

# M2D2015

P. Delgada/Portugal



**Proceedings of the  
6th International Conference on  
Mechanics and Materials in Design**

**Editors**

**J.F. Silva Gomes**  
*FEUP/U. Porto  
Portugal*

**Shaker A. Meguid**  
*MADL/U. Toronto  
Canada*

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(2015)





**PROCEEDINGS**  
6th International Conference on  
**MECHANICS AND MATERIALS IN DESIGN**  
(P. Delgada, 26-30 July 2015)

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## Editors Preface

**M2D2015** is the sixth international gathering of a prestigious series of conferences coordinated by the International Scientific Committee of Mechanics and Materials in Design. This series of conferences are wholly devoted to advances in mechanics, materials, structural integrity and design. **M2D2015** is sponsored by the University of Porto, the University of Toronto and the University of Azores. The conference attracted over 320 participants with 423 accepted submissions from 42 countries out of 620 submissions. These papers were presented in July 26-30, 2015 in the magnificent city of Ponta Delgada, Azores. The conference themes which address novel and advanced topics in Mechanics and Materials in Design focused on analytical and numerical tools at all scales, testing and diagnostics, surface and interface engineering, tribology, mechanical design and prototyping, modes of failure, composite and engineered materials, biomechanics, energy and thermo-fluid systems, impact and crashworthiness and case studies.

We believe that the meeting offered our delegates a forum for the dissemination of their recent work in mechanics and materials and their applications in engineering design, fostered research that integrates mechanics and materials in the design process, and promoted exchange of ideas and international co-operation among scientists and engineers in this important field of engineering.

We are particularly indebted to the authors and special guests for their presentations. Each of the more than 423 contributions offered opportunities for thorough discussions with the authors. Particularly, we acknowledge the excellent contributions of the participants, their innovative ideas and research directions, the novel modeling and simulation techniques, and the invaluable critical comments. We are also indebted to the outstanding keynote speakers who highlighted the conference themes with their contributions and covered the main topics of the conference. We also take this opportunity to thank the members of the International Scientific Committee and the reviewers for their time, effort and helpful suggestions.

We offer our sincere gratitude to the symposia organisers for their efforts and valuable contributions to the success of the event, and the local organising committee for attending to the conference demands and delegates needs.

All in all, **M2D2015** was a great success and the credit must go to all the participants for their significant contributions and lively discussions, the keynote speakers for bridging the gap between the different disciplines and the organizing committee for an absolutely superb organization of the meeting in this magnificent city. To all of you, we offer our gratitude.

Given the rapidity with which science is advancing in all areas of mechanics and materials, the next conference in this series (Integrity, Reliability and Failure - IRF2016) will take place in Porto, Portugal in July 2016. Undoubtedly, we expect IRF2016 to be as stimulating and interesting as **M2D2015**, as evidenced by the excellent contributions offered in this current event. We look forward to seeing all of you in Porto in 2016.

*Shaker A. Meguid and J.F. Silva Gomes*

*P. Delgada / Azores, July 2015*

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**M2D2015**P. Delgada/Portugal  
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## 6th International Conference on MECHANICS AND MATERIALS IN DESIGN

(P. Delgada, 26-30 July 2015)

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**M2D2015**

P. Delgada/Portugal



6th International Conference on  
**MECHANICS AND MATERIALS IN DESIGN**

P. Delgada/Azores, 26-30 July 2015

# **M2D2015**

# **PROGRAM**

**University of Porto**  
**University of Toronto**  
**University of Azores**



## MAIN TOPICS

- |   |  |
|---|--|
| <b>A</b> - Analytical and Numerical Tools. (Sessions: 2A-3A)    | <b>I</b> - Composite & Advanced Materials. (Sessions: 4B-6B) |
| <b>B</b> - Testing and Diagnostics. (Sessions: 2B-3B)           | <b>J</b> - Nanotechnologies & Nanomaterials. (Session: 1A)   |
| <b>C</b> - Surface and Interface Engineering. (Sessions: 2C-3C) | <b>K</b> - Biomechanical Applications. (Sessions: 5D-6D)     |
| <b>D</b> - Civil Engineering Applications. (Sessions: 2D-3D)    | <b>L</b> - Energy and Thermo-Fluid Systems. (Session: 7G)    |
| <b>F</b> - Tribology, Gears and Transmissions. (Session: 4F)    | <b>M</b> - Impact and Crashworthiness. (Sessions: 7D-8D)     |
| <b>G</b> - Mechanical Design and Prototyping. (Sessions: 5C-6C) | <b>N</b> - Case Studies. (Session: 8D)                       |
| <b>H</b> - Modes of Failure. (Session: 1C)                      |  |

## THEMATIC SYMPOSIA

- EXPERIMENTAL MECHANICS IN DESIGN, by *Hernani Lopes (ISEP/IPP, Portugal) and Jaime Monteiro (INEGI/U.Porto, Portugal)* - Session: 1B.
- DYNAMICS, STABILITY AND CONTROL IN STRUCTURAL ENGINEERING: CASE STUDIES, by *Rui C. Barros (FEUP/U. Porto, Portugal)* - Session: 7B
- ANALYSIS DESIGN & TESTING OF TOWERS AND POLES, by *Rui C. Barros (FEUP/U. Porto, Portugal)* Session: 8B.
- DESIGN AND PRODUCT DEVELOPMENT, by *Jorge Lino (FEUP/U. Porto, Portugal) and Xavier de Carvalho (FEUP/U.Porto, Portugal)* - Session: 4C.
- MECHANICAL BEHAVIOUR OF BIO-BASED MATERIALS, by *Nuno Dourado (CITAB/UTAD, Portugal) and Marcelo Moura (FEUP/U. Porto, Portugal)* - Session: 5E.
- SYSTEMATIC INNOVATION AND LEAN APPROACH IN ENGINEERING, by *Helena V.G. Navas (FCT/UNL, Portugal) and Anabela Alves (U. Minho, Portugal)* - Sessions: 5G-6G.
- SEISMIC BEHAVIOUR CHARACTERIZATION AND STRENGTHENING OF CONSTRUCTIONS, by *António Arêde (FEUP/U. Porto, Portugal), Humberto Varum (FEUP/U. Porto, Portugal), Hugo Rodrigues (ESTG/IPL, Portugal) and Aníbal Costa (DECivil/U. Aveiro, Portugal)* - Session: 1D.
- MECHANICS AND MATERIALS IN DENTAL MEDICINE, by *J.C. Reis Campos (FMD/U. Porto, Portugal) and Mário A.P. Vaz (FEUP/U. Porto, Portugal)* - Sessions: 4D-5D.
- OPTIMIZATION FOR SUSTAINABLE DEVELOPMENT, by *Carlos C. António (FEUP/U. Porto, Portugal) and Catarina F. Castro (FEUP/U. Porto, Portugal)* - Sessions: 5A-6A.
- CARDIOVASCULAR AND ORTHOPEDIC MECHANICS DESIGN, by *Luísa C. Sousa (FEUP/U. Porto, Portugal) and Catarina F. Castro (FEUP/U. Porto, Portugal)* - Session: 7E.
- MECHANICAL BEHAVIORS OF ADVANCED MATERIALS & STRUCTURES AT ALL SCALES, by *Yu Su (Beijing Institute of Technology, China)* - Sessions: 1E-4E.
- MECHANICAL BEHAVIOR OF SOFT BIOMATERIALS, by *Renato N. Jorge (FEUP/U.Porto, Portugal), Pedro Martins (FEUP/U.Porto, Portugal) and Marco Parente (FEUP/U.Porto, Portugal)* - Session: 8E.
- NON-DESTRUCTIVE INSPECTION TECHNIQUES FOR MATERIALS AND STRUCTURES, by *João Tavares (FEUP/U.Porto, Portugal), Luís Durão (ISEP/IPP, Portugal) and João Rebello (UFRJ, Brazil)* - Sessions: 7C-8C.
- THERMAL COMFORT IN BUILDINGS, by *Marta Silva (U. Aveiro) and Mário Talaia (U. Aveiro, Portugal)* - Session: 8G.
- TRIBOLOGY TRENDS FOR HIGHER EFFICIENCY AND RELIABILITY, by *Ramiro Martins (INEGI/U.Porto, Portugal), Jorge Castro (INEGI/U.Porto, Portugal), Armando Campos (INEGI/U.Porto, Portugal) and Jorge Seabra (INEGI/U.Porto, Portugal)* - Sessions: 5F-6F.
- RECYCLING AND RE-USE OF INDUSTRIAL AND HOUSEHOLD WASTES INTO NEW COMPOSITE MATERIALS, by *A. Fiúza (CIGAR/U.Porto, Portugal) and M.C.S. Ribeiro (INEGI/U.Porto, Portugal)* - Sessions: 7F-8F.
- QUALITY CONTROL AND METROLOGY IN ENGINEERING, by *José Barradas (CATIM, Portugal), José Carlos Sá (IPVC, Portugal) and José Oliveira (IPVC, Portugal)* - Session: 1G.
- THERMODYNAMICS AND FLUIDS, by *Clito F. Afonso (FEUP/U.Porto, Portugal)* - Session: 8G.
- COMPUTATIONAL MECHANICS IN DESIGN, by *Xiong Zhang (Tsinghua University, China)* - Sessions: 1F-3F.
- FIBER BASED MATERIALS: DESIGN, DEVELOPMENT AND APPLICATIONS, by *Maria José Abreu (U. Minho, Portugal) and André Catarino (U. Minho, Portugal)* Session: 4G.
- THIN FILMS AND COATINGS IN TRIBOLOGY, by *Albano Cavaleiro (FCTUC/U. Coimbra, Portugal) and Tomas Polcar (U. Southampton, U.K.)* - Sessions: 2G-3G.
- ADVANCED DISCRETIZATION TECHNIQUES IN COMPUTATIONAL MECHANICS, by *Jorge Belinha (INEGI/U.Porto, Portugal) and Carla Roque (INEGI/U.Porto, Portugal)* - Session: 4A.
- SAFETY IN WOOD MATERIALS, by *Elza Fonseca (IPB, Portugal) and Débora Ferreira (IPB, Portugal)* - Session: 7A.
- FIRE AND STRUCTURAL ENGINEERING, by *P. Piloto (IPB, Portugal) and A. Meda (U. Rome, Italy)* - Session: 8A.

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# PROGRAM

## SUNDAY, 26 JULY 2015

15:00-18:00

EARLY-BIRD REGISTRATION AND WELCOME DRINK

Lobby

## MONDAY, 27 JULY 2015

08:00-09:00

REGISTRATION

Lobby

09:00-09:30

OPENING SESSION

Serreta

09:30-10:15

KEYNOTES SESSION - 1

Serreta & Auditorium

A (Room: Serreta) Chair: Prof. J.F. Silva Gomes (U.Porto, Portugal)	B (Room: Auditorium) Chair: Prof. Peter Hess (U. Heidelberg, Germany)
<p>Professor Shaker A. Meguid (University of Toronto, Canada)</p> <p><b>ENERGY ABSORPTION IN AXIAL CRUSHING OF ULTRALIGHT STRUCTURES</b></p>	<p>Professor Noritsugu Umehara (Nagoya University, Japan)</p> <p><b>RECENT DEVELOPMENTS IN TRIBOLOGY FOR ENERGY SAVING IN SUSTAINABLE SOCIETY</b></p>

10:15-10:45

COFFEE-BREAK

Lobby

10:45-12:30

PAPERS SESSION - 1

All Rooms

1A (Monchique-1) Topic-J Chair Shaker Meguid	1B (Monchique-2) Symp-2 Chair Jaime Monteiro	1C (Urzelina-1) Topic-H Chair José Maria Cirne	1D (Urzelina-2) Symp-10 Chair Hugo Rodrigues	1E (Auditorium) Symp-17 Chair Yu Su	1F (Serreta-1) Symp-25 Chair Xiong Zhang	1G (Serreta-2) Symp-23 Chair José Barradas
Ref: 5549 HEAT-RESISTANT CELLULAR MATERIALS BASED ON COMPOSITE (GYSPUM-SILICA) BINDER. E.V. Voitovich, N.I. Kozhukhova, A.V. Cherevatova, I.V. Zhernovskiy	Ref: 5357 A NEW METHOD FOR THE RECONSTRUCTION OF INCOMPLETE EXPERIMENTAL SPECTRAL RESPONSE MATRICES. José Antunes, Laurent Borsoi, Xavier Delaune, Philippe Piteau	Ref: 5442 A FULLY IMPLICIT COMPUTATIONAL APPROACH TO DYNAMIC DELAMINATION UNDER LARGE DISPLACEMENTS. Marco Paggi, Mauro Corrado, José Reinoso	Ref: 5536 SEISMIC REABILITATION OF BUILDINGS: STANDARDIZATION OF INFORMATION FOR BIM. Filipa Salvado, Maria João Silva, Paula Couto, Alvaro Azevedo	Ref: 5340 EXPERIMENTAL INVESTIGATION ON PROPAGATION OF ADIABATIC SHEAR BAND. Lu Ming, Tao Suo, Chao Zhang, Busheng Zhang, Fengbo Liu	Ref: 5369 A NEW TYPE OF HIGH-ORDER ELEMENTS BASED ON MESH-FREE GALERKIN FORMULATIONS. Yigang Wang, Dean Hu, Xu Han	Ref: 5376 STATISTICAL PROCESS CONTROL - THE IMPORTANCE OF USING CALIBRATED MEASUREMENT EQUIPMENT - CASE STUDY. José Barradas, Marta Mendes
Ref: 5585 DEVELOPMENT OF MODIFIED WETABILITY SURFACES ON METALLIC SUBSTRATES BY SHORT PULSE LASER MICROSTRUCTURING. R. Jagdheesh, J.J. Bqllesteros, A.V. Tur, J.L. Ocana	Ref: 5424 INVESTIGATION OF THERMAL AND MECHANICAL PROPERTIES OF QUENCHABLE HIGH STRENGTH STEELS IN HOT STAMPING. Anton Gorriño, Carlos Angulo, Maider Muro, Julian Izaga	Ref: 5755 STUDY ON THE MECHANICAL PERFORMANCE OF ALUMINUM ALLOY 6156 SKIN BUTT JOINTS WITH ELECTRON BEAM WELDING. Theano Examilioti, Nikolaos D. Alexopoulos, George Stefanou, Vasilis Stergiou, Stavros K. Kourkoulis	Ref: 5541 IN-PLANE SEISMIC BEHAVIOR OF A STRONG MASONRY INFILL. Milad Oliiae, Paolo Morandi, Guido Magenes	Ref: 5342 IMPACT RESPONSE OF FOAM FILLED CONCRETE USING A DROP HAMMER TEST SYSTEM. Yiping Liu, Zejia Liu, Zhenyu Jiang, Liqun Tang	Ref: 5374 AN ADAPTIVE COUPLING MOLECULAR DYNAMICS-SMOOTHED MOLECULAR DYNAMICS (MD-SMD) METHOD FOR NANO-MECHANICS. Niangfeng He, Yan Liu, Xiong Zhang	Ref: 5548 APPROACH TO THE CALIBRATION OF CALLIPERS - ISO13385:2011 vs DIN862:1988 STANDARDS. Isabel Perfeito



Ref: 5666 DESIGN SENSITIVITY ANALYSIS OF THERMAL CONDUCTIVITY OF NANOMATERIALS. Seonho Cho, Hong-Lae Jang, Hyun-Seok Kim, Youmie Park	Ref: 5495 TOLERANCE ANALYSIS OF THIN-WALL CFRP STRUCTURAL ELEMENTS USING TOMOGRAPHIC IMAGING. E. Casarejos, Pablo Aguiar, J.D. Barreiro, Pablo Izquierdo, A. Segade, José Vilan, P. Yanez, Alfredo Iglesias	Ref: 5757 SUPERPLASTIC DEFORMATION OF a/b BRASS UNDER FRICTION CONDITIONS. Alexey Moshkovich, Louisa Meshi, Lev Rapoport	Ref: 5594 CAPACITY CURVES FOR REINFORCED CONCRETE BUILDINGS DESIGNED IN ACCORDANCE WITH PORTUGUESE REGULATION. Maria João Silva	Ref: 5345 DOMAIN STABILITY IN SOFT FERROMAGNETIC NANOPATELETS AND POLAR-VORTEX TRANSFORMATIONS CONTROLLED BY MECHANICAL LOADS. Qiang Sheng, Weijin Chen, Yue Zheng	Ref: 5388 INCOMPRESSIBLE MATERIAL POINT METHOD FOR FREE SURFACE FLOW. Fan Zhang, Xiong Zhang, YanPing Lian	Ref: 5574 IDEA MANAGEMENT SYSTEM - AN ESSENCIAL COMPONENT IN THE IMPROVEMENT OF QUALITY. Gilberto Santos, José Afonseca, Nuno Lopes, Manuel Doiro, M. Rui Alves
Ref: 5670 ADJOINT SENSITIVITY ANALYSIS OF CONSTANT TEMPERATURE MOLECULAR DYNAMICS. Hong-Lae Jang, Hyun-Seok Kim, Youmie Park, Seonho Cho	Ref: 5619 NUMERICAL AND EXPERIMENTAL ASSESSEMENT OF THE DISPLACEMENT FIELD ON PDMS SAMPLE. João Ribeiro, Hernani Lopes, Pedro Martins, Mário Vaz	---	Ref: 5729 HORIZONTAL LOAD-PATH EFFECTS IN RC COLUMNS UNDER BIAXIAL BENDING. Hugo Rodrigues, André Furtado, António Arêde, Humberto Varum	Ref: 5476 EXPERIMENTAL INVESTIGATION OF THE CONTACT STRENGTH OF POLYIMIDE AND GRAPHITE UNDER DIFFERENT TEMPERATURES. Hetong Liu, Qinwei Ma, Shaopeng Ma	Ref: 5396 DIFFERENTIAL QUADRATURE TIME FINITE ELEMENT METHOD FOR STRUCTURAL DYNAMICS. Yufeng Xing, Mingbo Qin, Jing Guo	Ref: 5672 EDUCATION FOR ENGINEERING STANDARDS   PRODUCT DEVELOPMENT AND QUALITY CONTROL: CASE STUDY. Cláudia Fernandes, Luís Rocha
Ref: 5754 REINFORCEMENT AT THE NANOSCALE OF CEMENTITIOUS MATERIALS MADE FROM WHITE CEMENT WITH MULTIWALL CARBON NANOTUBES. Nikolaos D. Alexopoulos, Spyridoula Boutsioukou, Foteini Giannakopoulou, Zoi Metaxa, Stavros K. Kourkoulis	Ref: 5777 EXPERIMENTAL RESEARCH ON HOLE-EDGE STRESS CONCENTRATION OF LONG GLASS FIBER REINFORCED POLYPROPYLENE COMPOSITE. Xujing Yang, Shuyong Duan	---	Ref: 5730 MONOTONIC AND CYCLIC CHARACTERIZATION OF THE OUT-OF-PLANE BEHAVIOUR OF INFILL MASONRY WALLS. André Furtado, Hugo Rodrigues, António Arêde	Ref: 5356 MEASUREMENT OF TRACTION SLIP BASED ON IMAGE MORPHOLOGY ALGORITHM. Xi Shi Zhiliang He, Zhiliang He	Ref: 5400 TOPOLOGY OPTIMIZATION OF CONTINUUM STRUCTURES WITH UNCERTAINTY IN LOADING DIRECTION. Jie Liu, Guilin Wen, Xiaoyue Chen, Qixiang Qing	Ref: 5688 HOW TO ANALYSE AND JUDGE SHAFTS FOR SEALING APPLICATIONS. Frank Bauer, Werner Haas
Ref: 5761 FRICTION AND WEAR PROPERTIES OF CU-AL2O3-GR COMPOSITES PREPARED BY REACTION MILLING. Tao Yan, Gui-min Liu, Bin Li, Zhong-xu Yang	---	---	---	Ref: 5450 TAILORED WRINKLE PATTERNS ACHIEVED BY A MICROSTRUCTURED MEMBRANE. Dong Yan, Kai Zhang, Gengkai Hu	---	---

12:30-14:00

LUNCH

VIP Restaurant

14:00-15:45

PAPERS SESSION - 2

All Rooms

2A (Monchique-1) Topic-A Chair Luisa Sousa	2B (Monchique-2) Topic-B Chair C. Pappalètere	2C (Urzelina-1) Topic-C Chair N. Umehara	2D (Urzelina-1) Topic-D Chair M <sup>a</sup> João Barros	2E (Auditorium) Symp-17 Chair Yu Su	2F (Serreta-1) Symp-25 Chair Xu Han	2G (Serreta-2) Symp-27 Chair Albano Cavaleiro
Ref: 5354 ANALYTICAL BUCKLING LOADS OF CONCRETE-FILLED STEEL TUBULAR COLUMNS WITH INTERLAYER SLIP. Simon Schnabl, Igor Planinc	Ref: 5382 EXPERIMENTAL ANALYSIS OF THE ORIGINS OF THE ANISOTROPY IN CYCLIC BEHAVIOR OF THE 2017 AA ALUMINUM ALLOY. Abdelghani May	Ref: 5362 SELECTION OF MATERIALS FOR IMPLANTS OF THE HUMAN HIP-JOINT AND TECHNOLOGY OF THEIR MACHINING WITH HIGH PRECISION AND QUALITY OF SPHERICAL SURFACES. Raul Turmanidze, Tamara Aptsiauri	Ref: 5347 BIM ENVIRONMENT IN THE MAINTENANCE OF BUILDINGS. A. Zita Sampaio, Diogo Simões	Ref: 5346 LARGE CONTROLLABILITY OF DOMAIN EVOLUTION IN FERROELECTRIC NANODOT VIA ISOTROPIC SURFACE CHARGE SCREENING. Weiming Xiong, Chenming Wu, Weijin Chen, Yue Zheng	Ref: 5402 SIZE EFFECT ANALYSIS OF COMPRESSIVE STRENGTH FOR RECYCLED CONCRETE USING THE BFEM ON MICROMECHANICS. Yijiang Peng, Jiwei Pu	Ref: 5423 SELF-ORGANIZED NANOCOMPOSITE WEAR RESISTANT TIALN COATING WITH SUPERIOR PROPERTIES. Juraj Todt, Reinhard Pitonak, Arno Köpf, Ronald Weißbacher, Jozef Keckes
Ref: 5391 MATHEMATICAL MODEL FOR EDDY CURRENT TESTING OF SURFACE FLAWS IN A TWO-LAYER METAL PLATE. Valentina Koliskina, Andrei Kolyshkin	Ref: 5404 INFLUENCE OF A WELDING DEFECT ON A HSLA S500MC STEEL PLATE: MICROSTRUCTURE AND RESIDUAL STRESS EVALUATION. Intissar Frih, Pierre-Antoine Adragna, Guillaume Montay	Ref: 5390 OPTIMISATION OF INTERFACE ROUGHNESS AND COATING THICKNESS TO MAXIMISE COATING-SUBSTRATE ADHESION. Mian H. Nazir, Zulfiqar Khan, Keith Stokes	Ref: 5348 BIM IN STRUCTURAL ANALYSES OF BUILDINGS. A. Zita Sampaio, Vitalino Azevedo	Ref: 5478 SIMULATION OF TENSILE FRACTURE OF GRAPHITE MATERIAL BASED ON THE DAMAGE EVOLUTION MEASURED BY DIGITAL IMAGE CORRELATION. Erqiang Zhao, Xiang Wang, Hongtao Wang, Shaopeng Ma	Ref: 5405 EXPERIMENTAL STUDIES AND OPTIMIZATION DESIGN OF CORRUGATED SANDWICH PANELS. Shujuan Hou, Xu Han, Qing Li	Ref: 5512 INSPECTION OF THE WEAR OF AN IMPELLER OF A CENTRIFUGAL PUMP COATED BY HARD METAL FOR PUMPING OF VINASSE UNDER CAVITATION. A.R. Augusto, J.T.N. Medeiros



Ref: 5411 EVALUATION OF THE NSIFs ON THE BASIS OF THE AVERAGED STRAIN ENERGY DENSITY UNDER MIXED MODE. Alberto Campagnolo, Filippo Berto	Ref: 5433 A COMBINED STRUCTURAL HEALTH MONITORING AND WEIGH-IN-MOTION SYSTEM FOR RAILWAY BRIDGES. Peter Favai, Eugene Obrien, Ales Znidaric, Hans Van Loo, Przemyslaw Kolakowski, Mairead Ni Choine, Robert Corbally	Ref: 5398 FATIGUE IMPROVEMENT OF WELDED ELEMENTS BY ULTRASONIC IMPACT TREATMENT (UIT). Yuri Kudryavtsev	Ref: 5593 EXPERIMENTAL AND NUMERICAL ANALYSIS OF POST INSTALLED ADHESIVE ANCHORS. Masoud Babaei, Mojtaba Hosseini, Bijan Bastae	Ref: 5331 NONLINEAR DYNAMIC CONTACT USING VARIATIONAL INEQUALITIES:THEORY AND APPLICATIONS. Shaker A. Meguid	Ref: 5416 DYNAMIC WETTING ON LYOPHILIC PILLAR-ARRAYED SURFACES. Quanzi Yuan	Ref: 5554 BIOTRIBOLOGICAL BEHAVIOR OF AG-ZRCXN1-X COATINGS AGAINST UHMWPE FOR JOINT PROSTHESES DEVICES. V.S. Calderon, J.C. Sanchez-Lopez, Albano Cavaleiro, Sandra Carvalho
Ref: 5456 QUASI-STATIC AND DYNAMIC SIMULATION OF SHEET METAL FORMING PROCESSES USING LINEAR AND QUADRATIC SOLID SHELL ELEMENTS. Peng Wang, Hocine Chalal, Farid Abed-Meraim	Ref: 5448 THE T2 MULTIVARIATE STATISTICAL CONTROL CHARTS CAPACITY WHEN APPLIED ON EQUIPMENTS CONTROL. Suzana Lampreia, Rui Parreira, Vitor Lobo	Ref: 5455 MODIFICATION OF METALLIC SURFACES BY DUPLEX TREATMENTS INVOLVING SEVERE PLASTIC DEFORMATION. Thierry Grosdidier, Youssef Samyh, Marc Novelli	Ref: 5611 STRESS/DISPLACEMENT ANALYSIS OF EBF WITH DOUBLE SHEAR PANEL WITH LOW YIELD STRENGTH STEEL. Sadegh Bakhtiari Morteza	Ref: 5332 ANALYSIS OF FREQUENCY-DEPENDENT BEHAVIORS IN FERROELECTRIC MATERIALS. Ning Liu, Yu Su	Ref: 5509 DEPENDENCE OF FRICTION FRONT PROPAGATION ON THE LOCAL STRESS STATE. Xiaoming Liu, Dandan Xu, Zhanli Liu, Zhuo Zhuang, Yueguang Wei	Ref: 5595 NI-TI-CU SHAPE MEMORY ALLOY INTERLAYERS SUPPORTING LOW-FRICTION W-S-C COATINGS. Mauro Callisti, Tomas Polcar
Ref: 5460 NUMERICAL PREDICTIONS OF DUCTILE FRACTURE LIMITS IN DEEP DRAWING PORCESSES. Hocine Chalal, Farid Abed-Meraim	Ref: 5461 SIMULATION AND EXPERIMENTS OF INSTRUMENTED MICRO-INDENTATION FOR THE DESIGN OF A NEW HIGH TEMPERATURE MICRO-INDENTER. Xiongjie Liu, Mohamed Rachik, Jerome Favregeon	Ref: 5489 ADHERENCE KINETICS OF A VISCOELASTIC GRIPPER STAMP WITH INHERENT SURFACE TACKINESS: A PRE-STUDY TO AN INDUSTRIAL APPLICATION. Umut Cakmak, Michael Fischlschweiger, Ingrid Graz, Zoltan Major	Ref: 5617 ANALYSIS OF THE SUSCEPTIBILITY OF INFILLING MASONRY WALLS TO CRACK DUE TO VERTICAL DEFORMATION OF CONCRETE STRUCTURES. Rui Sousa, Hipólito Sousa	Ref: 5335 PREDICTION OF LARGE-AMPLITUDE NONLINEAR DYNAMIC RESPONSE OF THERMALLY BUCKLED COMPOSITE PLATES IN COMBINED ENVIRONMENTS. Liu Liu, Bing-Yang Lv, Qiong Guo, Ti-Ren He	Ref: 5520 ANALOGY TECHNIQUE OF MODE SHAPE PARTIAL SLOPE FOR LAUNCH VEHICLE. ZhongWen Pan, YongZhenh Lian	Ref: 5605 THE EFFECT OF CHROMIUM CONTENT ON CUTTING PERFORMANCE AND OXIDATION RESISTANCE OF TiAlCrN COATINGS. Martin Daneš, Tomas Polcar
---	Ref: 5475 PULSED EDDY CURRENT AND TIME-FREQUENCY ANALYSIS IN DETECTING THE CORROSION DISTRIBUTION IN A MULTILAYER ALUMINUM PLATE. Aouni Lakis, Mohammad Hosseini, Mohammad Toorani, S. Sassi	---	---	Ref: 5336 THE MICROBUCKLING FAILURE OF DYNEEMA COMPOSITE BEAM. Guangyan Liu, Wei Zhu	---	---
---	Ref: 5485 APPLICATION OF ALTERNATIVE METHODS AT EARTHWORKS QUALITY CONTROL. Dominika Durekova, Katarina Zgutova, Martin Pitonak	---	---	---	---	---

15:45-16:15

COFFEE-BREAK

Lobby

16:15-18:00

PAPERS SESSION - 3

All Rooms

3A (Monchique-1) Topic-A Chair Jurij Avsec	3B (Monchique-2) Topic-B Chair Mohammad Toorani	3C (Urzelina-1) Topic-C Chair Yuri Kudryavtsev	3D (Urzelina-2) Topic-D Chair Hipólito Sousa	3E (Auditorium) Symp-17 Chair Yu Su	3F (Serreta-1) Symp-25 Chair Yufeng Xing	3G (Serreta-2) Symp-27 Chair Tomas Polcar
Ref: 5543 ANALYSIS OF PIPELINE VIBRATION FOR PRESSURE DRIVEN   ELECTROMAGNETIC AND COMBINED FLUID FLOW IN MACRO   MINI AND MICRO REGIME. Jurij Avsec, Urban Avsec	Ref: 5506 STUDY ON ANTI-SLIP CRITERION OF PRE-TIGHTENED STRUCTURE WITH VISCOELASTIC MATERIAL IN VIBRATION ENVIRONMENT. Jinpeng Wen, Fangmei Wang, Jiang Xue	Ref: 5494 EXPERIMENTAL CHARACTERIZATION AND NUMERICAL MODELLING OF DIRECT BONDING INTERFACE. Marina Voisin, Natacha CochetEAU, Aurélien Maurel-Pantel, Frédéric Lebon, Sonia Ait Zaid, Yves Salaun	Ref: 5676 INNOVATIVE SYSTEMS FOR EARTHQUAKE RESISTANT MASONRY ENCLOSURES IN RC BUILDINGS - INSYSME PRELIMINARY WORK AT UNIVERSITY OF MINHO. Luis M. Silva, Graça Vasconcelos, Paulo B. Lourenço	Ref: 5337 POLYNOMIAL STRESS FUNCTIONS FOR GENERAL 2D PROBLEMS. Yingtao Zhao, Tianbing Zhao, Huiming Yin	Ref: 5556 PARAMETRIC AND TOPOLOGICAL OPTIMIZATION OF DIFFERENT DESIGNS OF FLAT ENDS IN PRESSURE VESSELS. Bogdan Szybinski	Ref: 5699 BIOTRIBOLOGICAL BEHAVIOUR OF A-C:AG NANOCOMPOSITE COATINGS. Noora K. Mannien, Sandra Carvalho, Albano Cavaleiro



Ref: 5596 NEW CONCEPTS FOR THE DESIGN OF FUTURE FRACTURE RESISTANT AND DAMAGE TOLERANT COMPOSITES. Otmar Kolednik, Masoud Sistaninia, Josef Predan, Dieter Fischer	Ref: 5535 ACOUSTIC EMISSIONS IN TITANIUM GRADE 5 DURING UNIAXIAL FATIGUE TESTING. Claudia Barile, Caterina Casavola, Giovanni Pappalettera, Carmine Pappalettera	Ref: 5510 A TRIBOLOGICAL ASSESSMENT OF PEEK SURFACE MODIFIED BY FEMTOSECOND LASER TREATMENT. Sabrina Hammouti, Alina Pascale-Hamri, Cyril Maclair, Stéphane Benayoun, Stéphane Valette	Ref: 5689 PUSHOVER ANALYSIS APPLICATION FOR DAMAGE ASSESSEMENT IN CRITICAL SECTION OF REINFORCED CONCRETE FRAME. Agniles Nekomouche, Mohand Hamizi, Said Boukais, Naceur Eddine Hannachi	Ref: 5394 MECHANICAL BEHAVIOUR OF TAPE SPRINGS USED IN THE DEPLOYMENT OF REFLECTORS AROUND A SOLAR PANEL. Florence Dewalque, Jean-Paul Collette, Olivier Brûls	Ref: 5600 NON-STOCHASTIC PROCESS MODEL FOR TIME-VARYING UNCERTAINTY ANALYSIS AND CORRESPONDING NON-RANDOM VIBRATION THEORY. Chao Jiang, Bingyu Ni	Ref: 5702 SELF-ADAPTIVE THIN FILMS FOR MECHANICAL ENGINEERING. Tomas Polcar, Albano Cavaleiro
Ref: 5639 A ROTARY DRAW BENDING OF RECTAGULAR TUBES: EXPERIMENTS AND NUMERICAL ANALYSES. Simone Ancellotti, Matteo Benedetti, Virgilio Fontanari, Marco Tassan, Stefano Slaghenaufi	Ref: 5552 INFLUENCE OF THE GROWING ANGLE ON THE FATIGUE STRENGTH OF EOS MARAGING STEEL PRODUCED BY ADDITIVE METAL MACHINE. Dario Crococolo, Massimiliano De Agostinis, Stefano Fini, Giorgio Olmi, Snezana Kostic, Aleksandar Vranic	Ref: 5531 IMPROVEMENT OF MECHANICAL AND SURFACE PROPERTIES OF METALLIC ALLOYS BY LASER SHOCK PROCESSING. José Ocana, Juan Porro, Carlos Correa, Marcos Diaz, Leonardo Lara, David Peral	Ref: 5741 A SIMULATOR FOR OPTIMIZING ROLLER-COMPACTED CONCRETE MIX DESIGNS. Silvia R. Garcia, Carlos Padilla, Luis De la Rosa	Ref: 5406 MODELLING THE YIELD STRENGTH AND DUCTILITY IN COMPOSITE NANOTWINNED COPPER. Linli Zhu, Xiang Guo	Ref: 5662 REFACTORIZATION OF PRINCIPAL SUBMATRICES AND ITS APPLICATION TO TOPOLOGICAL OPTIMIZATION. Ren Yang, Qi Song, Mingsen Su, Hao Zhou, Pu Chen	Ref: 5713 LUBRICIOUS TiSi(V)N FILMS FOR HIGH TEMPERATURE APPLICATIONS WITH CONTROLLED RELEASE OF THE LUBRICIOUS AGENT DEPOSITED BY DEEP OSCILLATION MAGNETRON SPUTTERING (DOMS) MODE. Filipe Fernandes, João C. Oliveira, Tomas Polcar, Albano Cavaleiro
---	Ref: 5566 LIMITS OF ULTRASONIC WAVES PROPAGATION IN CONCRETE: APPLICATION OF WATERMAN & TRUPELL MODEL. Abdelaziz Boudchicha, M.S. Othmani Marabout, Jean-Louis Gallias, Norbert Renault	Ref: 5626 EFFECT OF ALTERNATING ELECTRIC FIELD INTENSITY ON ADHESION OF THERMOPLASTIC RESIN. Motoyuki Murashima, Noritsugu Umehara, Hiroyuki Kousaka	Ref: 5753 RESEARCH OF MESO DAMAGE AND FRACTURE OF CONCRETE PAVEMENT BASED ON EXTENDED FINITE ELEMENT METHOD. Chengcheng Chen, Junqing Liu	Ref: 5421 MECHANICAL RESPONSE OF NANOSCALE MATERIALS INDUCED BY ELASTIC INSTABILITY. Duc Tam Ho, Sung Youb Kim	Ref: 5673 SHAPE DESIGN SENSITIVITY ANALYSIS OF DYNAMIC CRACK PROPAGATION USING PERIDYNAMICS. Jae-Hyun Kim, Song-Hyun Cha, Hyun-Seok Kim, Seonho Cho	Ref: 5763 NOVEL MATERIALS IN FLUID FILM BEARING DESIGN. Sergei Glavatskikh
---	Ref: 5568 DAMAGE DETECTION OF A BRIDGE. Milan Sokol, Michal Venglar, Aroch Rudolf, Michal Fabry	---	---	Ref: 5452 PEAK LOAD ESTIMATION OF PRE-CRACKED PLAIN CONCRETE BEAMS IN MIXED-MODE FRACTURE. Xiang Guo, Ray K.L. Su, Ben Young	---	---
---	Ref: 5678 CHARACTERIZATION OF TENSILE AND FRACTURE TOUGHNESS OF A P11 EX-SERVICE STEEL BY SMALL PUNCH TEST. Nuno M.A. Ribeiro, António Correia da Cruz, Afonso Sousa Leite, Manuel A.R. Gomes	---	---	---	---	---
---	Ref: 5756 TEST AND ANALYSIS OF A SHORT-SPAN RAILWAY BRIDGE. Tomasz Kaminski, Jan Bien	---	---	---	---	---

**14:00-19:00**

**POSTERS SESSION - 1**

**Lobby**

TOPICS: A, C, D, J ; SYMPOSIA: 2, 10, 17, 25, 27

**Topic: A**

Ref: 5371

EXPERIMENTAL INVESTIGATION AND NUMERICAL SIMULATION OF THE EXTRUSION DRILLING AND TAPPING PROCESSES. Sigita Kilikevicius, Ramunas Cesnavicius, Povilas Krasauskas

Ref: 5481

SIMULATION OF SURFACE CORROSION DAMAGE OF AERONAUTICAL ALUMINUM ALLOY 2024 WITH ARTIFICIAL SURFACE DEFECTS. Paraskevas Papanikos, Nikolaos Alexopoulos, Constantinos Stergiou, Vasilis Sagias

Ref: 5482

STRESS INTENSITY FACTORS FOR AN ANISOTROPIC ELASTIC CYLINDER WITH A CRACK. Takeshi Tane, Takeshi Uchida, Toru Sasaki, Hiriki Hamano

Ref: 5483

SIMILAR ANALYSIS FOR PIEZOELECTRIC MATERIAL AND ANISOTROPIC MATERIAL WITH AN ELLIPTICAL CAVITY AND ITS APPLICATION. EVALUATION OF ELECTRICAL FIELDS BASED ON SIMILARITY. Toru Sasaki, Takeshi Tane, Toshimi Kondo

Ref: 5545

STRESS CONCENTRATION AT SHARP AND ROUNDED V-NOTCHES IN ORTHOTROPIC PLATES. Mykhaylo Savruk, Andrzed Kazberuk, Marta Kosior-Kazberuk

Ref: 5692

NUMERICAL STUDY OF STEEL PLATE REINFORCED CONCRETE WALLS BEHAVIOR. Ali Kezmane, Luca Placidi, Mohand Hamizi, Said Boukais, Naceur Hannachi

Ref: 5725

ISOGEOMETRIC ANALYSIS OF STRESS INTENSITY FACTORS FOR CURVED CRACK PROBLEMS. Minho Yoon, Myung-Jin Choi, Seonho Cho

**Topics: C & D**

Ref: 5612

A STUDY ON CRACKING IN RBS JOINTS IN MOMENT RESISTING FRAMES. Sadegh Bakhtiari Somayeh, Sadegh Bakhtiari Morteza

Ref: 5726

FULL-SCALE TESTS OF TEMPORARY STEEL (FOOT) BRIDGES. Marcela Karmazinova, Jindrich J. Melcher, Milan Pilgr, Michal Strba

Ref: 5765

IN-PLANE AND OUT-OF PLANE EXPERIMENTAL CHARACTERIZATION OF RC MASONRY INFILLED FRAMES. Farhad Akhoundi, Graça Vasconcelos, Paulo B. Lourenço, Carlos Palha, Luis Silva

**Topic: J**

Ref: 5380

MECHANICAL PROPERTIES OF HMX AND RDX CRYSTALS DETERMINED BY NANOINDENTATION TEST. Xin-Jie Wang, Yan-Qing Wu, Feng-Lei Huang

Ref: 5550

DIMENSIONAL INTERVAL AND CRITICAL SIZES OF NON-LEGAND NANO- AND MICRO- PARTICLES. A.N. Kharkhardin, V.V. Strokova, N.I. Kozhukhova

Ref: 5564

DETERMINATION OF BASIC CHARACTERISTICS OF PROTECTIVE LAYERS BASED ON POLYMERIC NANOFIBERS. Pedra Ticha, Alexey Sveshnikov, Pavel Demo, Michal Havrlik, Martin Cernohorsky

Ref: 5724

SHAPE DESIGN SENSITIVITY ANALYSIS OF MOLECULAR DYNAMICS FOR NANOSCALE LATTICE STRUCTURES. Hong-Lae Jang, Song-Hyun Cha, Youmie Park, Seonho Cho

Ref: 5727

NANOSCALE SELECTIVE NOISE REMOVAL AND EXTRACTION OF INTRINSIC GEOMETRY FROM AFM EXPERIMENTAL DATA. Hong-Lae Jang, Hyun-Seok Kim, Youmie Park, Seonho Cho

Ref: 5762

THE EFFECT OF LA ON PROPERTIES OF AL<sub>2</sub>O<sub>3</sub>/CU COMPOSITES. Gui-min Liu, Tao Yan, Zhong-xu Yang, Bin Li**Symp: 2**

Ref: 5409

PRECISION INSPECTION OF FLATNESS BY MOIRÉ INTERFEROMETRY. Meguellati Said

Ref: 5582

CRAFT SHOES DEVELOPMENT: POETICS OF CREATION TO MAKING PROCESSES. Castori Souza

**Symp: 10**

Ref: 5505

AN OVERVIEW THROUGH PORTUGUESE SEISMIC DESIGN REGULATION AND THE NEW EUROCODES. Maria João Silva

Ref: 5588

COST-BENEFIT ANALYSIS FOR SEISMIC REABILITATION OF BUILDINGS. Filipa Salvado, Maria João Silva

Ref: 5677

SEISMIC REINFORCEMENT OF CONCRETE BUILDINGS. M. Tavares da Silva, Maria João Silva

Ref: 5750

APPLICATION OF LIGHT STEEL FRAMING IN SEISMIC REHABILITATION. Raquel Fernandes, Maria João Silva

Ref: 5774

SEISMIC BEHAVIOUR OF PORTUGUESE RAMMED EARTH BUILDINGS. Ricardo Barros, Humberto Varum, Hugo Rodrigues, Mariana Correia, Graça Vasconcelos, Paulo Lourenço

**Symp: 17**

Ref: 5392

ABNORMAL FRACTURE IN TITANIUM ALLOY TA6V. Thomas Paris, Aymeric Migliarini

Ref: 5463

FRACTURE TOUGHNESS OF HDPE EVALUATED BY FATIGUE AND NOTCH PRECRACKING. Luis Iglésias, Thais Sequeira, Marysylvia Costa, Celio Costa

Ref: 5503

THEORETICAL AND EXPERIMENTAL STUDY OF PIEZOELECTRIC CANTILEVER BIMORPH DYNAMIC CHARACTERISTICS BY ELECTROMECHANICAL EQUIVALENT REPLACEMENT. Hongzhuang Zhang, Shijun Luo, Jiangtian Shi

**Symp: 25 & 27**

Ref: 5703

ARTIFICIAL NEURAL NETWORK: A MODULAR APPROACH. Catarina F. Castro

Ref: 5723

ADJOINT DESIGN SENSITIVITY ANALYSIS OF DYNAMIC CRACK PROPAGATION USING PERIDYNAMIC THEORY. Jae-Hyun Kim, Song-Hyun Cha, Seonho Cho

Ref: 5587

TRIBOLOGICAL PERFORMANCE OF MODIFIED W-S COATINGS IN RUBBER MOULDING APPLICATIONS. Anatoliy Manaia, Geet Raju, Albano Cavaleiro, Tomas Polcar

**19:30-22:00****WELCOME DINNER****VIP Restaurant**



**TUESDAY, 28 JULY 2015**

**08:00-12:00**

**POSTERS SESSION -2**

**Lobby**

TOPICS: F, I ; SYMPOSIA: 5, 26

**Topic: F**

Ref: 5353

EFFECT OF SURFACTANT ON SURFACE MODIFICATION OF CaCO<sub>3</sub> NANOPARTICLES FOR LUBRICANT APPLICATION. EunMin Song, DoWon Kim, JongChoo Lim

Ref: 5425

POSSIBILITY OF REDUCING THE EFFECTIVE EQUIVALENT MISALIGNMENT IN HELICAL GEARS BY A DISC-TYPE LARGE WHEEL CENTRE. Maciej Krasinski

Ref: 5437

DEVELOPMENT OF A SYSTEM OF FIXING FOR RECTIFYING THE INTERNAL DIAMETER OF GEARS. Marlon Intriago, Alessandra Montenegro

Ref: 5449

PREPARATION OF ENVIRONMENTAL FRIENDLY BENZENE-FREE METAL SULFONATE SURFACTANT FOR LUBRICANT ADDITIVE FORMULATION. EunMin Song, DoWon Kim, ByungJo Kim, JongChoo Lim

Ref: 5562

PROCESS FOR TREATMENT SURFACE BY USING GRANULAR VIBRO-IMPACT. Khaled Hamouda, A.P. Babichev

Ref: 5577

FRICITION AND WEAR CHARACTERISTICS OF MAGNETORHEOLOGICAL ELASTOMER UNDER VIBRATING CONDITION. Chenglong Lian, Kwang-Hee Lee, Chul Hee, Eun Sang

**Topic: I**

Ref: 5422

INVESTIGATION OF LOCALLY RESONANT ABSORPTION OF PHONONIC GLASS. Meng Chen, Meng Dan, Yuren Wang, Heng Jiang, Yafei Feng

Ref: 5435

SPECIAL CLASS OF QUASI-ISOTROPIC LAMINATES FOR AEROSPACE APPLICATIONS. Biranchi N. Panda, M. Raju Bahubalendruni, Bhusan Biswal

Ref: 5493

SHEAR THICKENING FLUIDS IMPREGNATED SPACER FABRICS FOR ENERGY ABSORBING SYSTEMS. Lukasz Wierzbicki, Marcin Leonowicz, Malysa Maria

Ref: 5508

WALL-SLIP AS A PHENOMENON ATTENDING PROCESSING OF HIGHLY POWDER PARTICLE FILLED POLYMER MELTS. Daniel Sanetnik, Berenika Hausnerová, Eva Hnatkova

Ref: 5518

VISCOELASTIC ANALYSIS OF THE PRE-STRESSED DOUBLE-RINGS UNDER THE STATE OF CONSTANT TEMPERATURE DISPERSION. Min Yang, Shenglai Chen

Ref: 5547

MECHANICAL PROPERTIES OF ALLOYS | SiO<sub>2</sub> AND AUTOMATED SYSTEM OF ANISOTROPY VISUALIZATION. Anatoliy Onanko, Georgiy Prodayvoda, Yriy Onanko, Aleksandr Shabaturova, Galina Onanko, Artue Onischenko

Ref: 5573

ANALYSIS OF LONG-TERM INFLUENCE OF CHLORIDE AGGRESSIVE ENVIRONMENT ON THE UHPC. Radka Pernicova, Daniel Dobias

Ref: 5634

NOVEL COMPOSITE ALLOY FOR COMBUSTION ENGINE PISTONS. Jozef Zurek, Zenon Slawinski, Antoni Jankowski

Ref: 5637

RHEOLOGY-SIMULATION OF SHORT FIBRE REINFORCED CONCRETE CASTING. Heiko Herrmann, Aarne Lees, Michael Krause, Marcel Padilla, Emiliano Pastorelli

Ref: 5659

MICROSTRUCTURE EVOLUTION AND MECHANICAL PROPERTIES OF COLD DRAWN HYPEREUTECTOID STEEL WIRE. Zifei Ni, Lili Yao, Huafang Ni

Ref: 5697

COMPARATIVE STUDY BETWEEN GEOPOLYMERS ENABLED WITH SODIUM AND POTASSIUM HYDROXIDES. Rozineide Boca Santa, Humberto Gracher Riela, Nivaldo Cabral Kuhnen

Ref: 5708

STUDY OF THE INCORPORATION OF MINERAL ADDITIVES AND CARBON FIBER ON THE DURABILITY AND PERFORMANCE OF A MORTAR FOR REHABILITATION WORKS. Djihen Benchiheub, Chahinez Amouri, Hacene Houari

Ref: 5737

OPTIMIZATION OF COMPOSITES FEEDSTOCKS WITH MWCNT NANOREINFORCMENT. T.J. Ferreira, M.T. Vieira

**Symp: 5 & 26**

Ref: 5561

STUDY OF TRIBOLOGICAL BEHAVIOUR OF PEEK REINFORCED WITH DIFFERENT TYPES OF FIBRES. Enrique Casarejos, Miguel Castro, António Collazo, Maria Perez, Abraham Segade, José Vilan

**09:30-10:15**

**KEYNOTES SESSION - 2**

**Serreta & Auditorium**

<p style="text-align: center;"><b>A</b> (Room: Serreta) Chair: Prof. Sergei Mileiko (RAS, Russia)</p>	<p style="text-align: center;"><b>B</b> (Room: Auditorium) Chair: Prof. S.A. Meguid (U. Toronto, Canada)</p>
<p style="text-align: center;">Professor Peter Hess (University of Heidelberg, Germany) <b>ON THE USE OF GUIDED WAVES IN NONDESTRUCTIVE DIAGNOSTICS AND FAILURE ANALYSIS</b></p>	<p style="text-align: center;">Professor Ng Teng Yong (NTU, Singapore) <b>EXTREME INSULATORS FOR EXTREME ENVIRONMENTS: UNDERSTANDING THE PROPERTIES OF ULTRALIGHT AEROGELS AND 2D MATERIALS</b></p>



10:15-10:45

COFFEE-BREAK

Lobby

10:45-12:30

PAPERS SESSION - 4

All Rooms

4A (Monchique-1) Symp-28 Chair Jorge Belinha	4B (Monchique-2) Topic-I Chair D. Croccolo	4C (Urzelina-1) Symp-5 Chair Jorge Lino	4D (Urzelina-2) Symp-11 Chair J. Reis Campos	4E (Auditorium) Symp-17 Chair Yu Su	4F (Serreta-1) Topic-F Chair Klaus Kunze	4G (Serreta-2) Symp-26 Chair M <sup>a</sup> José Abreu
Ref: 5349 AN ISOGEOMETRIC 2D PLATE FORMULATION BASED ON LAGRANGIAN AND B-SPLINE INTERPOLATION FUNCTIONS FOR GEOMETRIC LINEAR AND NONLINEAR ANALYSES. Vinzenz Sattinger, Daniel Supanz	Ref: 5377 COMPOSITION AND STRUCTURE OF BIMODAL WC-Co MATERIALS RELATED TO MECHANICAL PROPERTIES AND ABRASIVE WEAR. Der-Liang Yung, Maksim Antonov, Irina Hussainova, Renno Veinthal, Sture Hogmark	Ref: 5355 ADDITIVE MANUFACTURING IN THE DEVELOPMENT OF AN INTRAMEDULLARY NAIL: STUDY OF CLINICAL CASE. Maria G. Fernandes, Fernando Alves, Elza Fonseca	Ref: 5716 THE APPLICATION OF GRAPHENE IN REMOVABLE PROSTHESIS. Patricia Leite, Patricia Fonseca, J.C. Reis Campos, Maria Helena Figueiral	Ref: 5463 FRACTURE TOUGHNESS OF HDPE EVALUATED BY FATIGUE AND NOTCH PRECRACKING. Luis Iglésias, Thais Sequeira, Marysilvia Costa, Celio Costa	Ref: 5395 A STUDY ON TRIBOLOGICAL BEHAVIOUR OF a-C:H COATINGS UNDER LUBRICATED CONDITIONS UP TO 250 °C. Rolf Waesche, Manfred Hartelt, Roman Ehrke	Ref: 5429 USING ULTRASONIC IR THERMOGRAPHY FOR DETECTING DEFECTS IN MILITARY-ORIENTED POLYARAMIDE MATERIALS. Waldemar Swiderski, Daria Derusova, Monika Pracht, Vladimir Vavilov
Ref: 5358 A QUASI USER-INDEPENDENT MESHLESS METHOD FOR THE ANALYSIS OF PLATES. Carla Roque, Pedro Martins	Ref: 5383 MICROPARTICLES OF CORK AS REINFORCEMENT MATERIAL IN BRITTLE STRUCTURAL ADHESIVES. Ana Barbosa, Lucas Silva, Andreas Oechsner, Joana Abenojar, Juan Carlos del Real	Ref: 5445 SALMON CHALLENGE METHOD (SCM): MECHANICAL CREATIVITY IN NEW PRODUCT DEVELOPMENT. Iko Avital, Gedalya Mazor	Ref: 5722 BIOMECHANICAL ANALYSIS OF FULL-ARCH IMPLANT-SUPPORTED REHABILITATIONS WITH DIFFERENT DESIGNS. Maria Inês Barahona, J.C. Reis Campos, Nuno V. Ramos, Mário Vaz, Maria Helena Figueiral, André Correia	Ref: 5473 NONLINEAR DYNAMIC CHARACTERISTICS AND OPTIMAL CONTROL OF SHAPE MEMORY POLYMER WINGS SUBJECTED TO STOCHASTIC EXCITATION. Jia Xu, Yingxiao Kong, Zhiwen Zhu	Ref: 5434 TRIBOLOGICAL BEHAVIOUR OF DUCTILE CAST IRON-STEEL PAIR FOR WORM GEARING. Vigilio Fontanari, Matteo Benedetti, Christian Girardi, Lorenzo Giordanino	Ref: 5457 EXPERIMENTAL INVESTIGATION ON THE PROPERTIES AND PERFORMANCE OF SELF-COMPACTING CONCRETE WITH VEGETABLE AND SYNTHETIC FIBERS. Ahmed Belkadi, Abdelhamid Guettala, Chahinez Amouri, Hacene Houari
Ref: 5427 THE NONLINEAR ANALYSIS OF PLATES USING THE NATURAL NEIGHBOUR RADIAL POINT INTERPOLATION METHOD. Jorge Belinha, Lucia Dinis, Renato Jorge	Ref: 5439 VOXEL MODELING OF POROUS CERAMICS FOR BENDING DISK STRENGTH TEST. Natalia Dolganina, Oleg Kudryavtsev, Sergei B. Sapozhnikov	Ref: 5567 DEVELOPMENT OF A PROJECT AND MANUFACTURE METHODOLOGY FOR TITANIUM ALLOYS JOINT PROSTHESES. João Leite, Jorge Lino Alves, Rui Neto, Teresa Duarte	Ref: 5731 FATIGUE TEST ON A 3-ELEMENT IMPLANT BRIDGE COMBINING A CONVENTIONAL AND A DYNAMIC ABUTMENT. José Ferreira, Marta Oliveira, Nannan Song, Margarida Machado, André Correia, Ana Reis	Ref: 5487 TEMPERATURE AND TIME DEPENDENT BEHAVIOUR OF Z2CN18.10 STAINLESS STEEL UNDER UNIAXIAL LOADING. Gang Chen	Ref: 5533 ON THE LUBRICATION CAPABILITY OF RAPESEED OIL. Constantin Georgescu, Liviu Solea, George Cristea, Lonena Deleanu	Ref: 5526 THEORY AND SIMULATION OF SHORT FIBRE REINFORCED COMPOSITES. Heiko Herrmann, Aarne Lees, Emiliano Pastorelli
Ref: 5471 FROM CAD MODELS TO THE EMBEDDED SOLIDS IN THE EXTENDED FINITE ELEMENT METHOD. Frédéric Duboeuf, Eric Bechet	Ref: 5462 POST-CRACKING BEHAVIOUR OF BASALT FIBRE REINFORCED CONCRETE. Marta Kosior-Kazberuk, Julita Krassowska	Ref: 5580 CONSIDERATIONS ABOUT THE INFLUENCE OF THE GEOMETRICAL DEVIATIONS ON THE CLEARANCES OF MECHANICAL ASSEMBLIES. António Mourão	Ref: 5732 SURFACE CHARACTERIZATION OF A NEW CERAMIC DENTAL IMPLANT. Mónica Miranda, Tiago Marques, André Correia, Fábio Lobo, Maria Helena Fernandes, Célia Miranda, Filipe Araújo	Ref: 5504 DYNAMIC CHARACTERISTICS AND CONTROL OF ROTARY PRECISION POSITIONING DEVICE DRIVING BY IMPACT FORCE OF PIEZOELECTRIC BIMORPHS. Hongzhuang Zhang, Shijun Luo, Jiangtian Shi	Ref: 5540 INFLUENCE OF ARAMID FIBERS ON TRIBOLOGICAL BEHAVIOR OF PBT. Mihail Botan, Constantin Georgescu, George Cristea, Lorena Deleanu	Ref: 5565 ANALYSIS OF DOUBLE FACE FINISHED COTTON PROPERTIES FOR BED SHEET APPLICATIONS. Filipe Rodrigues, Maria José Abreu, Graça Soares
Ref: 5571 THE NON-LINEAR NUMERICAL ANALYSIS USING MESHLESS METHODS. Jorge Belinha, Lucia Dinis, Renato Jorge	Ref: 5464 MAGNETOMECHANICAL PROPERTIES OF TERFENOL-D BASED COMPOSITES. Mariusz Hasiak, Jerzy Kaleta, Rafal Mech	Ref: 5606 AGILE MANUFACTURING PRACTICES FOR NEW PRODUCT DEVELOPMENT. Vanessa Braz, Marco Leite	Ref: 5734 BIOMECHANICS AND OVERDENTURES. Margarida Sampaio Fernandes, Paula Vaz, Patricia Fonseca, J.C. Reis Campos, Maria Helena Figueiral	Ref: 5652 TEXTILE REINFORCED MORTAR SYSTEM AS A MEANS FOR CONFINEMENT OF MASONRY STRUCTURES EXPOSED TO ELEVATED TEMPERATURES. Theofanis Krevaiakas	Ref: 5620 DEVELOPMENT AND TRIBOLOGICAL CHARACTERISATION OF COMPOSITE TRIBO-PATCHES. Manuela Andrich, Klaus Kunze, Niels Modler, Robert Kupfer, Dieter Lehmann, Hans-Joachim Scheibe, Jayashree Bijwe	Ref: 5636 APPLICATION OF JUTE FIBER ON AUTO VEHICLES INSTRUMENTS PANEL FRAME. Gilmar C. Silva, José R.G. Carneiro, Pedro P. Brito, Luiz O. Ghelli, Fernando Almeida, Raphael F. Batista
---	Ref: 5486 RHEOLOGICAL PROPERTIES OF ASPHALT MIXTURES WITH ADDITIVES. Juraj Sramek, Erika Sramekova, Dominika Durekova	---	Ref: 5738 AESTHETIC DESIGNS IN REMOVABLE PARTIAL DENTURES. Francisco Gois, Margarida Sampaio Fernandes, Patricia Fonseca, Bruno Henriques, João Sampaio Fernandes	Ref: 5654 DEFORMATION AND FRACTURE OF MMC WITH PHASE TRANSFORMATIONS IN MATRIX. Sergei N. Kulkov	Ref: 5691 ONE APPLICATION OF THE INTERNATIONAL TERMINOLOGICAL STANDARD BDS ISO 10825 FOR THE DAMAGE IDENTIFICATION ON THE TEETH OF GEAR TRANSMISSIONS. Valentin Abadjiev, Georgi Dimchev, Emilia Abadjieva, Dimitar Karastoyanov	---



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12:30-14:00

LUNCH

VIP Restaurant

14:00-15:45

PAPERS SESSION - 5

All Rooms

5A (Monchique-1) Symp-12 Chair Carlos C. António	5B (Monchique-2) Topic-I Chair Elzbieta Pieczyska	5C (Urzelina-1) Topic-G Chair António Mourão	5D (Urzelina-2) Sym-11 + Top-K Chair J. Reis Campos	5E (Auditorium) Symp-6 Chair Marcelo Moura	5F (Serreta-1) Symp-21 Chair Ramiro Martins	5G (Serreta-2) Symp-9 Chair Helena Navas
Ref: 5360 OPTIMIZATION OF FGM SANDWICH BEAM USING IMPERIALIST COMPETITIVE ALGORITHM. Saeed Kamarian, Mahmoud Shakeri	Ref: 5522 SYNERGY IN COMPOSITES. Sergei Mileiko (Invited Paper)	Ref: 5426 INVESTIGATIONS OF STRUCTURAL STRENGTH AND OPERATING PROPERTIES OF WAVE-RING GASKETS. Andrzej Trojnacki, Bogdan Szybinski	Ref: 5758 PREFORMED COMPOSITE RESIN CROWNS VS STAINLESS STEEL CROWNS IN PRIMARY DENTITION - IN VITRO STUDY. Cátia C. Silva, Artur Miler, Nuno V. Ramos, Mário Vaz, Cristina C. Silva, J.C. Reis Campos	Ref: 5719 NUMERICAL AND EXPERIMENTAL CHARACTERIZATION OF STEEL - WOOD DOWELED JOINTS UNDER QUASI-STATIC LOADING. Nuno Dourado, Marcelo F.S.F. Moura, Abílio Jesus, José Xavier	Ref: 5361 CHEMICALLY COMPATIBILISED PA-PTFE ANTI-FRICTION COATINGS WITH A HIGH WEAR RESISTANCE. Dieter Lehmann, Michaela Gedan-Smolka, Anne Marschner, Gert Heinrich, Rainer Franke, Ingrid Haase, Klaus Kunze	Ref: 5468 CLEANER PRODUCTION: AN STRATEGY FOR IMPROVEMENT AND RISKS PREVENTION TOWARDS SUSTAINABLE DEVELOPMENT. Gilberto Santos, Manuel Rebelo, Rui Silva
Ref: 5412 OPTIMIZATION OF AIRCRAFT STRUCTURES WITH USE OF BIOMIMETIC STRUCTURAL OPTIMIZATION METHOD. Michal Nowak, Krzysztof Brudlo, Hubert Hausa, Robert Roszak	Ref: 5539 INFLUENCE OF HYDROPHOBIC ADDITIVES ON SUSCEPTIBILITY TO THE FORMATION OF EFFLORESCENCE ON CONCRETE ELEMENTS. Radka Pernicova	Ref: 5432 COMPRESSIVE PROPERTY CHARACTERIZATION OF FDM PRINTED CELLULAR STRUCTURES. Biranchi N. Panda, Marco Leite, André Carvalho, Bhusan Biswal	Ref: 5759 DESIGN AND DEVELOPMENT OF AN INNOVATIVE TEMPOROMANDIBULAR JOINT PROSTHESIS. Michel Mesnard, António Ramos	Ref: 5720 BIOCIDAL PROPERTIES OF NANOTEXTILES DOPED WITH FUNGICIDES AGAINST DRY ROT FUNGUS SERPULA LACRYMANS. Monika Terabesyova, Pavla Ryparova, Petr Kuklik	Ref: 5381 CHEMICALLY MODIFIED POLY(TETRAFLUOROETHYLENE) AS ADDITIVE IN LUBRICANTS FOR CONVEYOR SYSTEMS. Thorsten Hoffmann, Dieter Lehmann, Martin Anders, Thorsten Schmidt, Markus Michael	Ref: 5576 SYSTEMATIC INNOVATION AND LEAN APPROACH APPLIED TO PNEUMATIC TESTS OF AIRCRAFT COMPONENTS. Diogo Campos, Teresa Morgado, Helena Navas
Ref: 5417 DESIGN INTEGRITY AND OPERATIONAL SAFETY OPTIMIZATION TECHNIQUES. Soliman Mahmoud	Ref: 5551 EVALUATION OF CONTAMINATED MORTARS WITH ZINC BY ELETTROCHEMICAL IMPEDANCE SPECTROSCOPY. Caroline Venâncio, Janaíde Rocha, Malik Cheriaf	Ref: 5444 MOTORCYCLE APPLICATION OF MULTI-TUBULAR CHASSIS CFRP-CFRP. Miguel Gonzalez, Montserrat Sanchez, Rafael Weyler, Mike Blundell	Ref: 5328 RISK FACTORS POSTURAL OF THE BACKPACK SCHOOL FOR PRIMARY SCHOOL CHILDREN IN MAPUTO-MOZAMBIQUE. Lina Zacaria, Alberto Graziano	Ref: 5497 DETERMINATION OF MODE I FRACTURE TOUGHNESS OF CORTICAL HUMAN BONE USING THE DCB TEST. Marcelo F.S.F. Moura, Filipe G.A. Silva, Nuno Dourado, José Xavier, Fábio A.M. Pereira, José J.L. Morais, Maria I.R. Dias, Paulo J. Lourenço, Fernando M. Judas	Ref: 5586 NOVEL BISMUTH-BASED TRIBOLOGICAL COATINGS FOR HIGH PERFORMANCE INTERNAL COMBUSTION ENGINE BEARING APPLICATIONS. Ignacio Tudela, Yi Zhang, Madan Pal, Andrew Cobley, Ian Kerr	Ref: 5579 LEAN MAINTENANCE MANAGEMENT ACTIVITIES IN AN OIL TERMINAL: CASE STUDY. Tiago Palmeira, Marco Maia, Teresa Morgado, Helena Navas
Ref: 5446 IDENTIFICATION OF MATERIAL AND SHAPE BASED ON EIGENVALUES AND TRACES OF EIGENMODES. Cristian Barbarosie, Anca-Maria Toader	Ref: 5555 MORPHING COMPOSITE STRUCTURES FOR ADAPTIVE HIGH LIFT DEVICES. Alessandro Airoldi, Paolo Panichelli, Alessandro Gilardelli, Giuseppe Quaranta, Giuseppe Sala	Ref: 5465 A NEW MOLD DESIGN FOR QUALIFICATION OF POWDER/BINDER SEPARATION IN PIM TECHNOLOGY. Jakub Huba, Berenika Hausnerová	Ref: 5330 ANALYSIS OF LOWER LIMBS EXPLOSIVE FORCE IN EX-PLAYERS MEN AND WOMEN BASKETBALL MAPUTO CITY: A COMPARATIVE STUDY. Alberto Graziano, Anicência Fabião	---	Ref: 5598 IRREVERSIBLE EFFECTS ON GREASE STRUCTURE DUE TO FRICTION ENERGY. Erik Kuhn	Ref: 5631 AN INITIATION OF A LEAN JOURNEY IN A CLOTHING COMPANY. Rúben Eira, Laura C. Maia, Anabela C. Alves, Celina P. Leão
---	Ref: 5563 STUDY OF CFRP-PEEK BONE PLATES: TEST AND FEM ANALYSIS. M. Castro, P. Aguiar, A. Barreiro, J.D. Barreiro, E. Casarejos, A. Gonzalez, A. Iglesias, P. Izquierdo, M.C. Pérez, A. Segade, M. Vila, J.A. Vilán, P. Yañez	---	Ref: 5418 INTRA-OPERATOR RELIABILITY OF PHASE VELOCITY MEASUREMENTS OF FLEXURAL ACOUSTIC WAVES IN THE HUMAN TIBIA IN VIVO. Florian Vogl, Karin Schnüriger, Hans Gerber, William R. Taylor	---	Ref: 5680 LOAD DISTRIBUTION IN HELICAL GEARS INCLUDING ELASTIC AND FRICTION EFFECTS. Pedro M.T. Marques, Ramiro Martins, Jorge H.O. Seabra	Ref: 5649 THE CUSUM VERSUS MCUSUM MODIFIED CONTROL CHARTS WHEN APPLIED ON DIESEL ENGINES PARAMETERS CONTROL. Suzana Lampreia, Rui Parreira, José Requeijo, Vitor Lobo
---	Ref: 5776 THREE DIMENSIONAL SYNTHETIC MICROSTRUCTURE GENERATION FOR SOLID OXIDE FUEL CELL ELECTRODE. Safa Koç, Fethi Yücel, Selahattin Çelik, Serkan Toros, Bora Timurkutluk	---	Ref: 5431 SOME FUNCTIONS IN DANDELION FLOWER HEAD AND SEED HEAD. Seiichi Sudo, Maki Sato	---	---	---



15:45-16:15

COFFEE-BREAK

Lobby

16:15-18:00

PAPERS SESSION - 6

All Rooms

6A (Monchique-1) Symp-12 Chair Carlos C. António	6B (Monchique-2) Topic-I Chair Jerzy Kaleta	6C (Urzelina-1) Topic-G Chair António Mourão	6D (Urzelina-2) Topic-K Chair Mário A.P. Vaz	6E (Auditorium)	6F (Serreta-1) Symp-21 Chair Ramiro Martins	6G (Serreta-2) Symp-9 Chair Helena Navas
Ref: 5644 MULTIOBJECTIVE OPTIMIZATION AS ALTERNATIVE SEARCH OF SUSTAINABLE COMPOSITE STRUCTURES. Carlos C. António. (Invited Paper)	Ref: 5597 THERMOFORMING OF THERMOPLASTIC WOVEN COMPOSITES: MODELLING AND VALIDATION. Martin Machado, Michael Fischlschweiger, Zoltan Major	Ref: 5517 DESIGN AND SIMULATION OF A POLYMERIC 3D PRINTED FALL ARREST SYSTEM FOR CLIMBING. Martin Reiter, Matei Miron, Zoltan Major	Ref: 5479 FINITE ELEMENT EVALUATION OF THE MECHANICAL BEHAVIOUR OF A DETAILED FOOT/FOOTWEAR MODEL. Zoi Koutkalaki, Panagiotis Papagiannis, Philip Azariadis, Paraskevas Papanikos	---	Ref: 5746 ROLLING BEARING WEAR IN WIND TURBINES. Beatriz Graça, Ramiro Martins, Jorge H.O. Seabra	Ref: 5650 A PRACTICAL MODEL TO EVALUATE COMPETITIVENESS. Nuno Cavaco, Virgílio Machado
Ref: 5528 SUSTAINABLE SOLUTIONS UNDER THE AXIOMATIC DESIGN PRINCIPLES: THE NEED FOR RESILIENCE. João Fradinho, António Santos, António Gonçalves-Coelho, António Mourão	Ref: 5601 THERMOMECHANICAL ANALYSIS OF SHAPE MEMORY POLYURETHANE PUSMP. Elzbieta Piecyszka, Maria Staszczak, Michal Maj, K. Kowalczyk-Gajewska, M. Cristea, H. Tobushi, S. Hayashi	Ref: 5557 TESTS AND COMPUTER SIMULATIONS OF ELECTRIC BUSES. Miloslav Kepka, Stanislav Spirk	Ref: 5630 PLASTICITY EFFECTS DURING THE 4-POINT BENDING OF INTRAMEDULLARY LEG LENGTHENING IMPLANTS WITH TELESCOPIC STRUCTURES. Mikko Kanerva, Zahra Besharat, Ryan Livingston, Harri Hallila, Mark Rutland	---	Ref: 5747 COMBINED SURFACE CONTACT FATIGUE AND WEAR IN SPUR GEARS. José A. Brandão, Jorge H.O. Seabra, Manuel J.D. Castro, Ramiro Martins	Ref: 5679 LEAN COMPANIES IN THE TRACK OF SUSTAINABILITY. M. Florentina Abreu, Anabela C. Alves
Ref: 5602 MULTIOBJECTIVE DESIGN OF AUTOMOBILE COMPOSITE APPLICATIONS BASED ON FEASIBILITY ROBUSTNESS. Carlos C. António, Luísa Hoffbauer	Ref: 5607 COST AND TECHNICAL PERFORMANCE AND ENVIRONMENTAL IMPACT AS SIMULTANEOUS CONSTRAINTS FOR THE SELECTION OF COMPOSITE MATERIALS IN THE EARLY DESIGN STAGES OF AIRCRAFT STRUCTURES. Elcin Calado, Marco Leite, Arlindo Silva	Ref: 5712 APPLICATION OF BAYESIAN UPDATING AND STOCHASTIC FINITE ELEMENT METHOD TO THE LOAD AND RESISTANCE FACTOR DESIGN (LRFD) OF A ROUND BAR HAVING RANDOM GEOMETRY. Yuji Nakasone, Shun Miyazaki	Ref: 5655 POROSITY AND MECHANICAL PROPERTIES OF ZIRCONIUM CERAMICS. Sergei N. Kulkov, Ekaterina S. Kalatur, Svetlana P. Buyukova	---	Ref: 5748 WIND TURBINE GEAR OILS PERFORMANCE EVALUATION. Ramiro Martins, Carlos M.C.G. Fernandes, Jorge H.O. Seabra	Ref: 5687 LEAN SOLUTIONS APPLIED IN THE BELVER HYDROELECTRIC CENTRAL - EDP_132. Pedro Gaspar, Teresa Morgado, Francisco Freitas
Ref: 5668 ISOGEOMETRIC CONFIGURATION DESIGN OPTIMIZATION OF HEAT CONDUCTION PROBLEMS USING BOUNDARY INTEGRAL EQUATION. Minho Yoon, Myung-Jin Choi, Seonho Cho	Ref: 5624 ANALYSIS OF THE STRESS FIELD IN PHOTOVOLTAIC MODULES DUE TO IMPACT LOADINGS. Mauro Corrado, Andrea Infuso, Marco Paggi	Ref: 5768 AXIOMATIC DESIGN BASED ASSESSMENT OF OFFSHORE WIND TURBINE SUPPORT STRUCTURES. Konstantinos Salonitis, Athanasios Kolios	Ref: 5773 BIOMECHANICS OF THE HUMAN STOMACH AFTER BARIATRIC SURGERY. Noor M. Shamlooh, Roustem Miftahof	---	Ref: 5751 FRICTION TORQUE OF POLYMER GREASES WITH DIFFERENT THICKENER CONTENT. David Gonçalves, Samuel Pinho, Armando Campos, Beatriz Graça, Jorge H.O. Seabra	Ref: 5690 INNOVATIVE APPROACH FOR CONTROL AND AUTOMATIZATION OF MICROCLADDING PROCESS. Jorge M.S.P. Torres, Teresa Morgado, Helena V.G. Navas
---	Ref: 5707 MECHANICAL BEHAVIOR THROUGH TRIAXIAL TEST OF SAND SLAG TREATED BY GRANULATED SLAG. Hayet Cherfa, Nacera Saoudi, Khedidja Ait Mokhtar, Abd Elmounim Younsi, François Duhaime	---	---	---	Ref: 5752 FORMULATION   RHEOLOGY AND THERMAL AGING OF POLYMER GREASES. David Gonçalves, Armando Campos, Beatriz Graça, Jorge H.O. Seabra	Ref: 5735 TRIZ AS AN AMPLIFIER FOR CORPORATE CREATIVITY AND CORPORATE INNOVATION ABILITY. Barbara Gronauer
---	Ref: 5718 SPARK PLASMA SINTERING OF ALPHA- AND BETA- SIALON. Kiyotaka Matsuura, Toko Tokunaga	---	---	---	---	---

**14:00-19:00****POSTERS SESSION - 3****Lobby**

TOPICS: B, G, H, K ; SYMPOSIA: 6, 19, 21

**Topic: B**

Ref: 5372

STUDY OF WELDING LINE UNRIPPING TEST OF METAL BELLOWS. Zhongbin Tang, Yulong Liu, Tao Suo, Qiong Deng

Ref: 5466

ANALYSIS OF THE AIRCRAFT OPERATION IN THE CONTEXT OF SAFETY AND EFFECTIVENESS. Jozef Zurek, Antoni Jankowski, Jan Rajchel

Ref: 5544

REMARKS TO TESTING OF STRENGTH AND FATIGUE LIFE. Miloslav Kepka, Jan Chvojan

Ref: 5581

INFLUENCY OF HEAT TREATMENT IN THE MECHANICAL PROPERTIES AT HIGH TEMPERATURES OF P91 STEEL-PIPE WELDED JOINTS. Tatiane Chuvas, António Correia da Cruz, Manuel Gomes, Maria Cindra Fonseca

Ref: 5645

VANE SEGMENT CASTING GEOMETRY IMPACT ON THE STRESS IN THE AIRFOIL SURFACE LAYER. Pawel Kocurek, Pawel Rokicki, Rafal Cygan, Jacek Nawrocki, Andrzej Nowotnik, Jan Sieniawski

Ref: 5653

HEAT TREATMENT EFFECT ON MICROSTRUCTURE AND PROPERTIES OF SINGLE CRYSTAL CMSX-4® NICKEL-BASED SUPERALLOY. Andrzej Nowotnik, Pawel Rokicki, Grzegorz Jakubowicz, Daniel Kurkowski, Grazyna Mrowka-Nowotnik, Malgorzata Wierzbinska, Jan Sieniawski, Jacek Nawrocki

Ref: 5674

FATIGUE BEHAVIOR AND CUMULATIVE DAMAGE OF NOTCHED GFR COMPOSITES. Alessio Carofalo, Vito Dattoma, Riccardo Nobile, Fania Palano, Francesco Panella

Ref: 5693

INVESTIGATION OF THE MECHANICAL BEHAVIOUR OF ZIRCONIUM ALLOY AT DIFFERENT STRAIN RATES USING SUB-SIZE TENSILE SPECIMENS. Pavel Konopik, Martin Rund, Jan Dzugan

Ref: 5775

TOOL CONDITION MONITORING IN DRILLING BASED ON SPINDLE AND FEED MOTOR CURRENT. Alfonso González, David Rodríguez, Justo García Sanz-Calcedo, Inocente Cambero, José Herrera

**Topic: G**

Ref: 5352

SMALL-SCALE STRAIGHT-BLADED DARRIEUS VERTICAL AXIS WIND TURBINE. Rafael de Almeida Alves, Carlos Alberto Gallo

Ref: 5454

LIFE CYCLE ANALYSIS (LCA) AND RELIABILITY TECHNIQUES IN INDUSTRIAL DESIGN PROJECTS. Justo Calcedo, David Salgado, Alfonso Gonzalez, Inocente Rivero, José Herrera

Ref: 5603

CONSIDERATIONS ON OPERATION OF A TURBOJET ENGINE WITH THE 'BYPASS' DESIGN. Miroslaw Kowalski

Ref: 5760

SPATIAL FACE RACK DRIVES: MATHEMATICAL MODELS FOR SYNTHESIS AND SOFTWARE ILLUSTRATIONS. Emilia Abadjieva

**Topic: H**

Ref: 5410

THREE-DIMENSIONAL EFFECTS ON WELDED LAP JOINTS UNDER TENSILE-SHEAR LOADING. Filippo Berto, Alberto Campagnolo

Ref: 5667

EVALUATION OF STAINLESS STEEL PLATES OF HEAT EXCHANGER DAMAGE. H. Abdel-Aleem, B. Zaghoul, S.A. Khodir

**Topic: K**

Ref: 5584

MEASUREMENT OF INPUT ACOUSTIC IMPEDANCE OF HUMAN AUDITORY SYSTEM. Daniel Carmona, Leonardo Molisani, Maria Bellini

Ref: 5696

ANALYSIS OF THE CORE STABILITY TO IMPROVE SINGLE LEG STANCE (CASE STUDY). Ana Couto, Mário Vaz, Sara Morais

**Symp: 6**

Ref: 5618

NUMERICAL SIMULATION OF WALL DEFORMATION IN AN ANEURYSM MODEL. João Ribeiro, Rui Lima, Hernani Lopes, Mário Vaz, J.F. Silva Gomes

**Symp:19**

Ref: 5407

MAGNETIC CHARACTERIZATION BY EDDY CURRENT TESTING TO EVALUATE THE AGED MICROSTRUCTURE OF REFORMER FURNACE TUBES. João Rebello, M. Arenas, M.C.L. Areiza, L.H. Almeida, R. Sacramento, G.R. Pereira

Ref: 5420

MEASUREMENT OF RESIDUAL STRESSES IN WELDED ELEMENTS AND STRUCTURES BY ULTRASONIC METHOD. Yuri Kudryavtsev, Jacob Kleiman, Lana Potapova

Ref: 5447

MINIATURIZED SAMPLES CREEP TEST AS A NON DESTRUCTIVE SOLUTION. Heloisa Furtado, Fernanda Santos, Luiz Almeida, Luisa Coutino

Ref: 5532

INFLUENCE OF SUPERALLOY CASTING STRUCTURE ON PROPAGATION OF ULTRASONIC WAVE. Jacek Nawrocki, Kamil Gancarczyk, Wojciech Manaj, Robert Albrecht, Rafal Cygan, Krzysztof Krupa, Jan Sieniawski

Ref: 5661

EVALUATION OF FATIGUE PROPERTIES OF NICKEL BASED SUPERALLOY MAR 247 WITH ALUMINIDE COATING AND CRACK DETECTION BY NON-DESTRUCTIVE TECHNIQUES. Dominik Kukla

**Symp: 21**

Ref: 5675

MACHINED SURFACE ANALYSIS AT HIGH CUTTING SPEED USING CARBIDE DRILL IN A AL-SI ALLOY. Paulo S. Martins, José R.G. Carneiro, Gilmar C. Silva, Pedro P. Brito

**19:30-24:00****CONFERENCE BANQUET****Coliseu  
Micaelense**



**WEDNESDAY, 29 JULY 2015**

**08:00-12:00**

**POSTERS SESSION - 4**

**Lobby**

TOPICS: L, M, N ; SYMPOSIA: 3, 4, 13, 18, 20, 22, 24, 29, 31

**Symp: L, M & N**

Ref: 5378

CFD CONTRIBUTION TO OPTIMIZE THE LOCATION OF POLLUTANT EQUIPMENT IN VENTILATED ROOMS. Rui Pitarma, Miguel Lourenço, João Ramos

Ref: 5656

EVALUATION OF THE EFFECTS OF HIGH SPEED TRUCK CRASH INTO A BRIDGE COLUMN. Zdenek Vintr, Pavel Manas, Miroslav Vala

Ref: 5663

INTERACTION OF FLOWING LIQUID WITH DEFORMABLE BOUNDARY BY COUPLING SPH TO FE. Ludek Hyncik

Ref: 5657

NUMERICAL AND EXPERIMENTAL TESTING OF ANTI SHOCK PANELS. Grzegorz Slawinski, Tadeusz Niezgodna, Pawel Dziewulski, Pawel Bogusz, Marek Swierczewski

Ref: 5658

NUMERICAL AND EXPERIMENTAL TESTING OF SELECTED CRASH CUSHION AND ROAD BARRIER. Tadeusz Niezgodna, Pawel Dziewulski, Wieslaw Barnat, Andrzej Kiczko, Grzegorz Slawinski, Slawomir Dzieńis

Ref: 5514

ANALYSIS ON DYNAMIC BALANCE OF SUSPENDED BASKET IN CENTRIFUGAL TEST WITH CUBICAL CONTAINER. Shenglai Chen, Changchun Zhu

Ref: 5515

MECHANICAL PROPERTY RESEARCH OF DIFFERENT MATERIAL AND DIFFERENT SECTION SHAPE SUPPORTING RING. Zhang-hua Tang, Sheng-lai Chen

Ref: 5570

QUALITATIVE ANALYSIS ON THE PROTECTION OF INDUSTRIAL DESIGN IN EUROPE. Lourdes Liso

**Symp: 3 & 4**

Ref: 5513

A PIEZOELECTRIC BERNOULLI-EULER BEAM THEORY CONSIDERING MODERATELY CONDUCTIVE AND INDUCTIVE ELECTRODES. Juergen Schoeffner, Gerda Buchberger

Ref: 5604

ANAYSIS OF UNSTEADY OPERATION OF AIRCRAFT ENGINES AFTER SUCTION OF GUNPOWDER COMBUSTION GAS FROM MISSILE ENGINES.

Mirosław Kowalski

**Symp: 13 & 18**

Ref: 5629

RECONSTRUCTING STENOTIC CAROTID MODELS FROM ULTRASOUND IMAGES. Helena Henriques, Catarina Castro, Luisa Costa, Carlos C. António, Rosa Santos, Pedro Castro, Elsa Azevedo

Ref: 5651

EFFECT OF ANNEALING ON THE CORROSION RATE OF A NOVEL METALLIC AMALGAMATE FOR BIODEGRADABLE STENTS. Jennifer Frattolin, Luca Gottellini, Ranjan Roy, Olivier Bertrand, Rosaire Mongrain

Ref: 5366

INTRINSIC MECHANICAL PARAMETER ANALYSIS IN DIFFERENT SCAFFOLDS FOR CARTILAGE TISSUE ENGINEERING. Cátia Bandejas, António Completo, António Ramos

Ref: 5709

COMPOSITE MATERIALS AND BOVINE CORTICAL BONE DRILLING: THERMAL EXPERIMENTAL ANALYSIS. Maria Fernandes, Elza Fonseca, Renato N. Jorge, Mário Vaz, Maria Isabel Dias

**Symp: 20 & 24**

Ref: 5386

REPLACEMENT OF AN OLD CHP FOR A NEW ONE ON THE TOURISTIC SECTOR: ENERGETIC AND ECONOMIC ANALISYS. Clito Afonso

Ref: 5414

COMPARATIVE STUDY OF THE LEARNING PROCESS BETWEEN A COLD AND A HOT ENVIRONMENT. Mário Talaia, Marta Silva

**Symp: 22, 29 & 31**

Ref: 5393

NOVEL CERAMIC TILES PRODUCED WITH WOOD WASTE. Rui Novais, M.P. Seabra, João Labrincha

Ref: 5628

TENSILE STRENGTH OF PINE AND ASH WOODS - EXPERIMENTAL AND NUMERICAL STUDY. Débora Ferreira, Elza Fonseca, Cristiana Pinto, Paula Borges

Ref: 5711

BALANCED SUMMATION MODEL FOR THE CALCULATION OF THE FIRE RESISTANCE OF PARTIALLY ENCASED STEEL SECTIONS: NEW PROPOSALS.

Paulo Piloto, David Almeida, Ana Ramos-Gavilan, Luís Mesquita

Ref: 5743

TIMBER COVERED BRIDGES ON THE SLOVAK TERRITORY. Ivan Balaz, Zuzana Kamenicka, Yvona Kolekova

**08:45-09:30**

**KEYNOTES SESSION - 3**

**Serreta & Auditorium**

<b>A</b> <i>(Room: Serreta-1)</i> <i>Chair: Prof. Mário Vaz (U.Porto, Portugal)</i>	<b>B</b> <i>(Room: Auditorium)</i> <i>Chair: Prof. S.A. Meguid (U. Toronto, Canada)</i>
<p>Professor J.C. Reis Campos (University of Porto, Portugal)</p> <p><b>MECHANICS AND MATERIALS APPLICATIONS IN PROSTHODONTICS AND DENTAL MEDICINE. CHALLENGES AND OPPORTUNITIES</b></p>	<p>Professor Han Xu (Unan University, China)</p> <p><b>CONVEX-MODEL-BASED NON-PROBABILISTIC UNCERTAINTY ANALYSIS AND RELIABILITY DESIGN FOR COMPLEX STRUCTURES</b></p>



09:30-11:00		PAPERS SESSION - 7					All Rooms
7A (Monchique-1) Symp-29 Chairs: Elza Fonseca & Débora Ferreira	7B (Monchique-2) Symp-3 Chair Rui C. Barros	7C (Urzelina-1) Symp-19 Chair João Rebello	7D (Urzelina-2) Topic-M Chair Wojciech Mocko	7E (Auditorium) Symp-13 Chairs: Luisa Sousa & Catarina Castro	7F (Serreta-1) Symp-22 Chair António Fiúza	7G (Serreta-2) Topic-L Chair Clito Afonso	
Ref: 5592 IMPLEMENTATION OF NON-METALLIC MEMBRANES INTO STEEL SUPPORTING STRUCTURES. David Jermoljev, Josef Machacek	Ref: 5401 THE NETWORK DYNAMIC STABILITY OF FLOATING AIRPORT WITH FLEXIBLE CONNECTORS BASED ON AMPLITUDE DEATH MECHANISM. Daolin Xu, H.C. Zhang, S.Y. Xia, E.R. Qi, J.J. Hu, Y.S. Wu	Ref: 5370 GAMMA-RADIATED POLYETHYLENE ANALYZED BY ULTRASONIC NDE. Carla Marinho, Rafael Freitas, João Rebello, Marysilvia Costa, Celio Costa	Ref: 5363 APPLICATION OF THE DIGITAL IMAGE CORRELATION METHOD FOR DETERMINING TRUE STRESS-STRAIN CURVES OF COMMERCIAL PURE TITANIUM UNDER DYNAMIC LOADING CONDITIONS. Wojciech Mocko, Adam Brodecki	Ref: 5430 EXPLORING ULTRASOUND IMAGES OF THE CAROTID ARTERIES USING NEURAL NETWORK TOOLS. Catarina Castro, Carlos C. António, Luisa Sousa, Helena Henriques, Rosa Santos, Pedro Castro, Elsa Azevedo	Ref: 5373 NOVEL CERAMIC PRODUCTS BASED ON INDUSTRIAL WASTES. L. Buruberrí, Rui Novais, M.P. Seabra, João Labrincha	Ref: 5365 EXPERIMENTAL STUDY AND ENERGY BALANCE CALCULATION OF VENTILATED CERAMIC TILE ROOF IN MEDITERRANEAN CLIMATE. João Ramos, Luis Almeida, Rui Pitarma	
Ref: 5599 FIRE RESISTANCE OF CELLULAR WOODEN SLABS WITH RECTANGULAR AND CIRCULAR PERFORATIONS. David Couto, Elza Fonseca, Paulo Piloto, Jorge Meireles, Luisa Barreira, Débora Ferreira	Ref: 5408 ANTI-CONTROLLING NEIMARK-SACKER BIFURCATION IN A TYPE OF CENTRIFUGAL GOVERNOR SYSTEM UNDER WEAK IMPULSE EXCITATION. Huidong Xu, Guilin Wen, Zengyao Lv, Shan Yin	Ref: 5419 HIGH TEMPERATURE STRAIN GAGES USES FOR RESIDUAL LIFE PREDICTION. Fernanda Santos, Heloisa Furtado, Luiz H. Almeida	Ref: 5379 DYNAMIC RESPONSES OF AN INDIVIDUAL RDX ENERGETIC PARTICLE IN RESPONSE TO IMPACT LOADING. Yan-Qing Wu, Mingyang Wang, Fenglei Huang, Ming Huang	Ref: 5589 DEVELOPMENT OF A NOVEL BIODEGRADABLE METALLIC STENT USING COLD SPRAY. Rosaire Mongrain, Rajib Barua, Jennifer Frattolin, Luca Gottelini, Stephen Yue, Olivier Bertrand	Ref: 5496 RECYCLING OF Nd-Fe-B SINTERED MAGNETS USING HDDR PROCESS. Mateusz Szymanski, Bartosz Michalski, Marcin Leonowicz, Zbigniew Miazga	Ref: 5501 THE EXPLOITATION OF ULTRA LOW-ENTHALPY GEOTHERMAL ENERGY IN ORC PROCESS IN COMBINATION WITH RES AND HEAT PUMP. Urska Novosel, Jurij Avsec, Ivana Trselic, Sonja Novak	
Ref: 5627 FIRE BEHAVIOUR OF TABIQUE WALL - EXPERIMENTAL AND NUMERICAL STUDY. Débora Ferreira, Alexandre Araújo, Elza Fonseca, Paulo Piloto	Ref: 5440 DESIGN OF A QUASI-ZERO-STIFFNESS ISOLATOR WITH CAM-RINGER-SPRING MECHANISM AND EXPERIMENTAL TESTS. Jiayi Zhou, Daolin Xu, Yi Wang	Ref: 5498 DAMAGE ASSESSMENT IN COMPOSITE LAMINATES: A FRACTAL APPROACH. Jorge Silva, João Matos, Stella Abreu, João Tavares, Luis Durão	Ref: 5453 THE PROTECTING DESIGN FOR BOMB-BORNE RECORDING APPARATUS. Jiaqiao Jiang	Ref: 5764 WALL SHEAR STRESS NUMERICAL STUDY OF PATIENT-SPECIFIC LEFT CORONARY BIFURCATION BASED ON COMPUTED TOMOGRAPHY. Sónia I.S. Pinto, João B.L.M. Campos	Ref: 5546 ADDED MASS EFFECTS ON THE NATURAL FREQUENCIES OF MARINE CURRENT TURBINE BLADES. Clara Tiago, J.A.C. Campos, João Baltazar	Ref: 5524 ADDED MASS EFFECTS ON THE NATURAL FREQUENCIES OF MARINE CURRENT TURBINE BLADES. Clara Tiago, J.A.C. Campos, João Baltazar	
Ref: 5686 CONSIDERATE SDT METHODS FOR SAFETY ASSESSMENT OF HISTORIC TIMBER. Milos Drdacky, Michal Kloiber	Ref: 5778 SEMI-ACTIVE CONTROL OF BUILDING STRUCTURES USING A NEURO-FUZZY CONTROLLER WITH ACCELERATION FEEDBACK. M. Braz-César, K. Oliveira, Rui C. Barros	Ref: 5613 MULTIFRACTAL ANALYSES OF WELD DEFECTS PATTERNS OBTAINED FROM D-SCAN IMAGES. Lindberg Gonçalves, Elineudo Moura	Ref: 5469 PERFORATION RESISTANCE OF ALUMINUM / POLYETHYLENE SANDWICH STRUCTURE. Ming-ming Xu, Guang-yan Huang, Shun-shan Feng, G.J. McShane, W.J.Stronge	Ref: 5608 BIOMECHANICAL STUDY OF CERVICAL SPINE WITH PATEOLOGY. Tatiana Teixeira, Luisa Sousa, Marco Parente, Renato Jorge, João Gonçalves, Rolando Freitas	Ref: 5558 EVALUATION OF MAIN ALUMINIUM ALLOYS IN NON-FERROUS FRACTION OF AUTO-SHREDDER RECYCLING PROCESS. Fernanda Margarido, Carlos Nogueira, R. Novais, F. Durão, Carlos Guimarães, Maria Trancoso, Paula Oliveira, Fátima Pedrosa, Ana Gonçalves	Ref: 5542 ECO-ENERGY ANALYSIS OF HYDROGEN PRODUCTION AND USE OF DISTRICT HEATING IN COMBINATION WITH SLOWENIAN NUCLEAR POWERPLANT. Jurij Avsec, Urska Novosel	
Ref: 5717 DETERMINATION OF CHARACTERISTIC VALUES IN NBR 7190: 1997 FOR DESIGN AND FIRE SAFETY IN WOOD MATERIALS: HITS AND MISSES. Carlos Matos	---	Ref: 5525 STRENGTH ANALYSIS OF COMPOSITE STRUCTURES USING FINITE FRACTURE MECHANICS. Pedro Camanho, Albertino Arteiro	Ref: 5534 EXPERIMENTAL RESULTS ON BALLISTIC PLATES WITH STRATIFIED ARAMID FABRICS. Catalin Pirvu, Lonena Deleanu, Simona Badea, Marcel Istrate	Ref: 5609 BIOMECHANICAL STUDY OF IDIOPATHIC SCOLIOSIS. Liliana Reis, Luisa Sousa, Marco Parente, Renato Jorge, João Gonçalves, Rolando Freitas	Ref: 5704 UTILIZATION OF WASTE MATERIALS TO IMPROVE ASPHALT MIXTURES PERFORMANCE. Sara Fernandes, Liliana Costa, Hugo Silva, Joel Oliveira	Ref: 5679 FLUID STRUCTURE INTERACTION MODELLING OF WIND TURBINE BLADES BASED ON COMPUTATIONAL FLUID DYNAMICS AND FINITE ELEMENT METHOD. Athanasios Kolios, Lin Wang	
Ref: 5742 LATERAL TORSIONAL STABILITY OF TIMBER BEAMS. Ivan Balaz, Yvona Kolekova	---	Ref: 5745 FRACTURE TOUGHNESS AND CRACK RESISTANCE CURVES IN THE LONGITUDINAL COMPRESSIVE FAILURE OF POLYMER COMPOSITES. Giuseppe Catalanotti, José Xavier, Pedro Camanho	Ref: 5770 EFFECT OF DAMAGES PROMOTED BY BENDING LOADS ON THE IMPACT STRENGTH. Ana P. Amaro, Paulo N.B. Reis, Maria A. Neto, José M. Cirne	---	---	---	



**11:30-13:00**

**PAPERS SESSION - 8**

**All Rooms**

<b>8A</b> <i>(Monchique-1)</i> Symp-31 Chairs: Paulo Piloto & Alberto Meda	<b>8B</b> <i>(Monchique-2)</i> Symp-4 Chair Rui C. Barros	<b>8C</b> <i>(Urzelina-1)</i> Symp-19 Chair João Rebello	<b>8D</b> <i>(Urzelina-2)</i> Topics – M&N Chair N. Alexopoulos	<b>8E</b> <i>(Auditorium)</i> Symp-18 Chair Pedro Martins	<b>8F</b> <i>(Serreta-1)</i> Symp-22 Chair António Fiúza	<b>8G</b> <i>(Serreta-2)</i> Symp-20 & 24 Chair Marta Silva
Ref: 5490 FIRE ANALYSIS OF REINFORCED CONCRETE PRECAST TUNNEL LINING CONSIDERING THE SPALLING EFFECT. N. Bettini, R. Felicetti, G. Lilliu, A. Meda, P. Riva	Ref: 5681 ANALYSIS AND DESIGN OF THE PRINCIPAL AUXILIARY TESTING STRUCTURE OF A TOWER TESTING STATION IN PORTUGAL - PART I. Fabio Paiva, Jorge Henriques, Rui C. Barros	Ref: 5642 QUANTITATIVE DETECTION OF CONTACT FAILURES IN COMPOSITES USING INFRARED THERMOGRAPHY AND THE RECIPROCITY FUNCTIONAL APPROACH. Luiz Abreu, Marcelo Colaço, Helcio Orlande, Carlos Alves	Ref: 5660 COMPARISON OF IMPACT BEHAVIOUR OF BUILDING STRUCTURAL STEELS OBTAINED BY TWO DIFFERENT SET-UPS USING SHPB TECHNIQUE. Leopold Kruszka, Wojciech Mocko	Ref: 5350 THE HUMAN UTERUS AS A SOFT BIOLOGICAL SHELL. Roustem Miftahof	Ref: 5705 A MECHANICAL ANALYSIS OF ASPHALT RECYCLED MIXTURES PRODUCED WITH HIGH RECYCLING RATES. Liliana Abreu, Joel Oliveira, Hugo Silva, Daniela Palha, Paulo Fonseca	Ref: 5413 CONFORT AREA FOR AN IMPROVED LEARNING PROCESS IN HOT ENVIRONMENT. Marta Silva, Mário Talaia
Ref: 5428 IMPACT OF MODEL UNCERTAINTY ON STEEL BEAM STRUCTURAL SAFETY EVALUATION FOR FIRE CONDITIONS. Mariusz Maslak	Ref: 5682 ANALYSIS AND DESIGN OF THE PRINCIPAL AUXILIARY TESTING STRUCTURE OF A TOWER TESTING STATION IN PORTUGAL - PART II. Fabio Paiva, Jorge Henriques, Rui C. Barros	Ref: 5664 EVALUATION OF ULTRASONIC DISSIMILAR BONDS BY ULTRASONIC TESTING IMMERSION METHOD: C-SCOPE MODE. H. Abdel-Aleem, S.A. Khodir	Ref: 5715 TEMPERATURE DEPENDENCY OF DYNAMICALLY LOADED POLYURETHANE FOAM. Eva Kasperek, Robert Scheidemann, Mike Weber, Holger Völzke	Ref: 5375 RUPTURE OF BREAST IMPLANTS: A MECHANICAL ANALYSIS MEASURED BY UNIAXIAL TENSILE TEST. Nilza Ramião, Pedro Martins, António A. Fernandes, Maria Barroso, Diana Santos	Ref: 5706 MECHANICAL ANALYSIS OF ASPHALT MIXTURES PRODUCED WITH WASTE PLASTIC MODIFIED BINDERS. Liliana M.B Costa, Sara Fernandes, Hugo Silva, Joel Oliveira, Ricardo Miranda	Ref: 5610 THERMAL MASS NUMERICAL STUDY - ANALYSIS OF SOME FACTORS INVOLVED AND THEIR IMPORTANCE. Hipólito Sousa, Fernando Sousa, Rui Sousa
Ref: 5640 THE BEHAVIOR OF OSB BOARD'S FIRE PROTECTION COATING UNDER THE NOMINAL FIRE. Petr Kuklik, Magdalena Charvatova	Ref: 5683 ANALYSIS AND DESIGN OF THE SECONDARY AUXILIARY TESTING STRUCTURE OF A TOWER TESTING STATION IN PORTUGAL - PART I. Fabio Paiva, Jorge Henriques, Rui C. Barros	Ref: 5695 MEASUREMENT OF THE FATIGUE CRACK DEPTHS IN ALUMINIUM PLATES. Artur L. Ribeiro, Helena G. Ramos, Jerónimo Pasadas, Tiago Jorge Rocha	Ref: 5441 FAILURE ANALYSIS OF MAIN LANDING GEAR IN CIVILIAN AIRCRAFT. Arie Bussiba, Meir Kendler	Ref: 5572 USING EVOLUTIONARY OPTIMIZATION TO DETERMINE THE MECHANICAL PROPERTIES OF BIOMATERIALS. Pedro Martins, Carla Roque, Renato Jorge	Ref: 5721 DUCTILITY IMPROVEMENT OF AL ALLOYS BY HETEROMORPHIC DIE EXTRUSION. Kiyotaka Matsuura, Toko Tokunaga	Ref: 5384 THE INFLUENCE OF THE LOCATION OF A THERMOELECTRIC COOLER SYSTEM ON REFRIGERATION CABINS UPON INSIDE AIR TEMPERATURES AND VELOCITIES. Clito Afonso
Ref: 5710 BENDING RESISTANCE OF PARTIALLY ENCASED BEAMS AT ELEVATED TEMPERATURE: ADVANCED CALCULATION MODEL. Paulo Piloto, David Almeida, Ana Ramos-Gavilan, Luís Mesquita	Ref: 5684 ANALYSIS AND DESIGN OF THE SECONDARY AUXILIARY TESTING STRUCTURE OF A TOWER TESTING STATION IN PORTUGAL - PART II. Fabio Paiva, Jorge Henriques, Rui C. Barros	Ref: 5701 USING A MOUSE IN ECT DETECTORS. Helena G. Ramos, Artur L. Ribeiro, Tiago J. Rocha, Dário J. Pasadas	Ref: 5529 3D FEM ANALYSIS OF PRECAST CONCRETE APARTMENT BUILDINGS UNDER MINING TREMORS: A CASE STUDY. Piotr Berkowski, Jacek Baranski	Ref: 5641 STEM CELLS MECHANICS ON REGENERATIVE PROCEDURES: A PRELIMINARY COMPUTATIONAL STUDY OF THE ACTIN NETWORK ACTIVE BEHAVIOUR. João p. Ferreira, Marco Parente, Renato N. Jorge	Ref: 5739 SUSTAINABILITY IMPROVEMENT OF A COMPOSITE MATERIALS - INDUSTRY THROUGH RECYCLING AND RE-ENGINEERING PROCESS APPROACHES. M.C.S. Ribeiro, António Fiúza, A.C.M. Castro, F.J.G. Silva, J.P. Meixedo, M.L. Dinis, M.R. Alvim	Ref: 5521 PREDICTION OF UNSTEADY SHEET CAVITATION ON MARINE CURRENT TURBINES WITH A BOUNDARY ELEMENT METHOD. João Baltazar, J.A.C. Campos
Ref: 5733 A PRELIMINARY INVESTIGATION ON THE FAILURE OF PRESTRESSED MEMBERS UNDER NATURAL FIRES. Natasa Kalaba, Patrick Bamonte, Roberto Felicetti	Ref: 5685 ANALYSIS AND DESIGN OF THE UNIVERSAL BASE OF A TOWER TESTING STATION IN PORTUGAL. Fabio Paiva, Jorge Henriques, Rui C. Barros	---	---	---	Ref: 5771 COMPOSITE BINDERS OF URBAN WASTE GLASS-METAKAOLIN CHEMICALLY ACTIVATED, EFFECT OF THE TYPE OF ALKALINE AGENT. D.E. Ortega-Zavala, L.Y. Gomez-Zamorano, J.I. Escalante-Garcia	---

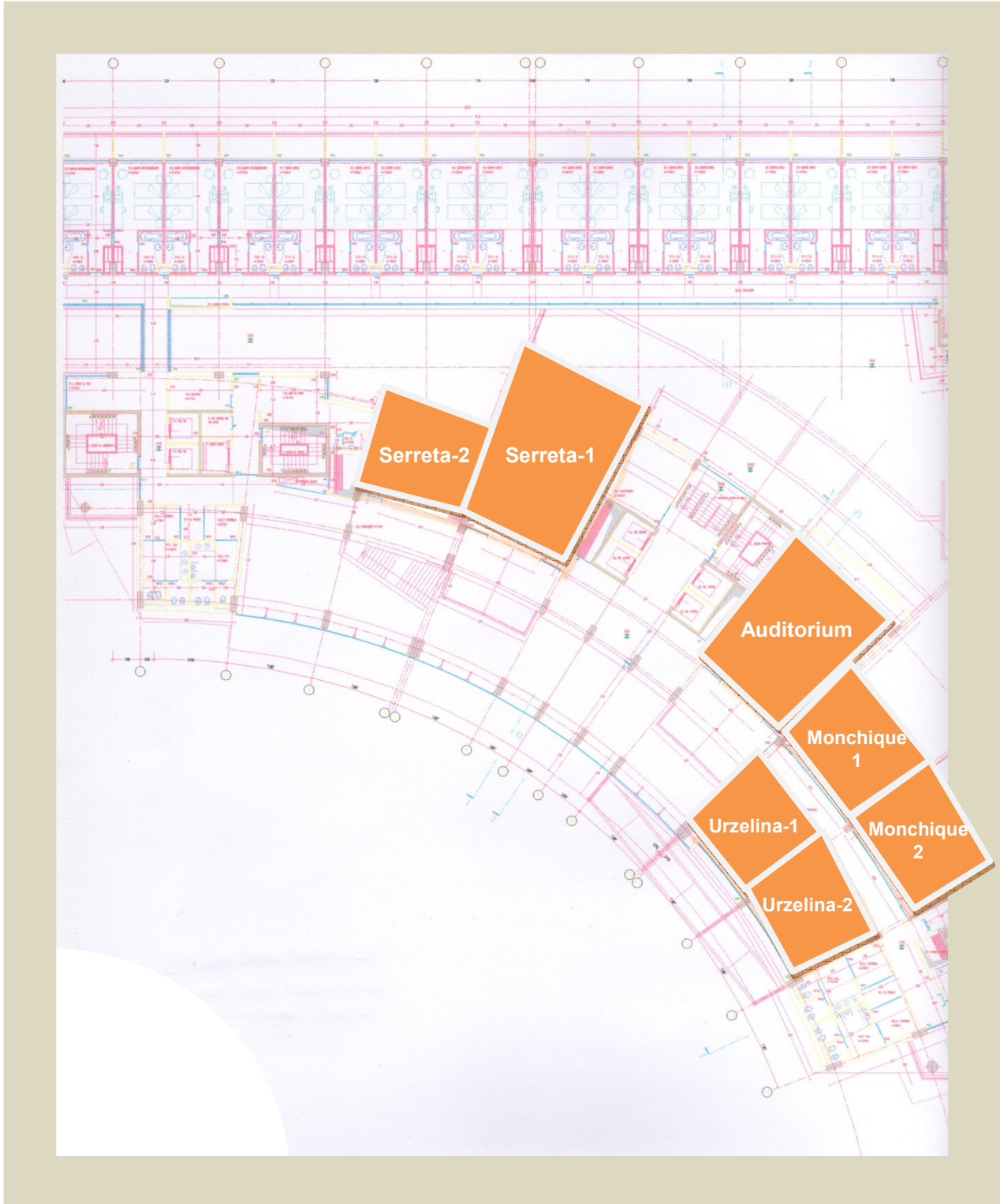
**13:00-15:00**

**LUNCH & CONFERENCE CLOSURE**

**VIP Restaurant**



**VIP Executive Azores Hotel  
(Floor-2)  
Location of M2D2015 conference Rooms**



# M2D2015 PROGRAM

P. Delgada, 26-30 July 2015

Time	SUNDAY 26 July	MONDAY 27 July	TUESDAY 28 July	WEDNESDAY 29 July	THUR 30 July													
08:00	EARLY-BIRD REGISTRATION	REGISTRATION	REGISTRATION & POSTERS SESSION (2) Topics: F, I / Symp: 5, 26	REGISTRATION & POSTERS SESSION (4) L, M, N / 3, 4, 13, 18, 20, 22, 24, 29, 31	TECHNICAL VISITS AND EXCURSIONS													
09:00		OPENING SESSION	KEYNOTE 1-A Prof. S.A. Meguid	KEYNOTE 1-B Prof. N. Umehra		KEYNOTE 2-A Prof. Peter Hess	KEYNOTE 2-B Prof. Ng Teng Yong	KEYNOTE 3-A Prof. J. Reis Campos	KEYNOTE 3-B Prof. Han Xu									
10:00		COFFEE-BREAK	COFFEE-BREAK	Session 7A (Symp-29)		Session 7B (Symp-03)	Session 7C (Symp-19)	Session 7D (Topic-M)	Session 7E (Symp-13)	Session 7F (Symp-22)	Session 7G (Topic-L)							
11:00		Session 1A (Topic-J)	Session 1B (Symp-02)	Session 1C (Topic-H)		Session 1D (Symp-10)	Session 1E (Symp-17)	Session 1F (Symp-25)	Session 1G (Symp-23)	Session 4A (Symp-28)	Session 4B (Topic-I)	Session 4C (Symp-05)	Session 4D (Symp-11)	Session 4E (Symp-17)	Session 4F (Topic-F)	Session 4G (Symp-26)		
12:00		COFFEE-BREAK	COFFEE-BREAK	Session 8A (Symp-31)		Session 8B (Symp-04)	Session 8C (Symp-19)	Session 8D (T-M+T-N)	Session 8E (Symp-18)	Session 8F (Symp-22)	Session 8G (S-20+S-24)							
13:00		LUNCH	LUNCH	LUNCH & CONFERENCE CLOSURE														
14:00		Session 2A (Topic-A)	Session 2B (Topic-B)	Session 2C (Topic-C)		Session 2D (Topic-D)	Session 2E (Symp-17)	Session 2F (Symp-25)	Session 2G (Symp-27)	Session 5A (Symp-12)	Session 5B (Topic-I)	Session 5C (Topic-G)	Session 5D (S-11 + T-K)	Session 5E (Symp-06)	Session 5F (Symp-21)	Session 5G (Symp-9)		
15:00		COFFEE-BREAK	COFFEE-BREAK	Session 3A (Topic-A)		Session 3B (Topic-B)	Session 3C (Topic-C)	Session 3D (Topic-D)	Session 3E (Symp-17)	Session 3F (Symp-25)	Session 3G (Symp-27)	Session 6A (Symp-12)	Session 6B (Topic-I)	Session 6C (Topic-G)	Session 6D (Topic-K)	Session 6E (void)	Session 6F (Symp-21)	Session 6G (Symp-9)
16:00		COFFEE-BREAK	COFFEE-BREAK	POSTERS SESSION (1) Topics: A, C, D, J / Symp: 2, 10, 17, 25, 27		POSTERS SESSION (3) Topics: B, G, H, K / Symp: 19, 21												
17:00		Session 3A (Topic-A)	Session 3B (Topic-B)	Session 3C (Topic-C)		Session 3D (Topic-D)	Session 3E (Symp-17)	Session 3F (Symp-25)	Session 3G (Symp-27)	Session 6A (Symp-12)	Session 6B (Topic-I)	Session 6C (Topic-G)	Session 6D (Topic-K)	Session 6E (void)	Session 6F (Symp-21)	Session 6G (Symp-9)		
18:00	POSTERS SESSION (1) Topics: A, C, D, J / Symp: 2, 10, 17, 25, 27	POSTERS SESSION (3) Topics: B, G, H, K / Symp: 19, 21																
19:00	WELCOME DINNER	CONFERENCE BANQUET																

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PAPER REF: 5355

## **ADDITIVE MANUFACTURING IN THE DEVELOPMENT OF AN INTRAMEDULLARY NAIL: STUDY OF CLINICAL CASE**

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### **ABSTRACT**

The additive manufacturing is currently an indispensable tool in different areas. Its application in orthopaedic area has been essential in the development of surgical procedures, visualization of anatomical structures and especially in the new implants design to improve the conditions for patients' treatment. The present study considered different techniques of additive manufacturing applied in design, diagnosis and planning of a locked intramedullary nail used in the femoral diaphysis fractures (type A). This study was complemented with the follow-up of a surgery case to the femoral diaphysis fracture. It was performed a biomechanical analysis using the finite element method and 3D models through a printing in full colour, allowing to obtain the colour levels related to von Mises stresses. All the studied techniques have proved to be important, since they allow a three-dimensional view of real dimensions of the implant by helping health professionals to do a more accurate and safe surgical planning.

**Keywords:** additive manufacturing, femur, fracture, locked interlocking nail, finite elements.

### **1 INTRODUCTION**

In orthopaedic surgery, the femoral diaphysis fractures are the most common occurrence. These surgeries are considered serious injury as result of violent forces and, most of the times derived from car or motorcycle accidents, road kill and falls from height, usually involving young adults (Poozzi, 2011).

There are different systems of classification which identify the types of fractures that can occur in a particular anatomical region or specific bone. This work was based on the classification system developed by Swiss Group AO, which includes the fractures classification of the long bones (Muller, 1991). The AO classification developed by Muller (Muller, 1991) organizes the fractures of each bone segment (proximal, middle and distal) in three different types (A, B and C), in accordance with the injury severity. Thus, simple fractures are classified in type A, wedge fractures are classified in type B and complex fractures are type C. The Figure 1 shows the three classifications.

Depending on the type of fracture, it is necessary to understand the best way of treatment to allow the creation of a biological environment that maximizes the normal processes of bone repair. The advances in technology allowed a wide variety of instruments, materials for implants and various techniques for the internal fixation of femoral diaphysis fractures.

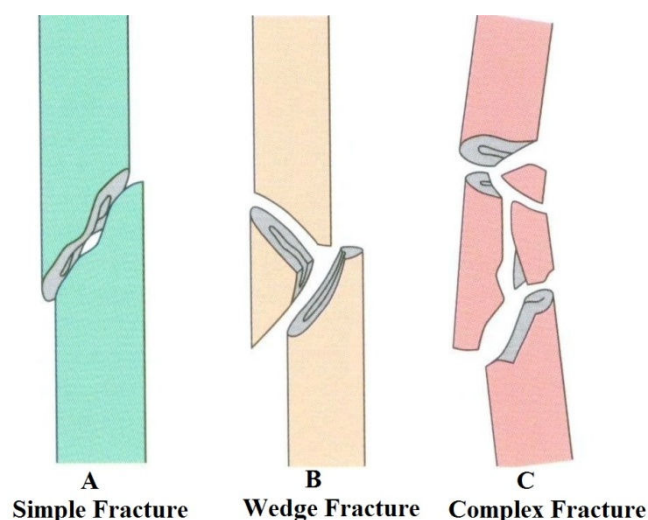


Fig. 1 - Type of fractures described by Muller (Muller, 1991)

The intramedullary fixation with intramedullary nail is one of the possible treatments for this type of fracture. These implants have a locking system through surgical screws that allow the intramedullary nail remains attached in the bone on the proximal and distal zone (Rodrigues, 2008; Stiffler, 2004). However, the main objective is to design an implant that decreases rehabilitation time and offers better results for patients. The additive manufacturing coupled to the medicine has proven to be a great tool in the improvement and planning of this type of surgeries (Costa, 2011). Through medical images in *DICOM* format, from a computed tomography (*CT*), it is possible to obtain three-dimensional (3D) digital models. After file image processing, it is possible to obtain physical models that allow the handling of patient anatomical parts and the surgical guides manufacture.

The main goal of this study was to evaluate the potential of the additive manufacturing technique in design, diagnostic and planning of implants used in femoral diaphysis fractures (type A). The study was complemented with the follow-up of a surgery case to the femoral diaphysis in a specialized Hospital from Brazil (Fernandes, 2013).

## 2 METHODOLOGIES OF STUDY

### 2.1 Study of clinical case

The accompanying a surgery case to the femoral diaphysis was performed to better understand all procedures used of this type of treatment. The followed surgery, was carried out in a male patient, which had an open fracture in the femoral diaphysis on the right lower limb, resulting from a motorcycle accident. The treatment of the fracture was performed through the intramedullary fixation with the insertion of an intramedullary nail of stainless steel, and opening of the medullary canal. The lock of intramedullary nail was performed with three locking screws, increasing the stability of fixation. In distal zone of femur, the lock was performed using two 3.5mm diameter screws, placed in parallel. The proximal locking was performed through the proximal guide and with a 6.5mm diameter screw placed in the diagonal position (Fernandes, 2013). The images presented in the Figure 2 show two x-rays exams of the patient before and after the insertion of the intramedullary nail. Following this treatment, the 3D physical solid model (biomodel) was performed to be used in numerical simulation, as close as possible to the real situation.



Fig. 2 - Femoral diaphysis fracture and post-operative (Hospital of Itabira, Brazil)

## 2.2 Description of Biomodel

Following the method used in the clinical case, a 3D model of the femur-implant-screws was created. The femur model was obtained from digital medical images (*DICOM*) of a computed tomography exam. The segmentation and the treatment of the interested regions were performed using the *InVesalius* program (Figure 3).

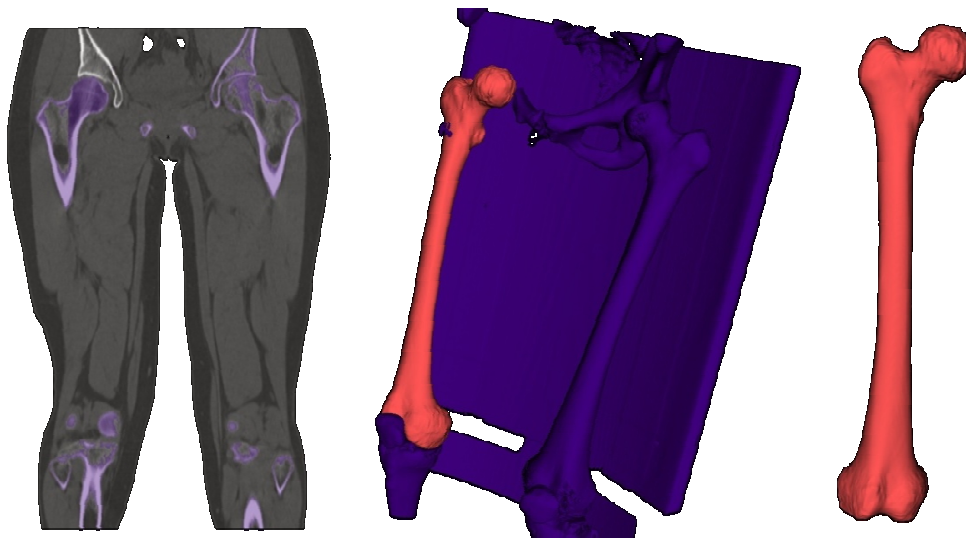


Fig. 1 Segmentation using *InVesalius* program

The *CAD* model of the intramedullary nail was built through *SolidWorks* program and with the same dimensions of the intramedullary nail used in the clinical case. Figure 4 shows the real intramedullary nail and the *CAD* model, with a diameter equal to 11mm and 360mm of length. The locking screws, without thread, two for the distal zone femur with 3.5mm of diameter and one for the proximal femur with 6.5mm of diameter, were also developed in *SolidWorks* program.



Fig. 4 - Intra-medullary nail and CAD model

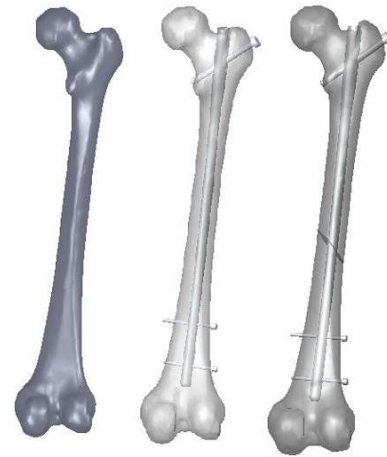


Fig. 5 - CAD Model: femur,  
femur-implant-screws

The *CAD* model of the intra-medullary nail was assembled with the femur biomodel. In *SolidWorks* program a simple fracture (type A) in the femur model was developed and also incorporated the locked intra-medullary nail and locking screws (Figure 5). The stresses analysis in this type of fractures was performed using the finite element method with the *Ansys* program (v14.5).

### 2.3 Finite Element Analysis of Biomodel

In the numerical analysis a 3D finite element (*Solid45*) was used (Figure 6). It was considered an elastic modulus equal to 210GPa for stainless steel material of the intra-medullary nail and screws (Rodrigues, 2008). The elastic modulus for femur bone was assumed equal to 21,1GPa (Currey, 2009). For all materials Poisson's ratio was 0.3. In this study, the numerical simulations were performed assuming a perfect contact among all materials. Considering that the patient has a body weight of 70kg, a compression force equal to 700N was applied on the femoral head at a distance of 40.5mm to the intra-medullary nail. The resulting forces from the muscular action were not considered and proceeded to the femoral fixation in the distal part (Figure 6). In this study was considered a static linear analysis and isotropic materials.

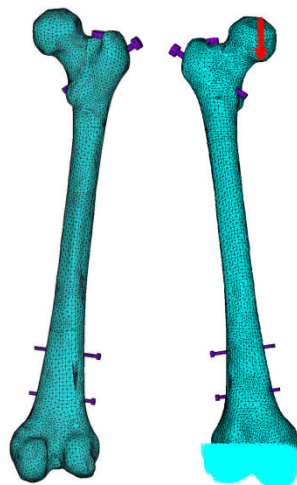


Fig. 6 - Finite element model and boundary conditions

The numerical analysis allowed to study the biomechanical effect of the intramedullary nail (stainless steel), the osteosynthesis of the fractured bone and the effect on the femoral diaphysis fracture, type A (Fernandes, 2013). The stresses in the biomodel were analysed before and after placing the intramedullary nail, Figures 7 and 8, respectively. The results are displayed in a colour scale, representing different levels of stresses. The analysis in the model was performed after the insertion of the intramedullary nail, at an early stage of osteosynthesis, which means that the fractured zone of the bone is represented by a continuous model in only some nodal points of the respective model. After analysis and interpretation of the von Mises stress distribution, it was observed that when the bone has a diaphysis fracture, there is a stress concentration with more critical values along the fracture zone (74MPa), creating instability along the all bone. The applied load in the femur head caused a bending moment along the diaphysis, which created compressive stresses of the medial side of the femur (shortening) and tensile stresses on lateral side (elongation).

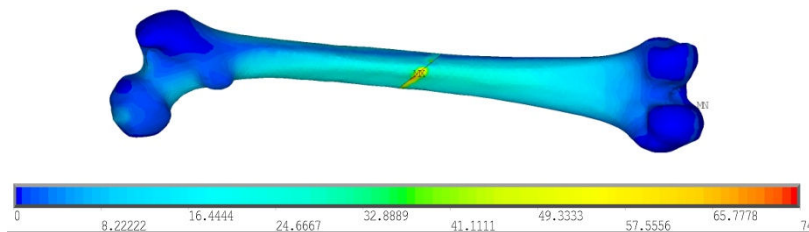


Fig. 7 - von Mises stresses (MPa) in biomodel without intramedullary nail

The insertion of the intramedullary nail caused a significant reduction of von Mises stresses in the femur model and also decreased the mechanical stresses in the bone. This fact allowed a greater stability along the bone, promoting its consolidation. After the intramedullary nail insertion, the fractured zone remains as the critical one but the von Mises stresses decreased (29MPa). Before placing the intramedullary nail in the fractured zone, a value equal to 74MPa was reached. In the external and adjacent areas to the fracture, there are lower values compared with the fractured zone, in the order of 17 MPa. Regarding the stresses obtained on the intramedullary nail, it is observed that the distribution along the intramedullary nail is relatively greater than in bone, around 80MPa.

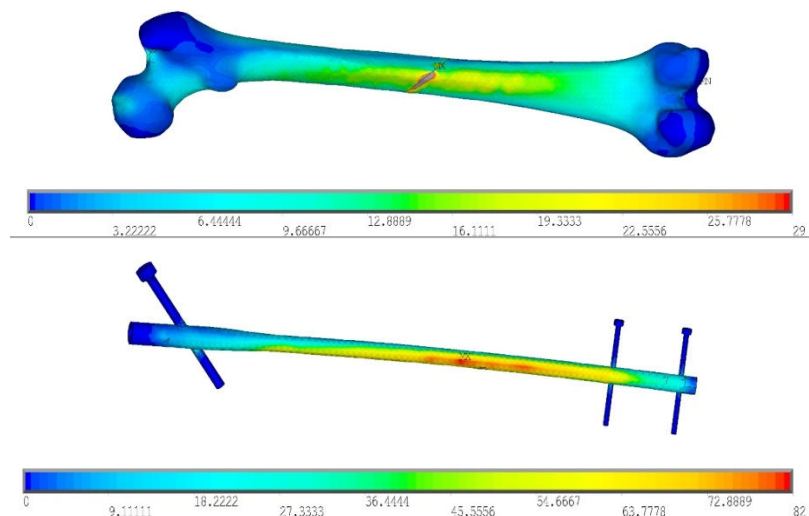


Fig. 8 - von Mises stresses (MPa) in femur-implant-screws, with simple fracture

The results obtained in this study were consistent with the results from Pauwels (Pauwels, 1980), which describes the concepts of load transfer within the bone. The placement of the intramedullary nail allowed the neutralization of the forces and prevented the shortening and lengthening generated along the femur.

### 3 RAPID MANUFACTURING OF THE INTRAMEDULLARY NAIL

There are various prototyping technologies that allow manufacturing physical models. The high speed with which these models are obtained in different materials and degrees of complexity allows to health professionals: reduction the time of surgical intervention, creation of custom tools, improve the dialog with the patients and explore the potentialities of custom prosthesis by additive manufacturing (Dvorak, 2006; Foggiato, 2006).

This study presents some additive manufacturing processes applied to the manufacture of a locked intramedullary nail and the set femur-implant-screws. Different processes were used with the purpose of evaluating the models and the manufacturing quality in the diagnosis and planning of implants placement. *CAD* models (intramedullary nail and femur-implant-screws) were converted in *STL* format for further production of physical models.

#### 3.1 Stereolithography

The Stereolithography (SL) was performed in the *Viper si2* equipment, from *3D* systems. In pre-processing stage, the intramedullary nail was put on a virtual platform in conjunction with supports to sustain it while was constructed, Figure 9. The manufacture was performed through the photopolymerization of an *epoxy resin*, resulting in a prototype with  $22.04\text{cm}^3$  of volume and with 131.655 layers of approximately 0.1mm thickness.

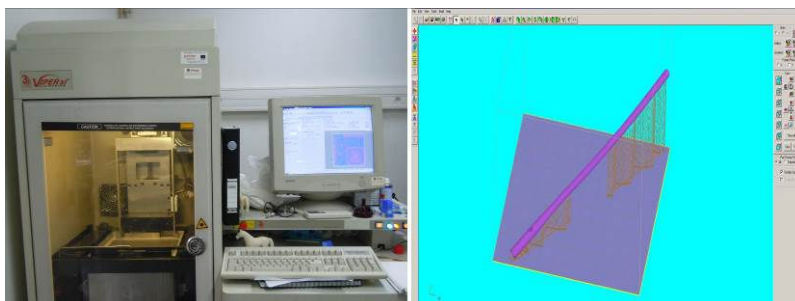


Fig. 9 - *Viper si2* equipment, creation of model and supports in virtual platform

After total construction of the model it was necessary to clean the prototype and remove all support material (Figure 10). The model was subsequently cured in an ultraviolet oven.

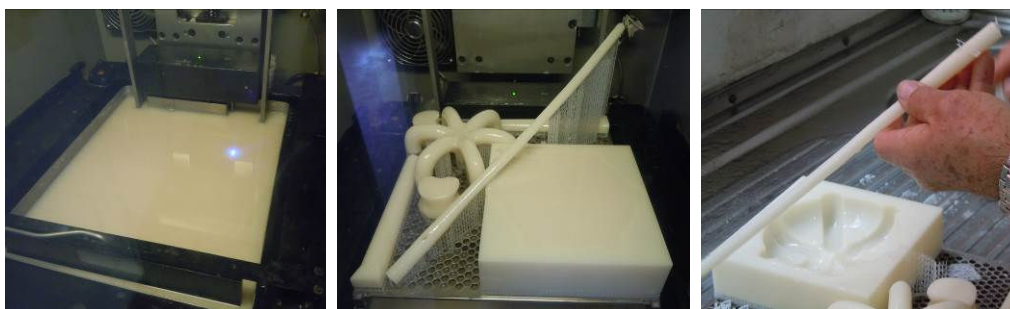


Fig. 10 - SL additive manufacturing and model finishing

The prototype was subjected to sanding operations to remove all imperfections and irregularities created by supports. Finally, the piece was painted to obtain an appearance similar to the real intramedullary nail (Figure 11). All process stages lasted approximately 540 minutes.



Fig. 11 - Painting and final model

### 3.2 Fused Deposition Modelling

The Fused Deposition Modelling (FDM) was performed in a *Fortus 250mc* equipment. The *Fortus 250mc* works with Insight software that allowed to build the virtual model of the intramedullary nail and the supports, Figure 12. The model was manufactured by extruding ABS polymer filaments (*ABS plus 430*) through a printing head. This polymer was heated (310°C) and melted when going through the printing head and each layer was deposited over the previous one melting it, partially, and becoming a continuous structure, with 20.37cm<sup>3</sup> of volume.

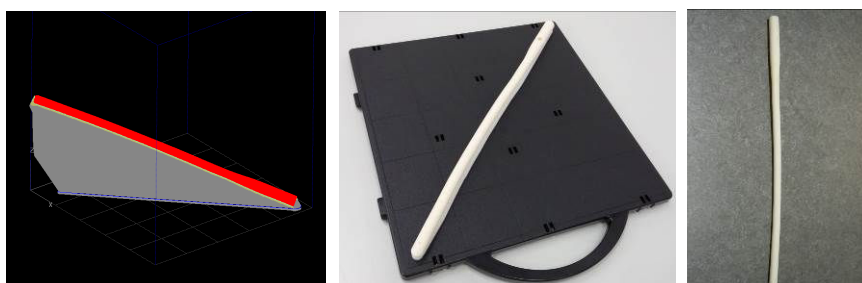


Fig. 12 - FDM additive manufacturing and final model

### 3.3 3D Printing

The 3D Printing (TDP) is an additive manufacturing that stands out because can produce monochrome and colour models, in reduced time and competitive costs.

In this study, two different 3D Printers were used: *Zprinter 310 Plus* and *Zprinter 650*, for building monochrome and colour models, respectively.

- **TDP Monochrome**

The model was built layer-by-layer with powder composite (*zp130*) bonded through an aqueous base binder (*zb58*). Figure 13 shows the several phases from model manufacturing, going from the layer impression until the cleaning of the residual dust. The cleaning

operations consist in the global remove of excess material by the compressed air action to obtain a rough surface. After that, model surface consolidation was done by applying the cyanoacrylate layer which strengthens the connection among particles and increase the mechanical resistance. The final prototype presented a  $22.04\text{cm}^3$  volume and 2234 layers, each one with  $0.0889\text{mm}$  thickness. The total duration of the procedure was approximately 90 minutes.

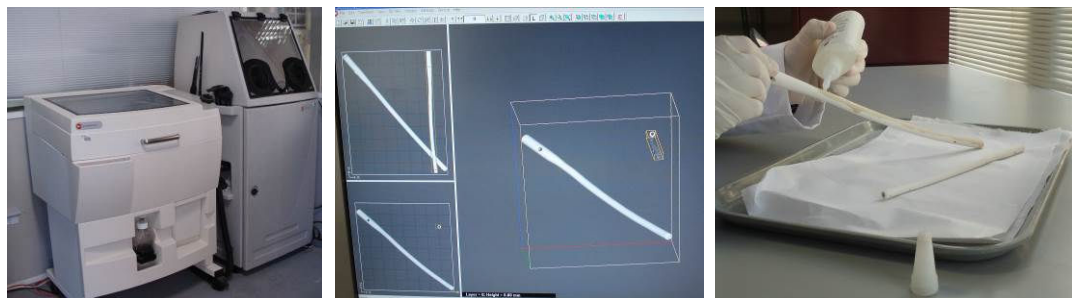


Fig. 13 - Main steps to fabricate the intramedullary nail using monochrome TDP

- **TDP Chromatic**

The TDP chromatic process was applied in the production of two models. This process was used to print the intramedullary nail and the femur-implants-screws, with the respective colour levels associated with the von Mises stresses. Through this printing process, a direct visualization and physical distribution of the stresses field throughout the model was possible, allowing the evaluation of the more critical regions in this type of orthopaedic surgeries. This technique was performed in a *Zprinter 650* equipment with a ceramic material. It is important to note that, unlike previous techniques, this process requires the conversion of the *3D CAD* file for the *VRML* format, in order to obtain models with colour. The models were manufactured with approximately 930 layers, each one with  $0.0875\text{mm}$  of thickness (Figure 14).



Fig. 14 - Main steps to fabricate the colour models



Fig. 15 - Models manufactured by colour TDP

As in the previous process, the models removed from the printing machine need a surface treatment based on the application of a cyanoacrylate resin (Figure 15). The total duration of the manufacturing process was approximately 450 minutes.

Table 1 presents the summary of the all different additive manufacturing processes and their characteristics used in this study.

Table 1 - Comparison of different additive manufacturing processes (Chua, 2010; Volpato, 2007)

RP Processes	SL	FDM	TDP	
			Monochromatic	Chromatic
Company	3D Systems	Stratasys	Zcorporation	
Equipment	Viper si2	Fortus 250mc	Zprinter 310 plus	Zprinter 650
Material	Epoxy resin	ABS plus 430	Zp 130 powder/ zb58 binder	Ceramic high- performance polymer
Format file	STL	STL	STL	VRML
Number of layers	131655	-	2234	930
Layer thickness, mm	0.10	0.18	0.0889	0.0875
Supports	Yes	Yes	No	No
Post processing	Yes. Post-cure oven and removal of supports	Yes. Removal of supports	Yes. Air jet and infiltration with resin	
Total time of manufacture (minutes)	540	217	90	450
Manufacture speed	Medium	Low	High	
Mechanical strength	Medium	Medium	Low	
Initial acquisition cost	High	Medium	Low	Medium
Material cost	High	Medium	Medium	Medium-high
Prototype cost	High	Medium-high	Low	Low-medium

## CONCLUSION

The additive manufacture applied in the medical area has been revealed to be essential powerful tool for visualization and direct manipulation of prototypes, offering several advantages, such as simulation, surgical planning and exposure of clinical case to the patient.

In this work, some additive manufacturing techniques available on the market were applied to manufacture a locked intramedullary nail and the femur-implant-screws. The application of these different techniques allowed to evaluate the final quality of each model, as well as the duration of the different procedures and the involved costs.

Through the numerical analysis of the femur-implant-screws, it was possible to visualize the distribution of von Mises stresses throughout the model and understand which regions considered most critical in this type of surgery. The addition of an intramedullary nail, in this type of situation, allows a load distribution, resulting always in the sharp decrease of the stresses in the bone, especially in the fracture region, promoting greater stability.

The colour printing of intramedullary nail and femur-implant-screws, allowed the actual view of physical models with the respective colours related to the involved stresses. All the discussed techniques are essential in orthopaedic area by 3D view, the real dimensions of the implant and the intended location for the placing, helping health professionals for a more accurate and safe surgical planning.

## ACKNOWLEDGMENTS

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