ISISE NEWS LETTER

01 . BIANNUAL
SEPTEMBER, 2011

INDEX

ISISE HIGHLIGHTS

The Institute for Sustainability and Innovation in Structural Engineering (ISISE) was initiated in 2007 as a joint initiative by Universities of Coimbra and Minho, in Portugal. ISISE is one of the largest research, development and innovation centres in the field of Civil Engineering in Portugal, with 30 PhD members, 80 PhD students and about 7.5 M€ in contracted funding. In the last Research Assessment Exercise (2003-2007), ISISE was rated as Very Good, the maximum rank in Civil Engineering. The Unit is organized in three Research Groups, addressing the topics of construction technologies in historical materials and masonry, steel and mixed materials, and concrete. In short, ISISE aims at promoting innovation and sustainability, with a close link to the construction sector industry. In order to disseminate the work being carried out in the centre, the Direction of ISISE decided to create a newsletter issued twice a year. This publication will include highlights related to ISISE research projects, technologies, PhD theses, and events, as well as general information about MSc and PhD courses. This first edition comprises the activities developed mainly in the first semester of 2011. Special emphasis is given to the ISISE Day-Out and the 3rd PhD workshop event, as well as an exciting ISISE technology: the "ttt – transportable tourist tower".

ISISE DAY-OUT

TTT
TRANSPORTABLE
TOURIST
TOWER

PHD COMPLETED

› *Assessment of the mechanical microstructure of masonry clay brick by nanoindentation* – **Konrad Józef Krakowiak** / Supervisors: Paulo B. Lourenço (University of Minho, Portugal) and Franz-Josef Ulm (Massachusetts Institute of Technology, USA) – 14th April, 2011

› *Safety Assessment of Old Timber Structures* – **Ricardo José Delgado Sousa Brites** / Supervisors: Paulo B. Lourenço (University of Minho, Portugal) and José Saporiti Machado (National Laboratory for Civil Engineering, Portugal) – 7th July, 2011

› *Numerical Analysis of FRP Strengthened Masonry Structures* – **Claudio Maruccio** / Supervisors: Daniel Oliveira (University of Minho, Portugal); Paulo B. Lourenço (University of Minho, Portugal); Giorgio Monti (Universitá di Roma La Sapienza, Italy) – 27th July, 2011

R&D STARTED PROJECTS

› *Rehabilitation of Building Floors with Lightweight High Performance GFRP Sandwich Panels* – Prof. Joaquim Barros – 181,896€ – PTDC/ECM/113041/2009 – Funding Entity: FCT – Principal Contractor: IST; Participating Institutions: UM, ALTO.

› *PrePAM – Pre-fabricated thin panels using advanced materials for structural rehabilitation* – Prof. Joaquim Barros – 181,286€ – PTDC ECM/114511/2009 – Funding Entity: FCT – Principal Contractor: UM.

› *CutInDur – Long-term structural and durability performance of concrete elements strengthened with the NSM technique* – Prof. Sena Cruz – 157,498€ – Funding Entity: FCT – Principal Contractor: UM.

› *PRELAMI – Performance of reinforced concrete structures strengthened in flexural with an innovative system using prestressed NSM CFRP laminates* – Prof. Salvador Dias – 178,674€ – PTDC/ECM/114945/2009 – Funding Entity: FCT – Principal Contractor: UM; Participating Institutions: Clever & Reinforcement Iberica.

EVENTS

ASCP'2011

The 2nd National Congress on Safety and Conservation of Bridges – ASCP'2011 – was held at the Faculty of Science and Technology, University of Coimbra, from 29th June to 1st July, 2011. The congress was organized in fourteen parallel sessions dedicated to the theme of safety and preservation of bridges and four plenary sessions, where we highlighted a special session dedicated to "25th April Bridge in Lisbon" and sessions given by leading experts, including: Prof. Dan Frangopol (IABMAS President), Prof. Jose Maria Goicolea, Mr. Leo Klatt, Mr. Vincent and Mr. Armando Rito. In addition to the scientific sessions there was also a technical exhibition with the participation of 13 entities linked to the theme of the ASCP. The ASCP'2011 had 168 participants from universities, companies, design offices and other entities, in addition to a significant number of students.

2011 ISISE DAY-OUT

The 2011 ISISE Day-Out and 3rd PhD workshop from ISISE were a joint event, held on last 20th -21st January, 2011. The event took place in Unhais da Serra, which is a very interesting and beautiful region of Portugal. This was a great opportunity for all ISISE members to interact with each other, and also to have some nice time out. This event had the participation of 18 ISISE PhD members and 49 PhD students, in addition of the Advisory Board Panel of ISISE composed by Prof. Michele Calvi, Prof. Nemy Banthia and Dr. Reidar Bjorhovde.

On the first day, swimming pool activities and interaction between members occurred, followed by a social dinner. The 3rd PhD workshop was held the next morning. After a brief presentation of Prof. Paulo B. Lourenço about the ISISE, 12 PhD students orally presented their doctoral work. From the Advisory Board Panel analysis, the "Best Presentation Award" went to António Correia for the presentation "Fire resistance of steel and composite steel-concrete columns". After lunch, the 2011 ISISE Day-Out and 3rd PhD workshop ended with a stroll held in the vicinity of the hotel.

SEMINAR PAREDES 2011

The Department of Civil Engineering of University of Minho organized on the last 22nd June the seminar "Paredes 2011: Paredes divisórias – Passado, presente e futuro", in Porto city. The seminar came as a sequence of two other seminars organized in 2002 in Porto and in 2007 at the National Laboratory of Civil Engineering and is a unique initiative in Portugal. The seminar "Paredes 2011" had the major aim of promotion and dissemination of the most recent developments in the construction technology of partition walls, namely of the national funded research project SipdECO – Development of innovative solutions for eco-efficient partition walls, but also intended as a bridge with traditional solutions for partition walls and to promote some reflections about technical aspects of performance of non-load bearing walls to seismic actions and construction sustainability.

ISISE TECHNOLOGIES

TTT TRANSPORTABLE TOURIST TOWER EXPO 2010 SHANGHAI CHINA PARTICIPATION – ARCHITECT JOSÉ PEQUENO

The transportable tourist tower (ttt) is an innovation in sustainable architecture which represents a new habitability concept and was presented for the first time at the EXPO 2010 in Shanghai, China in the UBPA (Urban Best Practices Area), a space set aside for the best environmental practices in terms of architecture and urban solutions. ttt is based on important strategic principles such as tourism and mobility; urbanity and modularity; sustainability and materiality; energy and construction technology. Developed by architect José Pequeno, in a partnership between University of Minho / ISISE and the dst group, ttt represented Portugal as the second Portugal Pavilion at the biggest Universal Exhibition ever, as a widely recognized and awarded technology. Transportable tourist tower follows on from another product – Et3 Energetic modular technology –, recently winning the V Edition of the BES National Innovation Competition, in the Energy category. Et3 can be incorporated in the ttt optimising its energy autonomy, as a structural timber-glass panel, which is industrialised, modular, polyvalent and usable as a slab or resistant wall. It includes passive solar energy systems, active solar energy systems and bioclimatic functions, which directly lead to greater energy efficiency – an innovation in terms of prefabricated structural elements. Both products are under industrial and intellectual international protection of patents and model protections.

RESEARCH HIGHLIGHT

RESEARCH PROJECT SIPDECO- DEVELOPMENT OF INNOVATIVE SOLUTIONS FOR ECO-EFFICIENT PARTITION WALLS

The research project SipdECO aimed at proposing an innovative eco-efficient solution for partition walls by valuing several industrial by-products, namely flue gas desulfurization (FGD) gypsum from exhaust gases of thermoelectric power plants; granulate cork and textile fibres from the recycling of used tyres. Besides the study of the composite material, the design of the masonry block and the technology of construction of the partition walls were achieved. The main issue to be solved is the placing of electrical and hydraulic installations without making grooves after construction of the walls. In spite of partition walls not being structural, the validation of mechanical behaviour under compression to impact loads and to eccentric compression was assessed. Additionally, the thermal and acoustic, as well as environmental sustainability, were also evaluated.

SipdECO – Development of innovative solutions for eco-efficient partition walls – Prof. Graça Vasconcelos – 187,229€ – QREN (N.º 3419) – Funding Entity: Adi – Principal Contractor: SOFALCA; Participating Institutions: BIOSAFE, PEGOP, UM.

ISISE 'S THESIS

ASSESSMENT OF THE MECHANICAL MICROSTRUCTURE OF MASONRY CLAY BRICK BY NANOINDENTATION - KONRAD JÓZEF KRAKOWIAK

The implementation of recent advances in the material science into the field of structural clay products applied to masonry constructions is the focus of the PhD thesis titled "Assessment of the mechanical microstructure of masonry clay brick by nanoindentation" (http://hdl.handle.net/1822/1248), presented by Konrad J. Krakowiak at the University of Minho, on 14th April, 2011. The experimental analysis carried out by the author is focused on the detailed description of the heterogeneous microstructure of the fired clay brick, as a function of its composition and processing conditions. Multi-field methods of investigation have been combined, from standard mechanical tests carried out on bulk material on the macro-scale to novel nanoindentation techniques, which infers the mechanical properties of the solids on the nano- and microscales. Moreover, the complex interplay between the different components of this heterogeneous solid is traced with Scanning Electron Microscopy methods or Mercury Intrusion Porosimetry. The existing hierarchical ordering of fired brick microstructure is framed in the multi-level model (see Figure 1), where the building blocks are classified and described as: Level "0" (<10-6 [m]), "Primary Brick" (<10-4 [m]) and "Secondary Brick" (<10 2 [m]), w.r.t the type of morphology present and mechanical characteristics.

The Statistical Grid Indentation (SGI) method, originally developed for cement based materials is extended to the field of structural ceramics. Such an index experimental analysis of mechanical phase properties is carried out with the aid of Gaussian Mixture Modelling, which together with the Maximum Likelihood concept and Expectation-Maximization algorithm, provides a robust and efficient deconvolution strategy, which can be easily extended to other types of complex heterogeneous materials. This deconvolution technique is validated on Ordinary Portland Cement, brass alloy and investigated fired brick. The relation between the characteristic scale of depth-sensing measurement and the mechanical characteristics inferred from the bulk of composite material is presented. Additionally, Buckle's rule-of-thumb is approached with a probabilistic model of biphasic composite materials, which represent idealized microstructures. The mechanical properties of the 'glassy' matrix, incorporated at Level "0" of the fired brick are investigated in the depth-sensing experiment. Different regimes of the indentation force are considered along the experimental campaign. The relation between the morphology of the 'glassy' matrix, its composition and measured indentation modulus, elastic modulus and indentation hardness is studied. Additionally, the composite 'polycrystalline-amorphous' nature of the matrix of the brick is corroborated and documented in detail.

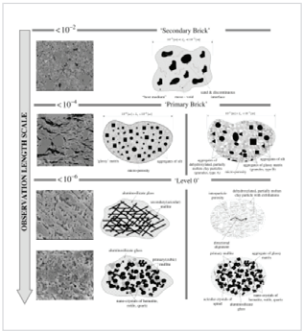


Figure Caption: Hierarchical think-model of facing clay brick [T»1050 (°C) (left) and common brick microstructures [T»950 (°C) (right)]

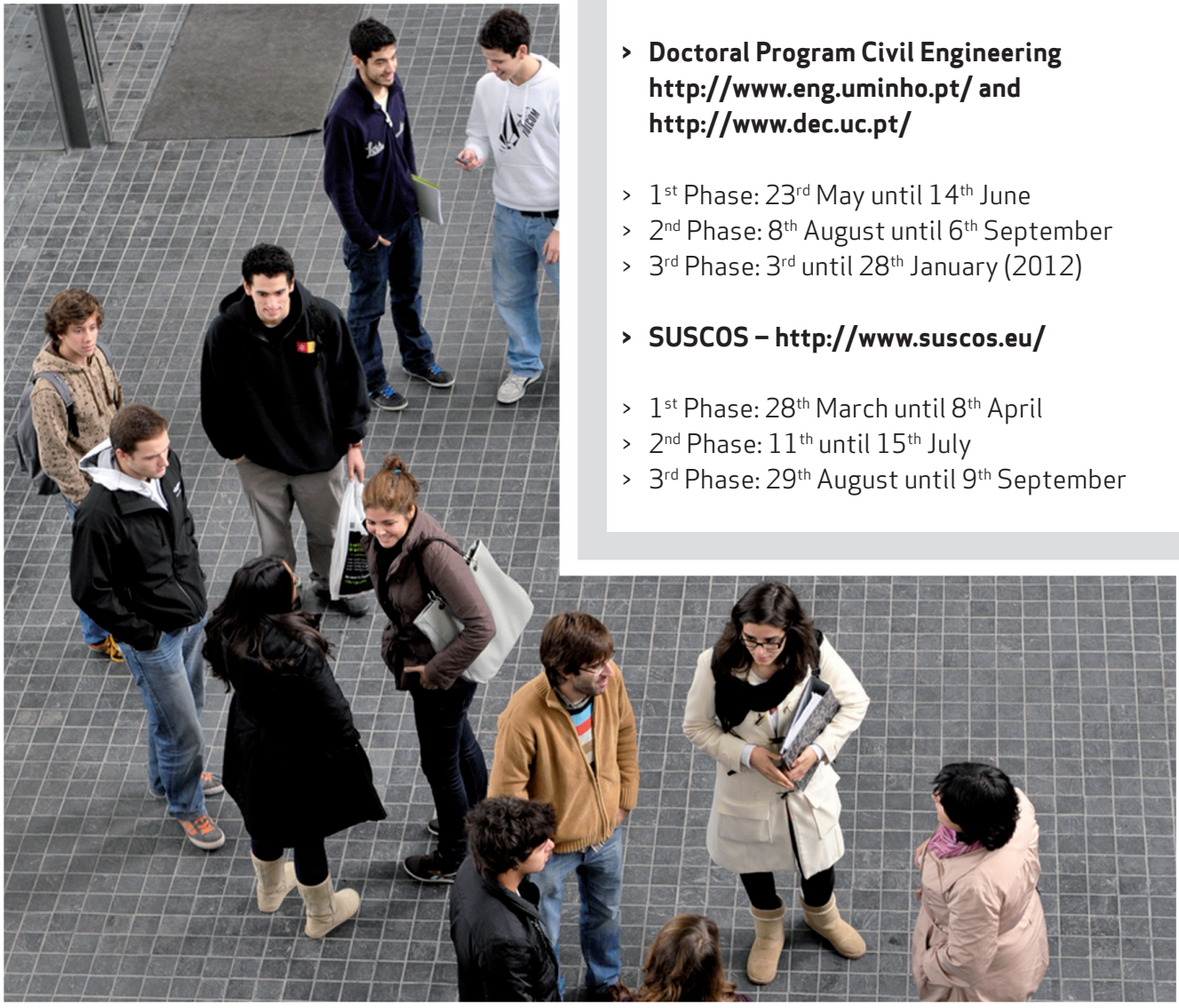
KonradJ. Krakowiak – is a Postdoctoral Associate in the Concrete Sustainability Hub (CSHub), at the Massachusetts Institute of Technology. He received his doctoral degree in Civil Engineering from the University of Minho, Portugal, and his Master's degree in Theory and Computer Analysis of Structures from the Warsaw University of Technology, Poland. He is the co-author of several journal and conference publications in the fields of building ceramics, concrete science, and numerical modelling and analysis of historical engineering structures. His professional experience includes the structural design and strengthening of modern and historical constructions, serving as co-author of engineering reports for prominent Portuguese monuments (e.g. the Monastery of the Hieronymites in Lisbon, classified as Cultural World Heritage by UNESCO). His current research activities are focused on advanced experimental analysis and modelling of building materials, mainly cement-based materials and fired ceramics, ranging from the nanoscale to the macroscale of day-to-day engineering applications.

UPCOMING EVENTS

15th International Brick/Block Masonry Conference, Florianópolis, Brazil, 3rd – 6th June, 2012. www.15ibmac.com

8th RILEM International Symposium on Fibre Reinforced Concrete: Challenges and Opportunities (BEFIB 2012), Guimarães, Portugal, 19th – 21st September, 2012. www.befib2012.civil.uminho.pt

8th International Conference on Structural Analysis of Historical Constructions, Wroclaw, Poland, 15th – 17th October, 2012. www.sahc2012.org



MASTER COURSES

- **SAHC – http://www.msc-sahc.org/**

- 1st Phase: 15th November until 20th January
- 2nd Phase: 15th March until 10th May
- 3rd Phase: 1st July until 20th August

- **SUSCOS – http://www.suscos.eu/**

- 1st Phase: 28th March until 8th April
- 2nd Phase: 1st until 15th July
- 3rd Phase: 19th September until 3rd October

PHD COURSES

- **Doctoral Program Civil Engineering http://www.eng.uminho.pt/ and http://www.dec.uc.pt/**

- 1st Phase: 23rd May until 14th June
- 2nd Phase: 8th August until 6th September
- 3rd Phase: 3rd until 28th January (2012)

- **SUSCOS – http://www.suscos.eu/**

- 1st Phase: 28th March until 8th April
- 2nd Phase: 11th until 15th July
- 3rd Phase: 29th August until 9th September