

University of Cantabria / University of Oviedo

Organizers:

UC



Universidad de Oviedo

# REHABEND 2024

## Euro-American Congress

CONSTRUCTION  
PATHOLOGY,  
REHABILITATION  
TECHNOLOGY AND  
HERITAGE MANAGEMENT

Gijón (Spain) - May 7<sup>th</sup> - 10<sup>th</sup>, 2024

Sponsor entities:



Principado de  
Asturias



Ayuntamiento  
de Gijón

laboral  
ciudad de la cultura

visita gijón  
Convention  
Bureau



tecnal:a  
MEMBER OF RASQUE RESEARCH  
& TECHNOLOGY ALLIANCE

# **REHABEND 2024**

**CONSTRUCTION PATHOLOGY, REHABILITATION TECHNOLOGY AND  
HERITAGE MANAGEMENT**

*(10<sup>th</sup> REHABEND Congress)*

**Gijón (Spain), May 7<sup>th</sup>-10<sup>th</sup>, 2024**

PERMANENT SECRETARIAT:

**UNIVERSITY OF CANTABRIA**

Civil Engineering School

Department of Structural Engineering and Mechanics

Building Technology R&D Group (GTED-UC)

Avenue Los Castros 44, 39005 SANTANDER (SPAIN)

Tel: +34 942 201 761 (43)

Fax: +34 942 201 747

E-mail: [rehabend@unican.es](mailto:rehabend@unican.es)

[www.rehabend.unican.es](http://www.rehabend.unican.es)

**10<sup>TH</sup> EURO-AMERICAN CONGRESS ON CONSTRUCTION PATHOLOGY,  
REHABILITATION TECHNOLOGY AND HERITAGE MANAGEMENT  
REHABEND 2024**

ORGANIZED BY:



**UNIVERSITY OF CANTABRIA (SPAIN)**  
[www.unican.es](http://www.unican.es)



**Universidad de Oviedo**  
**UNIVERSITY OF OVIEDO (SPAIN)**  
[www.uniovi.es](http://www.uniovi.es)

CONGRESS CHAIRMEN:

**IGNACIO LOMBILLO  
ALFONSO LOZANO**

CONGRESS COORDINATORS:

**HAYDEE BLANCO  
YOSBEL BOFFILL**

EDITORS:

**YOSBEL BOFFILL  
IGNACIO LOMBILLO  
HAYDEE BLANCO**

GUEST EDITOR:

**ALFONSO LOZANO**

INTERNATIONAL SCIENTIFIC ADVISORY COMMITTEE:

**HUMBERTO VARUM – UNIVERSITY OF PORTO (PORTUGAL)  
PERE ROCA – TECHNICAL UNIVERSITY OF CATALONIA (SPAIN)  
ANTONIO NANNI – UNIVERSITY OF MIAMI (USA)**

The editors does not assume any responsibility for the accuracy, completeness or quality of the information provided by any article published. The information and opinion contained in the publications are solely those of the individual authors and do not necessarily reflect those of the editors. Therefore, we exclude any claims against the author for the damage caused by use of any kind of the information provided herein, whether incorrect or incomplete.

The appearance of advertisements in these Scientific Publications (Printed Book of Abstracts & Digital Book of Articles - REHABEND 2024) is not a warranty, endorsement or approval of any products or services advertised or of their safety. The Editors does not claim any responsibility for any type of injury to persons or property resulting from any ideas or products referred to in the articles or advertisements.

The sole responsibility to obtain the necessary permission to reproduce any copyright material from other sources lies with the authors and REHABEND 2024 Congress can not be held responsible for any copyright violation by the authors in their article. Any material created and published by REHABEND 2024 Congress is protected by copyright held exclusively by the referred Congress. Any reproduction or utilization of such material and texts in other electronic or printed publications is explicitly subjected to prior approval by REHABEND 2024 Congress.

ISSN: 2386-8198 (printed)

ISBN: 978-84-09-58990-6 (Printed Book of Abstracts)

ISBN: 978-84-09-58989-0 (Digital Book of Articles)

Legal deposit: SA - 132 - 2014

Printed in Spain by Círculo Rojo

<b>Introduction.....</b>	<b>3</b>
<b>Previous Congresses.....</b>	<b>4</b>
<b>Sponsor &amp; Collaborating Entities.....</b>	<b>5</b>
<b>International Scientific Committee.....</b>	<b>9</b>
<b>Topics.....</b>	<b>15</b>
<b>Abstracts of the Congress.....</b>	<b>17</b>
<b>Keynote Lectures.....</b>	<b>37</b>
<b>1.- Previous Studies.....</b>	<b>41</b>
1.1.- Multidisciplinary studies (historical, archaeological, etc.).....	43
1.2.- Heritage and territory.....	58
1.3.- Urban regeneration.....	70
1.5.- Social participation processes and socio-cultural aspects in rehabilitation projects .....	81
1.6.- Construction pathology.....	83
1.7.- Diagnostic techniques and structural assessment.....	98
1.8.- Vulnerability studies and risk management.....	135
1.9.- Guides and regulations.....	142
<b>2.- Project.....</b>	<b>145</b>
2.1.- Theoretical criteria of the intervention project.....	147
2.2.- Traditional materials and construction methods.....	152
2.3.- Novelty products applicable and new technologies.....	174
2.4.- Sustainable design and energy efficiency.....	196
<b>3.- Building Intervention.....</b>	<b>225</b>
3.1.- Intervention plans.....	227
3.2.- Rehabilitation and durability.....	230
3.3.- Reinforcement technologies.....	242
3.5.- Conservation of industrial heritage.....	252
3.6.- Examples of intervention.....	255
<b>4.- Maintenance.....</b>	<b>267</b>
4.1.- Construction maintenance and infrastructures .....	269
4.2.- Preventive conservation of built heritage.....	279
<b>5.- Diffusion and Promotion.....</b>	<b>293</b>
5.1.- Heritage and cultural tourism.....	295
5.2.- Teaching and training.....	308
5.3.- New technologies applied to the heritage diffusion.....	310
5.4.- Accessibility to cultural heritage.....	321
5.5.- Built heritage management .....	325

<b>COUNTRY</b>	<b>NAME</b>	<b>ENTITY</b>
Albania	Dr. Julinda Keci	Epoka University
Argentina	Dr. Fabián H. Iloro	LEMIT
Argentina	Dr. Noemi G. Maldonado	CeReDeTeC
Argentina	Dr. Pablo E. Martín	CeReDeTeC
Bosnia and Herzegovina	Dr. Naida Ademovic	University of Sarajevo
Brazil	Dr. Ana Luiza Oliveira	Universidade de Brasília
Brazil	Dr. Antonio Paulo Cavalcante	Universidade Federal do Ceará
Brazil	Dr. Esequiel Mesquita	Universidade Federal do Ceará
Brazil	Dr. João Luiz Calmon Nogueira da Gama	Universidade Federal do Espírito Santo
Brazil	Dr. José Luiz Rangel Paes	Universidade Federal de Viçosa
Brazil	Dr. Luiz Antônio Melgaço	Universidade Federal de Minas Gerais
Brazil	Dr. Márcio Albuquerque Buson	Universidade de Brasília
Brazil	Dr. Obede B. Faria	Universidade Estadual Paulista
Brazil	Dr. Paulo de Souza Tavares Miranda	Instituto Federal de Educação, Ciência e Tecnologia do Ceará
Brazil	Dr. Robson Luiz Gaiofatto	Universidade Católica de Petrópolis
Brazil	Dr. Sofia A. L. Bessa	Universidade Federal de Minas Gerais
Chile	Dr. Claudia C. Torres Gilles	Universidad de Chile
Croatia	Dr. Davorin Penava	Josip Juraj Strossmayer University of Osijek
Croatia	Dr. Dina Stober	Josip Juraj Strossmayer University of Osijek
Croatia	Dr. Margareta Turkalj Podmanicki	Josip Juraj Strossmayer University of Osijek
Denmark	Dr. Inge Rörig-Dalgaard	Technical University of Denmark
Dominican Republic	Dr. Virginia Flores Sasso	Pontificia Universidad Católica Madre
Germany	Dr. Kay-Uwe Schober	Mainz University of Applied Sciences
Greece	Dr. Fillitsa Karantoni	University of Patras
Greece	Dr. Panagiotis Michalis	National Technical University of Athens
Greece	Dr. Thanasis C. Triantafillou	University of Patras
Hungary	Dr. Katalin Bagi	Budapest University of Technology and Economics
Italy	Dr. Agostino Catalano	Università degli Studi del Molise
Italy	Dr. Alessandro Lo Faro	Università degli Studi di Catania
Italy	Dr. Andrea di Filippo	Università degli Studi di Salerno
Italy	Dr. Antonella Guida	University of Basilicata
Italy	Dr. Antonella Saisi	Politecnico di Milano
Italy	Dr. Antonello Pagliuca	University of Basilicata
Italy	Dr. Antonino Recupero	Università degli Studi di Messina
Italy	Dr. Donatella Radogna	Università "G. D'Annunzio" di Chieti – Pescara
Italy	Dr. Enrico Sergio Mazzucchelli	Politecnico di Milano

<b>COUNTRY</b>	<b>NAME</b>	<b>ENTITY</b>
Italy	Dr. Fabio Fatiguso	Politecnico di Bari
Italy	Dr. Filiberto Lembo	University of Basilicata
Italy	Dr. Francesco P. Marino	University of Basilicata
Italy	Dr. Gabriele Milani	Politecnico di Milano
Italy	Dr. Graziella Bernardo	University of Basilicata
Italy	Dr. Ippolita Mecca	Pegaso Telematic University
Italy	Dr. Luigi Sorrentino	Sapienza Università di Roma
Italy	Dr. Mariangela De Vita	Università degli Studi dell'Aquila
Italy	Dr. Marianna Rotilio	Università degli Studi dell'Aquila
Italy	Dr. Marianovella Leone	University of Salento
Italy	Dr. Mariella De Fino	Politecnico di Bari
Italy	Dr. Rosa Maria Vitrano	Università degli Studi di Palermo
Italy	Dr. Stefano De Santis	Roma Tre University
Italy	Dr. Valentino Sangiorgio	Università "G. D'Annunzio" di Chieti – Pescara
Italy	Dr. Vito Porcari	University of Basilicata
Mexico	Dr. Bertha Olmos	Univ. Michoacana San Nicolás de Hidalgo
Mexico	Dr. Fernando Peña	Univ. Nacional Autónoma de México
Mexico	Dr. José M. Jara	Universidad Michoacana San Nicolás de Hidalgo
Paraguay	Dr. Pablo Benítez	Universidad Nacional de Itapúa
Peru	Dr. Genner Villarreal Castro	Universidad de San Martín de Porres
Peru	Dr. Eduardo Zárate	Universidad Nacional Pedro Ruiz Gallo
Peru	Dr. Haydeé Chirinos	Universidad Nacional Pedro Ruiz Gallo
Peru	Dr. Nicola Tarque	Pontificia Universidad Católica del Perú
Peru	MSc. William Rodríguez Serquén	Universidad Nacional Pedro Ruiz Gallo
Portugal	Dr. Alice Tavares Costa	Universidade de Aveiro
Portugal	Dr. Ana Cristina Briga de Sá	University of Trás-os-Montes e Alto Douro
Portugal	Dr. Anabela Correia de Paiva	Universidade de Trás-os-Montes e Alto Douro
Portugal	Dr. Bruno Marques	Universidade Lusíada Porto
Portugal	Dr. Carlos Oliveira	Instituto Politécnico de Viana do Castelo
Portugal	Dr. Cilisia Ornelas	FEUP Porto
Portugal	Dr. Cristina Reis	Universidade de Trás-os-Montes e Alto Douro
Portugal	Dr. Daniel V. Oliveira	Universidad de Minho
Portugal	Dr. David Leite Viana	University Institute of Lisbon
Portugal	Dr. Débora Rodrigues de Sousa Macanjo Ferreira	Instituto Politécnico de Bragança
Portugal	Dr. Eduarda Luso	Instituto Politécnico de Bragança
Portugal	Dr. Eva Barreira	FEUP Porto
Portugal	Dr. Fernando F. S. Pinho	Universidade Nova de Lisboa

<b>COUNTRY</b>	<b>NAME</b>	<b>ENTITY</b>
Portugal	Dr. Guilherme Ascensão	Universidade de Aveiro
Portugal	Dr. Hipólito de Sousa	FEUP Porto
Portugal	Dr. Hugo Rodrigues	Universidade de Aveiro
Portugal	Dr. Humberto Varum	FEUP Porto
Portugal	Dr. Inês Flores-Colen	Instituto Superior Técnico-Lisboa
Portugal	Dr. Isabel Torres	Universidade de Coimbra
Portugal	Dr. Isabel Maria Assunção Marta Oliveira Bentes	Universidade de Trás-os-Montes e Alto Douro
Portugal	Dr. Joana Maia de Oliveira Almeida	Instituto Politécnico de Viana do Castelo
Portugal	Dr. João Carlos Gonçalves Lanzinha	Universidade da Beira Interior
Portugal	Dr. João Paulo Miranda Guedes	FEUP Porto
Portugal	Dr. Jorge Tiago Queirós da Silva Pinto	Universidade de Trás-os-Montes e Alto Douro
Portugal	Dr. José Melo	FEUP Porto
Portugal	Dr. José Manuel Santos	Universidade da Madeira
Portugal	Dr. José Miguel Castro	FEUP Porto
Portugal	Dr. Luiz António Pereira de Oliveira	Universidade da Beira Interior
Portugal	Dr. Manuel Pinto	Politécnico de Viseu
Portugal	Dr. Maria do Rosario Veiga	Laboratório Nacional de Engenharia Civil
Portugal	Dr. Maria João Falcão Silva	Laboratório Nacional de Engenharia Civil
Portugal	Dr. Patrício Rocha	Instituto Politécnico de Viana do Castelo
Portugal	Dr. Paulo Lourenço	Universidade de Minho
Portugal	Dr. Pedro Delgado	Instituto Politécnico de Viana do Castelo
Portugal	Dr. Raimundo Mendes da Silva	Universidade de Coimbra
Portugal	Dr. Ricardo Almeida	Politécnico de Viseu
Portugal	Dr. Romeu da Silva Vicente	Universidade de Aveiro
Portugal	Dr. Rui de Oliveira	Instituto Politécnico de Bragança
Portugal	Dr. Rui Fernandes Póvoas	FAUP Porto
Portugal	Dr. Sandra Pereira	Universidade de Trás-os-Montes e Alto Douro
Portugal	Dr. Tiago Martins	UPM - Madrid TECH
Portugal	Dr. Vitor Silva	Universidade de Aveiro
Portugal	Dr. Xavier Romão	FEUP Porto
Serbia	Dr. Marko Marinkovic	University of Belgrade
Spain	Dr. Alfonso Lozano	Universidade de Oviedo
Spain	Dr. Amaia Santamaria	Universidade del Pais Vasco
Spain	Dr. Antonio Aguado	UPC - Barcelona TECH
Spain	Dr. Antonio Burgos Núñez	Universidade de Granada
Spain	Dr. Carlos Renedo	Universidade de Cantabria
Spain	Dr. Carlos Rivera	Universidade de Sevilla

<b>COUNTRY</b>	<b>NAME</b>	<b>ENTITY</b>
Spain	Dr. Carlos Thomas	Universidad de Cantabria
Spain	Dr. César Carrasco	Universidad de Cantabria
Spain	Dr. Cesar Diaz	UPC - Barcelona TECH
Spain	Dr. César Medina	Univeridad de Extremadura
Spain	Dr. David Villanueva	Universidad Europea Miguel de Cervantes
Spain	Dr. Eduardo Sebastian Pardo	Universidad de Granada
Spain	Dr. M <sup>a</sup> Esperanza Rodríguez Mallorga	Universidad de Sevilla
Spain	Dr. Esther Moreno	UPM - Madrid TECH
Spain	Dr. Esther Puertas García	Universidad de Granada
Spain	Dr. Francisco J. García Sánchez	Universidad de Cantabria
Spain	Dr. Gustavo Arcones	Universidad Europea Miguel de Cervantes
Spain	Dr. Haydee Blanco	Universidad de Cantabria
Spain	Dr. Ignacio Lombillo	Universidad de Cantabria
Spain	Dr. Ignacio Marcos	Universidad del Pais Vasco
Spain	Dr. Ignacio Piñero	Tecnalia
Spain	Dr. Isabel F. Sáez	Universidad de Extremadura
Spain	Dr. Iván Flores	Universidad del Pais Vasco
Spain	Dr. Javier Balbás	Universidad de Cantabria
Spain	Dr. Javier Garabito	Universidad de Burgos
Spain	Dr. Javier Pinilla Melo	UPM - Madrid TECH
Spain	Dr. Javier Sánchez Haro	Universidad de Cantabria
Spain	MEng. Jesús Díez	Tecnalia
Spain	Dr. Jorge Aragón	Universidad de La Coruña
Spain	Dr. Jorge Gosálbez	UPV - Valencia TECH
Spain	Dr. José A. Martínez	Universidad de Burgos
Spain	Dr. José M. Adam	UPV - Valencia TECH
Spain	Dr. Josep Lluís i Ginovart	Universitat Internacional de Catalunya
Spain	Dr. Juan Francisco García Nofuentes	Universidad de Granada
Spain	Dr. Juan Manuel Santiago Zaragoza	Universidad de Granada
Spain	Dr. Juan Monjo	UPM - Madrid TECH
Spain	Dr. Juan Pedro Cortes	Universidad de Extremadura
Spain	Dr. Juan Pérez Miralles	Diputación de Castellón - Servicio de Restauración
Spain	Dr. Juan Pérez Valcárcel	Universidad de La Coruña
Spain	Dr. Leire Garmendia	Universidad del Pais Vasco
Spain	Dr. Luca Pelà	UPC - Barcelona TECH
Spain	Dr. Manuel J. Carretero Ayuso	Universidad de Alcalá
Spain	Dr. María de las Nieves González	UPM - Madrid TECH
Spain	Dr. María Jesús Rubio	UPM - Madrid TECH

<b>COUNTRY</b>	<b>NAME</b>	<b>ENTITY</b>
Spain	Dr. Maria L. Ruiz-Bedia	Universidad de Cantabria
Spain	Dr. Maria Paz Sáez	Universidad de Granada
Spain	Dr. Maria Soledad Camino	Universidad de Valladolid
Spain	Dr. Maria V. Biezma	Universidad de Cantabria
Spain	Dr. Miguel Cano	Universidad de Alicante
Spain	Dr. Miguel Cisneros	Universidad de Cantabria
Spain	Dr. Miguel A. Sánchez Carro	Universidad de Cantabria
Spain	Dr. Miguel A. Sanjuan Barbudo	IECA
Spain	MEng. Mónica Sangil	Sika
Spain	Dr. Nelson Tuesta	Universidad Europea Miguel de Cervantes
Spain	Dr. Pablo Pujadas Álvarez	UPC - Barcelona TECH
Spain	Dr. Pere Roca	UPC - Barcelona TECH
Spain	Dr. Pilar Alonso	Universidad de Valladolid
Spain	Dr. Purificación González Martínez	Universidad de Navarra
Spain	Dr. Rafael Gallego Sevilla	Universidad de Granada
Spain	Dr. Ramón Sancibrián	Universidad de Cantabria
Spain	Dr. Rosa Bustamente	UPM - Madrid TECH
Spain	Dr. Roser Martínez Ramos e Iruela	Universidad de Granada
Spain	Dr. Salvador Ivorra	Universidad de Alicante
Spain	Dr. Santiago Bellido	Universidad Europea Miguel de Cervantes
Spain	Dr. J. Tomás San José	Universidad del País Vasco
Spain	Dr. Yosbel Boffill	Universidad de Cantabria
Turkey	Dr. Meltem Vatan	Bahcesehir University
United Kingdom	Dr. Giovanni Pesce	Northumbria University
United Kingdom	Dr. Marco Corradi	Northumbria University
United Kingdom	Dr. Tiago Miguel Ferreira	University of the West of England (UWE Bristol)
United States of America	Dr. Francisco J. de Caso y Basalo	University of Miami
United States of America	Dr. Matthew Dejong	UC Berkeley
United States of America	Dr. Miguel A. Pando	Drexel University
United States of America	Dr. Stephen Kelley	University of Illinois
Uruguay	Dr. Gemma Rodriguez de Sensale	Universidad de la República
Uruguay	Dr. Gonzalo Cetrangolo	Universidad de la República

**2.- PROJECT**
**2.1.- Theoretical criteria of the intervention project.**

239	AN INSIGHT INTO THE ADJUSTMENTS FOR CHANGES IN COSTS FORMULA FOR CONSTRUCTION CONTRACTS ATTENDING REAL PLANNING <i>Oliveira, Rui A. F.; Abreu, Maria Isabel; Lopes, Jorge</i>	147
245	INTERVENTION ON DIFFUSED ARCHITECTURAL HERITAGE IN SEISMIC AREA: WHICH INVESTIGATIONS FOR WHICH INTERVENTION? <i>Saisi, Antonella</i>	148
295	DIFFERENT METHODOLOGIES FOR EVALUATING THE EQUIVALENT DAMPING RATIO DUE TO CROSS LAMINATED TIMBER ROOF STRUCTURE IN SEISMIC RESTORATION OF AN HISTORICAL CHURCH <i>Longarini Nicola; Crespi Pietro; Zucca Marco</i>	149
325	CONSERVATION-RESTORATION OF STONE MATERIALS: PROTOCOL FOR THE DEVELOPMENT OF PROJECTS BASED ON THE CHARACTERIZATION AND KNOWLEDGE OF THE MATERIALS <i>Zornoza-Indart, Ainara; Guasch-Ferré, Núria; Gaudenzi, Mainardo; Anthonisen-Añabeitia, Iraia</i>	150
357	MINIMUM INTERVENTION CRITERIA AS A REFERENCE IN THE SPANISH FORTIFICATIONS' CONSERVATION AND VALORISATION <i>Gómez Martínez, Vidal</i>	151

**2.2.- Traditional materials and construction methods.**

22	INFLUENCE OF THE RUSTIC CONSTRUCTION TECHNIQUE OF THE BAMBOO ENVELOPE ON THE THERMAL PERFORMANCE OF VERNACULAR HOUSING IN THE ECUADORIAN COASTAL REGION: THE CASE OF EL CARMEN-MANABÍ <i>Carpio, Rodrigo; Valarezo, Fernanda; Aguirre-Maldonado, Eduardo; Balcázar-Arciniega, Cristian</i>	152
23	USE OF RECYCLED AGGREGATES FROM DEMOLITION AND CONSTRUCTION WASTE IN THE DEVELOPMENT OF SOIL-BASED MATERIALS <i>Figuerola- Torres, Mateo; Balcázar- Arciniega, Cristian; Aguirre- Maldonado, Eduardo</i>	153
24	CEMENT SUBSTITUTE BASED ON RECYCLED MARBLE POWDER TO IMPROVE THE STRENGTH AND DURABILITY OF MORTAR <i>Carpio- Moreno, Valeria; Balcázar- Arciniega, Cristian; Aguirre- Maldonado, Eduardo</i>	154
25	ADOBE STABILIZED WITH ASHES FROM THE COMBUSTION OF PRUNING AND GARDENING WASTE <i>Pinzón- Sinche, Christian; Balcázar- Arciniega, Cristian; Aguirre- Maldonado, Eduardo</i>	155
65	IMPLEMENTATION OF COLOMBIAN TRADITIONAL MATERIALS IN CONTEMPORARY ARCHITECTURE – ANALYSIS OF ARCHITECT SIMÓN VÉLEZ' WORKS <i>Salazar-Ocampo, Carolina; Tolosa-Correa, Ricardo Augusto</i>	156
105	EXPERIMENTAL AND NUMERICAL ANALYSIS FOR EARTH STRUCTURES, FROM MATERIAL CONSTITUENTS TO MASONRY WALLS <i>Baldelli, Jacopo; Baraldi, Daniele; Boscato, Giosuè; Cecchi, Antonella; Thatikonda, Nandini Priya</i>	157
109	ANALYSIS OF THE PERFORMANCE OF NATURAL LIGHTING IN TRADITIONAL ARCHITECTURE ON LAND. THE CASE OF THE CITY OF LOJA, ECUADOR <i>Torres-Iñiguez, Nicole; Aguirre-Maldonado, Eduardo; Balcazar-Arciniega, Cristian</i>	158
114	COLLABORATIVE WORK PRACTICES IN THE IMPROVEMENT OF TRADITIONAL HOUSING IN BOLIVIA'S CHIQUITANIA REGION <i>Monteros Cueva, Karina; Soto Toledo, Katherine Haydee</i>	159
115	ARGAMASA: THE EXPRESSION OF AN INDIGENOUS COMMUNITY FOR THE NOVO HISPANIC BAROQUE OF THE SIERRA GORDA IN QUERETARO, MÉXICO <i>Álvarez López, María del Pilar; Nava Townsend, José María Wilford</i>	160
117	CONSTRUCTION OF A PREFABRICATED VAULT PROTOTYPE WITH RAW EARTH AND WOOD AS A ROOF FOR BUILDINGS <i>Cruz-Naranjo, Katherine; Cárdenas-Haro, Xavier; López-Palacios, Martín; Vélez-Dávila, Julio; Serrano-Tapia, Alex</i>	161
153	LESSONS FROM VERNACULAR BAMBOO ARCHITECTURE FOR SUSTAINABLE DESIGN IN HOT HUMID AREAS OF COASTAL MANABI <i>Platt, Guy; Aguirre-Maldonado, Eduardo; Balcázar-Arciniega, Cristian</i>	162
171	EVALUATION AND CHARACTERIZATION OF THE BUILT RURAL ENVIRONMENT OF THE MONTESINHO NATURAL PARK, PORTUGAL. THE INHAVIT PROJECT <i>Luso, Eduarda; Ferreira, Débora</i>	163
186	COMPARATIVE STUDY OF CONSTRUCTION OPTIONS BASED ON SUSTAINABILITY ASSUMPTIONS <i>Rivani, Maria L. A.; Oliveira, Rui A. F.; Ribeiro, Rodrigo S.</i>	164

**CODE 239****AN INSIGHT INTO THE ADJUSTMENTS FOR CHANGES IN COSTS FORMULA FOR CONSTRUCTION CONTRACTS ATTENDING REAL PLANNING****Oliveira, Rui A. F.<sup>1</sup>; Abreu, Maria Isabel<sup>2</sup>; Lopes, Jorge<sup>3</sup>**

Departamento Construções Civas e Planeamento. Instituto Politécnico de Bragança

e-mail: [roliveira@ipb.pt](mailto:roliveira@ipb.pt); [isabreu@ipb.pt](mailto:isabreu@ipb.pt); [lopes@ipb.pt](mailto:lopes@ipb.pt)**KEYWORDS:** Exceptional Regime; Homologous rate of change; Adjustment for changes in cost; Current formulas; Current cost indices; Adjustment multiplier; Construction contracts.**ABSTRACT**

The cost management of construction contracts has required increasing rigor, using methodologies that can be adjusted to the diversity of cyclical changes. Price fluctuations, especially price increases in construction materials, due to the unstable market situation, require planning and decision-making that starts with the project. In many cases, planning is done considering only the present, but during the construction works unforeseen events and various external factors arise, which in many cases do not allow for procedural changes at a bureaucratic level, triggering management problems and money losses. The “adjustment for changes in cost” applicable to contracts covers the updating of prices based on updated indices of materials, labour, and equipment, but in certain phases of the construction works they do not compensate for the real and effective increase in prices of some materials. The adjustment for changes in cost is made based on an average of the most significant materials present in the project design, distributed throughout the construction works (contract application).

About a year ago, the exceptional regime applicable to adjustment for changes in cost, as known by “price revision” was created, and its application was extended until December this year, and considered other activities. This change contemplates the possibility for interested parties to present a correction or change in the application of the adjustment for changes in cost regime. This is attended to when the current one is not adjusted to the specificities of the contract or when it is omitted in the specifications. The new regime allows this adjustment, but in the future, this may not be possible, so the design of “adjustment for changes in cost” formulas must take into account some particularities of the construction work and foresee possible constraints, and lessons can be learned from current price inflation.

The paper intends to present formulas present in construction contracts and the proposal of possible solutions, procedures, and adjustments to these formulas, considering the planned planning for them. Their application in the calculation using the formulas meets the materials applied on specific dates, often neglected situations. The establishment of comparisons between the different projects under study allows us to know the financial compensation for contractors in the different situations studied, extending the comparisons with the price increase that occurred in materials.