaning, the application of consolidants or water repellents. On the other hand, restoration mortars on a lime basis are perhaps the most frequently used materials in the interventions of historical and archaeological constructions.
Taking into account this situation, a consortium led by the GRUPO PUMA company, together with the company ALSENS TECH and the research organizations Universidad de Córdoba and Fundación CIAC, have agreed to tackle this problem. They are developing functional materials based on encapsulation techniques to obtain products based on lime mortars with biocidal activity, for the rehabilitation of historical heritage. These materials are developed from inorganic supports such as mesoporous materials, laminar hydroxides or clays and in polymeric materials, in which substances with biocidal activity are encapsulated. The objective is to lengthen the biocidal activity of the mortar and reduce the initial concentration of biocide required. The results are confirming the encapsulating capacity of the selected supports, their effectiveness in the release of these products and the inhibition of the growth of microorganisms.

CODE 408

IMPLEMENTATION OF BIM METHODOLOGY IN BUILDING PATHOLOGY ASSESSMENT

Fernández Ridocci, José Francisco[1]*; Teixeira Martins, Tiago[2]; Fernández Gómez, Jaime[3]

1: Sondeos, Estructuras y Geotécnia S.L.
e-mail: jfernandez@seg-sa.es, web: http://www.seg-sa.es
2: Universidad Politécnica de Madrid
e-mail: tiago.teixeira.martins@alumnos.upm.es, web: http://www.upm.es
3: Universidad Politécnica de Madrid
e-mail: jaime.fernandez.gomez@upm.es, web: http://www.upm.es

KEYWORDS: BIM, point cloud, model, damage mapping, structural assessment.

ABSTRACT

This article aims to show how the use of BIM methodology and all the associated research and information management techniques can help to organize the results of a building pathology assessment campaign.
The use of this methodology allows transferring data collected in a field campaign to a 3D model in which can be documented the main results obtained in a pathological study.
Thus, it is described how the use of techniques such as laser scanner and photogrammetry point cloud acquisition allow the generation of a building condition model and documenting the existing damages.
The main uses of BIM analyzed are: (i) Modeling of an existing building from the available technical documentation and data achieved in field campaigns; (ii) Integration of field campaign results in the model file; (iii) Structural building assessment from the model data.
With these processes, it is intended to generate a well structured and easily accessible information database, in which can be possible to know, on time, the results of all field campaigns carried out, their location, and the results of the tests and analysis performed. In addition, all the information can be organized in a way that together allows the insertion of the obtained data in the assessment reports.

CODE 416

ENERGY PERFORMANCE AND MOISTURE CONTROL IN RESIDENTIAL BUILDINGS WITH PCM

Sá, Ana[1]; Guimarães, Ana[1]; Abrantes, Vitor[1]

1: CONSTRUCT – GEQUALTEC/LFC
University of Porto, Faculty of Engineering / Department of Civil Engineering – FEUP/DEC
R. Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal
e-mail: vazsa@fe.up.pt, web: https://paginas.fe.up.pt/~construct/

KEYWORDS: Condensation risk; dew point temperature; Phase Change Materials (PCM); moisture control and numerical simulation.

ABSTRACT

The condensation of water vapour on inner surfaces of residential buildings is a crucial problem, which influences the health and thermal comfort of the occupants. It also has important detrimental effects on the appearance and durability of construction materials. The mitigation of condensation risks is not simple, particularly in the process of rehabilitation of old buildings. The preservation of architectural features precludes the possibility of using thermal insulation materials in facades. The installation of these materials inside buildings (on walls and ceilings), when possible, leads to other problems, such as: (i) breeding of thermal bridges; (ii) reducing of thermal inertia; (iii) reducing the interior area.
Phase Change Materials (PCM) can be incorporated into traditional building materials with the aim to increase heat storage capacity, enable stabilization of interior surface temperatures of buildings whereby influencing the thermal comfort sensation and the stabilization of the interior ambient temperatures and without influencing the aspect of those traditional building materials.
This paper aims to assess the possibility of using PCM plastering mortars to mitigate condensation risks in the inner surfaces of walls of old residential buildings. The use of PCMs in internal coatings can potentially avoid (or strongly reduce) the occurrence of condensation temperatures in the inner surfaces, thus fulfilling their twofold intent: improvement of inner thermal comfort and minimization of condensation risks. Numerical simulations are used to predict dew point temperatures due to exterior climatic conditions and envelope characteristics of typical Portuguese old residential buildings. The influence of PCM on condensation risk mitigation is assessed and the global results are presented with the goal of highlighting behavioural differences in regard to common construction materials.

CODE 429

INFLUENCE OF WOOD WASTE INCOPORATION ON THERMAL BEHAVIOUR OF CEMENT MORTARS AND GYPSUM COMPOSITES. IMPLEMENTATIONS IN BUILDING REHABILITATION WORKS

Pedreño Rojas, M. Alejandro[1]; Morales Conde, Mª Jesús[1]*; Pérez Gálvez, Filomena[1]; Rodríguez Liñán, Carmen[1]; Rubio de Hita, Paloma[1]

1: Universidad de Sevilla, Escuela Técnica Superior de Arquitectura, Dpto. de Construcciones Arquitectónicas I.
e-mail: mpedreno@us.es; mmorales@us.es

KEYWORDS: Thermal behaviour; wood waste; cement and gypsum composites; rehabilitation.

ABSTRACT

The aim of this work is the study of the influence, from the point of view of the thermal behaviour, of wood waste incorporation in cement and/or gypsum composites and its constructive implementation in building rehabilitation works.
Previously, a characterization of the used waste is carried out and the physical (density) and mechanical properties (flexural and compressive strength) of the resulting composites are analyzed.
Finally, the influence of the new composite materials use in building rehabilitation works is studied by incorporating them into thermal covering. Direct implementation techniques and/or new prefabricated products are incorporated. These solutions are compared with traditional constructive solutions. The results show that the incorporation of wood waste in gypsum and cement composites implies, in all cases, an improvement in the thermal behavior of the materials and, consequently, of the building façades in which they are applied.

CODE 459

SANTA MARÍA OF VITORIA: FIRST STEPS ON ITS WALLS CONSERVATION BASED ON NANOMATERIALS. THE NANO-CATHEDRAL PROJECT FROM HORIZON 2020. G. A. 646178

L. Cámara[1]; E. Estívariz[1]; B. Fernández[2]; P. García[1]; I. Koroso[1]; B. Narbona[2]; S. Tamayo[2]

1: Fundación Catedral Santa María
e-mail: nanocathedral@catedralvitoria.eus, web: www.catedralvitoria.eus
2: Servicio de laboratorio General
Diputación Foral de Álava
e-mail: stamayo@araba.eus, web: www.araba.eus

KEYWORDS: Nanomaterials, heritage conservation, stone consolidation, stone protection, non-invasive methodology.

ABSTRACT

After more than 3 centuries of deterioration and different structure modifications, back in the 1990's Santa María Cathedral closed its doors to the public in order to begin an integral rehabilitation, which after 20 years of duration has reached great achievements in terms of Conservation of its Heritage.
Within Santa María's conservation works, it is of utmost importance the restoration of the stone covering its walls and, moving in with the researching and innovating line, the Fundación Catedral Santa María, in the company of the General Laboratory Service from the Diputación Foral de Álava, joined the European Project 'Nano-Cathedral' in 2015, an initiative providing funding from the European Union for the nano-materials researching and its application to heritage and high artistic importance buildings through stone consolidation and protection products.
Coordinated from the University of Pisa and constituted of a Consortium including several entities from 6 different countries: Austria, Belgium, Germany, Italy, Norway and Spain, this Project summarizes basically in a three essential phase action application such as: development and study of new materials, application and validation at a laboratory scale on specific lithotypes and final application and validation in monuments from the European geography.
Santa María Cathedral and its materials conservation process will begin yet in a few years, nevertheless this initiative entry is included within the intervention overall plan currently being prepared; in which is very important to find a stone affine product for the building, lengthening its conservation and slowing down its decay, being this the main objective pursued by the Foundation and Laboratory.
The Project 'Nano-Cathedral' is currently in its final stage and, through its almost 3 years of duration, several improvements have already been produced, not only in developed materials and good achieved results for the different studied lithotypes (limestones, sandstones and marbles) but non-destructive or invasive test methodologies, complete characterizations of these lithotypes and mapping systems for decay detection in the different studied stones.

CODE 468

SANDWICH PANEL WITH CORRUGATED CORE OF SUGAR CANE BAGASSE PARTICLES

Pozzer, Thales[1]; Fiorelli, Juliano[2]

1: Programa de Pós-Graduação em Engenharia e Ciência de Materiais
Universidade de São Paulo
e-mail: thales.pozzer@hotmail.com
2: Núcleo de Pesquisa em Materiais para Biossistemas
Universidade de São Paulo
e-mail: julianofiorelli@usp.br

KEYWORDS: Particle boards; composite material; agroindustrial by-products; ecological materials; sustainable construction

ABSTRACT

The construction industry is one of the human activities that most consumes natural resources and generates great amount of debris. Therefore, there is a bias towards to lessening the environmental impact derived from this sector through the development of new alternatives that enable more lightweight, efficient and low-cost materials so that attending to the concept of sustainability. In this context, the sandwich panels which are already potentially applied into the aerospace industry begin to have application into the civil construction industry sector, due to associating high resistance and lightweight, bringing them to be used on the vertical sealing system and even on the structural flooring, offering this way alternatives to the conventional floor slab. Particle panels are widely used on the furniture industry, and a range variety of academic studies have been suggesting the adoption of non-conventional lignocellulosic raw material in the production of these panels, such as sugarcane bagasse, coconut fibres, peanut peels and others still. The goal of those researches is to add value to those agroindustrial by-products and provide alternative raw materials to the panels industry. The present research paper aims to provide possibilities of application of sugarcane bagasse particles sandwich panels agglomerated with castor bean oil base polyurethane resin. It is about an innovative particles panel that brings structural properties due to its sandwich form with its corrugated nucleus, which increases potentially the stiffness to the material flexibility. Such material has been characterized with the physicomechanical properties according to the recommendations of the specific north american norms for sandwich panels from the American Society for Testing and Materials (ASTM). The results obtained permitted to conclude that the panel studied in this research is able to support typical residential loads for the application as structural flooring and attends to the load requirements stablished by the International Building Code (2006) for its purpose.

CODE 483

CONCRETE PAVEMENTS WITH ELECTRIC ARC FURNACE SLAG AS AGGREGATE

Ortega-López, Vanesa[1]; Fuente-Alonso, José Antonio[2]; Skaf, Marta[3]; Fiol, Francisco[4]; Manso, Juan Manuel[5]; Chica, José Antonio[6]

1: Civil Engineering Department
University of Burgos
e-mail: vortega@ubu.es , web: http://www.ubu.es
2: Construction Department
University of Burgos
e-mail: jafuente@ubu.es, web: http://www.ubu.es
3: Construction Department
University of Burgos
e-mail: mskaf@ubu.es, web: http://www.ubu.es
4: Construction Department
University of Burgos
e-mail: ffiol@ubu.es, web: http://www.ubu.es
5: Civil Engineering Department
University of Burgos
e-mail: jmmanso@ubu.es, web: http://www.ubu.es
6: Sustainable Construction Division
Fundación Tecnalia Research & Innovation
e-mail: joseantonio.chica@tecnalia.com, web: http://www.tecnalia.es

KEYWORDS: Recycling; steelmaking waste; concrete slab; electric arc furnace slag; mechanical properties.

ABSTRACT

Steelmaking industry generates vast amount of waste aggregates. The practical use of electric steelmaking furnaces is divided into two stages: the primary melting-oxidizing processes and the secondary-reducing processes. In the first, an Electric Arc Furnace will generate slag (EAFS) in proportions of 150 to 180 kg per ton of steel. In Spain, approximately 70% of total steel is produced in electric arc furnaces representing around 15% of total European EAF steel, and leaving more than 1 Million tons of EAFS every year. In order to reduce these EAFS, many researchers around the world are studying applications for their incorporation.
In the present research, mixes of steel slag concrete (CEAFS) were reinforced with fibers, and their properties in fresh and the hardened state were analyzed; likewise, some real slabs were constructed. The results were very promising, reaching the CEAFS reinforced with around 0.5% of fibers, good mechanical behavior, appropriate toughness, and suitable impact resistance for its use in pavements and slabs of buildings.

CODE 45

PASSIVE HYGROTHERMAL BEHAVIOUR AS A RESULT OF THE CONSTRUCTIVE EVOLUTION OF THE TRADITIONAL BASQUE ARCHITECTURAL MODEL: CASE STUDY OF LEA VALLEY

Etxebarria, Matxalen[1]*; Etxepare, Lauren[2]; de Luxán, Margarita[3]

1: University of the Basque Country, Higher Technical School of Architecture of San Sebastian, Department of Architecture
e-mail: matxalen.etxebarria@ehu.eus
2: University of the Basque Country, Higher Technical School of Architecture of San Sebastian, Department of Architecture
e-mail: lauren.etxepare@ehu.eus
3: Technical University of Madrid, Higher Technical School of Architecture of Madrid, Emeritus Professor
e-mail: mrgluxan@telefonica.net

KEYWORDS: Traditional architecture; constructive evolution; hygrothermal behaviour.

ABSTRACT

The main objective of this paper is to diagnose and determine the evolution of the passive hygrothermal behaviour in the traditional Basque architectural model as a consequence of its periodical adaptation. For that purpose, the traditional architecture of river Lea's valley, which is located in the Historical Territory of Bizkaia (Basque Country, Spain) and characterized by a temperate-humid climate, has been analysed.

Since its origin in the 15th century as an «architectural model», it has suffered from many construction adaptive solutions due to the social, economic and technical demands, which have also implied the evolution or variation of its passive hygrothermal behaviour. Not only do the construction system, structure, architectural composition and construction materials evolve, but also the hygrothermal performance is altered.

Once local traditional architecture's construction system's evolution has been evaluated, that is, the building type, construction system and envelope materials, the most representative models have been defined by the energy simulation Design Builder v. 5.0.1.024 programme. Therefore, the two hygrothermal variables, Operative Temperature [ºC] and Relative Humidity [%], have been collected according to the external environmental conditions and building type. Finally, the obtained results have been summarized and chronologically compared based on winter, summer and mid-season division.

CODE 69

ENERGY IN CULTURAL HERITAGE: THE CASE STUDY OF MONASTERIO DE SANTA MARIA DE MONFERO IN GALICIA

Lisitano, Ivana Mattea[1]; Laggiard, Deborah[1]; Fantucci, Stefano[2]; Serra, Valentina[2]*; Bartolozzi, Carla[3]; Blanco Lorenzo, Enrique Manuel[4]; Sabín Díaz, Patricia[4]

1: Politecnico di Torino, e-mail: s214641@studenti.polito.it; s218783@studenti.polito.it;
2: Department of Energy, TEBE Research Group, Politecnico di Torino
e-mail: stefano.fantucci@polito.it; valentina.serra@polito.it; web: www.tebe.polito.it
3: Department of Architecture and Design, Politecnico di Torino
e-mail: carla.bartolozzi@polito.it;
4: Department of Architecture and Urbanism; Department of Construction and Architecture Structure, Civil and Aeronautic, UDC
e-mail: enrique.blanco@udc.es; patricia.sabin@udc.es

KEYWORDS: Historical building retrofit; internal wall insulation; heat and moisture simulations; cultural heritage; indoor thermal comfort;

ABSTRACT

Facing a project aimed at the energy refurbishment in historical buildings means – first of all – to declare which are, for the designer, the priorities to respect. Every intervention on cultural heritage, actually, especially when the focus is pointed to the goal of improving energy and sustainability related aspects, assumes a strong cultural relevance.
The case study of the Monastery of Santa Maria de Monfero in Galicia, Spain, is an interesting example to explore the range between a general “adaptive reuse” project and the “energy refurbishment” good practice according to the conservation guidelines for historical buildings. The research is targeted at this monumental complex, which has been in state of abandonment for more than two hundred years, with a large part that is now in ruin.
The project that has been used for the research analysis is the result of the first prize in an international ideas competition aimed at giving a new cultural and touristic vocation to the monastery. The competition was won by the Spanish architects Patricia Sabin Diaz and Enrique M. Blanco, co-authors of the paper.
A focus of the study here presented was to investigate the actual performance of different building envelope retrofit solutions, in terms of thermohygrometric compatibility between existent wall and new internal insulation layers, thermal comfort provided and energy demand reduction. Results confirmed the importance of evaluating the proper retrofit strategy by coupling heat and moisture simulations and pointed out that guidelines, which can be applied on a "case by case" basis, are needed, since the retrofit of historical buildings represents an important part of conservation and protection actions and not a mere intervention aimed at reducing the energy consumption.

CODE 92

EVALUATION OF HERITAGE BUILDINGS USING ENVIRONMENTAL AND LIFE CYCLE APPROACHES

Seduikyte, Lina[1]; Grazuleviciute-Vileniske, Indre[2]; Mantas Dobravalskis[3]; Paris A. Fokaides[4]; Angeliki Kylili[5]

1: Faculty of Civil Engineering and Architecture
Kaunas University of Technology
e-mail: lina.seduikyte@ktu.lt, web: http://2017.ktu.edu/lt/statybos-ir-architekturos-fakultetas/
2: Faculty of Civil Engineering and Architecture
Kaunas University of Technology
e-mail: indre.grazuleviciute@ktu.lt, web: http://2017.ktu.edu/lt/statybos-ir-architekturos-fakultetas/
3: Faculty of Civil Engineering and Architecture
Kaunas University of Technology
e-mail: mantas.dobravalskis@ktu.edu, web: http://2017.ktu.edu/lt/statybos-ir-architekturos-fakultetas/
4: School of Engineering and Applied Sciences
Frederick University
e-mail: paris.fokaides@gmail.com, web: http://www.frederick.ac.cy/school-of-engineering-and-applied-sciences-home
5: School of Engineering and Applied Sciences
Frederick University
e-mail: paris.fokaides@gmail.com, web: http://www.frederick.ac.cy/school-of-engineering-and-applied-sciences-home

KEYWORDS: Heritage building; renovation; environment; LCA.

ABSTRACT

Buildings of European countries use almost 40 % of the global energy, by generating the 40–50 % of the total output of greenhouse gases. The heating requirement is responsible for almost 80 % of the energy demand in houses. Since historic buildings constitute 25 % of the European built environment they have a role to play in delivering CO2 emissions reduction targets along with the rest of the domestic stock. Reuse of existing heritage buildings is a creative challenge for all countries.
This paper discusses different approaches for evaluation of heritage buildings' sustainability. Comparison of new buildings and renovated heritage buildings is made with respect to environmental aspects and life cycle analyses. Renovation and refunctioning of heritage buildings are giving benefit in saving of material resources (compared with new buildings), reduction of environmental pollution because of materials production and transportation, reduction of production waste and energy needed for construction.
Life cycle analyses is presented a good method to evaluate environmental issues and to make sustainable decisions.
Social and cultural aspects of sustainability as an important part of sustainability are also discussed.

CODE 105

STRUCTURAL DESIGN AND COMPARATIVE LCA OF TWO STRENGTHENING TECHNIQUES: CONCRETE BEAMS UNDER FLEXURAL LOADS

Palacios-Munoz, Beatriz[1]*; López-Mesa, Belinda[2]; Gracia Villa, Luis[3]

1: University of Zaragoza, School or Engineering and Architecture, Department of Mechanical Engineering
e-mail: bpalacios@unizar.es
2: University of Zaragoza, School or Engineering and Architecture, Department of Architecture
e-mail: belinda@unizar.es
3: University of Zaragoza, School or Engineering and Architecture, Department of Mechanical Engineering
e-mail: lugravi@unizar.es

KEYWORDS: Environmental impact; life cycle assessment; concrete reinforcement.

ABSTRACT

The recognized environmental benefits of upgrading existing reinforced concrete structures or extending their service life have led to the need of including environmental criteria when a structural intervention is designed. Life Cycle Assessment (LCA) is a methodology to assess environmental impacts associated to a product or a process which considers energy, materials, and emissions over its whole life.
This study presents a LCA comparison between two techniques used when reinforcing concrete beams: steel sheets, placed with metallic anchors and epoxy resin, and carbon fibre reinforced plastic laminates (CFRP laminates) attached with epoxy resin. The objective is to provide environmental decision criteria as well as scientific data able to be incorporated in a whole building LCA.
Results reveal that the environmental impact of carbon-fibre production is greater than that of steel. Nevertheless, the whole CFRP reinforcement has a better environmental behaviour compared to steel/epoxy due to the mechanical properties of CFRP that leads to a reduction of the required material. Using metallic anchors results in a significant reduction of environmental impact revealing the responsibility of epoxy resin and the importance of considering the constructive process.

CODE 113

MANUFACTURE OF ELECTRICAL GENERATORS WITH RECYCLED MATERIALS FOR SELF-CONSUMPTION IN BUILDING

Balbás, Francisco Javier[1]; García, Javier[2]; Aranda, José Ramón[1]; Ceña, Alberto[3]

1: Technology group of the building, GTED
University of Cantabria
e-mail: balbasfj@unican.es; web: http://grupos.unican.es/gted/
2: School of industrial engineering and telecommunications
University of Cantabria
e-mail: Fbg14@mail.com
3: Association of renewable energy maintenance companies
e-mail: acena@aemer.org; web: http://www.aemer.org

KEYWORDS: Landfills; self-consumption; wind turbine; magnets; synchronous generator.

ABSTRACT

Currently, the reduction of the useful life of some technologies, generates a large amount of electronic waste whose main destination are landfills located in underdeveloped countries. On the other hand, the lack of availability of electric power can contribute to the use of other less efficient generation means and with a high environmental impact.
Therefore, to solve these questions is interesting recycling certain waste to manufacture of small power wind turbines to use in the buildings rehabilitation of those countries.
This article presents a practical example of the manufacture of an electrical machine for wind turbines, paying special attention in didactic training in the correct recycling of materials and manufacturing and testing of synchronous generators carried out in workshop schools.
Different possibilities of obtaining stators and magnets, their treatment and varieties of assembly are presented. Subsequently, with the manufactured generator, the results obtained are shown.
To conclude, the possible social, economic and environmental advantages for the regions involved are listed, proposing their analysis as an interesting future study.

CODE 158

SUSTAINABILITY WITH SELF-POLYURETHANE FLOORINGS ON REHABILITATION FLOORS

Miranda, María*; Ureña, Alejandro; Jiménez-Suárez, Alberto; Rubio, Mª Jesús

1: Sika, e-mail: miranda.maria@es.sika.com
2: e-mail: alejandro.urena@urjc.es
3:e-mail: alberto.jimenez.suarez@urjc.es
4: Facultad Ingenieros de Caminos, Canales y Puertos
e-mail: mjrubio@isoquiral.com

KEYWORDS: Self-leveling polyurethane; sameless; carbon footprint; energy efficiency; sustainability.

ABSTRACT

The materials of the flooring systems used in rehabilitation projects of historical buildings, public and commercial buildings such as schools, hospitals, hotels and museums, have a high wear due to their intense use. A frequent choice is the resilient floors and in particular the continuous systems, seamless, based on self-levelling polyurethane, executed in situ, which allow to extend the service life compared to prefabricated systems such as linoleum or PVC.
This will increase the service life of the system and therefore reduce the maintenance and retrofit required over the years, making it a more sustainable solution. As an advantage, when rehabilitation must be carried out, the existing system does not need to be removed. The new system can be applied over the old one without generating waste that must be taken to landfill.
These flooring solutions have low emissions and exceed the highest global standards for indoor air quality.
The color choice is another factor that influences sustainability. Different color means different consumption of the energy of the building
In this article, I will present a Life Cycle Assesment study from cradle to grave that will show results in energy efficiency for the specified surface. The service life will be done for a building service life of 40 years. It will be assumed the need replacing the PVC and linoleum system every 20 years and a refit facelift for the self-levelling polyurethane floor. The analysis investigates the total costs and environmental profile of the specified flooring systems over the entire assumed life cycle.

CODE 159

IMPROVING ENERGY EFFICIENCY IN PUBLIC BUILDINGS THROUGH SOCIAL INMOTICS

Montalbán Pozas, Beatriz[1]; Bustos García de Castro, Pablo[2]; Barrena García, Manuel[3]; Sánchez Domínguez, Agustín[4]; García Rodríguez, Pablo[5]; Del Río Pérez, Mariano[6]

1: Departamento de Construcción
bmpozas@unex.es, http://comphas.unex.es
2 y 4: Departamento de Tecnología Computadores y de las Comunicaciones
pbustos@unex.es, agustin.robolab@gmail.com, https://robolab.unex.es/
3 y 5: Departamento de Ingeniería Sistemas Informáticos y Telemáticos
barrena@unex.es, pablogr@unex.es, https://gim.unex.es/
6. Departamento de Física Aplicada
lmdelrio@unex.es, http://comphas.unex.es
Universidad de Extremadura

KEYWORDS: Energy efficiency; energy consumption; smart building; inmotic, social participation.

ABSTRACT

Energy efficiency is a complicated challenge in existing public buildings due to their internal complexity and age. Added difficulties come from the required user's disposition to collaborate and the intervention of public administrations. Real-time monitoring of ambiental variables and energy consumption data through an open information system can facilitate the management of these problems and provide new sources of solutions. The SmartPoliTech project provides tested experiences and data in two complex centers belonging to the University of Extremadura and the Government of Extremadura. Some the benefits expected from the project are the decrease in heating energy consumption, reduction of clean water use and improved fresh air renewal decreasing CO2 levels Air Quality Indoor). The final success of the project is directly related to the involvement of final users by providing easy to use information and persuasive indications. Also, a crucial aspect will be to achieve a proactive response from the building's users so they become ready to detect problems and propose innovative solutions.

CODE 211

PUBLIC HOUSING SUSTAINABILITY

Ferreira, Marta[1]*; Sousa, José[2]; Álvares, Manuela[3]

1: DomusSocial, EM
e-mail: mdferreira@domussocial.pt, web: http://www.domussocial.pt/
2: Instituto Superior de Engenharia do Porto, ISEP
e-mail: jso@isep.ipp.pt, web: https://www.isep.ipp.pt/
3: DomusSocial, EM
e-mail: manuela.alvares@domussocial.pt, web: http://www.domussocial.pt/

KEYWORDS: Sustainable construction; public housing; Oporto; LíderA – Sistema de Avaliação da Sustentabilidade; sustainability.

ABSTRACT

DomusSocial, EM, is the enterprise responsible for the management and maintenance of public buildings, residential and non-residential, at Porto city, with 48 neighborhoods comprising 12,617 apartments, plus 272 buildings scattered throughout the city with 535 apartments and 112 other public municipal buildings.
In the last decades there's been a massive consumption of resources due, mostly, to the industrial evolution, the world population exponential growth and the social-economic policies applied worldwide. The current consumption model puts the preservation of resources at risk, compromising the future generations. So, it stands clear the need of a new model of sustainable construction, that focus on a optimization of natural, social and economic resources.
With this in mind, the (presented) study has as objective the evaluation of sustainability in two neighbourhood of Public Housing under Domus Social management: neighbourhood of Carvalhido, build in 1958 with 14 buildings and 264 apartments, and neighbourhood of Pasteleira, build in 1960, with 27 buildings and 608 apartments.
The evaluation is based on the Portuguese method "LíderA – Sistema de Avaliação da Sustentabilidade" whose methodology is based on six fundamental principles: local integration, efficient use of resources, reduction of environmental impact, promotion of sustainable socio-economic living, guarantee of environmental comfort, and sustainable use through environmental management and innovation.
The aim is to reinforce the importance of sustainability principles in low-cost housing, construction and maintenance, in order to identify the main deficits and possible improvement points, redesigning social housing with space and technology solutions that enhance optimization, performance, quality and efficiency of buildings, in response to user needs, namely reduction of energy poverty index, indoor air quality and the enhancement of the dwelling function.

CODE 272

OVERALL APPROACH TOWARDS LCC ESTIMATION ON CONSTRCUTION SECTOR

Mêda, Pedro[1]*; Sousa, Hipólito[2]; Moreira, Joaquim[1;] Morais, Marco[3]

1: CONSTRUCT-GEQUALTEC, Construction Institute, Faculty of Engineering, Porto University
e-mail: pmeda@fe.up.pt; jjm@fe.up.pt, web: https://paginas.fe.up.pt/~icfeup/index.html
2: CONSTRUCT-GEQUALTEC, Civil Eng. Department, Faculty of Engineering, Porto University
e-mail: hipolito@fe.up.pt, web: www.fe.up.pt
3: LÚCIOS – Engenharia e Construção
e-mail: MarcoGilMorais@lucios.pt, web: http://www.lucios.pt/

KEYWORDS: Competitiveness; efficiency; contractor; strategy; life-cycle

ABSTRACT

After a period in which the construction activity went down on its production levels, presently the industry is gaining new directions and assuming again a leading role on the countries development. In Portugal, there are still many relevant infrastructures to be built and some new building construction for services and for residential uses. Building refurbishment is gaining a strong relevance. Strategic documents drawn for the industry highlight the importance of rehabilitation for the industry production KPI's. Notwithstanding, they place in parallel other requirements as efficiency and sustainability, from environmental, social and economic points of view. The present paper is endorsed to the economic issues, namely the provisions in terms of Life Cycle Cost (LCC). Base on literature review, standards, legal framework and work developed with a major contractor the research explored and defined a strategic approach to initiate the development of streamlined LCC analysis, from the investor/contractor point of view. These processes will contribute to the construction objectives and also for the compliance of provisions set on the new Public Procurement European Union (EU) Directive.

CODE 274

CONSTRUCTION PRODUCTS INFORMATION – IMPORTANCE AND INFLUENCE TOWARDS DIGITALIZATION

Sousa, Hipólito[1]*; Mêda, Pedro[2]; Moreira, Joaquim[2]; Costa, Rui[1]

1: CONSTRUCT-GEQUALTEC, Civil Eng. Department, Faculty of Engineering, Porto University
e-mail: hipolito@fe.up.pt; ruifcosta@fe.up.pt, web: www.fe.up.pt,
2: CONSTRUCT-GEQUALTEC, Construction Institute, Faculty of Engineering, Porto University
e-mail: pmeda@fe.up.pt; jjm@fe.up.pt, web: https://paginas.fe.up.pt/~icfeup/index.html

KEYWORDS: Decision support; efficiency; competitiveness; product data template; life-cycle.

ABSTRACT

One of the main challenges of building refurbishment operations is the combination of traditional/ancient technical solutions with current/innovative technologies. In addition to the requirements in terms of aesthetics and compatibility with the preexistence, there are also requirements in terms of functionality, efficiency and durability. This research benefits from the experience of a contractor on rehabilitation strategies, clients demands and work results. Yet, in order to implement innovative processes to improve construction competitiveness and sustainability, there are information gaps and processes that need to be streamlined. Construction information digitalization is found to be a driver to achieve these outcomes. This paper presets a simple case study (but that is representative of the industry practices) of a commonly used product; Gypsum board, using a small sample (3 manufacturers) and developing an analysis focused on the information requirements towards an improved efficiency of the industry.

CODE 323

LIGHTWEIGHT STRUCTURAL SYSTEM FOR FREE INTEGRATION OF TECHNOLOGIES FOR ENVELOPE ENERGY RETROFITTING

Alvarez, Izaskun[1]*; Garay, Roberto[2]; Lacave Isabel[3]

1: Sustainable Construction Division TECNALIA
e-mail: izaskun.alvarez@tecnalia.com, web: http://www.tecnalia.com
2: Sustainable Construction Division TECNALIA
e-mail: roberto.garay@tecnalia.com, web: http://www.tecnalia.com
3: Technology & Innovation Division
ACCIONA INFRAESTRUCTURAS
e-mail: isabel.lacave.azpeitia.EXT@acciona.com, web: http://www.acciona-infraestructuras.com

KEYWORDS: Energy retrofit; envelopes; ventilated façade; structure.

ABSTRACT

In the context of the environmental challenges set by the EU for the year 2020 and the promotion by public administrations of the implementation of technologies that reduce the energy consumption of buildings, numerous solutions have been developed in recent years for the energy retrofit of building envelopes.
Currently, conventional solutions are based on a single solution for the whole surface of the building. However, the ongoing technical developments in this field hint at the future development of hybrid solutions combining different technologies. The energy efficiency of current building could be substantially improved by combining active solutions collecting solar energy with passive solutions increasing the thermal resistance of the thermal envelope. This requires the development of a substructure that is able to integrate the different systems and guarantee their maintenance.
Current solutions that feature an auxiliary substructure, such as ventilated façades, most often require many anchoring points to the existing wall. Nevertheless, the stability of this element is not always guaranteed.
This paper presents the development of a substructure that is especially conceived for integrating diverse envelope retrofit solutions and guaranteeing their interchanging and maintenance, while being structurally independent from the original façade. Anchoring points are therefore restricted to the structural elements of the building. Architectural and mechanical considerations are discussed, presenting the technical solutions developed and their full-scale experimental verification.

CODE 324

EXPLORING THE INTERPLAY OF CLIMATE AND HYGROTHERMAL RISK FOR INSULATED WALL ASSEMBLIES IN THE IBERIAN PENINSULA

Arregi, Beñat[1]

1: Sustainable Construction Division
TECNALIA Research & Innovation
e-mail: benat.arregi@tecnalia.com, web: http://www.tecnalia.com

KEYWORDS: Energy retrofit; climate; thermal insulation; hygrothermal numerical simulation.

ABSTRACT

On the road towards an energy neutral building stock, increasingly demanding insulation levels are advised for both new and retrofitted buildings. While centuries of past experience have led to vernacular construction methods suited to local climates, the incorporation of thermal insulation to existing walls fundamentally alters their moisture balance and drying capacity. The impact of insulation assemblies on moisture risk is relatively well studied for cold climates; however, research and case studies are scarce for the warmer climates of Southern Europe, where such highly insulated walls have been unusual up to now.

This paper presents a parametric study evaluating the hygrothermal performance of 3 types of insulated wall assemblies exposed to 5 climates of the Iberian Peninsula. In particular, the influence of climatic parameters on hygrothermal risk is investigated, using transient numerical simulation methods.

Results show that the impact of solar irradiation and wind-driven rain over different orientations can outweigh that of temperature and humidity. Moreover, their combined effect can be either beneficial or detrimental, depending on the interplay of the specific climate and type of assembly. Hence, it is found that simplified assessment methods that do not consider the impact of wind-driven rain underestimate risk significantly for certain scenarios. Finally, the hygrothermal performance of the assessed wall assemblies is evaluated in the context of Iberian climates, discussing possible improvements.

CODE 325

HEAT TRANSFER THROUGH ANCHORING ELEMENTS IN A REAR-VENTILATED RAINSCREEN INSULATION SYSTEM FOR FAÇADE RETROFIT

Arregi Goikolea, Beñat[1]*; Garay Martinez, Roberto[2]; Riverola Lacasta, Alberto[3]; Chemisana Villegas, Daniel[4]

1: Sustainable Construction Division
TECNALIA Research & Innovation
e-mail: benat.arregi@tecnalia.com, web: http://www.tecnalia.com
2: Sustainable Construction Division
TECNALIA Research & Innovation
e-mail: roberto.garay@tecnalia.com, web: http://www.tecnalia.com
3: Applied Physics Section, Environmental Science Department
Universitat de Lleida
e-mail: alberto.riverola@macs.udl.cat , web: http://www.udl.cat
4: Applied Physics Section, Environmental Science Department
Universitat de Lleida
e-mail: daniel.chemisana@macs.udl.cat , web: http://www.udl.cat

KEYWORDS: Thermal insulation; ventilated façade; thermal bridge; finite element method.

ABSTRACT

Rear-ventilated rainscreen façade insulation systems are becoming a popular retrofit solution in Southern European climates, due to their good thermal performance in both winter and summer conditions. In these assemblies, the substructure of the new cladding is anchored to the original building, thus puncturing the thermal insulation. This study assesses the impact of such thermal bridges on the overall thermal performance of the external wall. The renovation of a conventional Spanish wall construction with a ventilated façade is used as a case study, featuring an anchoring system with L-shaped aluminium brackets. Two scenarios have been assessed: in the first one these brackets are fixed onto both the reinforced concrete slabs and the existing brickwork of the building, while in the second one they are anchored solely to the structural slabs. Simplified one-dimensional calculations are compared with two- and three-dimensional numerical models. Results indicate that anchoring elements can account for a substantial increase in heat flow. If the additional heat transfer through the anchoring elements is not taken into account, the energy savings delivered by the renovation could be considerably lower than expected by calculations, resulting in an increase of energy consumption over predicted values.

(1) Topics: Indicate the subject area to which this abstract belongs. The codes for each area are defined on Congress website (HERE). You can only select one code.

CODE 364

DURABILITY OF NEW BINARY CEMENTS

Sáez del Bosque, Isabel Fuencisla[1]; Medina, Gabriel[2]; Medina, José María[3]; Asensio, Eloy[4]; Frías, Moisés[5]; Sánchez de Rojas, María Isabel[6]; Medina, César[7]*

1: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: isa.f.saez@gmail.com
2: Universidad de León, Escuela de Ingenierías Industrial e Informática.
e-mail: gmedinaia@gmail.com
3: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: ingepisuerga@gmail.com
4: Consejo Superior de Investigaciones Científicas, Instituto de Ciencias de la Construcción Eduardo Torroja.
e-mail: eloyadl@ietcc.csic.es
5: Consejo Superior de Investigaciones Científicas, Unidad Asociada UEX-CSIC, Instituto de Ciencias de la Construcción Eduardo Torroja.
e-mail: mfrias@ietcc.csic.es
6: Consejo Superior de Investigaciones Científicas, Unidad Asociada UEX-CSIC, Instituto de Ciencias de la Construcción Eduardo Torroja.
e-mail: srojas@ietcc.csic.es
7: Universidad de Extremadura, Unidad Asociada UEX-CSIC, INTERRA, Escuela Politécnica de Cáceres.
e-mail: cmedinam@unex.es

KEYWORDS: Durability; additions; cement; performance; valorisation.

ABSTRACT

The durability of cement-based materials is one of the most pressing issues in today's infrastructure park, given the high cost of repair and maintenance where it is compromised. The use of additions has consequently become widespread in the design of binary cements or cast-in-place concrete as a way of enhancing durability throughout the service life of structures exposed to aggressive (marine, freeze-thaw or sulfate) environments.
That, in conjunction with today's socio-economic demands to replace the current linear with a circular economic model has encouraged the scientific-technical community to seek alternative raw materials in pursuit of high performance end products.
This study compared the effect of including 10 wt% of mining and electric power generation industry waste on the durability of new eco-efficient cements. Cured, 1x1x6 cm prismatic paste specimens were exposed to a sulfate-high environment. After exposure they were characterised for strength and their microstructure was analysed to identify the respective reaction products.
The main conclusion drawn is that the inclusion of this waste induces no loss of durability in cement-based materials exposed to sulfate-rich environments.

CODE 365

WATER TRANSPORT MECHANISMS IN RECYCLED AGGREGATES

Cantero, Blas[1]*; Plaza, Pablo[2]; Velardo, Paula[3]; Matías, Agustín[4]; Sánchez de Rojas, María Isabel[5]; Sáez del Bosque, Isabel Fuencisla[6]; Medina, César[7]

1: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: bcanteroch@unex.es
2: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: pplazaca@alumnos.unex.es
3: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: pvelardo@alumnos.unex.es
4: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: amatias@unex.es
5: Consejo Superior de Investigaciones Científicas, Instituto de Ciencias de la Construcción Eduardo Torroja.
e-mail: srojas@ietcc.csic.es
6: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: isa.f.saez@gmail.com
7: Universidad de Extremadura, Escuela Politécnica de Cáceres.
e-mail: cmedinam@unex.es

KEYWORDS: Durability; water penetration; construction and demolition waste; concrete.

ABSTRACT

As a porous material, concrete is vulnerable throughout its service life to physical and chemical agents present in the medium. That vulnerability can wreak considerable damage in environmental exposure classes where sulfates, chlorides or carbon dioxide are present and can penetrate into the concrete in aqueous solution or as gases.
Water permeability is a durability indicator that quantifies a structure's resistance to penetration by external agents. An understanding of this parameter is of particular significance, for water is one of the main vehicles for the ingress of such substances into concrete interiors, in addition to being directly related to freeze-thaw damage in exposure class H-F environments.
This study compared the effect of the partial (25 wt% and 50 wt%) replacement of natural aggregate with recycled aggregate processed from two types (concrete and mixed) of construction and demolition waste on water permeability in the respective recycled concretes. Cylindrical concrete specimens (15x30 cm and 10x20 cm) were moulded, cured and tested for total water absorption and water penetration under pressure.
The findings support the conclusion that in recycled concrete structures, water penetration mechanisms are essentially unaffected by the nature of the recycled aggregate used in partial replacements of the natural material.

CODE 369

LEARNING FROM THE PAST, SUSTAINABILITY IN TRADITIONAL ARCHITECTURE: THE CASE OF THE OTTOMAN WAST-EL-DAR HOUSE TYPOLOGY IN THE CASBAH

Marwa, Benchekroun[1]; Samia, Chergui[2]; Silvia, Di Turi[3]

1: University Saad Dahleb Blida1, Institute of architecture and urban planning, Algeria
e-mail: Marwa.Benchekroun1991@outlook.fr
2: University Saad Dahleb Blida1, Institute of architecture and urban planning, Algeria
e-mail: samiachergui@gmail.com
3: Construction Technologies Institute- Italian National Research Council (ITC-CNR), branch of Bari, Italy
e-mail: silvia.dituri@itc.cnr.it

KEYWORDS: Residential heritage of Algiers Casbah; indoor microclimate; thermal comfort.

ABSTRACT

Algiers is a city that has a rich building heritage with high historical value, where different solutions meet environmental requirements and more precisely the needs of current comfort.
Various issues have been raised in many scientific debates through previous works. This reveals the architectural richness of the Casbah houses as well as the important potential of study and work on this subject. Nevertheless, these scientific researches, focused on a case study, the Ottoman house has never been analyzed in terms of energy efficiency, comfort and thermal environment conditions.
The aim of the presented work is to answer to this lack in the study of the Ottoman houses in the Casbah by trying to insert ourselves in the framework of the comfort and the energetic aspect. This work is done in logic of continuity by punctual and more in-depth aspects that the different transformations and modifications made on the interior comfort could have, more precisely on the hygrothermal comfort of the residential building.
The idea developed in the research is that the old design offers practical and sustainable solutions to problems related to the quality of the environment and the comfort of housing, with a view to correlate the impact of the transformation during the colonial and post-colonial period on the residential buildings of the old city of Algiers.
In this work we evaluate the microclimatic conditions and the comfort level in these traditional houses, in their former and current state. We specify that the purpose of this work is not to establish new methodologies, but rather build an in-depth knowledge of the operation of these houses to meet the requirements of current comfort.
Numerical simulation, the in-situ measurements and the study of many parameters were the tools that enabled us to evaluate certain houses that have maintained favorable living conditions.

CODE 398

APPLICATIONS OF INFRARED THERMOGRAPHY FOR THE THERMAL TRANSMITTANCE ANALYSIS OF THE ENVELOPE OF A BUILDING IN A COASTAL ENVIRONMENT

Madruga, Fco. Javier[1]*; Rubio, Diana[2]; Lombillo, Ignacio[3]

1: Universidad de Cantabria, Escuela de Ingenieros Industriales y de Telecomunicación. Grupo de Ingeniería Fotónica (GIF) – Dpto. TEISA
e-mail: francisco.madruga@unican.es
2: Universidad de Cantabria, Escuela de Ingenieros de Caminos, Canales y Puertos
e-mail: dianarubiogomez@citop.es
3: Universidad de Cantabria, Escuela de Ingenieros de Caminos, Canales y Puertos. Grupo de Tecnología y Gestión de la Edificación (GTED-UC) – Dpto. Ing. Estructural y Mecánica
e-mail: ignacio.lombillo@unican.es

KEYWORDS: Infrared thermography; thermal transmittance; building envelope; energy efficiency; climate change.

ABSTRACT

Climate change is one of the main challenges for our society. The need for reducing the emission of polluting gases to the atmosphere has been corroborated by data from the World Meteorological Organization (WMO); emissions of CO2 in 2015 reached 400 ppm, which worryingly surpasses the natural balance between atmosphere, oceans and biosphere, i.e., 278 ppm. In order to revert this unbalance, replacing fossil energy sources with renewable sources and reducing consumption are paramount requirements. The exponential increase of energy consumption to satisfy comfort conditions at homes is associated with 40% of the total consumption in Europe, and is mainly due to the implementation of inefficient thermal envelope solutions (approximately 55% of heat losses in a building during winter occur through opaque parts of the front facades and roofs, and 18 % are produced through glass and thermal bridges). Therefore, the study of the thermal transmittance is crucial in order to determine whether a building envelope is optimal or, on the contrary, energy efficiency improvement is required.

Conventionally, the calculation of thermal transmittance in buildings has been carried out by means of methods based on ad-hoc temperature measurements, hence constraining the applicability of the obtained results to the specific scenario. Infrared Thermography (IRT) stands out as a promising technique that allows to overcome the aforementioned limitations by performing real-time measurements over the entire front surface of a building within predetermined time intervals. Additionally, IRT has been shown to be easier to implement and less expensive when compared to other well-known strategies.

In this paper, we consider adapting IRT as a useful methodology to analyze the thermal transmittance of existing buildings. The fundamental aspects of the technique are addressed, and the measurement procedure is described in detail. Finally, the IRT-based methodology is applied to the front facade of a building located at the seaside in Santander, Spain. As a conclusion, it can be stated that IRT has been proven to be an accurate and versatile tool for non-destructive evaluations of thermal transmittance in existing buildings and its application to scenarios which location and environmental conditions allow to fix technological limitations and establish procedural improvements.

CODE 412

IMPROVING ENERGETIC PERFORMANCE: SOCIAL-ECONOMIC-ENVIRONMENTAL EFFECTS

Oliveira, Mariana[1]; Andrade, Joana[2]; Álvares, Manuela

1: Domus Social, EM
e-mail: moliveira@domussocial.pt, web: http://www.domussocial.pt/
2: Domus Social, EM
e-mail: jandrade@domussocial.pt, web: http://www.domussocial.pt/
3: Domus Social, EM
e-mail: manuela.alvares@domussocial.pt, web: http://www.domussocial.pt/

KEYWORDS: Rehabilitation; energetic efficiency; municipal public housing; social and economic effects.

ABSTRACT

Domus Social, EM, is an Oporto company, whose purpose comprises the promotion and management of municipal public housing, including the building maintenance and rehabilitation, accompanying equipment and inherent infrastructures.

The municipal public housing estate under its supervision, built between 1940 and 2008, presents architectural and constructive solutions outdated and non-operational by current regulations requirements.

The ever-present concern for the promotion of tenants' quality of life in what concern habitation settings, associated with the commitment in order to promote buildings' sustainability, have motivated the development of rehabilitation projects which enhances energetic efficiency.

The case study here presented - rehabilitation of S. Roque da Lameira (buildings 21 to 23) – aims to analyze the economic, social and environmental effects after rehabilitation from a global point of view (company, tenant and society) after implementation of energetic efficiency solutions, mainly solar thermal panels to integrate an existing hot water system.

CODE 414

THE REABILITATION'S SUSTAINABILITY – A SIMPLIFIED MODEL TO ASSESS INTERVENTIONS

Ramos, Ana[1]; Almeida, Cláudia[2] *; Silva, J António[3,4]

1: Civil Engineering Department, Superior School of Technology, Instituto Politécnico de Castelo Branco, Portugal. Av. Do Empresário, 6000-767, Castelo Branco, Portugal.
e-mail: ana_ramos@ipcb.pt
2: Civil Engineering Department, Faculty of Science and Technology, University of Coimbra, Portugal. Rua Sílvio Lima, Universidade de Coimbra – Pólo II, 3030-790, Coimbra, Portugal.
e-mail: salehi.atefeh@student.dem.uc.pt
3: Civil Engineering Department, Faculty of Science and Technology, University of Coimbra, Portugal. Rua Sílvio Lima, Universidade de Coimbra – Pólo II, 3030-790, Coimbra, Portugal.
4: ADAI/LAETA, Association for the Development of Industrial Aerodynamics, University of Coimbra, Coimbra, Portugal
e-mail: raimundo@dec.uc.pt

KEYWORDS: Sustainable development, sustainable construction, assessing sustainability, old urban centres.

ABSTRACT

Recovering old urban centres is a Portuguese strategy to promote development and economic growth, supported by the strong evolution in the tourism sector that has been revealed as a key element for increasing gross domestic product (GPB). The Europe has also a specific worry in which built environment is concerned, namely through the European goals until 2020 that are based on the need to reduce the energetic consume and to increase the use of renewable resources.
Having in mind these aspects, in this paper the following tasks were done: i) sustainable assessment tools for rehabilitation actions were analysed; ii) European and national policies for urban rehabilitation and renewal were studied, in deeper sense, the one towards sustainability; iii) to create a simplified model to assess sustainability in old city centres interventions, criteria were defined; iv) a model was designed with areas, criteria and assessment indicators. The model presented is accurate with the built environment and its application makes possible to assess the impact of solutions, systems and techniques adopted in the design process, with the analysis of the defined criteria and the aim of improving the environmental, social and economic performances of buildings and old urban centres.

CODE 424

THERMIC CONTRIBUTION OF THERMOPLASTIC MICROESPHERS IN ELASTOMERIC COATING FOR ROOFING APPLICATIONS

Garcia Navarro, Ramiro[1]*; Pámpanas Martín, Pilar[2]; Rubio Encinas, María Jesús[3]; González Garrudo, Luis Carlos[4]

1: Research & Development Department, SIKA S.A.U. Technology Center, Madrid
e-mail: garcia.ramiro@es.sika.com, web: http:www.sika.com
2: Research & Development Department, SIKA S.A.U. Technology Center, Madrid
e-mail: pampanas.pilar@es.sika.com, web: http:www.sika.com
3: E.T.S.I.C.C. y P. (Madrid)
e-mail: mjrubio@isoquiral.com, web: http://www.isoquiral.com
4: Director de TM pavimentos. Sika, SAU
e-mail: gonzalez.carlos@es.sika.com, web: http://www.sika.es

KEYWORDS: Thermic performances; cool roof; waterproofing coating; roofing solutions; Paslink network; polymeric microspheres; weathering and durability.

ABSTRACT

The main scope of this research study has been to evaluate the thermic contribution of specific microspherical thermoplastic particles consisting of a polymeric shell encapsulating a gas into different elastomeric coating solutions.
As complementary objectives, there were conducted other trials to demonstrate suitability and durability of this technology in exposed roofing solutions, where its thermic contribution could help to reduce the gradient of temperature without any drawback in required waterproofing performances of these coating solutions.
As proposed methodology, after proper characterization in laboratory conditions, there were conducted specific trials with most promising solution to achieve a comprehensive characterization in dynamic outdoor conditions, according to Paslink Network test methodology.
As main results, it has been possible to demonstrate the feasibility and suitability of this technology in elastomeric coatings. It has been measured its quantitative contribution to this “cool roof” approach in elastomeric solutions for waterproofing coatings, and finally, it has been opened a promising "toolbox" in formulations where this thermic performances could help to improve energetic efficiency in building elements like roofs.

CODE 427

ANALYSIS OF THE PATIO´S BEHAVIOR AS AN URBAN POROSITY MODIFICATION FACTOR IN THE CONTEXT OF HISTORICAL CENTERS.

Jorge Roa-Fernández[1]; Carmen Galán-Marín [1]; Juan Rojas-Fernández[1]; Carlos Rivera-Gómez[1]

1: Department of Building Technology, Escuela Técnica Superior de Arquitectura, Universidad de Sevilla, Avda. Reina Mercedes, 2, Seville 41012, Spain;
e-mail: cgalan@us.es, jroa@us.es

KEYWORDS: Urban densification; GIS; climate zoning; patio; urban heat island.

ABSTRACT

The present research is an investigation about Mediterranean vernacular inner courtyards, using GIS tools and monitoring. The topic is investigated from different perspectives and placed at the centre of energy conscious design for Mediterranean climates. The focus varies from analysis on vernacular architectural morphology, building codes and their relationship with climate, detailed monitoring of internal and external conditions, and integration of other different studies on inner courtyards. This study aims to contribute to the scientific debate and the current architectural discourse on the role of courtyards in architecture and their importance in the context of sustainable design solutions, identifying appropriate morphology for optimum thermal conditions in the climatic context of Spain. Such knowledge can contribute to energy design, to enable reduction of energy use for cooling, the main concern in warm climates, along with the reduction in associated CO2 emissions. To perform that comparison, morphological and measurement methods have been used to delineate spatial boundaries of urban densification. This methodology has been applied to a real case study in Spain, where building codes establish several climatic zones.

CODE 428

PROPOSITION FOR LIGHTING SYSTEMS RETROFIT METHODOLOGY USE WITH LED TECHNOLOGY: ANALYSIS IN SHOPPING CENTERS

Moura, Mariângela [1]*; Mota, Ana Lucia[2]; Noya, Mauricio [3]; Lopes, Ricardo. G[4]

1: Universidade Federal Fluminense – Niterói – Rio de Janeiro – Brazil.
e-mail: mm_arquitetura@globo.com
2: Universidade Federal Fluminense – Niterói – Rio de Janeiro – Brazil.
e-mail: anaseroa@hotmail.com
3: Universidade Federal Fluminense – Niterói – Rio de Janeiro – Brazil.
e-mail: mauricionoya@hotmail.com
4: Universidade do Estado do Rio de Janeiro – RJ/ Rio de Janeiro – Brazil.
e-mail: ricardo@ricmon.com.br

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 – shopping centers. 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 430

REVIEW OF THE EUROPEAN DWELLING STOCK AND ITS POTENTIAL FOR RETROFIT INTERVENTIONS USING SOLAR-ASSISTED HEATING AND COOLING

Elguezabal, Peru[1]; Arregi, Beñat[1]; Schuetz, Philipp[2]; Gwerder, Damian[2]; Scoccia, Rossano[3]; Tsatsakis, Konstantinos[4]; Biosca, Javier[5]; Bortkiewicz, Anna[6]; Waser, Remo[2]; Sturzenegger, David[2]

1: Sustainable Construction Division, Tecnalia Research & Innovation
e-mail: peru.elguezabal@tecnalia.com, e-mail: benat.arregi@tecnalia.com, web: www.tecnalia.com
2: School of Engineering and Architecture, Lucerne University of Applied Sciences and Arts
e-mail: philipp.schuetz@hslu.ch, e-mail: damian.gwerder.01@hslu.ch, e-mail: remo.waser@hslu.ch, e-mail: david.sturzenegger@hslu.ch, web: www.hslu.ch
3: Department of Energy, Politecnico di Milano
e-mail: rossano.scoccia@polimi.it, web: www.polimi.it
4: Hypertech AE
e-mail: k.tsatsakis@hypertech.gr, web: www.hypertech.gr
5: Symelec renovables SL
e-mail: eup@symelec.com, web: www.symelec.com
6: Iznab Sp. Z.o.o.
e-mail: anna.bortkiewicz@iznab.home.pl, web: www.iznab.pl

KEYWORDS: European building stock; energy performance; energy retrofit; solar heating; solar cooling.

ABSTRACT

This study provides a characterization of the existing European stock of residential buildings, with a specific focus on their energy performance. Eight countries with different characteristics and climates have been selected as a representative sample. After identifying relevant parameters, data has been compiled from several sources, including national statistical bodies and European datasets from official and unofficial bodies, as well as previous research projects. Based on those projects as initial source of information, the study is complemented with energy efficiency related regulations as well as with external climate data. The collected information has been subject to a critical review and analysed to identify insights and trends related to the energy performance of European dwellings. The information gathered is intended to provide a general view about the current status for each of the assessed countries and by extension a global picture of the European stock. The outcomes of this study will constitute a realistic baseline scenario for identifying needs, potentials and constraints for renewable energy technologies, and will assist the development of a novel software tool for planning energy-efficient retrofits of residential buildings.

CODE 439

EFFECTIVE CHARACTERIZATION OF A BUILDING'S THERMAL ENVELOPE EFFICIENCY BEFORE AND AFTER ITS REHABILITATION

Gómez Melgar, Sergio.[1]*; Martínez Bohórquez, Miguel Ángel[2]; Andújar Márquez, José Manuel[3]

1: University of Huelva, ETS Ingeniería, TEP192 Control y Robótica
e-mail: sergomel@uhu.es, web: http://www.uhu.es/ccth/tep192-grupo-de-control-y-robotica/
2: University of Huelva, ETS Ingeniería, TEP192 Control y Robótica
e-mail:bohorquez@uhu.es, web: http://www.uhu.es/ccth/tep192-grupo-de-control-y-robotica/
3: University of Huelva, ETS Ingeniería, TEP192 Control y Robótica
e-mail:andujar@uhu.es, web: http://www.uhu.es/ccth/tep192-grupo-de-control-y-robotica/

KEYWORDS: Energy efficiency; sustainable design; energy retrofit; passive architecture; measurements; U-value.

ABSTRACT

The building sector is responsible for more than 40% of greenhouse gas emissions, according to Eurostat. Massive energy retrofittings of the pre-normative built blocks are the best and most effective solution to this problem. However, it is not possible to act with guarantees in the existing buildings without the effective characterization of the efficiency of their thermal envelope before and after their retrofitting. This means that it is necessary to carry out thermal transmittance measurements (U-value, expressed in W/m2K), i.e., the amount of energy that flows through the building's envelope per unit area before and after its energy retrofitting. But today, if many thermal transmittance measurements in a short time are needed, the current devices, cannot carry out them, except if a great amount of devices are used at once (which is impractical due the cost) along with intensive and tedious post-processing and analysis work. This is a serious handicap because only with measurements it is possible demonstrate in an effective way the envelope improvements carried out and the consequent energy savings.
This paper presents a new device, developed by the University of Huelva's Research Group TEP192 Control and Robotics, for the measurement of the thermal transmittance of the building envelope. The developed device is modular, scalable, and fully wireless; it is capable of taking as many measurements at once as user needs.
The developed device has been tested in in a study case of social housing energy retrofitting. Taking measurements before and after the energy retrofitting has been possible determining the amount of heat that is left to transmit through the building's thermal envelope. From here we have been able to carry out calculations of savings in the electric consumption and, consequently, estimate the investment payback.

CODE 465

KEY FACTORS OF THE REHABILITATION OF THE THERMAL ENVELOPE OF RESIDENTIAL BUILDINGS CONSTRUCTED BETWEEN 1940-1980

Sánchez-Ostiz, Ana[1]*; Monge-Barrio, Aurora[2]; San Miguel-Bellod, Jorge[3]; Ramos Ruiz, Germán[4]

1: Escuela de Arquitectura. Universidad de Navarra (Spain).
e-mail: aostiz@unav.es
2: e-mail: amongeb@unav.es
3: e-mail: jsan@alumni.unav.es
4: e-mail: gramrui@unav.es

KEYWORDS: Thermal envelope; energy demand; renovation scenarios; monitoring; simulation.

ABSTRACT

As part of the fight against the on going climate change is the retrofitting of existing buildings. Around 50% of homes in Spain were built between 1940 and 1980, among these buildings are numerous neighbourhoods dedicated to social housing. Nowadays, the rehabilitation of these social housing units is essential with regards to thermal envelope to reduce energy consumption and to increase thermal comfort.

This paper presents some of the results of the study which were performed on different typologies of residential buildings in Pamplona (Spain). The results were obtained during the research performed for the project prestaRener Protocol. From the study, key factors for the demand reuction were identified, among them are: climate, orientation, the position of the dwelling within the building and the building within the block, the patterns of use, etc. ...

The results are presented using a matrix, which can be used as a decision-making tool that allows selecting levels of intervention and its efficient investments. Starting from the conditions established under regulations, CTE-DB-HE1, the savings to be achieved vary between 20% and 80% depending on the rehabilitation scenarios (partial or total thermal envelope performances) and the levels of intervention (either inside or outside the enclosure, and with different thicknesses of insulation in each case).

3.- BUILDING INTERVENTION

CODE 91

SAFEGUARDING PLAN FOR THE MUNICIPAL CEMETERY. SANTIAGO DE LOS CABALLEROS', DOMINICAN REPUBLIC

Paz Rodríguez, Harold[1]; Tió Santos, Iván; Betances Díaz, Yenifer

1: Pontificia Universidad Católica Madre y Maestra,
Humanities Faculty
School of Architecture and Design
e-mail: haroldpazr@hotmai.com

KEYWORDS: Plan to safeguard; heritage intervention; architectural heritage; Dominican architectural heritage; cemeterial heritage; funereal heritage.

ABSTRACT

Considering it one of the most important collections of cultural artifacts, it is the obligation of each nation to safeguard its historical memory. The architectural heritage, including nineteenth century cemeteries, is no exception. The city of has been, historically, one of the most prosperous cities in the Dominican Republic. Its municipal cemetery holds some of the local architectural-funereal gems, samples of dissimilar burial typologies and architectural styles that have evolved from the cemetery's foundation in the mid-nineteenth century until the modern day. However, the inexistence of an integral safeguarding plan puts the permanence of diffusion of this cultural asset at risk. The principal objective of this work is to elaborate an intervention plan that conserves, shares, and intervenes in the heritage that this cemetery possesses. This project is a continuation of a previous project, "INVENTORY AND CATALOGING OF GRAVES WITH ARCHITECTURAL-MONUMENTAL VALUE AT 30 DE MARZO CEMENTERY, SANTIAGO DE LOS CABALLEROS, (DOMINICAN REPUBLIC)" that was presented at this congress in 2016. This project was completed using two fundamental strategies: clerical work and field work. With the first, the framework for the intervention and plan of action was constructed. With the second, the necessities for the conservation and intervention of the cemetery were inventoried. The final result is an intervention project that consists of two main axes: the first, a remodeling, conservation, and restoration plan; the second, diffusion and awareness.

CODE 127

INTERVENTION PLAN FOR THE RESTORATION OF PALACE ARRUABARRENA, CONCORDIA, ENTRE RÍOS, ARGENTINA

Bruno, María Alejandra(*); Sota, Jorge Daniel; Traversa, Luis P

Grupo GIICMA –Universidad Tecnológica Nacional Facultad Regional Concordia
e-mail: arq.alebruno@gmail.com
e-mail: jdsota@gmail.com

KEYWORDS: Heritage; palace; pathologies; restoration; intervention plan.

ABSTRACT

The Arruabarrena Palace, was erected between 1916 and 1919 with the project and direction of the architect Gabriel Dulin. In 1926, the house was sold and in 1973 it was about to be demolished by the Argentine Army. Finally, the municipality buys the house and becomes the headquarters of the Municipal Regional Museum. The building is solved in the language of French eclecticism, has an important access and is crowned by a mansard. The access is materialized with a Carrara marble staircase. The residence has four floors: the basement, the main floor, the first floor and the mansard. The interior decoration is also eclectic. The work carried out in the building consisted in the survey of the existing pathologies, which cause and cause deterioration, the problems of water ingress and deterioration in the roofs, as well as the interior and exterior ornamentation, the wall coverings and enclosures. And subsequently, it is indicated how to approach the treatment of the aforementioned pathologies, for their subsequent intervention, always taking into account the paramount of maintaining the original image in the building. The tasks of Valorization and Restoration have not yet begun, but it is in the stage of elaboration of an Intervention Plan that includes actions, sequences, progress schedules of the work, and stageability.

CODE 133

EXPERIENCES IN REHABILITATION OF HOTEL STRUCTURES

Muñiz Gómez, Santiago[1]*; Freire-Tellado, Manuel J.[2]

1: Universidad de La Coruña, ETS Arquitectura.
e-mail: santiago@udc.es, web: http:www.estructuras.udc.es
2: Universidad de La Coruña, ETS Arquitectura
e-mail: manuel.freire.tellado@udc.es, web: http:www.estructuras.udc.es

KEYWORDS: Structural rehabilitation; hotels; inspection; rehabilitation; pathology.

ABSTRACT

During the rehabilitation, the hotels presents own characteristics. So it is normal that there is a change of ownership, or the need to update equipment in order to adjust to the hotel categories and technological advances that implies the hotel use itself.
On the other hand, it is usual for the building to be fully operational during the various pre-work phases, such as structural inspection or the architectural project itself, which implies access difficulties in the necessary structural research of the building. These phases should complement the execution of the work itself. These technical indeterminations affect the content of the project, they also have consequences in phases as fundamental as the budgetary allocations or the own execution periods, always very tight and fixed. This last aspect is important. It is usual that in very early stages of work already exist reservations of rooms or other stays for the reopening, reason why, delays of work are not an option.
This paper describes and exemplifies on real cases this dynamic and presents the methodology that we have been used in various buildings of this type that we have rehabilitated over time, with very different structural and site characteristics.

CODE 135

THE EPIDERMAL MOULT: OR THE TRANSFORMATION OF THE CITY THROUGH ENERGY INTERVENTION - THE CASE OF ERRENTERIA -

Uranga, Eneko J.*; Etxepare, Lauren; Lizundia, Iñigo; Sagarna, Maialen

Department of Architecture
Higher Technical School of Architecture
University of the Basque Country
e-mail: enekojokin.uranga@ehu.eus ; lauren.etxepare@ehu.eus ;
inigo.lizundia@ehu.eus ; maialen@sagarna@ehu.eus

KEYWORDS: Energy; intervention; architecture; building; residential.

ABSTRACT

As in the animal kingdom some species throughout their life make a change in their epidermis, existing buildings are undergoing a transformation in its envelope. There are several reasons for this epidermal moult, but the main reason is the need for an energy optimization in buildings.
For the first time in history, the construction sector has focused more its development in the intervention on the existing buildings than on the construction of new buildings. The main reason is the need for energy saving on existing buildings as a priority for the European Union. The transformation of our cities through the epidermal moult is a fact. Existing residential buildings are being transformed to improve their energy characteristics. So far the energy interventions that have been made in our cities have been isolated and with the sole purpose of the energy saving improvement. But as a result, a number of issues arise in this regard: Has an analysis been done of what will be the result of this epidermal moult? Is the only consideration that must be taken into account when we must intervene on an existing building? There are no more values within the urban architecture and its configuration that should be considered?
In this regard this paper aims to answer some of these questions. For this purpose we have analyzed the town of Errenteria (Gipuzkoa), where some of these transformations have already begun. Other considerations in addition to the energy results should be taken into account. Definitely other points of view on the architecture of the city and its transformation should be linked to the energy intervention on existing buildings.

CODE 187

THE MASTER PLAN OF DE WALLS OF TRUJILLO. RESERACH AND RECOVERY OF THE ARCHITECTURAL HERITAGE.

Rosado-Feito, Juan Ignacio[1]*; Vera-Morales, Juan Antonio[2]; Muriel-Martín, Idoia[2]; Serrano-Sánchez, Manuel[2]

1: Arquitecto. Doctor. Máster en Arquitectura y Patrimonio Histórico.
e-mail: estudio@arup4.com
2: Servicio de Obras y Proyectos. Consejería de Cultura e Igualdad. Junta de Extremadura.
e-mail: juanantonio.vera@juntaex.es
e- mail: idoia.muriel@juntaex.es
e-mail: manueljavier.serrano@juntaex.es

KEYWORDS: Architectural heritage; intervention and management of heritage; walls; master plan.

ABSTRACT

The Walls of Trujillo were built by the Muslims during the Caliphal era, in the Tenth Century, reformed in Century XI and expanded in the centuries XIII, XV, and XVI. They were adapted to the most unfavorable contours for the defense of the mountain where they lay, resulting in a sinuous drawn. In the interior, a hamlet was settled and at one end the castle.
The Directorate General of Heritage of Junta de Extremadura considered as essential the existence of a Master Plan to present the adequate proposals as a base document and structure for the preservation of The Walls, also following the recommendations from the National Plan of Defensive Architecture of the Ministry of Culture. Objectives, methodology and results of the Master Plan are exposed and analyzed, based in an intense research work: historical archeological study, planimetric survey, architectural study, of the characterization and behavior of materials of factory, pathological analysis; juridical, urbanistic and environmental studies. From this point the criteria, objectives, and priority of actions are established; the times and the intervention budgets of each section are valued; uses for the enclosures and the revitalization of the set and the surroundings are proposed, as well as a variety of actions for the cultural diffusion of its historical and architectural worth.

CODE 190

APPROACH TO ROOFTOP EXTENSIONS AS A ROUTE FOR EFFICIENT RENOVATION AT TECHNICAL AND ECONOMIC LEVEL

Aparicio-González, Elena[1]; Domingo-Irigoyen, Silvia[2]; Sánchez-Ostiz, Ana[3]

1: Escuela de Arquitectura
Universidad de Navarra
e-mail: maparicio@alumni.unav.es,
2: Escuela de Arquitectura
Universidad de Navarra
e-mail: sdirigoyen@unav.es
3: Escuela de Arquitectura
Universidad de Navarra
e-mail: aostiz@unav.es

KEYWORDS: Energy efficient renovation; loft conversions; rooftop extensions; upward extensions.

ABSTRACT

This study is based on the present need to restore the current building stock in Europe. The building sector accounts for 40% of final energy consumption and 36% of CO2 emissions in Europe. The European Union set the goal of 20% reduction of these emissions by 2020 for member countries (from 1990 levels). In the specific case of Spain, 58% of the buildings were built before the first thermal regulation, which makes this building stock a key for emission reduction. Because of this need of energy efficient renovation, the need of an integral refurbishment is added due to the poor condition of the buildings and the lack of universal accessibility in them.
However, in order to face these actions, we encounter multiple legal, economic and social barriers. Facing the economic barrier, we find the rooftop extensions as a possible solution.
The rooftops of the buildings present a high potential to carry out interventions with low environmental impact, as it does not use land and takes advantage of the existing infrastructures. In turn, these actions can finance the refurbishment, as the sale of the interventions made will generate income that can be invested in the existing building improvement.
On the basis of the rooftop extension potential for the construction market recovery and the profitability of refurbishment, the aim of this study is to analyze the development of such actions in Europe and in Spain. The analysis is done on legislative, constructive and social levels; assessing the potential barriers and means to address these interventions.

CODE 228

PROPOSAL FOR STRUCTURAL INTERVENTION OF A 17TH CENTURY ADOBE CHAPEL IN MEXICO

Nochebuena, Elesban[1]; Martínez, Guillermo[2]; Jara, José[3]; Olmos, Bertha[4]

1: Universidad Michoacana de San Nicolás de Hidalgo, Facultad de Arquitectura
e-mail: elesbanm@hotmail.com, web: http://www.posarq.umich.mx/ersm.php
2: Universidad Michoacana de San Nicolás de Hidalgo, Facultad de Ingeniería Civil
e-mail: guillermo.mtzruiz@gmail.com, web: http://www.posgfic.estructuras.umich.mx
3: e-mail: jmjara70@gmail.com, web: http://www.posgfic.estructuras.umich.mx
4: e-mail: ba.olmos@gmail.com, web: http://www.posgfic.estructuras.umich.mx

KEYWORDS: Adobe; finite elements; earthquake; intervention.

ABSTRACT

Mexico has a very rich heritage of religious structures built mostly in masonry using different types of stone existing in each region of the country, however, in populations of the center-south where it exists clay soils typical of the agriculture regions, the buildings built in earth had a great influence on most of the vernacular and religious construction. Unfortunately, much of this adobe work has been lost due to the effects of climate, lack of maintenance and in other cases due to the action of earthquakes, which has generated a constant concern on the part of the municipalities and universities to preserve such buildings with its original characteristics, so the analytical and experimental study of simple and economical intervention proposals in constructions in vulnerable condition, acquires today a sense more in line with the vision of the modern restaurateur, being the responsibility of said professional to improve and optimize the current methodologies in order to achieve a better practice, that guarantees a healthy procedure in the complex structural area of conservation and restoration. In the present work the structural behavior is analyzed in detail before a certain seismic demand, of a 17th century adobe chapel located in the south-west of the Mexican Republic within the municipality of los Reyes, Michoacán, which presents an important deterioration level and interventions that have not been the most appropriate, suggesting a proposal for improvement of seismic behavior using compatible materials and intervention techniques common in the local construction, illustrating solution possibilities that could be applied to structures with similar typological characteristics.

CODE 261

MITIGATION AND LOCAL ADAPTABILITY TO CLIMATE CHANGE OF HISTORIC DISTRICTS IN MEDITERRANEAN AREA. A CASE STUDY

Cantatore, Elena[1]*; Fatiguso, Fabio[1]

1: Department of Civil, Environmental, Territory, Building Engineering and of Chemistry
Polytechnic of Bari, Italy
e-mail: elena.cantatore@poliba.it, web: www.dicatech.poliba.it

KEYWORDS: Historic center; urban heat island effect; mitigation; local adaptability.

ABSTRACT

The necessity to identify strategies useful to management of issues strictly connected to climate changes at local scale supported the scientific and administrative fervour in determining adaptive actions at urban scale, suitable and complementary to the mitigation ones. On the contrary, in managing Urban Heat Island effect and energy retrofit issues of existent residential heritage, built enclosed in historic districts represents a challenge in both fields until now.
In fact, the necessity to coordinate actions useful to the reduction of energy consumption of historic built heritage cannot overlook his inherent physical complexity, as well the future increasing trend of temperatures highlighted by scientific community and local amplification effects in urban areas. For these reasons, paper analyses the historic district of Molfetta, located along the coastal area of Apulia region (Italy) in order to identify a system of strategies useful to management and correction of energy level of criticism and to identify inherent factors of resilience to climate changes.

CODE 431

APPLICATION OF THE ANALYSIS METHODOLOGY OF NON-DESTRUCTIVE TEST SON OLD WOOD STRUCTURES IN 18TH CENTURY BUILDINGS IN THE CENTRAL REGION OF MINAS GERAIS

Silva, Larissa[1]*; Vieira, Eduarda[2]; Carrasco, Edgar[3]

1: Universidade Federal de Minas Gerais, Escola de Arquitetura.
e-mail: larissacamilo@belohorizonte.com,
2: Universidade Católica Portuguesa, Centro de Investigação em Ciência e Tecnologia das Artes, CITAR, Escola das Artes.
e-mail: evieira@porto.ucp.pt
3: Universidade Federal de Minas Gerais, Escola de Arquitetura.
e-mail: mantilla@dees.ufmg.br

KEYWORDS: Wood structures; historical buildings; non-destructive testing.

ABSTRACT

The Brazilian colonial architecture is singular due to the different European influences contributed in the Portuguese colony in the XVI centuries until the end of the XIX century. In the state of Minas Gerais, cities such as Ouro Preto, Mariana, Sabará, São João Del-Rey and Tiradentes are world references of colony architecture; the masters of works succeeded in building monuments, which today are the patrimony of humanity. The preservation and restoration works in the last decades in Brazil had a great impulse, - considering the need to preserve our culture and the international guidelines presented through patrimonial letters. However, historical buildings, which do not stand out as part of the great historical centers, end up being forgotten, without proper conservation over time. Non-destructive testing on wooden structures is an unexplored alternative for the study and preservation of historical constructions. The armor-plated scissors, a constructive system that was widespread between the 17th and 19th centuries in Brazilian historic cities, is a structural cover that, due to the fragility of its stability, suffers great plastic deformations and displacements, weakening underlying constructive systems such as linings and masonry. In this article we aim at the applicability of the methodology to the non-destructive tests in armor-sheared scissors in the city of Jequitibá and in the district of São Bartolomeu, belonging to the city of Ouro Preto, central region of the state of Minas Gerais, characterizing the deformations and structural pathologies , respecting the integrity of the structure as well as describing the methodologies of analysis and the importance of the non-destructive survey in historical wood structures.

CODE 29

SEISMIC RETROFITTING STRATEGY OF THE HISTORIC MONASTERIES IN SIKKIM, INDIA, AFTER THE 2011 M 6.9 SIKKIM EARTHQUAKE

Joti, Sutapa[1]; Mitra, Keya[2]

1: Doctoral Scholar
Department of Architecture, Town and Regional Planning
Indian Institute of Engineering, Science and Technology, Shibpur, India.
e-mail: arsutapa.joti@gmail.com,
2: Professor
Department of Architecture, Town and Regional Planning
IndianInstitute of Engineering, Science and Technology, Shibpur, India.
e-mail: keyamitra@arch.iiests.ac.in.

KEYWORDS: Buddhist monasteries, construction typology, retrofitting policies, retrofitting measures, seismic retrofitting strategy.

ABSTRACT

Sikkim, the second smallest state in India is situated in the highly tectonically active Himalayan Arc. The entire state of Sikkim lies in Zone IV with maximum expected shaking intensities of VIII on the Modified Mercalli Intensity (MMI) scale. Sikkim has many historical religious structures mainly numerous old Buddhist monasteries which constitute the rich cultural heritage of the state. After an earthquake of magnitude 6.9 on 18 September 2011 at 18:11 hrs IST in Sikkim-Nepal Border region many areas in Sikkim sustained various degrees of damages. The monasteries were impacted highlighting the urgent need for intervention

To achieve better performance of the monasteries in next earthquakes some strong recommendations creating a holistic approach to fulfill the requirements for future sustainability of the vulnerable monasteries are required. Some guidelines, action plans and retrofitting policies are pointed out for further considerations.

There are many approaches and possibilities for the seismic retrofit of the monastery buildings but the appropriate retrofitting techniques should be used economically using of locally available materials, with suitable modifications. Earthquake experts should be deputed for supervision. The measures to be undertaken are building specific. So to begin with the retrofitting processes the weak parts and also the parts which have become weak have to be identified. Then the strengthening measures have to be applied to weak members or of the old structures.

The originality of historical heritage should be kept in mind during retrofitting. To keep their pristine identity of the historic monasteries is quite complex and thus special attention should be focused on this aspect of action.

CODE 67

SEISMIC BEHAVIOR OF MASONRY BUILDINGS AFTER INTERVENTIONS OF THE LOAD BEARING SYSTEM

Karantoni, Fillitsa[1]; Sarantitis, Dimitrios[2]

1: Professor, Department of Civil Engineering
University of Patras
e-mail: karmar@upatras.gr,
2: Civil Engineer
e-mail: dimsaran@gmail.com

KEYWORDS: URM; interventions; reinforced concrete frame; steel frame; tie-beam.

ABSTRACT

The response of rehabilitated unreinforced masonry (URM) structures to strong ground motions is studied in the present paper. Commonly used radical interventions comprise addition of a steel or reinforced concrete frame in the interior of the structure after removal of interior load bearing or/and partition walls. The embedded substructure is designed to support the functional loads of the building and commensurate seismic design forces associated with its mass. In this setting, perimeter walls are relieved of any bearing action apart from resisting the state of stress associated with their self-weight. An important design decision is the extent of contact and interaction that is allowed to occur between the perimeter URM wall and the interior structural system; both options present advantages and disadvantages. The effect that this design option has on the seismic response of the composite system is studied in this paper using linear elastic finite element analysis. It is found that connection of the frame to the masonry walls at several points around the floor and roof perimeters creates a diaphragm action that effectively reduces the out-of-plane bending of the self-standing perimeter URM walls without excessive local stress intensities and increases the shear strength of the building. Lack of contact between the old and new load bearing elements leads to higher intensity stresses due to bending and only the addition of a reinforced concrete tie belt at the top of the walls may mitigate serious damage.

CODE 74

EVALUATION AND REPAIR OF A REINFORCED CONCRETE STRUCTURE: A CASE STUDY

Oliveira, Fábio Giovanni Xavier de[1]*; Oliveira, Flávio Roberto Xavier de[2]

1: Rehabilitar Engenharia Ltda.
e-mail: fabio@rehabilitarengenharia.com, web: www.fabiogiovanni.com.br
2: FR Projetos e Consultoria Ltda.
e-mail: flavioroberto@frprojetos.com.br, web: www.frprojetos.com.br

KEYWORDS: Durability; carbonation; reinforcement corrosion; structural evaluation; structural repair.

ABSTRACT

Reinforced concrete structure durability has been getting a lot of attention in academic research related to building security and stability. Thus, knowledge about the condition of the structures, particularly those affected by issue symptoms, is a powerful tool to minimize costs and improve structural reinforcement and repair service efficiency. Steel corrosion in reinforced concrete frames is the most frequent pathological manifestation in buildings around the world, and it is closely linked to the concept of structural integrity and safety. This paper describes, explains, and remarks on the services performed by a company specialized in structure pathology in determining the causes, origins, and mechanisms involved in steel corrosion in reinforced concrete frames in the ground and mezzanine floors of a building located in the coastal city of Cabedelo/PB. Mechanical, physical, chemical, and electrochemical tests were conducted in the structure, and the conclusion was that concrete carbonation was the mechanism behind the pathological manifestation, and the source of the issue was linked to the execution of the work. The therapy process adopted was divided into levels related to the degree and progress in the observed degradation, and a few structural repair techniques were adopted, such as traditional structure repair, chemical realkalinization, corrosion inhibition, and surface protection.

CODE 77

TEST TO EVALUATE THE RELATION BETWEEN THE HEAT FLOW AND THE WATER VOLUME IN OLD BRICK AND MORTAR SPECIMENS

Camino-Olea, María Soledad[1]; Llorente, Alfredo[2]; Cabeza, Alejandro[3]; Rodríguez-Esteban, María Ascensión[4]; Sáez-Pérez, María Paz[5]; Olivar José M[a6]

1: Departamento de Construcciones Arquitectónicas IT y MMC y TE
Universidad de Valladolid
mcamino@arq.uva.es
2: Departamento de Construcciones Arquitectónicas IT y MMC y TE
Universidad de Valladolid
llorente@arq.uva.es
3: Departamento de Construcciones Arquitectónicas IT y MMC y TE
Universidad de Valladolid
alejandro.cabeza@uva.es
4: Departamento de Construcción y Agronomía
Universidad de Salamanca
mare@usal.es
5: Departamento de Construcciones Arquitectónicas
Universidad de Granada
mpsaez@ugr.es
6: Departamento de Construcciones Arquitectónicas IT y MMC y TE
Universidad de Valladolid
jmo@arq.uva.es

KEYWORDS: Brick; humidity; heat flow; restoration; non-destructive test.

ABSTRACT

Many of the historic Spanish buildings have been built with ceramic brick and mortar of lime and sand. These materials undergo degradation processes because over time, mainly by the action of water from the ground, rain and the environment. These degradation processes are very frequent so it is interesting to design some test procedure, non-destructive, that allows to know the volume of water that can contain a brick wall. Once this volume of water is known, it is possible to define more accurately the appropriate interventions in the rehabilitation of buildings with lesions that have been originated by the processes of water absorption and desorption. The basis of this experiment is based on two principles: 1) the heat flow that crosses a wall is conditioned with its insulating capacity. 2) Water is one of the best heat transmitters. For the same external conditions, the heat flow through a wall is greater if it contains more water. Therefore, if we know the heat flow we could know the water content of a wall. This article describes the laboratory tests carried out with brick work specimens, in accordance with European regulations, in order to analyze whether a non-destructive test could be carried out to evaluate the water content of a brick factory wall.

CODE 154

SPRAY APPLIED ELASTIC WATERPROOFING MEMBRANE SYSTEMS FOR TUNNELS AND UNDERGROUND STRUCTURES TO APPLY IN REPAIRING OF TUNNELS AND MAINTENANCE OF GALLERIES

Miranda, María*; Ureña, Alejandro; Jiménez-Suárez, Alberto; Rubio, Mª Jesús

1: Universidad Rey Juan Carlos
e-mail: miranda.maria@es.sika.com
2: e-mail: alejandro.urena@urjc.es
3: e-mail: alberto.jimenez.suarez@urjc.es
4: Facultad Ingenieros de Caminos, Canales y Puertos
e-mail: mjrubio@isoquiral.com

KEYWORDS: Spray; waterproofing membrane; service life; maintenance; refurbishment.

ABSTRACT

My contribution is the analysis of mechanical and chemical characteristics: shore hardness, tensile strength, elongation at break, water absorption, adherence to concrete, to membrane, to wet concrete; bond strength, curing time, crack bridging, elasticity, bending, sagging and waste cause to rebound while spraying. This analysis will prove a better long term performance regarding service life. And it compares differents formulas in order to improve the characteristics mechanical and chemical.
This fast application to reduce construction time and costs, easy application, suitable for complex geometries.

CODE 168

BRIDGE REHABILITATION INCORPORING ISOLATION SYSTEMS TO REDUCE SEISMIC DEMANDS

Jara, José[1]*; Olmos, Bertha[2]; Martínez, Guillermo[3]

1: Universidad Michoacana de San Nicolás de Hidalgo, Facultad de Ingeniería Civil.
e-mail: jmjara70@gmail.com, web: http:www.umich.mx
2: e-mail: ba.olmos@gmail.com, web: http:www.umich.mx
3: e-mail: guillermo.mtzruiz@gmail.com, web: http:www.umich.mx

KEYWORDS: Bridge damages; bridge rehabilitation; isolation systems; seismic demands.

ABSTRACT

Frequently the highway bridges are subjected to seismic actions that cause damage. After a destructive seismic event, it is necessary to evaluate different rehabilitation and / or reinforcement techniques to improve the expected behavior in the future. Common rehabilitation techniques increase the stiffness and the strength of the structure; among them are: jacketing, external prestressing, addition of structural elements, use of composite materials and passive control systems. The inclusion of an isolation system is an alternative that can reduce seismic demands and at the same time increases the energy dissipation capacity of the structure. In this study, the addition of isolation systems in existing bridges built in Mexico is evaluated as an option to improve their seismic behavior. The main objective is to determine the feasibility of using lead rubber isolators to improve the seismic response and reduce the vulnerability of the bridges. For the study, two bridges built in Mexico are selected with proximity to the seismic sources and are subjected to typical accelerograms registered in Mexico. Non-linear time-history analyzes are carried out to determine the effect of isolation systems on the demand of shear forces and expected displacements in piers. The results allow to quantify the viability of the use of these systems in the reduction of the seismic response and the importance of the parameter selection of the isolation system on the expected seismic vulnerability.

CODE 183

ALTERNATIVES TO DEMOLITION IN AN ANCIENT CONCRETE BRIDGE WITH SERVICE LIFE EXCEEDED

Martínez Martínez, José Antonio[1]*; Aragón Torre, Ángel[2]; García Castillo, Luis María[3]

1: University of Burgos.
jamartinez@ubu.es
2: aragont@ubu.es
3: lmgcite@ubu.es

KEYWORDS: Actions; concrete bridges; service live; rehabilitation; standards.

ABSTRACT

The first constructions with the concept of modern concrete date from the end of 19th century, although, in many European countries, some developments took place at the begining of the nineteenth century. The concrete as a structural material was new so it had not been taught in universities; and it replaced other classical materials such as stone, and it worked differently, so it required a different and specific structural typology. But not only were different the structural forms, but also the materials in its working behaviour. They were different from those that existed at the moment, but also very different from the concrete used nowadays. Despite everything, many of these structures made with concrete with more than one hundred years built are still in use, however, with serious problems of conservation and resistant capacity, acording to the new requirements of loads. The typology analyzed in this study is a bridge of "pi" shaped beams executed "in situ" with three isostatic spans of approximately 9 meters length. The máximum load had already been limited, and, also, some previous interventions had been done, but in spite of it its condition was very deplorable. In this paper, the evaluation of its initial state, the intervention proposals, the intervention itself and the decision making during the execution of the reinforcement work through the application of new materials as carbon fibers are analyzed.

CODE 204

CONCRETE CRACK SEALING BY COLLOIDAL NANOSILICA INYECTION: EFFECTIVENESS AGAINST WATER ABSORPTION

Sánchez Moreno, Mercedes[1]*; García Calvo, José Luis[1]

1: Instituto de Ciencias de la Construcción Eduardo Torroja (IETcc), CSIC
e-mail: mercesanc@ietcc.csic.es, web: http://www.ietcc.csic.es
e-mail: jolgac@ietcc.csic.es, web: http://www.ietcc.csic.es

KEYWORDS: Concrete crack sealing; durability performance improvement; capillary absorption coefficient; colloidal nanosilica injection.

ABSTRACT

In the present work, an innovative treatment based on colloidal nanosilica injection for crack sealing in concrete is proposed. Nanosilica particles polymerize within the crack, acting as a filler but also interacting with the substrate on the crack sides, even forming new hydration products on the crack.
Cylindrical fiber reinforced mortar samples (10x20 cm) made with siliceous sand 0-4 mm and a water/cement ration of 0,4 were fabricated. After a curing period of 90 days in a climatic chamber (100%, 21ºC), the samples were cut in slices of 4-cm thickness. The slices were pre-cracked up to a crack mouth opening displacement (CMOD) of 300 µm.
The crack sealing was carried out after a drying process under laboratory conditions until constant weight was reached in order to simulate the real conditions of a concrete cracked surface. A commercial dispersion of colloidal nanosilica (Bindzil 301 CC) was used for the treatment. Three experimental conditions were studied: reference sample without cracking (REF), water injection in the crack (WATER) and nanosilica injection (CNS). Three samples were evaluated in each case.
After the treatment the samples were maintained in high humidity conditions (100% HR) before characterizing the treatment effectiveness. The effectiveness was assessed at 7 and 28 days after the treatment by determining the water capillary absorption coefficient. The results shown that filling the crack with colloidal nanosilica improved the durability performance of the treated concrete by decreasing both the rate of penetration and the total amount of absorbed water, although the cracked was not totally sealed. It must be remarked the influence of the curing postreatment period on the sealing effectiveness, with lower values of the capillary absorption coefficient for the longer post-treatment curing periods.
Authors acknowledge Zeus Química S.A. for supplying the colloidal nanosilica dispersion. M. Sánchez also acknowledges the financial support from the Spanish project BIA2014-56825 JIN and from the COST Action CA15202.

CODE 233

COMPARATIVE STUDY OF COMMERCIAL AVAILABLE GROUT AND LABORATORY FORMULATION FOR STRENGTHENING AND CONSOLIDATION OF ANCIENT MASONRY

Luso, Eduarda[1]

1: ISISE, Institute for Sustainability and Innovation is Structural Engineering,
Polytechnic Institute of Bragança, Portugal
e-mail: eduarda@ipb.pt

KEYWORDS: Grouts; masonry; consolidation.

ABSTRACT

The grouts injection is one of the possible techniques for structural consolidation works of stone masonry walls. However, besides the reversibility, one of their biggest problems is precisely the choice of mortar or grout to use. Due to easy preparation, the commercially available grouts (pre-dosed products that you need only add water) are preferred over the grouts dosed and prepared "in-situ" because they requiring less labour and less equipment for its elaboration. However, the use of commercial grout has some disadvantages, mainly from an economic point of view besides presenting in the respective datasheets limited information which makes the direct comparison between materials more difficult. This work aims to demonstrate that compositions with proper proportions of metakaolin, cement and hydrated lime, plasticizer and water, may have very similar features or even higher than some of the commercial products available in the market. This study aims to compare the rheological properties, physical (texture and colour) and mechanical of one of the commercial grouts with one composition made in the laboratory as well as an economic study, demonstrating that these materials constitute a possible alternative to existing commercial grouts on the market.

CODE 234

SURVEY OF THE CONDITIONS OF HABITABILITY AND HYGROMETRIC CHARACTERIZATION OF SMALL BUILDING BUILDINGS IN NORTHEAST OF PORTUGAL

Luso, Eduarda[1]; Ferreira, D.[2]; Monteiro, L.[3]

1: IPB, Instituto Politécnico de Bragança, eduarda@ipb.pt
2: IPB, Instituto Politécnico de Bragança, debora@ipb.pt
3: IPB, Instituto Politécnico de Bragança, mila_monteiro25@hotmail.com

KEYWORDS: Moisture; habitability conditions; ancient buildings.

ABSTRACT

As a result of the permanence of people, mainly elderly and not only, in the interior spaces of old buildings situated in strict climatic zones, both rural and urban, has been a greater concern with the thermal comfort and air quality inside. This concern is fundamentally based on improving the living conditions of residents in order to avoid abandonment and to arouse their interest in them, since these areas are often areas of great tourist interest that need to be preserved and kept alive.
In spite of the enormous evolution of thermal energy conservation systems and control of indoor air quality in construction, as well as of the regulations governing its implementation, the ancient buildings do not follow this evolution, presenting a thermal and hygrometric behaviour that sometimes can compromise the comfort, health and activities of its users.
This article intends to characterize the inside habitability conditions of sixteen buildings located in the historic centre of Bragança, more precisely in the city's Citadel, buildings characterized by being small, with little natural light and rarely subject to thermal rehabilitation work . It is also intended to compare with the results obtained in 2012 with a similar study and to verify the influence of the programs of incentive to the rehabilitation that have arisen in the meantime.
In this way, were analysed the main parameters of hygrometrical nature inside inhabited buildings, chosen at random, such as: temperature and relative humidity, as well as the state of degradation of the building and the existence of pathologies both outside and inside.

CODE 266

GENERAL PATHOLOGY AND THE ANALYSIS OF CONSEQUENTIAL DEVALUATION BY MEANS OF AN ALTERED ROSS-HEIDECKE MODEL

Oliveira, Jorge[1]; Pantoja, João C.[2]*; Santoro, Aline M. C.[3]

1: UniCEUB
e-mail: tecnoplandf@gmail.com, web: https://www.uniceub.br/
2: Faculdade de Arquitetura e Urbanismo, Universidade de Brasília
e-mail: joaopantoja@gmail.com, web: http://www.ppgfau.unb.br/
3: Faculdade de Arquitetura e Urbanismo, Universidade de Brasília
e-mail: alinemcsantoro@gmail.com, web: http://www.ppgfau.unb.br/

KEYWORDS: General pathology; physical devaluation; depreciation coefficient; conservation state.

ABSTRACT

When reinforced concrete was first used, it was believed to be indestructible. Many years later, however, we have learned that it is not only destructible; it has a determinable life-span. In Brazil, the appearance of pathologies has led us to discover a series of flaws in construction and maintenance of both concrete structures and secondary elements. Along with the development of the Ross-Heidecke model, the degradation found in buildings can now be used to determine their actual real estate value. The devaluation model we have used is based on the Ross-Heidecke model; however instead of analysing the building as a whole, it is applied to each of its parts. With the use of visual inspections, photographic evidence, and the determination of both the projected life-span and the actual life-span, we were able to determine the physical devaluation of a multi-storey apartment complex through the study of the degradation and conservation state of its individual components.

CODE 280

RESINS FOR FLOORING ON ASPHALT FOR CONSERVATION AND MAINTENANCE OF HISTORIAL CENTERS OF CITIES

Miranda, María*; Ureña, Alejandro; Jiménez-Suárez, Alberto; Rubio, Mª Jesús

1: Universidad Rey Juan Carlos
e-mail: miranda.maria@es.sika.com
2: Universidad Rey Juan Carlos
e-mail: alejandro.urena@urjc.es
3:e-mail: alberto.jimenez.suarez@urjc.es
4: Facultad Ingenieros de Caminos, Canales y Puertos
e-mail: mjrubio@isoquiral.com

KEYWORDS: Asphalt; flexibility; sustainability; flooring resin; historical centers.

ABSTRACT

There is a growing concern about how to preserve and maintain the historical centers of cities. The administration and private companies have been carried out works of conditioning and improvement, in order to the historic centers regain the importance and quality of life they had in their day.
One of the major objectives is to reduce pollution and dirt produced by motor traffic, and to promote non-motorized transport such as bicycles or electric vehicles. To enhance this type of transport we need to have bike lanes and the electric carparks. For that we need delimited these areas. Both solutions can be covered with resin floors compatible with asphalt.
In this article, we will analyze the characteristics of these resins compatible with asphalt: flexibility and scratch resistance, impact resistance, elasticity, aspect (glossiness), QUV resistance, ice cycle. These resins contribute to a more sustainable life first with less contamination and second because I will present the analysis of Life Cycle Assesment in compare with epoxy and epoxy water base resins.

CODE 317

LABORATORY ASSESSMENT OF FUNGI GROWTH ON A TABIQUE WALL REHABILITATED WITH LIME MORTAR

Barreira, Eva[1]; Almeida, Ricardo M.S.F.[2]; Silva, Elisabete[3]; Brás, Isabel[3]; Rocha, Ana[1]; Costa, Catarina[3]

1: CONSTRUCT-LFC, Department of Civil Engineering
University of Porto, Faculty of Engineering
e-mail: barreira@fe.up.pt; ec12302@fe.up.pt
2: CI&DETS - Polytechnic Institute of Viseu / CONSTRUCT-LFC, Department of Civil Engineering
Escola Superior de Tecnologia e Gestão de Viseu / University of Porto, Faculty of Engineering
e-mail: ralmeida@estv.ipv.pt
3: CI&DETS - Polytechnic Institute of Viseu
Escola Superior de Tecnologia e Gestão de Viseu
e-mail: beta@estv.ipv.pt; ipbras@estv.ipv.pt; catarinakisabel@hotmail.com

KEYWORDS: Fungi; painting systems; lime mortar; tabique.

ABSTRACT

The development of fungi inside the buildings has not only aesthetic consequences but also it affects the durability of materials and constructive solutions. However, no less important is its effect on the health of the buildings users. The paint system is a main key to be considered when dealing with the resistance of the wall to biological activity. Additionally, in the rehabilitation of a tabique wall, one of the main concerns is the selection of the mortar, as it must be compatible with the existing materials. The mortar choice will have consequences in the selection of the painting system.
In this work, a specimen with 1.22 x 0.45 m^2 extracted from a tabique wall of an old building located in the historical centre of the city of Viseu was used to evaluate the resistance to the fungi growth of different paint systems applied on a lime mortar. Eight painting systems with different chemical compositions (organic paint, silicate mineral paint and lime paint) were selected. They were applied in a mesh of 0.15 x 0.14 m^2 elements. For each scenario three samples were prepared, in a total of 48 tests. The specimen was placed inside a climatic chamber under constant hygrothermal conditions (T = 22 ºC and RH = 90%) for 5 months. Fungi growth was evaluated by counting the number of Colony Forming Units (CFU) and by visual inspection using photographic record, which included the quantification of the percentage of black pixels.
From all paint systems that were assessed, the one with the less satisfactory performance inhibiting biological growth was the lime paint, since it was the only one where fungi were visually detected and with the highest CFU values. These results may be explained due to the relative humidity that was kept permanently very high throughout the all test.

CODE 319

OUTDOOR WOOD WEATHERING AND PROTECTION

Dulce Franco Henriques[1,3], Ana Cristina Borges Azevedo[2]

1: Civil Engineering Department
ISEL – Instituto Superior de Engenharia de Lisboa- Instituto Politécnico de Lisboa
Rua Conselheiro Emídio Navarro, 1, 1959-007 Lisboa
web: http://www.isel.pt; e-mail: mfhenriques@dec.isel.pt
2: Civil Engineering Department
ISEL – Instituto Superior de Engenharia de Lisboa- Instituto Politécnico de Lisboa
Rua Conselheiro Emídio Navarro, 1, 1959-007 Lisboa
web: http://www.isel.pt; e-mail: cristinaborges@dec.isel.pt
3: CERIS - Investigação e inovação em engenharia civil para a sustentabilidade

KEYWORDS: Wood; degradation; durability; building outdoors; aggressive environmental agents; surface protection.

ABSTRACT

This paper deals with the wood durability when applied in the building façades and outdoor subject to aggressive environmental agents and its means of protection. This study is justified since wood outdoors is an important part of the built heritage that needs to be preserved. The aim of this work was to obtain the relationship between the performance of wood surface protection products and different service situations. It was evaluated its coating ability to the environmental aggressions, simulating an application above ground and exposed to the weather (use class 3.2 - EN 335-2:2013) and to the attack by fungi simulating an application in direct contact with soil (use class 4.1). The long-term goal of this work is to contribute for the creation of a results network making easier for the user to protect wood from external aggression. Four different environmental conditions were chosen: next to the coast (saline); urban centre (pollution); interior of the country (high thermal amplitude); soil contact (fungi and moulds) and building interiors (control). Three commercial water based products were chosen due to its characteristics: WRN - water resistance assured by nanotechnology; WAC - weatherproof acrylic copolymer; ART - acrylic resins with Teflon®.
This work showed that the most aggressive environment was the one with high thermal amplitudes. Comparing the performance of tested products: WRN exhibits the lowest protection levels, only antifungal function was comparable to the other products, in this formulation instead of sealing the pores, nanoparticles "dress them", assuring that water is effectively repelled by chemical forces; WAC and ART were very similar since both form a protective film increasing the surface resistance; ART presents the best performance with respect to coating integrity with very positive influence against the development of cracks.

CODE 326

ASSESSING THE THERMAL RESISTANCE OF A TABIQUE WALL

Almeida, Ricardo[1]*; Vicente, Romeu[2]; Mendes da Silva, José[3]

1: CI&DETS - Polytechnic Institute of Viseu / CONSTRUCT-LFC, Department of Civil Engineering
Escola Superior de Tecnologia e Gestão de Viseu / University of Porto, Faculty of Engineering
e-mail: ralmeida@estv.ipv.pt
2: RISCO, Civil Engineering Department, University of Aveiro,
Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
e-mail: romvic@ua.pt
3: LAETA-ADAI, Departamento de Engenharia Civil, Universidade de Coimbra, Rua Sílvio Lima, Pólo II da Universidade de Coimbra, 3030-790 Coimbra, Portugal
e-mail: raimundo@dec.uc.pt

KEYWORDS: Thermal resistance; hot-box; tabique wall.

ABSTRACT

The detailed characterization of the old building stock is fundamental in any rehabilitation process. In the specific case of energy rehabilitation, it is crucial to accurately evaluate the thermal properties of the original building elements, especially the thermal resistance, in the case of opaque elements of the external building envelope. This determination is usually made by calculation based on the tabulated properties of the materials.
However, either because of the uniqueness of the materials and constructive solutions found in older buildings or because of their conservation status, such quantification can lead to values that do not reflect the real thermal performance of the buildings. In this sense, both in-situ and laboratory tests are fundamental for a more rigorous evaluation. These concerns are particularly important in constructive solutions of high heterogeneity, such as the wood-mortar traditional partition walls.
On the other hand, although usually assumed as constant in the thermal and energetic models, the thermal resistance of the building elements presents variability, due to factors such as temperature and moisture content.
In this work, the thermal resistance of a specimen extracted from a partition wall of a building in the historical center of the city of Viseu was evaluated in laboratory, trying to establish its variability as a function of temperature and relative humidity. For this purpose, the "Hot-Box" method was used and followed the methodology recommended in ISO 8990. Several cycles were established, with different values of temperature and relative humidity to evaluate the variability of the thermal resistance of the partition wall.

CODE 399

CONCRETE REPAIRING BY CRACK SEALING BY MEANS OF EXPANSIVE GROUTS

Carballosa, Pedro[1]; Revuelta, David[2]; García Calvo, José Luis[3]; Fernández-Escandón, Alfredo[4]; Beltrán, Rubén[5]

1: Instituto de Ciencias de la Construcción Eduardo Torroja
Consejo Superior de Investigaciones Científicas
e-mail: carballosa@ietcc.csic.es, web: http://www.ietcc.csic.es
2: Instituto de Ciencias de la Construcción Eduardo Torroja
Consejo Superior de Investigaciones Científicas
e-mail: d.revuelta@ietcc.csic.es, web: http://www.ietcc.csic.es
3: Instituto de Ciencias de la Construcción Eduardo Torroja
Consejo Superior de Investigaciones Científicas
e-mail: jolgac@ietcc.csic.es, web: http://www.ietcc.csic.es
4: Escuela Técnica Superior de Ingeniería Civil
Universidad Politécnica de Madrid
e-mail: ruben.beltran.cobos@alumnos.upm.es, web: http://www.ingenieriacivil.upm.es

KEYWORDS: Concrete repairing; crack sealing; expansive grouts; expansive agents

ABSTRACT

The present work refers to one of the main problems related to concrete structures and elements such as the appearance of cracks that compromise mechanical behavior and limit the durability of concrete. In order to avoid or limit this tendency to cracking, innovative technologies based on the use of inorganic expansive additives are proposed. In particular, the use of expansive grouts with high penetration capacity in the crack is evaluated in order to avoid the entry of aggressive agents and to recover the initial mechanical properties. In this study the expansive grouts are composed of CEM I 52,5R and different proportions of two types of expansive agents: type K (based on calcium sulfoaluminate) and type G (based on calcium oxide). Both agents promote expansive behavior by increasing the content of a specific type of hydrate; the first one promotes the formation of ettringite while the second one promotes the generation of portlandite. In this study, the mechanical properties and the expansion characteristics of the manufactured slurries were evaluated under conditions of uniaxial restriction. In the results obtained, a clear influence of the type of expansive agent and its content was detected. Eventually, the sealing efficiency of the slurries was evaluated. Cylindrical samples of steel fiber reinforced mortar were manufactured and cracks of 1500 μm were induced after 28 days of curing by means of the Brazilian test controlling the crack opening. Once cracked, the samples were stored in relative humidity greater than 98% and at 20°C for 28 days. At that age, the recovery of the initial mechanical properties was evaluated. The results show that expansive behavior improves the repair efficiency.

CODE 402

DURABILITY AND COMPATIBILITY OF LIME-BASED MORTARS: THE EFFECT OF AGGREGATES

Santos, Ana Rita[1]; Veiga, Maria do Rosário[1]; Matias, Luís[1]; Santos Silva, António[2]; de Brito, Jorge[3]

1: Núcleo de Revestimentos e Isolamentos do Departamento de Edifícios
Laboratório Nacional de Engenharia Civil
e-mail: arsantos@lnec.pt, rveiga@lnec.pt, lmatias@lnec.pt
2: Núcleo de Materiais Metálicos do Departamento de Materiais
Laboratório Nacional de Engenharia Civil
e-mail: ssilva@lnec.pt
3: CERIS, Departamento de Engenharia Civil, Arquitectura e Georrecursos
Instituto Superior Técnico da Universidade de Lisboa
e-mail: jb@civil.ist.utl.pt

KEYWORDS: Mortar; aerial lime; aggregates; experimental testing; performance.

ABSTRACT

In order to fully perform their functions and be durable, mortars for renders and plasters are requested to have a set of characteristics that can vary with the type of exposure to external environmental actions and the type of substrate. Generally, they need moderate strength, high deformability, some water protection capability, and good adhesion to the substrate.
To be used in rehabilitation works, especially for application on old buildings, with structural masonry walls, it is of utmost importance that mortars are compatible with pre-existent materials.
The presence of water and its movement inside the pore structure of the mortars are among the most significant causes of degradation. However, several authors consider that the main factors for durability and good performance of lime-based mortars are mostly related with the good quality of the binder and the use of adequate aggregates with appropriate particle size distribution.
Accelerated weathering tests are the easiest, quickest, and most commonly used way of studying the durability of a construction material exposed to given environmental conditions.
This paper intends to study the effect of ageing, on the properties and durability of air lime mortars, using aggregates of different lithological natures. For this purpose, different mortars compositions are made and exposed to an accelerated weathering test under defined conditions. The obtained characteristics are discussed and finally compared with the results obtained with the same mortars tested in laboratory conditions. The effect of the aggregate type on the durability of mortars is highlighted and discussed. Some remarks are made about the fields of application of these mortars.

CODE 415

ECOLOGICAL AND FUNCTIONAL TECHNICAL MORTARS WITH IMPROOVED THERMAL BEHAVIOUR

Matias, Gina[1]; Torres, Isabel[12*]; Rei, Filipe[3]; Gomes, Filipe[3]

1: ITeCons - Institute for Research and Technological Development in Construction, Energy, Environment and Sustainability
e-mail ginamatias@itecons.uc.pt, web: http://www.itecons.uc.pt/
2: Department of Civil Engineering, Faculty of Sciences and Technology, University of Coimbra;
ADAI/LAETA, Association for the Development of Industrial Aerodynamics, University of Coimbra, Portugal
e-mail: itorres@dec.uc.pt, web: https://www.uc.pt/fctuc/dec
3: Primefix - Colas e Argamassas Técnicas, Lda.
e-mail: fr.primefix@gmail.com, das@primefix-technik.com, web: http://www.primefix-technik.com/

KEYWORDS: Durability; sustainability; functionality; mortar; thermal behaviour.

ABSTRACT

Mortars have a fundamental role in buildings' global behaviour. They provide protection to the constructive elements and contribute significantly to thermal and acoustic comfort of the users. The selection of an adequate product for repair or replacement of old mortars is a very important issue.
Considering the current quality required for mortars' industries in what concerns to technical specificities and environment, it is fundamental the use of natural raw materials, with lower environmental impact. The development of multifunctional mortars, suitable for different substrates, also guarantees the versatility of these products, a major requirement in the context of rehabilitation. In this way, mortars with the incorporation of granulated cork, a bi-product from the exploration of cork, largely produced in Portugal, were developed. With this work, it is intended to develop lighter mortars with improved thermal behaviour comparatively with common cement based mortars, and suitable for different substrates.
For this purpose, 3 different compositions were analysed, with fine cork granulate, black common pigments and black "NIR (near-infrared) control surface coatings" pigments.
Mechanical behaviour was determined through compressive and flexural strength, dynamic elasticity modulus and adhesive strength for different substrates. Mortars' higrothermal behaviour was also evaluated considering the results obtained for water vapour permeability, capillary absorption and thermal conductivity tests.
Very promising results were obtained, which allow the framing of these mortars in the recent context of CE marking requirements for rendering and plastering mortars.

CODE 426

EFFECT OF FROST DAMAGE ON GAS PERMEABILITY AND MICROSTRUCTURE OF CEMENT-BASED MATERIALS

Wieczorek, Alicja[1]; Koniorczyk, Marcin[2]; Bednarska, Dalia[3]; Konca, Piotr[4]

1: Department of Building Physics and Building Materials
Technical University of Lodz
e-mail: alicja.marciniak@p.lodz.pl
2: e-mail: marcin.koniorczyk@p.lodz.pl
3: e-mail: dalia.bednarska@p.lodz.pl
4: e-mail: piotr.konca@p.lodz.pl

KEYWORDS: Frost damage; durability; permeability; microstructure; cement-based materials

ABSTRACT

The relation between transport phenomena and frost durability of cement-based materials are a main focus of research. The purpose of the study is to understand how the cyclic water freezing (0, 50,100 and 150 freeze-thaw cycles) impacts on microstructure as well as mechanical and transport properties of cement-based materials. The experimental study is conducted on cement mortar and concrete with two water to cement ratio equal to 0.50 and 0.40 without air-entraining admixtures. The changes of pore size distribution and water absorption coefficient are investigated for cement mortars by means of mercury intrusion porosimetry and capillary absorption test. Moreover, the interaction of frost action with permeability and mechanical properties of concrete is discussed. The damage of material is characterized by the reduction of elastic modulus, as well as the permeability evolution due to cyclic water freezing. It is established that a variation in the mechanical properties induces an increase of water transport parameters such as intrinsic permeability coefficient. In case of w/c=0.50 one can observe the extension changing both mechanical and transport parameters. For w/c=0.40, it can be noticed a lack of reduction of the ice-induced microstructure degradation. With the increasing number of freeze and thaw cycles, no further destruction of the pore structure is noticed.

CODE 472

FAILURE OF SLAB ON GRADE SUPPORTED ON EXPANSIVE SOIL

Ramadan E. Suleiman[1], Fathi M. Layas[2]

1: Prof Civil Eng. Dept., Faculty of Eng., University of Benghazi, e-mail resuleiman@yahoo.com
2: Prof Civil Eng. Dept., Faculty of Eng., University of Benghazi, e-mail: fmlayas@yahoo.com

KEYWORDS: Expansive soil; swell potential; differential heave.

ABSTRACT

Slab on grade supported on expansive soils though not common in Benghazi, however few cases have been encountered. These slabs are subjected to large deformations due to the volumetric strains induced in this type of soils upon wetting and drying yielding high detrimental damages to these structures.
A case history is presented in this paper where foundations of a residential building of total plan area 200 m^2 are constructed with tie beams at 1.2 m above the formation level. Expansive soil is used as back fill material to the ground floor level. After being wetted and lightly compacted, plain concrete slabs of thickness 120 mm are poured between the tie beams. This produces different sizes of slabs on grade. After one month of heavy rain a pattern of wide cracks including longitudinal, diagonal and warping cracks appears on the slabs due to the large uneven deformation of the expansive soil.
This paper includes photos of the uneven large deformations of the slabs that took place and the different cracks induced. The paper also includes the geotechnical properties of this expansive soil as well as its potential to swell and shrink and applies two different methods in predicting the pressure induced in these slabs due to the differential heave.

CODE 488

STUDY OF THE EXISTING PATHOLOGIES, PROPOSAL OF RESTORATION AND IMPROVEMENT OF THE STRUCTURAL-CONSTRUCTIVE BEHAVIOUR OF THE IGLESIA DE LA ENCARNACIÓN IN LOJA, GRANADA

Vallecillo Capilla, Ángel[1]; Vallecillo Zorrilla, Ángel[2]; Serrano Garrido, Noemí[3]; Rodríguez Jerónimo, Gracia[4*]

1: Universidad de Granada, Departamento de Mecánica de Estructuras
e-mail: avc@ugr.es
2: Investigador de la Universidad de Granada, Escuela Técnica Superior de Arquitectura.
e-mail: avallecillo@correo.ugr.es
3: Universidad de Granada
e-mail: noemiserranogarrido@gmail.com
4: Universidad de Granada, Departamento de Mecánica de Estructuras.
e-mail: grodjer@ugr.es

KEYWORDS: Restoration; building pathology; religious heritage; structural-constructive behaviour.

ABSTRACT

The municipality of Loja is located halfway between the cities of Málaga and Granada, it is the last town to the west of Granada with a population close to 25.000 and its economy is mainly based on the primary sector which is home to an important monumental heritage with civil, military and religious constructions, as well as Roman remains and prehistoric from the lower Paleolithic.
A significant part of Loja´s monumental heritage has disappeared and the other part is found in an advanced stage of damage. This was the case of Iglesia Mayor de la Encarnación. This church, which situation is in the town centre was named by the Reyes Católicos to show the victory of Christians over muslims and it is dedicated to Santa María de la Encarnación.
The construction began approximately in 1491 on the site previously occupied by the old aljama mosque at the iniciative of the Bishop of Malaga Pedro Díaz de Toledo y Ovalle. The Renaissance altarpiece of the church from Miguel Sánchez and Pedro Machuca stands out from the rest. It was declared National Historic Monument in 1979.
By the time when the restoration works began it showed and advanced state of damage, with a pathology. This situation, added to the seismic location, recommended an integral intervention on it as well as incorporate new constructive-structural elements to improve its stability. Always carrying out this process following the recommendations of the restoration letters and the latest investigations.
The aim of this article is to describe all the damages found and their analysis to find out the causes that have originated them along with the justification of the constructive solutions adopted. It is also an objective of this article the decision to incorporate new constructive-structural systems capable of ensuring a better overall performance of the monumental complex; as well as the design and constructive justifications of them.

CODE 5

EXPERIMENTAL ANALYZE IN CONCRETE BEAMS IN BENDING REINFORCEMENT WITH CARBON FIBER

Cararo Fernandes, Michel[1]*; Vargas, Alexandre[2]; Costa Piccinini, Ângela[3]; dos Santos Godinho, Daiane[4]

1: Universidade do Extremo Sul Catarinense, Curso de Engenharia Civil
e-mail: michelcarfer@gmail.com, web: http:www.unesc.net
2: e-mail: avargas@unesc.net
3: e-mail: acp@unesc.net
4: e-mail: dss.engcivil@gmail.com

KEYWORDS: Concrete; reinforcement; bending; carbon fiber.

ABSTRACT

Reinforcement in structures aims to restore the carrying capacity, when there is a need for correction any anomaly or its increase to a new purpose. The objective of the present study is to evaluate the efficiency of reinforcement with carbon fiber composites in concrete beams through a theoretical design and experimental analysis. For this, the behavior of two groups with three beams was evaluated. Group A was the reference group (without reinforcement) and group B received reinforcement in the traction region of the beam. The load capacity was analyzed by reaching the maximum displacement allowed by Brazil standard (L / 250) and the load capacity at the time of the rupture. As a result, a load increase was obtained in the beams of group B, in relation to group A, of approximately 20% when reaching the maximum displacement established by norm and load increase around 12% in the rupture. At the rupture, the beams of group B also had an average displacement around 24% lower compared to group A.

CODE 6

EXPERIMENTAL ANALYZE OF THE SHEAR REINFORCEMENT WITH STEEL PLATES IN CONCRETE BEAMS

Bez Batti, Marília M.[1]*; Vale Silva, Bruno[2]; Costa Piccinini, Ângela[3]; dos Santos Godinho, Daiane[4]; Guglielmi Pavei Antunes, Elaine[5]

1: Universidade do Extremo Sul Catarinense, Curso de Engenharia Civil
e-mail: mariliabezbatti@hotmail.com , web: http:www.unesc.net
2: Centro Universitário de Adamantina, Departamento de Engenharia Civil
e-mail: dovalesilva@hotmail.com, web: http://www.unifai.com.br
3: e-mail: acp@unesc.net, web: http:www.unesc.net
4: e-mail: dss.engcivil@gmail.com, web: http:www.unesc.net
5: e-mail: elainegpa@unesc.net, web: http:www.unesc.net

KEYWORDS: Concrete; shear; reinforcement; steel sheets.

ABSTRACT

In some situations, it is necessary to reinforce or rehabilitate the structure in the short term, but for this it is necessary a critical analysis of the causes, in order to be able to define what better technique to use. The structural reinforcement is used to increase the element's ability to withstand an effort, which due to faults, wear, thermal variations, lack of maintenance, no longer meets the original conditions or new needs of use. The objective of the present study is to evaluate the reinforcement behavior with SAE 1020 steel sheets, with a thickness of 0.75 mm, bonded with structural epoxy adhesive. The steel sheets were applied in the shear area of reinforced concrete beams before and after the breaking load. With the results of the tests, it is possible to conclude the effectiveness of the reinforcements applied in the sound beams, increasing their capacity by up to 50%. In the reinforced beam, after being ruptured, in which the fissure was restored with epoxy-based structural adhesive, its load capacity increased by 49.2%. The beams that had the cracks filled with mortar presented a drop in their bearing capacity in 58.70%, in relation to the reference beams, presenting an unsatisfactory performance.

CODE 12

BEHAVIOUR OF FRP STRENGTHENED RECTANGULAR CONCRETE COLUMNS. EXPERIMENTAL STUDY

de Diego, Ana[1]*; Martínez, Sonia[2]; Echevarría, Luis[3]; Gutiérrez, José Pedro[4]; Barroso, Javier[5]; López, Cecilio[6]

1: CSIC, Eduardo Torroja Institute for Construction Science.
e-mail: adediego@ietcc.csic.es, web: http:www.ietcc.csic.es
2: e-mail: soniamdm@ietcc.csic.es
3: e-mail: l.echevarria@ietcc.csic.es
4: e-mail: jpgutierrez@ietcc.csic.es
5: e-mail: jbarroso@ietcc.csic.es
6: e-mail: clhombrados@ietcc.csic.es

KEYWORDS: Strengthening; columns; FRP; confinement.

ABSTRACT

One of the most attractive applications of fibre reinforced polymers (FRP) is the confinement of concrete columns to enhance both strength and ductility. Concrete confinement can be achieved by bonding layers of hoop FRP around the column. Many experimental studies have been conducted on small-scale plain concrete specimens of circular cross-sections confined with FRP and subjected to pure axial compressive loading, and several design models have been proposed. Experimental studies on non-cylindrical specimens are much scarcer and show that confinement is less effective.
This paper presents results of an experimental investigation on the behaviour of axially loaded square and rectangular columns strengthened with carbon fibre reinforced polymer (CFRP). A total of 10 compression tests have been conducted, including one control specimen, and the behaviour of the specimens in the axial and transverse directions has been investigated. The parameters considered in the study are: amount of FRP reinforcement (1, 2 and 3 layers), aspect ratio of the cross section (1, 1.5 and 2) and corner radius (20, 25 and 30mm). The specimens height is 600 mm and cross-sectional dimensions are: 150x150, 150x225 and 150x300 mm^2.
The test results show that FRP confinement can enhance the compressive strength and ductility of RC rectangular columns with rounded corners. The strength enhancement increases with the amount of reinforcement and the corner radius, and the confinement efficiency is strongly influenced by the aspect ratio of the cross-section. The rupture strain of the FRP jacket is lower than the ultimate strain obtained by standard tensile testing of the FRP material.

ACKNOWLEDGEMENTS

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CODE 15

IMPROVEMENT OF THE RESISTANCE OF CLAY MORTARS WITH LOCAL AGGLUTINANTS

Mosquera, Harlene[1]; Galarza, José Luis[2]

1: School of Architecture of the Universidad Técnica Particular de Loja.
e-mail: hymosquera@utpl.edu.ec
2: Teaching Researcher of the Universidad Técnica Particular de Loja. Investigation Group SITA- Sistemas Innovadores en Tecnologías Arquitectónicas.
e-mail: jlgalarza@utpl.edu.ec

KEYWORDS: Clays, natural fiber, nopal, cadillo, PVA polyvinyl acetate.

ABSTRACT

This document presents an option of improving the resistance of mortars based on clay by adding natural binders derivatives macerating plants: nopal (Opuntia) cocklebur (Bidens pilosa) for removing a gel with a viscosity suitable for increasing the cohesion of the clay particles and thus the compactness needed to withstand erosive atmospheric agents, in a smaller percentage PVA (Polyvinyl Acetate) as artificial stabilizer was used. It began with the study of local clays and natural binders suitable for a plaster. Then through the characterization of the chemical composition clays was used to determine the amount of silica is obtained. The result is within the framework of regulatory requirements for application in adobe houses, thus obtaining an economical and efficient alternative application.

CODE 83

ANALYSIS AND OPTIMIZATION OF CONFINEMENT MODELS FOR SQUARE RC PILLARS WITH FRP

Amo Martínez, Jessica[1]*; Fernández Gómez, Jaime[2]; Villanueva Llauradó, Paula[3]

1: Universidad Politécnica de Madrid, ETSICCP
e-mail: jessica.amo.martinez@gmail.com
2: Universidad Politécnica de Madrid
e-mail: jaime.fernandez.gomez@upm.es
3: Universidad Politécnica de Madrid
e-mail: p.v.llaurado@gmail.com

KEYWORDS: Structural retrofitting; FRP; confinement; analytical modelling.

ABSTRACT

It has been accentuated in the last few years a rising concern about rehabilitation on buildings and other constructions such as civil works with the aim of increasing their service life. Consequently, the use and study of the Fibre Reinforced Polymers (FRP) for structural retrofitting have increased notoriously. Specially, the reinforcements for confinement of reinforced concrete structures. The extensive research undertaken to date has resulted in a number of numerical and pseudo-empirical models that take into consideration the effectiveness of these reinforcements in different structures, being the geometry of the reinforcement one of the most relevant parameters. A comparative study of the existing models is presented, for the case of vertical structures (pillars) with square or rectangular section under axial compressive stresses. A database comprising 235 tests was built. The model fitting of the models has been evaluated with that database. Furthermore, the analysis revealed the critical influence of the following parameters: the section geometry, the concrete strength of the unreinforced member and the FRP-reinforcement thickness, on the confinement effectiveness. The final aim of this study has been the improvement of the existent models that presented the best goodness-of-fit for the considered database. The optimization was done by the modification of their coefficients in order to accomplish a more exactly calculus of the structural retrofitting and its functioning. The reference models used to achieve the optimization were the ones by Lam and Teng (2003a) and by Pham and Hadi (2014). The most remarkable finding of the analysis is the obtainment of two optimized models, in which the least square was noticeably reduced.

CODE 109

A TECHNICAL-ECONOMIC COMPARISON OF THREE STRENGTHENING SOLUTIONS FOR REINFORCED CONCRETE COLUMNS. ADVANTAGES AND DISADVANTAGES

Calderón Bello, Enrique[1]; Gómez Barrado, Sergio[1]; Díaz-Pavón Cuaresma, Eduardo[1]; Rodríguez Escribano, Raúl Rubén[1]

1: Instituto Técnico de Materiales y Construcciones (INTEMAC).
e-mail: ecalderon@intemac.es, web: http://www.intemac.com
e-mail: sgomez@intemac.es
e-mail: ediazpavon@intemac.es
e-mail: rrodriguez@intemac.es

KEYWORDS: Strengthening column; reinforced concrete jacket; steel jacketing; FRP confinement.

ABSTRACT

Two cases of intervention in a building are exposed, related with strengthening solutions for reinforced concrete columns (particularly for rectangular sections): an example of a damaged column on a random building floor, an another where it`s necessary to reinforce all building floors. Each of them for three commonly used strengthening solutions: reinforced concrete jacket, steel jacketing, and FRP confinement. In the case of the first two alternatives, a substitution reinforcement is proposed in which the collaboration of the existing damaged section is despised.
The analysis of these examples reveale the aspects that are critical in the structural design of each of the alternatives. A technical-economic comparison of the solutions is exposed, analyzing the advantages and disadvantages of each case, being able to draw conclusions about that in which cases it may be preferable to opt for one alternative over another.

CODE 146

STRENGTHENING OF BEAMS AND SLABS WITH PRE-DEFORMED STEEL SHAPES

Rodríguez Escribano, Raúl Rubén(*)[1]; Enrique González Valle; Ley Urzaiz, Jorge[1]; Calderón Bello, Enrique[1]; Díaz-Pavón Cuaresma, Eduardo[1]

1: Instituto Técnico de Materiales y Construcciones (INTEMAC).
2. Escuela de Arquitectura, Ingeniería y Diseño de la Universidad Europea de Madrid
e-mail: rrodriguez@intemac.es, web: http:www.intemac.es
e-mail: egonzalezvalle@yahoo.es
e-mail: jley@intemac.es
e-mail: ecalderon@intemac.es
e-mail: ediazpavon@intemac.es

KEYWORDS: Beams strengthening; slabs strengthening; actively strengthening.

ABSTRACT

One technique for strengthening reinforced concrete beams and slabs, entails caulking the underside of these members with steel shapes.
This sort of strengthening is often designed from a passive approach; i.e., until the load is increased, the shapes are either not loaded or are only slightly loaded to some unquantified extent by caulking with steel shims.
An alternative is an active approach, by applying forces (with jacks or threaded bars, for instance) between the shape and the member to be strengthened. The shape is subsequently caulked under the beam at the points where the forces are applied with steel shims, mortar or similar. As deflection calculations in steel girders are extremely reliable, the forces applied with this procedure can be very precisely determined by measuring the deflections of the shape, not only when the strengthening is settled down, but in any time.
This type of strengthening has been analysed in a Doctoral Thesis presented by one of the authors of the present paper, under the direction of Prof. Enrique González Valle and Prof. Jorge Ley Urzaiz, in the E.T.S. of Civil Engineers of the U.P.M.
This paper presents some examples of this type of strengthening. The examples show the technical aspects to be considered in the design, execution and control.

CODE 165

AN INNOVATIVE SOLUTION FOR THE STRENGTHENING OF A "DEPRESSED AULT" IN MASINO CASTLE (ITALY)

Jurina, Lorenzo[1]*

1: Politecnico di Milano (Italy), ABC Department
e-mail: lorenzo.jurina@polimi.it, web: http://www.jurina.it

KEYWORDS: Structural consolidation; innovative solutions; reinforced arch method; depressed vault.

ABSTRACT

In the consolidation of masonry arches and vaults, the designer is asked to find effective solution compatible with the existing material and respectful of the historical evidence, according to the principle of "minimum intervention". The author has developed an innovative technique for the consolidation of masonry arches, vaults and domes called "RAM - Reinforced Arch Method". This technique consists in modifying the loads acting on the structure through the application of post-tensioned steel cables, either at the extrados of the arch or at the intrados, that increase the axial compression. The structural efficiency of the method has been widely tested under vertical loads, analyzing more than 400 arches of different shape and scale. Furthermore, recent experimentations, performed on more than 100 small scale physical models, were oriented to verify the effectiveness of the system to resist also horizontal loads, such as seismic ones. In the present paper an intervention in Masino Castle (Italy) is described, where RAM was adopted. Fifteen years ago, an evident longitudinal crack appeared crossing all the 20 meters long, finely decorated, barrel vault of the Galleria dei Poeti, together with a 15 cm depression of the central part of the vault. Due to this considerable damage, a consolidation intervention was required. It was aimed to reduce the horizontal thrusts of the vault, not sufficiently counteracted by the perimeter walls, and, mainly, to improve the stress state of the masonry in the depressed zone. Light and reversible choices were adopted, operating only on the extrados of the vault. The RAM was adopted to locally restore the behaviour of the vault in the depressed zone. Several post tensioned cables were applied over the vault, each one strictly connected with the surface. In the central zone, small anchorages were used to force the cables to follow the depressed shape.

CODE 174

SYSTEMATIZATION OF REPAIR AND REINFORCEMENT TECHNIQUES OF REINFORCED CONCRETE IN BUILDINGS

Belgas, Lurdes[1]*; Branco, Fernando[2]; Mascarenhas, Jorge[3]

1: Polytechnic Institute of Tomar, Engineering's Department
e-mail: lbelgas@ipt.pt, web: http:www.ipt.pt
2: University of Coimbra, Department of Civil Engineering
e-mail: fjbranco@dec.uc.pt web: http://www.uc.pt/fctuc/dec
3: Polytechnic Institute of Tomar, Engineering's Department
e-mail: jmascarenhas@ipt.pt,web: http:www.ipt.pt

KEYWORDS: Reinforced concrete; rehabilitation techniques; repair; reinforcement.

ABSTRACT

Building rehabilitation is currently recognized as a national need for the conservation and safeguarding of built heritage, for the improvement of the quality of life of the populations and for the revitalization of historic centers, in which most of the buildings contain structural masonry walls and pavements, and structural timber frameworks.
Since the 40s of the last century, with the advent of concrete, masonry and wood in some of these buildings started to be successively replaced by reinforced concrete structures. These buildings are known as "transition buildings". Many of these constructions were built prior to the introduction of reinforced concrete regulations in the 1960s, and therefore require intervention due to pathologies caused by construction faults that affect their structural safety; advanced degradation due to lack of quality of the building materials; changes in use and adaptations to modern functional requirements.
In the 70's and 90's, there was a substantial increase in the construction of buildings with reinforced concrete structures in Portugal, many without structural and aesthetic quality. Although these constructions are quite recent, they also require intervention, in particular due to advanced degradation of concrete and the need for structural reinforcement particularly to prevent seismic damage.
Therefore, Portugal has an important heritage of reinforced concrete buildings requiring rehabilitation. Several processes, techniques and materials are available to carry out these interventions, but information on the different processes is dispersed in literature and specialty journals and scientific articles. This paper aims at systematizing the techniques currently used in the repair and reinforcement of reinforced concrete structures, describing concerning processes, limitations and applications.

CODE 181

STAINLESS STEEL RIBBONS FOR THE SEISMIC STRENGTHENING OF EXISTING BUILDINGS

Recupero, Antonino[1]*; Scilipoti, Cosimo Damiano[2]

[1]University of Messina University, Dep. of Engineering
e-mail: antonino.recupero@unime.it
[2]R&S Engineering Consulting – Messina
e-mail: rs.engineering@virgilio.it

KEYWORDS: Earthquake masonry; strengthening; stainless steel ribbons; historical heritage.

ABSTRACT

Unreinforced masonry (URM) structures are typical of many seismic countries around the entire world. In Italy, many of the constructions of the historical heritage are, generally, characterized by masonry having low mechanical properties, both for its texture and for the bad mechanical characteristics of mortar. Masonry walls are often consisted by irregularly shaped stones, although sometimes minimally worked or selected for similar size, and rubble masonry fill, without any transverse connections. Therefore, the earthquake performance of URM elements is often unsatisfactory.
Within the framework of a research project at University of Messina (Italy), the chance of improving the relatively poor performance of ancient masonry buildings, which characterize the region of Sicily, by strengthening URM walls with an innovative system was investigated.
The use of steel ribbons to improve the seismic performance of URM walls was used in the past. This method consists of adding normal-strength steel rebar or ribbons along different directions on either one side or both sides of URM walls. The ties comprise steel strips, which are anchored to the walls using steel bolts, and they are either fixed or not fixed to the ground-foundation.
In this paper, the experimental research will be shown and an application to real case will be presented and discussed.

CODE 259

REHABILITATION OF PEDESTRIAN BRIDGES WITHOUT ENGINEEIRNG DESIGN

Olmos, Bertha[1]*; Martínez, Guillermo[2]; Jara, José[3]

1: División de Estudios de Posgrado, Facultad de Ingeniería Civil, Universidad Michoacana de San Nicolás de Hidalgo
e-mail: ba.olmos@gmail.com, web: http:www.umich.mx
2: División de Estudios de Posgrado, Facultad de Ingeniería Civil, Universidad Michoacana de San Nicolás de Hidalgo
e-mail: guillermo.mtzruiz@gmail.com, web: http:www.umich.mx
3: División de Estudios de Posgrado, Facultad de Ingeniería Civil, Universidad Michoacana de San Nicolás de Hidalgo
e-mail: jmjara70@gmail.com, web: http:www.umich.mx

KEYWORDS: Pedestrian bridges; steel rehabilitation; RC rehabilitation.

ABSTRACT

Several pedestrian bridges in cities of Mexico have small clear spans, and their structure was built by reinforced concrete or steel. Many of the steel ones have been designed without full fill the appropriate design code, i.e. based on the experience of steel structures workers. It is noticed that many of these structures lack of the basic design requirements, as it is to full fill the service limit state, for example in limiting excessive vibration with the pedestrian walking. Farther, there is not a constant evaluation program whose aim most be to determine the damage state of the bridges in their structural elements, this is needed in order to provide an adequate maintenance service along the pedestrian bridges service life. Because of the lack of these action, frequently the structures present excessive damage. The present work presents a case of study aiming to develop three possible reinforcement alternatives for a pedestrian bridge. The work is based on a topographical survey and on an ambient measurements campaign to determine the bridge's geometry and dynamic properties, these work allowed us to build a numerical model of the damaged bridge that was calibrated based on the ambient vibration tests, and based on it to get to know the original structure by inferring the material properties. There were identified the structural deficiencies with the aim to develop alternatives that were modelled analytically. The results allow to determine the best reinforcing alternative that could be implemented in pedestrian bridges with a similar structure of the case studied in this work.

CODE 322

EXPERIMENTAL DETERMINATION OF THE PULLOUT STRENGTH OF GLUED-IN RODS IN CHESTNUT WOOD

Martins, João[1]; Negrão, João[2]*

1: MSc in Civil Engineering
University of Coimbra
e-mail: joao.acs.martins@gmail.com
2: Associate Professor, Department of Civil Engineering
University of Coimbra
e-mail: jhnegrao@dec.uc.pt

KEYWORDS: Glued-in rods; hardwoods; chestnut; new timber; old timber.

ABSTRACT

The increasing use of glued-in rods (GiR) in timber structures and the persisting lack of european standardization for this connecting system have been gearing the research on this topic. Most of the existing work has been carried out with softwoods, because these are the most frequently used in new timber structures, where the application of the technique is focused. However, it is also of use in the rehabilitation of ancient degraded timber structures, often made up with hardwood species, as is the case with chestnut in Portugal. This paper describes the experimental work carried out with specimens of both old and new chestnut wood, aiming at the characterization of glued-in rods behaviour, the comparison with values provided by some design methods proposed in the literature and the feasibility of its estimative application in strengthening and repair design.
With pull-pull tests, cohesive failure in the glueline was the prevailing failure mode of new wood specimens, while the old wood specimens showed a cohesive failure in the wood. With pull-push tests, the share of cohesive failures in the glueline increases in both types of specimens. The comparison of experimental results with those provided by proposed design methods shows that some are not on the safe side.

CODE 343

STRENGTHENING OF TIMBER BEAMS WITH TEXTILE-REINFORCED ELASTOMERS

Aslankaya, Guzide[1]; Ustundag, Cenk[2]

1: Department of Architectural Technology
Polytechnic University of Catalonia
e-mail: guzide.aslankaya@upc.edu, web: http://www.upc.edu
2: Structural and Earthquake Engineering Working Group
Istanbul Technical University
e-mail: ustunda1@itu.edu.tr, web: http://www.itu.edu.tr

KEYWORDS: Timber beams; strengthening; glass textile mesh; sprayed elastomer.

ABSTRACT

Timber is one of the oldest and widely used construction material all over the world, thus there exists huge number of historical timber building. The main principle of preservation of historical timber buildings is minimum intervention and maximum retention of materials. At this point, instead of replacing, the retrofitting or strengthening of existing timber members by means of innovative techniques plays a vital role. Strengthening of existing structural members with Fiber Reinforced Polymers (FRP) has been widely used in the latter decades. In this study, a new strengthening method with textile-reinforced elastomers is introduced. The strengthening method consists of combined application of a glass fiber textile in open mesh configuration and a special sprayed elastomer to the outer surface of the structural member. Within the scope of the experimental program, unstrengthened and strengthened timber beams were tested to failure under four point bending. The strengthening method provided a notable enhancement of strength, stiffness and ductility of the timber beams.

CODE 361

PRODUCTION AND NUMERICAL ANALYSIS OF SISAL FIBRES COMPOSITES BASED EPOXY MATRIX FOR REINFORCEMENT CONCRETE BEAM

Francklin, Henrique Machado[1]*; Motta, Leila Aparecida de Castro[2]; Roquete, Pedro Henrique Rocha[3]; Vianna, Jamila Beatriz Dias de Velloso[4]; Cunha, Jesiel[5]

1: Civil Engineering Faculty
Federal University of Uberlândia
e-mail: henriquefrancklin@gmail.com, web: http://www.ufu.br
2: Civil Engineering Faculty
Federal University of Uberlândia
e-mail: lacastro@ufu.br, web: http://www.ufu.br
3: Civil Engineering Faculty
Federal University of Uberlândia
e-mail: pedrorocha81@hotmail.com, web: http://www.ufu.br
4: Civil Engineering Faculty
Federal University of Uberlândia
e-mail: jamilavv@hotmail.com, web: http://www.ufu.br
5: Civil Engineering Faculty
Federal University of Uberlândia
e-mail: jecunha@ufu.br, web: http://www.ufu.br

KEYWORDS: Structural reinforcement; reinforced concrete structures; polymers reinforced with carbon fibres; polymers reinforced with sisal fibres.

ABSTRACT

The recovery and reinforcement of the concrete structures has been significantly increased in recent years. Polymeric composites reinforced with fibres have been currently one of the most appropriate choices to structural reinforcement performance. Recent research suggests the use of new fibre-matrix combinations for composite development, producing a system that meets the structural requirements with reduced costs and environmental impacts. The replacement of synthetic fibres to natural fibres is an alternative to the production of these composites. The sisal fibre is abundantly in Brazil, has excellent mechanical properties and low cost. This paper analyzes the use of sisal fiber composite epoxy matrix as bending reinforcement in reinforced concrete beams. The epoxy matrix composites with sisal fibers aligned unidirectionally in content 50%, 60% and 70% by volume. The 70% fibre composites showed the best mechanical properties with modulus on the order of 36 GPa and tensile strength equal to 309 MPa. The performance of these composites as structural reinforcement has been evaluated by comparing your performance with carbon fiber composites. To this end, numerical simulations were carried out using the finite element method, by relating the increase on load capacity of beams reinforced with carbon fiber composites and the sisal fiber composites. The results showed that for the same performance of epoxy laminates with carbon fibres, composites with vegetable reinforcement required a thickness of 4.8 times larger, so your use as structural reinforcement may be feasible.

CODE 366

EXPERIMENTAL BEHAVIOUR OF FULL SCALE MASONRY COLUMNS CONFINED WITH FRP OR FRCM SYSTEMS

Balsamo, Alberto[1]; Maddaloni, Gennaro[2]*; Micelli, Francesco[3]; Prota, Andrea[4]; Melcangi, Giuseppe[5]

1: Department of Structures for Engineering and Architecture
University of Naples "Federico II"
e-mail: albalsam@unina.it
2: Department of Structures for Engineering and Architecture
University of Naples "Federico II"
e-mail: gennaro.maddaloni@unina.it
3: Department of Innovation Engineering
University of Salento
e-mail: francesco.micelli@unisalento.it
4: Department of Structures for Engineering and Architecture
University of Naples "Federico II"
e-mail: aprota@unina.it
5: Structural Strengthening Line
Mapei S.p.A.
e-mail: composite@mapei.it

KEYWORDS: FRCM; axial experimental test; confinement; full-scale.

ABSTRACT

In last decades, several experimental tests were carried out in order to investigate the effectiveness of strengthening systems by using FRP as a confinement technique of masonry columns. Recently, in order to solve problems related to the compatibility of FRPs with masonry members, a new technique based on the use of inorganic matrix rather than resins has been developed (FRCM - *Fabric Reinforced Cementitious Matrix*).
In order to investigate the structural effectiveness of FRCM systems, an experimental program was carried out on full-scale masonry columns by means of uni-axial compression tests. In particular, the effectiveness of FRCM systems based on the use of A.R. glass fibre grid embedded in lime-based mortar with high mechanical properties has been investigated. Test programme, material mechanical properties, and test setup are herein presented along with the preliminary experimental results in terms of load and ductility capacity of a control and strengthened specimen. A preliminary comparison between the performance of FRP and the strengthening systems is also reported.

CODE 382

INNOVATIVE MASONRY STRENGTHENING TECHNIQUES MAINTAINING THE ORIGINAL BRICKWORK APPEARANCE: AN OVERVIEW

Monni, Francesco[1]*

1: AHRTE Srl Spin Off of Polytechnic University of Marche, c/o DICEA – Department of Civil and Building Engineering and Architecture, via Brecce Bianche, 60131, Ancona, Italy.
e-mail: f.monni@ahrte.it

KEYWORDS: Architectural heritage; facing-masonry; strengthening methods.

ABSTRACT

In many seismically active regions, historical masonry buildings represent a significant portion of the building heritage. These structures very often are characterised by masonry having low mechanical properties, both for its texture and for the bad mechanical characteristics of mortar. If it is wanted to preserve this heritage, the use of strengthening methods is necessary and, as consequence of an increasing interest in the conservation of historic construction, there is wide interest nowadays in studying new strengthening techniques. In fact, in the past was widely used "conventional" techniques as grout injections or concrete external reinforcement, but these systems have shown problems over time in terms of effectiveness and durability. In most recent years, new reinforcement materials were introduced to the world of restoration like Fibre Reinforced Polymers (FRP) or Fibre Reinforced Cementitious Matrix (FRCM), which are made up of synthetic fibres embedded in resins or mortar, respectively. However where is requested to maintain the original aspect of facing-masonry all the previous techniques seem to be unsatisfactory. In this paper is presented a review of the innovative techniques recently proposed to solve this problem, in order to facilitate the role played by designers in restoration and rehabilitation interventions.

CODE 390

EVALUATION OF THE BOND STRENGHT BETWEEN GFRP REBARS AND CONCRETE, UNDER CORROSIVE ENVIRONMENTS

Ruiz Emparanza, Alvaro[1]; De Caso Y Basalo, Francisco[2]; Kampmann, Raphael[3]; Adarraga Usabiaga, Itziar[4]

1: Department of Civil, Environmental and Architectural Engineering
University of Miami, FL (USA)
e-mail: axr1489@miami.edu, web: http://www.um-sml.com
2: Department of Civil, Environmental and Architectural
University of Miami, FL (USA)
e-mail: fdecas1.6
o@miami.edu, web: http://www.um-sml.com
3: Department of Civil and Environmental Engineering
Florida State University, FL (USA)
e-mail: kampmann@eng.famu.fsu.edu, web: http://eng.fsu.edu/kampmann/home
4: Department of Mechanical Engineering
University of the Basque Country (Spain)
e-mail: itziar.adarraga@ehu.eus

KEYWORDS: GFRP rebars; durability; bond strength; temperature; surface enhancement.

ABSTRACT

Due to the significant growth of traffic in the last years, along with increasing environmental impacts, the deterioration of the infrastructure has increased. This degradation in reinforced concrete structures is mainly caused by the corrosion of the steel reinforcement. To increase the life span of these structures, the implementation of new non-corrosive materials has become more prominent in the last years. Glass fiber reinforced polymer (GFRP) reinforcement bars are one of the non-corrosive alternatives to the traditional steel rebars. The GFRP rebar industry is, to-date, very broad, where manufacturers produce rebars with very different surface textures to enhance the bond between the rebars and the concrete.
This study focuses on the analysis of the bond properties between GFRP rebars and concrete under corrosive environments, such as costal zones in Florida, in order to evaluate the deterioration of this mechanical property. To simulate these conditions, the bond samples were submerged in sea-water tanks at different temperatures (30, 40 and 60 ºC) and two exposure periods (60 and 120 days) were analyzed. In the scope of the project, three different types of rebars (with different surface enhancements) were tested.
The preliminary results of these bond tests, following the American standard ACI440-3R (B.3), show that no major degradation of the bond properties after the exposure has occurred.

CODE 391

INVESTIGATION OF THE BOND AND SHRINKAGE BEHAVIOUR OF TRM STRENGTHENING FOR RAMMED EARTH

Silva, Rui A.[1]*; Oliveira, Daniel V.[2]; Barroso, Cristina[3]; Ramírez, Rafael[4]; Pereira, Eduardo[5]; Lourenço, Paulo B.[6]

1: University of Minho, School of Engineering, ISISE
e-mail: ruisilva@civil.uminho.pt, web: www.isise.net
2: University of Minho, School of Engineering, ISISE
e-mail: danvco@civil.uminho.pt, web: www.isise.net
3: University of Minho, School of Engineering, Department of Civil Engineering
e-mail: cris25alexandra@hotmail.com, web: www.civil.uminho.pt
4: University of Minho, School of Engineering, Department of Civil Engineering
e-mail: r.92@outlook.es, web: www.civil.uminho.pt
5: University of Minho, School of Engineering, ISISE
e-mail: eduardo.pereira@civil.uminho.pt, web: www.isise.net
6: University of Minho, School of Engineering, ISISE
e-mail: pbl@civil.uminho.pt, web: www.isise.net

KEYWORDS: Rammed earth; textile reinforced mortar; strengthening; bond; shrinkage.

ABSTRACT

Raw earth has been used as a building material for centuries, resulting in a significant and worldwide spread built heritage, among which rammed earth is one of the most common building techniques. Nevertheless, the existence of this heritage is continuously endangered by the occurrence of earthquakes, even by those with relatively moderate intensity, as earthen structures are acknowledged by their high seismic vulnerability. Thus, the protection of this heritage and of the respective inhabitants requires adopting seismic strengthening solutions that are simultaneously efficient and compatible with the original materials. The seismic strengthening of rammed earth walls with textile reinforced mortars (TRMs) is a solution being recently investigated within this framework. The pursuing for fulfilling compatibility requirements led to the incorporation of earth based mortars and low-cost strengthening meshes in the proposed solutions. The fact is that the role of the mortar in this strengthening solution is yet insufficiently investigated, namely with respect to the shrinkage and bond behaviours.
An experimental program was carried out to better comprehend the bond and shrinkage behaviour of mortars applied in TRM strengthening for rammed earth walls. The characterisation of the bond and linear shrinkage of different mortars was investigated by means of pull-off and Alcock's tests, respectively. In addition, the influence of the rammed earth support on the shrinkage behaviour of the earth mortar was also investigated by monitoring its drying with digital image correlation (DIC) after application. As conclusions, it can be referred that the clay content of earth mortars must be controlled to minimize shrinkage and that the shrinkage of earth mortar coatings is a very fast process. Furthermore, the selected earth based mortar was shown to achieve similar adhesion performance to that of stabilised earth mortars or of stronger cement based mortars.

CODE 396

STRENGTHENED MASONRY WALLS WITH "FRP" COMPOSITE MATERIALS

Martínez, Sonia[1]; Gutiérrez, J. Pedro[2]; García, M. Dolores[3]

1 y 2: Eduardo Torroja Institute for Construction Science. Spanish National Research Council (IETcc-CSIC)
1: e-mail: soniamdm@ietcc.csic.es, web: http://www.ietcc.csic.es
2: e-mail: jpgutierrez@ietcc.csic.es, web: http://www.ietcc.csic.es
3: Superior Technical School of Architecture of Madrid (ETSAM)
e-mail: mdolores.garcia@upm.es, web: http://www.aq.upm.es

KEYWORDS: Structural strengthening; fiber reinforced polymer; FRP; masonry structures.

ABSTRACT

An experimental study on externally bonded FRP (*fiber reinforced polymer*) laminates bonded to masonry structures subjected to out of plane bending and axial load has been carried out. This technique, well known and widespread for strengthening reinforced concrete elements, can be effective as a structural reinforcement of masonry, due to the poor capacity of this material to resist tensile forces, which makes them vulnerable when they are subjected to accidental destabilizing actions.
Strengthening masonry with "FRP" materials may be interesting mainly in the event of damage due to exceptional events (such as earthquakes), damage occurring with time in the life of a building (such as differential soil settlement) or in the event of an increase in live loads.
This work presents the main results of an experimental campaign carried out on nine solid brick masonry specimens reinforced with different type and amount of carbon FRP. The specimens were tested subjected to out of plane bending and compression.
The obtained results differ in part from those documented in experimental tests carried out by other authors, which pure flexion tests were predominated, and show that the compression level supported by the wall is a key factor in the behavior and ultimate strength capacity of the strengthened masonry walls. It is also verified that it is possible to obtain remarkable increases in out of plane bending capacity of walls using this reinforcement technique. The flexible formats (not preimpregnated sheets) result very interesting and allow a better adaptation to the irregular masonry surface.

ACKNOWLEDGE

This work is part of the Project PIE 201760E066 "*Experimental Analysis and Assessment of Structural Systems*" funded by the Spanish National Research Council and the Project BIA 2016-80310-P "*Study on FRP strengthening of rectangular reinforced concrete columns based on full-scale tests and proposal of a new design model*" funded by AECI and FEDER.

CODE 484

EVALUATION OF THE BOND BEHAVIOUR IN CFRP-STEEL DOUBLE-STRAP JOINTS

Jimenez-Vicaria, J. David[1, 2*]; G. Pulido, M. Dolores[3]; Castro-Fresno, Daniel[4]

1: Centro Tecnológico. ACCIONA Construcción
e-mail: josedavid.jimenez.vicaria@acciona.com
2: GITECO. Universidad de Cantabria
e-mail: jose-david.jimenez@alumnos.unican.es
3: Instituto CC Eduardo Torroja – CSIC
e-mail: dpulido@ietcc.csic.es
4: GITECO. Universidad de Cantabria
e-mail: daniel.castro@unican.es

KEYWORDS: Strengthening; carbon fibre reinforced polymers; steel; joint; adhesive.

ABSTRACT

Carbon fibre reinforced polymers (CFRPs) are being increasingly used in the last years in civil engineering applications. This innovative material is attractive due to its high strength, light weight and good resistance to corrosion. The use of adhesively-bonded CFRP laminates is a very promising technique to strengthen steel structures that have deteriorated due to corrosion, ageing or increasing loads. One of the most critical issues in this strengthening strategy is the adhesive layer placed between CFRP and steel and its interfaces with the materials joined (CFRP and steel). To study the bond behaviour between CFRP laminates and steel plates in such strengthened structures, a series of tests has been carried out in double-strap joints under tensile loading, evaluating the effects of different steel surface preparation and different bond lengths on joint strength and failure mode. Based on the experimental results, some parameters of an analytical model used to predict the bond strength of double-strap joints have been adjusted. Also, numerical models with finite elements have been calibrated from the results of these tests. The combination of the experimental, analytical and numerical evaluation of the behaviour of the bond in CFRP-steel double-strap joints can be a good tool for the design of CFRP strengthening strategies for steel structures.

CODE 120

THE RESTORATION OF THE PORTICO CHURCH OF ST. FRANCIS IN URBINO: AN EXAMPLE OF SCHOOL SITE

Baratin, Laura[1]; Bertozzi, Sara[1]; Cattaneo, Alessandra[1]; Moretti, Elvio[1]; Papi, Michele[1]

1: School of Conservation and Restoration
Department of Pure and Applied Sciences DiSPeA
University of Urbino Carlo Bo
e-mail: laura.baratin@uniurb.it; sara.bertozzi@uniurb.it; alessandra.cattaneo@uniurb.it; elvio.moretti@uniurb.it; michele.papi@uniurb.it

KEYWORDS: Restoration; valorization; sustainability; innovation; communication.

ABSTRACT

The restoration of the portico of St. Francis was an example of active collaboration between different public institutions. Concerted actions have been developed on the cheap that, in respect of the architectural-historical-artistic values recognized to the monument, have allowed its conservation and enhancement. This has all been possible thanks to the various private sponsors who have contributed to the restoration of the monument. A model has been put into to rationalize public spending in the field of culture. Also it was an important training moment for the students of the School of Conservation and Restoration; in fact, through on site training, they were able to learn and put into practice the methods and techniques underlying the interventions. The restoration project was developed within the Master in *Instruments and Methodologies for Cultural Heritage Conservation and Valorization* of the University of Urbino Carlo Bo in collaboration with the School of Specialization in Architectural Heritage and Landscape - University of Rome Sapienza and with ICCROM. The restoration of the portico of the Church of St. Francis was an opportunity to implement a design of and for the restoration of well - defined historical - critical tracks. Intentionalities have been predominantly conservative and respect for material authenticity has been assumed as a starting point. The design choices have respected the criteria and principles invoked in the science of restoration. Thanks to the use of GIS systems and 3D digital systems, further and possible reintegration interventions of some missing parts of the monument to be realized in the immediate future are occurring. With a view to pursuing a greater awareness of cultural heritage by those who are not professionals, a multimedia project is being developed that is able to communicate to the public the important work carried out to date.

CODE 147

METHODOLOGIES OF INTERVENTION IN THE REHABILITATION OF INDUSTRIAL HERITAGE IN THE PROVINCE OF BADAJOZ

Vera-Morales, Juan Antonio[1]*; Muriel-Martín, Idoia[1]; Serrano-Sánchez, Manuel[1]; Rosado-Feito, Juan Ignacio[2]

2: Servicio de Obras y Proyectos. Consejería de Cultura e Igualdad. Junta de Extremadura.
e-mail: juanantonio.vera@juntaex.es
e- mail: idoia.muriel@juntaex.es
e-mail: manueljavier.serrano@juntaex.es
2: Dr. Arquitecto. Master en Arquitectura y Patrimonio Histórico.
e-mail: estudio@arup4.com

KEYWORDS: Industrial heritage; architectonic intervention; rehabilitation.

ABSTRACT

In Spain, a current of performance has begun in places for industry for a few decades. Through expanding and rehabilitations the changes of uses. In the province of Badajoz rehabilitation of industrial buildings have been carried out which have been promoted mainly by Culture Council of Government of Extremadura, through the Works and Projects Service, with good results in general, which is usually accompanied of a change of the use of the buildings among which museums, libraries, youth leisure, accommodation, etc., also following the recommendations of the National Industrial Heritage Plan of the Culture Ministry.

Some interventions have been selected in the way of the most significant examples in the province of Badajoz, boarding the most productive own sectors, which are characterized by the agri-food industry, markets and public infrastructures. When dealing with architectural interventions, the actions on these buildings and the projectual value of the before said works and its cultural impact are also valued.

So that a methodology of intervention with changes of the use of industrial heritage is presented, which is based on the acquisition of some diagnostic filing cards of the buildings, where details of its material and urban environment and describing, detecting constructive and compositional elements which configure them. The study is completed with graphic historical information and the analysis of plans and old photographs with the rehabilitation projects, comparing the reformed current and visualizing the new solutions or the restorations of the restorations of existing elements.

The rehabilitation of industrial architectures has a character of safeguard of the patrimony, reason why it is necessary a study of the new use of the building that conserves the values of industrial heritage.

CODE 243

RECYCLING IN ARCHITECTURE: REFUNCTIONALIZATION OF INDUSTRIAL AND AGRICULTURAL HERITAGE

Sánchez Rivero, Mónica Victoria[1]*; Bote Alonso, Inmaculada[2]; Montalbán Pozas, María Beatriz[3]

1: Universidad de Extremadura.
e-mail: msanchezvj@alumnos.unex.es
2: Universidad de Extremadura
e-mail: ibotealo@alumnos.unex.es
3: Universidad de Extremadura, Escuela Politécnica.
e-mail: bmpozas@unex.es

KEYWORDS: Heritage; circular economy; ecological footprint; recycle.

ABSTRACT

The Industrial-Agrarian Heritage in the Extremadura landscape is based on whole of buildings full of meaning and architectural values, which are in a precarious situation due to, in the absence of a viable use, they are being abandoned until their slow disappearance. The collective conscience for the protection of the environment, differs from the impunity that exists for the environmental impact created by these obsolete buildings. Our aims to give alternatives to the agricultural model of the 20th century under the concept of “Recycling”, a term that indicates the volition to modify the building use in a new reality, furthermore, searching new uses because they are not practical nowadays and they have become obsolete or amortized. Recycling is, undoubtedly, a sustainability strategy because it reduces the architecture impact in our environment by seeking the reuse of existing infrastructure and keeping the natural territories. Considering recycling over demolition leads us to minimize the "footprint" of architecture. By means of the study and analysis of the different variables to be taken into account for its cataloging and subsequent action as recyclable architecture, the concrete indicators of this type of buildings are established, in order to indicate the guidelines to protect the native heritage with useful constructions that enhance the regeneration of the site and do not increase the built heritage.

CODE 254

RESTORATION OF THE 19TH CENTURY LOCOMOTIVE STATION IN MALAGA

Linares, Ángela[1]; López, Javier[1]; Sánchez, Jorge[1]; Puertas, Alba[1]; Assiego, Rafael[1]

1: Escuela de arquitectura de Málaga
e-mail: angela.linares.v@gmail.com , jlopezgabarron@hotmail.com , puertasvillalobos@gmail.com , jorgeamsanchez@gmail.com , rassiegodl@uma.es
web: www.arquitectura.uma.es

KEYWORDS: Industrial heritage; consolidation; historical analysis; rehabilitation; master plan.

ABSTRACT

The work in research is motivated by the need for a debate on the conservation of patrimonial assets and the development of the city itself; a debate on how to re-value buildings that have been marginalized for a long time and that nevertheless, were really important in the past, relating itself to the city in a balanced manor.
The project focuses on an old construction of an industrial character from the early nineteenth century in Málaga that was used as a repair shop for locomotives. The current image of the building is the result of the pressure it has suffered from the urban developments in the area, highlighting the construction of the new high-speed station and the subway, this last action forced the dismantling of a bay and a half of itself.
A methodology is being worked with to put in value the current ruin in relation to the environment and to return the splendour of the element as an articulating urban element. In addition, the necessary construction techniques are proposed to conserve and consolidate the current building.
To do this, we carry out a historical investigation by studying graphic documentation that allows us to understand the building in its origins. Next, we work on case studies presented in the history of restoration, highlighting examples such as the actions carried out in the Colosseum in Rome by Stern and Valadier or the interventions "case by case" by Annoni.
Finally, we propose an intervention to search the unit of style, with three objectives, that we maintain the drama present in the building, that it allows us to know how the building was in its origins and that it provides the necessary flexibility to it for the coexistence of the future uses with a city of opportunities.

CODE 310

IPÊ-AÇU RAILWAY STATION RESTORATION PROJECT

Fabres, Emanuela[1]*; Pimentel, Viviane[2]

1: Mestranda em Projeto e Patrimônio, PROAQRQ/UFRJ
emanuelanfabres@gmail.com
2: Doutoranda em História e Preservação do Patrimônio Cultural, PROARQ/UFRJ
pimentelvix@gmail.com

KEYWORDS: Restoration; industrial patrimony; train station; Ipê-Açu station.

ABSTRACT

The train station Ipê-Açu, located in the city of Vargem Alta/ES - Brasil, situated on the highest point of the Linha do Litoral, is found in a state of abandonment and degradation, due to, in the biggest part, the action of the weather, vandals and the passing of time. Taking into account the industrial architecture, the patrimonial letters and the restaurantion theoreticals, Reigl and Brandi, with emphasis in the values of instrumental and novelty and on the esthetical and historical instances, in addition to interviews with local residents, visits to the place and researchs with the responsable groups. This paper proposes the realization of the project that aims to repair the building with the least posible amount of intervention, changing the use into a museum of the train station and the station, with a coffee shop attached. Aiming to contribute to the divulgation and permanence of the industrial patrimony of the region and to boost the use of the place with the opeening of a colonial coffee shop able to attract a diversified group of people to the Station.

CODE 395

THE PROTECTION AND VALUE OF THE ELEVATORS AS INDUSTRIAL HERITAGE IN VALPARAISO AND ITS INCORPORACION AT THE URBAN STRUCTURE OF THE CITY

Kaplan, Paulina

School of Construction Engineering
Pontifical Catholic University of Valparaiso- Chile
e-mail: paulina.kaplan@pucv.cl, web: http://www.pucv.cl

KEYWORDS: Industrial heritage; Elevators; Cultural good; Globalization; Authenticity; Integrity

ABSTRACT

Valparaíso, declared a World Heritage Site in 2003 by UNESCO and recognized as the Historic Area of the City of Valparaíso Port, which implies that it is a CULTURAL PROPERTY that, in terms of the World Heritage Convention, corresponds to a set of buildings, within a developing city.
The nomination distinguishes a city whose essential character is given by two interrelated factors. On the one hand, being the main Port of the Southern Cone in the late nineteenth and early twentieth centuries and the second factor for its architecture, urbanism and infrastructure, factors that are expressed both in architectural styles and in urban forms, construction methods and means of urban transport, among them the ELEVATORS declared Historical Monuments within the Chilean National legislation.
This seal of the nineteenth century responds to the condition of a city with a great legacy of the industrial age and early GLOBALIZATION, with its commercial exchanges and technological advances. On the other hand, the stamp that gives its peculiar geography and topography, which imposed exceptionally strong conditions for its development, which its inhabitants knew how to assume with great creativity, marks the character of the city.Both seals - geographic and historical Heritage. They were combined operating together to create a unique city, which given its historical evolution has preserved its AUTHENTICITY and INTEGRITY. Therefore, the importance of the construction of the elevators that made possible the displacement between plan and hill, managing to respond the peculiarity that Valparaíso has today.
Currently the elevators are part of the INDUSTRIAL HERITAGE of Chile and are an integral part of the urban history of the city, so its value is the revitalization of the neighborhood in which they are inserted.
Valparaíso had 32 elevators in operation at the beginning of the 20th century. It currently has 15 elevators of centennial data, some operational and others in restoration and is the only city in the world, in which this transportation system is fully valid and is essential for the movement of its inhabitants. This originates in the application of the technological advances of the industrial age, in the eagerness of progress of its inhabitants and in the applied creativity to solve the problems imposed by the geographical environment and the quality of life of its inhabitants.

CODE 451

COGNITIVE AND CONSTRUCTIVE ANALYSIS OF SPANISH MEDIEVAL NAVAL ARSENALS OF BARCELONA, SEVILLE AND VALENCIA

Pagliuca, Antonello[1]; Robador González, María Dolores[2]; Debenedictis, Domenico[3]*

1: UNIBAS, Università degli Studi della Basilicata,
DiCEM, Dipartimento delle culture europee e del Mediterraneo.
e-mail: antonello.pagliuca@unibas.it
2: Universidad de Sevilla, Construcciones Arquitectónicas II
e-mail: lolarobador@us.es
3: UNIBAS, Università degli Studi della Basilicata
DiCEM, Dipartimento delle culture europee e del Mediterraneo
e-mail: domenico.debenedictis@unibas.it

KEYWORDS: Industrial heritage; dockyard; modular structures; aisle plant; photogrammetric survey.

ABSTRACT

Medieval dockyards, belonging to an architectonic typology of Mediterranean harbour cities, even if morphologically similar, present specifical peculiarities regarding the materials and the traditional construction techniques of the places where they were built. The structural system, generally articulated by rows of pillars connected each other with arches, repeats the same composition principles of a religious system. The substantial differences that distinguish Christian buildings from naval industries are primarily concerned with the absence of a decorative apparatus, and then the number of aisles settled according to the needs of the port, unlike the places of worship where there is a central aisle flanked on both sides by two or four lower ones (basilical plant with three or five naves). Although Mediterranean ports, both maritime and riverine, are numerous, the number of arsenals is far lesser than that of churches, and therefore the study of these industrial architectures is restricted to relatively few specimens, which require a cognitive analysis of specific and accurate construction techniques. For this reason, a research process focused on comparative analysis of these buildings has been carried out to delineate the distinctive features of the constructive elements and the materials used in order to record, preserve and/or recover these emplacements. In the first phase of this process, the Spanish arsenals of Barcelona, Seville and Valencia have been analyzed through new photogrammetric survey technologies with the aim of delineating geometries, both on a planimetric and a detailed scale, to stress the affinities as well as the discrepancies between these structural plants, which in the next research phase will be compared with the Italian ones to expand the study of these architectures that played a key role within the Mediterranean.

CODE 4

THE VALUE OF HISTORY AND MEMORY. AOSRN HEADQUARTERS OF "7MENOS4"

Ladiana, Daniela

University of Chieti and Pescara, Architecture Department.
e-mail: d.ladiana@unich.it, web: http://www.dda.unich.it

KEYWORDS: Archaeology and architecture; design approach; technologies; materials and language.

ABSTRACT

The preservation of the historical and archaeological heritage depends strongly on the ability to operate an architectural and urban development that is useful for making a connection between past and future. The lack of effectiveness of safeguard policies and the difficulty of tackling the issue of reuse often depend on the lack of cooperation between the various disciplines involved in the project.
The present essay aims to develop a critical reflection on the design approach adopted in a building restoration project, implemented in the oldest urban context of the city of Porto, focusing attention on the recognition of the value of the underlying archaeological site.
The project of rehabilitation of the ancient building affirms the value of architecture as essential tool to introduce the contemporary values in the urban contest and, at the same time, for consolidating, enhancing, of what has been inherited. The project is configured as an act, at the same time, critical and creative, strongly related to the theme of history and of transformations of the specific context.
The building, in effect, is conceived as a true functional device to the knowledge of the place whose value is identified in its historical stratification.
The analysis of the transformation events and of the physical and symbolic relationships with the existing, has conducted to the definition of contents for an action of rehabilitation that reaffirms values essential for the collective memory and urban identity.

CODE 9

AN EXAMPLE OF RECOVERY OF SUSTAINABILITY USING HISTORICAL EXPERIENCE. CUBIERTA DE LA ESTACIÓN DEL NORTE

Calderón, Lucrecia[1]; Maristany, Jordi [2]; Sandra, Ramirez[3]; Carlos, Muñoz[4]

1: Departamento de Estructuras
Universidad Politécnica de Cataluña
e-mail: lucrecia.calderon@upc.edu
2: Departamento de Estructuras
Universidad Politécnica de Cataluña
e-mail: jordi.maristany@upc.edu
3: e-mail: s.ramirez.anaya@gmail.com
4: Departamento de Estructuras
Universidad Politécnica de Cataluña
e-mail: carlos.munoz@upc.edu

KEYWORDS: Modernism; steel; Estació del Nord; polonceau trusses.

ABSTRACT

The refined use of building materials, especially in the case of steel, is one of the Catalan Modernism most representative features. Another very important feature is that buildings constructed in this period usually help to the better understanding of the structural system that bears the loads. At that time, steel was more expensive than Manpower. For this reason, architects needed to design innovative and sustainable structures that have nowadays been lost.
The reduction of steel quantity was the main challenge for former structural engineers during the structural design. In contrast with the current situation, manpower cost was, by far, under the cost of construction materials.
As a consequence, in comparison, much more time was spent in thinking the solution thoroughly. The result were structures that clearly showed its structural behaviour. It is the case of structures that were designed at the beginning of XXth century, that show in their structural layouts how the material is accumulated in the areas with bigger forces.
The objective of this work is to analyse the structure typology designed to cover the railway and platform zones from the Estació del Nord in Barcelona. The use of two different kind of Polonceau trusses joined together results in the increase of structural safety and in a significant material saving compared to the indiscriminate utilization of identical isostatic trusses that is used nowadays in similar situations. This way, we would obtain more sustainable structures.

CODE 13

EMERGENCY INTERVENTION OVER THE SUPPORTING STRUCTURE OF AN APARTMENT BUILDING

Aragón Fitera, Jorge*; González Novoa, Raquel

1: UDC University and CK estructuras consultant, Founding partner,
e-mail: j.aragon@udc.es: First author
2: CK estructuras consultant, Partner,
e-mail: raquel.gonzalez.novoa@gmail.com: Second author

KEYWORDS: Structural damage; intervention; propping; reinforcement.

ABSTRACT

As a result of a apartment building routine inspection carried out in 2014, in Ourense city (Spain), a severe structural damage was detected affecting the back facade, built in 1955 with supportive brick wall.
Based on this problem, a technical judgment was drawn up which identified the cause and extreme severity of the problem. As a result, the property was evicted along with an emergency propping project in rolled steel structure.
The design projected in it was based on a unique candle substructure, adapted to the damage facade, which was reconverted to mixed main structure, in steel and concrete, in the later phase of structural consolidation.
In addition, given the dificult circumstances of the interior court and the time restrictions of any emergency intervention, it became a very unique execution and of considerable complexity.

CODE 79

REHABILITATION OF THE COVER STRUCTURE OF THE INSTITUTE EUSEBIO DA GUARDA DE A CORUÑA

Pérez Valcárcel, Juan

Universidade da Coruña, ETS Arquitectura, Group of architectural structures
e-mail: valcarce@udc.es, web: http://investigacion.udc.es/es/Research/Details/G000399

KEYWORDS: Architectural heritage; pathology of timber structures; reinforcement of timber structures;timber structures.

ABSTRACT

The Eusebio da Guarda Institute is a very remarkable eclectic style building located in the center of A Coruña. It was the first secondary study center in the city and was built in 1889 thanks to the funding of the philanthropist Eusebio da Guarda. In addition to its architectural values, it is a historically significant building, because it was the School of Arts and Picasso studied it during his stay in A Coruña.
From the structural point of view, the most remarkable feature is the roof structure, made up of trusses of pine wood (pino tea) from Cuba, with a very unique layout. It is a very high quality wood, but the union with the masonry walls was very poor, so in January 2016 strong decays were detected in the heads of the trusses and in the timber lintels of the upper floor windows. Strong attacks by xylophagous insects, such as termites, were also observed.
Being a school building of great occupation, the Department of Education of the Xunta de Galicia decided to carry out an urgent intervention. It consisted in the total replacement of damaged parts, for which a complete diagnosis was made of them. The repair was carried out from May to September 2016.
The paper analyzes the whole process followed, both in the diagnosis and in the reinforcement. The history of the building will also be briefly explained to help us understand the reasons for the pathology observed and the structural analysis of the affected elements. Finally, the specific actions that have been taken to solve the problem will be described.

CODE 137

INSPECTION, DIAGNOSIS AND PROPOSAL FOR INTREVENTION IN A MULTI-FAMILY BUILDING FROM DE 60'S, IN PORTUGAL

Marcelino, Inês I. G.[1]; Lanzinha, João C. G.[2]*

1: University of Beira Interior, Covilhã, Portugal.
e-mail: ines.vr@hotmail.com
2: C-Made, LABSED, University of Beira Interior, Covilhã, Portugal.
e-mail: jcgl@ubi.pt, web: http://www.ubi.pt/Pessoa/jcgl

KEYWORDS: Inspection; diagnosis; rehabilitation; multi-family building.

ABSTRACT

The Portuguese built up area presents an advanced stage of degradation, mainly in the older buildings in the historic cities' centers, this creates an increasing need to intervene to solve the situation. Throughout this built up area, it is posible to identify constructive periods that kept up the implementation of different trends and technological evolutions, defining distinct strategies for the intervention. The 60's deserve some emphasis in Portugal because it is composed by a significant group of buildings with reinforced concrete structure, with no preoccupations from the thermic behavior point of view until the 90's, that nowadays are inhabited mainly by elder people, most times, living alone. In this work, a study case about a multi-family building from the 60's located in the city of Covilhã is presented. This work consists in two main stages: the technical inspection of the building (complemented with some measurements on site) and the setting of intervention proposals according to the detected weaknesses. Not being systematic or obligatory, the inspections should be performed after the recognition of the need for repair. In a first stage, it was created an analysis methodology that includes the creation and implementation of a technical inspection registration form and the execution of surveys to the residents to know the terms of occupation, sensibility, and intervention expectations. According with the visual inspection and the gathering of the residents' opinion, it was possible to get information about its building elements, facilities, accessibility, state of conservation and data about use and occupation.
In the course of the inspection work, it was possible to take essential considerations to propose intervention solutions. The proposals to improve were studied, predicting the implementation of a solutions, always with the concern of creating better accessibility, use and comfort conditions.
The methodology and analysis used, the main obtained data and the proposals for intervention of rehabilitation are presented in this article.

CODE 141

TECHNICAL AND ECONOMICAL DETERMINING FACTORS IN CHOOSING THE MOST SUITABLE WATERPROOFING MEMBRANE FOR FIXING WATER LEACKAGE IN A REINFORCED CONCRETE SHEETS SLOPING ROOF

Sánchez Arroyo, Jesús(*)[1]; Calderón Bello, Enrique[1]; Luzón Cánovas, José M.[1]

1: Instituto Técnico de Materiales y Construcciones (INTEMAC).
e-mail: jsanchez@intemac.es, web: http:www.intemac.es
e-mail: ecalderon@intemac.es
e-mail: jmluzon@intemac.es

KEYWORDS: Structures made from reinforced concrete sheets; Liquid Applied Roof Waterproofing Kits (LARWK); PVC-P waterproofing sheets; background conditions.

ABSTRACT

A sloping roof whose structure is made of a several reinforced concrete sheets, arches and struts, is needed to be refurbished and properly waterproofed due to its poor building: the roof is leaking and the reinforced concrete structure is being damaged (some rust in frame, some cracks in concrete, etc.).
Bearing in mind the complex, outstanding external curved surfaces of the roof structure, which can be clearly seen from the surrounding buildings, a Liquid Applied Roof Waterproofing Kit (LARWK) is first chosen for the refurbishing design draft, instead of waterproofing membrane kit (bitumen, PVC-P, rubber, etc.): these membranes need to be cut up to adjust the surfaces -curved sheets, arches and struts edges, corners, etc- and all the overlaps between membranes should be watertight sealed; the more cuts and overlaps you have, the more likely leaks are to occur. Besides, the new waterproofing system should look like the original white finishing roof coat.
A detailed study of the roof surfaces -as a waterproofing system background- was made: they were coarse and irregular. Due to this, in the end a waterproofing PVC-P membrane system is chosen instead of a LARWK one for the refurbishing design. This decision was taken in order to not increase the budget nor the construction time period: to properly apply a LARWK, flat, solid, dry surfaces are needed; if not, they should be previously make ready, usually by using concrete mortar layers that have to be dry before LARWK applying. By contrast, PVC-P waterproofing membranes can be directly screwed on the current surfaces, placing a textile fabric among the membranes and the background for further protection.
By choosing light grey PVC-P membranes and carefully cutting them up, the final look of the refurbishing works is considered satisfactory.

CODE 145

INDUSTRIAL HERITAGE REFURBISHMENT: THE CASE STUDY OF A MANUFACTURING SITE IN CANALE (ITALY)

Mazzucchelli, Enrico Sergio[1]*; Stefanazzi, Alberto[2]

1: Politecnico di Milano, Department of Architecture, Built environment and Construction engineering
e-mail: enrico.mazzucchelli@polimi.it, web: http://www.abc.polimi.it
2: Politecnico di Milano, Department of Architecture, Built environment and Construction engineering
e-mail: alberto.stefanazzi @polimi.it, web: http://www.abc.polimi.it

KEYWORDS: Industrial heritage; roof; refurbishment; building site management; asbestos.

ABSTRACT

The preservation and refurbishment of the industrial heritage plays a fundamental aspect in terms of improving the energy performance, but also in terms of comfort and healthiness of working environments, that often prove to be very lacking in this regard. In this framework, the paper describes and analyses the reclamation and redevelopment of the roofs of one of the largest productive-industrial sites in the town of Canale (Italy). The case study is made up of a series of adjacent buildings, many of which built in different periods, to a total area of over 20,000 sq. m. This particular situation, that is the simultaneous presence of many different types of roofing, most of which characterized by the presence of elements containing asbestos, resulted in a considerable level of deepening and detail in the design phase. Moreover, the need to maintain the production lines of the plant without any operational interruption during the refurbishment phases has led to a strong engineering and optimization of the planned operations, so as to minimize their impact on the production activities. The paper, after describing the production site initial situation, analyses and deepens in detail the design and the construction site optimization issues, as well as the technological and operational solutions adopted both to improve the indoor environmental conditions (thermal and lightning comfort) and to minimize the interference with the production activities, highlighting how such solutions could be used as guidelines in case of similar refurbishment interventions.

CODE 167

REGENERATION AND RESTORATION PROJECT OF THE EX BIRRA PERONI FACTORY IN ROME

Valentina Minicozzi [1]

1: Dottoranda in Architettura e costruzione,
Dipartimento di ingegneria civile ed informatica Università di Roma "Tor Vergata"
e-mail: valentina.minicozzi@uniroma2.it

KEYWORDS: Recupero; tutela; consolidamento; recovery; protection; consolidation.

ABSTRACT

The need to intervene on existing building heritage, which is characterized by en-ergy efficiency, seismic safety, inclusiveness, living comfort and use that is inade-quate to current needs, is one of the most commonly used themes. Indeed it is imperative to make this heritage more enjoyable, safe and functional. In this con-text, the restoration and upgrading of the buildings of the former Peroni Beer Plant in Rome by G. Giovannoni (1909-1913), carried out in collaboration with arch. A.M. Racheli, Arch. M.C. Bodini and Ing. Antonio Maria Michetti, who has been involved in the consolidation project. This intervention, which took place be-tween 1989 and 1992, concerns in particular two of the three lots in which the plant is subdivided and tries to combine the technical and performance choices with the need to protect and enhance the architectural specificities. The aim was to return to this complex the urban role and the functionality that had once giving a contribution to the redevelopment of the surrounding area.

CODE 186

REHABILITATION OF HISTORICAL BRIDGES PERTAINING TO TRADITIONAL DROVING ROUTES IN EXTREMADURA

Muriel-Martín, Idoia[1]; Serrano-Sánchez, Manuel[1]; Vera-Morales, Juan A.[1]

1: Servicio de Obras y Proyectos de Patrimonio Histórico y Equipamientos Culturales.
Secretaría General de Cultura. Junta de Extremadura.
e-mail: idoia.muriel@juntaex.es
e-mail manueljavier.serrano@juntaex.es
e-mail juanantonio.vera@juntaex.es

KEYWORDS: Rehabilitation; droving routes; bridges; historical heritage.

ABSTRACT

The historical bridges related to the droving routes network constitute a very important historical heritage, with a relevant role in both the agricultural and cattle activities in rural Spain.
From the 1950s on, the introduction of technological changes in the farming activities as well as the improvements applied to the transport industry rendered the traditional routes obsolete. These routes where therefore abandoned, inevitably starting its deterioration.
However, this infrastructure possesses a great heritage value, since not only reflect the inheritance of the construction and production techniques slowly evolving since the Middle Ages within the popular culture, but they also constitute unique examples of great construction and design quality that deserves being preserved.
The Office of Historical Heritage and Cultural Equipment (Works and Projects Service) belonging to the Culture Secretary's Office, in collaboration with the Droving Routes Section of the Rural Development Office of the Government of Extremadura, have been developing a number of interventions in bridges related to the Droving Routes Network in the province of Cáceres in order to recover its unique heritage value as well as facilitating cultural and tourist opportunities with the support of the eco-routes in which these historical routes have become.
In this paper we present the methodology of such interventions, from the selection of the bridge within the Droving Routes Network, to the identification of its pathologies and the intervention techniques until the rehabilitation is concluded. The interventions will be included in a catalogue –Historical Bridges in the Droving Routes Network of the Province of Cáceres– as a means of supporting cultural and eco-tourism.

CODE 209

ANALYSIS OF THE MANAGEMENT MODEL OF EMERGENCIES OF THE CULTURAL HERITAGE IN THE SEISM OF LORCA, MAY 11, 2011

Martínez Ríos, Carmen[1]; García Martínez, María del Sagrado Corazón[2]

1: General Direction of Cultural Property. Region of Murcia.
mcarmen.martinez5@carm.es
2: Town hall of Lorca. Planning and Management Service.
maria.garcia@lorca.es

KEYWORDS: Emergency management; damage assessment; earthquake damage; seismic risk; cultural property.

ABSTRACT

The emergency actions of cultural heritage in the earthquake of Lorca on 11th May 2011 were a challenge in the response to this catastrophe due to the necessary immediacy and coordinated management between the Local, Autonomous and State Administrations, together with the Bishopric of Cartagena, in the inspection of cultural property and subsequent intervention of structural funding and consolidation.
In the emergency phase, damage assessment was carried out as a priority on cultural property, continuing with the properties listed for their cultural relevance, in accordance with the Catalog of the Special Plan for the Protection of the Historic Area of Lorca (PEPRI). Equally, cultural property had priority, which without cultural protection had cultural values because of their uniqueness and representativeness.
It analyzes the management of times of intervention for building through schedules as well as the quantification of economic resources that made it possible for such emergencies of cultural heritage to be developed and justified before the Government of the Nation in the 4 months following the seismic event. The graph shows the evolution and degree of execution of the state investment in building and a significant number of movable assets located in the historical centre of Lorca. It also analyzes and synthesizes the administrative procedure necessary for the correct definition of emergency actions, urgent contracting of works, expenditure control and justification within the applicable legal framework.
From this analysis we obtain conclusions about the process that allow to establish future lines of work of optimization in the management of cultural heritage protection in the emergency phase by seismic risk, to design a methodology of evaluation of damages and to establish a prioritization of actions on goods cultural interest furniture and building in any of its categories.

CODE 252

STRUCTURAL RETROFITTING OF THE COLUMNATE OF THE "SALA DE LOS PASOS PERDIDOS" OF THE PARLIAMENT OF THE BALEARIC ISLANDS

Obiol, Agustí[1,2]; Oliver-Saiz, Elena[1]*; Jerez, Alicia[1]*

1: BAC Engineering Consultancy Group
e-mail: aobiol@bacecg.com, web: www.bacecg.com
e-mail: eoliver@bacecg.com, web: www.bacecg.com
e-mail: ajerez@bacecg.com, web: www.bacecg.com
2: Universidad Politécnica de Cataluña, Escuela Superior de Arquitectura de Barcelona

KEYWORDS: Intervention; heritage; masonry; structural retrofitting; numerical analysis.

ABSTRACT

This paper analyses the process of replacing two columns that were seriously damaged in the "Sala de los Pasos Perdidos" of the Parliament of the Balearic Islands. After the replacement of these two columns, cracks appeared in the upper part of one of the adjacent columns, although this action had been carried out following the most usual and recommended guidelines for this type of intervention. Faced with the risk of a "domino effect", which would oblige to gradually replace all the columns of the set, it is decided to carry out a detailed study based on a numerical analysis using a Finite Element model. This model allows to reproduce the overall behavior of the "Marés" stone structure and material in order to understand its previous behavior and to anticipate its response in the future with the aim of devising a suitable replacement strategy for the affected columns. This finite element model allows to study the sensitivity to different variables, especially in relation to the vertical displacement of the lintels supported by these groups of columns, as well as to determine how the load distributions are altered as a function of these displacements, which inevitably are necessary for the entrance in charge of the whole colonnade. The results obtained allow to develop a retrofitting strategy to replace four adjacent columns, by the use of hydraulic jacks and with the aim of shoring up the whole colonnade and of disconnecting the columns, by controlling that the displacements are similar to those obtained in previous analyses. Finally, the construction process has been documented and shows the effectiveness of the proposed strategy.

CODE 305

REHABILITATION OF SWING METAL BRIDGE DESIGNED IN THE 19TH CENTURY: TRETO'S BRIDGE, NORTH OF SPAIN

Collazos-Arias, Felipe[1]; Garcia-Sánchez, David[2]; Ruiz-Bedia Maria L[3]; Ramos-Gutiérrez, O-R[4]; Delgado-Nuñez, M-A[5]

1: Departamento de Transportes y Tecnología de Proyectos y Procesos
Universidad de Cantabria
e-mail: felipecollazos.fc@gmail.com,
2: Tecnalia
e-mail: david.garciasanchez@tecnalia.com
3: Departamento de Transportes y Tecnología de Proyectos y Procesos
Universidad de Cantabria
e-mail: maria.ruiz@unican.es,
4: Louis Berger, Spain
e-mail: ORamos@apiaxxi.es,
5: Tecyrsa
e-mail: madelgado@tecyrsa.com

KEYWORDS: Rehabilitation; swing bridge; heritage; repair; reinforcement.

ABSTRACT

The bridge over the Asón estuary at Treto, is located in kilometer point (KP) 173,800 of the N-634 road, formerly known also E-70, in the North of Spain, and has been continuously inspected and studied in recent years because of its bad general condition and its importance in the regional transportation network road. This bridge presented significant problems and the structural condition level was critical previously to its intervention in 2015. The rehabilitation project included the restoration of the structural and functional safety level of the structure was deled after material studies and tests were performed. The new updated of the structure from the old nineteenth centuries to the new standard codes was also performed.
The structural non-uniformity of the bridge and the heterogeneity of the materials conditioned a rehabilitation clearly differentiated by the typology of the units and materials. This differentiated rehabilitation required the development of very specific works in an extremely worthy environment. Some innovative actions to mitigate the different sources of risks during the works on site are also explained. One of the most singular mitigation actions was the placement of a movable scaffold wearing an ad hoc encapsulation system in order to comply with the condition of no discharge to the Asón estuary of any sand blasting treatment for the cleaning of the rust on the entire steel surface of the metal elements.
A part from the “green” and safe-security aspects, the intervention took into account all the social requirements of the population in the area who recovered the pride in this emblematic and centenarian infrastructure and it is, itself, a successful intervention from the resilient point of view.

CODE 331

STRUCTURAL INTERVENTION IN THE AREA OF THE ROMAN THEATRE OF CADIZ

Martinez-Cañete, Marta[1]*; Rodriguez-Mayorga, Esperanza[2]; Cobo, Alejandro[3]; Saez, Andres[4]

1: University of Sevilla
e-mail: martmc14@hotmail.com
2: University of Sevilla
e-mail: espe@us.es
3: University of Sevilla
e-mail: alejandro.cobo.arq@gmail.com
4: University of Sevilla
e-mail: andres@us.es

KEYWORDS: Heritage; historical buildings; Roman Theatre of Cadiz; archaeological excavation; grout umbrellas.

ABSTRACT

The Roman Theatre of Cadiz was built in the century I b.C. It is the oldest Roman theatre in Spain and one of the biggest ones: its diameter is approximately 120 m and 10000 viewers could be accommodated inside it. The theatre of Cadiz had been buried for years under 'El Pópulo' district. 'El Pópulo' is the seminal area of Cadiz and one of the oldest neighbourhoods in Europe. It was founded by the king Alfonso X in the century XIII and encloses many listed buildings with historical interest.
The theatre was discovered in 1980 by chance. Many archaeological excavations have undug part of the theatre by demolishing uninteresting buildings. The fact that a biggest area of the *cavea* and the complete *scaena* are hidden under some heritage buildings arose the dilemma of recovering the Roman remains of the city maintaining the medieval constructions. To this end, a new vaulted space was designed under the ground floor of the heritage buildings using the grouted umbrellas technique. This space will allow maintaining both stratum of the history of the city of Cadiz in the same place.
The description of the creation of the vaults under the buildings, as well as its assessment, are the mail goal of this paper.

CODE 350

THE THEORY IN THE PRACTICE OF INTERVENTION IN THE TRAIN SQUARE: RESTORATION AND REHABILITATION ALONGSIDE MEGA EVENTS IN RIO DE JANEIRO

Csepcsényi, Ana Cristina [1]; Ribeiro, Rosina Trevisan M.[2]*

1: Doutoranda do Programa de Pós Graduação em Arquitetura – PROARQ, Faculdade de Arquitetura e Urbanismo – FAU, Universidade Federal do Rio de Janeiro – UFRJ.
e-mail: anacsep@gmail.com, web: http://www.proarq.fau.ufrj.br/novo/
2: D. Sc. PROARQ, FAU, UFRJ.
e-mail: rosinatrevisan@gmail.com, web: http://www.proarq.fau.ufrj.br/novo/

KEYWORDS: Intervention; restoration; rehabilitation; industrial patrimony.

ABSTRACT

The theory of restoration applied to interventions to built heritages does not always occur consistently, often due to political or economic pressures, implying arbitrary actions. In scenarios such as mega-events, these interferences in intervention practices are more frequent, impacting patrimony preservation. The purpose of this study is to reflect on the appropriation of restoration theory in the practice of heritage intervention in the context of the 2016 Olympic Games in the city of Rio de Janeiro. The case of the Intervention Project and the subsequent works on the Train Square set, an industrial patrimony representative of one of the most important complexes of the railway sector in Latin America, will be used. The correlation between theory and practice in the study is made through the analysis of projected and conducted interventions, based on the verification of the theoretical basis and its coherence with restoration and rehabilitation concepts, focused particularly on the dynamics of the city's suitability for mega events. The results reinforce that the rehabilitation operation at the patrimony does not dispense technical actions, which are usually understood as being exclusive to the restoration. In addition, restorative interventions are not exempt from a creative and new character, which are normally seen as inherent to rehabilitation.
This work intends to emphasize that, even though it is undeniable that the rehabilitation of the Brazilian heritage is pressed by economic issues, and that, in the context of mega events, this topic can gain a larger scale than the pressures that the Cultural Heritage Industry normally operates with, the intervention of rehabilitation in cultural heritage must be a critical, creative, technical and action coherent with the theoretical reference. A key condition for this is the sensitivity of the agents involved in preserving memory.

CODE 355

REPLACEMENT OF BEARINGS IN VIADUCTS OVER THE RIVER TAGUS ON MOTORWAY A-66, CÁCERES

González Rodríguez, Juana Isabel[1]*; Canseco Martín, Inés[2]; Sellers Bermejo, Jose Ignacio[3]; Medina Martínez, César[4]; Morán Martín, Jose Pedro[5]

1: Ministerio de Fomento. Dirección General de Carreteras.
e-mail: jigonzalez@fomento.es,
2: Universidad de Extremadura. Escuela Politécnica de Cáceres.
e-mail: Segundo autor: inescansecom@gmail.com
3: Ministerio de Fomento. Dirección General de Carreteras.
e-mail: jisellers@fomento.es,
4: Universidad de Extremadura. Escuela Politécnica de Cáceres.
e-mail: cmedinam@unex.es
5: Ministerio de Fomento. Dirección General de Carreteras.
e-mail: jpmoran@fomento.es

KEYWORDS: Rehabilitation; steel structures bridges; viaducts; bearings.

ABSTRACT

This paper describes the works entitled 'Replacement of neoprene bearing pads under both carriageways in the Arcos de Aconétar viaducts over the River Tagus, Motorway A-66, KP 519 +700, Province of Cáceres'. These twin steel arch viaducts, with a span of 220 m and a rise of 42.5 m, carry composite steel and concrete decks 400 m long and 13.50 m wide.
A number of inspections and instrumental readings detected anomalies in the bearings: dislocation (due to stake-out errors and creep), deformation (longitudinal and transverse warping), detachment or disengagement and cracking or fracture.
After studying the technical alternatives, 42 550x650x137 mm hooped neoprene bearings were replaced: 32 on steel piers over the arch, eight on concrete piers at the arch springline and two on one of the approach piers.
The neoprene pads were sandwiched horizontally on top and bottom between horizontal steel plates, in turn positioned under or over other plates in contact with the non-horizontal structure. The wedge-shaped gap between the two non-parallel steel elements was then filled with epoxy resin and vacuum-injected steel balls, forming a shim with which to level and secure the bearings.
To perform the works, the deck was hoisted pier by pier with 1000 kN hydraulic jacks and computer-synchronised hoisting kit, with lift point monitoring and measuring of both loads and travel. Two mobile, C-shaped structures were specifically designed and built to ensure safe access, working conditions and material supply on the pierhead platforms.

CODE 442

THE FUNCTIONAL AND TECHNICAL RESTORATION OF A BUILDING BY ATTILIO LAPADULA AND PIER LUIGI NERVI: THE KURSAAL BATHING ESTABLISHMENT

Mornati, Stefania

Department of Civil Engineering and Computer Science
University of Rome Tor Vergata
e-mail: mornati@ing.uniroma2.it

KEYWORDS: Modern architecture; restoration; concrete; Pier Luigi Nervi; Attilio Lapadula.

ABSTRACT

The text focuses on the renovation of an important work of seaside architecture designed by the architect Attilio Lapadula, with the fundamental collaboration of the engineer Pier Luigi Nervi. The project is situated in Ostia, a town on the coast of the city of Rome. The interventions were made to a project that, while difficult to consider a true “modern monument”, nonetheless played a central role in the evolution of construction and architecture. In any case, it represents an example, albeit modest, of the combination between experiments with technologies-construction and the progress of form that defined Italian construction over the course of the twentieth century.
The primary objective of the text is to present the architectural project by the young Lapadula, and the singular construction technologies invented by Nervi for the construction of the central pavilion and the famous diving tower (1949-50). Technologies that range from structural prefabrication to the use of ferrocement, whose absolute originality belong to the experiments initiated by the engineer back in the 1930s, and applied to many projects over the years that followed.
The text then moves on to analyse the restoration of the bathing establishment (2014), necessary to halt the advanced deterioration of the structure and adapt it to new economic objectives aimed at increasing its potentialities and attracting a new group of users accustomed to more complete services distributed throughout the course of the day.
The history of the Kursaal, from its inauguration to the present, also highlights the diverse periods of modern architectural restoration in Italy. What is more, it testifies to the birth, albeit late, of a cultural awareness of the values of evolution in the field of building technologies.

CODE 448

REALIGNMENT AND REORDERING PROJECT FOR THE UNIQUE OFFICE OF THE GRECO AND SEFARDI MUSEUMS IN TOLEDO. SPAIN

Pardo Calvo, Fernando

Estudio de Arquitectura Fernando Pardo Calvo
e-mail: fernandopardocalvo@telefonica.net
web: http://www.pardotapia.com

KEYWORDS: Museums; restructuration; adecuation; urban regeneration; history.

ABSTRACT

The city generates itself by super scribing its architecture trough the overtime will of its inhabitants. The place remains, transforms, contracts, expands. Over the city discourse we can find continuity weaves that follows the forms of preceding times or those which recovery the customs or new languages that propound new voices for impelling the future.
The exercise propose to preserve the time trace generated during centuries in the plot registration, amplifying its meaning to encircle the new volume, and for this reason it is propound an use and an action for rehabilitating the architecture and place it in its moment.
The space is manifest, defined by an existing historic form integrated in the city; the intervention must be subtle, sanitating the architecture to prepare blank spaces to continue the architectural discourse that allows the actual reading, intermediate spaces where the city expands before giving course to the new volume. It is wanted to preserve the buildings surroundings for bringing them into use and value.
The intervention propounds the recuperation and restitution of the membrane of the external historic facade that becomes a container of the new formulated edification volume. The facade is preserved up to the cornice line maintaining the existing hollows, recovering carpentries and constructive elements such as lattices.
This strategy definitely reaches the conservation and preservation of the historical trace of plots which are one of the priorities for the intervention in Toledo's historical center. New architecture will be inserted "within the limits" conformed by facades. The arrangement of the new volume leaned against the facades of Samuel Leví and the San Juan de Dios´ alley allows to create an interstices space between this and the facades in contact with de Transito´s Synagogue (Sefardi Museum). The volume is arranged in such a way for not interposing between the visuals of the street travelers and the notable buildings of this city environment: Tránsito´s Synagogue (Sefardi Museum), Maternity Building and Greco Museum. Furthermore the intervention reaches the preservation, recuperation and restoring of the ornamental and constructive elements, that are characteristics and singulars, integrating all of them in the new building.

CODE 460

BIO-CONSOLIDATION OF THE MARBLE COLUMNS OF THE LIONS COURTYARD IN THE ALHAMBRA

Arizzi, Anna[1,2]; Rodríguez-Navarro, Carlos[1]; Elert, Kerstin[1]; Sebastián Pardo, Eduardo[1,2]; Ruíz Sánchez, Antonio[3]; Cabello, José[4]

1: Department of Mineralogy and Petrology of the University of Granada; e-mails: arizzina@ugr.es; carlosrn@ugr.es; kelert@ugr.es; rolando@ugr.es,
2: Tesela Consulting and Innovation in Sustainable Materials, Spin-Off of the University of Granada; e-mails: annaarizzi@teselainnova.com,
web: http://www.teselainnova.com
3: Council of the Alhambra and the Generalife, Conservation and Protection Service, Granada (Spain)
e-mail: antonio.r.sanchez@juntadeandalucia.es, web: http://www.alhambra-patronato.es
4: KBYOBIOLOGICAL, Granada (Spain)
e-mail: pepecabello@kbyobiological.com, web: http://kbyobiological.com/

KEYWORDS: MYXOSTONE M3P; marble; bacteria; exopolymeric organic substances; calcium carbonate.

ABSTRACT

This study demonstrates the effectiveness of the MYXOSTONE M3P bio-consolidation treatment applied on the weathered marble of the columns of the Lions Courtyard of the Alhambra in Granada (Spain). The Lions courtyard is one of the most magnificent examples of the Nasrid dynasty and it is formed by galleries supported by 124 columns made of marble from Macael (Almeria, Spain). White marble from Macael has always been considered one of the most beautiful stones, for its colour and brightness, but it shows low durability towards thermal variations. The columns of the Lions Courtyard facing South are indeed extremely deteriorated, being scaling, swelling and material loss the most common deterioration patterns observed. Application of the MYXOSTONE M3P by means of poultice or spraying has shown to generate a tough bacterial cement of calcium carbonates nanoparticles embedded in bacterial exopolymeric substances that provides protection towards further weathering. This study also shows that the carbonatogenic activity of bacteria is still possible in low porous stones that present deterioration by-products such as gypsum, as well as surface deposits of clay minerals and previous (non-effective) alkoxysilane treatments.

CODE 471

BEARING CAPACITY FAILURE OF RAFT FOUNDATION SUPPORTING 4 STORY BUILDING

Fathi M. Layas[1], Ramadan E. Suleiman[2]

1: Prof Civil Eng. Dept., Faculty of Eng., University of Benghazi
e-mail: fmlayas@yahoo.com
2: Prof Civil Eng. Dept., Faculty of Eng., University of Benghazi
e-mail resuleiman@yahoo.com

KEYWORDS: Collapsible soil; loess; bearing capacity.

ABSTRACT

This is a case history of bearing capacity failure of a 4 story in-situ reinforced concrete building, constructed in 2000 and located in Benghazi – Libya. The building is of total plan area 65 m2, supported on 80 cm thick raft foundation and of total weight 6300 kN. The building is resting on a profile of sandy loess classified in the literature as collapsible soil due to the large decrease in its shear strength characteristics upon wetting. The layer extends for more than 6 m below the foundation level, a typical lithological profile of this area in Benghazi city.
Few months before the building sudden failure, a local company started the construction of infrastructure near the building where too much water leaked from a broken pipe line. Tested soil samples extracted from nearby excavated test pits indicate that water infiltrated to the soil underneath building foundation, resulting in substantial decrease in soil bearing capacity particularly in the north side of the building.
Although, the structure tilted completely towards the north direction, inspection of its structural elements indicates that none of them yielded any pattern of cracks, due to the rigidity of its raft foundation and reinforced concrete facade shear walls of the ground floor.
The paper includes description of the building and geotechnical properties of the supporting soil. The paper also shows that the induced bearing pressure on the supporting soil estimated by finite element analysis exceeded the allowable bearing capacity of the supporting soil in wet conditions as estimated by conventional Terzaghi's bearing capacity equation.

CODE 494

REFLECTIONS ON THE REPAIR OF THIN-SHELLED MASONRY VAULTS STAIRS AFTER MELILLA EARTHQUAKE OF JANUARY 2016

Díaz Pavón, Eduardo[1]*; Enrique Calderón Bello[2]; Ramón Álvarez Cabal[3]; Raúl Rodríguez Escribano[4]

1:Instituto Técnico de Materiales y Construcciones (INTEMAC)
Jefe del Departamento de Patología
e-mail: ediazpavon@intemac.es
2: Instituto Técnico de Materiales y Construcciones (INTEMAC)
Jefe del Departamento de Rehabilitación
e-mail: ecalderon@intemac.es
3: Instituto Técnico de Materiales y Construcciones (INTEMAC)
Jefe del Área de Estructuras
e-mail: ralvarez@intemac.es
4: Instituto Técnico de Materiales y Construcciones (INTEMAC)
Director de la División de Estudios
e-mail: rrodriguez@intemac.es

KEYWORDS: Thin-shelled masonry vaults; timbrel vaults; earthquake; Melilla.

ABSTRACT

On January 25, 2016 there was an earthquake of magnitude 6.3 on the Richter scale with epicenter in the Alboran Sea that caused some damage in Melilla.
The intensity assigned to the autonomous city was VI according to the information provided by the National Geographic Institute, so the structural damage caused was generally mild.
Inspections carried out after the earthquake showed a typology of damages in the buildings of the so-called "modernist triangle" (current neighborhood Heroes de España): these were cracks of different kinds on staircases formed by thin-shelled masonry vaults (“catalonian” or “timbrel” vaults).
Although in most cases these cracks were inherent to their own structural configuration, in some buildings they could grow as a consequence of the earthquake, which required the analysis of these elements.
In the paper these aspects are analyzed with a general character from the analysis of some particular cases, in order to determine the actions that were judged as more appropriate in this kind of staircases with damages as observed.

4.- MAINTENANCE

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

CODE 14

BUILDING MAINTENANCE ACTIVITIES IN A GOVERNMENT PUBLIC INSTITUTION: CASE STUDY

Morais, Gabriela[1]; Lordsleem Jr., Alberto[2]*

1: Programa de Pós-Graduação em Engenharia – PEC, Universidade de Pernambuco.
e-mail: gatm_pec@poli.br
2: e-mail: acasado@poli.br, web: http://www.politech.poli.br

KEYWORDS: Building maintenance; maintenance management; public buildings; pathological manifestations.

ABSTRACT

Buildings are designed to meet the needs of its users for a long time. However, it is natural that they wear out through their lifetime. Building maintenance is inserted into this context as a tool to maintain functionality and habitability ensuring the safety and comfort for users. In the public sector, maintenance activities are directly affected by the shortage of financial resources and workforce as well as the barriers imposed by excessive bureaucratization for the acquisition of materials and hiring staff and bidding processes, which value the lowest price more than quality. Given the above, this work aims to present a diagnosis of building maintenance processes in an institution managed by the government through a case study. As methodology, data was collected through interviews, the activities were characterized and a database of the institution maintenance requests was analyzed. As a conclusion of this diagnosis, it was found that the average rate of requests met reached 87% and the services that represent the greatest demands are the maintenance of cooling systems, electrical and water/sanitary installations, which together represent 55% of the requests. Furthermore, it was verified the necessity of a better structure for the system of requests intakes, along with a stricter assessment of the performed services. As a contribution in this area of study, the diagnosis of maintenance management, the proposed improvements and the identification of the main pathological manifestations, serves as a reference for the building maintenance activities in government public institutions with potential to guide organizational actions in similar cases.

CODE 36

EVALUATION OF CONSERVATION AND MAINTENANCE OF SÉC XIV BUILDING IN HISTORICAL CENTRE OF OPORTO, PORTUGAL

Rodrigues, Fernanda[1]; Costa, Anibal[2]; Matos, Raquel[3]; Tavares, Alice[3]; Fonseca, Jorge[4]; Alves, Ana[5], Alvares, Manuela[6]

1: Fernanda Rodrigues,
RISCO, Department of Civil Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal e-mail: mfrodrigues@ua.pt, web: http://www.ua.pt/risco/fernanda_rodrigues
2: Aníbal Costa,
RISCO, Department of Civil Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal e-mail: agc@ua.pt, web: http://www.ua.pt/risco/anibal_costa
3: Raquel Matos,
Department of Civil Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal, e-mail: rvpm@ua.pt
4: Alice Tavares
RISCO, Department of Civil Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal e-mail: tavares.c.alice@ua.pt
5: Jorge Fonseca
Department of Civil Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal e-mail: jfonseca@ua.pt
6: Ana Alves
Department of Civil Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal e-mail: anadralves@gmail.com
7: Manuela Alvares
Domus Social, EM, Rua do Monte dos Burgos, 12, 4250-309 Porto, Portugal
e-mail: manuela.alvares@domussocial.pt

KEYWORDS: Evaluation; state conservation; rehabilitation; maintenance.

ABSTRACT

Historical Archive of Oporto – Infant House, located on historical centre of Oporto, includes 11 blocs (buildings), which construction date from Sec. XIV to Sec. XVII. Since this time, building have been facing some interventions and expansion, so, the building presents several constructive typologies. Due to combination of several factors, this building presents a high state of degradation, often more visible in roofs, drainage system, windows and openings, that could cause anomalies in surround materials.
An interior and exterior inspection was done which aims, assess the degradation state of materials and building. Thus, it was done a data collection about constructive elements, such as, windows and openings, wooden support structures of roofs, infrastructures and structural stability. It was also analysed existent anomalies, identified probable causes, as well, identified rehabilitation solutions. Besides that, it was proposed a maintenance plan, which include maintenance actions, respective periodicity and estimated cost for each existent element included in the building.
It is concluded, that an increase of the durability of interventions and the implementation of an effective maintenance plan is essential and necessary for implementation of an effective maintenance plan. Therefore, it is presented the relation cause-effect between constructive solutions and mainly existent anomalies in this building, in order to increase its durability and delete recorded anomalies.

CODE 106

ELECTRICAL SAFETY OF INSTALLATIONS IN REHABILITATION OF BUILDINGS

Aranda, José Ramón[1]; Balbás, Francisco Javier[1]; Madrazo, Alfredo[2]

1: Technology group of the building, GTED
University of Cantabria
e-mail: jose.aranda@unican.es; web: http://grupos.unican.es/gted/
2: Electrical and energy engineering department
University of Cantabria
e-mail: alfredo.madrazo@unican.es

KEYWORDS: Rehabilitation; opportunity cost; electrical safety; grounding installation; grounding rod electrode.

ABSTRACT

The relevance of rehabilitation in Spain is described. Due to the normative change experienced, the actions of non-specialized personnel, the deterioration of the installations and the increase of the power of the receivers, there are risks in the electrical installations that can generate enormous material and human damages.
In spite of a steady increase in the cost of energy, it is better to maintain the electrical safety of the building than carrying out energy efficiency measures to obtain a possible economic reduction. Therefore, it shows the importance of the renovation and maintenance of electrical installations as the main constructive actions.
Due to its relevance as a protection element for users, special attention is paid to the status of the grounding installation, detailing the different tests and their problems.
Finally, the activation of the electrode and its technological improvements are presented as possible actions in building rehabilitation with its technical and economic advantages. Highlighting the usefulness for installers and the duration of the features of the grounding installation with a low economic cost.

CODE 286

FACILITY MANAGEMENT PERFORMANCE INDICATORS TO CREATE A TEMPORAL LINE IN HOSPITAL MAINTENANCE IN COLOMBIA

Madroñal, M.[1]*; Galeano, B.J.[2]; Fernández, J.D.[3], Cuartas, D.[4]; Escobar, N.J.[5]

1: Universidad Pontificia Bolivariana, Bioengineering Research Group.
e-mail: manuel.madronal@upb.edu.co, web: http:www.upb.edu.co
2: Universidad Pontificia Bolivariana, Bioengineering Research Group.
e-mail: beatriz.galeano@upb.edu.co, web: http:www.upb.edu.co
3: Universidad Pontificia Bolivariana, Research Group of Applied Systems in Industry.
e-mail: javier.fernandez@upb.edu.co, web: http:www.upb.edu.co
4: Universidad Pontificia Bolivariana, Technology Management and Innovation Research Group.
e-mail: diego.cuartas@upb.edu.co, web: http:www.upb.edu.co
5: Universidad Pontificia Bolivariana, Bioengineering Research Group.
e-mail: nelson.escobar@upb.edu.co, web: http:www.upb.edu.co

KEYWORDS: Hospital maintenance; health physical asset; facility management; performance indicators; performance management.

ABSTRACT

Healthcare physical asset maintenance is obliged by norm to exceed 5% of the budget of the Health Institutions in Colombia, whereas the expenses generated in Spain by this non-sanitary department of greater consumption can reach 17% in public hospitals. However, with the worldwide implementation of disciplines such as Asset & Facility Management in the hospital environment based on the life cycle of physical assets, they can cover higher percentages mentioned above by including other activities (cooking, cleaning, laundry, security …). Health Service Providers will have to optimize their physical asset management with the consequent creation of a time line for performance measurement in the management of their physical assets through organizational Key Performance Indicators or Performance Indicators of FM department. The authors of this work have been investigating the literature of the most referred authors in this subject worldwide to propose a selection of Performance Indicators and after having sought the validation of international experts in Facility Management. Subsequently the authors have socialized the Performance Indicators resulting from the validation in different health institutions with clinical engineering managers. As a result of this work, the authors present a list of Performance Indicators that may be the basis for implementing performance management through Facility Management to the clinical engineering department of a health institution to support the strategic vision of hospital physical assets.

CODE 345

HIM (HISTORIC INDOOR MICROCLIMATE) AND PRECAUTIONARY CONSERVATION

Fabbri, Kristian[1]; Pretelli, Marco[2]; Anna, Bonora[3]

1: Department of Architecture Università di Bologna
e-mail: kristian.fabbri@unibo.it, web: http://www.kristianfabbri.com
2: Department of Architecture Università di Bologna
e-mail: marco.pretelli@unibo.it
3: Department of Architecture Università di Bologna
e-mail: anna.bonora3@unibo.it

KEYWORDS: Historic indoor microclimate; heritage building; thermal comfort; HVAC; Heting Ventilation and Air-Conditioning; new approach.

ABSTRACT

Architecture of historic build heritage, the one preceding the introduction of modern technologies and materials, had the special characteristic of comprehending, as a whole concept, the formal aspects and the structural performances.
Among the performances that building needed to guarantee, microclimatic characteristics are often mentioned in historic essays on architecture. Often are described strategies, technologies as well as compositional solutions that would lead to obtain a specific microclimate inside the building, as well as to guarantee the ideal conservation condition for the built heritage itself.
The introduction of modern HVAC (Heating, Ventilation and Air Conditioning) systems after the Industrial Revolution had the effect of decoupling the formal, material and technological characteristics of buildings from their microclimatic performances. This has, in relatively short times, determined the loss of a millenary heritage of knowledge and technological know-how on the subject.
Historic built heritage has suffered, in many cases, the introduction of HVAC systems during the last 150 years. These changed completely the microclimatic characteristics of buildings, often deteriorating their conservation level.
Currently ongoing studies at the Department of Architecture of the University of Bologna are exploring this area of research. Among the goals, they try to reconstruct the different phases of the microclimatic history of a building, as well as to explore the relations between the microclimatic conditions and the conservation or decay of the same building. The final aim would be to find instruments to individuate the microclimatic conditions that would allow to precautionarily conserve each architecture.
This paper shows the specifics and the dynamics that link each architecture to its specific microclimate, with the support of specific study cases.

CODE 406

THE IMPORTANCE OF COMPLAINTS REGISTRATION, MAINTENANCE AND CURRENT REHABILITATION ACTIONS, AND THEIR COSTS IN CONDOMINIUM MANAGEMENT OF CURRENT COLLECTIVE HOUSING BUILDINGS

Neves, Vitorino[1]; Silva, José[2]*; Paiva, Anabela[3]

1: Departamento de Engenharia Civil
Universidade de Coimbra
e-mail: vitorinoneves83@gmail.com, web: http://www.uc.pt/fctuc/dec
2: Departamento de Engenharia Civil
Universidade de Coimbra
e-mail: raimundo@dec.uc.pt, web: http://www.uc.pt/fctuc/dec
3: Departamento de Engenharias
Universidade de Trás-os-Montes e Alto Douro
e-mail: apaiva@utad.pt, web: http://www.degois.pt/visualizador/curriculum.jsp?key=0780785541109953

KEYWORDS: Maintenance of buildings; maintenance management; preventive rehabilitation; reactive rehabilitation; maintenance costs.

ABSTRACT

The performance and durability of buildings are intimately related to their maintenance. However, maintenance is frequently casuistic and merely reactive, regardless of the latest scientific developments in this field. In order to improve the maintenance management process in current buildings, particularly in collective housing, it is of the utmost importance to be aware of the most frequent anomalies as well as their cost of repair, being necessary, in Portugal, to promote systematic records of these operations. It is also known the influence of management of condominiums and their annual budgets in the decision process on maintenance actions, both preventive and reactive.
In the present article, which reflects the work carried out within the framework of a master's thesis, it is presented and analyzed the data of the maintenance registration actions in a set of 100 collective housing buildings, less than 40 years old, in the centre of Portugal, resulting from the co-owners complaints. The work carried out also includes the general characterization of the buildings concerned, both in architectural and constructive terms, considered essential for the analysis of their behaviour. Particularly noteworthy in this work is the analysis of repair costs and the study of their relationship with the characteristics of buildings and the condominiums budget.
The results obtained demonstrate the relationship between the number of pathologies/anomalies observed in the various condominium complaints, the age of the buildings and the area of the facades, the relationship between total rehabilitation costs and total maintenance costs, in the last 6 years, in 71 sample condominiums and the total costs of repairing pathologies/anomalies in the constituent elements of buildings.

CODE 107

SMART HERITAGE CITY

Ruiz Entrecanales, Rosa[1]; Henon, Aurélien[2]; Mar, Adriana[3]; Monteiro, Fernando[3]; San José Alonso, Susana[4]; Gandini, Alessandra[5]; Zubiaga Mikel[5]; Pérez Campos, Rosa[6]; Abián Pérez, Miguel Ángel[6]; García García, José Carlos[7]; Basulto García-Risco, Daniel[7]

1. Ayuntamiento de Ávila, Unidad de Patrimonio de Ávila, España.
2. NOBATEK/INEF4, Francia.
3. CTS - UNINOVA, Dep. de Engenharia Electrotécnica, FCT NOVA, Portugal.
4. Centro Tecnológico CARTIF Departamento de Robótica y Visión Artificial, España.
5. Centro tecnológico TECNALIA, España.
6. Instituto Tecnológico AIDIMME, España.
7. Fundación Santa María la Real del Patrimonio Histórico, Dep. de Conservación del Patrimonio, España.

KEYWORDS: Smart city; monitoring; management 4.0; rehabilitation; heritage buildings.

ABSTRACT

Smart Heritage City (SHCity) is a European cooperation project whose main aim is to develop a technological answer destined to improve the management of the urban historical sites, making the maintenance and decision-making easier. SHCity will implement a 4.0 tool in urban historical sites and an application focused on tourism, which carries on with the task of monitoring SHBuildings Project. The technology is proven in Avila, Spain, a historical centre declared a World Heritage Site and whose example can be exported to other historical European centres.

SHCity is based on the installation of a network of sensors, distributed among different strategic points in the historical centre of Avila, which in real time measure different environmental or structural parameters, as well as other ones related to security, energy consumption or the flow of visitors. The information provided will be applied in two software tools. An Auto diagnosis web tool will be capable of answering automatically or supporting the decisions of the patrimonial consultants, and in this way acting in situations that can put at risk the integrity of the historical site. The second tool is a mobile application destined for tourism and all citizens, with a perspective of divulgation and preventative maintenance of patrimonial components.

The result of the project tries to find a way to make the process easier to make decisions about the preservation of the historical site, its maintenance and its tourist development, optimizing the work of the organizations in charge of its management.

This Project is being carried out by a multidisciplinary committee of qualified workers belonging to the "Fundación Santa María la Real del Patrimonio Histórico", "The Avila Town Hall", the Tecnological Institute AIDIMME, the Technological Centre CARTIF, Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa, NOBATEK, the Technological Centre TECNALIA.

CODE 108

STORM (SAFEGUARDING CULTURAL HERITAGE THROUGH TECHNICAL AND ORGANISATIONAL MANAGEMENT)

Resta, Vanni[1]; de Wit, Rosmarie[2]; Kogias, Dimitrios; Patrikakis, Charalampos[3]; Ravankhah, Mohammad[4]; Boi, Silvia[5]

e-mail: resta@kpeople.com, web: http:www.kpeople.com
2: Zentralanstalt für Meteorologie und Geodynamik,
e-mail: rosmarie.dewit@zamg.ac.at, web: www.zamg.ac.at
3: Piraeus University of Applied Sciences,
e-mail: dimikog@puas.gr, bpatr@puas.gr web: http://www.puas.gr/index.php/en/
4: University of Stuttgart, Institute of Spatial and Regional Planning,
e-mail: mohammad.ravankhah@ireus.uni-stuttgart.de web: http://www.uni-stuttgart.de/ireus/
5: Engineering Ingegneria Informatica S.p.A,
e-mail: silvia.boi@eng.it web: http://www.eng.it

KEYWORDS: Resilience; climate change; natural hazard; crowdsensing.

ABSTRACT

The protection and conservation of cultural heritage is a value for all the civilized Countries since centuries. The year 2018 will be dedicated to cultural heritage which is “the fabric of our lives and societies” as written in the European Commission dedicated website. Cultural identity preservation is a wealth creator also, bringing tourism-related business opportunities on which many communities depend. However, Europe’s heritage assets are extremely exposed to climate change and natural hazards. The goal of the STORM (Safeguarding Cultural Heritage through Technical and Organisational Management) project is to provide critical decision-making tools to multiple sectors and stakeholders engaged in the protection of cultural heritage from climate change and natural hazards on the local, regional and national levels. The concept is tested through pilot site studies at five different heritage locations, all with unique risk profiles: the Diocletian Baths in Rome, Italy; the Mellor Heritage site, Manchester, UK; the Roman Ruins of Tróia, Setúbal, Portugal; the the Forteza Fortes of Rethymno Crete, Greece and the amphitheatre of Ephesus, Izmir, Turkey. The evaluation of historical records, real-time on-site monitoring, regional climate projections, and statistically downscaled time series for individual cultural heritage sites at risk supports the risk assessment methods on which these tools are based. In addition, climate indices are evaluated to create a complete situational picture. Here, the STORM project will be presented, focusing on the implementation of Intergovernmental Panel on Climate Change climate projections as well as meteorological observations in the risk assessment procedure, hence playing a pivotal role in cultural heritage conservation.

CODE 152

CRISTO OBRERO CHURCH REINFORCED STEEL CORROSION PROBLEM

Pedrón , Miguel[1]; Morquio, Atilio[2]

1: Departamento de Estructuras, Instituto de Estructuras y Transporte "Prof. Julio Ricaldoni".
Facultad de Ingeniería - Universidad de la República Oriental del Uruguay
e-mail: amiguel@fing.edu.uy, web: https://www.fing.edu.uy/iet
2: Departamento de Estructuras, Instituto de Estructuras y Transporte "Prof. Julio Ricaldoni".
Facultad de Ingeniería - Universidad de la República Oriental del Uruguay
e-mail: atilio@fing.edu.uy, web: https://www.fing.edu.uy/iet

KEYWORDS: Corrosion; reinforced bars; electrochemical potential; historical monument.

ABSTRACT

The "Cristo Obrero" church, which is located at the Atlántida station on the Canelones department, is one of the most emblematic constructions of the Engineer Eladio Dieste. This construction conjugates the excellence of architecture and engineering with an elegant and majestic use of the reinforced ceramic, making use o bricks as a way of expression. This piece of art is nowadays recognized as a Historical National Monument.
Due to the relevance of this building, a management and conservation plan has been designed for the church, this plan is called "CREATION OF A CONSERVATION MANAGEMENT PLAN AND ADMINISTRATION SYSTEM FOR CRISTO OBRERO CHURCH, ATLÁNTIDA", sponsored by Getty Foundation through the program "Keeping it modern". We took participation on this project as members of the work group which is incharge of pathologies and damages diagnostic, studying the steel corrosion, motivated by the structural relevance that these have on the stability of the elements, and the determination of deteriorations located on the bricks joint. In this way, studies about the most relevant components of the building have been realized, those are: Main cover, perimetral walls, baptistery and bell tower. These studies were carried out to know the state of the reinforcing bars and the mortar in contact with these. The carried out studies basically consist of the exploration of the reinforcing bars, electrochemical tests and other physical chemical studies on mortars. As a result, there have been found various affected zones, and other ones with potential risk of corrosion development.
In this work, obtained results and analyses are presented, as well as the possible causes which started the problem of the corrosion in the reinforced bars and some possible solutions are proposed.

CODE 178

INNOVATION OF THE MANAGEMENT PROCESS FOR THE RECOVERY AND MAINTENANCE OF CULTURAL HERITAGE

Guida, Antonella[1]; Porcari, Vito Domenico[2]*

1: University of Basilicata, DiCEM-Matera, Italy
e-mail: antonella.guida@unibas.it
2: University of Basilicata, DiCEM-Matera, Italy
e-mail: vito.porcari@unibas.it

KEYWORDS: Prevention; maintenance; HBIM; cultural heritage.

ABSTRACT

Today's technical and technological solutions, developed in reference to the delicate issue of monumental prevention, must necessarily respond to a clear reflection that the refurbishment today indicates, that is a planned and controlled maintenance of the Cultural Heritage.
This activity is silent but at the same time is fundamental and necessary both to respect the value of testimony that this heritage possesses, as well as to the correct use of the monument also understood as complete cultural accessibility.
Considering the extensive Italian Architectural Heritage, this work is to be a valid and concrete response in the key of conservation, valorisation and monitoring for all national heritage, while also observing the absence of specific regulations and the patchy and anachronistic archiving of content and project documents, indispensable for the knowledge of the monument itself.
The approach of the research project just started, aims to use and integrate the BIM tool through the methodology known as Historical Building Information Modeling (HBIM) for the management and recovery of cultural heritage and the systematization of information stored in parametric objects and updated in real time through monitoring activities.
The collection and digitization of this information will constitute a database used to implement a technological platform consisting of a network of sensors, in situ and ex situ measurements, a data storage and data processing system useful for programming activities for Maintenance and management of interventions.

CODE 335

HBIM MODELING FOR THE CONSERVATION OF THE DIANA TEMPLE IN MÉRIDA (BADAJOZ)

Prieto Muriel, Paloma[1], Cortés Pérez, Juan Pedro[2]; Candelario Garrido, Alonso[3], Sánchez Fernández, Manuel[4]

1: Grupo de Investigación NEXUS
Universidad de Extremadura
e-mail: jpcortes@unex.es
2: Consultora
e-mail: palomaprimu@gmail.com
3: Ayesa S.A.
e-mail: alonsocandelariogarrido@gmail.com
4: Grupo de Investigación NEXUS
Universidad de Extremadura
e-mail: manuel.1633@gmail.com

KEYWORDS: Heritage conservation; HBIM; Templo de Diana; parameterization.

ABSTRACT

Building Information Modeling (BIM) methodology has been applied in the most developed countries in construction industry since some years ago. However, the main application of BIM is new building construction. In this technology, the virtual and parametric model of the building is performed from a previous design. BIM methodology has been implemented for the last years in historical heritage, called Heritage Building Information Modeling (HBIM). In HBIM, building parametric virtual model is created from existing reality.
The HBIM methodology allows the integration of the information originated from different sources in the same tool and database, making a more accurate analysis of the information possible and, therefore, a more reliable assessment.
The modeling and integration process of the Diana Temple information in Merida (Badajoz) by HBIM are being introduced in this communication. Diana Temple is a Roman building from the late first century B.C., which is part of the World Heritage Site since 1993. During the late fifteenth century, Corbos Palace was built inside the temple, which is part of the temple nowadays.
The modeling has been made from the scanned geometry by terrestrial laser scanner. The point cloud treatment has been carried out by Autodesk Recap tool and the BIM model by Autodesk Revit tool.
When the geometric model is finished, the historic information, real materials, visual survey and information of pathology are added to the model.

CODE 351

MEASUREMENT OF ATMOSPHERIC CORROSION AND SOILING EFFECTS ON CULTURAL HERITAGE MATERIALS IN THE CITY OF COIMBRA

Vidal, Fábio[1]; Vicente, Romeu[1]; Mendes Silva, J.[2]; Catarino, Lídia[3]; Bastos, A.C.[4]

1: University of Aveiro, RISCO, Department of Civil Engineering
e-mail: fabiovidal@ua.pt, romvic@ua.pt, web: http://www.ua.pt/decivil/
2: Faculdade de Ciências e Tecnologia, University of Coimbra, LAETA, Department of Civil Engineering
e-mail: raimundo@dec.uc.pt, web: http://www.uc.pt/fctuc/dec
3: Faculdade de Ciências e Tecnologia, University of Coimbra, CGeo, Department of Earth Sciences
e-mail: lidiagil@dct.uc.pt, web: http://www.uc.pt/fctuc/dct
4: University of Aveiro, CICECO, Department of Materials and Ceramics Engineering
e-mail: acbastos@ua.pt, web: https://www.ua.pt/demac/

KEYWORDS: Atmospheric pollution; cultural heritage; traditional materials; corrosion; soiling.

ABSTRACT

The preservation and safeguarding of cultural heritage is a topic of evolutional discussion since it deals with invaluable and irreplaceable assets that historically identify countries and communities. In recent years, the manner this conservation is thought has changed and the concern over the degradation of materials exposed to atmospheric pollution has increased, especially considering the vulnerability that is associated to traditional materials when exposed to atmospheric pollutants. Due to the exponential growth of the transport sector in urban areas, motorized traffic is an important source of pollutants such as SO_2, NO_x, O_3 and particulate matter that lead to different forms of degradation on materials. Among several types of degradation phenomenon, two of the most noticeable and studied effects are corrosion and soiling. The contribution of this work is to study the effect of atmospheric pollution and general weathering over specimens of different metals such as copper, zinc and cast iron following standardized methods, and also over limestone coverings of different superficial roughness when exposed to the environment. This paper presents preliminary corrosion and soiling results, corresponding to a 3-months exposure period, that are used to categorize specific sites in the urban area of Coimbra and the near-coastal city of Aveiro. When concluded, these field exposure tests will validate dose-response functions applied to the Historic Centre of Coimbra, including sites integrating UNESCO's World Heritage List, and used in the development of a building vulnerability index that can assist future decision-making processes regarding traffic mitigation and the preservation of cultural heritage. Corrosion of standard metals is measured in terms of mass and reflectance loss, while the preliminary soiling of stone samples is measured in terms of colour and lightness changes. Since limestone surface recession is a much slower process, it has not been measured in this paper.

CODE 352

ANALYSIS ON REPAIR OF SEOKGATAP STONE PAGODA AND 9.12 GYEONGJU EARTHQUAKE IN KOREA

Kim, Derk Moon[1]; Kim, Si Hyun[2]*; Lee, Ha Na[3]

1: National Research Institute of Cultural Heritage,
Safety and Disaster Prevention Division
e-mail: kimdmn@korea.kr
2: National Research Institute of Cultural Heritage,
Safety and Disaster Prevention Division
e-mail: shkim1242@korea.kr
3: National Research Institute of Cultural Heritage,
Safety and Disaster Prevention Division
e-mail: leehana0917@korea.kr

KEYWORDS: Earthquake; stone pagoda; seismic capability; dismantlement and assembly.

ABSTRACT

An earthquake of magnitude 5.8 occurred in Gyeongju on September 12, 2016, the largest in the history of seismic observations in Korea. The area was the capital of Silla dynasty for about a thousand years and many cultural heritages were damaged by the earthquake. However, there was no problem after the earthquake in the Three-story Stone Pagoda of Bulguksa Temple(so-called Seokgatap). The purpose of this study is to analyze the seismic behavior of 9.12 earthquake and the structural characteristics of Seokgatap in order to contribute for earthquake preparation of cultural heritages in Korea.
Gyeongju is an area with high seismic risk adjacent to the Yangsan fault, and there are many records of earthquake damage in history books such as ‘Samguksagi’ and ‘Goryeosa’. Seismic performance was evaluated by seismic vibration test. And it is compared with the earthquake records in history books. As a result, it is expected that it was stable in the past earthquake because test showed stable result in lateral dynamic load. As a result of analyzing the structure of Seokgatap and 9.12 earthquake, the structural characteristics of the stone pagoda were similar to the damper system which is the seismic structure used in modern architecture. This suggests that the stone pagoda had no damage during the earthquake. This study emphasizes the viewpoints of structure and building techniques from the viewpoint of style.

5.- DIFFUSION AND PROMOTION

CODE 185

THE MUSEUM BUILDING AS A PIECE OF ART. STRATEGIES FOR THE VALORISATION OF A HISTORIC BUILDING WITH MUSEUM USES

López Cenamor, Lucía

Politecnico di Milano
e-mail: lucia.lopez@polimi.it

KEYWORDS: Heritage; valorization; architecture; museum.

ABSTRACT

Numerous historical buildings that have lost their original function have been reused, transformed and adapted as museums. Old hospitals, convents, railway stations, palaces or factories are housing nowadays outstanding exhibitions under a new nomenclature. However, the historical and artistic value of these constructions has been relegated to the background by taking the building as a mere container of art. Through the presentation of several examples of museums implanted in historic buildings, it has been observed that this architecture does not receive the importance that it deserves, even going unnoticed by visitors. Taking the revaluation of architecture as the main goal, it has been pursued, on one hand, to appease the "container-content" duality and, on the other, to avoid forgetting the past history of the historical construction. Different strategies have been proposed in order to achieve these purposes, such as proposing itineraries that involve the historical architecture, to use lighting that enhances its artistic values and self-supporting assembly systems that respect the construction, to dedicate a permanent space to the history and transformation of the architecture or the virtualization of the building through 3D models, in such a way that the visitor can contemplate the entire construction and its spaces as well as understand the social and cultural importance of these buildings throughout its history. In this way, it is possible to involve the historical building in the exhibition as part of the museum collection; secondly, to recover the essential values of a construction that had lost its original function, and, finally, to reconcile the social memory with the current progress that supposes the new museum.

CODE 194

PRESERVATION OF THE HISTORICAL QUARRIES ASSOCIATED WITH THE MONUMENTAL ARCHITECTURAL HERITAGE: THE INCHAPA PROJECT

Baltuille Martín, José Manuel[1,2]; Álvarez Areces, Enrique[1,2]; Fernández Suárez, Jorge[1]; Martínez-Martínez, Javier[1]; Galván Blanco, José Antonio[3]; Molina Dorado, Arturo[3]

1: Unit of Natural Stone and Monumental Heritage. Geological Survey of Spain.
e-mail: j.fernandez@igme.es, e.alvarez@igme.es; jm.baltuille@igme.es; javier.martinez@igme.es
web: http://www.igme.com
2: CONSTRUROCK Network of Natural Stone and Architectural Heritage
web: http://www.igme.es/construrock/default.htm
3: Government of Extremadura
Presidency
e-mail: joseantonio.galvan@juntaex.es; arturo.molina@juntaex.es
web: http://www.juntaex.es/portavocia/director-general-de-bibliotecas-museos-y-patrimonio-cultural

KEYWORDS: Extremadura; architectural heritage; historic quarries; protection figure; natural stone.

ABSTRACT

The National Inventory of Historic Quarries associated with the Architectural Heritage (INCHaPA according to its acronym in Spanish) is a global research project focused on the location and characterization of the historic quarries related to the architectural and monumental heritage of Spain. This project is developed by the Geological Survey of Spain (Instituto Geológico y Minero de España, IGME). Results presented in this paper show the complete research methodology designed for the location and study of the historic quarries and applied in the INCHaPA project.
During the development of the first part of this national inventory, several risks were detected that affect a significant number of historical quarries. Some of these risks are related to their anthropization or the threat to be buried by future urban expansion areas. Due to these problems, it is also proposed the creation of a specific protection figure for the historic quarries in order to facilitate their correct preservation.
Maintenance of historic quarries and historic extractive areas are very important because of the fact that: they allow obtaining original building materials for replacement works; they constitute archaeological sites; we can quantify the total extracted volume as well as their real economic potential; and, finally, historic quarries constitute valuable elements for the touristic and socio-economic development of the geographic area where they are located.

CODE 434

GUESTHOUSES AND POSADAS IN THE SOUTHEAST PENINSULAR. TOOLS FOR THEIR INVENTORY

Baños Oliver, Rosario[1]*; Segado Vázquez, Francisco Enrique[2]

1: Universidad Politécnica de Cartagena, Doctorate in Tecnología y Modernización en Ingeniería Civil, Minera y Ambiental.
e-mail: rosarioba@coamu.es
2: Universidad Politécnica de Cartagena, Escuela Técnica Superior de Arquitectura y Edificación
e-mail: francisco.segado@upct.es

KEYWORDS: Heritage, roads; guesthouses; inns; cartography.

ABSTRACT

For centuries, the existence of guesthouses and inns that marked the precarious and terrible roads of Spain made possible the development of travel routes. Without a place to stop on the way in order to rest, feed and change beasts, it would not have been possible to travel through the difficult roads in Spain. Its importance is reflected on the specific legislation on guesthouses and inns that existed since the time of the Reyes Católicos as well as on their inclusion in historical cartography or in the geographical dictionaries. They came to be distinguished as an architectural typology of their own, to the point of being the subject of a project and a proposal for examination to access the degrees of architect or master builder in the different Academies of Fine Arts that emerged in Spain for the regulation of the architecture exercise.
At present, these pieces are in disuse and many of them have disappeared or are in danger of disappearing without having documented their morphological, compositional, constructive aspects as well as their relations with the society of the moment. Nevertheless, the study of the 19th Century cartography, together with other tools, has allowed to proceed to its location in order to contribute to the knowledge and value of these auxiliary constructions to the roads, which are part of civil engineering heritage and, therefore, of the Cultural Heritage, of the old cultural inheritance of a society that must be transmitted to present and future generations.

CODE 436

THE CAMINITO DEL REY AND THE LANDSCAPE ARCHITECTURE

Machuca Casares, Luis[1]*; Alonso Núñez, Ángeles[2]

1: Universidad de Málaga, Escuela Técnica Superior de Arquitectura.
e-mail: machuca@uma.es,
web: www.arquitectura.uma.es
2: Universidad de Málaga, Escuela Superior de Ingenierías Industriales
e-mail: angelesalonsonunez@gmail.com,
web: www.uma.es/escuela-de-ingenierias-industriales

KEYWORDS: Landscape; environment; heritage; rural tourism; economy.

ABSTRACT

The origin of the Caminito del Rey dates from the early s. XX. At the beginning it was used by the workers of the "Conde del Guadalhorce" dam, as a service road for the maintenance of the channel and by the families who lived in the surrounding of the path, especially in the village El Chorro in Alora town, to avoid the long journey of going around the mountains to get to the town. Thus, children could go to school and families could buy the essential products, as well as being exposed with other people who lived in the nearby mountains (cave houses).
Over time, it became known worldwide as the most dangerous road in the world, caused by the use it was then subjected (exclusive for hikers and high-level climbers), as well as by an evident absence of maintenance. In 2015 after its closure due to its poor conservation status, it was undertaken the difficult, special and peculiar recovery intervention of the Caminito del Rey. Through the exhaustive analysis of the Recovery Intervention carried out, that has promoted and enhanced on one hand, its character as a tourist attraction, a functional aspect that it lacked in its origin; as well as, on the other hand, placing value and protecting, the industrial heritage that means the Caminito del Rey.
By studying the recovery carried out some guidelines are proposed to establish a line of action, of architecture, in the landscape, and to analyze similar actions that may suffer the same functional evolution, not only with respect to typological - constructive aspects, but also, through statistical data, that allow demonstrating the tourist-economic-social impact that an intervention of this type in the landscape entails in its environment.

CODE 449

ENDAGERED MEXICAN HERITAGE: FROM MEDIA TOURISM TO CULTURAL TOURISM

Álvarez, María del Pilar[1]; Nava, José María Wildford[2]

1: Universidad Iberoamericana Ciudad de México,
Departamento de Arquitectura, Urbanismo e Ingeniería Civil.
e-mail: maria.alvarez@ibero.mx,
2: Universidad Iberoamericana Ciudad de México,
Departamento de Arquitectura, Urbanismo e Ingeniería Civil.
e-mail: josem.nava@ibero.mx,

KEYWORDS: Media tourism; responsible cultural tourism; heritage degradation; local identity.

ABSTRACT

This work is derived from a growing concern by the authors, that have detected how, in recent years, the heritage sites of our country have been deteriorating, because among other things, the increasing number of tourists attracted not just by the cultural qualities of these sites, but because of the propaganda bombardment through the mass media. The work seeks to establish the bases to start a depth research process, about the phenomenon that we have called “Media Tourism”, its consequences and the possibility to redirect it.
“The main objectives are: To differentiate “Media Tourism”, from the “responsible cultural tourism”. Identify sites that have suffered significant levels of heritage degradation due to the massive influx of tourism. Establish a position from the academic and formative perspective, to derive in strategies of awareness toward responsible cultural tourism and local identity as a response to the mercantilist economy.
The methodology used in this work, integrates an analytical process on specialized literature in the field of tourism and its evolution, as well as the teaching experience of the authors, directly carried out with students Architectural design workshop of the Universidad Iberoamericana at Mexico City, which ponders the comprehensive analysis of a heritage site, defining strategies of intervention at an urban and architectural scale, and at the same time, enables to bring new generations to define a critical stance of valuation to the cultural heritage of our country.

CODE 476

HMTT: THE HERITAGE MANAGER OF TOURIST TERRITORIES OF SOUTH SPAIN AS A MANAGEMENT TOOL FOR THE INTEGRAL CYCLE OF HERITAGE 3.0

López-Arquillo, Juan D.[1]; Sebastián Pardo, Eduardo[1,2]; Arizzi, Anna[1,2]; Navarro Torres, Eugenio[1]; Parrilla Fernández, Raul[1]; Porta Igual, Jorge[1]; Roldán Martín, Julio[1]; Sebastián Jiménez, Cristina[1]

1: Tesela Consulting and Innovation in Sustainable Materials, Spin-Off of the University of Granada; e-mails: jdla@teselainnova.com; rolando@ugr.es; annaarizzi@teselainnova.com, eugenionavarro@teselainnova.com, raul@teselainnova.com, info@teselainnova.com, julioroldan@teselainnova.com, cristinasebastianjimenez@gmail.com
web: http://www.teselainnova.com
2: Department of Mineralogy and Petrology of the University of Granada; e-mails: rolando@ugr.es, web: http://www.ugr.es/~minpet/

KEYWORDS: Territory; heritage; cycle; parametrization; big data.

ABSTRACT

It is obvious to affirm that internet has changed the way in which the majority of human beings relate to each other, and the relationship of the human being with the entities external to himself, from the city to nature. The use of tourist resources for travel planning and personal travel management make up the most important touristic world portals: in 2016 tripadvisor received more than 150,000,000 reviews, photographs and comments, it has 3,700,000 indexed tourist resources and was consulted for something more than 50,600,000 million people every month. The cultural tourism merges as a common denominator the cultural interest of a territory or tourist node (which is a potential valued for economic effects of impact) with the concept of cultural heritage, which is subjective and dynamic; It does not depend on the objects or goods but on the values perceived by society and tourism in general, a value that determines which goods are those that must be protected and preserved for posterity. To this purpose, the integral development of a heritage manager of tourist territories in south Spain is planned, an active database of data, rather than a traditional static database, a multiple entry database and an unfolded interface containing the documentation of heritage substitution qualified for cultural and heritage goods to guarantee, improve and implement protection through the classification of goods, conservation through the parametrized documentation of goods, for incorporation into Big Data bases, the enhancement through diffusion by reading at various levels including georeferencing and recovery and rehabilitation through analysis and proposals for them.

CODE 241

FINAL WORK OF GRADUATION AND COOPERATION TO THE DEVELOPMENT: INTERVENTIONS IN LA MEDINA OF TETUÁN

Bosch, Montserrat[1]*; Rosell, Joan Ramon[1]; Navarro, Antonia[1]; González, Belén[1]; Líndez, Bernardino [2]

1: Universitat Politècnica de Catalunya.
e-mail: montserrat.bosch@upc.edu, web: http:www.epseb.upc.edu
e-mail: joan.ramon.rosell@upc.edu
e-mail: antonia.navarro@upc.edu
e-mail: belen.gonzalez.sanchez@estudiant.upc.edu
2: Universidad de Granada
e-mail: blindez@ugr.es

KEYWORDS: Autonomous apprenticeship; cooperation to the development; diagnosis; Medina Tetuán.

ABSTRACT

The Medina of Tetuán features one of the most interesting architectural and urban heritage in all North Africa. In 1997 it was enlisted in UNESCO World Heritage List and constitutes the structural axe of the social life of the town. With an area of 53,60 Ha and more than 50'000 habitants, until recently there were not initiatives of rehabilitation of the heritage, with the consequent issues of lacking of equipments, basic infrastructures and inner mobility, as well as a high rate of unemployment and of risk of exclusion for social groups. Although it is certain that in the last years several strategic plans were implemented, the Medina is still an architectural compound and an urban space with many necessities.
The Project that we are proposing aimed mainly to realize diagnostic investigations and proposals of rehabilitation in the Medina of Tetuán and it focused on the collaboration and the transfer of the knowledge. The work was also planned as an opportunity to strengthen the links among Universities and as a strategy for students' education and training.
In that sense several students from the Graduation Course in Technical Architecture have attended this project, resulting in a Final Graduation Work on the Casa Sellam El-Haj, an Eighteenth – century old aristocratic housing, which allowed to identify the building systems proper of the Medina, to realize diagnostic investigations, to characterize different materials and to propose possible solutions for the rehabilitation and restoration of exceptional elements such as the zellige.
The results of the whole process were satisfying, the general and specific objectives of the activity were assumed and different disseminating activities have been realized, such as the presentation at this Congress, that allow to extend the educational methodology which represents at the same time a project of cooperation to the development.

CODE 370

CHILDREN HERITAGE EDUCATION ACTIVITIES ROLE IN RAISING THE PUBLIC AWARENESS IN DEVELOPING COUNTRIES

Mohamed, Dalia[1]

1: Misr University for Science and Technology, Architectural Department
e-mail: daliahossam89@gmail.com

KEYWORDS: Heritage education; cultural awarness; heritage club; children heritage school; heritage conservation.

ABSTRACT

The lack of awareness of the value of heritage and the lack of opportunities to engage in preserving and safeguarding heritage in the developing countries not only puts the heritage in risk of being irremediably lost. It also impoverishes the younger generation's sense of identity and belonging within its respective socio-cultural continuum, and thus limits its ability to engage and contribute meaningfully to society at large. Education plays a critical role in this regard. Educational programmes which integrate heritage and local knowledge yielded multiple benefits in the area of self-development, improved social skills and improved economic prospects. In addition, such programmes also lead to improved learning outcomes by keeping learners more engaged. This paper emphasis the important role that children heritage education plays in raising the public awareness in developing countries and by using the analytical methodology it was able to reach the aim of the research to clarify the correct methods of children heritage education and activities carried out in that field to raise the awareness of young people and engage them in the conservation process. With a long-term view to strengthening the protection of heritage in all its forms, facilitating access to and enjoyment of heritage among the younger generation as related to development of their self-identities, as well as to transfer this awareness to their families this will affect the general culture awareness for the whole society even for who didn't want to participate.

CODE 200

METHODOLOGICAL PROPOSALS FOR ACCESSIBILITY AND DIFFUSION TO THE HISTORIC HERITAGE BY MEANS OF VIRTUAL REALITY TECHNIQUES

Atkinson, Alan D.J.[1]; Sanjosé Blasco, José Juan de[2]; Sánchez Fernández, Manuel[3]

1: NEXUS Research Group, Graphic Expression Department
University of Extremadura
e-mail: atkinson@unex.es
2: e-mail: jjblasco@unex.es
3: e-mail: msf@unex.es

KEYWORDS: Historic heritage; Virtual reality; VR; Accessibility; Tourism.

ABSTRACT

The new technologies allows accessing to the historical heritage and cultural heritage elements as this never was imagined before, only some years ago. In this paper, we present the methodological proposal for the integration of historical, architectonical and scientific information about existing historic heritage elements by means of low cost VR techniques. By means of this methodology, audiovisual information is integrated in 360º spherical sceneries that allow the user immersion in an environment that due to specific circumstances is not accessible for him or her. This kind of environment let the user acquire knowledge in advance, before the visit to the architectural element.
As in every process of heritage documentation, the reliability, access and knowledge of the documentary sources are the main point to design the contents visualization process. The following outstanding aspect is the knowledge of the possible users profile for the project, both heritage level and technological level. Finally, it is remarkable the technical staff formation for the project.

CODE 356

BIM APPLICATION IN INFRASTRUCTURE PROJECT IN THE REUSE OF HISTORICAL CITIES

Ronca, Paola[1]; Crespi, Pietro[2]; Zichi, Alessandro[3]; Mayol, Andrea[4]

1-2-3: Politecnico di Milano, Department of Architecture, Built environment and Construction engineering
e-mail: paola.ronca@polimi.it, pietro.crespi@polimi.it, alessandro.zichi@polimi.it
4: Salini-Impregilo SPA, Copenaghen Metro Team site, Construction department
e-mail: a.mayol@cmt-cityringen.dk andrea.mayol@gmail.com

KEYWORDS: BIM; smart cities; old town; historical buildings.

ABSTRACT

The evolution of the Smart cities in the old town is one of the most important aspects developed by the European Municipalities. To develop a smart city in an old town, the municipality must design new infrastructures for transports, subway lines, underground parking areas and, furthermore, design new technological systems for lighting, heating-cooling and other services. The possible interferences between the historical buildings and existing infrastructures during design, construction and for the facility management are well known. In this way, the BIM Modelling of the existing and old town help designers and owners to envelope new projects to re-green the cities or to transform them. The example shown in this article is about the new metro line and stations of Copenhagen. In this work, a process to envelope the BEP for the survey and the base model to develop the construction and evaluate the interferences with the existing buildings is suggested.
A complete BEP may help to envelope an integrate model to represent:

- 3D for the modeling and analysis of the city, MEP, Structural and architectural modeling for the new metro station.
- 4D for the association of all the model elements to a specific temporal phase during construction, for the coordination of the several subcontractor companies regarding excavation works, tunneling, casting, reinforcement and electromechanical works, for both stations and tunnels.
- 5D for the computing and estimation for all the works.
- 6D regarding the sustainability.
- 7D regarding the underground facility and monitoring management.

CODE 362

A USER-CENTERED IMMERSIVE EXPERIENCE FOR HERITAGE EXPLORATION

Pisanu, Maddalena[1]*; Sanjust, Paolo[2]

1: University of Cagliari, DICAAR ((Department of Architecture, Environmental and Civil Engineering)
e-mail: pisanumaddalena@gmail.com
2: University of Cagliari, DICAAR ((Department of Architecture, Environmental and Civil Engineering)
e-mail: psanjust@unica.it, web: http://people.unica.it/paolosanjust/

KEYWORDS: Heritage promotion; digital heritage; new technologies; user experience-design; mobile apps.

ABSTRACT

In recent years, digital heritage has started to change the process of reconstructing and understanding the past. This new field combines the traditional areas of expertise of heritage management, archaeology, history, museology with the great new digital information technology tools and has a big potential to face the new challenges of the heritage sector.
Digitally enriched museum exhibitions, virtual visits through historic buildings, and mobile apps to enjoy arts and culture have provided a new perspective to heritage exploration. Even if visiting physical monuments and institutions stays the most common way to engage with the historical and cultural inheritance, ICT tools have brought a new dimension into experiencing heritage. Mobile technologies such as smart phones and tablet computers have been used increasingly frequently by heritage organizations to improve information communication and engage visitors with exhibits or installations. Furthermore, the role of visitors in museums, exhibitions and heritage sites in general, is shifting from that of a simple audience to that of active participants, thanks to the introduction of the new technologies.
The paper will present a case study of a mobile application that guides users along a tour of the architectural heritage of Cagliari University. The concept of visitor is substituted by that of user with the aim of creating a human-centered cultural experience. The technology is purposefully conceived to be as discreet as possible in order to bring places and stories from the past into the present giving engaging and meaningful experience. The aim is to create a technology that could support heritage exploration instead of competing with it for visitors' attention.

CODE 35

CONSERVATION OF THE HISTORICAL CENTER OF GUANAJUATO: LIMITATIONS AND MODIFICATIONS

Colmenero Fonseca, Fabiola[1]; Pérez Ponce, Alfredo[2]; Cruz Ramírez, Cristian Alan[3]

1: Departamento de Arquitectura. C.A. Cultura y Arte
Departamento de Arquitectura
e-mail: f.colmenero@ugto.mx
e-mail: fa.colmenerof@gmail.com
2: Departamento de Arquitectura. C.A. Cultura y Arte
Departamento de Arquitectura
e-mail: alfredo.perez@ugto.mx
3: Egresado de la Licenciatura en Arquitectura
(Proyecto de Titulación para obtención de Grado)
Departamento de Arquitectura
e-mail: alancr369@gmail.com

KEYWORDS: Conservation; accessibility; cultural property.

ABSTRACT

The objective of this research is to study the landscape of the city of Guanajuato and its conservation of the historic center, through its conformation, evolution and the transformations it has undergone in urban mobility issues.
This study starts from the historical-evolutionary analysis, later it is taken to an analysis of urban landscape, its social, economic and sustainable dynamics. Without leaving behind the studies, constructive and urban-landscape elements.
The study is to show that there is an undeniable heritage, and that there is currently a relationship between the individual and the functional limitations of the environment in urban mobility issues. The focus of this research was aimed at strengthening and generating sustainable projects without altering the integrity of the heritage asset and without using means that condition the conservation of the environment. Accessibility should be considered in the urban planning of every heritage city, restoration and conservation of public space, without altering its architecture and the natural environment. The elements that were used were: architectural surveys, photographic records, accessibility projects in Latin America and universal design manuals, in order to create a bank of projects. Allowing us to conclude that we all have the right to access any public space, under no visual limitations and / or physical barriers. Guanajuato is characterized for being a changing city, for being dynamic, when interacting between its streets and alleys. That is why any failed intervention in this city is because the passerby is not considered the main protagonist. It is concluded that the city of Guanajuato is not very accessible in terms of urban and pedestrian mobility, which is why it is necessary to review the regulations, as well as the generation of inclusive proposals as a World Heritage City.

CODE 142

FRUITION AND REUSE FOR THE REHABILITATION OF DISMISSED HISTORICAL AREAS: A FUTURE FOR THE ABANDONED MONASTERIES IN SALERNO

Ribera, Federica[1]*; Manfrotto, María Belén[2]; De Guglielmo, Fabio[3]

1: University of Salerno, Department of Civil Engineering
e-mail: fribera@unisa.it, web: http://docenti.unisa.it/federica.ribera
2: University of Salerno, Department of Civil Engineering
e-mail: manfrottobelen@hotmail.com
3: University of Salerno, Department of Civil Engineering
e-mail: fdeguglielmo@unisa.it, web: https://www.researchgate.net/profile/Fabio_De_Guglielmo

KEYWORDS: Accessibility; rehabilitation; historical centers; dismissed monasteries.

ABSTRACT

The cause of the abandonment and decay of some historical urban contexts often has to be searched in the particular orography and low accessibility of sites that therefore go to be isolated and excluded from the active life of contemporary cities. A study conducted on the historical aspects and accessibility of the Northeastern ancient heart of Salerno, in Southern Italy, was aimed to propose a correct rehabilitation of the site in the respect of the preservation of its authenticities. The area is characterized by the presence of a number of monasteries, which were founded in the Middle Ages and transformed during the centuries; they changed their functions several times, but they are currently abandoned because of their limited connection with the rest of the city. The advanced state of physical and social decay of the whole site currently necessitates a prompt enhancement of which a new proposal is here presented: an integrated restoration of the monasteries should highlight their historical and artistic values and at the same time identify a new function for them compatibly with their peculiar characteristics; the elimination of the architectural barriers is an important goal to achieve for the usability of the outdoor and indoor spaces; the connection among the buildings and between the site and the rest of the old town has to be guaranteed.

CODE 313

URBAN ACCESSIBILITY ANALYSIS AND HERITAGE PROTECTION PLAN. CASE STUDY PROPELLED CABLE STATION MANIZALES, COLOMBIA

Montoya, Jorge[1]; Escobar, Diego[2]; Sarmiento, Juan[3]

1: Facultad de Ingeniería y Arquitectura. Departamento de Ingeniería Civil
Universidad Nacional de Colombia
e-mail: joamontoyago@unal.edu.co
2: PhD. en Gestión del territorio e infraestructuras del transporte. Profesor Asociado del Departamento de Ingeniería Civil, Universidad Nacional de Colombia
e-mail: daescobarga@unal.edu.co
3: Facultad de Ingeniería y Arquitectura. Escuela de Arquitectura
Universidad Nacional de Colombia
e-mail: jmsarmienton@unal.edu.co

KEYWORDS: Accessibility; coverage; mobility; transportation.

ABSTRACT

In the present investigation an analysis of urban territorial accessibility of the Cable Station in the city of Manizales, Colombia is carried out. The cable station, currently defined as a patrimonially protected building, which functions as the headquarters of the students of Architecture of the National University of Colombia, is also located in a sector of the city where the activity trade, cultural, economic and social is quite strong, generating pressure on the processes of heritage protection that must be carried out for this construction. The accessibility analysis is based on the application of geostatistical techniques that allow identifying which sectors of the city of Manizales are better connected with the sector in question, which allows to clearly define the necessary infrastructural interventions, or those operative interventions in relation to the different modes of transport. The analyzes allow to know, for example, how the coverage of the population is presented according to its socioeconomic stratum from the patrimonial construction, which will allow to identify the mode (s) of transport that possibly should be object of improvement or impulse to mitigue or diminish to the maximum the effects that these appear in the building or in the sectors surrounding it.

CODE 450

CITADEL OF THE UNIVERSITY OF ANTIOQUIA, CULTURAL AND ARCHITECTURAL HERITAGE OF COLOMBIA

Cardona-Chaves, Myriam[1]*; Pérez-Salazar, Jhony[1]; Flórez, Juan Fernando[1]

1: Facultad de Arquitectura e Ingeniería. Institución Universitaria Colegio Mayor de Antioquia
myriam.cardona@colmayor.edu.co, jhony.perez@colmayor.ed.co, juan.florez@colmayor.edu.co
web: http://www.colmayor.edu.co

KEYWORDS: Heritage; restoration; declaration; protection; memory.

ABSTRACT

Three decades ago the city of Medellín Colombia began the identification and recovery of its architectural heritage. The Faculty of Architecture and Engineering of the Institución Universitaria Colegio Mayor de Antioquia is a pioneer in the analysis of the state of the heritage, developing academic proposals that integrates the common knowledge of students and teachers, seeking a higher level of respect and public awareness about the value of history and culture of the city. Heritage interventions require updated inventories and databases in relation to buildings with patrimonial declarations at municipal, regional, national or global level. Those updated databases gather information such as: location, existence or not of blueprints, interventions made, construction data, owners and charts on the current conditions of the buildings.

In resolution 1115 of May 6, 2011 the Universidad de Antioquia Campus was declared as a group of buildings with cultural interest at national level. This declaration arises the interest and the need to carry out descriptive research that allows documenting the most relevant characteristics of the buildings that compose the university campus by means of datasheets. In addition to the analysis of the buildings, was developed the classification of forty-three (43) art pieces scattered throughout the campus and denominated Open Museum. In order to undertake this project, we took into account, bibliographic search from various sources, technical visits, guided tours and photographic record throughout the campus.

The results of this research are fundamental to encourage interest in the preservation of the architectural heritage in Medellín and to implement educational information campaigns that aim to recognize it, such as guided tours for the community and links in different institutional platforms.

CODE 470

UNIVERSAL ACCESSIBILITY IN HERITAGE AREAS: CASE STUDY SUBCONJUNTO HISTÓRICO "SAN JUAN DEL VALLE", ECUADOR

Soto Toledo, Katherine Haydee[1]*; González Tandazo, Fanny del Cisne[2]

1: Universidad Técnica Particular de Loja , Departamento de Arquitectura y Arte.
e-mail: khsotox@utpl.edu.ec, web: http://www.utpl.edu.ec
2: Universidad Técnica Particular de Loja, Titulación de Arquitectura
e-mail: fdcisne4@gmail.com

KEYWORDS: Regulations; universal accessibility; heritage.

ABSTRACT

The rules of universal accessibility, intends in the first instance to break the paradigm of selective application in favor of a small group, the application of this regulation implies the creation of spaces where we can all move safely without stratification of physical states. Intervening in heritage sites seeking to implement universal accessibility regulations is emerging; the premise is not to deteriorate or affect the historical, but to readjust in order to ensure optimal coexistence of society.
In the present investigation, the methodology focuses on analyzing European regulations taking Barcelona as a case study; and in Latin America, Colombia, Chile, Ecuador and Bolivia are analyzed. In Ecuador, the analysis is comparative with the historic centers declared Cultural Heritage such as Quito and Cuenca; subsequently, information is collected to strengthen the cultural identity of the square and the surrounding streets of the historic sub-set "San Juan del Valle" for its application. The urban parish "San Juan del Valle" has patrimonial characteristics and is classified as a historical subset by the local municipality; in the collective memory it keeps the historical aspect, but with the passing of the years it is evidencing greater commercial connotation lacking basic accessibility guidelines; in the Av. Salvador Bustamante Celi main artery that connects this sector with tourist and cultural facilities is where this activity is most evident. The proposal therefore proposes not to weaken this connotation or affect the commercial activity, but rather to improve it including the application of the accessibility rules to the physical environment, likewise encouraging the pedestrian and bicycle flow, so that the citizens can exercise recreational activities, and tourism, at the same time focusing on cohabitating the sector feel included and benefited in the intervention.

CODE 75

APPLICATION OF THE DESIGN THINKING METHOD DETERMINING THE NEEDS OF THE USERS OF THE INTEGRATED HERITAGE BUILDINGS RENOVATION ASSESSMENT PLATFORM

Grazuleviciute-Vileniske, Indre[1]; Seduikyte, Lina[2]

1: Faculty of Civil Engineering and Architecture
Kaunas University of Technology
e-mail: indre.grazuleviciute@ktu.lt, web: http://2017.ktu.edu/lt/statybos-ir-architekturos-fakultetas/
2: Faculty of Civil Engineering and Architecture
Kaunas University of Technology
e-mail: lina.seduikyte@ktu.lt, web: http://2017.ktu.edu/lt/statybos-ir-architekturos-fakultetas/

KEYWORDS: Heritage building; renovation; assessment; Design Thinking method.

ABSTRACT

Building renovation and the improvement of their energy efficiency are currently relevant both in the European Union member states and elsewhere. It is argued that building renovation should not be limited to the renovation of structure and building insulation, but should take into consideration the surrounding environment, aesthetic, social, economic context etc. This is of crucial importance in the case of renovation of heritage buildings. The renovation, adaptation to the present day needs and improvement of energy efficiency of heritage buildings in some extent is a part of the general process of building renovation, but together it encompasses other social, cultural, heritage preservation, economic, and life-cycle aspects non-related to conventional building renovation. This encourages to change the existing practice of assessment of renovation of heritage buildings, where buildings are evaluated separately using energy and heritage related criteria, and to develop the sustainable heritage buildings renovation assessment system integrating heritage preservation, energy, environmental, and social-economic criteria. Such system must be user friendly and accessible to the professionals of different fields including heritage preservation, architecture, civil engineering etc. and should allow to evaluate as much as possible comprehensively the change of heritage building and its impact on environment and society. This makes the development of such system or tool a very complex task. Thinking of the approach that would enable comprehending the needs of the potentialy different users of the system and to find working and innovative ways of integrating heritage preservation, energy, environmental, and social-economic dimensions, we have selected the Design Thinking approach as human-centered strategy for innovation. In this research we elaborate and specify the five standard stages (Empathise, Define, Ideate, Prototype, and Test) in the Design Thinking process to fit our specific task regarding assessment of heritage buildings renovation.

CODE 138

GRANADILLA: RESEARCHES AND ANALYSIS OF THE CURRENT SITUATION AND APPROACHES OF APPLICATION FOR ITS MANAGEMENT

Agudo Martínez, Andrés[1]; Fernández Castelló, Francisco[2]; Vázquez Sánchez, Gloria[3] Álvarez Álvarez, Marina[4]

1: Grupo de Investigación TEP-951: Aprovechamiento de residuos industriales, de construcción y/o demolición para la fabricación de hormigón estructural y no estructural (ARHENE)
Universidad de Cádiz
e-mail: andresam@us.es
2: Ciclos Formativos y Bachillerato
IES Santa Eulalia, Mérida (Badajoz)
e-mail: fernandezcastello@hotmail.com
3: Universidad de Sevilla
glovazsan@alum.us.es
4: Universidad de Extremadura
maalal@hotmail.com

KEYWORDS: Management; heritage; consortium.

ABSTRACT

Granadilla, old walled village of feudal origin placed in the northwest of the province of Cáceres, was put out in the middle of the 20th century, due to the construction of the water reservoir of Gabriel y Galán. In 1980 the village was declared historical and artistic ensemble and in 1984, was included in the Program of Recovery of Left Villages.
The Program was signed by the Departments of Public Works and Urbanism, Agriculture, Fishing and Food, and Education and Science, previous transfer of the Hydrographic Federation of the Tajo.
The Program includes an Experimental Plan of Reconstruction and Restoration of Granadilla that foresees the raising of walls, the selection of the recovered material during the cleaning, the cleanliness of streets and places and the construction and creation of gardens.
In the current situation, with the intention and the intent of developing the diffusion, the promotion, the recovery and the reconstruction, promoting the welfare, cultural or social aims of this singular enclosure, we propose the creation of a Consortium (similar to the Monumental City of Mérida), provided with a stable budget, with management autonomy, where all the implied administrations are represented, which allows a medium term - length term programming, supported on a Master Plan of the Historical Artistic Set.

CODE 166

OPENED BY WORKS IN THE RESTORATION OF THE RENAISSANCE FACADE OF THE UNIVERSITY OF ALCALÁ. MANAGEMENT AS AN OPPORTUNITY

da Casa, Fernando[1] (*); Vega, Juan Manuel[1]; Echeverría, Ernesto[1]; Celis, Flavio[1]

1: Department of Architecture
University of Alcalá
e-mail: fernando.casa@uah.es, web: http://www.uah.es

KEYWORDS: Restoration; open for works; integral management of the heritage.

ABSTRACT

From August 2016 to April 2017, the restoration of the Renaissance façade of the University of Alcalá has been carried out. The facade is a national monument since 1914. The intervention posed a great social impact, generating a problem derived from the concealment of the facade, with the potential loss of tourist attraction, more at the time of the fourth centenary of the death of Cervantes.
This problem is considered as an opportunity, as part of the management of the Heritage, beyond the technical intervention itself. With the approach of a conception from the own project phase, of the action within the known as "open for works".
The objective is to achieve: retrieve the visualization of the Monument trace; an approach of the Monument to the citizens, that allows to see it and to know it from a closer point of view "like the own craftsmen who built it"; and expand the knowledge of the Monument, with the opportunity that represents for the investigation, putting in value, diffusion. The communication presents the method used for the application of the integration process of all the factors in the Integral Management of an Intervention in the Architectural Heritage, beyond the constructive project measures.

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