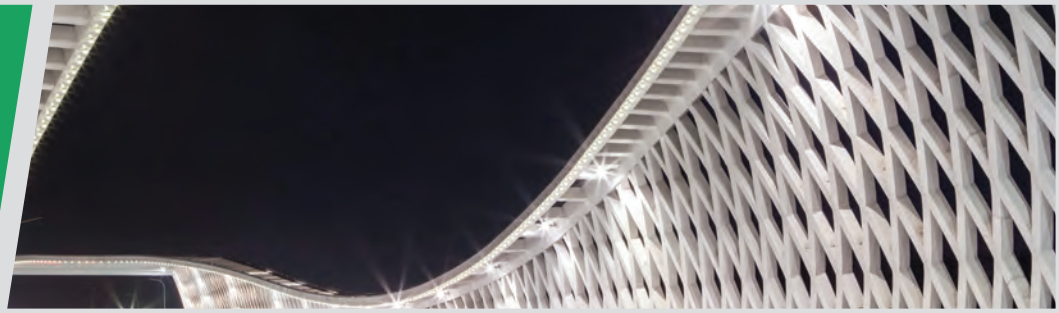
ISISE NEWS LETTER

18. BIANNUAL
MARCH, 2020



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ISISE AGAINST COVID-19

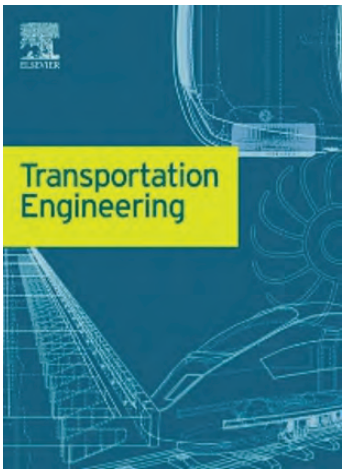
These are exceptional times, with an unforeseeable crisis that has almost paralyzed the world. The pandemic has shown how vulnerable our societies are but also people's commitment and responsibility. Thanks to everyone who makes the world a safer and better place. After difficult times, brighter days will come.
ISISE, as all of us, is being affected, cancelling events, stopping testing activities, delaying part of the activity and postponing some of the personnel hiring.
We appreciate the effort made by our members and our host institutions to keep the Institute operating. In particular, we express our strongest solidarity to our (many) international members, far away from their family and countries.

ISISE HIGHLIGHTS

The Management Board from ISISE was just reappointed for a new term, keeping Paulo B. Lourenço as Head and Luís Simões da Silva as Co-Head. The Board further includes as Vice-Heads José Sena-Cruz and Carlos Rebelo. ISISE currently comprises about 220 researchers (80 PhD members and 160 PhD students). ISISE research was recently evaluated as "Very Good" in the Research Assessment Exercise by the Portuguese Science Foundation. According to the three rankings that consider the "scientific area" / "subject", where research impact plays a key role (Shanghai Ranking, NTU Ranking and QS World University Rankings), "Civil Engineering" is the best research area in our host institutions, and top 140 in the world.
We thank in advance the new Advisory Panel of our Institute: Bill Spencer from University of Illinois at Urbana-Champaign, David Nethercot from Imperial College, Francesco Asdrubali from Roma Tre University and Henrik Stang from DTU. We also thank our past Advisory Board for the great job of the last period: Bozidar Stojadinovic from ETHZ, Thanasis Triantafillou from University of Patras and Olivier Vassart from ArcelorMittal.

ISISE HIGHLIGHTS (CONTINUED)

It is excellent news that ISISE received two long term postdoctoral positions from the Portuguese Science Foundation, as a result of a national-wide competition with a success rate of only 8%. The awardee distinguished researchers are Mohammadali Rezazadeh and Tiago M. Ferreira. ISISE is also the host of a new prestigious Marie Skłodowska-Curie Individual Fellowship from this year application. Congratulations to Lucía Garijo and welcome to ISISE.



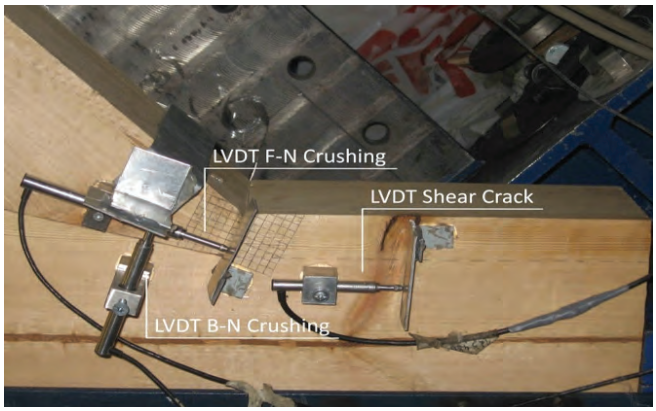
António Gomes Correia has been appointed as editor of a new Elsevier journal "Transportation Engineering". After an important success of the Elsevier Journal Transportation Geotechnics (SCIE, IF:2,385), Prof. António Gomes Correia was invited by Elsevier to be the Editor-in-Chief of this new Journal launched in January 2020. Transportation Engineering covers all aspects of transport engineering, including both vehicle engineering (including automotive, aerospace, and naval) and civil engineering (planning, design, construction, maintenance, and operation for all type of systems infrastructures). The journal welcomes papers on all topics related to transportation engineering as well as integrated research where intelligent vehicles and intelligent infrastructure meet in order to address the safety and quality of life of the end users. More details at: https://www.journals.elsevier.com/transportation-engineering/

R&D COMPLETED PROJECTS

> **ProTimber – Probabilistic Assessment of Existing Timber Structures**

ISISE Principal Investigator: *Jorge Branco*
Budget: *Global: 199.542,00€/ISISE-UM: 81.726,00€*
ID: *PTDC/ECM-EST/1072/2014*
Funding Entity: *FCT*
Principal Contractor: *LNEC*
Duration: *From 01/06/2016 to 31/12/2019*
Summary: ProTimber project aimed at applying probabilistic models based on non and semi-destructive testing methods (including visual strength grading) for the assessment of existing timber structures (historic or not).
The project tackled four main issues: 1) how to obtain reliable predictions about the resistance variables associated with timber structural elements (solid timber and GLT); 2) how to proceed with the probabilistic assessment of structural joints; 3) how to evaluate, in a reliable way, the effect of load history and decay; 4) how to incorporate this information in a coherent manner in order to promote a true probabilistic assessment of timber structures.

The results of the project included, among others, the use of Bayesian networks for assessing the reference mechanical properties of solid timber based on an automatic algorithm that rearranges the nodes of the network in order to obtain the best precision of prediction. Moreover, a model for probabilistically define the distance between knots and its size was made with information obtained by experimental results.



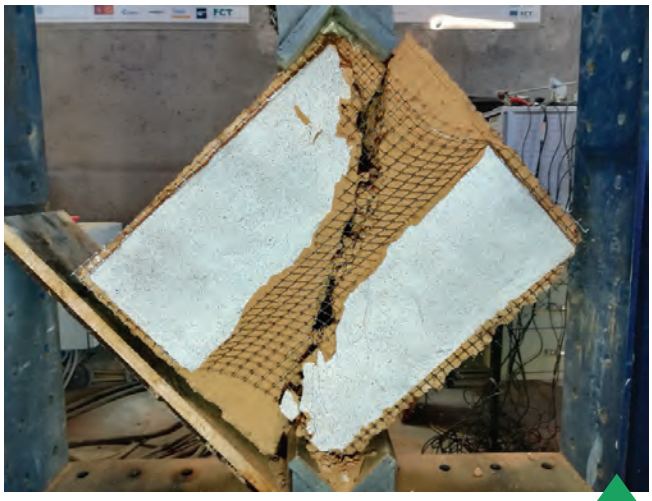
> ASPASSI – Safety evaluation and retrofitting of infill masonry enclosure walls for seismic demands

ISISE Principal Investigator: *Graça Vasconcelos*
Budget: *Global: 199.680,00€/ISISE-UM: 44.928,00€*
ID: *PTDC/ECM-EST/3790/2014*
Funding Entity: *FCT*
Principal Contractor: *Universidade do Porto*
Duration: *From 01/06/2016 to 30/11/2019*
Summary: The major objective of the contribution of UMinho for the project was the assessment of the effect of strengthening of masonry infills in the in-plane and out-of-plane behavior of RC frames with masonry infill walls. The strengthening was based on designed textile reinforced meshes (textile reinforced rods – DTRM; commercial meshes – CTRM). In addition, steel ties were also used to assess the influence of the connection of internal and external leaves in the out-of-plane behaviour. The validation of the mechanical performance of the textile meshes was based on the cyclic in-plane and out-of-plane testing on RC frames with masonry infills designed to represent rc frames from the eighties. From the experimental results, it was seen mainly that: (1) the textile reinforced mortar (TRM) technique enhanced the in-plane behavior of infilled frame, namely the initial stiffness and lateral strength; (2) the textile reinforced meshes did not represent a significant increase in the out-of-plane resistance of masonry infill walls; (3) both for the in-plane and out-of-plane loading, the textile meshes were important to control the damage in the masonry infills.

Strengthening of masonry infills

> SafEarth – Seismic protection of earthen construction heritage

ISISE Principal Investigator: *Rui Silva*
Budget: *Global: 199.752,00€/ISISE-UM: 85.416,00€*
ID: *PTDC/ECM-EST/2777/2014*
Funding Entity: *FCT*
Principal Contractor: *UMINHO*
Duration: *From 01/06/2016 to 30/11/2019*
Summary: A better comprehension on the seismic performance of the earthen built heritage is of utmost importance to promote its correct preservation. This lack of knowledge is a matter of concern for many countries around the world, namely for Portugal, where an important built heritage made of adobe and rammed earth can be found. The SafEarth project sought to respond to this lack of knowledge by using advanced experimental procedures and numerical approaches to: (i) identify seismic culture aspects of earthen constructions from Portugal; (ii) characterize comprehensively the mechanical behavior of earthen materials; (iii) develop and characterize a compatible



Diagonal compression test on TRM-strengthened wallet

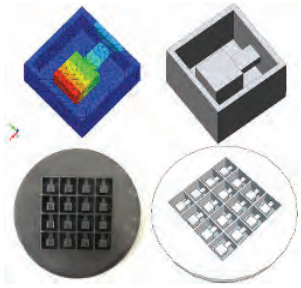
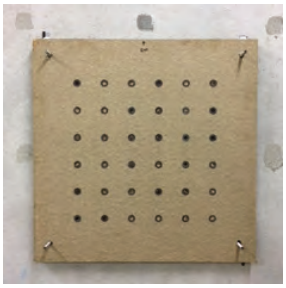
TRM-based strengthening solution; (iv) characterize the quasi-static behavior of structural earthen components and buildings; (v) characterize the dynamic behavior of structural earthen components and buildings; (vi) develop numerical models capable to correctly portray the dynamic behavior of structural earthen components and buildings. As a highlight of the developed activities, a dataset of results from shaking table tests was obtained and guidelines for seismic assessment and preservation of earthen buildings were proposed.

Shaking table test

> Development of high-performance multifunctional panels | SMARTCORE

ISISE Principal Investigator: *Paulo Amado Mendes*
Budget: *Global: 609732€*
ID: *POCI-01-0247-FEDER-017759*
Funding Entity: *COMPETE2020, Portugal2020 and FEDER*
Principal Contractor: *Vicaima – Indústria de Madeiras e Derivados, S.A.*
Duration: *From October 2016 to December 2019*
Summary: The objective of this research project was the development of new concepts of construction panels, incorporating innovative and sustainable core solutions for acou stic and thermal insulation, in national and international terms, for application in separating systems or in noisy equipment encapsulation.

The development intended to maximize the performance (at different levels, such as acoustic, thermal, fire resistance, durability and sustainability) of the multifunctional products, without compromising its operability with higher weights and thickness, and being flexible to be incorporated into different types of final solutions, such as doors, panels, separating walls or equipment encapsulations. The systems were validated in the laboratory, giving it a high commercial value and, cumulatively, high exportation potential.

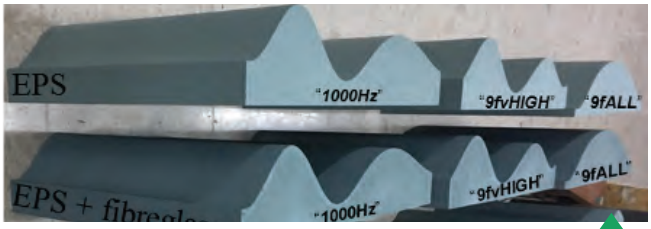
a)  b) 

a) Micro-resonant structures studied using a FEM model (top), and materialized by 3D printing (bottom); b) Reduced-scale testing of panels with embedded resonant masses

The project was developed in a sequence of tasks and sub-tasks, structured in order to achieve the defined objectives and its success. Some of the tasks and activities took place with some time overlap, benefitting of a development in parallel. The following tasks were considered: preparatory and follow-up studies; design and development of core material; industrialization and incorporation into products; experimental validation and performance evaluation; final product characterization; promotion and dissemination; technical project management.

> New 3D acoustic diffusers with organic shape | 3DFuser

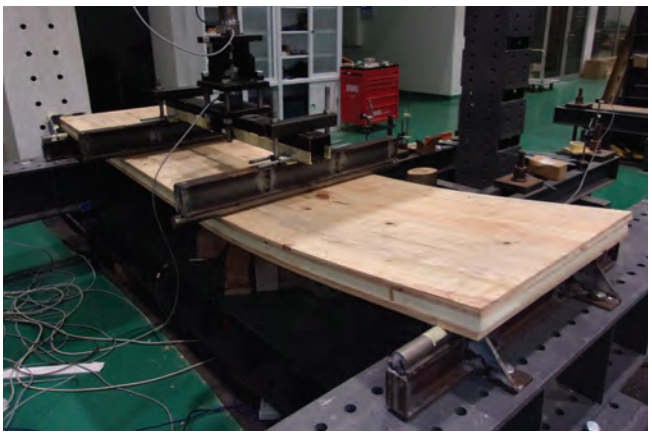
ISISE Principal Investigator: *Paulo Amado Mendes*
Budget: *Global: 10000€*
Funding Entity: *INOV C 2020 and CENTRO 2020*
Principal Contractor: *University of Coimbra*
Duration: *From July 2018 to October 2019*
Summary: Acoustic diffusers are currently used in the acoustic conditioning of spaces with greater acoustic requirements (for example, studios, theatres, etc.). Most of the diffusers currently available correspond to solutions with angular geometries and based on parallelepiped wells or sub-elements (in fact, many are based on the well-known Schroeder diffusers). Its appearance is quite depreciated by architects and users of the rooms for which they are intended. There are variations of this type of acoustic diffusers on the market, often designed more for aesthetic reasons than as a result of optimizing its performance. The main objective of this project was to demonstrate the possibility of developing innovative solutions of acoustic diffusers with optimized acoustic performance, based on the most modern techniques of numerical modelling and optimization, which can present a more organic shape (i.e. curvilinear) and be aesthetically more appreciated. and better accepted. In this context, there is a clear opportunity to develop highly innovative products, duly certified experimentally and with the potential for industrialization and commercialization. In the scope of a recently concluded PhD thesis in the University of Coimbra, advanced numerical modelling techniques have been developed and implemented that, together with the development of optimization tools, such as genetic algorithms, allowed to obtain surfaces of the diffuser elements optimized from the point of view of diffuse reflections. With this project, the mathematical principles and optimization criteria underlying the development of acoustic diffusers had dedicated attention, in view of the integration of product design concepts, in order to allow them to be effectively produced on an industrial scale (industrial requirements of production), be economically viable and add value to potential customers and users. From the solutions obtained within the numerical optimization process, prototypes were manufactured for experimental acoustic evaluation (the diffusion coefficient). The prototyping of the models enable assessing the product's empathy with potential consumers, anticipating industrialization errors and choosing the type of materials and manufacturing processes to implement.



Organic shaped acoustic diffusers: EPS prototypes constructed, without surface finish and with fiberglass finish

> OPTIMIZEDWOOD – Optimização de recursos florestais na construção

ISISE Principal Investigator: *Alfredo Dias*
Budget: *Global: 465 615 € /ISISE: 192 144 €*
ID: *POCI-01-0247 FEDER-017867*
Funding Entity: *P2020*
Principal Contractor: *Pedrosa e Irmãos, SERQ, UC, IPL*
Duration: *From 01/12/2016 to 30/11/2019*
Summary: The main objective of this project is to develop and validate a wood-based product for structural application with many innovative features. We intend to develop this project through co-branding between four distinct entities: the leading promoter,



Pedrosa e Irmãos (P&I), and basic and applied research copromotores, University of Coimbra (UC), the Center for Innovation and Skills of forest (SerQ) and the Polytechnic Institute of Leiria (IPLeiria). The product to develop will be innovative in various perspectives, such as: optimization of structural and non-structural performance of the own panel, possibility of improvement of electromagnetic shielding, more rational use of raw materials and increased value of national species of wood. The research will also include the development of connection technology between the panels themselves but also the compatibility of these with the existing building. The reach of the objectives necessarily presupposes the use of a set of complementary methodologies related to each other such as document analysis, numerical simulation, experimental analysis and industrial production.

R&D STARTED PROJECTS

> **Opening architectural heritage to communities during the post-earthquake long-term restoration process: digital technologies and new competencies for cultural professionals**

ISISE Principal Investigator: *Paulo Lourenço*
Budget: *Global: 337.000,26€/ISISE-UM: 65.001,01€*
ID: *OPHERA - 607601-CREA-1-2019-1-IT-CULT-COOP1*
Funding Entity: *EC – Creative Europe*
Principal Contractor: *Ministero per i Beni e le Attività Culturali*
Duration: *From 15/10/2019 to 14/06/2021*

> **Heritage Within**

ISISE Principal Investigator: *Javier Ortega*
Budget: *Global: 406.844,07€/ISISE-UM: 134.440,50€*
ID: *H-Within - 614719-CREA-1-2019-1-PT-CROSS-SECT-INNOVLAB*
Funding Entity: *EC – Creative Europe*
Principal Contractor: *University of Minho*
Duration: *From 01/01/2020 to 30/06/2021*

> **CircularBIM**

ISISE Principal Investigator: *Miguel Azenha*
Budget: *Global: 224.240,00€/ISISE-UM: 27.350,00€*
ID: *2019-1-ES01-KA203-065962*
Funding Entity: *EC – Erasmus+ (KA 2 – Parcerias Estratégicas)*
Principal Contractor: *Universidad de Sevilla*
Duration: *From 01/09/2019 to 31/08/2021*

> **Cognitive Computerized Maintenance Management System**

ISISE Principal Investigator: *Miguel Azenha*
Budget: *Global: 1.843.824,13€/ISISE-UM: 285.667,59€*
ID: *CMMS - 33574*
Funding Entity: *ANI*
Principal Contractor: *Valuekeep, Lda.*
Duration: *From 19/10/2019 to 18/10/2022*

> **AMConstruction – Additive Manufacturing in Steel Construction**

ISISE Principal Investigator: *Trayana Tankova*
Budget: *Global: 249 998,40€/ISISE-UC: 124 999,20€*
Funding Entity: *International Patronage R&D UC Program 2019*
Duration: *From 01/01/20 to 31/12/23*

> **WUIFireSafe – Safety Enhancement and Resilience of Wildland-Urban Interface Areas Against Fire**

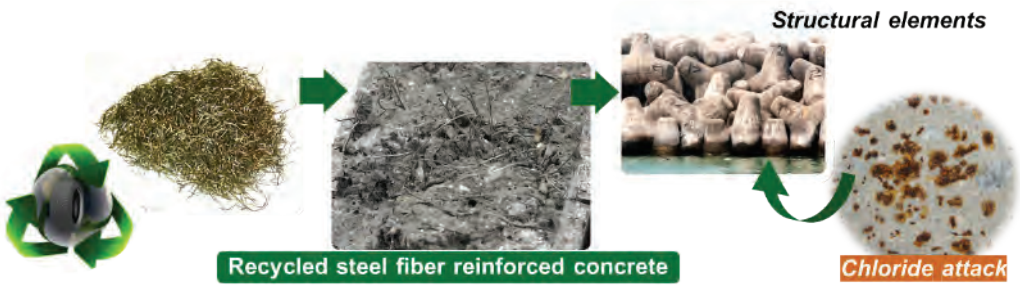
ISISE Principal Investigator: *Hélder Craveiro*
Budget: *Global: 299.915.00€/ISISE-UC: 149.179,00€*
ID: *PCIF/AGT/0062/2018*
Funding Entity: *Portuguese Foundation for Science and Technology*
Principal Contractor: *University of Coimbra*
Duration: *From 1/1/2020 to 31/12/2022*

COMPLETED PHD THESES

> Recycled Steel Fiber Reinforced Concrete for Structural elements subjected to chloride attack: Mechanical and Durability performance

Author: Cristina Maria Vieira Frazão
Supervisors: Joaquim Barros; José Alexandre Brito Aleixo Bogas (IST)
Date: 19/12/2019
Summary: The main purpose of this PhD research was to assess the potentialities of using recycled steel fibers (RSF) from the tire recycling industry as an effective reinforcement of concrete (RSFRC) subjected to chloride environment, with focus on its mechanical and durability performance. To achieve such goal, the research methods included: (i) State-of-the-art review; (ii) Laboratory experiments; (iii) Analytical/Numerical research; and (iv) Life Cycle Analysis. A sustainable mix composition of RSFRC was attained with 1% in volume of RSF. The obtained results showed that used RSF had not inferior post-cracking strengthening performance that Industrial Fibers. RSF corrosion in uncracked concrete should be essentially a surface phenomenon. For 3 months of dry-wet chloride cycles, a negligible effect of chloride attack was observed on the post-cracking behavior of pre-cracked RSFRC with crack widths up to 1 mm. The post-cracking constitutive laws of the RSFRC were obtained by inverse analysis.

CV: **Cristina Frazão** is a Civil Engineering graduated from FEUP/University of Porto and with a master's degree from University of Minho. She has strong experience in the design of concrete structures, and in the experimental research to characterize the mechanical and durability performance of fiber reinforced cement-based composite materials. Currently, she is a collaborator of CiviTest Company.



Motivation of the PhD Research

EVENTS

> XII Conference on Steel and Composite Construction

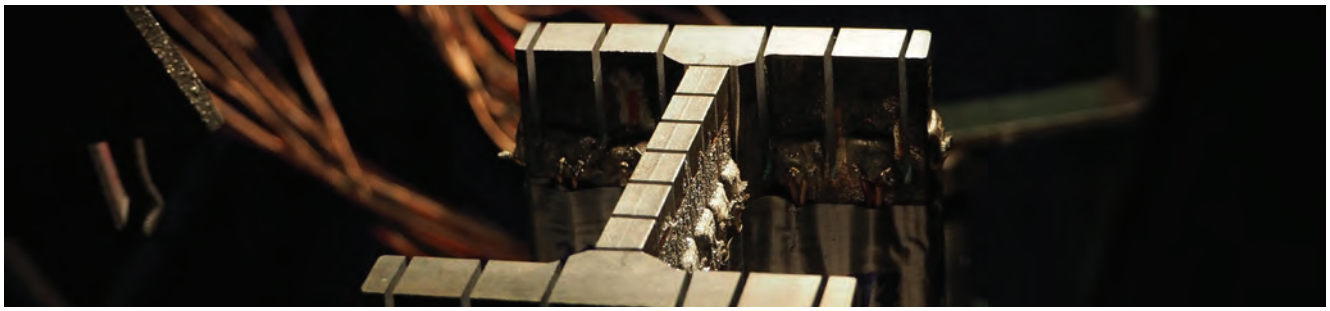
Venue: Convento São Francisco, Coimbra
Date: From 21/11/2019 to 22/11/2020
Website: https://www.cmm.pt/congresso12
Summary: The XII Conference on Steel and Composite Construction intended to promote the most recent innovations and achievements in this type of construction, and contributing decisively for the promotion, consolidation and development of the sector. In this edition it has been given special relevance to the theme "Steel structures as an answer to climate changes".

> DENORMS COST Action CA15125 – Final event & Exhibition "Acoustics and Beyond"

Venue: Department of Civil Engineering & Science Museum of the University of Coimbra, Coimbra
Date: From 18/02/2020 to 21/02/2020 & From 21/02/2020 to 31/02/2020
Website: https://denorms.eu/2019/05/03/workshop-8/ & http://www.museudaciencia.org/index.php?module=events&option=exhibitions&action=&id=988
Summary: The COST funding for four years of networking activities came to an end. To celebrate the networking achievements of the these four years, the DENORMS COST Action CA15125 Final event took place from 18th to 21st February 2020 in the University of Coimbra (Portugal) and was the occasion of promoting the Action's breakthroughs.
Rings, bracelets or a necklace? No! These are structures that interact with sound and vibrations to make everyday life better for everybody. Hidden in houses, cars, or outside they make your room more quiet or stop your car seat from shaking. Acoustic labyrinths can even slow sound down. Art, aesthetics, and science go hand in hand to create modern applications. The exhibition "Acoustics and Beyond" is shown from February 21st until March 31st 2020 in the Science Museum of the University of Coimbra. It shows objects and interactive installations made in universities all over the world, straight out of the laboratory. You can discover how sound can travel, and how science helps to keep the noise around us low.

> 3rd Rilem Spring Convention 2020 – Ambitioning a sustainable future for built environment: Comprehensive strategies for unprecedented challenges

Venue: Guimarães
Date: From 09/03/2020 to 14/03/2020
Website: https://www.rscc2020.civil.uminho.pt/
Summary: 'Ambitioning a Sustainable Future for Built Environment: comprehensive strategies for unprecedented challenges' was the theme of the 3rd RILEM Spring Convention and Conference 2020, which took place in Guimarães for 6 days. Delegates from more than 50 different countries have participated in two venues, the School of Engineering at the University of Minho and an adapted virtual world!



> **10th meeting of the fib Working Group 2.4.2 – Modelling of Fibre reinforced concrete structures**

Venue: Guimarães
Date: March 9th, 2020
Summary: The actual version of the chapters of the state-of-the-art that is being prepared were discussed. Two-twin real scale T cross section steel fibre reinforced concrete beams flexurally reinforced with conventional steel bars and without conventional shear reinforcement in the shear span were tested under the framework of a benchmark for predicting the behaviour of this type of beams up to failure. 37 proposals were received, and the results are planned to be announced during April 2020.

UPCOMING EVENTS

> **Conference IPW 2020**

Venue: *Guimarães, Portugal*
Date: *September 23-25, 2020*
Website: *www.ipw2020.com*

> **ISCHP 2021 – International Scientific Conference on Hardwood Processing**

Venue: *University of Coimbra*
Date: *Summer of 2021*
ISISE Member: *Sandra Monteiro and Prof. Alfredo Dias*

> **IX Workshop on Connections in Steel Structures**

Venue: *Coimbra, Portugal*
Date: *New dates TBA*
Website: *https://connectionsix.dec.uc.pt*

MASTER COURSES

> Advanced Masters in Structural Analysis of Monuments and Historical Constructions (SAHC)

Venue: Dept. of Civil Engineering University of Minho
Website: http://www.msc-sahc.org/
Application dates:
> 2nd Call: 20th May 2020
> 3rd Call: 20th August 2020

> European Master in Building Information Modelling (BIM A+)

Venue: Dept. of Civil Engineering University of Minho
Website: https://bimaplus.org/
Application dates:
> 2nd Call:31st May 2020
> 3rd Call: 31st August 2020

Master in Structural Engineering (STREMUM)

Venue: Dept. of Civil Engineering University of Minho
Website: http://www.stremum.uminho.pt/
Application dates:
> 1st call: 24th April 2020
> 2nd Call: 15th July 2020
> 3rd Call: 2nd September 2020

PHD COURSES

> Doctoral Program Steel and Composite Construction

Venue: Dept. of Civil Engineering, University of Coimbra
Website: https://apps.uc.pt/courses/EN/course/8181
Application dates:
> 2nd call: 1st April until 15th June 2020
> 3rd: 17th to 31st August 2020
> EXTRA: 15th to 26th October 2020

> Doctoral Program in Civil Engineering

Venue: Dept. of Civil Engineering University of Minho
Website: http://www.pdec.civil.uminho.pt/
Application dates:
> 2nd call 1st Edition 2020/2021: 10th July until 30th July 2020
> 3rd call 1st Edition 2020/2021: 1stz September until 24th September 2020
> 1st call 2nd Edition 2020/2021: 10th July until 30th July 2020
> 2nd call 2nd Edition 2020/2021: 07th December until 18th December 2020