THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Abstract Book:

7th Annual International Conference on **Civil Engineering**

19-22 June 2017, Athens, Greece

Edited by

Gregory T. Papanikos

2017

Abstracts

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(In Alphabetical Order by Author's Family name)

Preface

This book includes the abstracts of all the papers presented at the *7th Annual International Conference on Civil Engineering, 19-22 June 2017*, organized by the Athens Institute for Education and Research (ATINER). All ATINER's conferences are organized by the Academic Committee (https://www.atiner.gr/academic-committee). This conference has been organized with the assistance of the following academics, who contributed by chairing the conference sessions and/or by reviewing the submitted abstracts and papers:

1. Gregory T. Papanikos, President, ATINER.
2. Thomas Attard, Associate Professor, The University of Alabama at Birmingham, USA.
3. Dawen Gao, Professor, Northeast Forestry University, China.
4. Amde Amde, Professor, University of Maryland, USA.
5. Zbigniew Pasek, Professor, University of Windsor, Canada.
6. Peter Boehm, Professor, University of Applied Sciences Trier, Germany.
7. LuAnn Carpenter, Director, Student Program Assessment and Administration, Auburn University, USA.
8. Roberto Gomez, Academic Member, ATINER & Associate Professor, National Autonomous University of Mexico, Mexico.
9. Dimitrios Goulias, Associate Professor, University of Maryland, USA.
10. Elhem Ghorbel, Professor, University of Cergy Pontoise, France.
11. Fouad Mohammad, Academic Member, ATINER & Senior Lecturer, Nottingham Trent University, UK.
12. Dillon Chrimes, Technical Integration Coordinator, Vancouver Island Health Authority, Canada.
13. Lampros A. Pyrgiotis, President, Greek Society of Regional Scientists, Greece.
14. Sabrina Herbst, Scientific Assistant / PhD Student, Ernst-Abbe-Hochschule Jena, Germany.
15. Isotilia Costa Melo, MSc Student, University of São Paulo, Brazil.
16. Vassilis Skianis, Research Fellow, ATINER.
17. Olga Gkounta, Researcher, ATINER.
18. Hannah Howard, Research Assistant, ATINER.

In total 33 papers were submitted by over 35 presenters, coming from 16 different countries (Brazil, Canada, China, Czech Republic, France, Germany, India, Luxembourg, Mexico, South Korea, Spain, Thailand, Tunisia, Turkey, UK and USA). The conference was

organized into 12 sessions that included a variety of topic areas such as design considerations, optimization, foresight and more. A full conference program can be found beginning on the next page. In accordance with ATINER's Publication Policy, the papers presented during this conference will be considered for inclusion in one of ATINER's many publications.

The purpose of this abstract book is to provide members of ATINER and other academics around the world with a resource through which to discover colleagues and additional research relevant to their own work. This purpose is in congruence with the overall mission of the institute. ATINER was established in 1995 as an independent academic organization with the mission to become a forum where academics and researchers from all over the world could meet to exchange ideas on their research and consider the future developments of their fields of study.

It is our hope that through ATINER's conferences and publications, Athens will become a place where academics and researchers from all over the world regularly meet to discuss the developments of their discipline and present their work. Since 1995, ATINER has organized more than 400 international conferences and has published nearly 200 books. Academically, the institute is organized into seven research divisions and 38 research units. Each research unit organizes at least one annual conference and undertakes various small and large research projects.

For each of these events, the involvement of multiple parties is crucial. I would like to thank all the participants, the members of the organizing and academic committees, and most importantly the administration staff of ATINER for putting this conference and its subsequent publications together.

Gregory T. Papanikos
President

FINAL CONFERENCE PROGRAM
4th Annual International Conference on Engineering,
19-22 June 2017, Athens, Greece
PROGRAM
Conference Venue: Titania Hotel, 52 Panepistimiou Avenue, Athens, Greece

C O N F E R E N C E P R O G R A M

Monday 19 June 2017

08:00-09:00 Registration and Refreshments

09:00-09:30 (Room D-10th Floor) Welcome and Opening Address

Gregory T. Papanikos, President, ATINER.

09:30-11:00 Session I (Room D-10th Floor): Structural and Dynamic Analysis	**09:30-11:00 Session II (Room E-10th Floor): Manufacturing and Materials I**
Chair: Olga Gkounta, Researcher, ATINER.	**Chair:** Zbigniew Pasek, Professor, University of Windsor, Canada.
1. Nirjhar Dhang, Professor, Indian Institute of Technology, India & Subhra De, Research Scholar, Indian Institute of Technology, India. Calibration of Semi-Rigid Joints of Frame Structures using Fuzzy Finite Element Method. 2. Raul Pereda Garcia, Professor, University of Cantabria, Spain, Julio Manuel de Luis Ruiz, Professor, University of Cantabria, Spain, Rubén Pérez Álvarez, Post-Doctoral Researcher, University of Cantabria, Spain, Felipe Piña García, Associate Professor, University of Cantabria, Spain & Elena Castillo López, Professor, University of Cantabria, Spain. Mathematical Model of Forward Motion in Bathymetries and Its Effect on the Measurement Conditions. 3. Fouad Mohammad, Senior Lecturer, Nottingham Trent University, UK & Ahmed Mezgeen, Lecturer, Duhok University, Iraq. Modal Analysis of Reinforced Concrete Square Slabs. 4. Ji-Ho Kang, Senior Researcher, Korea Atomic Energy Research Institute, South Korea & Chang Keun Jo, Project Manager, Korea Atomic Energy Research Institute, South Korea. Friction Model Performance Comparison for the Dynamic Analysis of Nuclear Graphite Blocks. 5. Lintai Wang, PhD Candidate, Beijing University of Technology, China. Decreasing Vibration Technology for Tunnel Blasting Based on Building Modal Analysis.	1. Peter Boehm, Professor, University of Applied Sciences Trier, Germany & Jannis Marion, University of Applied Sciences Trier, Germany. New Experiences in Welding Magnesium Alloys. 2. Sabrina Herbst, Scientific Assistant / PhD Student, Ernst-Abbe-Hochschule Jena, Germany, Johanna Gerlach, BSc Student, Ernst-Abbe-Hochschule Jena, Germany, Frank Engelmann, Engineer, Ernst-Abbe-Hochschule Jena, Germany & Karl-Heinrich Grote, Chair of Design Engineering, Otto-von-Guericke-Universität, Germany. Challenges of Maintenance, Repair and Overhaul in Hazardous Areas. 3. Josef Meyer, PhD Student, Hochschule Hannover, Germany, Bin Cui, PhD Student, Hochschule Hannover, Germany, Ulrich Luedersen, Professor, Hochschule Hannover, Germany & Martin Gottschlich, Professor, Hochschule Hannover, Germany. Experimental Heat Transfer Analysis of a Rotary Swing Chamber Expander. 4. Joao Marcos Ferreira Santos, Research Student, IFAL - Instituto Federal de Alagoas, Brazil, Thannys Nascimento Silva, Research Student, IFAL - Instituto Federal de Alagoas, Brazil & Justino Marques Sheyla Karolina, Advisor Professor, Federal Institute of Alagoas - IFAL, Brazil. Analysis of the Behaviour of Unserviceable Tire Rubber in Floor

	Manufacturing.

11:00-12:30 Session III (Room D-10th Floor): Wind and Seismic Performance	**11:00-12:30 Session IV (Room E-10th Floor): Manufacturing and Materials II**
Chair: Dawen Gao, Professor, Northeast Forestry University, China.	**Chair:** Peter Boehm, Professor, University of Applied Sciences Trier, Germany.
1. Naveed Anwar, Executive Director, Asian Institute of Technology (AIT), Thailand, Shilpa Nirman Thilakarathna, MSc Student, Asian Institute of Technology (AIT), Thailand, Pramin Norachan, Structural Engineering Manager at AIT Solutions, Asian Institute of Technology (AIT), Thailand & Fawad Najam, PhD Student, Asian Institute of Technology (AIT), Thailand. Effect of Wind Loads on the Seismic Performance of Tall Buildings. 2. David Sanders, Professor, University of Nevada, Reno, USA, Mohammed Mohammed, PhD Student, University of Nevada, Reno, USA & Ian Buckle, Professor, University of Nevada, Reno, USA. Experimental and Analytical Investigation of Structural Response of Bridge Columns using Ground Motions from the Tohoku 2011 Earthquake. 3. Roberto Gomez, Associate Professor, National Autonomous University of Mexico, Mexico, Mendoza-Salas, Research Associate, National Autonomous University of Mexico, Mexico, Oscar Noe Rosales-González, Research Associate, National Autonomous University of Mexico, Mexico, Luis Martin Arenas García, Research Associate, National Autonomous University of Mexico, Mexico, Adrian Pozos-Estrada, Associate Professor, National Autonomous University of Mexico, Mexico & José Alberto Escobar-Sánchez, Associate Professor, National Autonomous University of Mexico, Mexico. Experimental Verification of Tension Forces in a Cable Stayed Bridge.	1. Hector Estrada, Professor, University of the Pacific, USA, Jonathan Trovillion, U.S. Army Engineer Research and Development Center, USA, Hugh McManus, U.S. Army Engineer Research and Development Center, USA, Ashok Kumar, U.S. Army Engineer Research and Development Center, USA, Larry D. Stephenson, U.S. Army Engineer Research and Development Center, USA & William Lewis, U.S. Army Engineer Research and Development Center, USA. Experimental Results of Accelerated Long-Term Durability Performance of FRP Composite Materials. 2. Amel Bourguiba, PhD Student, University of Cergy Pontoise, France. Effect of a Thinner (Methyl Octanoate) on Mechanical Strengths and Fracture Behavior of Epoxy Resin Mortars. 3. Christian Lamberti, PhD Student, University of Luxembourg, Luxembourg. Laser Assisted Joining of Aluminum and Polyamide 6.6 – Evaluating the Mechanical Strength of Multi Material Structures. 4. Emanuel Filipe Santos Amaral, Research Student, IFAL - Instituto Federal de Alagoas, Brazil, Jose Diogo Barbosa de Almeida, Research Student, IFAL - Instituto Federal de Alagoas, Brazil & Justino Marques Sheyla Karolina, Advisor Professor, Federal Institute of Alagoas - IFAL, Brazil. Study of Viability of Using Rice Husk Ash in Manufacturing of Hollow Block.

12:30-14:00 Session V (Room D-10th Floor): Advanced Materials and Chemistry

Chair: Fouad Mohammad, Senior Lecturer, Nottingham Trent University, UK.

1. Dawen Gao, Professor, Northeast Forestry University, China. How one-Stage Deammonification Process Succeed?
2. Elhem Ghorbel, Professor, University of Cergy Pontoise, France, Mariem Limaiem, PhD Student, University of Cergy Pontoise, France and University of Tunis El Manar, Tunisia & Oualid Limam, Professor, Tunis El Manar University, Tunisia. Reinforcement Effects of Concretes with CFRP Materials.
3. Shamim Sheikh, Professor, University of Toronto, Canada & Zahra Kharal, University of Toronto, Canada. Comparison of Steel- and GFRP-Reinforced Concrete Members under Seismic and non-Seismic Loads.

14:00-15:00 Lunch

15:00-17:00 Session VI (Room D-10th Floor):Design and Optimization	**15:00-17:00 Session VII (Room E-10th Floor): Foresight**
Chair: Elhem Ghorbel, Professor, University of Cergy Pontoise, France.	**Chair:** Isotilia Costa Melo, MSc Student, University of São Paulo, Brazil.
1. Shian Gao, Lecturer, University of Leicester, UK & Ahmed Qasim Ahmed, PhD Research Student, University of Leicester, UK. Large Eddy Simulation of Air Flow and Temperature Distributions in an Office Room Served by a Displacement Ventilation System. 2. Erdem Baltaci, Industrial Engineer, Turkey, Sevgi Ozlem Bulu, Industrial Engineer, Turkey & Sila Isyar, Industrial Engineer, Turkey. Production Facility Layout Design for a Project Based Company. 3. Haider Iqbal Hanif, PhD Student, Hochschule Hannover, Germany, Dennis Saul, Research Assistant, Hochschule Hannover, Germany, Henrik Rüscher, Research Assistant / PhD Student, Hochschule Hannover, Germany, Lars-Oliver Gusig, Professor, Hochschule Hannover, Germany & Christian Bohn, Professor, Clausthal University of Technology, Germany. Module Design Methodology for the Conceptionalization of a Portable Unit for Providing Heat, Cold and Electricity in BEVs and Buildings. 4. Sahar Elaiwi, PhD Student, Plymouth University, UK. Analysis and Design of Castellated Beams.	1. Abhijit Deshmukh, James J. Solberg Head and Professor, School of Industrial Engineering, Purdue University, USA. ReThinking IE – Innovations at the Frontiers of Industrial Engineering. 2. Dimitrios Kyriakou, Lead Economist, European Commission, Spain. Implementing Smart Specialisation Strategies: Projected Issues and Foresight. 3. Jin-Wei Wang, PhD Student, Beijing Institute of Technology, China & Yi-Ming Wei, Professor, Beijing Institute of Technology, China. Developing Foresight Intelligence for Energy Technology: Qualitative Comparative Analysis Method.

17:00-19:00 Session VIII (Room D-10th Floor): ***A Symposium on the Future Developments and Prospects of Engineering and Science Education & Research in a Global World***

Chair: Lampros A. Pyrgiotis, President, Greek Society of Regional Scientists, Greece.

1. **Abhijit Deshmukh**, James J. Solberg Head and Professor, School of Industrial Engineering, Purdue University, USA. Convergence of Knowledge.
2. **Anthony Koutoulis**, Professor & Head of School of Biological Sciences, University of Tasmania, Australia. The Future Developments and Prospects of Biology Education and

Research in a Global World – a Tasmanian and Australian context.
3. **LuAnn Carpenter**, Director, Student Program Assessment and Administration, Industrial and Systems Engineering, Auburn University, USA. Issues and Trends in Engineering Education at Auburn University, Alabama, United States of America.
4. **David H. Sanders**, UNR Foundation Professor, Past-Chair UNR Faculty Senate, Department of Civil and Environmental Engineering, University of Nevada, Reno, USA. Is the Future for Higher Education bright in the United States?
5. **Ravi Mukkamala**, Professor, Old Dominion University, USA. The Future of Computer Science.

For details on the discussion please click here.

21:00-23:00 The Pragmatic Symposium of the Conference as Organized in Ancient Athens with Dialogues, Food, Wine, Music and Dancing but fine tuned to Synchronous Ethics

Tuesday 20 June 2017

07:30-10:30 Session IX: An Educational Urban Walk in Modern and Ancient Athens

Chair: Gregory Katsas, Vice President of Academic Affairs, ATINER & Associate Professor, The American College of Greece-Deree College, Greece.

Group Discussion on Ancient and Modern Athens.
Visit to the Most Important Historical and Cultural Monuments of the City (be prepared to walk and talk as in the ancient peripatetic school of Aristotle.

11:00-12:30 Session X (Room D-10th Floor): Structural Design Considerations

Chair: Roberto Gomez, Associate Professor, National Autonomous University of Mexico, Mexico.

1. Amde Amde, Professor, University of Maryland, USA & Andreas Paraschos, Senior Structural Engineer, New York City Department of Transportation, USA. Effects of Inline Cantilever Wingwalls on Integral Abutment Bridge Pile Stresses.
2. Yanglin Gong, Professor, Lakehead University, Canada. Test of All-Bolted Angle Connections for Catenary Action.

12:30-14:00 Session XI (Room D-10th Floor): Advanced Materials and Chemistry

Chair: Amde Amde, Professor, University of Maryland, USA.

1. Dimitrios Goulias, Associate Professor, University of Maryland, USA & Sahand Karimi, University of Maryland, USA. Risk Analysis for Highway Materials of Flexible Pavement Structures.
2. Lucas Willian Aguiar Mattias, Student Researcher, Federal Institute of Alagoas - IFAL, Brazil, Jesimiel Pinheiro Cavalcante, Professor, Federal Institute of Alagoas - IFAL, Brazil & Eliedson Carvalho, Student Researcher, Federal Institute of Alagoas - IFAL, Brazil. Reuse of Gypsum Residue in the Manufacturing of 3D Decorative Wall Covering Panels.
3. Amanda Lys Matos dos Santos Melo, Student / Researcher, Federal Institute of Education, Science and Technology of Alagoas (IFAL), Brazil, Filipe da Silva Duarte, Student / Researcher, Federal Institute of Education, Science and Technology of Alagoas (IFAL), Brazil & Rodrigo Mero Sarmento da Silva, Teacher, Federal Institute of Education, Science and Technology of Alagoas (IFAL), Brazil. Prototypes of an Air Incorporating Bioadditive Derived from Castor Oil.

14:00-15:00 Lunch

15:00-16:30 Session XII (Room D-10th Floor): Geotechnical and Construction Engineering

Chair: Dimitrios Goulias, Associate Professor, University of Maryland, USA.

1. Josef Zak, Assistant Professor, Czech Technical University in Prague, Czech Republic. Asphalt Mixtures that Dissipate Energy.
2. Dayana Carla de Macedo, Teacher, Midwest University of Paraná, Brazil, E. C. M. Ishikawa, Midwest University of Paraná, Brazil, C. B. Santos, Midwest University of Paraná, Brazil, S. N. Matos, Midwest University of Paraná, Brazil, H. B. Borges, Midwest University of Paraná, Brazil & A. C. Francisco, Midwest University of Paraná, Brazil. DRM-F: Dimensionality Reduction Method based in Framework.

21:00- 22:30 Dinner

Wednesday 21 June 2017
Educational Island Tour or Mycenae and Epidaurus Visit

Thursday 22 June 2017
Delphi Visit

Emanuel Filipe Santos Amaral
Research Student, IFAL - Instituto Federal de Alagoas, Brazil
Jose Diogo Barbosa de Almeida
Research Student, IFAL - Instituto Federal de Alagoas, Brazil
&
Justino Marques Sheyla Karolina
Advisor Professor, Federal Institute of Alagoas - IFAL, Brazil

Study of Viability of Using Rice Husk Ash in Manufacturing of Hollow Block

This research was entirely developed in Federal Institute of Alagoas -Brazil by Civil Engineering Research Group andconsists on studying the viability of using rice husk ash on manufacturing of hollow block, thuscreating ternary compositionsin order to obtain ahigh performance, durable and low-costproductthat could be made in industrial scale. Since the block reuse wastedrice husk ash, it becomes an ecological alternative. The residues used on the block's confection come originally from the burning of rice husk. In general, hollow blocks are a compacted and homogeny mixing of soil, Portland cement and water inappropriate portions in order to meet the requirements requested by standards. In the research, the group used soil from Palmeira dos Índios –AL(Brazilian city), Portland cement CP II Z-32 RS and rice husk ash residues from Piaçabuçu –AL(Brazilian city). Then, it was studied the residue addition in different levels (2%, 6%, and 10%), producing 12 samples for each formulation. The method used to analyze the block's behavior was based on tests of mass loss by immersion, water absorption and compression strength. The tests were performed on the samples with two different ages, in this case, 7 and 14 days of curing period. The test results are considered viable compared to Brazilian Standards requirements (ABNT -Associação Brasileira de Normas Técnicas). The tests of mass loss by immersion, water absorption and compression resistance were even better than those required by the standards, reaching high-level performance. The obtained results show that the residue addition between 2% and 6% keeps the block on a great technical level.

Amde Amde
Professor, University of Maryland, USA
&
Andreas Paraschos
Senior Structural Engineer, New York City Department of Transportation, USA

Effects of Inline Cantilever Wingwalls on Integral Abutment Bridge Pile Stresses

Current bridge design procedures used by bridge engineers to design integral abutment bridges built with cantilever wingwalls start with girder design, continue with superstructure design, abutment design, pile design, and end with the design of the cantilever wingwalls. The design procedure does not cycle back to include the effects of wingwall forces on the other bridge elements previously designed. This paper investigates the stresses induced in the piles of integral abutments from those wingwall forces by means of parametric studies using as parameters the bridge length, length of wingwalls, presence or absence of predrilled holes, temperature loads in both rising and falling temperatures, and various types of soil behind the abutments and wingwalls. In all cases, the soil around the piles consisted of very stiff clay. The parametric studies were conducted by means of three-dimensional nonlinear finite element models that included both soil-structure and soil-pile interaction. The results indicate an increase in the magnitude of pile stresses as a result of those unaccounted wingwall forces and that the most critical combination occurs during temperature contraction when no predrilled holes are used and dense sand is behind the abutments and the wingwalls.

Naveed Anwar
Executive Director, Asian Institute of Technology (AIT), Thailand
Shilpa Nirman Thilakarathna
MSc Student, Asian Institute of Technology (AIT), Thailand
Pramin Norachan
Structural Engineering Manager at AIT Solutions, Asian Institute of Technology (AIT), Thailand
&
Fawad Najam
PhD Student, Asian Institute of Technology (AIT), Thailand

Effect of Wind Loads on the Seismic Performance of Tall Buildings

Wind and earthquake loadings are the two major types of lateral dynamic excitations experienced by high-rise buildings. An efficient design must ensure the safety of structural and non-structural components of a building against both types of loadings. This study evaluates the seismic performance of high-rise buildings primarily designed based on different levels of lateral wind loads. A 40-story dual system case study building is selected for this purpose. In dual systems, the lateral load is mainly resisted by a combination of reinforced concrete core wall and the special moment resisting frame. The case study building is separately designed for wind loading using three different levels of wind speeds (low, moderate and high), which are selected to represent the anticipated hazards at various global wind zones. The detailed seismic performance exhibited by three different design cases (corresponding to different levels of wind hazard) is evaluated. The case study building is assumed to be located in a moderate-level seismic zone. The Nonlinear Response History Analysis (NLRHA) procedure is used to obtain the true inelastic seismic demands of all three design cases of the case study building. The results showed that the level of design wind load can significantly alter the seismic performance of high-rise dual system buildings. Therefore, even for the cases where the wind demands control the design of lateral load-resisting system, the detailed performance-based seismic evaluation should still be carried out to ensure the overall structural safety and integrity.

Erdem Baltaci
Industrial Engineer, Turkey
Sevgi Ozlem Bulu
Industrial Engineer, Turkey
&
Sila Isyar
Industrial Engineer, Turkey

Production Facility Layout Design for a Project Based Company

Efficient facility planning and design contribute to efficiency of the production. This study considers the layout of a new factory for a company, using the analysis and information from its current facilities. Since the company is a project based one, there is no standard material or work flow and nearly each order is different than others. Hence, raw materials' size and shape, production plan and work plan change according to orders. Because of the capacity problems, the company is planning to relocate to its new factory. Layout of the current factory creates too much part and material mobility which causes waste of time and energy, increases the traffic and the operational costs. There are 30 machines for primary and secondary operations in the factory and same set of the machines will be moved to new facility. The aim of this study, is to design the layout of the new factory to reduce material handling costs and transportation time between the machines. Current operations are analyzed to identify the flow of the materials using 5 years' data. The aim of this analysis is to find the flow of the raw materials to primary operation machines and the flow of the parts that comes from primary operations to the secondary operations. This analysis was made with 5-years data. Product families are identified and a layout for the new factory is proposed with respect to findings.

Peter Boehm
Professor, University of Applied Sciences Trier, Germany
&
Jannis Marion
University of Applied Sciences Trier, Germany

New Experiences in Welding Magnesium Alloys

The role of light weight constructions gets more and more important in the field of the automobile though the aircraft industry. In view of that fact some structural elements in these kind of fields will be constructed of light weight metal - magnesium. Magnesium alloys are featuring relatively suitable mechanical properties in relationship to their weight. Moreover the casting of magnesium is well known, so that a great number of parts can be produced. Actually magnesium components are joined by screwing processes. Bolting connections have the disadvantage to be comparatively cost-intensive and underlie in many cases the risk of corrosion. To be more flexible in the construction of magnesium components optimized joining technologies are demanded. Currently only a small knowledge to join these magnesium alloys by welding technologies is available. To start solving the problem two different magnesium alloys, AZ91 and AM60 (Two pressure casting alloys, different in aluminium content) were examined by different welding procedures, e.g. the laser welding technology. Preliminary investigations showed that particularly the Tungsten-Inert-Gas Method stood the test. In the course of the investigations some different filler materials were tested in verifying all main welding parameters. On the one hand all welded specimen were tested against their mechanical-technological properties, particularly with regard to a sufficient strength of the weld seams. On the other hand the influence of the appearance of different solid solutions as well as the influence of different precipitation phases with a view to the structure of the weld was researched by metallographic methods as well as by scanning electron microscope analyzing procedures. The results obtained by the investigations lead to precise indications to an optimized welding process for the examined basis-material/filler-material combinations. On the basic principle of the fundamental knowledge of the precipitation creation improved welding results for further basis-material/filler- material combinations can be expected.

Amal Bourguiba
PhD Student, University of Cergy Pontoise, France

Effect of a Thinner (Methyl Octanoate) on Mechanical Strengths and Fracture Behavior of Epoxy Resin Mortars

Epoxy resin mortars are mainly used in the implementation of precast elements used in civil engineering field. The workability of these mortars represents a major obstacle to their development. In order to improve this property, we introduced an organic thinner into its composition. The amount of thinner should be optimized to ensure ease of implementation without compromising the final mechanical properties of the mortar.

In this work we present the influence of the thinner (methyl octanoate), added at different percentages, on the properties of resin mortars in the fresh state as well as on their mechanical resistances and their fracture behavior. The studied epoxy resin mortars were formulated with two types of sand: standardized sand and recycled one, by varying the percentage of the polymeric binder between 9 and 20%. Methyl octanoate was added with 2%, 5%, 7% and 9% by weight, based on the total mass of mortar.

In the fresh state, workability tests were performed with Abrams mini-cone. The obtained results show that methyl octanoate improved the workability of the various types of epoxy resin mortars. In the cured state, three-point bending and compression tests were carried out at different maturation ages on 4x4x16 cm3 specimens. The results show that this thinner induced the decrease of the mechanical strengths. Indeed, at 7 days, we recorded a loss of bending strength equal to 20% when adding 5% of methyl octanoate to the mortar prepared with 20% of polymeric binder.

The fracture behavior was studied by a three-point bending test on pre-notched 4x4x16 cm3 specimens. As a result, the addition of thinner improved the fracture properties of the epoxy resin mortars. Indeed, the addition of methyl octanoate increased the fracture energy "G_F" as well as the critical stress intensity factor "K_{IC}". We remarked that, the "G_F" increases by 41% when adding 7% of methyl octanoate to the mortar prepared with 9% of polymer.

Abhijit Deshmukh
James J. Solberg Head and Professor, School of Industrial Engineering,
Purdue University, USA

ReThinking IE – Innovations at the Frontiers of Industrial Engineering

Now is a truly transformational time for Industrial Engineers. On one hand, the world is recognizing the importance of what we do – from big-data analytics to systemic risk mitigation; from additive manufacturing to service science. At the same time, we are facing challenges that are hard to tackle with our current toolkit – from stopping pandemics to protecting global infrastructure; from creating incentives for individuals to designing social networks. The grand challenges facing society today inspire and drive us once again envision new perspectives and invent novel ways to improve the world we live in. This talk focuses on ReThinking IE in order to make a lasting impact on the society going forward.

Nirjhar Dhang
Professor, Indian Institute of Technology, India
&
Subhra De
Research Scholar, Indian Institute of Technology, India

Calibration of Semi-Rigid Joints of Frame Structures using Fuzzy Finite Element Method

In structural analyses, joints are considered as rigid or pinned. Whereas the pinned joints can uniquely be modeled but the rigid joints may not perform as per assumptions because of insufficient detailing of joints as in the case of reinforced concrete, or the moment resisting connections in case of steel structures. Therefore, the rigid joints can be classified to different types of semi-rigid connections, according to its partial fixity or restrained. In prefabricated structures, joints are taken for granted as pinned connection though they are actually semi-rigid. Therefore, modeling of semi-rigid connections in structural analysis provides more realistic and reliable results. Generally, the moment springs are provided in modeling semi-rigid joints, but in the present study, the semi-rigid frame element is developed introducing two fixity factors (ranging from 0 to 1) to describe its rigidity. Further this may be noted that the performance of semi-rigid joints can be quantified according to their moment-rotation curve and in the present study, this is further described in terms of fixity factors as introduced for computation of the stiffness matrix. Moreover, the joints are classified into five categories, such as, hinge, low, semi, medium, and rigid, according to the bending moment developed in the joint. For this purpose, the fuzzy finite element is developed to compute displacements and member forces by describing above fuzzy variables with a range of values giving lower and upper interval. The hinge and rigid joints are described as a trapezoidal function whereas other three fuzzy variables such as, low, semi and moderate are described as triangular functions. By giving proper intervals, the semi-rigid joints are described by five variables avoiding infinite values of fixity factors and fuzzy rules can be made. The method can be used for different types of joints, such as L-joints, T-joints, cross-joints and design curves can be prepared. Further, this method can be used to record the state of joints observing cracks in case of reinforced concrete buildings and can be taken into consideration while modeling the structure for the purpose of retrofitting.

Sahar Elaiwi
PhD Student, Plymouth University, UK

Analysis and Design of Castellated Beams

The castellated beam is one of the steel members, which uses less material but has equal performance as the I-beam of the same size. The process of fabrication castellated beams led to increase the beam's depth and then the bending strength and stiffness around the major axis without adding additional materials.

Existing studies have shown that the resistance of the castellated beam is influenced by shear stresses particularly those around web openings and under the T-section, which could cause the beam to have different failure modes. However, most of design guidance does not take into account the shear effect. As far as the bending strength is concerned, the neglecting the shear effect may not cause problems. However, for the calculation of serviceability, the shear weakness due to web openings in castellated beams could affect the performance of the beams and thus need to be carefully considered.

The aim of the present paper is to investigate the effect of web openings on the transverse deflection of castellated beams by using both analytical and numerical methods. The purpose of developing analytical solutions, which adopted the classical principle of minimum potential energy is for the design and practical use; while the numerical solutions obtained using ANSYS software are for the validation of the analytical solutions. In addition, this present study has been presented to evaluate the shear-induced transverse deflection of castellated beams subjected to uniformly distributed transverse loads. The analytical and numerical solutions have been employed for a wide spectrum of geometric dimensions of I-shaped castellated beams with two command boundary conditions, namely simply support and simply-clamped support subjected to a uniformly distributed transverse load This study has contributed to enhancing the knowledge of the effect of web openings on the transverse deflection of castellated beams at a uniformly distributed transverse load.

Hector Estrada
Professor, University of the Pacific, USA
Jonathan Trovillion
U.S. Army Engineer Research and Development Center, USA
Hugh McManus
U.S. Army Engineer Research and Development Center, USA
Ashok Kumar
U.S. Army Engineer Research and Development Center, USA
Larry D. Stephenson
U.S. Army Engineer Research and Development Center, USA
&
William Lewis
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Experimental Results of Accelerated Long-Term Durability Performance of FRP Composite Materials

Fiber reinforced polymer (FRP) composite materials have been increasingly used in many infrastructure applications, including seismic rehabilitation, retrofitting, and repair of structural systems (for example, strengthening of concrete beams, slabs, and columns). FRP composites are ideal for these applications compared to traditional materials because of their inherent customizability, multi-functionality (including characteristics related to survivability), durability, and high specific properties (high strength-to-weight and stiffness-to-weight ratios). However, these applications require materials to perform adequately over long periods of time in harsh environments, such as exposure to moisture and high temperatures. Therefore, it is important for engineers responsible for the design and maintenance of these systems to understand the long-term durability of the materials to these environmental stimuli.

This paper presents results of experimental tests that can be used to estimate the service life of a composite system. The results can be used to augment the current knowledge of observed material behavior and degradation mechanisms to create a practical method for estimating the service life of composites. The results include the effects of transport phenomena (heat and moisture), degradation mechanisms (hygro-thermal and material post-cure) using hygro-thermal degradation of E-glass/epoxy composites in accelerated tests under controlled temperatures and relative humidities. These results can also be used to calibrate predictive semi-empirical modes.

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Analysis of the Behaviour of Unserviceable Tire Rubber in Floor Manufacturing

Currently, the usage of concrete floors is growing all over the world. Besides, the use of waste has proved to be a good alternative in reducing the impact caused by uncontrolled consumption of raw material and the reduction of dump areas, considering the growing volume of garbage discarded each year. Within this context, we point out the tire waste derived from retreading, associated to concrete plates for paving, having standardized dimensions for use in human traffic areas. Such waste does not yet have proper disposal, industrial or economic purpose, because of that it is usually deposited in large quantities in workshops and concessionaires that provide resurfacing service. This work exposes and discusses the results of characterization of the necessary elements for the production of concrete plate, in addition to studying its behavior with partial incorporation of rubber - compositions of 10%, 8%, 4% and 2% of residues - by comparison with a reference concrete, through technological tests. The thermogravimetric analysis revealed that the softening and combustion temperatures occur in a range in which the concrete already has its properties deficient. Fluorescence has confirmed that the heavy elements are low rate in rubber. It was verified that in terms of tenacity the increase was not significant. However, an increase in compressive strength was observed while the water cement factor was adjusted. It leads us to believe that by increasing the size of the fibers, the results that depend on the toughness can be improved. Thus, these results can be considered satisfactory, producing a viable embodied cementitious plate for the market.

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How Do One-Stage Deammonification Processes Succeed?

The sewage treatment by activated sludge system has been employed for one hundred years and is still worldwide applied today. However, some drawbacks such as the request for high energy, large footprint and the emission of greenhouse gas slowed down the development of it and urged us to think about a more sustainable way to treat sewage. Anaerobic digestion has been applied to treat both industrial and municipal wastewater in mainstream for a long time. In recent years, anammox-centered autotrophic nitrogen removal has been proven to be applicable in the main stream of WWTPs. An expanded granular sludge bed (EGSB), which was modified with a set of aeration system, was used to regain one-stage deammonification process. The restoration of one-stage deammonification process was investigated by substrates inhibition under limited oxygen condition. The impact of temperature (stepwise decreased from 30°C to 20°C and 10°C) was a primary focus, aiming to reveal the response of the anaerobic digestion (AD) and anammox efficiency to the temperature variation. As the temperature decreases, the sCOD removal rate was 90.6%, 90.0% and 84.7% respectively; TN removal was 69.4%, 48.8 %, 38.4% respectively; NH4+-N removal was 91.3%, 74.9%, 65.1% respectively. Methanogenic activity of UAFB was significantly influenced by low temperatures, while the unavoidable growth of heterotrophic organisms in EGSB also contributed to the sCOD removal by utilizing a certain amount of VFAs, even at 10°C. Lower working temperature (10/20°C) limited the growth and activity of AOB and anammox bacteria, but improved the NOB activity.

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Large Eddy Simulation of Air Flow and Temperature Distributions in an Office Room Served by a Displacement Ventilation System

Air flow motion and temperature distributions are considered the most important factors that influence the contaminant concentration distribution and indoor thermal comfort for the occupants. Although the indoor air flow movement, especially in the occupied zones, is unsteady and sometimes unstable, much of the research literature to date is focused on the time averaged investigations. In addition, most studies have ignored the influences of fluctuating velocity, turbulence intensity and fluctuating frequency on the thermal microenvironment and indoor thermal comfort. In this paper, the Large Eddy Simulation (LES) approach has been used to investigate the characteristics of air flow field and temperature distributions in a complex office room served by a displacement ventilation (DV) system. The computational results show that the air flow field and temperature distributions in the office are highly unsteady and unstable, especially in the occupied zones where the buoyancy force works effectively, which generates the high perturbations. It is also shown that the LES method has the ability to make accurate predictions of the velocity and temperature distributions in a complex office, compared to the RANS modelling.

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Mathematical Model of Forward Motion in Bathymetries and Its Effect on the Measurement Conditions

Bathymetries constitute a fundamental element of building objects settled on submerged land: dikes, docks, underwater pipelines; in addition to dredging works, volume calculating of reservoir, etc. In civil engineering the bathymetry affect areas of small extent in which measures should be the most accurate as possible, influencing many factors in its precision. Among these factors can be distinguished: speed of sound in water, positioning system, vessel movements (pitch and roll), vertical movement and forward motion of the boat.

Perhaps, this last movement of the vessel, forward motion, could be one of the least studied factors, but their influence on the accuracy of bathymetries might be very important depending on boat speed and depth that exists at the time of measurement in addition the speed of the sound in water. In this sense, for one measured depth, the position may be wrong allocated.

This paper defines a mathematical model based on measurements of bathymetry observed with GPS and echo sounder, that lets you define the real position in which one measured depth was gauged a according to boat trajectory and velocity, and the speed of sound in water in that moment. From this point, the paper quantifies this effect in order to correct the position in which the depth was measured with an echo-sounder.

Finally, from the results it is possible to obtain a set of recommendations about operations to measure a bathymetry depending on the accuracy that you want to obtain.

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Reinforcement Effects of Concretes with CFRP Materials

The aim of this paper is to study the effect of reinforcement and reparation of concrete by CFRP (Carbone Fiber reinforced Polymer) material on its compression mechanical behavior. It consists on repairing damaged concrete samples by loading/unloading cycles. Two damage values are fixed to realise on concrete samples in order to repair them. Monotonic compression tests on reinforced/repaired concrete sample showed a great enhancement of mechanical properties in compression such as ductility, stiffness and the limit compressive strength. These tests will serve to model numerically the behavior of confined concrete.

Through decades, civil engineering structures underwent much degradation due to several environmental conditions and process steps which harms to its service. The efficient and sustainability of reparation of these structures are an urgent priority to maintain or to restore.

Different techniques of reparation showed successful results, traditional ways such as steel lining and replacement of a part or the entire structure in urban areas are very difficult and delicate. In fact, it may cause a great delay for traffic time and supplementary operator costs. Another solution for reparation is expanded, is the composite material CFRP. This material has excellent mechanical performances and an ease of use in site.

The goal of this work is to study the effect of confinement reparation by CFRP on the compression behavior in order to study its sustainability.

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Experimental Verification of Tension Forces in a Cable Stayed Bridge

Dynamic vibration tests are a very well known technique to experimentally determine the frequencies associated with vibrational modes of structures or structural components. These tests comprise the measurement of accelerations produced by vibrations caused by wind, traffic or specific dynamic excitations interacting with the structure. This report presents a detailed description of this experimental technique, methods and procedures, applied for the determination of tensions forces for each of the stays of the superstructure of the most important cable-stayed bridge in Mexico.

The experimental study was carried out through the measurement of natural frequencies for each stay. A wireless triaxial accelerometer was fastened to each cable using a metallic clamp. With the help of a crane, the sensor was placed as high as possible on the stay, and its vibration was produced by an original designed device that allowed the vibration of this element. Accelerations were recorded and processed using well known signal analysis techniques.

The study was prompted by the importance of the bridge and the increase in number and magnitude of the live loads registered in the last year, and because of maintenance tasks. The data necessary to

know the actual values of the tension in the cables will be provided with this study. It is also shown that an indirect measure of the tension through vibration measurements is more practical, economic and faster than the direct measurements using mechanical devices, such as hydraulic jacks.

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Test of All-Bolted Angle Connections for Catenary Action

This paper reports an experimental test of four bolted angle connections under a double-span condition or so-called central-column-removal scenario. The test is a part of a research program on the robustness of steel connections in the context of progressive collapse of building structures.

The design of the test angles follows Canadian standard. The test parameters include angle thickness, bolt strength and connection configuration. Two huge H-shape steel beams are used as permanent test beams. One end of the test beams is simply-supported (through a pin), while the other end is connected to a huge test column by a test connection. The test column is supported by the two test beams to simulate its lower half being removed. A concentrated load is increasingly applied to the test column until the angle connections fail by rupture. The potential failure modes include angle rupture and bolt rupture in shear or in tension.

The load vs. displacement at the test column and the moment distribution of the test beams will be measured. Analytical results will be compared with the test results to explain the observed behaviors. It is anticipated a design approach for the robustness of angle connections will be developed through this study.

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Risk Analysis for Highway Materials of Flexible Pavement Structures

The highway industry has been shifting towards performance specifications for highway pavement structures. In such approach contractors get rewarded on the basis of the difference in predicted performance between the "design" and "as-built" pavement. Multiple studies have linked the material properties to pavement performance and service life. This study examines the relationship between risks of accepting lower quality (agency risk, Type I error) and rejecting high quality (contractor risk, Type II error) flexible pavement materials to pay factors. Monte Carlo simulation and Operating Characteristic curves are used to assess such effects. It is the objective of the analysis to present a methodology to balance materials' QA cost and associated risks to the contractor and agency. Data from various case studies were used in the analysis along with existing performance specifications. The proposed methodology could be used to define rational and defensive pavement material specifications for highway agencies elsewhere.

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Module Design Methodology for the Conceptionalization of a Portable Unit for Providing Heat, Cold and Electricity in BEVs and Buildings

Based upon the current problem of the limited range of battery electric vehicles (BEVs), the thermal conditioning of the battery pack and the passenger compartment needs special consideration. In the ongoing research project "Scalability of mobile micro-combined heat and power (mCHP) units", concepts for mCHP with an electrical power in range of 1 to 15 kW are investigated and a mobile prototype will be developed. The mCHP are units for combined generation of electrical energy and usable heat, for example as stationary CHP for domestic-hot-water and space heating in residential buildings. A special mCHP concept provided by IAV GmbH upgrades a normal mCHP unit to a trigeneration of power, heat and cold. This mobile concept, the power conditioning unit (PCU), should be integrated into the energy and thermal management of BEVs in order to increase the range and overall sustainability in energy utilization.

A previous investigation, carried out by authors, has shown that the realization of the PCU as portable unit with more than 1 kW electrical power is not possible. The present paper explains the application of a new module design methodology for the conceptionalization of a portable PCU developed in the Institute for Engineering Design, Mechatronics and Electromobility. Furthermore, according to this methodology, various PCU concepts are developed, presented and discussed. Finally the comparison of the PCU with systems from the state of the art on the basis of new mathematical indicators is shown. The new indicators reflect the relationship between the mathematical quantities like power, additional range, weight and installation space of the PCU. Due to the new module design

methodology the realization of portable PCU concepts for the application in BEVs and buildings is possible. These concepts could be a transitional solution in order to reduce CO_2 emissions and increase the range and acceptance of BEVs.

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Challenges of Maintenance, Repair and Overhaul in Hazardous Areas

Maintenance, repair and overhaul (MRO) are necessary measures for companies from the manufacturing industry. This division enable a constantly running production process. An objective is to ensure value creation process. The activities for MRO are organised on procedures collected by experiences.

Current studies and trends show a change from experiential to data base MRO. Reasons for the change are new developments in data exchange in manufacturing technologies like cloud computing or internet of things. The states of machines get verified based on selected machine- and process-data from real-time tracking.

Working with data base realized predictable maintenance. With the knowledge it is possible to develop a specific MRO-system in an enterprise, which considers efficiency and effectiveness. Certain industries and companies use these technologies. They improve e.g. expense for maintenance stock, time of machine failure and reaction time to repair a machine.

In hazardous areas is MRO a challenging assignment. MRO must ensure the safety among to the machine and process requirements. In consequence of explosion protection MRO is complex and expensive. The activities in MRO are supported by standards, directives and a lot of experience. For this reason the objective of this project is the adjustment of MRO for hazard areas according to the current developments in view of using data base.

To achieve these objectives is the first step a status analysis. To identify the gap between experiential and data base MRO in hazardous areas it is necessary to explore the existent practices. Surveys and interviews with Operators in hazard area e.g. refineries or pharmaceutical producers support the analysis.

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Friction Model Performance Comparison for the Dynamic Analysis of Nuclear Graphite Blocks

Korea Atomic Energy Research Institute (KAERI) is developing a prismatic type very high temperature reactor (VHTR) of own design. The Korean VHTR has a prismatic core which is made of multiple graphite blocks, reflectors, and core supports. One of the design issues is the assessment of the structural integrity of the graphite blocks under seismic events because the graphite blocks are not restrained mechanically in horizontal and vertical directions. The only restraints are dowel joints between upper and lower blocks. In addition, the small horizontal gaps between blocks allow relatively large displacements of the block columns and the rocking motion of individual block, which may cause significant impact forces during the seismic movement of the reactor vessel. To describe the motions of individual blocks and evaluate the maximum impact load, a structural dynamic analysis computer program for the block motions, SAPCOR(Seismic Analysis for Prismatic COR of a HTGR) has been developing for years in VHTR Development Team in KAERI. In this study, especially a new friction model between blocks were introduced and the performance of the program using the new friction model was compared with a previous computer program, SONATINA, which was developed in Japan Atomic Energy Research Institute (JAERI).

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Implementing Smart Specialisation Strategies: Projected Issues and Foresight

In implementing smart specialisation strategies (S3) one must keep in mind its goal, namely place-based regional economic transformation. At the same time one should avoid both the Charybdis of top-down dirigisme, and the Scylla of hands-off handicapped government. Foresight can help precisely on identifying longer-term transformational aspects, and caveats/challenges along the way. Short-termism should be avoided for transformation processes; nevertheless, there are certain visible first steps and first fruits in a long regional economic transformation process can be highlighted, as well as longer term projected and underappreciated challenges, to which foresight can shed light. The latter include the pitfall of top-down expediency, often accompanied by tempting simplistic one-size-fits-all solutions, the emergence of collective action problems, and the need to give voice to the voiceless in such implementation processes.

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Laser Assisted Joining of Aluminum and Polyamide 6.6 – Evaluating the Mechanical Strength of Multi Material Structures

The development of new strategies to combine dissimilar materials like polymers and metals is of highest interest for all types of industry. Especially the automotive and aerospace sectors are expecting major improvements for lightweight designs from the combination of the complimentary thermal, electrical or mechanical properties of Polyamide 6.6 and Aluminum within lightweight multi-material structures. Laser direct joining offers a very quick alternative to conventional joining technics that yields high strength. However, the different melting points of the materials and the limited temperature stability of PA demand well-defined supply of thermal energy. The present paper deals with the influence of process variables on the joint quality. Critical temperatures are considered to prevent thermal or chemical degradation of the polymer during laser joining. A combination of penetration and conduction laser welding is applied to control the temperature at the interface between the joining partners while maintaining sufficient processing speed. It is shown that good results are achieved at temperatures between the melting of the polymer around 255 °C and 350 °C. The hydrophilic properties of PA 6.6 lead to further complications during the thermal joining process. The influence of the moisture content of the polymer base material on the quality of the joint after laser direct joining is reviewed by means of optical and electron beam microscopy. The development of voids in the polymer melt is observed, which are expected to influence the structural strength of the compound negatively. It is shown that the conditioning of the PA 6.6 before laser joining can extend the limited process window.

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DRM-F: Dimensionality Reduction Method based in Framework

This search of knowledge and extraction patterns of the databases demands the use of a tool with analytics capability to extract information that are implicit, and are previously unknown, but, potentially useful. The following research proposes a new method to reduce the dimensionality of data in any domain,. Dimensionality reduction methods are applied in various domains, however, the area involving gene expression data was opted for. The new method of data dimension reduction is called DRM-F and it is able to identify in n bases of a gene domain the most relevant attributes, using the concepts of equivalence and generalization. For this experiment three databases of gene expression, which derived from Kent Ridge Biomedical data, were used. The bases are called DLBCL, DLBCL – tumor and DLBCL ALL / AML. The DLBCL base has gene expression data on Diffuse Lymphoma cancer of Large B Cells. Also, this method as applied in Customer Doman, in both domain the performance was high comparing with the Attribute Selection Method. This method is based in Framework. Johnson and Foote (1988) define a Framework from structural point of view, as being a "set of abstract and concrete classes that form the abstract project for a group of related problems". From the point of view of purpose, Framework is defined as a structure of an application that is instantiated by the developer of applications (Johnson, 1997).Framework allows for reuse of code, project or analyses. The reuse of analyses is obtained because it describes the objects, their relationships and the way by which big problems are modularized (Budd, 2002). The reuse of projects occurs when the Framework

contains abstract algorithms and the definition of their interfaces, such as the obstacles of an implementation. The Attribute Selection Method has as goal to identify the relevant attributes for a target task, taking into account the original attribute. This paper identified five main steps in order to comparison of the two methods: Preparation of Database, Choice of Database, Application of the Attributes Selection and Framework Concepts Methods, Execution of the Algorithms of the Classification and Evaluation of the Results. With the implementation of theses five steps composed of several processes, it was possible to compare the two methods and identify the best classifiers algorithms and consequently to create the attributes more relevant for a database, increasing the performance of the learning process. Of this way, with the best subset identified is possible submit them to the application of the Data Mining Tasks which allow the building of rules that help the Knowledge Management of a specific domain.

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Reuse of Gypsum Residue in the Manufacturing of 3D Decorative Wall Covering Panels

This article focuses on the application of recycled gypsum in the manufacturing of 3D decorative wall covering plates and their possible economic and environmental impacts. The gypsum recycling process used in this research consisted in two simple steps: waste collection in constructions and demolitions, and hand trituration. 3D decorative wall covering panels are commonly a composite of cement, sand and gypsum, and they must meet the following requirements: aesthetics, watertightness, thermal and acoustic comfort. Five alternative compositions were made with partial and complete replacement of commercial gypsum by recycling, and a standard composition, with only commercial gypsum for comparison purposes. Two samples were produced for each composition to perform technical-functional performance tests, economic feasibility analysis and subsequent prototype molding. The visual analysis of the plates produced for the tests proved to be favorable in the aesthetic aspect. Following the recommendations of the Associação Brasileira de Normas Técnicas - ABNT (Brazilian Association of Technical Standards), water absorption and density tests were performed for each sample. The results were satisfactory, presenting to the market three compositions with the use of recycled gypsum, without loss of performance, and up to 38% more economical than conventional. Among the five compositions, three presented a lower percentage of water absorption than the standard. In the environmental issue, it is possible to reduce up to 1 ton of CO2 emissions per cubic meter produced from the proposed compositions. Finally, the produced 3D gypsum panels meet the sustainability tripod: environmental, economic and social viability.

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Experimental Heat Transfer Analysis of a Rotary Swing Chamber Expander

Initiated by the EU energy strategy the energy production sector is in a phase of upheaval. The approaches to meet the requirement differ in Germany and extends from improving existing high technologies to increasing the range of energy recovery systems to the development of decentral renewable CHP systems within the low power range for domestic households.

The University of Applied Sciences and Arts Hannover is developing an innovative engine for expansion and compression with high efficiency which is based on a rotary swing chamber system and can be used in energy recovery and CHP systems. The new flexible and sustainable expansion and compression system is perfectly suited to access new energy levels for recuperation. The engine consists of two interlocking rotors with four blades each, which create four moving chambers within the housing. With separate fluctuating transmissions gears for the rotors, the blade movement against each other creates the characteristic oscillating swinging chambers within the housing. With 32 chamber fillings each rotation the compact engine achieves a high volume turnover and is applicable for a wide range of applications.

For the modelling of the temperature fields and the heat transfer performance the newly developed engine is thoroughly tested and under continuously improvement. The experiment used a suitable instrumentation to monitor process parameters such as mass flux, temperature and pressure before and after the engine. Additionally the wall temperatures of the housing was measured at selected locations on the housing. The results in the laboratory facility are presented. Based on the experimental data an analysis of the heat transfer rate during the expansion process to the housing is carried out and discussed.

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Modal Analysis of Reinforced Concrete Square Slabs

The Modal Analysis (MA) has recently become more popular as a sophisticated non-destructive testing (NDT) technique that is primarily employed to obtain the dynamic parameters of a structure, specifically the natural frequencies and mode shapes. Accordingly, natural frequencies and/or mode shapes are used as damage indicator whereby the functionality of a structure can be judged. This paper investigates a modal analysis (MA) of reinforced concrete (RC) square slabs. Both theoretical and experimental analysis was carried out on RC slabs freely suspended at the four corners. The theoretical work was obtained both analytically which can be used as a benchmark, as well as numerically using finite element modeling of the RC slabs, solved by ANSYS software. The experimental work involved modal analysis on two RC square slab specimens of dimensions 600mm x 600mm x 40mm. The samples were excited by an impact hammer to induce vibration. Tests were conducted on RC square slab specimens in order to compare with the theoretical modal analysis made by the finite element method. Accelerometers, Pico Scope 6 device and MATLAB software were used to acquire data, analyse and plot Frequency Response Function (FRF). There was good agreement between the theoretical and experimental results with a maximum difference of 18.8%. Such discrepancy is quite acceptable in case of reinforced concrete analysis. This is because the theoretical model assumes concrete slabs to be linear, elastic, homogeneous and isotropic. Whereas in reality, concrete is a heterogeneous and anisotropic material, and the specimens inevitably contained imperfections in forms of crack, defects, steel bars misalignment.

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Experimental and Analytical Investigation of Structural Response of Bridge Columns using Ground Motions from the Tohoku 2011 Earthquake

Subduction earthquakes create the possibility of long-duration earthquakes. Most design codes do not consider earthquake duration. Subduction earthquakes occurred 2011 in Japan (Tohoku Earthquake) and in 2010, 2014, and 2015 in Chile. These earthquakes are a reminder of the possibility of a large magnitude subduction earthquake along the Pacific northwest coast of the United States. Researchers showed similarities between the Tohoku fault and the Cascadia, however the Cascadia's length is much longer. For example, a similar scenario to the Tohoku earthquake is possible to repeat along the Cascadia subduction zone resulting in a M9.0 or more earthquake. The main objective of the paper is to present the performance of seismically designed reinforced concrete bridge columns under subduction earthquakes. The experimental program included identical columns that were tested on a shake table using different motions from the Tohoku Earthquake. Responses were compared to a previously tested identical column that was subjected to a regular crustal motion. Columns subjected to subduction ground motions had reduced displacement capacity. A companion analytical study using OpenSees is also presented. Additional subduction and crustal motions were applied to the column. The analyses showed agreement with the conclusions determined from the experimental tests, where the long duration associated with these types of motions significantly affected the collapse capacity of the columns.

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Prototypes of an Air Incorporating Bioadditive Derived from Castor Oil

Economical, efficient and sustainable additives, that optimize the use of natural resources and minimize the adverse impacts of these activities on the environment, is a global shortage of construction. The air incorporator additive, developed by industry, used for manufacture of cellular concrete is being widely utilized due to the growth of the works that use the constructive system of walls and structure with this type of concrete, which has a specific weight substantially reduced, thus creating a significant cost savings. The current substances used for producing industry of this additive are: linear alkylbenzene and miscellaneous materials. Due to the high toxicity of the components in these substances existing additives harm the environment when in contact with nature. In the face of this reality, this project developed a prototype air incorporator bioadditive oil based castor plant (Ricinus communis L), collected in the city of Arapiraca - AL, northeastern Brazil. This was possible after the verification of some of their physical and chemical characteristics, when compared with international standards, in order to contribute to the development of construction industry economic and efficient manner, without harming the environment.

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Comparison of Steel- and GFRP-Reinforced Concrete Members under Seismic and non-Seismic Loads

The total annual cost of steel corrosion worldwide in 2010 was estimated at USD $2.2 trillion which amounts to about 3% of the world's GDP. A significant part of this cost is the corrosion in reinforced concrete structures. The added cost to the society is the loss of time spent in traffic and the pollution created by the vehicles waiting to move on our roads and highways in addition to the loss of life. In a comprehensive research program underway at the University of Toronto, glass fibre reinforcement polymers (GFRP) are being investigated for their feasibility of replacing steel in new structures as well as in existing structures for retrofit. The experimental program includes testing of full-size steel- and GFRP-reinforced concrete beams, slabs and columns in which the behavior of GFRP-RC in flexure, shear, tension and compression has been investigated. Behaviour of columns under simulated seismic loads has also been studied. The analytical part of the research includes developing models for section and member behavior, tension stiffening and confinement of concrete.

Despite many advantages of GFRP such as its corrosion-resistance, light weight, high strength most designers are still reluctant to consider GFRP as the main reinforcement in concrete members due to its different behavior than steel and a lack of test data compared to steel-RC. The aim of this paper is to gain a better understanding of the overall behaviour of GFRP as internal reinforcement and identify the differences in their behaviour compared to that of the steel-reinforced concrete members. The paper will present significant results from this ongoing research.

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Developing Foresight Intelligence for Energy Technology: Qualitative Comparative Analysis Method

Energy technology foresight is essential to the strategy of future development. Various foresight methods have been developed over the years and applied to energy technology planning in many different areas. However, the systematic review about energy technology foresight methods has not been discussed to date. And the literature exhibits some space about constructing foresight methods framework to grab the opportunities and challenges from data technology(DT) era. This paper compares different applications of foresight methods in the literature, then groups methods into four: data-driven, strategy-driven, experience-driven, model-driven. The paper also identifies the key configurations of foresight methods by employing qualitative comparative analysis(QCA). Based on QCA results, the paper develops a foresight intelligence(FI) framework to integrate various methods for more flexible energy technology planning practice.

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Decreasing Vibration Technology for Tunnel Blasting Based on Building Modal Analysis

To control the infuence of tunnel blasting vibration on adjacent buildings, based on the engineering project of Urumqi subway tunnel blasting., the research of vibration response were carried out on a typical five-story frame structure under tunnel blast excitation. measuring points were arranged on building foundation, different floors, as well as the different location on the same floor for vibration monitoring. Using signal analysis, studied the response of different floors of the building under blasting vibration, selective absorption of energy under blasting vibration are analyzed, put forward a kind of method of rapid identification of structure modal under blasting vibration. The building natural frequency which was close to the blasting vibration main frequency can be identified. By adjusting the blasting scheme, change the millisecond delay interval, to adjust the blasting vibration frequency, so the main frequency of blasting vibration was changed. Comparison of different blasting scheme, it is concluded that the optimal scheme.

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Computation of Pavement Surface Roughness and International Roughness Index Derived from Point Clouds

The paper reports data from the research project where the objective was to develop and validate a tool that would be publicly available and would leverage the point cloud data commonly acquired on sites to calculate the pavement surface properties such as the International Roughness Index and Roughness. To do so, a unique RIRI program was written in Python to streamline the point cloud data analysis. The program is publicly available under the GNU General Public License. Further, the paper presents data from three test sections where the developed methodology was calibrated and used to calculate the pavement smoothness properties from a point cloud and compared to classical, reference, methodologies, such as the rod and level and precise levelling. The paper focuses on the variability and precision of all methodologies. It was found that the Pearson type IV distribution is a fitting descriptor for histograms calculated with the help of Freedman and Diaconis's law from rectified slopes and roughness values with regard to its fitness and use of its parameters for the pavement surface smoothness description.

It is believed that the software might be used by designers, contractors and road authorities to evaluate the current state of road networks, quality checks and as-build approvals.