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GROUPS
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Structures**
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**Steel and Mixed Construction
Technologies**
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Structural Concrete
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ISISE HIGHLIGHTS

The tenth issue of the ISISE Newsletter covers the main activities developed from the very late 2015 up to May 2016. In this period, 4 new national and international R&D projects were initiated with an overall funding for ISISE of about 750 k€, 5 PhD theses were concluded and 5 events were organized by ISISE members. Special emphasis is also given to the new facilities of ISISE: the Firelab and the IB-S.



Recently, the Fire Engineering Laboratory of the University of Coimbra (Firelab) has been started operating. This facility provides services in all areas of engineering and fire safety. It is also a center of excellence targeted towards providing services to companies, advanced technical training, consulting, research and development in fire safety, supported by the expertise of the ISISE research center. Firelab performs certification of materials and construction solutions, in accordance with the relevant standards. The Firelab is equipped with the most modern equipment to address multiple aspects, such as detection systems, fire extinguishing systems, smoke control, fire hazard, organization and safety management, and the design of steel structures subjected to fire.

The starting of operations in the building of IB-S took place in the 16th of December 2015. The event started with a meeting of the board of IB-S, its scientific council and the Rector of the University of Minho. Afterwards, a visit to the laboratories already in operation took place including a short presentation of the undergoing works.



The content and opinions expressed within the Newsletter are those of the researchers involved and are not necessarily shared by the Directors of ISISE



R&D COMPLETED PROJECTS

> HISTWIN_PLUS

ISISE Principal Investigator: Carlos Rebelo

Budget: Global: 478496,00€/ISISE-UC: 108053,00€

ID: RFS2-CT-2014-00023

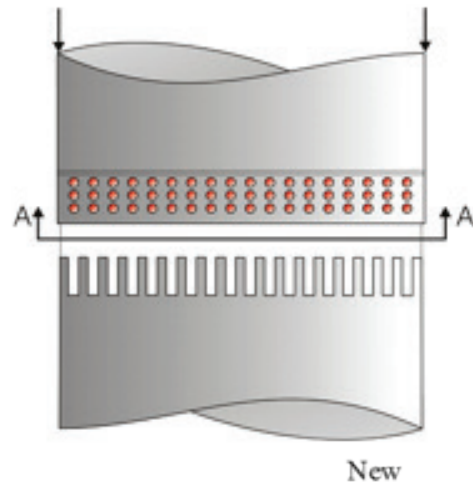
Funding Entity: EU-RFCS

Principal Contractor: Portilaa, Lda.

Participating Institutions: University of Minho

Duration: From 1st July 2014 to 31st December 2015

Summary: The project objectives are to promote the innovation studied and to disseminate conclusions developed during the research project, HISTWIN. The innovative aspects of the project are optimization of the use of higher strength steels and the improvement of fatigue behaviour using newly developed bolted connections.



The tower for wind turbines often has the hub height (80-100 m) and it is assembled with 2 connections. New software solutions for easier design of the tubular towers' most common failure modes are developed. The design manual, web page for dissemination of publications, modern software solutions, ECCS-Apps, and workshops are made. The complete list covering more than 40 titles of conference papers, journal papers and academic theses were prepared within the HISTWIN (and subsequent HISTWIN2) project. It is aggregated on <https://www.steelconstruct.com/site/>

R&D STARTED PROJECTS

> Desenvolvimento de painéis sanduíche compostos para a reabilitação de pisos de edifícios

ISISE Principal Investigator: José Sena Cruz

Budget: Global: 1.428.449,71€/ISISE-UM: 375.907,23€

ID: 3480

Funding Entity: ANI, cofinanciado pelo Fundo Europeu de Desenvolvimento Regional (FEDER), através do Programa Operacional Competitividade e Internacionalização (POCI)

Principal Contractor: Alto

Partners: IST, UMINHO

> INOV_LAMI Development of innovative reinforcement systems and improvement of design models for steel-concrete composite slabs

ISISE Principal Investigator: Rui Simões

Budget: 322 776,00 € / 217 257,00€

ISISE-UC: 206.802,00 € - O FELIZ

ID: 08/SI/2015/3483

Funding Entity: ANI Copromoção

Principal Contractor: O Feliz Metalomecânica S. A. / University of Coimbra



> **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
Partners: UMINHO, Instituto de Investigação Científica Tropical, I.P. (IICT)

> **SMWeld- South Mediterranean Welding Centre for Education, Training and Quality Control**

ISISE Principal Investigator: Dulce Rodrigues
Budget: Global: 1.259.420,00€/ISISE-UC: 88.983,00€
ID: 561786-EPP-1-2015-1-SE-EPPKA2-CBHE-JP
Funding Entity: EU
Principal Contractor: KUNGLIGA TEKNISKA HÖGSKOLA, KTH, STOCKHOLM

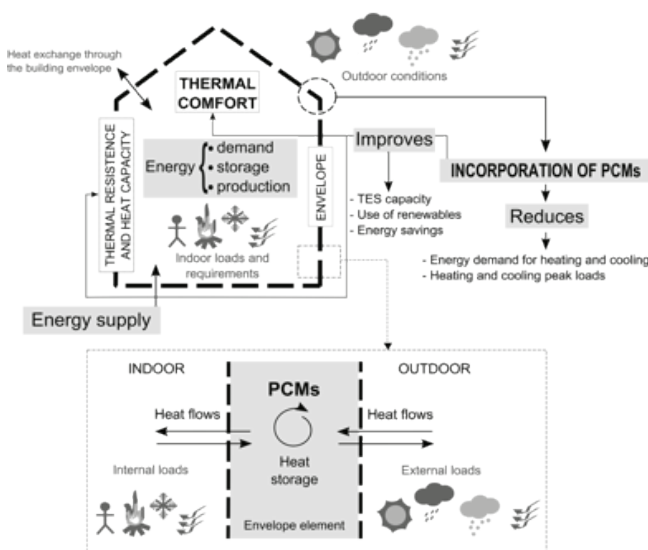
COMPLETED PHD THESES

> **Thermal energy storage with phase change materials (PCMs) for the improvement of the energy performance of buildings**

Author: Nelson Miguel Lopes Soares
Supervisors: Prof. José J. da Costa, Prof. Adélio R. Gaspar, Prof. Paulo Santos
Date: 11th December 2015
Summary: Soares's PhD work was focused on the study of construction solutions with PCMs towards the improvement of the energy performance of buildings. His research interests also included sustainability, light steel framing construction, thermal behaviour and energy efficiency of buildings, passive PCM-based thermal energy storage (TES) systems and dynamic simulation of energy in buildings.

One of his work main goals was to evaluate the heat transfer with solid-liquid phase-change through small TES units filled with different PCMs. The results provided experimental data to be used in the design of new TES systems for buildings and in the validation of numerical models. Another important goal was to provide some guidelines for the incorporation of PCM-drywalls in different typologies of buildings and climates, aiming to reduce the energy demand for heating and cooling during the operational phase.

CV: **Nelson Soares** received his PhD in Sustainable Energy Systems from the University of Coimbra (UC) in 2015, in the framework of the MIT-Portugal program. He also holds a master's degree in Energy for Sustainability in the specialization area of Indoor Climate and Comfort, and a master's degree in Civil Engineering in the specialization area of Constructions, both from UC. Soares is a researcher of both ADAI-LAETA and ISISE research centres.



Sketch of the building as a thermodynamic system and main advantages of incorporating TES systems with PCMs in buildings. Sketch of the physical domain of the envelope element as an energy system.



> Development of an Intelligent Earthwork Optimization System

Author: Manuel Afonso Parente

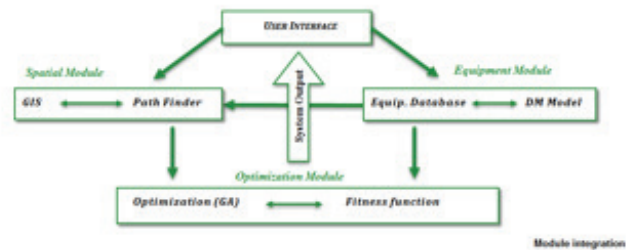
Supervisor: Prof. António Correia, Prof. Paulo Cortez (DSI)

Date: 18th December 2015

Summary: This research work explores the integration of different technologies in order to allow for an optimization of the earthworks process. This is translated in the form of an evolutionary multicriteria optimization system, capable of searching for the best allocation of the available equipment that minimizes a set of goals (e.g., cost, duration, environmental impact). The results stemming from the application of the system to a case study in a Portuguese earthwork construction site are presented. These comprise the assessment of the system performance, including a comparison between different optimization methods. Furthermore, an analysis regarding the improvement of workflow in the construction site after the implementation of the system is discussed, in the context of several comparisons

between original (i.e., obtained by manual design) and optimized allocation solutions.

System architecture overview



CV: Manuel Parente obtained his Integrated Master in Civil Engineering at University of Minho in 2011, with the thesis entitled “Compaction Management”. In 2015, he obtained his Ph.D. degree in Civil Engineering by the University of Minho with the thesis entitled “Development of an Intelligent Earthwork Optimization System”. He is a postdoctoral Grant holder and continuing his research at University of Minho.

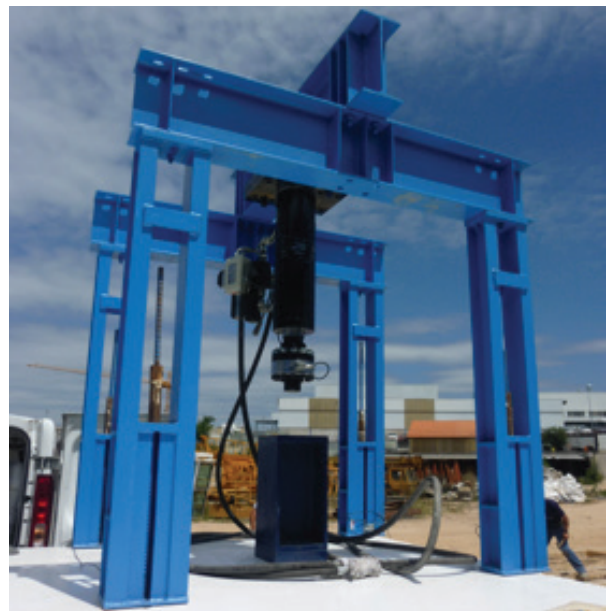
> Evaluation of the Performance of Steel Fibre Reinforced Self-Compacting Concrete in Elevated Slab Systems; from the Material to the Structure

Author: Hamidreza Salehian

Supervisors: Prof. Joaquim Barros

Date: 24th November 2015

Summary: The thesis aims to explore the potentialities of the post-cracking response of SFRSCC in elevated (E-SFRSCC) slab system where due to the support redundancy character of the structure, the benefits of SFRSCC are more efficiently mobilised and the stress redistribution capacity provides an ultimate load that is much greater than the load at crack initiation. In an extensive experimental programme, the post-cracking response of different series of SFRSCCs was characterised, at the material levels, through various approaches conventionally used in the literature to evaluate the influence of the test methodology on the derived constitutive laws of SFRSCC. At the structural level, a quarter-scale prototype of E-SFRSCC was built and tested for assessing the performance of this structural system under serviceability and ultimate limit state conditions. These two experimental levels are correlated with each other by performing advanced FEM-based numerical simulations.



CV: Hamidreza Salehian concluded his PhD in 2015 at University of Minho while he is a researcher in ISISE since 2009. He is currently assistant professor and director of the SGHPC Research Centre of Civil Engineering Department of Islamic Azad University of Semnan, Iran. His research interests include mechanical and structural performance of FRC, advanced modelling, and strengthening of structures.



> **Fire Resistance of Cold-Formed Steel Columns**

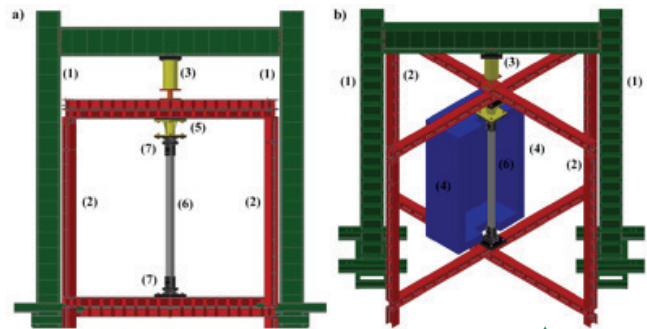
Author: Hélder David da Silva Craveiro
Supervisors: Prof. João Paulo Correia Rodrigues and Doctor Luís Miguel Laím

Date: 13th January 2016

Summary: In this research an extensive experimental and numerical analysis was undertaken in order to accurately assess the physical behaviour of cold-formed steel (CFS) columns under fire conditions with restraint to thermal elongation. Ambient and fire tests were performed on CFS columns with single, open and closed built-up cross-sections, assessing the influence of cross-section geometry, boundary conditions and levels of restraint to thermal elongation. Generally, it was found that restraint to thermal elongation play a relevant role on the behaviour of isolated CFS columns. It was observed that increasing the level of restraint to thermal elongation the failure of CFS columns may be controlled by the generated axial restraining forces, whereas for lower levels of restraint the failure may be controlled by temperature increase and consequent degradation of the mechanical properties. Higher levels

of restraint led to higher values of generated restraining forces and to lower values of critical temperature.

CV: **Hélder David Craveiro** graduated in Civil Engineering at the University of Coimbra in the area of expertise in Structural Mechanics. Recently he submitted his PhD thesis developed in the scope of the PhD program in Fire Safety Engineering. He published several papers in Scientific Journals and International Conferences.



Comparison between experimental and numerical (FEA) deformed shapes for CFS columns with closed built-up cross-section.

> **Decision Support System Model based in Data Mining for Pavement Management Maintenance (Truck Overload)**

Author: Andri Irfan Rifai
Supervisor: Prof. Sigit Sigit Pranowo Hadiwardoyo (Universitas Indonesia), Prof. A. Gomes Correia, Prof. Paulo Pereira (UMinho)

Date: 14th January 2016

Summary: DM techniques, particularly and Artificial Neural Network (ANN) and Support Vector Machine (SVM) algorithms, proved to be powerful tools for exploring pavement deterioration model. Indeed, these tools were able to learn with high accuracy the complex relationships between IRI and their contributing factors. ANN achieved a performance higher than 0.91, using R2as a performance indicator. The Genetic Algorithm Approach method, by taking advantages mathematical programming, offers a systematic, easy-to-use approach to the pavement maintenance optimization. Although only budget constraint is considered, other constraints could be easily added to the formulation. The GIS technology integrates graphical information

in the GIS maps and the pavement performance model results obtained from the segment-level and the network-level seamlessly.



CV: **Andri Irfan Rifai** obtained his degree in Civil Engineering by the University of Indonesia. In 2015, he obtained his Ph.D. degree in Civil Engineering by University of Indonesia in a Sandwich program with the University of Minho with the thesis entitled "Decision Support System for Maintenance Optimization of Overload Highway Pavements under Financial Constraints".

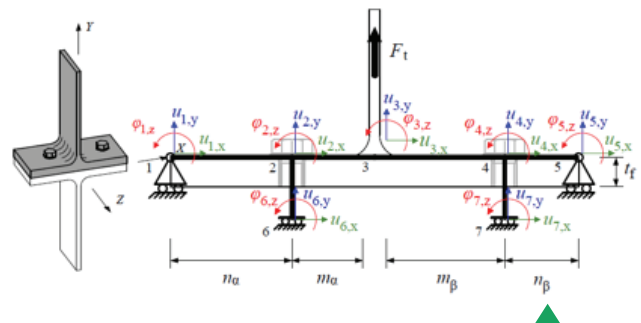


> **Fire Resistance of Cold-Formed Steel Columns**

Author: Juan José Jiménez de Cisneros Fonfría
Supervisor: Prof. Luís Simões da Silva and Prof. Juan de Dios Carazo (Universidad de Jaén – España)
Date: 3rd February 2016
Summary: The research addresses the study of asymmetric T-stub components subjected to tensile loads, through analytical, numerical and experimental approaches, defined in the case of bolted moment end plate connections with asymmetry conditions. The main objective is to calculate the properties of strength and stiffness, and compare them with symmetric components. The behaviour of the component was characterized through an equivalent matrix model, and the internal forces calculated were used to evaluate the ultimate resistance and the stiffness. Values obtained were compared with experimental results from tests developed in both symmetric and asymmetric configurations. The model fits to the experiments with allowable precision. Finite elements simulations from models tested and

from beam-to-column end plate connections were carried out also, in order to study additional parameters to estimate the suitability of the component proposed to the global behavior of the connection.

CV: **Juan José Jiménez de Cisneros Fonfría** is mechanical engineer specialized in design and vibrational analysis of steel structures of industrial plants by finite elements. He develops his professional activity as consultant with different companies in Spain and South America and as a researcher and docent at Pontificia Universidad Católica del Perú.

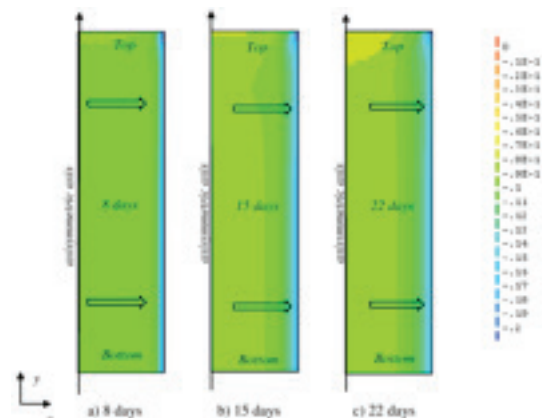


Analytical frame model

> **A Multi-Physics Approach Applied to Masonry Structures with Non-Hydraulic Lime Mortars**

Author: Mateus Antônio Nogueira Oliveira
Supervisor: Prof. Paulo Lourenço, Prof. Miguel Azenha
Date: 24th February 2016
Summary: Considering the emergent interest in study the historical constructions, in the thesis, experimental and numerical approaches have been adopted in the studying of aerial lime mortar, in view of multi-physics modeling. For this objective a coupled hygro-carbo-mechanical model has been developed in FDM. For the numerical aspects, a software capable to simulate the coupled hygro-carbo fields has been implemented. The results may be then exported for a software based in the FEM that processes the mechanical analyses. This framework is considered important, since such kind of structures last for long ages, and the simplified mechanical analysis may not be sufficient to reproduce the complex behavior. The numerical models could fairly reproduce the experimental data. Experimentally, diverse innovative procedures regarding the tests in aerial lime mortar

were done. In summary, the work developed may be considered seminal, due to the scarce of literature information about the subject.



CV: **Mateus A. N. Oliveira** received his bachelor's degree in civil engineer in Brazil, from Federal University of Minas Gerais, with the award of "best student". He has been working as structural engineer in different areas (projects of dams, bridges, etc), since 2006. Recently, Mateus received the PhD degree from University of Minho, with the highest classification.



IB-S

The Institute of Science and Innovation for Bio-Sustainability (IB-S) is a partnership between ISISE and CBMA (Molecular and Environmental Biology Research Centre). IB-S aims at the development of cutting-edge research and innovation in Sustainability Sciences with special focus on the combined sustainability of built and natural environments with a multi-disciplinary approach and in close collaboration with the business community.

The IB-S premises include two infrastructures located at the Campi of Gualtar (Braga) and Azurém (Guimarães). The building in Braga will host bio-prone activities, while the building in Guimarães hosts engineering experimentation. These infrastructures comprise about 3.000 m² of laboratories and other technical facilities.

The IB-S research is based in two axes: sustainability and energy. These cross with three main research lines, namely: Urban Rehabilitation; Industrial Ecology / Natural Resources; and Sea, Coast and Ports.

The board of IB-S is supported by a Strategic Council which is an advisory board composed by a group of 13 companies with the task of helping in the definition, implementation and development of the research strategy of the Institute.

The research operations started officially in the building of Azurém in the 16th of December 2015. In this building there are already 7 groups/laboratories operating and 2 spin-offs. Their activities vary from material science, structural engineering, embedded systems, micro sensors, fibers and energy and sustainable construction. The event started with a meeting of the board of IB-S, its scientific council and the Rector of the University of Minho. Afterwards, a visit to the laboratories took place including a short presentation of the undergoing works.





EVENTS

> HISTWIN+ INTERNATIONAL WORKSHOP

Venue: Coimbra & Oliveira de Frades

Date: 27th November 2015 and 4th December 2015

Website: www.steelconstruct.com/histwin

Summary: The International Workshop was composed of two events. The 1st event, was dedicated to the general information and achievements obtained during the HISTWIN project and some theoretical background. It was organized in Coimbra in the Business Center Leonardo da Vinci, Coimbra iParque. The 2nd event was dedicated to the detailed design of connections, to the practical aspects of the design, production, construction and maintenance of the steel wind turbine towers and was organized in Oliveira de Frades, in the facilities of Martifer Metallic Constructions and of Senvion Portugal, former Repower Portugal. These two companies were partners in the HISTWIN research project that was the basis for this dissemination.



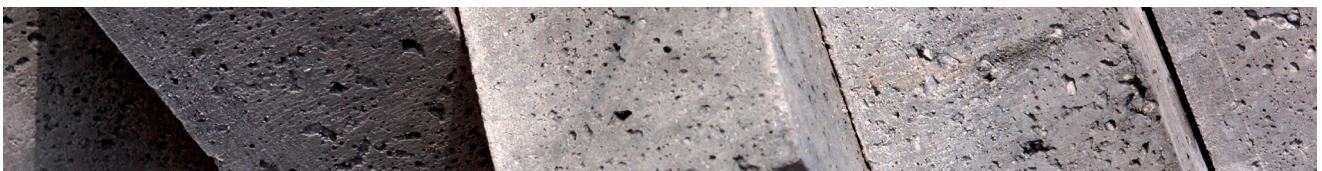
> “CM14 - National Conference on Steel Structures”

Venue: Cluj-Napoca, Romania

Date: From 18th November 2015 to 22th November 2015

Website: www.cm14.ro

Summary: The conference aims to facilitate the exchange of ideas and technology transfer from research to industry. Ensuring the competitiveness of steel construction and sustainable development requires constantly new concepts, methods and means for supporting educational activities, research, training and professional designers, teachers and researchers in this field, in constant connection with the producers and performers in the field.





> **X Congresso de Construção Metálica e Mista**

Venue: Coimbra

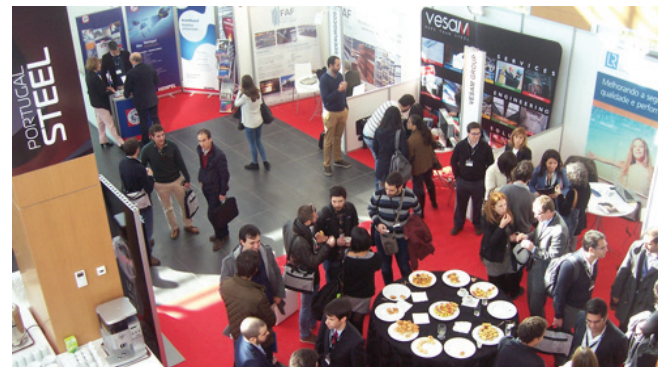
Date: 26th November 2015 and 27th November 2015

Website: www.cmm.pt

Summary: The biennial congress of the CMM - Associação Portuguesa da Construção Metálica e Mista took place on 26 and 27 November 2015, in iParque - Coimbra.

The keynote this year's conference were: Modular Construction of High-rise Buildings of Engineer Mark LAWSON; Retrofitting steel with a global view of Prof. Pierre ENGEL; seismic hazard in Portugal and choose acelerométricos records to Prof. structures analysis Carlos Sousa Oliveira; Rehabilitation of the bridge Hercílio Light Engineer Hermes CARVALHO; State of art and new strategies in the seismic design of connections of Engineer Gianvittorio RIZZANO;

Rehabilitation of the building: chance or design? Professor Raimundo Mendes da Silva; Challenges of Steel Construction - Offshore in the Oil & Gas sector of Engineer Carlos MARTINS DE ANDRADE; and the place of steel and composite structures for the rehabilitation of old buildings of Engineer John APPLETON



> **European Commissioner for Research, Science and Innovation**

Venue: Coimbra

Date: 6th November 2015

Website: www.dec.uc.pt

Summary: The European Commissioner for Research, Science and Innovation, Carlos Moedas, visited DEC-UC. As part of the celebrations of 40 years of the first graduates, DEC received on the 6th of November the European Commissioner Engineer Carlos Moedas, an event that gathered in the auditorium Laginha Serafim more than 250 participants.

The event was attended by the Magnific Rector of UC, Prof. João Gabriel and by multiple personalities.





> **2nd Workshop of COST Action TU1406 - An overview of Key Performance Indicators across Europe and Overseas.**

Venue: Metropol Palace Hotel, Belgrade, Serbia

Date: 30th March to 1st April 2016

Website: <http://www.tu1406.eu/belgrade>

Summary: The 2nd Workshop of COST Action TU1406 had place in Belgrade, Serbia, in 30th March -1st April, 2016. Working group meetings were also developed before the Workshop with objective to characterize of WP-s and their interaction, in particular of WP1, bridge performance indicators, WP2, target values, and WP3, quality control plans. The Action is chaired by Prof Jose C Matos, who actively participated in the organization

of this event. The main outcomes of this Workshop can be seen at www.tu1406.eu.



UPCOMING EVENTS

> *First Young Transportations Geotechnics Engineers Meeting (1st YTGE meeting)*

Venue: University of Minho, Azurém

Date: 4th September 2016

Website: civil.uminho.pt/3rd-ICTG2016/YTGE.php

> *3rd International Conference on Transportation Geotechnics (3rd ICTG2016)*

Venue: School of Engineering of University of Minho and Vila Flor Cultural Centre, Guimarães, Portugal

Date: 4th to 7th September 2016

Website: www.civil.uminho.pt/3rd-ICTG2016/

> *Seminar Reabilitação de Fachadas*

Venue: University of Minho, Azurém

Date: 22nd September 2016

Website: www.civil.uminho.pt/reabilitacao2016

> *AEOLUS4FUTURE WORKSHOP: Sustainability and life cycle assessment*

Venue: University of Coimbra, Department of Civil Engineering

Date: From 17th October 2016 to 18th October 2016

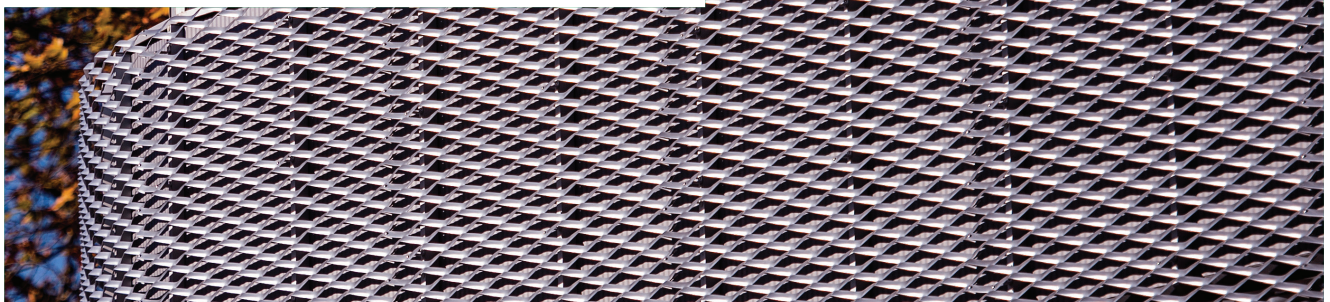
Website: www.isise.net

> *3rd Workshop of COST Action TU1406 + WG meetings*

Venue: Delft, the Netherlands

Date: 20th and 21st October 2016

Website: <http://www.tu1406.eu>





MASTER COURSES

> Master Course on Acoustic and Energy Efficiency for a Sustainable Construction-Edition 2016/2017

Venue: Department of Civil Engineering, University of Coimbra

Website: <https://apps.uc.pt/courses/PT/course/6182>

Application dates:

- > First call: 01st March until 30rd May;
- > Second call: 01st June until 15th July;
- > Third call: 24th August until 5th September

> Master Course in Building Rehabilitation – Edition 2016/2017

Venue: Department of Civil Engineering, University of Coimbra

Website: <https://apps.uc.pt/courses/pt/course/6201/2016-2017>

Application dates:

- > First call: 01st March until 30rd May;
- > Second call: 01st June until 15th July;
- > Third call: 24th August until 5th September

> SAHC Erasmus Mundus Masters Course

Venue: Department of Civil Engineering, University of Minho

Website: <http://www.msc-sahc.org>

Application dates:

- > Third call: 15th June

> STREMUM - Structural Engineering Master programme at the University of Minho

Venue: Department of Civil Engineering, University of Minho

Website: <http://www.stremum.uminho.pt>

Application dates:

- > First call: 01st February;
- > Second call: 27th May;
- > Third call: 15th July

