ISISE NEWS LETTER
13. BIANNUAL
DECEMBER, 2017

INDEX

ISISE HIGHLIGHTS

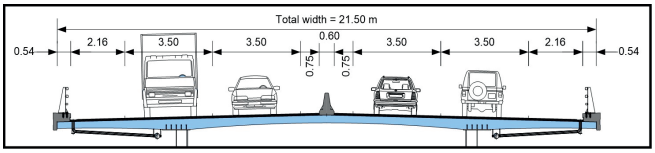
The 2017 ISISE Day-Out and 8th PhD Workshop was held on 16th and 17th October at the University of Coimbra with about 120 participants. This event started with some outdoor and indoor group activities that allowed icebreaking and interaction between the participants coming from the two Universities. The group had also the opportunity to share a pleasant dinner in the end of the first day, after listening to the invited keynote speaker Professor João Carlos Marques, who is biologist in the research center MARE-UC and talked about "Costal systems in transition: The game of possibilities for sustainability under global climate change". During the second day, eleven PhD students presented their current work during the 8th PhD Workshop. To finalize the Workshop the invited alumni José Henriques shared with the audience his experience after he finished the doctoral program in UC. The event ended with the awarding of the "Best Presentation Prize" to Filip Ljubinkovic, with the presentation entitled "Cylindrically curved steel panels in bridge design". The event also benefited of the presence and participation ISISE Advisory Committee members, Prof. Olivier Vassart, Prof. Thanasis Triantafillou and Prof. Bozidar Stojadinovic, who also had a fruitfull meeting with the ISISE Directory Board.

IB-S Day One marked the beginning of a new institute and a new step towards a sustainable tomorrow. In the morning, two lectures were held by Paolo D'Odorico on water and food security in a globalized world followed by Vitor Cunha , holder of the IB-S/dst Chair, on Digital construction towards a smarter, more sustainable and interactive built environment. The afternoon programme consisted of the official inauguration by the Minister of Science, Technology and Higher Education, Manuel Heitor, and the State Secretary of Environment, José Mendes. A week later dstgroup, University of Minho, ILCH and IB-S unveiled the tribute to Prof. Vítor Aguiar e Silva and work of art "Arts, Humanities and Engineering", by Raul Ferreira. The statue was built by a multidisciplinary team and now stands proudly outside the University of Minho library. The work of art incorporates waste in its composition, combining the classic architecture of the perfect arch with the sustainable tomorrow of its materiality.

R&D COMPLETED PROJECTS

> OPTIBRI - Optimal Use of High Strength Steel Grade Within Bridges

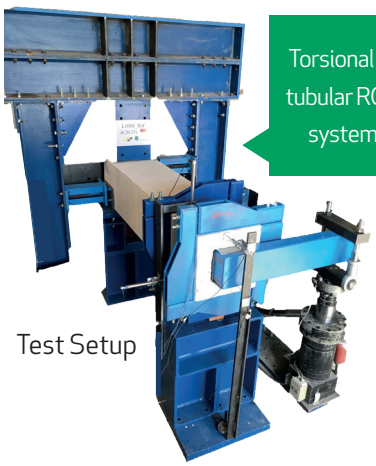
ISISE Principal Investigator: *Luís Simões da Silva*
Budget: *Global: 1.773.924,00€/ISISE-UC: 82 782,00€*
ID: *RFS2-CT-2014-00026*
Funding Entity: *EU – RFCS*
Principal Contractor: *University of Liège*
Duration: *From 1/07/2014 to 30/06/2017*
Summary: The project aims to develop welded bridges using High Strength Steel where it is required (mainly in highly stressed web). As usually the fatigue resistance of the welded joint as well as stability issues reduce the interest of using HSS in bridges, the project studies: the optimal welding and post welding treatment in order to have a high fatigue resistance, as well as, the buckling behaviour of multiaxially stressed plates. The quantification of the interest of HSS welded bridge from the point of view of cost and environment is performed on a 20 m wide highway bridge spans 80 m.



Three designs of the same bridge are compared through Life cycle environmental assessment (LCA), Life cycle cost (LCC) analysis, Life cycle performance (LCP). The first bridge design (A) is classical and uses only standard S355 steel grade when the second design (B) uses HSS S690 QL steel, however with the current Eurocode state which does not account of the steel grade in many issues. Finally the third design (C) is performed relying on the real HSS behaviour and HFMI post treated welds or welds with LTT material filler. This third design and more generic case study demonstrate the need of updating of Eurocode. The research will provide a window example to inform the Civil Engineering community about the interest of using HSS within bridges.

> ENDURE - European Network for Durable Reinforcement and Rehabilitation Solutions

ISISE Principal Investigator: *Joaquim Barros*
Budget: *Global: 3.870.520,94€/ISISE-UM: 257.078,25€*
ID: *FP7- PEOPLE-2013-ITN-60875*
Funding Entity: *EC - European Commission*
Principal Contractor: *The University of Sheffield-UK*
Duration: *From 01/10/2013 to 30/09/2017*
Summary: The aims of this Network were to train researchers on the major scientific challenges and practical problems in the use of composite materials for structural reinforcement and strengthening by: (i) creating the environment for delivering the best training for young researchers and further development of experienced researchers; (ii) enabling young researchers through their training and mobility to "cross-pollinate" industry and academia; (iii) providing comprehensive solutions to current scientific challenges and supporting the development of standards, tests and models; (iv) investigating the potential of new composite materials for applications in construction; (v) developing innovative and sustainable strengthening techniques to improve or restore the performance of existing structures; (vi) assisting the European advanced composites industry to identify improvements and new uses for their materials for applications in construction; (vii) gathering and maintaining databases of information for the benefit of the wide research/industry community; (viii) maintaining an updating on the state-of-the-art in the field; (ix) disseminating the research findings and guidelines.



Torsional strengthening of thin walled tubular RC structures with NSM CFRP systems (research carried at UM)

Test Setup

> **Piloto Inovação RESINA+**

ISISE Principal Investigator: *Alfredo Dias*
Budget: *Global: 19.500,00€/ISISE-UM: 0,00€*
ID: *017217*
Funding Entity: *P2020*
Principal Contractor: *Pedrosa & Irmãos, Lda*
Duration: *From 20/05/2016 to 15/03/2017*
Summary: This project aimed the evaluation of different resin methods in alternative to the traditional ones, with application in wood species that can be found in Portugal, namely Maritime Pine (Pinus pinaster Ait.), Stone Pine (Pinus pinea) and Radiata Pine (Pinus radiata). One method was chosen in particular due to the good results achieved in other countries when used in other species – the borehole tapping method, developed by Prof. Alan Hodges. In Portugal during the 60's, 70's and 80's the resin sector was very active (achieved 140 000 tons per year) and Portugal was the third largest resin exporter in the world, in the year of 1984. However, since the 90's decade, the activity decreased severely (-96%) due to several factors and the productivity achieved the lowest value in 2008 with less than 5 000 tons per year. Despite the good productivity results achieved by the borehole tapping method in the USA for some softwood species, this method did not increased significantly the productivity of resin extraction in the three species experimented in Portugal, when compared with the traditional methods.

R&D STARTED PROJECTS

> **Athor - Advanced thermomechanical multiscale modelling of refractory linings**

ISISE Principal Investigator: *Paulo Lourenço*
Budget: *Global: 373.7239,56€/ISISE-UM: 715.069,08€*
ID*: 764987 - ATHOR - H2020-MSCA-ITN-2017*
Funding Entity: *EC - European Commission*
Principal Contractor: *University de Limoges (UNILIM-France)*
Partners: *UMinho, AGH University (Poland), RWTH (Germany), MUL (Austria), UORL (France)*

> **EQUALJOINTS plus - Valorisation of knowledge for European pre-QUALified steel JOINTS**

ISISE Principal Investigator: *Carlos Rebelo*
Budget: *Global: 1.218.711,55€/ISISE-UC: 112.043,75€*
ID*: RFCS-AM 754048*
Funding Entity: *Research Fund for Coal and Steel, Call: RFCS-2016*
Principal Contractor: *Universita Degli Studei di Napoli Federico II. Italy*
Duration: *01/07/2017 to 30/06/2019*

> **INNO3DJOINTS - Innovative 3D joints for robust and economic hybrid tubular construction**

ISISE Principal Investigator: *Luís Simões da Silva*
Budget: *Global: 1.483.735,50€/ISISE-UC: 295.562,00€*
ID: *RFCS-2016-749959*
Funding Entity: *RFCS*
Principal Contractor: *University of Coimbra*
Duration: *From 01/07/2017 to 30/06/2020*

> **Stronger steels in the built environment (STROBE)**

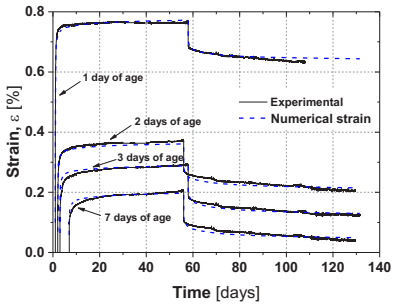
ISISE Principal Investigator: *Luís Simões da Silva*
Budget: *Global: 1.520.000€/ISISE-UC: 240.000€*
ID: *743504-STROBE*
Funding Entity: *European Commission*
Principal Contractor: *SCI Steel Construction Institute, UK*
Duration: *From 01/07/2017 to 31/12/2020*

COMPLETED PHD THESES

> Time-dependent behaviour and durability of RC slabs strengthened with NSM CFRP strips

Author: Patrícia Moreira da Silva
Supervisors: José Sena Cruz, Miguel Azenha
Date: 14th July 2017
Summary: The present PhD thesis intends to contribute for the knowledge on the durability and time-dependent behaviour of RC slabs strengthened NSM CFRP systems. The main objectives were: (i) to develop experimental tests to study the durability and the time-dependent behaviour of strengthened slabs and the intervening material, in order to identify mechanisms of degradation provided by chemical, physical and environmental degradation factors; and, (ii) to apply analytical and numerical models to predict the structural and time-dependent behaviour. The results obtained in the tests of the slabs have shown a marginal variation on their ultimate response due to the environmental conditions and the fatigue action. The slabs submitted to the elevated temperatures were the ones that presented major changes. In the creep tests, the deformation throughout the time revealed to be mostly dependent on the creep of the concrete. In general, the used tools (numerical and analytical ones) allowed to simulate with enough accuracy the experimental responses.

CV: **Patrícia Silva** holds her M.Sc. and Ph.D. degrees in Civil Engineering at the University of Minho. Author of 33 published works (distributed by journal and conference papers, reports and books) in the field of RC structures strengthened with FRP materials. She is currently starting up a company named 'Zeta Engineers' on consulting and innovation services in Engineering.

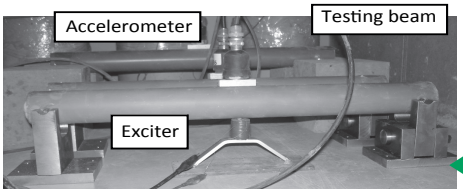


Time-depend behaviour of the epoxy adhesive

> Continuous monitoring of deformability of stabilized soils based on modal identification

Author: Jacinto João do Rosário da Silva
Supervisors: Miguel Azenha, António Correia
Date: 21st July 2017
Summary: The present PhD thesis aims to extend the preliminary work of Azenha *et al* (2011), which emanated from the MSc work of the author of this PhD thesis, by introducing a set of improvements to EMM-ARM (Elastic-Modulus Measurement through Ambient Response Method), as to increase its robustness and demonstrate its feasibility as a quality control tool for stabilized layers. The improvements include: modifications to the test mould (i.e., shape and length); extending the test period to reference age of 28 days of age; development of sampling methodology capable to obtain samples representative of stabilized layers suitable to be tested with EMM-ARM; reduce the effect of undesirable contaminations of the ambient noise increasing the robustness of the modal identification; development of methodology capable to predict with confidence the E-modulus at reference ages based on EMM-ARM results obtained during the firsts days of curing. The work performed also comprised a systematic application of EMM-ARM to different types of soils treated with chemical additives. The application of EMM-ARM to a mixture of a soil treated with quicklime cured at distinct temperatures (20ºC, 30ºC and 40ºC) allowed to observe the temperature effect on the E-modulus and to compute the apparent activation energies of the reactions involved in the curing.

CV: **Jacinto Silva** holds his M.Sc. and Ph.D. degrees in Civil Engineering at the University of Minho. Author of 7 published works (distributed by journal and conference papers) in the field of monitoring of deformability of stabilized soils.

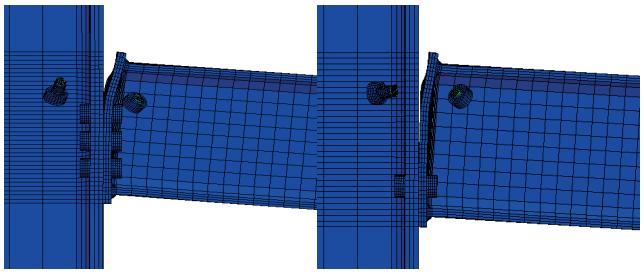


Testing beam for forced experimental modal analysis (FRM)

> Post seismic structural robustness in moment resisting frame steel buildings

Author: David Cassiano
Supervisors: Carlos Rebelo, Mario D'Aniello and Raffaele Landolfo
Date: 8th September 2017
Summary: This thesis was aimed at studying the post seismic structural robustness of moment resisting frame steel structures. To achieve this purpose, a numerical parametric study was carried out and the influence of the following parameters was analysed: number of storeys, interstorey height, span length and building plan layout.
It was concluded that the structural configuration significantly influences robustness, with low-rise long-span structures displaying high propensity to progressive collapse. It was also concluded that the beam-to-column joints are the most strained elements which determine the collapse. However, adopting improved detailing rules in these elements can potentially improve robustness. The contribution of claddings was analysed and found to prevent progressive collapse for structures with low robustness. For what concerns post seismic robustness, it was verified that moderate seismic action in moment resisting frames in DCH class does not introduce sufficient damage to reduce robustness.

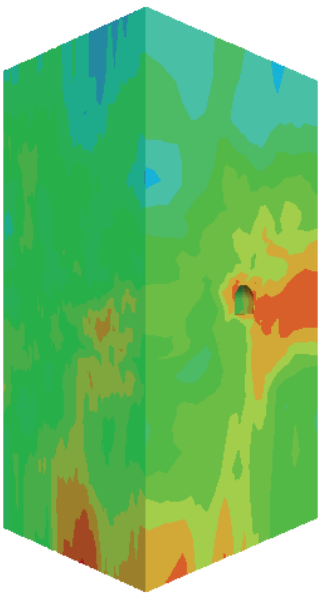
CV: **David Cassiano** 2001-2006 – Degree in civil engineering, Instituto Superior Técnico, Universidade de Lisboa. 2010-2011 – Post graduate course on structural engineering, Instituto Superior Técnico, Universidade de Lisboa. 2012-2017 – PhD in steel and composite construction, Faculdade de Ciências e Tecnologia, Universidade de Coimbra.



> Numerical Methodology to Characterise Heterogeneous Rock Masse

Author: Marisa da Mota Pinheiro
Supervisors: Tiago Miranda, Luís Nolasco Lamas (LNEC)
Date: 13th October 2017
Summary: The thesis proposes a methodology to be used in the characterization of heterogeneous rock massescombining the uncertainty reduction with spatial variability and heterogeneities normally present in the rock masses. The methodology core technique is geostatistics, which have proved to be efficient in identifying rock mass heterogeneities and in considering the spatial variability, combined with clustering techniques, so that a more realistic geomechanical model of the rock mass is obtained. For the methodology validation, real data from two case studies were used: a Chilean gold deposit and the Salamonde II hydroelectric complex recently built in the North of Portugal. Besides the new numerical methodology, another relevant problem, such as the boreholes plan definition, was dealt with and a new optimization methodology was developed. This second methodology allows obtaining the optimized location and minimum depth to be considered at the time that new additional boreholes are executed.

CV: **Marisa Pinheiro** holds a PhD in Civil Engineering by the University of Minho (2017) within the scope of geostatistics applied to geotechnical modelling. His research interest covers topics in the field of geostatistics, geotechnical, uncertainty and spatial variability assessment and numerical modeling. She has some publications in international journals and conference within these topics.

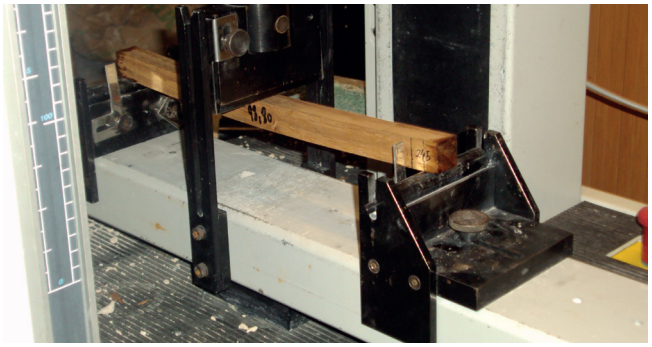


3D representation of the rock mass deformation modulus obtained after geostatistical simulation (colour scale 25 GPa - blue to 52 GPa - red)

> Characterization of African wood species, Iroko and Sapele

Author: Carlos José Parreira da Cunha
Supervisors: Jorge M. Branco, Luís C. Neves
Date: 8th November 2017
Summary: The current standardization for the mechanical classification of the species, is based on softwoods with the implicit acceptance of hardwoods. The new EUTR enforces sustainability criteria in the importation of tropical hardwoods, thus leading to the introduction of new species in the European market. The objective of this thesis is to define an expeditious alternative model. For the Iroko and Sapele species, above 400 small and free from defects specimens were prepared. These underwent ultrasound tests and static bending tests campaigns that were prepared according with the ISO 3131 and ISO 3133 standards. After this, a set of bending tests was performed on specimens of structural dimensions, in agreement with the EN 408. From these specimens, small dimension specimens and mesospecimen were extracted and tested in bending and tension. From the correlations studied between the properties of the different campaigns, new models are proposed for the mechanical characterization of tropical hardwoods.

CV: Since 2010, **Carlos Cunha** is a university lecturer of the Civil Engineering course at the University Jean Piaget, in Angola. He was responsible for the creation of the master programmes at the University Jean Piaget, in Angola, in partnership with the University of Minho. Responsible for the business cluster "Divisão de Acção Empresarial – Piaget".



AWARDS & PRIZES

> SustIMS project wins the GRAA 2017 award

The SustIMS project comes from a partnership between Engineering College of University of Minho (EEUM), represented by the ALGORITMI research group, the Centre for Territory, Environment and Construction (CTAC) and the Institute for Sustainability and Innovation in Engineering Structures (ISISE), with 21 researchers in total, the University of Nova Lisboa and ASCENDI, a roadway infrastructure manager. The award was attributed on October 30th in Dubai.

The main goal of SustIMS project is the development of a sustainable management platform for roadways infrastructures. This platform will allow a more sustainable and articulated management of the main elements of an infrastructure, including bridges and similar structures, slopes, retaining walls, pavements and telematics equipment. This platform will allow the improvement of the information available on the infrastructure, the improvement of future performance forecasts, and a better decision making regarding the conservation of each element of the infrastructure. Managing efficiently, sustainably, and with fewer resources, while ensuring the required infrastructure performance is another goal of SustIMS.

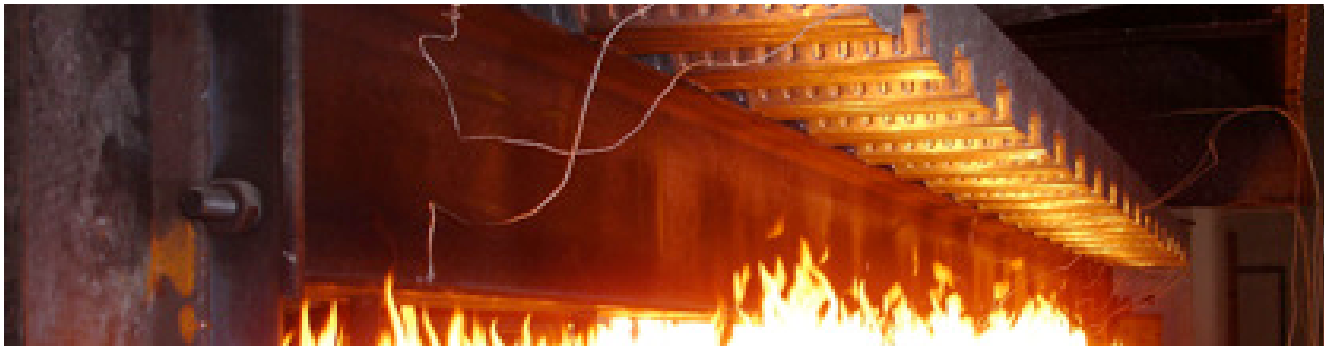
The award of the GRAA 2017 prize, assigned by an association involving several infrastructure managers, acknowledges that this solution is innovative, disruptive and can be used internationally. Under these conditions, the prize was awarded in the category of asset conservation and maintenance management, which took place in Dubai during the IRF Middle East & North Africa Regional Congress & Exhibition. "At this moment, some infrastructure managers are aware of the project and they are interested in this platform, and ASCENDI has already implemented and tested it. We hope that in the short/medium term we will have comparative results that will allow us to quantify - with greater accuracy - what are the savings in resources and what are the improvements in terms of the performance of our infrastructures," explained by José Matos, professor in the Department of Civil Engineering and one of the project research coordinator. "This award shows that this project has gone beyond academic boundaries since it has been recognized by business entities. It will be an excellent opportunity for EEUM to position itself in Civil Engineering worldwide. SustIMS project shows that in civil engineering there is still a lot to do," added the researcher.

As part of the celebrations of 245 years of the Faculty of Science and Technology, University of Coimbra, Luís Simões da Silva was honored as a result of entrepreneurship activities and initiatives related to new research projects and other research and development initiatives and activities (R & D activities)

http://noticias.uc.pt/multimedia/videos/faculdade-de-ciencias-e-tecnologias-da-uc-celebrou-245-anos/

The award for the best presentation at the ISISE Day-Out and 8th PhD Workshop held on 16th and 17th of October at the University of Coimbra, with the title "Cylindrically Curved Steel Panels in Bridge Design". The competition is a part of this event, which is happening every year, where ten students both from the University of Coimbra and the University of Minho show their up-to-date PhD works. ISISE awarded also the winner with funding to attend an international conference to present his work.

Name: Filip Ljubinković
University: Coimbra



EVENTS

> LEST SUMMER PARTY 2017 – LEST @ BEACH!

Venue: Praia da Foz do Minho
Date: 24th July 2017
Summary: LEST (Structural Laboratory of ISISE@UM) organised its traditional summer party, this year held at the beach, with the aim to bring the group together and encourage friendship and cooperation among users. All participants were involved in team building activities, while some of them had some unplanned encounters with the water. The winning team was 'Portulianos'! The event closed with a hearty picnic and some very happy participants.

> EUROSTEEL 2017

Venue: Scandic Copenhagen Hotel
Date: From 13/09/17 to 15/09/17
Website: http://www.eurosteel2017.dk/
Summary: The conference was organized by the Technical University of Denmark (DTU) and the Danish Steel Institute (DSI). The Eurosteel Conference is a European University organised activity focussing on the improvement of education through strengthening of the research work in the field of structural steel. It is considered the largest European and maybe worldwide conference on steel structures and this year there were more than 600 participants. There was a strong participation from the ISISE SMCT group.

> Design of Steel and Composite Structures under Fire

Venue: Ordem dos Engenheiros
Date: 29th to 30th September
Website: http://www.cmm.pt
Summary: The training Course on Design of Steel and Composite Structures under Fire, organized by CMM (Portuguese Association of Steel and Composite Construction) and coordinated by Professor Aldina Santiago, was held at the IParque Business Center in Coimbra. The course has as lectures the following specialist in this area: Professor Aldina Santiago and Professor Helder Craveiro (both from the University of Coimbra), Professor Paulo Piloto (Polytechnic Institute of Bragança), Professor Nulo Lopes (University of Aveiro), Dr. Sílvio Saldanha (TRIA) and Eng. Tiago Horta (Hempel). The main objective of this course was to present and to explain the standards EN 1991-1-2, EN 1993-1-2 and EN 1994-1-2, preparing the trainees for the design of Steel and Composite Structures under fire."

> Building Information Modeling (BIM)

Venue: Ordem dos Engenheiros
Date: Porto: 1st September to 4th November 2017
Braga: 4th September to 4th November 2017
Website: http://www.cursobim.com/
Summary: Following the strong demand for BIM training in the professional community, the 6th Edition of the National Course on Building Information Modelling, was recently held between September and November 2017 in Porto and Braga. The course is coordinated by ISISE members Miguel Azenha and José Carlos Lino, in a joint organization of the Universities of Minho, Porto and Lisbon.

> International Symposium on Structural Integrity of Old Steel Bridges organized within the International Conference on Structural Integrity

Venue: Funchal, Madeira, Portugal
Date: 06/09/2017
Summary: Following the strong demand for BIM training in the professional community, the 6th Edition of the National Course on Building Information Modelling, was recently held between September and November 2017 in Porto and Braga. The course is coordinated by ISISE members Miguel Azenha and José Carlos Lino, in a joint organization of the Universities of Minho, Porto and Lisbon.

UPCOMING EVENTS

> **Training School COST TU1406: "The assessment of road bridges through Key Performance Indicators (KPIs)"**

Venue: *Hotel St. Hubertushof Zell am See, Salzburg, Austria*
Date: *18th to 21st December 2017*
Website: *http://www.tu1406.eu/training/zellamsee*

> **Advanced Topics on the Analysis of Offshore Structures**

Venue: *Coimbra*
Date: *6 to 9 of February, 2018*
Website: *www.cmm.pt*

> **Training Course on Offshore Structures**

Venue: *Coimbra*
Date: *15 to 18 of May, 2018*
Website: *www.cmm.pt*

> **2º PTBIM – Portuguese Congress on Building Information Modelling**

Venue: *Lisbon, Portugal*
Date: *17-18 May 2018*
Website: *www.ptbim.org*

> **SynerCrete'18 - Interdisciplinary Approaches for Cement-based Materials and Structural Concrete: Synergising Expertise and Bridging Scales of Space and Time**

Venue: *Funchal, Portugal*
Date: *24th to 26th October 2018*
Website: *www.synercrete.com*

> **Conference IABSE 2019**

Venue: *Centro Cultural Vila Flor, Guimarães, Portugal*
Date: *27th to 29th March, 2019*
Website: *http://www.iabse.org/guimaraes_2019/*

> **SHATiS'2019 - International Conference on Structural Health Assessment of Timber Structures**

Venue: *Guimarães, Portugal*
Date: *September 2019*

> **CMN2019**

Venue: *Guimarães, Portugal*
Date: *September 2019*

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

Venue: *Coimbra*
Date: *November, 2019*
Website: *www.cmm.pt/congresso12*

> **CSS9 – 9th ECCS-AISC International Workshop on Connections**

Venue: *Coimbra*
Date: *2 to 4 June, 2020*

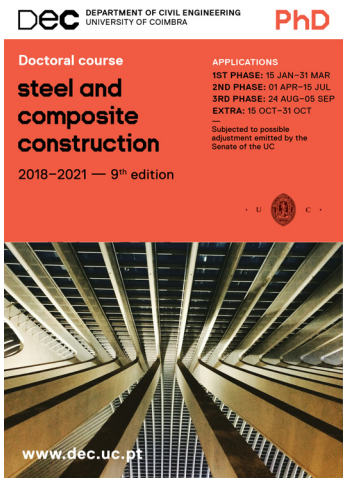
NEWS

> Chair dst/IB-S: Construction of the future

Automation and modularization is a joint initiative from the dst group and the Institute of Science and Innovation for Bio-Sustainability. This Chair aims to promote multidisciplinary research for the future of construction within distinct fields, such as Building Information Modeling and Integrated Production-Design Techniques, Advanced Manufacturing Processes, Innovative Materials and Systems for the Construction Industry, Modular and Reusable Systems for the Rehabilitation in Construction towards a Circular Economy.

> Doctoral Course in Steel and Composite Construction – 9th edition

Civil Engineering Department, University of Coimbra
https://apps.uc.pt/courses/PT/course/601



The doctoral course aims to provide high-level specialized training in the field of Steel and Composite Construction. Close collaboration between research centers of excellence in this area, with industry and professional organizations is promoted, leading not only to advanced theoretical training and the development of knowledge in this area, but also to the enhancement of this knowledge by a network in order to transfer it to the industry.

Application dates:
> First call: 15th January until 31st March;
> Second call: 01st April until 15th July;
> Third call: 24th August until 5th September
> Extra call:15th October until 31st October