Organizers:

VIII EDITION

2020

Virtual Conference

September 28-30, 2020

REHABEND

EURO-AMERICAN CONGRESS

GENERAL PROGRAMME

Sponsor entities:

GENERAL PROGRAMME

REHABEND 2020

CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

(8th REHABEND Congress)

Granada (Spain), September 28th-30th, 2020

VIRTUAL CONFERENCE

PERMANENT SECRETARIAT:

UNIVERSITY OF CANTABRIA
Civil Engineering School
Department of Structural and Mechanical Engineering
Building Technology R&D Group (GTED-UC)
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8TH CONGRESS ON CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT

REHABEND 2020

ORGANIZED BY:

UNIVERSITY OF CANTABRIA (SPAIN)
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UNITED STATES OF AMERICA-UNIVERSITY OF MIAMI

URUGUAY-UNIVERSIDAD DE LA REPÚBLICA

The Euro-American Congress REHABEND 2020 on Construction Pathology, Rehabilitation **Technology and Heritage Management** was initially scheduled from 24th to 29th **March** in **Granada (Spain)**. Due to COVID-19 outbreak, the organizers decided to postpone the Congress until the end of September 2020, maintaining a face-to-face modality. Finally, bearing in mind the evolution of the pandemic, the organizing committee took the decision **to virtualize the REHABEND 2020 Congress**. In this way, fifteen sessions (keynote, global partners and some selected parallel technical sessions) will be held live (streaming) during the days of the event (28th - 30th September); and the rest of parallel technical sessions will be virtualized asynchronously by means of video-presentations. The event is organized by seventeen organizations of **eight European and American countries**, and it is co-chaired by the **University of Cantabria**, through its Building Technology R&D Group (GTED-UC), and the **University of Granada**.

REHABEND 2020 **continues the series of the seven previous REHABEND international events**, which had been developed **since 2006 in different Spanish cities**. The previous one, in **2018**, was carried out in **Caceres**. In 2018 edition, **around 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 2020 edition of this technical event on these topics. This event aims 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 will meet more than 300 technical contributions coming from professionals, academics and specialists.

Based on previous experiences, the Congress **is proposed once again in the Euro-American cultural space**. The **official languages** are **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 most part of the congress' attendants, as it was evident in previous editions of REHABEND.

Under these premises and the successful previous editions, the Congress is sponsored by the **Government of Spain**, the **Government of Andalusia**, the **Provincial Government of Granada**, the **Municipality of Granada**, the **Andalusian Institute of Historical Heritage (IAPH)**, the **Council of the Alhambra and the Generalife**, **Tecnalia**, **Sika**, **Mapei**, **Kerakoll**, **Acerinox**, **Grupo Puma**, the **University of Cantabria** and the **University of Granada**. In addition, several Universities, Technical and Professional Associations, Institutes, Foundations and Companies commit their collaboration in order to the success of this initiative.

Finally, **REHABEND 2020 organizers would like to express, once again, our most sincere thanks** to all those involved in the Congress for your commitment and flexibility at this difficult time: 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 in spite of the difficulties. Sincerely, many thanks to all.

Dr. Ignacio Lombillo
Chairman of the REHABEND 2020 Congress
Associate Professor
University of Cantabria

Dr. María Paz Sáez
Chairman of the REHABEND 2020 Congress
Associate Professor
University of Granada

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), 6th (Burgos, 2016) and 7th Congress (Caceres, 2018), all of them carried out in Spanish cities. The ability to convene of the seven perfomed editions was prominent, gathering an appreciable number of experts in the topics of the Congress. As a reference, in the 7th edition (REHABEND 2018) 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.

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

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

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

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

REHABEND 2014 (Book of Abstracts)
ISBN: 978-84-606-6738-4 (in English)
ISBN: 978-84-616-8862-3 (several languages)
REHABEND 2014 (Digital Book of Papers)
ISBN: 978-84-616-8863-0 (several languages)

REHABEND 2016 (Book of Abstracts)
ISBN: 978-84-608-7940-4 (in English)
REHABEND 2016 (Digital Book of Papers)
ISBN: 978-84-608-7941-1 (several languages)

REHABEND 2018 (Book of Abstracts)
ISBN: 978-84-697-7032-0 (in English)
REHABEND 2018 (Digital Book of Papers)
ISBN: 978-84-697-7033-7 (several languages)

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COLLABORATING ENTITIES

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

UNIVERSITIES

Albania-Epoka University

Algeria-Ecole Polytech. d'Architecture et d'Urbanisme

Algeria-University of Blida1

Argentina-Universidad Tecnológica Nacional

Bosnia and Herzegovina-University of Sarajevo

Brazil-Universidade de Brasília

Brazil-Universidade Federal da Bahia

Brazil-Universidade Federal do Rio de Janeiro

Brazil-Instituto Federal Sul-rio-grandense

Brazil-Univ. Estadual Paulista

Brazil-Universidade Federal de Minas Gerais

Canada-University of Ottawa

Canada-Ryerson University

Chile-Universidad Austral de Chile

Chile-Pontificia Universidad Católica de Chile

Chile-Universidad de Chile

Colombia-Institución Universitaria Colegio Mayor de Antioquia

Colombia-Universidad Nacional de Colombia

Croatia-Josip Juraj Strossmayer University Osijek

Cuba-Universidad Central "Marta Abreu" de las Villas

Cyprus-University of Cyprus

Dominican Rep.-Pontificia Universidad Católica Madre y Maestra

Dominican Rep.-Universidad Nacional Pedro Henríquez Ureña

Ecuador-Universidad de Cuenca

Ecuador-Pontificia Universidad Católica del Ecuador

Egypt-Cairo University

Greece-University of Patras

Greece-National Technical University of Athens

Hungary-Budapest Univ. of Technology and Economics

Italy-Università degli studi di Firenze

Italy-Università degli studi della Basilicata

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Italy-Università degli Studi di Catania

Italy-Università degli Studi "G. d'Annunzio" Chieti - Pescara

Italy-Politecnico di Torino

Italy-Università degli Studi di Roma Tre

Italy-Università di Bologna

Italy-Università della Calabria

Italy-Università di Camerino

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Mexico-Universidad Michoacana de San Nicolás de Hidalgo

Mexico-Universidad Iberoamericana

Morocco-Mohammed V University

Netherlands-Hanze University of Applied Sciences Groningen

Norway-Western Norway University of Applied Sciences

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Peru-Pontificia Universidad Católica del Perú

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Spain-Universidad de Valladolid

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Spain-Universidad Politécnica de Cartagena

Spain-Universidad Politécnica de Valencia

Spain-Universidad de Oviedo

Spain-Universidad Internacional de Cataluña

Spain-Universidad de Extremadura

Switzerland-École polytechnique fédérale de Lausanne

Switzerland-University of applied sciences and arts of southern Switzerland

Turkey-Yildiz Technical University

United Kingdom-Northumbria University

United Kingdom-University of Dundee

United Kingdom-University College London

United States of America-New Mexico State University

United States of America-University of Illinois

United States of America-University of Miami

Uruguay-Universidad de la República

ASSOCIATIONS, FOUNDATIONS & PUBLIC ENTITIES

Argentina-CeReDeTeC Centro Regional de Desarrollos Tecnológicos para la Construcción, Sismología e Ingeniería Sísmica

Argentina-LEMIT Laboratorio de Entrenamiento Multidisciplinario para la Investigación

Italy-Eurac Research
"Task 59 - Renovating Historic Buildings towards Zero Energy" Project (IEA- International Energy Agency)

Italy-CNR Consiglio Nazionale delle Ricerche | Istituto per le tecnologie applicate ai beni culturali

México-Instituto de Ingeniería de la UNAM

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Portugal-ITECONS - UCoimbra

Portugal-Centre of Materials and Building Technologies C-MADE

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Spain-Fundación Rehabitar Tierra de Campos

Spain-Diputación de Castellón - Servicio de Restauración

Spain- Building Technology R&D Group - UC

Spain-Fundación Leonardo Torres Quevedo

Red Iberoamericana PROTERRA

COMPANIES

JOURNALS

MDPI – *Infrastructures* (ISSN 2412-3811)

ORGANIZING COMMITTEE

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- Prof. Dr. Ignacio Lombillo. University of Cantabria.
- Prof. Dr. Maria Paz Sáez. University of Granada.

CONGRESS COORDINATORS:

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- Dr. Yosbel Boffill. University of Cantabria.

CONGRESS ASSISTANS:

- PhD Student, Eng. Cesar A. Carrasco. University of Cantabria.
- PhD Student, Eng. Silvia Martiradonna. University of Cantabria / Polytechnic University of Bari.
- PhD Student, Eng. Rebeca Sánchez. University of Cantabria.
- PhD Student, Arch. Luisa Mª García. University of Granada.
- PhD Student, Arch. Almudena García. University of Granada.

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.

Day / Hour	Monday September 28th, 2020	Tuesday September 29th, 2020	Wednesday September 30th, 2020
14h15	**OPENING SESSION (10 minutes aprox.)**		
14h30 15h00	**KEYNOTE SESSION 1** Investigation on experimental techniques for the mechanical characterization of brick masonry **Prof. Dr. Pere Roca** *Universidad Politécnica de Cataluña, Spain*	**KEYNOTE SESSION 3** A procedure for multi-hazard risk assessment of historic buildings **Prof. Dr. Dina d'Ayala** *University College London, UK*	**KEYNOTE SESSION 5** El IAPH: Experiencias metodológicas para la conservación del patrimonio **Dr. Juan José Primo Jurado** *Instituto Andaluz de Patrimonio Histórico, Spain*
15h00 15h20	Global Partners: **KERAKOLL** SRG, Steel Reinforced Grout for strengthening masonry structures: from tests to applications **Ing. José Dobón Tamarit** *Product specialist in concrete restoration mortars and structural strengthening division Kerakoll Ibérica* **Ing. José Luis Sánchez** *Technical manager Kerakoll Ibérica*	Global Partners: **ACERINOX** Rebarinox. Stainless Steel Rebar. Preserving the past to build the future **Ing. Luis María Peiró Hergueta** *Technical Director* *CEDINOX (Spanish Stainless Steel Association)*	Global Partners: **TECNALIA** GENIA: inspection, evaluation and bridge management tool **Dr. Ignacio Piñero Santiago** *Fundación TECNALIA Research & Innovation*
	Q&A / BREAK	**Q&A / BREAK**	**Q&A / BREAK**
15h40 16h10	**KEYNOTE SESSION 2** Vulnerabilidade sísmica de edifícios de betão armado **Prof. Dr. Humberto Varum** *Universidade do Porto, Portugal*	**KEYNOTE SESSION 4** Metodologias de reabilitação do património do século XX **Prof. Dr. Anibal Costa** *Universidade de Aveiro, Portugal*	**KEYNOTE SESSION 6** Refuerzo "activo" de edificios históricos **Prof. Dr. Lorenzo Jurina** *Politecnico di Milano, Italy*
16h10 16h30	Global Partners: **SIKA** Gestión Total de la Corrosión en estructuras de hormigón armado **Arq. Borja Jiménez Salado** *Ingeniero de Producto, Sika, S.A.U.*	Global Partners: **GRUPO PUMA** Rehabilitación con Morteros industrializados de Cal. Ejemplo de Puesta en obra **Arq. Juan Pablo González** *Prescriptor Grupo Puma*	Global Partners: **MAPEI** La conservación del patrimonio con materiales tecnológicamente avanzados. Sistema MAPE-ANTIQUE de MAPEI: De la tradición a la puzolana moderna, "la Eco-Puzolana" **D. Joan Lleal** *Responsable de promoción de la prescripción de Mapei Spain S.A*
16h30 16h50	**TECHNICAL SESSION 1** Strengthening of low-strength concrete columns with fibre reinforced polymers. Full-scale tests **Dr. Sonia Martínez** *Instituto de Ciencias de la Construcción Eduardo Torroja, Spain*	**TECHNICAL SESSION 2** Investigation strategy for the structural assessment of historic Towers **Prof. Dr. Antonella Saisi** *Politecnico di Milano, Italy*	**TECHNICAL SESSION 3** Strengthening of a masonry wall in seismic prone area with the CAM system: experimental and numerical results **Prof. Dr. Nino Spinella** *Università degli Studi di Messina, Italy*
	Q&A	**Q&A**	**Q&A / CLOSING SESSION (10 minutes aprox.)**

NOTE: The first session will start at **14:15 h** (**UTC** – Coordinated Universal Time). Please, confirm the time in your region.

KEYNOTE SPEAKERS

Virtual Conference, September 28th-30th, 2020

	HOUR	COUNTRY	INSTITUTION	SPEAKER	TITLE
28/09/2020	14h30 - 15h00	 SPAIN	 UNIVERSIDAD POLITÉCNICA DE CATALUÑA	PROF. DR. PERE ROCA	INVESTIGATION ON EXPERIMENTAL TECHNIQUES FOR THE MECHANICAL CHARACTERIZATION OF BRICK MASONRY
	15h40 - 16h10	 PORTUGAL	 UNIVERSIDADE DO PORTO	PROF. DR. HUMBERTO VARUM	VULNERABILIDADE SÍSMICA DE EDIFÍCIOS DE BETÃO ARMADO
29/09/2020	14h30 - 15h00	 UNITED KINGDOM	 UNIVERSITY COLLEGE LONDON	PROF. DR. DINA D'AYALA	A PROCEDURE FOR MULTI-HAZARD RISK ASSESSMENT OF HISTORIC BUILDINGS
	15h40 - 16h10	 PORTUGAL	 UNIVERSIDADE DE AVEIRO	PROF. DR. ANIBAL COSTA	METODOLOGIAS DE REABILITAÇÃO DO PATRIMÓNIO DO SÉCULO XX
30/09/2020	14h30 - 15h00	 SPAIN	 INSTITUTO ANDALUZ DE PATRIMONIO HISTÓRICO	DR. JUAN JOSÉ PRIMO JURADO	EL IAPH: EXPERIENCIAS METODOLÓGICAS PARA LA CONSERVACIÓN DEL PATRIMONIO
	15h40 - 16h10	 ITALY	 POLITECNICO DI MILANO	PROF. DR. LORENZO JURINA	REFUERZO "ACTIVO" DE EDIFICIOS HISTORICOS

NOTE:The first session will start at 14:15 h (UTC - Coordinated Universal Time). Please, confirm the time in your region

KEYNOTE SESSION nº 1: September 28th, 2020, 14h30-15h00

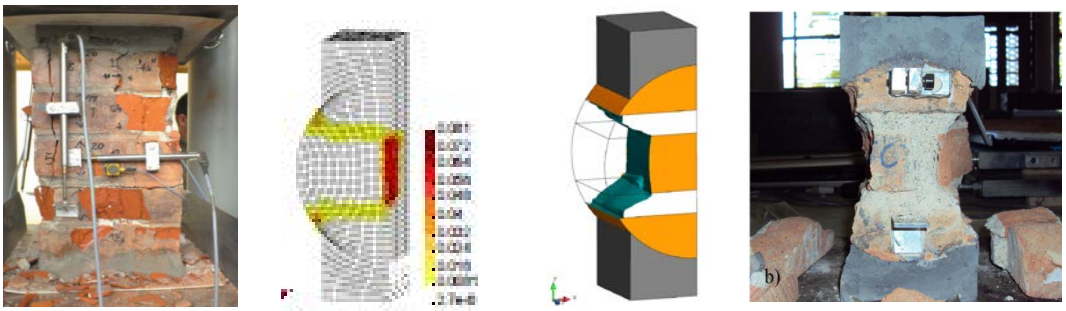
PROF. DR. PERE ROCA

Pere Roca is Professor at the School of Civil Engineering of Barcelona in the Technical University of Catalonia (UPC) since 2000, where he carries out his activity as lecturer, researcher and consultant on building structures. His research is oriented to structural analysis techniques, experimental analysis, structural monitoring, seismic evaluation, and strengthening techniques with focus on existing structures.

A significant part of his research effort has been devoted to the development of criteria and tools for the conservation and restoration of monuments and historical structures. He is an active member of the ICOMOS International Scientific Committee on Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH), which he chaired during 2005-2008. He is lecturer in the Advanced Masters on Structural Analysis of Monuments and Historical Constructions (SAHC). He is co-editor of the International Journal of Architectural Heritage since 2007 and co-advisor of the Conference Series on Structural Analysis of Historical Constructions. He has been consultant in over 100 case studies on existing and historical structures, including Romanesque and Gothic churches and cathedrals, medieval bridges and Modernist buildings. He has collaborated in the study of 9 UNESCO World Heritage buildings.

INVESTIGATION ON EXPERIMENTAL TECHNIQUES FOR THE MECHANICAL CHARACTERIZATION OF BRICK MASONRY

ABSTRACT: The assessment and verification of historical construction is still facing significant challenges due to the complexity of historical masonry as structural material. The large variety of masonry types, the material heterogeneity and the large scattering of the mechanical properties are among the most important sources of difficulty. The mechanical characterization of the material is also hindered by the fact that the available technical stardards are mainly oriented to the characterization of modern brickwork and do not consideer the peculiarties and difficulties posed by existing or historical masonries. In an attempt to discuss on these difficulties and provide possible solutions, a critical review will be presented on available and innovative experimental techniques for mechanical characterization by laboratory and in situ techniques. Several methods f applicable to the material components will be discussed first, including the Double Puch Test or different penetrometric tests on mortar joints and compression tests on different types of brick samples. The possibility of performing laboratorty compression or shear tests on cylindrical specimens extracted from real structures will be also discussed. All the methods presented will be evalaued in terms of real applicability, reliability and accuracy.



KEYNOTE SESSION nº 2: September 28th, 2020, 15h40-16h10

PROF. DR. HUMBERTO VARUM

Humberto Varum é Professor Catedrático da Faculdade de Engenharia da Universidade do Porto, desde setembro de 2014. Desde outubro de 2010 é Honorary Lecturer no Department of Civil, Environmental and Geomatic Engineering, da University College of London (UCL), Londres, Reino Unido. É Visiting Professor no College of Civil Engineering, Fuzhou University, Fujian, China. No ensino tem-se especializado nas áreas da dinâmica de estruturas e engenharia sísmica, resistência dos materiais e reabilitação das construções.

É Membro Integrado e Vice-Coordenador da Unidade de Investigação "CONSTRUCT, Instituto de I&D de Estruturas e Construção". Foi Perito Nacional Destacado no laboratório ELSA (European Laboratory for Structural Assessment), do JRC (Joint Research Centre), da Comissão Europeia, em Itália, no período de julho de 2009 a agosto de 2010. A sua experiência científica combina ensaios em estruturas e modelação numérica do comportamento não-linear de sistemas estruturais. Os seus principais interesses de investigação incluem: avaliação, reabilitação e reforço de estruturas, ensaios em estruturas, simulação do comportamento de estruturas, risco sísmico, monitorização de estruturas, reabilitação e reforço sísmico de construções em terra.

Desde maio de 2015, é membro da Direção do Instituto da Construção, da Universidade do Porto. É membro do Comité Nacional do ICOMOS (Council on Monuments and Sites), desde 2009, e Expert Member do ISCEAH (International Scientific Committee of Earthen Architectural Heritage), desde 2011. É membro da Rede Ibero-Americana PROTERRA, desde 2012. Participou em várias missões de reconhecimento pós-sismo, nomeadamente em L'Áquila (Itália, 2009), Lorca (Espanha, 2011), Emília-Romanha (Itália, 2012), Gorkha (Nepal, 2015) e Puebla (México, 2017). Participou na rede europeia EU-NICE (Eurasian University Network for International Cooperation in Earthquakes), financiada no âmbito dos projetos Erasmus Mundus. Coordena e participa em vários projetos de investigação. Orienta várias teses de mestrado e de doutoramento no domínio da caracterização do comportamento das estruturas, reabilitação das construções e reforço sísmico, e construções em terra.

É coautor de mais de 400 publicações em conferências e revistas nacionais e internacionais.

VULNERABILIDADE SÍSMICA DE EDIFÍCIOS DE BETÃO ARMADO

ABSTRACT: Um dos maiores desafios para a mitigação do risco sísmico do espaço edificado surge associado à vulnerabilidade sísmica de edifícios dimensionados de acordo com regulamentos anteriores à atual geração de regulamentação. Deve ser dada atenção à avaliação da vulnerabilidade sísmica deste vasto património e ao desenvolvimento de soluções de reforço adequadas.

Relatórios recentes de observação de danos pós-sismo unanimamente reconhecem que aspetos como as irregularidades estruturais, em planta e em altura, os detalhes de pormenrização das armaduras nos elementos de betão armado, assim como a interação com elementos não estruturais, em particular as paredes de alvenaria de enchimento com o sistema estrutural desempenham um papel muito importante na resposta e segurança sísmica dos edifícios de betão armado.

Nesta linha, tem-se observado nos últimos anos um interesse crescente no estudo do comportamento sísmico das paredes de alvenaria de enchimento e da sua influência na resposta dos edifícios quando é sujeito a uma ação sísmica. Reconhece-se que a sua influência pode ser favorável ou desfavorável à segurança estrutural, dependendo de uma série de fatores, tais como a sua distribuição em planta e em altura, existência ou não de ligação mecânica aos elementos de betão armado envolventes, rigidez relativa entre o painel e os elementos de betão armado, condições-fronteira, propriedades materiais e mecânicas, entre outras.

Nesta intervenção serão apresentados, de forma sumária, as principais causas de dano severo e colapso de estruturas de edifícios em betão armado observadas em sismos recentes, dando particular atenção às deficiências do comportamento estrutural decorrentes da influência dos painéis de alvenaria e aos problemas relacionados com mecanismos de rotura por corte dos elementos estruturais. Será também apresentada uma campanha de ensaios, realizada à escala real, visando a avaliação do comportamento de paredes de enchimento sujeitas a ações para fora-do-plano e a validação da eficiência de soluções de reforço recorrendo ao reboco

armado. Complementarmente, serão apresentados os resultados principais de estudos numéricos que realçam a influência das paredes de alvenaria de enchimento na resposta sísmica de edifícios de betão armado. Por fim, será apresentada uma campanha de ensaios sob pilares de betão armado não dimensionados de acordo com regulamentação sísmica, sujeitos à flexão uniaxial e biaxial. Serão apresentadas as principais conclusões relativamente à influência do confinamento dado pela armadura transversal na sua resposta e à eficiência de várias soluções de reforço estudadas experimentalmente, como por exemplo com recurso a mantas de fibra de carbono ou a cantoneiras metálicas, visando a melhoria do comportamento sísmico.

Exemplos de edifícios danificados no sismo de Áquila (Itália) em 2009.

KEYNOTE SESSION nº 3: September 29th, 2020, 14h30-15h00

PROF. DRA. DINA D'AYALA

Prof Dina D'Ayala, is the Professor of Structural Engineering at University College London, within the Department of Civil Environmental and Geomatic Engineering. She is head of Civil Engineering and Co-Director of the Earthquake and People Interaction Centre, EPICentre.

She is a director of the International Association of Earthquake Engineers and Fellow of the ICE. Her specialism is Structural Resilience Engineering with particular emphasis on the assessment, strengthening, preservation and resilience of existing buildings, structures, transport infrastructure and cultural heritage.

Her current research focusses on resilience of structures and infrastructure to natural hazards, supported through research grants from EU FP7, INFRARISK, Horizon 2020, TURNKey, the RCUK, PARNASSUS, STORMLAMP, SCOSSO, PRISMH, Learning form Earthquake.

She has 25 years' experience working with international agencies, the World Bank, ODA, UNDP, British Council, DfID, in countries such as Nepal, Pakistan, Jordan, Turkey, Iraq, Philippines etc., and leading interdisciplinary projects on enhancing resilience against natural hazards. She has produced Guidelines for DfID on assessment and strengthening of hospitals and reconstruction efforts in Nepal. She is the chief scientist for the World Bank on the Global Programme for Safe Schools (GPSS) and leads the development of the World Bank GLoSI project. She is a member of the Management Board of the International Centre for Collaborative Research on Disaster Risk Reduction (ICCR-DRR) at Beijing Normal University.

A PROCEDURE FOR MULTI-HAZARD RISK ASSESSMENT OF HISTORIC BUILDINGS

ABSTRACT: Cultural Heritage (CH) assets are a distinctive and valuable portion of the building stock worldwide, often representing a very important component of individual and collective identity. CH assets encompass not only individual buildings but also historic urban centres which are commonly formed by clusters of single units, undergoing to continuous transformations overt time. Although these clusters tend to maintain their original urban configuration, the transformations often modify the global structural behavior of the compounds. Furthermore, owing to their low-engineered construction features, CH assets are also often highly vulnerable to different natural hazards. To date, much research effort has been devoted to thoroughly understand the mechanism of damage that CH assets undergo in case of earthquakes. However, there is still a compelling need to develop quantitative methods able to assess the structural vulnerability of these buildings against different co-occurring perils, such as flooding or high wind speeds. Improved knowledge on this topic is of great importance to advance current mitigation measures for the retrofit of CH assets in multi-hazard prone countries, enhancing the decision-making process of their preservation to future generations.

This paper presents a mechanic-based procedure for the collapse load evaluation of historic masonry structures (HMS), exposed to earthquake, flood and wind loading.

KEYNOTE SESSION nº 4: September 29th, 2020, 15h40-16h10

PROF. DR. ANIBAL COSTA

Professor Catedrático da Universidade de Aveiro.

Licenciado em Engenharia Civil pela Faculdade de Engenharia da Universidade do Porto (FEUP); Doutor e Agregado em Engenharia Civil pela FEUP.

Membro do Conselho Permanente do Conselho Superior de Obras Públicas.

Especialista em Estruturas pela Ordem dos Engenheiros.

Membro Conselheiro da Ordem dos Engenheiros.

Membro da Direção do CICOP-Net de Portugal.

Editor de 21 livros e revistas com publicação nacional e internacional, autor de 90 capítulos de livros nacionais e internacionais, 100 artigos em revistas internacionais, 50 em revistas nacionais e mais de 500 artigos em conferências nacionais e internacionais. É orientador de inúmeras teses de Doutoramento e Mestrado.

Em parceria com a Direção Regional da Cultura – Norte acompanhou as intervenções de reabilitação e reforço estrutural de centenas de monumentos que integram o património nacional. Tem trabalhado em vários projetos de colaboração com o tecido industrial procurando desenvolver técnicas de reparação e reforço de estruturas existentes, tendo essa colaboração originado mais de 600 relatórios técnicos. Esteve ligado a centenas de projetos de Reabilitação.

METODOLOGIAS DE REABILITAÇÃO DO PATRIMÓNIO DO SÉCULO XX

ABSTRACT: O uso do betão armado na construção de edifícios surgiu no início do século XX, teve um grande desenvolvimento a partir da segunda metade do século XX, e uma grande aceitação pela generalidade dos técnicos (arquitetos e engenheiros) a nível nacional e mundial. Muitos desses edifícios, construídos ou alterados nos anos 50-60 do século XX, são hoje património e começam agora a necessitar de obras de reabilitação. Nesta situação, faz todo o sentido discutir como deve ser realizada essa reabilitação ou seja que metodologias devem ser usadas para avaliar a segurança estrutural dos edifícios existentes, face à Regulamentação Europeia, nomeadamente em relação ao EC8 parte 3 e como proceder ao dimensionamento do reforço, caso seja necessário.

Para exemplificar serão apresentados dois casos reais, um no centro de Aveiro, projeto de um dos maiores arquitetos português, Fernando Távora, Fig. 1, e outro, um edifício emblemático, situado no coração da cidade do Porto, na Avenida dos Aliados, Fig. 2.

Fig. 1

Fig. 2

KEYNOTE SESSION nº 5: September 30th, 2020, 14h30-15h00

DR. JUAN JOSÉ PRIMO JURADO

Juan José Primo Jurado (Córdoba, 1961) es doctor en Historia por la Universidad Rey Juan Carlos (Madrid) y licenciado en Filosofía y Letras, diplomado en Magisterio y máster en Didáctica de las Ciencias Sociales por la Universidad de Córdoba.

Desde noviembre de 2019 es Director del Instituto Andaluz del Patrimonio Histórico (IAPH) dependiente de la Consejería de Cultura y Patrimonio Histórico de la Junta de Andalucía.

Antes fue profesor en la Universidad de Córdoba (2018-2019), subdelegado del Gobierno en Córdoba (2012-2018), concejal de Patrimonio y Casco Histórico del Ayuntamiento de Córdoba (2011-2012), profesor en la Universidad Rey Juan Carlos (2007-2011) y entre 2000 y 2011 director del Archivo Histórico del Palacio de Viana, propiedad de la Fundación Cajasur, donde catalogó y puso en valor su valioso fondo documental. Anteriormente, durante 18 años, ejerció la enseñanza en diferentes colegios e institutos de la provincia de Córdoba.

Desde 1999 ha escrito más de un millar artículos, como historiador y analista en prensa, primero como colaborador fijo en el diario Córdoba y luego en el ABC. Ha pronunciado numerosas conferencias sobre temas históricos y tiene publicados 20 libros.

Es miembro de la Real Academia de Córdoba (2003). Cruz al Mérito Militar (2004) y Medalla de Plata al Mérito Social Penitenciario (2017).

EL IAPH: EXPERIENCIAS METODOLÓGICAS PARA LA CONSERVACIÓN DEL PATRIMONIO

ABSTRACT: El Instituto Andaluz del Patrimonio Histórico, IAPH, fue creado en 1989 por el gobierno de Andalucía para contribuir al desarrollo de las políticas regionales de cultura, con una visión del patrimonio integral y multidisciplinar. Agencia pública desde 2007 y acreditado como Instituto de investigación desde 2011, el IAPH participa en la generación de conocimiento innovador en patrimonio, y en su transferencia, y ayuda a orientar las políticas culturales como factor de desarrollo y crecimiento inteligente en Andalucía. En el campo de la conservación del patrimonio tiene entre sus funciones el análisis, estudio, desarrollo y difusión de teorías, métodos y técnicas aplicadas a la tutela del patrimonio histórico, y a su protección, conservación, gestión, investigación y disfusión.

La ponencia presentará aquéllas intervenciones de carácter ejemplar que han contribuido a la generación de un modelo metodológico, basado en procesos de conocimiento. Actuaciones sobre diferentes tipologías y soporte, desde la intervención en dos lienzos de gran formato de Murillo (2018) hasta los Programas de Conservación llevados a cabo sobre los Bienes Muebles del Palacio de San Telmo o la colección de la Iglesia del Salvador de Sevilla, entre otras. Incluyendo referencias a las grandes actuaciones sobre bienes inmuebles que atienden a diferentes escalas, desde la intervención paisajística en la ensenada de Bolonia (Cádiz) hasta la intervención en la Portada de Niculoso Pisano en el Convento de Santa Paula (Sevilla), pasando por el programa iconográfico de la Iglesia del Santo Cristo de la Salud (Málaga).

Iglesia del Santo Cristo de Salud (Málaga). Imagen: M Herce

Portada de Niculoso Pisano en el Convento de Santa Paula (Sevilla) Imagen: Fondo Gráfico IAPH

KEYNOTE SESSION nº 6: September 30th, 2020, 15h40-16h10

PROF. DR. LORENZO JURINA

Associate Professor of Structural Engineering at the School of Architecture Urban Planning Construction Engineering of Politecnico di Milano since 1983, professor of consolidation of historic buildings at the Postgraduate School of Architectural Heritage and Landscape and at the Doctorate of Architectural Heritage Conservation.

He has developed innovative methods in diagnostics and structural consolidation and he has cooperated with international experts and with the major exponents of the Italian restoration school.

He is author of over 200 publications on these topics and speaker in national and international conferences, concerning the cultural heritage sector.

Consultant for FAI, UNESCO, World Monument Fund, Ministry of Culture, Katolikos of Armenia.

Founding member of AIF, ATE, CIAS, member of the scientific committee of the magazine " Recupero e Conservazione ", De Lettera Ed., and Ingenio magazine. Member of the Board of the College of Engineers and Architects of Milan. Q-ing.

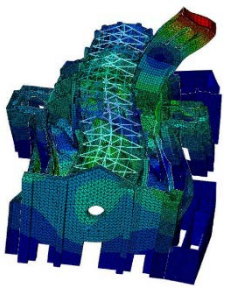
In his experience in the field of structural consolidation of complex historical and monumental buildings, he has played the role of designer and Site Supervisor in over 200 recovery interventions located both in Italy and abroad, of consultant and designer for new buildings, for seismic vulnerability assessments, even for strategically relevant buildings such as schools, hospitals, barracks.

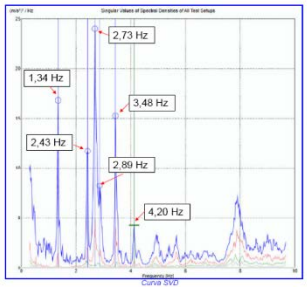
REFUERZO “ACTIVO” DE EDIFICIOS HISTORICOS

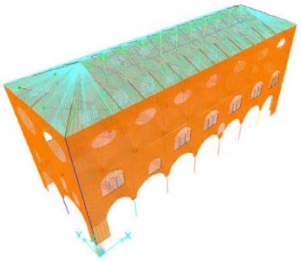
ABSTRACT: En la ponencia se ilustran aspectos relacionados con las principales patologías, al menos las más recurrentes, de los edificios historicos y a los refuerzos estructurales tradiccionales.

Seguidamente, son reportados varios ejemplos de intervenciones recientes llevadas a cabo por el autor, afectando tanto a muros portantes, forjados, arcos y bóvedas.

Para ello, el hilo conductor será el empleo de los refuerzos “activos”, es decir, intervenciones que actuan desde el primer istante de su puesta en obra, teniendo en cuenta otras necesidades importantes como que la intervencion sea ligera, declarada pero no ostentada, reversible y, en la medida de lo posible, elegante.







GLOBAL PARTNERS

Virtual Conference, September 28th-30th, 2020

	HOUR	SPONSOR	SPEAKER	TITLE
28/09/2020	15h00 - 15h20	KERAKOLL The GreenBuilding Company	ING. JOSÉ DOBÓN TAMARIT & ING. JOSÉ LUIS SÁNCHEZ	SRG, STEEL REINFORCED GROUT FOR STRENGTHENING MASONRY STRUCTURES: FROM TESTS TO APPLICATIONS
	16h10 - 16h30	Sika®	ARQ. BORJA JIMÉNEZ SALADO	GESTIÓN TOTAL DE LA CORROSIÓN EN ESTRUCTURAS DE HORMIGÓN ARMADO
29/09/2020	15h00 - 15h20	ACERINOX	ING. LUIS MARÍA PEIRÓ HERGUETA	REBARINOX. STAINLESS STEEL REBAR. PRESERVING THE PAST TO BUILD THE FUTURE
	16h10 - 16h30	grupopuma	ARQ. JUAN PABLO GONZÁLEZ	REHABILITACIÓN CON MORTEROS INDUSTRIALIZADOS DE CAL. EJEMPLO DE PUESTA EN OBRA
30/09/2020	15h00 - 15h20	tecnalia	DR. IÑAKI PIÑERO	GENIA: INSPECTION, EVALUATION AND BRIDGE MANAGEMENT TOOL
	16h10 - 16h30	MAPEI®	D. JOAN LLEAL	LA CONSERVACIÓN DEL PATRIMONIO CON MATERIALES TECNOLÓGICAMENTE AVANZADOS. SISTEMA MAPE-ANTIQUE DE MAPEI: DE LA TRADICIÓN A LA PUZOLANA MODERNA, "LA ECO-PUZOLANA"

NOTE:The first session will start at 14:15 h (UTC - Coordinated Universal Time). Please, confirm the time in your region

GLOBAL PARTNERS SESSION nº 1: September 28th, 2020, 15h00-15h20

ING. JOSÉ DOBÓN TAMARIT

Product specialist in concrete restoration mortars and structural strengthening division Kerakoll Ibérica

ING. JOSÉ LUIS SÁNCHEZ

Technical manager Kerakoll Ibérica

SRG, STEEL REINFORCED GROUT FOR STRENGTHENING MASONRY STRUCTURES: FROM TESTS TO APPLICATIONS

The use of Fiber Reinforced Polymer/Grout (FRP/G) composites for the external strengthening and repair of masonry structures has met over the years an increasing consensus at both the academic and industrial levels.

One of the most promising systems consist of Ultra-High Tensile Strength Steel galvanized micro wires twisted in cords or ropes, assembled parallel to each other to form unidirectional fabrics. Steel textiles can be externally bonded to the substrate via wet lay-up, by using either epoxy resin/mineral mortar, obtaining a composite known as Steel Reinforced Polymer/Grout (SRP/G). The inorganic matrix offers several advantages such as a great reduction in material costs, an higher vapour permeability and resistance to high temperatures as well as a much higher compatibility without compromising bond with the substrate and overall performance. A number of re-search studies have been carried out on SRP and SRG systems in the last fifteen years. Fundamental mechanical properties, durability and shear bond performance on masonry substrates have been investigated through tests on small- and medium-scale specimens (panels, brickwork pillars and masonry arches). These studies have shown that SRP and SRG are an effective, durable and cost efficient solution for the externally bonded rein-forcement of structures. This paper briefly introduces to the main properties and mechanical characteristics of steel fibers, presents few research results of tests performed on real scale structural members (walls, arches) and introduces some case studies on masonry structures demonstrating the different field applications of this new and effective strengthening solution.

GLOBAL PARTNERS SESSION nº 2: September 28th, 2020, 16h10-16h30

ARQ. BORJA JIMÉNEZ SALADO

Ingeniero de Producto, Sika, S.A.U.

GESTIÓN TOTAL DE LA CORROSIÓN EN ESTRUCTURAS DE HORMIGÓN ARMADO

La durabilidad de las estructuras de hormigón es un tema de gran actualidad. Dentro de ella, la cuestión de la corrosión de las armaduras es de máxima importancia. En esta ponencia se van a presentar técnicas de protección contra esa corrosión, y en concreto sistemas que son el estado del arte en este tema. Se presentarán sistemas de protección catódica, tanto pasiva como activa, con los que se puede controlar la evolución de la corrosión en una estructura a lo largo de su vida, a la vez que se puede prolongar en gran medida esta. Se explicará su funcionamiento, cálculo y experiencias al respecto.

GLOBAL PARTNERS SESSION nº 3: September 29th, 2020, 15h00-15h20

ING. LUIS MARÍA PEIRÓ HERGUETA

Technical Director

CEDINOX (Spanish Stainless Steel Association)

REBARINOX. STAINLESS STEEL REBAR. PRESERVING THE PAST TO BUILD THE FUTURE

It is stated that nothing lasts forever, and it's true. Especially if we refer to the service life of the material. Nevertheless ,there are some materials that due to their versatility and specific characteristics, are able to increase durability.

Nowadays we are facing an important and serious problem related to our infrastructures. Not only in terms of security but also in terms of huge economic expenditures too. It has been proved that most traditional ways of restoration fails after 10 years, becoming a recurrent problem over time.

Acerinox is offering its 50 years experience in Stainless Steel processing with its new trade mark Rebarinox, the stainless steel rebar that can be adapted to each situation and has been proved to be cost-effective in the long term.

Rebarinox has already been installed in many iconic engineering works, also in restoration. In spite of that, there is still a lack of knowledge and many questions related to this product and its utilization. The presentation will try to clarify them.

GLOBAL PARTNERS SESSION nº 4: September 29th, 2020, 16h10-16h30

ARQ. JUAN PABLO GONZÁLEZ

Prescriptor Grupo Puma

REHABILITACIÓN CON MORTEROS INDUSTRIALIZADOS DE CAL. EJEMPLO DE PUESTA EN OBRA

El empleo de morteros industrializados de cal en rehabilitación arquitectónica es una buena práctica que permite volver a poner en valor edificaciones de todo tipo respetando la naturaleza de los materiales originales. Las características de la cal permiten además incorporar propiedades a los morteros para facilitar la traspirabilidad de los muros y evitar los problemas causados por la humedad capilar.

GLOBAL PARTNERS SESSION nº 5: September 30th, 2020, 15h00-15h20

IGNACIO PIÑERO SANTIAGO; Jesús Díez Hernández; David Salgado Marina; Jesús Cuadrado Rojo; Aimar Orbe Mateo

Fundación TECNALIA Research & Innovation / Universidad del País Vasco

GENIA: INSPECTION, EVALUATION AND BRIDGE MANAGEMENT TOOL

Bridges are key elements in the road network and constitute an important source of investment for different administrations. Over time, the bridges deteriorate if the necessary maintenance and conservation measures are not taken. Likewise, because they are designed to provide a passage, any mishap in them can limit or interrupt them, with the inconveniences that this entails and the economic losses that may result.

This is why a better and more continuous assessment of the condition of bridges is required in order to better face the challenges presented by aging. The main inspections, which should be carried out every 5 years on highway bridges, are understood as the technical actions carried out in an organized manner that provide all the necessary data to evaluate, at one specific point time, the state of conservation of a bridge (functional and resistant state), being the basis to define the maintenance tasks.

This paper presents an innovative method to evaluate the condition of bridges based on the main inspection. The method has been developed following the MIVES methodology, a multiple criteria model for decision making that evaluates alternatives to solve a generic problem defined through a value index. This method increases objectivity and consistency in the evaluation of bridges by establishing general criteria to identify damages and automatically quantify their relative importance. The evaluation method has been implemented in a web application called GENIA that provides a global condition index of the bridge and improves the inspection system.

GLOBAL PARTNERS SESSION nº 6: September 30th, 2020, 16h10-16h30

D. JOAN LLEAL

Responsable de promoción de la prescripción de Mapei Spain S.A

LA CONSERVACIÓN DEL PATRIMONIO CON MATERIALES TECNOLÓGICAMENTE AVANZADOS. SISTEMA MAPE-ANTIQUE DE MAPEI: DE LA TRADICIÓN A LA PUZOLANA MODERNA, “LA ECO-PUZOLANA”

El redescubrimiento de las extraordinarias prestaciones de la cal en combinación con la puzolana natural o con la arcilla cocida en polvo, desde el punto de vista químico y mecánico, ha llevado a los laboratorios de investigación y desarrollo de Mapei, a estudiar sistemas innovadores para el saneamiento de los edificios, incluso los de valor histórico y artístico, utilizando materiales puzolánicos “modernos”. Las investigaciones efectuadas han llevado al uso de un producto particular, la Eco-Puzolana, un material de reacción puzolánica, de naturaleza inorgánica, de color muy claro, particularmente rico en sílice amorfa, con una elevada superficie específica y una alta reactividad. Gracias a estas características, la Eco-Puzolana es capaz de activar en muy poco tiempo el endurecimiento de la cal, a diferencia de lo que sucedía en el pasado donde el proceso discurría con extrema lentitud, confiriendo a los morteros de saneamiento y a las lechadas de inyección una elevada resistencia química a las sales solubles, a los pocos días de su aplicación.
Presentaremos las soluciones de la línea MAPE-ANTIQUE, empleadas para la reparación, refuerzo y protección de la mampostería que integra la ciudad amurallada de Ibiza, proyecto del equipo de arquitectos: Toni Marí, Txell Manresa y David Pareras (mipmarí arquitectura i disseny S.L.P.).

SELECTED TECHNICAL SESSIONS

Virtual Conference, September 28th-30th, 2020

	HOUR	COUNTRY	INSTITUTION	SPEAKER	TITLE
28/09/2020	16h30 - 16h50	 SPAIN	CSIC Consejo Superior de Investigaciones Científicas – Instituto de Ciencias de la Construcción Eduardo Torroja INSTITUTO DE CIENCIAS DE LA CONSTRUCCIÓN EDUARDO TORROJA	DR. SONIA MARTÍNEZ	STRENGTHENING OF LOW-STRENGTH CONCRETE COLUMNS WITH FIBRE REINFORCED POLYMERS. FULL-SCALE TESTS
29/09/2020	16h30 - 16h50	 ITALY	Politecnico di Milano POLITECNICO DI MILANO	PROF. DR. ANTONELLA SAISI	INVESTIGATION STRATEGY FOR THE STRUCTURAL ASSESSMENT OF HISTORIC TOWERS
30/09/2020	16h30 - 16h50	 ITALY	 UNIVERSITÀ DEGLI STUDI DI MESSINA	PROF. DR. NINO SPINELLA	STRENGTHENING OF A MASONRY WALL IN SEISMIC PRONE AREA WITH THE CAM SYSTEM: EXPERIMENTAL AND NUMERICAL RESULTS

NOTE:The first session will start at 14:15 h (UTC - Coordinated Universal Time). Please, confirm the time in your region

TECHNICAL SESSION nº 1: September 28th, 2020, 16h30-16h50

SONIA MARTÍNEZ; Ana de Diego; Viviana J. Castro; Luis Echevarría; Francisco J. Barroso; G. Rentero; R.Soldado; José Pedro Gutiérrez

Instituto de Ciencias de la Construcción Eduardo Torroja, Spain

STRENGTHENING OF LOW-STRENGTH CONCRETE COLUMNS WITH FIBRE REINFORCED POLYMERS. FULL-SCALE TESTS

Composite materials, also known as fibre reinforced polymers (FRP), are being increasingly used in rehabilitation of concrete structures due to their good corrosion resistance and high strength and stiffness in relation to their weight. Confinement of columns with externally bonded FRP sheets is an easy and effective way of enhancing the load carrying capacity and ductility of reinforced concrete columns.

Many experimental studies have been conducted on cylindrical small-scale unreinforced concrete specimens externally confined with FRP. It is widely accepted that confinement of square or rectangular columns is less efficient than the confinement of circular columns. The theoretical models for rectangular sections are mostly based on approaches created for circular columns modified by a shape factor, but the different models do not give similar results.

This paper presents an experimental program on large-scale square and rectangular RC columns externally strengthened with carbon FRP sheets and subjected to pure axial load. Large-scale tests on FRP confined columns are very limited by high cost and unavailability of the necessary equipment in many laboratories. The variables in the experimental program are the aspect ratio of the cross-section, the radius of curvature of the corners and the amount of FRP reinforcement. The tests results show that the FRP confinement can increase the strength and ductility of rectangular concrete columns with low strength concrete. The hoop ultimate strain of the FRP jacket is much lower than the material ultimate tensile strain obtained from flat coupon tests and the strain efficiency factor achieved on the tests is smaller than the value usually recommended by design guides.

TECHNICAL SESSION nº 2: September 29th, 2020, 16h30-16h50

ANTONELLA SAISI; Carmelo Gentile

Politecnico di Milano, Italy

INVESTIGATION STRATEGY FOR THE STRUCTURAL ASSESSMENT OF HISTORIC TOWERS

Thinking about the country and urban skyline, towers often represent a distinguishable but harmonized diffused entity in landscapes with a deep historic and symbolic significance; they embody the distinctive characteristics of the construction methods of the past, mainly related to masonry. The towers, defensive, religious or civic ones, are, at the same time, architectonic heritage and frequently challenging structures of their time. In most case, these structures were the top of the technology, engineering and architecture of the time and region, showing the builders deep knowledge of the materials locally available and of technological solutions.

Despite the frequent high quality of the past constructions, literature documents several unexpected damage during earthquakes or even sudden collapses without an evident direct action; the analysis of the case-studies shows some common problems, like the absence of a continue use and/or controls.

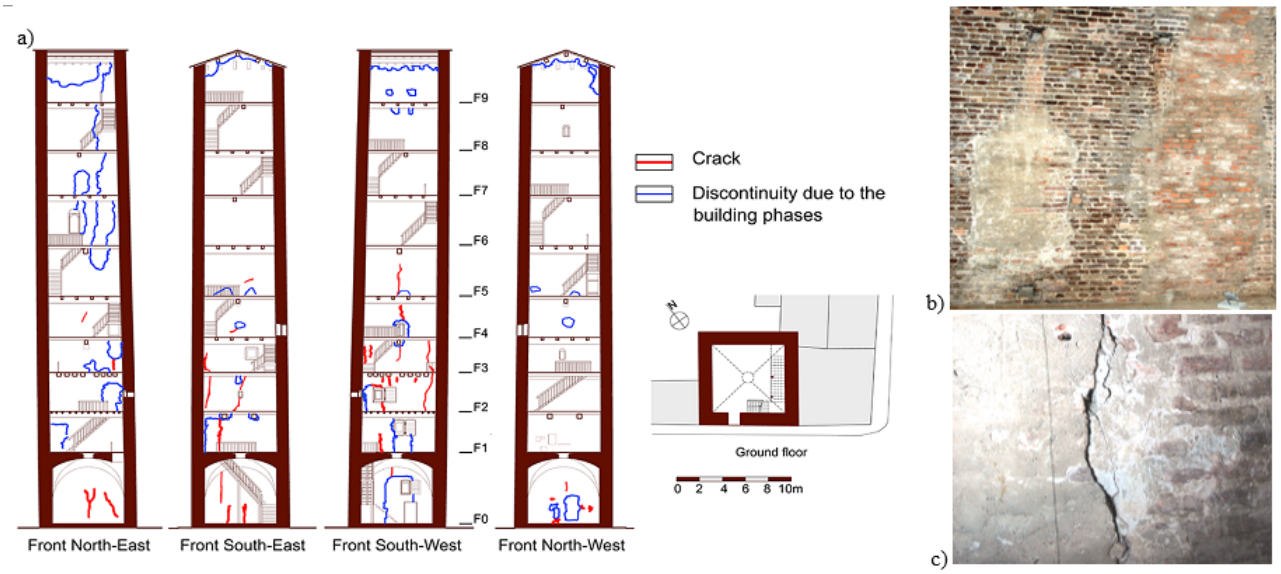
Due to the height, the structural survey of the towers could be difficult requiring a direct inspection of the wall surface. Extended and deep experimental investigation are difficultly to propose due to the large number of towers, particularly in historic centers.

The Authours have developed addressed procedures to study historic towers with different level of complexity and aimed at defining a baseline for the future monitoring of the structure.

The combination of direct survey of geometry, materials and damage, the collection of historic information and the dynamic testing define an effective minimal procedure to analyse the structural behaviour of historic towers. Dynamic monitoring complements the strategy, allowing the early warning of any structural change with a fully agreement between the safety requirements and the Conservation

principle.

The paper describe the procedures through some case studies recently investigated by the Authours. Furthermore, the manuscript focuses the advantages of each investigation and experimental step, stressing the type and the importance of each collected information as well as the following data merging and result comparison.



TECHNICAL SESSION nº 3: September 30th, 2020, 16h30-16h50

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STRENGTHENING OF A MASONRY WALL IN SEISMIC PRONE AREA WITH THE CAM SYSTEM: EXPERIMENTAL AND NUMERICAL RESULTS

In this work, experimental and numerical results of a research project on the structural behavior of seismically strengthened unreinforced masonry are presented and discussed. The topic of the research is to investigate the in-plane shear behaviour of an old masonry wall with an opening in the arch form, reinforced with a pioneering system of three-dimensional pre-tensioned stainless steel ribbons. The masonry wall was in-plane loaded until first cracking appeared, then it was reinforced and re-loaded until collapse. The results of the experiments carried out have highlighted the benefits in using the reinforcing method for masonry structures, specially its capacity to provide a large increasing in terms of strength and ductility. Analytical modelling of the wall behaviour was accomplished by applying non-linear finite element methods generally used for reinforced concrete elements.