Institute for Sustainability and Innovation in Structural Engineering

ISISE NEWSLETTER

28. BIANNUAL

MAY · 2025

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▪ ISISE Awarded EXCELLENT Rating by FCT

It is excellent news that ISISE has been awarded an EXCELLENT rating in the latest evaluation by FCT – Fundação para a Ciência e a Tecnologia. This distinction highlights the high-quality research, innovation, and impact produced by our team in the fields of structural engineering, sustainability, and advanced technologies. We extend our sincere thanks to all researchers, collaborators, and partners whose dedication and contributions made this achievement possible.

Institute for Sustainability and Innovation in Structural Engineering

Fundação para a Ciência e a Tecnologia

▪ European Researchers Night 2024

On September 27th, ISISE institutions participated in the European Researchers' Night 2024, under the theme "Science for Global Challenges." Held annually on the last Friday of September, this event is designed for the general public, with a special focus on families, pupils, and students, particularly those less engaged in STEAM fields or research activities. It provided a fantastic opportunity to showcase our work and engage in discussions on how science can help address some of the most pressing global challenges.

IMPACT STORIES

Luis Carlos M. Silva
Politecnico di Milano

ISISE gave me the foundation to start and build my academic career. It introduced me to my mentor, exceptional faculty members, and the HMS network...

- **In which circumstances did you join ISISE?**

My time at the University of Minho in Guimarães began in 2008, when I enrolled in the Integrated master's in civil engineering. After working for a year as a structural engineer in a consulting office, I joined ISISE at the end of 2014 as a PhD student.

- **How would you describe your experience in ISISE?**

My experience at ISISE was intense and far beyond just a professional one. I was fortunate to have an extraordinary mentor and role model who helped me build a solid technical foundation, provided valuable guidance, and gave me the autonomy to learn and continuously grow - even to this day.

Guimarães is a small city, and even so the Institute has gained such strong international recognition that it attracts many Master's, PhD, and Post-doc students from around the world. There are a lot of opportunities for international collaboration, as do chances to learn about new cultures and make lasting friendships. These experiences brought deep emotional meaning to my time at ISISE.

- **Is there any anecdotal situation that you experienced in ISISE, that is worthy of sharing?**

I have countless memories from my time at ISISE. What stands out most is the positive environment created by the amazing people I met over six years. I fondly remember the many dinners filled with laughter and long conversations, the international meals introducing new flavours, the tennis matches, the Christmas group dinners, the ISISE day-out events, and the local and international conferences hosted at UMinho. And of course, the incredible weekly football games — which were taken very seriously!

- **What was the impact of your time in ISISE on your career? And friends?**

ISISE gave me the foundation to start and build my academic career. It introduced me to my mentor, exceptional faculty members, and the HMS network. Without that opportunity and the growth I experienced there, my academic path would have looked very different — perhaps it would not even start. So, the impact was deeply significant.

On a personal level, ISISE also played an important role. I often say that ISISE gives you the gift of having friends all around the world!

R&D COMPLETED PROJECTS

▪ EVACUARFLORESTA

ISISE Principal Investigator: Aldina Santiago
Budget: Global: € / ISISE-UC: 269 990 00€
ID: PCIF/AGT/0061/2019
Funding Entity: FCT
Principal Contractor: UC
Duration: From 01/03/2021 to 28/02/2025
Summary: The research project EVACUARFLORESTA – Decisions and Evacuation Plans in Wildfire Scenarios, was funded by the Portuguese Foundation for Science and Technology (FCT) under the Programme for the Prevention and Combat of Forest Fires, created in response to the tragic 2017 wildfires. The project was led by the University of Coimbra, in partnership with the National Firefighters School (ENB) and the Forest Innovation and Competence Centre (SERQ). Evacuating during a wildfire is a complex process, requiring integrated planning, risk assessment, and timely alerts. Success depends on accurate models of fire behaviour, traffic, and human responses. While urban areas have been prioritised, small and medium-scale evacuations in fire-prone regions are increasingly critical, with strategies varying based on geography and vulnerability. This project aimed to support decision-making by: (i) characterizing territorial and demographic features; (ii) estimating evacuation risk; (iii) modelling human behaviour; (iv) evaluating protective-action scenarios; (v) optimising vehicle use and routing under uncertainty; and (vi) promoting public awareness and resilience through education and training. Case studies were selected in two regions severely affected by wildfires: Lousã and Sertã.

▪ MNARQ – Análise Sísmica do Museu Nacional de Arqueologia

ISISE Principal Investigator: Paulo Lourenço
Budget: Global: 37 500,00€ / ISISE-UM: 37 500,00€
ID: 11.m_MNARQ
Funding Entity: Associação Turismo de Lisboa
Principal Contractor: University of Minho
Duration: From 01/04/2023 to 30/09/2024
Summary: The project focuses on the seismic assessment of the National Museum of Archaeology (MNA) in Lisbon and assesses the need of reinforcement. It incorporates on-site inspections, ambient vibration testing (AVT), and advanced finite element (FE) modelling, under the framework of Eurocode 8 and NTC 2018. FE analyses, validated through AVT, showed that the west gallery, with timber trusses retrofitted with steel profiles in 1996, exhibits reduced lateral deformations, and a similar reinforcement for the east gallery roof is suggested. The lateral seismic capacity of the galleries is approximately 0.20g. Displacement-based analyses (DBA) met the requirements for Severe Damage (SD) limit state, for earthquakes with a 308-year return period, while for a 975-year return period earthquake significant damage occurs. Vertical load-bearing checks showed safety margins of up to 6.5 times the gravitational load. A possible retrofit solution using stainless steel tie rods embedded in the gallery vaults will increase lateral strength by 40% and reduce vault opening displacements by 60%. Yet, given the high cost and invasiveness, the current solution deems appropriate only for extreme seismic events.

MNA: south-west view, adapted from Google Maps (2023).

▪ REcube: REthink, REvive, REuse – Transmitting the knowledge for the green regeneration of the European Concrete Heritage

ISISE Principal Investigator: Joaquim Barros, Isabel Valente
Budget: Global: 399 873,00€ / ISISE-UM: 23 582,00€
ID: REcube – 2021-1-IT02-KA220-HED-000027628
Funding Entity: European Commission (Erasmus+ KA2)
Principal Contractor: Politecnico di Milano
Duration: From 01/12/2021 to 30/11/2024
Summary: The REcube project was focused on teaching a sustainable, integrated and holistic approach to the conservation and renovation of Modern Concrete European Architectural Heritage to master's students coming from 11 different Architecture and Engineering schools across Europe. The overall objective was conceiving and transmitting sustainable best practices to foster the development of a new mindset in the field of Modern Heritage Regeneration. In particular, this project aimed to:

- Establish and disseminate innovative interdisciplinary teaching methods in modern concrete heritage conservation at the intersection of engineering and architecture. Thus, nurturing a new generation of young professionals with a focus on research, innovation, durability and care.
- Develop best practises for sustainable modern concrete heritage preservation at the European and International level to encourage the sustainable and durable multidisciplinary approach to the regeneration and management of the Modern European building stock.
- Push the boundaries of professional praxis in the building and conservation sector towards a holistic, green and culturally conscious vision of modern heritage environments.

▪ MLCult – Machine Learning for Structural Health Monitoring of Cultural Heritage

ISISE Principal Investigator: Paulo Lourenço, Mayank Mishra
Budget: Global: 172 618,56€ / ISISE-UM: 172 618,56€
ID: HORIZON-MSCA-2021-PF-01-01 - 101063722
Funding Entity: European Commission (Marie Sklodowska-Curie Actions)
Principal Contractor: University of Minho
Duration: From 01/07/2022 to 30/11/2024
Summary: The research project MLCULT aimed to develop deep learning (DL)-models for surface damage diagnosis and reducing uncertainties in structural health diagnosis, which would enable more efficient structural interventions and repair. The objective of the MLCULT project was to use artificial intelligence (AI) techniques to assess the surface damage condition of CH constructions for reducing condition assessment costs and assessing building safety with minimum building intrusion and main achievements are summarised below.

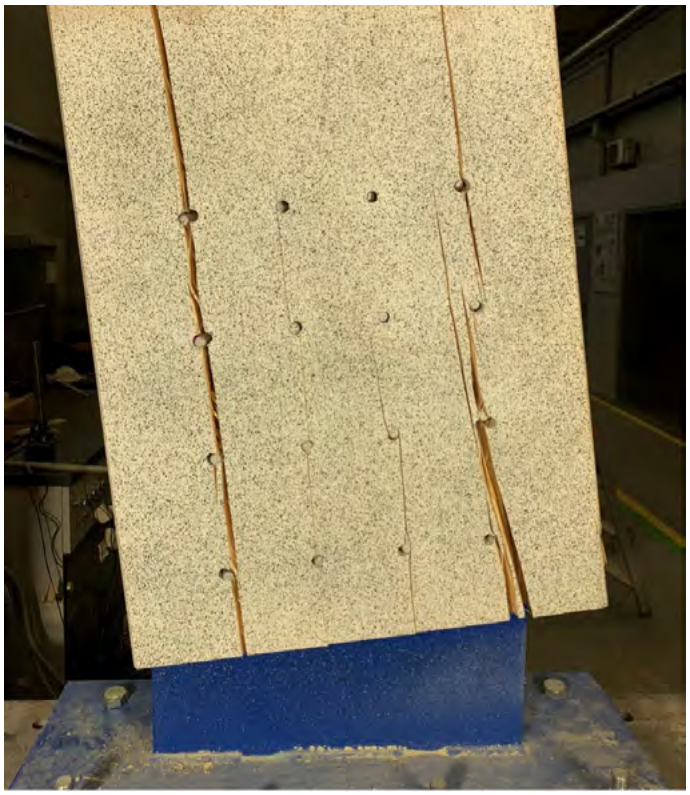
- For the first time, an AI-powered visual inspectionsystem was made that focussed on tiles with patterns (https://doi.org/10.1016/j.culher.2024.05.009), as all previous studies only deal with plain tiles. It is a practical application and can be directly used in the site.
- With the help of review paper (https://doi.org/10.1016/j.culher.2024.01.005), we addressed the gaps in AI-powered inspection systems, and what improvements needs to be made for the future of these technology.
- We also made a tool inside ChatGPT4.0 to give feedback of the damaged images without requiring any complex process and it is the first tool of its kind that may be used by practitioners.

▪ WUPA – Wupatki National Monument in Arizona

ISISE Principal Investigator: Paulo Lourenço
Budget: Global: 102 500,80€ / ISISE-UM: 102 500,80€
ID: WUPA
Funding Entity: University of Pennsylvania
Principal Contractor: Universidade do Minho
Duration: From 01/01/2021 to 30/01/2025
Summary: This project, coordinated by ISISE-UMinho under the "Integrated Site Conservation and Management Plan" for Wupatki National Monument (Arizona, USA), focused on the structural assessment and conservation of Wupatki Pueblo, one of the most important archaeological sites in the American Southwest, originally built in the 12th century and partially reconstructed during the 20th century. The activities included visual inspection, non-destructive testing, soil and mortar analysis, grout injection trials, and seismic and numerical analyses. Key achievements included the identification of degradation mechanisms, validation of a compatible clay-based grout for crack repair, and seismic vulnerability assessment using both empirical indices and advanced structural modelling. Results supported site-specific conservation strategies and guided the definition of long-term maintenance and intervention priorities. The collaboration with NPS and the University of Pennsylvania promoted on-site knowledge transfer, enhancing local capacity in heritage conservation. The project contributes to safeguarding this culturally and historically significant site against environmental and seismic hazards.

▪ TiMBER – European Master's in Integrated Design of Timber Constructions

ISISE Principal Investigator: Jorge Branco
Budget: Global: 55 000,00€ / ISISE-UM: 55 000,00€
ID: 101128206 — TiMBER
Funding Entity: European Commission (Erasmus+ Lump Sum Grants)
Principal Contractor: University of Minho
Duration: From 01/10/2023 to 31/12/2024
Summary: The objective of the Master is to offer an advanced education programme on Timber integrated design, with a strong focus on the collaborative practices that are the cornerstone of such integration. The Master combines the diversity of expertise at leading European universities in the relevant fields, offering education oriented to a multidisciplinary understanding of timber construction through the involvement of experts from complementary fields (engineers, architects, manufacturers and others). Students gain top-level knowledge on Timber Constructions in a research-oriented environment, with close cooperation with the industry and a strong focus on problem solving. The course combines the recent advances in research and development with practical activities applications.



▪ SUBlime: SUstainable Building Lime applications via Circular Economy and Biomimetic Approaches

ISISE Principal Investigator: Paulo Lourenço, Miguel Azenha , João Pereira
Budget: Global: 3 713 424,49€ / ISISE-UM: 1 151 287,22€
ID: SEP-210643855
Funding Entity: European Commission (Marie Sklodowska-Curie Actions – Research Networks)
Principal Contractor: Universidade do Minho
Duration: From 01/01/2021 to 31/01/2025
Summary: Lime, produced through the calcination of limestone, is one of the oldest industrial materials and remains vital to modern society. It plays a key role in EU industrial policy, particularly in raw material competitiveness. Lime is crucial across multiple sectors: steel, environmental protection, soil stabilization, construction, agriculture, and food. Around 18% of its market serves construction and civil engineering. Lime mortars are widely used in masonry, both as joint and plastering materials. Compared to cement, they offer advantages such as reduced water penetration, better moisture control, improved bonding, less cracking, lower efflorescence, easier maintenance, and a lower carbon footprint. They are also fully compatible with historic masonry, essential for heritage conservation.

The SUBLime project trained researchers to develop sustainable lime-based solutions for new construction and heritage conservation. It addressed material characterization, multi-physics modelling, functionality, and performance-based design. Innovations targeted enhanced functionality and sustainability, with biomimetic concepts and closed-loop recycling. SUBLime delivered solutions with self-cleaning, self-healing, and CO_2 capture capabilities.

Examples of the wallettes for moisture expansion test

▪ DucTimber – Hybrid engineered wood products towards innovative ductile performance

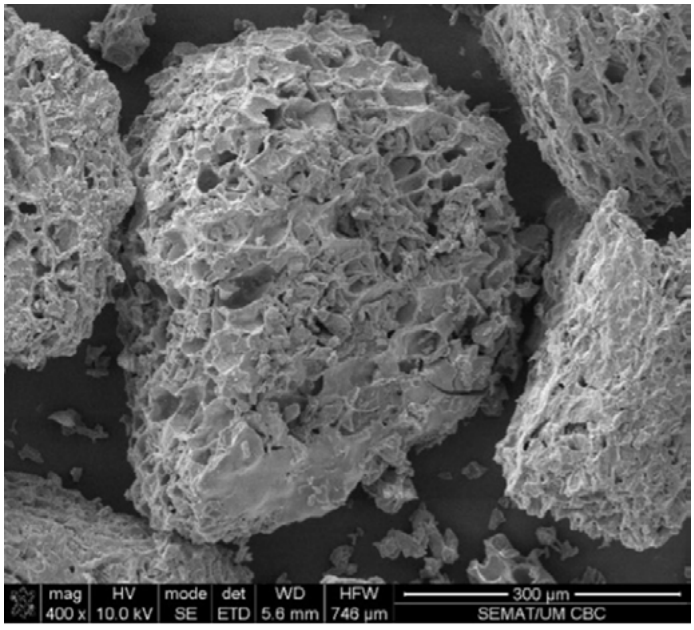
ISISE Principal Investigator: Carlos Martins
Budget: Global: 49 926.99€ / SerQ: 49 926.99€
ID: 2022.06937.PTDC
Funding Entity: Portuguese Foundation for Science and Technology (FCT)
Principal Contractor: SerQ – Innovation and Competence Forest Centre
Duration: From 01.01.2023 to 28.02.2025
Summary: The exploratory research project DucTimber aimed to increase knowledge about the bending performance of engineered wood products, such as glulam beams, made by native species, especially with a non-linear behaviour before failure. Using native species was critical to optimise resource usage for this type of structural application. Thus, maritime pine, sugi, poplar, chestnut and eucalyptus were the main species addressed for raw-material, finger-joint, and glulam beams production and respective mechanical characterisation within an experimental campaign and numerical modelling. Results show that native species have the potential to be implemented in the market based on their mechanical properties. Also, the combination of two species within the cross-section (higher mechanical properties at the outer layers, e.g. eucalyptus, and lower mechanical properties at the inner layers, e.g. poplar or sugi) conducted to a positive impact on the structural efficiency, as well as, the occurrence of an horizontal plateau of deflection of about 50 mm before failure. Project outputs were disseminated at 2 international conferences and journal papers, and more papers are in the submission process.

▪ RESISTANCE – Prediction of the out-of-plane dynamic behaviour of masonry structures using machine learning: towards new simple standards for in-field structural assessment

ISISE Principal Investigator: Paulo Lourenço, Nuno Mendes
Budget: Global: 49 949,15€ / ISISE-UM: 49 949,15€
ID: 2022.05425.PTDC
Funding Entity: Fundação para a Ciência e a Tecnologia | FCT
Principal Contractor: Universidade do Minho
Duration: From 01/03/2023 to 28/02/2025
Summary: The RESISTANCE project aimed to predict the out-of-plane collapse mechanisms of masonry walls by performing numerical analyses validated through shake table tests and to develop an automated methodology based on machine learning techniques. The project involved shaking tables tests in three specimens to evaluate out-of-plane one-way (rigid wall and vertical spanning strip wall) and two-way bending mechanisms (U-shaped specimens) for several earthquakes by increasing the amplitude and repeating the tests for the same seismic amplitude, and free-rocking tests. Moreover, the numerical analysis of the shaking table tests was done. The results of the experimental tests and numerical analyses allowed to create a large database on the out-of-plane response, and to develop machine learning models to predict the out-of-plane collapse mechanism and the seismic performance of existing masonry structures.

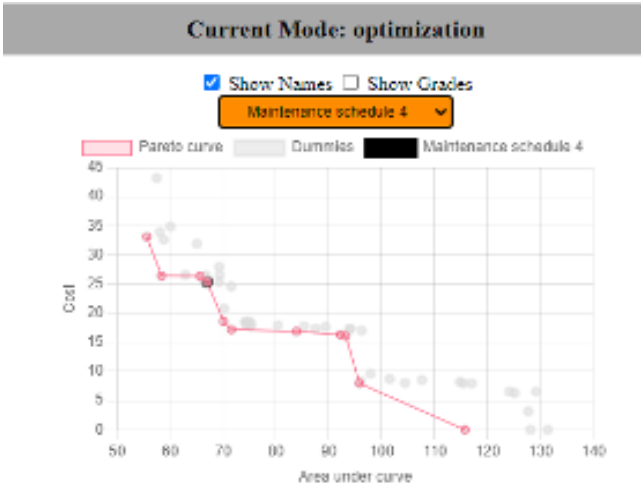
▪ S&E4M – Towards a sustainable integrated seismic and energy retrofit of masonry buildings

ISISE Principal Investigator: Daniel Oliveira
Budget: Global: 49 849,40€ / ISISE-UM: 49 849,40€
ID: 2022.01429.PTDC
Funding Entity: Fundação para a Ciência e a Tecnologia | FCT
Principal Contractor: Universidade do Minho
Duration: From 01/03/2023 to 28/02/2025
Summary: A significant number of European masonry buildings were built during a time when seismic codes were very limited and energy performance requirements were non-existent. These buildings face key challenges related to seismic safety, energy performance and sustainability. A novel Textile Reinforced Mortar (TRM) composite system for the integrated seismic and energy retrofit of traditional masonry building envelopes has been successfully developed and tested. The lime-based TRM matrices developed, incorporating bio-based products such as rice husk, cork and coffee grounds, exhibit enhanced thermal performance while presenting adequate mechanical properties. The sustainability of this system is twofold, resulting from the integration of both seismic and energy retrofits and the use of environmentally friendly materials. The retrofit approach adopted in the project directly incentivises the necessary renovation of masonry buildings, promoting a more resilient society at affordable financial and environmental costs.



▪ InfraROB – Maintaining integrity, performance and safety of the road infrastructure through autonomous robotized solutions and modularization

ISISE Principal Investigator: José Campos e Matos
Budget: Global: 4 752 117,50€ / ISISE-UM: 298 671,25€
ID: InfraROB – 955337
Funding Entity: European Commission (Horizon 2020)
Principal Contractor: Universidad de Vigo
Duration: From 01/09/2021 to 28/02/2025
Summary: At Universidade do Minho, we developed the decision-support software integrated into the InfraROB IT platform to improve pavement maintenance planning. The tool uses predictive models and traffic simulations to evaluate the impact of maintenance strategies and help identify optimal, cost-effective, and sustainable solutions. With a user-centric and multi-objective approach, the software supports decision-makers in balancing performance, cost, and user impact. It is adaptable to different data sources and operational contexts, and it was tested both in simulations and in a successful pilot demonstration in Austria. Designed for integration, the tool connects with robotic inspection data and digital twins developed by other InfraROB partners. Our contribution brings intelligence and adaptability to pavement management, supporting the project's goal of enhancing road infrastructure through automation and smart technologies.



▪ FemWebAI – Integrated approach for reliable and advanced analysis and design of sustainable constructions systems in fibre reinforced concrete

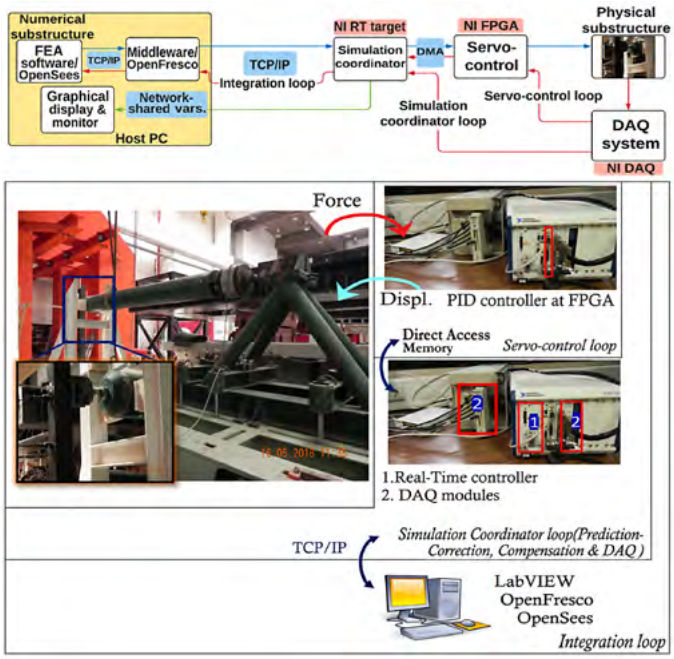
ISISE Principal Investigator: Joaquim Barros
Budget: Global: 249 979,58€ / ISISE-UM: 249 979,58€
ID: PTDC/ECI-EST/6300/2020
Funding Entity: Fundação para a Ciência e a Tecnologia | FCT
Principal Contractor: Universidade do Minho
Duration: From 29/03/2021 to 28/03/2025
Summary: The present project involved an integrated methodology to the design of fibre reinforced concrete (FRC) structures, mainly using approaches based on the finite element method (FEM). This methodology involved : 1) the execution of a series of international blind simulation competitions (BSC) of experimental programs with representative FRC structures of real scale and using the most advanced monitoring technology; 2) Critical analysis of the results from the BSC in order to assess the most influencing variables in FEM-based models and their impact on the predictive performance of the serviceability and ultimate limit state design verifications; 3) Assess the potential of global resistance methods on the design of FRC structures; 4) Compare the predictive performance of approaches based on FEM models and on more simple design formats like those supported on standard recommendations, mainly the ones proposed by Model Code 2010 and 2020, and Euro Code; 5) Propose recommendations to the structural engineering community on the use of FEM-based models for the design of FRC structures.

▪ DURABLE-FRP
Durabilidade de Estruturas de Engenharia Civil em Compósitos FRP

ISISE Principal Investigator: José Sena Cruz
Budget: Global: 249 935,00€ / ISISE-UM: 74 268,75€
ID: PTDC/ECI-EGC/4609/2020
Funding Entity: Fundação para a Ciência e a Tecnologia | FCT
Principal Contractor: University of Lisbon
Duration: From 29/03/2021 to 28/03/2025
Summary: The Durable-FRP projects addressed the long-term durability of Fibre Reinforced Polymer (FRP) composites used in civil engineering structures, based on the collaboration between three partners, namely the Instituto Superior Técnico of the University of Lisbon, the University of Minho and the National Laboratory for Civil Engineering. The objectives of Durable-FRP were (i) to improve the understanding of the effects of different environmental agents - acting in isolation or in combination - on FRP composites for civil applications, (ii) to develop degradation models and (iii) to contribute to the guidelines for the durability design of FRP composite structures. To support these objectives, (i) a large-scale survey of durability data on FRP composites was conducted, allowing the development of a comprehensive database of validated durability tests, (ii) an extensive experimental programme combining laboratory and in situ field tests was conducted, (iii) degradation models (deterministic and stochastic) were proposed to predict changes in the properties of different FRP composites exposed to different environmental conditions, and (iv) design recommendations for guidelines were drafted. Main outputs: 1 book, 14 papers in international journals, 15 papers in conferences, 4 PhD and 8 MSc theses, and an open access database of durability test results.

▪ HybridNET – Hybrid Simulation Integrated Facility for Real-Time, Multi-Hazard and Geographically-Distributed Testing

ISISE Principal Investigator: Nuno Mendes
Budget: Global: 61 986,47€ / ISISE-UM: 61 986,47€
ID: PTDC/ECI-EST/6534/2020
Funding Entity: Fundação para a Ciência e a Tecnologia | FCT
Principal Contractor: Universidade do Minho
Duration: From 29/03/2021 to 28/03/2025
Summary: The Hybrid Simulation Integrated Facility for Real-Time, Multi-Hazard and Geographically-Distributed Testing (HybridNET) project focused on the development of a hybrid simulation framework and its application through a network of geographically-distributed infrastructures. In the HybridNET project, the hybrid simulation framework was developed and implemented in a common LabVIEW environment for use at National Laboratory for Civil Engineering (LNEC, Lisbon), University of Minho and University Aveiro. Hybrid simulations were performed, with emphasis on multi-hazard structural response assessment dealing with earthquakes and fire.



R&D STARTED PROJECTS

▪ Agrivoltec

ISISE Principal Investigator: Artur Mateus
Budget: Global: 1 100 696,80€ / ISISE-UC: 424 375,08€
ID: COMPETE2030-FEDER-01200200
Funding Entity: Compete P2030
Principal Contractor: Steeltrax SA
Duration: From 01/09/2024 to 31/08/2027

▪ Adaptihand

ISISE Principal Investigator: Artur Mateus
Budget: Global: 1 252 326.63€ / ISISE-UC: 219 151.04€
ID: COMPETE2030-FEDER-01182500
Funding Entity: Compete P2030
Principal Contractor: INAUTOM-ROBÓTICA, LDA
Duration: From 01/09/2024 to 31/08/2027

▪ RollerPredict

ISISE Principal Investigator: Artur Mateus
Budget: Global:1 631 856.80€ / ISISE-UC: 227 727.24€
ID: COMPETE2030-FEDER-01202600
Funding Entity: Compete P2030
Principal Contractor: VLB Group
Duration: From 01/09/2024 to 31/08/2027

▪ SolarFIsh

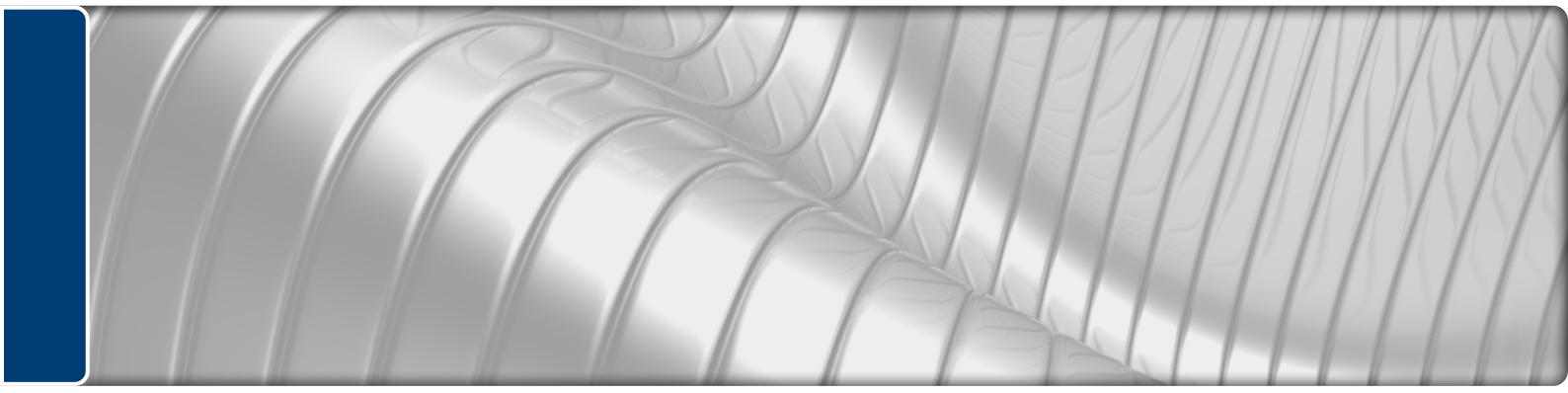
ISISE Principal Investigator: Artur Mateus
Budget: Global:1 882 389.12€ / ISISE-UC: 257 299.08€
ID: COMPETE2030-FEDER-00590900
Funding Entity: Compete P2030
Principal Contractor: FIGUEIRAFISH – Produção e Comércio de Peixe LDA
Duration: From 01/09/2024 to 31/08/2027

▪ Med-IREN – Mediterranean critical Infrastructure Resilience Engineering with Nature based solutions

ISISE Principal Investigator: José Campos e Matos
Budget: Global:11 466 040,00€ / ISISE-UM: 530 250,00€
ID: Project 101157707 — Med-IREN
Funding Entity: European Commission (HORIZON)
Principal Contractor: FUNDACION TECNALIA RESEARCH & INNOVATION
Duration: From 01/10/2024 to 30/09/2028

▪ WISE – Wireless transportation Infrastructure Safety Evaluation

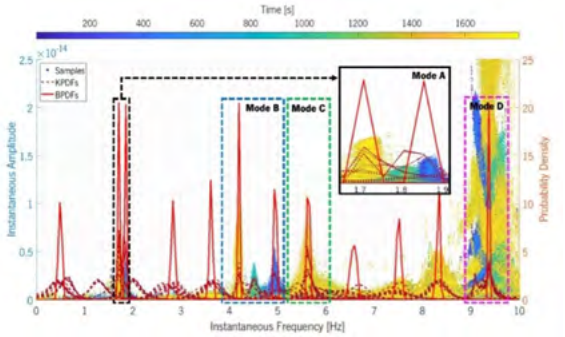
ISISE Principal Investigator: Joaquim Tinoco
Budget: Global:1 150 935,17€ / ISISE-UM: 182 520,84€
ID: WISE – COMPETE2030-FEDER-00574700
Funding Entity: Agência Nacional de Inovação
Principal Contractor: AETHRA, S.A
Duration: From 01/01/2025 to 30/08/2026



COMPLETED PHD THESES

▪ Time-Dependent Dynamic Identification: A new Approach for Structural Health Monitoring Through Vibration Measurements

Author: Manuel Andrés Hormazábal Fuentes
Supervisors: Daniel Vitorino de Castro Oliveira; Maria Giovanna Masciotta
Date: 02/10/2024
Summary: The most commonly used methods and algorithms for structural modal analysis in civil engineering cannot perform dynamic identification when nonlinearities are present. To overcome this limitation, a novel non-parametric algorithm for time-dependent dynamic identification – Enhanced Modal Identification for Long-term Integrity Assessment (EMILIA) – has been developed. EMILIA computes time-dependent functions for natural frequencies and mode shapes irrespective of noise contamination and also processes seismic records. The results demonstrate the algorithm's suitability for processing high-transient, noise-contaminated non-linear structural responses, surpassing many traditional methods. Furthermore, integrating EMILIA into a vibration-based damage identification strategy produces promising results, promptly detecting sudden variations in modal properties.

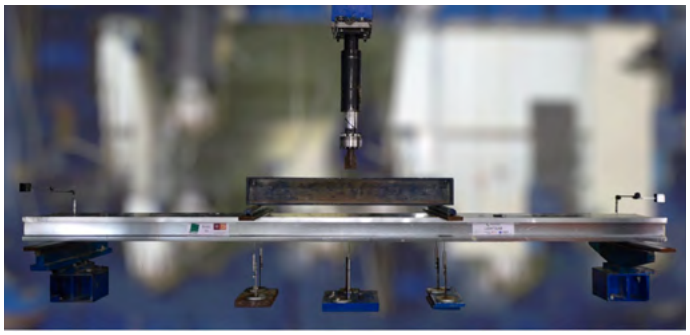


A time-dependent probability spectrum computed across three stiffness configurations showing four identified modes, where the first two presents variations on the modal frequencies.

Manuel Hormazábal's expertise and interests include, but are not limited to: Structural Engineering, Seismic Engineering, Vibro-Acoustic Engineering, Non-Linear Dynamics, Operational Modal Analysis, Structural Health Monitoring, Finite Elements Analysis, Machine Learning, Data Acquisition and Analysis, and Digital Signal Processing.

▪ A lightweight floor system based on sandwich panels: characterization and development

Author: Pier Giovanni Benzo
Supervisors: José Manuel de Sena Cruz, João Miguel Pereira
Date: 10/10/2024
Summary: Sandwich panels offer a promising solution for weight-sensitive construction applications, particularly in rehabilitating degraded floors in masonry buildings and modular constructions. To achieve the structural requirements, webs are incorporated into the core. However, the behaviour of web core sandwich panels has not been thoroughly investigated, and no design standards are available for such structural members. This thesis investigates the structural performance of cold-formed steel web core sandwich panels infilled with polyurethane foam and their connection systems to vertical walls. The research includes structural optimization using a genetic algorithm, experimental testing at material and full-scale levels, and analytical and numerical modelling of the panels. Findings highlight the importance of the polyurethane core-to-face sheets interface in affecting overall load capacity, and that design standards for cold-formed steel can be conservatively applied to these panels.



Pier Giovanni Benzo obtained a PhD degree in Structural Engineering in 2024 at the University of Minho and a MSc degree in Building Engineering - Architecture in 2018 at the University of Padua. His research includes structural optimisation with genetic algorithms, numerical modelling techniques for cold-formed steel structures, and experimental testing with digital image correlation.

▪ Validation of themo-mechanical models of refrractory masonry in industrial full-scale

Author: Pratik Naresh Gajjar
Supervisors: Paulo Barbosa Lourenço, João Miguel Pereira
Date: 18/10/2024
Summary: The PhD thesis extensively investigates mortarless refractory masonry linings commonly utilised in steel ladles under high-temperature steelmaking conditions. Comprehensive experimental tests characterise the orthotropic mechanical behaviour of alumina spinel bricks subjected to compressive, tensile, and flexural loads at ambient temperatures. Further experiments, ranging from ambient to 1400 °C, focused on the dry joint closure behaviour critical to mortarless masonry. Large-scale thermomechanical tests on pilot-scale ladle examined the temperature distributions across refractory layers, quantified the viscoplastic deformation in the working lining starting around 1200 °C, and identified the significant role of dry joint thickness. Numerical analyses employing a meso-modelling approach successfully replicated the complex thermomechanical responses, affirming the model's robustness for industrial use.

Pilot steel ladle

Pratik Gajjar holds a PhD in Civil Engineering from the University of Minho. He specialises in refractory masonry under high temperatures through experimental and numerical analyses. He has experience in numerical modelling of masonry under various conditions using FE software. He is competent in experimental testing using data acquisition sensors, Digital Image Correlation, and photogrammetry.

▪ Out-of-plane behaviour of masonry walls: Structural assessment and strengthening

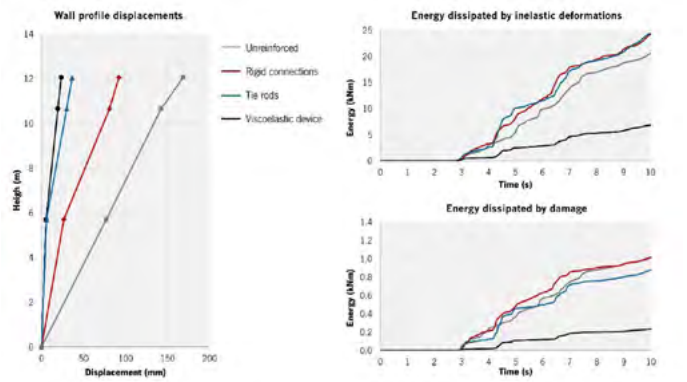
Author: Antonio Murano
Supervisors: Graça Fátima Moreira Vasconcelos, Hugo Filipe Pinheiro Rodrigues, Javier Ortega Heras
Date: 31/10/2024
Summary: This research project addressed the study of the out-of-plane behaviour in two-leaf masonry walls encompassing both experimental and numerical approaches. The numerical work was focused: (i) comparison of different numerical approaches, namely macro and micro finite element (FE) modelling and discrete element modeling (DE); (ii) parametric study involving (a) material mechanical properties from a database previously defined; (b) geometrical features characterizing the masonry bonds (arrangement of vertical and horizontal joints, layout of the connection leaf stones, masonry bond leaves and corner interlocking). The experimental work was conducted on two brick two-leaf masonry walls in undamaged and damaged conditions to assess the reliability of a textile-reinforced mortar (TRM) strengthening solution in enhancing their out-of-plane capacity, proving insight regarding the effectiveness of the TRM strengthening solution in improving the out-of-plane performance of two-leaf walls.

Post airbag test damage pattern in (a) UMW façade (b) RMW right side

Antonio Murano is Master in Building and Architecture Engineering from University of Calabria, Italy, Master in Structural Analysis sof Historical Construction, from University of Minho, and PhD In Civil Engineering from University of Minho, Portugal. Presently He works as Civil Engineer at the BOLINA Ingegneria S.r.l.

▪ Viscoelastic devices for reducing the seismic vulnerability of existing masonry buildings

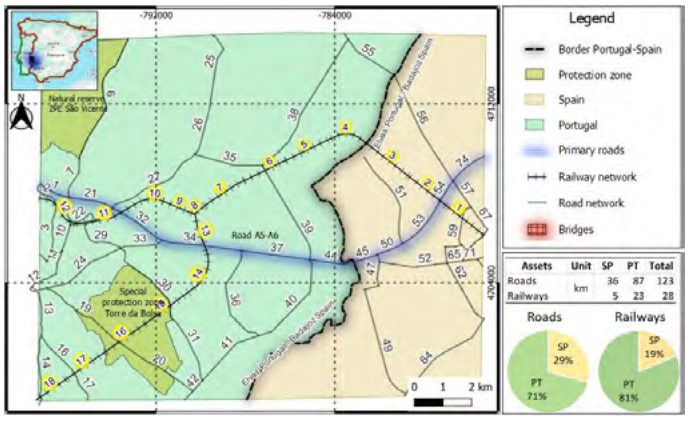
Author: Elesban Nochebuena Mora
Supervisors: Nuno Adriano Leite Mendes, Paulo José Brandão Barbosa Lourenço; José António Colaço Gomes Covas
Date: 04/12/2024
Summary: This thesis presents a new passive energy dissipation device (GNL-VED) to improve the out-of-plane seismic response of unreinforced masonry (URM) walls. The device, which amplifies relative displacements to induce shear in viscoelastic layers and dissipate energy, was tested through numerical simulations using FEM models. Case studies on Viceregal dwellings (Mexico) and gaioleiro buildings (Portugal) showed that the GNL-VED effectively controls displacements and minimizes damage. In the Viceregal dwelling, where out-of-plane collapse is the dominant failure mode, the GNL-VED effectively reduced displacements and minimized damage, outperforming traditional strengthening techniques such as steel tie rods. These results highlight the device's potential to enhance seismic safety in heritage buildings. In the gaioleiro buildings, further optimization is needed due to its complex dynamic behaviour. Overall, the GNL-VED shows potential for reducing seismic vulnerability in URM structures.



Elesban Mora has PhD in Civil Engineering (University of Minho), MSc in Structural Analysis of Monuments and Historical Constructions (University of Minho), and honour degree in Architecture and a specialty in Restoration of Sites and Monuments (UMSNH, Mexico). Specialized in seismic analysis and strengthening of masonry structures using FEM and energy dissipation devices.

▪ Wildfire Resilience Assessment and Management of Road Transport Networks

Author: Erica Llovana Arango Patiño
Supervisors: José António Silva Carvalho de Campos e Matos, Mark G. Stewart
Date: 23/01/2025
Summary: This Ph.D. research advances wildfire resilience in road transport networks through innovative multi-criteria decision-making tools. Key achievements include six journal publications and participation in over six international events. The work introduces GIS-based metrics to assess infrastructure exposure and prioritize interventions, along with a resilience assessment framework that integrates system functionalities, hazard intensities, and dynamic thresholds to evaluate preparedness and recovery capacity. A multi-objective optimization approach ensures cost-effective adaptation through grey, green, and soft measures. The research also addresses cross-border governance and highlights the importance of proactive strategies, contributing to more resilient and sustainable infrastructure systems. The proposed tools support both reactive and proactive actions, including emergency management and long-term adaptation.

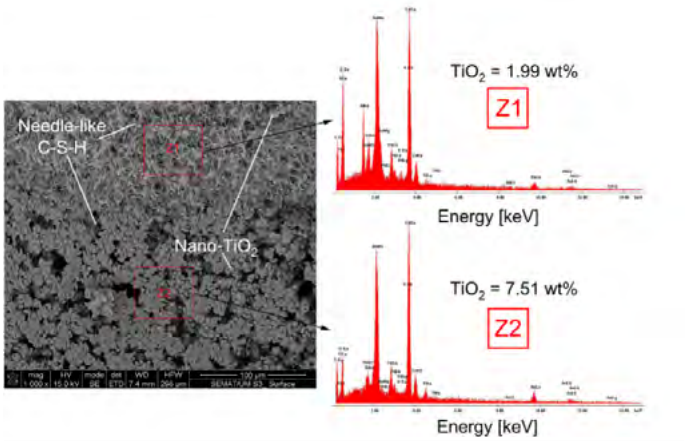


Erica Arango is a civil engineer with expertise in resilience assessment, infrastructure adaptation, and structural engineering. Skilled in leadership, teamwork, and problem-solving. Quick to adapt and learn. Currently coordinating the Resilience HydroTwin project as a postdoctoral researcher at Delft University of Technology. See complete research here: Erica Arango.

▪ Development of Multifunctional Cementitious Composites for 3D Concrete Printing'

Author: Behzad Zahabi Zadeh
Supervisors: Vítor Manuel do Couto Fernandes da Cunha
Date: 24/01/2025
Summary: This research aimed to develop and characterise multifunctional plain and fibre-reinforced cementitious mixtures for 3D Concrete Printing (3DCP). A mix design procedure was established based on printability and buildability as critical factors in wet extrusion 3DCP, governed by open time and workability. The key findings of this study are:

- Mechanical and physical tests showed that printed elements had comparable quality to mould-cast ones, with minor orthotropic behaviour.
- Sandblasting significantly improved interlayer bond strength.
- TiO_2-coated specimens exhibited enhanced photocatalytic and self-cleaning performance. Increased light intensity, coating rate, and curing time further improved efficiency.
- Incorporating crystalline admixtures enhanced stiffness recovery and crack self-sealing, especially in printed elements, likely due to better fibre alignment.
- Freeze-thaw and carbonation tests showed that printed elements exhibited good durability performance.

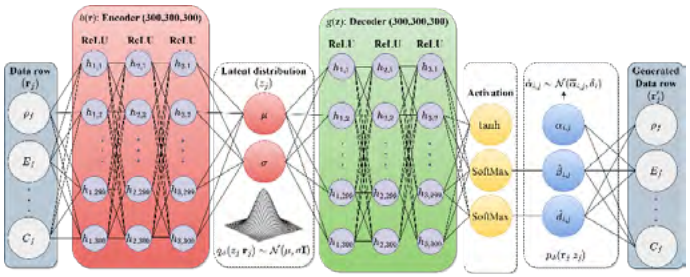


SEM-EDS analysis on the top surfaces of 3D Printed elements coated by TiO2 nanoparticles.

Behzad Zahabi Zadeh is a Civil Engineering researcher at ISISE, University of Minho. His research focuses on cement and concrete technology, including wet extrusion 3D concrete printing and multifunctional materials. He has published eight journal articles and reviewed several journal papers, for which he was recognised with an Outstanding Reviewer Award from ASCE in 2022.

▪ Data-driven analytical and ML-based models for shear-strengthened RC beams using FRP systems

Author: Amirhossein Mohammadi
Supervisors: Joaquim António Oliveira de Barros, José Manuel Sena Cruz
Date: 27/03/2025
Summary: This Ph.D. research addresses the enhancement of shear resistance in reinforced concrete beams using Carbon Fibre-Reinforced Polymer (CFRP) through Externally Bonded Reinforcement (EBR) and Near-Surface Mounted (NSM) techniques. Limitations in existing models were overcome by developing advanced analytical and Machine Learning models, significantly improving predictive accuracy. A comprehensive experimental database was established, supported by robust data preprocessing. Reliability-based calibration of resistance factors was conducted to ensure safety and cost-efficiency in design applications. The outcomes contribute to more accurate, reliable, and sustainable use of CFRP in structural strengthening.



A TVAE model developed for synthetic data generation

Amirhossein Mohammadi is a post-doc researcher at the University of Minho, specializing in structural engineering and the use of composite materials in RC structures. His Ph.D. thesis was titled "Data-driven analytical and ML-based models for shear-strengthened RC beams using FRP systems." And his work integrates machine learning, optimization, and reliability to advance structural predictive modelling.

AWARDS & PRIZES

▪IABSE Early Career Prize 2024

Winner: Hélder Sousa
Venue: Zurich,Switzerland
Date: 12/11/2024

The IABSE Early Career Prize 2024 is presented to Hélder Manuel da Silva e Sousa, Portugal, 'in recognition of his spirit to bridge between different professionals, society and to cooperate between generations, through his work on the field of risk and resilience assessment of existing structures and infrastructures.' The IABSE Early Career Prize was established to honour and encourage a member early in his or her career for outstanding achievement in structural engineering. The Award is conferred on an individual member, forty years of age or younger. The Prize includes prize money. The first IABSE Early Career Award was presented in 1983.

EVENTS

▪ fib International Conference on Concrete Sustainability

Venue: Guimarães, Portugal
Date: 11–13 September 2024
Website: https://www.fibiccs.org/
ISISE Member: José Campos e Matos, José Sena Cruz, Eduardo Pereira, Aires Camões, Ricardo Mateus, Elisabete Teixeira, Luís Correia and Miguel Azenha
Summary: fib-ICCS2024 brought together engineers, researchers, academics, producers, and developers to exchange and discuss their approaches and ideas focused on sustainable concrete structures. The conference included topics from design and assessment to material characterization, life cycle, intervention, and case studies. A total of 137 full papers were published in the conference proceedings.

▪ ISISE at INOVAÇÃO@UC

Venue: Coimbra, Portugal
Date: 25 September 2024
Website: https://www.uc.pt/events/inovacao-uc/
ISISE Member: Ana Francisca Santos, Laura Sousa
Summary: ISISE participated in INOVAÇÃO@UC, an annual initiative that puts innovation at the heart of the University of Coimbra's activities. This event provided an excellent opportunity to showcase some of the University's most exciting research projects and engage with leading companies and research institutions. It was an inspiring experience that underscored the vital role of collaboration in advancing innovation.

- **Towards the next generation of sustainable masonry systems: Mortars, renders, plasters and other challenges**

Venue: Funchal, Portugal
Date: 11-12 November 2024
Website: https://conference.sublime-etn.eu/
ISISE Member: Paulo B. Lourenço, Miguel Azenha and João M. Pereira
Summary: The SUBLime Conference in Funchal brought together 140+ experts from 30+ countries to exchange pioneering research on sustainable masonry systems. With four keynotes and 120 contributions, the event showcased innovations in mortars, renders, and plasters, driving collaboration and inspiring the next generation of sustainable building solutions.

- **ARISE Workshop – TL5: Digital Ecosystem, Sustainability, Risk and Management**

Venue: Guimarães, Portugal
Date: 16 January 2025
Website: https://www.arise-la.com
ISISE Member: Daniel Oliveira, José Sena Cruz
Summary: The TL5 ARISE Workshop aimed to present the key research activities developed under the 5th thematic line (TL5: Digital Ecosystem, Sustainability, Risk and Management) by the five research centres. The contractor CASAIS also delivered a presentation on the company's activities closely aligned with TL5, namely sustainable modular construction and industrialisation of construction.

- **Workshop T!MBER – Integrated Design of Timber Constructions**

Venue: Guimarães, Portugal
Date: 22 January 2025
Website: https://civil.uminho.pt/ensino/2o-ciclo/timber/
ISISE Member: Jorge Branco
Summary: The aim of this meeting was to prepare the master's degree and its application to the Erasmus programme, as provided for in the work programme of the TiMBER - 520409. CI0059 project approved under the ERASMUS-EDU-2023-EMJM-DESGIN call.

- **Closing Seminar of the Evacuarfloresta Project**

Venue: Coimbra, Portugal
Date: 24-25 january 2025
Website: https://evacuarfloresta.enb.pt/
ISISE Member: Aldina Santiago, Andreia Rodrigues
Summary: The final seminar of the Evacuarfloresta project was held on January 24 and 25 at the University of Coimbra. On January 24, the program included lectures on topics such as evacuation strategies, rural fire risk management, and the use of simulation tools. A training course on the Fire Dynamics Simulator (FDS) was delivered by Prof. Jianping Zhang (Ulster University). On January 25, an evacuation exercise took place in Ribeira da Misarela (Coimbra) in collaboration with the Coimbra Municipality.

- **Portugal Steel Workshop | Seismic Design & DREAMERS Project**

Venue: Porto, Portugal
Date: 12 March 2025
Website: –
ISISE Member: Ana Francisca Santos, Aldina Santiago
Summary: On March 12, the Portugal Steel Workshop on seismic design of steel and composite structures was held at FEUP, organised by the Portuguese Steelwork Association. ISISE researchers Ana Francisca Santos and Aldina Santiago, alongside Prof. Vincenzo Piluso from the University of Salerno, presented the vision, challenges, and key outcomes of the European DREAMERS project.

UPCOMING EVENTS

- **Portugal Steel | ADVANCE Project "Additional Dissemination, Valorisation and Collaborative Exploitation of PROGRESS project"**

Venue: Porto, Portugal
Date: 04 June 2025
Website: –
ISISE members: Helena Gervásio

- **XV Conference on Steel and Composite Construction**

Venue: Porto, Portugal
Date: 20-21 November 2026
Website: https://www.cmm.pt/congresso15
ISISE members: Luís Simoões da Silva

- **MODENERLANDS'25: CA20109 International Conference**

Venue: Figueira-da-Foz, Portugal
Date: 03-05 September 2025
Website: https://modenerlands.eu/final-conference/
ISISE members: Carlos Rebelo, Dora Pontinha, Helena Gervasio, Mariela Mendez- Morales

- **European Safety and Reliability Conference**

Venue: Guimarães, Portugal
Date: 14-19 June 2026
Website: https://esra.website/
ISISE members: José Campos e Matos, Paulo B. Lourenço

- **The 2nd International RILEM conference on early-age and long-term cracking in RC structures**

Venue: Katowice, Poland
Date: 11-12 September 2025
Website: https://crc2025.org/
ISISE members: Miguel Azenha

- **congREGA 2026**

Venue: Braga, Portugal
Date: 14-16 October 2026
Website: https://congrega.eu/
ISISE members: José Campos e Matos

- **International Conference on Moisture in Buildings**

Venue: Guimarães, Portugal
Date: 23-24 October 2025
Website: https://icmb25.pt/
ISISE members: Jorge Branco, Yina Moscoso, Sandra Silva, Rafael Lara

- **12th International Conference on Fiber-Reinforced Polymer (FRP) Composites in Civil Engineering**

Venue: Lisboa, Portugal
Date: 14-16 July 2025
Website: https://cice2025.org/
ISISE members: José Sena cruz, Joaquim Barros, Luís Correia

COURSES

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

Venue: Dept. of Civil Engineering, University of Minho
Website: www.msc-sahc.org

- **Erasmus Mundus Master Waves**

Venue: Dept. of Civil Engineering, University of Coimbra
Website: https://www.master-waves.eu

- **European Master in Building Information Modelling BIM A+**

Venue: Dept. of Civil Engineering, University of Minho
Website: www.bimaplus.org

- **European Master Course in Advanced Structural Analysis and Design using Composite Materials – FRP++**

Venue: Dept. of Civil Engineering, University of Minho
Website: https://msc-frp.org/

- **International Master in Risk Assessment and Management of Civil Infrastructures (NORISK)**

Venue: Dept. of Civil Engineering, University of Minho
Website: https://msc-norisk.org/

- **International Master on Sustainable Built Environment iMiSBE**

Venue: Dept. of Civil Engineering, University of Minho
Website: https://civil.uminho.pt/imisbe/

- **Master in Steel and Composite Construction**

Venue: Dept. of Civil Engineering University of Coimbra
Website: https://ucpages.uc.pt/fctuc/dec/descobre-o-dec/mecmm/

- **Master in Sustainable Construction and Rehabilitation (taught only in Portuguese)**

Venue: Dept. of Civil Engineering, University of Minho
Website: http://civil.uminho.pt/mcrs/

- **Doctoral Programme in Civil Engineering**

Venue: Dept. of Civil Engineering, University of Minho
Website: https://pdec.civil.uminho.pt/

- **Doctoral Program Steel and Composite Construction**

Venue: Dept. of Civil Engineering, University of Coimbra
Website: https://apps.uc.pt/courses/EN/course/8181

- **International Doctoral Programme in Sustainable Built Environment**

Venue: Dept. of Civil Engineering, University of Minho
Website: http://civil.uminho.pt/idisbe/