

RECENT ADVANCES IN INTEGRITY-RELIABILITY-FAILURE

J.F. Silva Gomes, Shaker A. Meguid
Editors



Proceedings of the 4th International Conference on Integrity, Reliability and Failure, Funchal, Portugal, 23-27 June 2013

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About the Book

Innovative engineering in mechanics, materials and systems have witnessed the most significant progress in recent years. Important and dramatic improvements in component design will continue to be made by the use of the latest advances in mechanics, materials and manufacturing processes. Different tools are available to optimize any engineering solution, and we must continue our efforts to develop and use superior materials, apply reliable analytical and numerical techniques and validate these with sound experimental methods. During the last few decades the development of computer based techniques, as well as laser-optics methods, nanotechnologies and nanomaterials, among many other technological advances, added new dimension and perspectives to minimize or prevent catastrophic failures of engineering systems, structures and components.

This volume contains the extended Abstracts of the 380 papers accepted for presentation in the IRF2013-4th International Conference on Integrity, Reliability and failure held in Funchal/Portugal, 23-27 June 2013. The book is complemented by an accompanying CD-ROM containing the full length papers.

IRF2013 is part of a prestigious series of conferences that was initiated in 1999, in Porto (Portugal), coordinated by the International Scientific Committee on Mechanics and Materials in Design. The conference attracted over 300 participants with 380 accepted submissions from 45 different countries around the world. These papers were presented in June 23-27, 2013 in the magnificent city of Funchal, Madeira, and the conference themes focused on nanoengineering, computational and structural mechanics, micromechanics, experimental mechanics, advanced materials, thermo-fluid systems and case studies, among other engineering topics.



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Editors

J.F. Silva Gomes and Shaker A. Meguid

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TABLE OF CONTENTS

Preface		xxvii
International Scientific Committee		xxviii
Organizing Committee and Secretariat		xxix
Acknowledgments		xxx
List of Tracks and Symposia		xxxii
A. KEYNOTE PAPERS		1
3501-KP	DYNAMIC CONTACT IN CONTINUA USING VARIATIONAL INEQUALITIES. <i>Shaker A. Meguid.</i>	3
3502-KP	RECENT DEVELOPMENTS ON MPM AND ITS APPLICATION IN IMPACT AND EXPLOSION SIMULATION. <i>Xiang Zhang.</i>	5
3503-KP	DESIGN FOR RELIABILITY AND MAINTAINABILITY. <i>E.A. Elsayed.</i>	7
3504-KP	ULTRA LOW FRICTION OF AMORPHOUS CARBON NITRIDE WITH CONTROLLING NANO SURFACE STRUCTURE. <i>Noriyaga Uschiro.</i>	9
B. TRACKS / MAIN TOPICS		11
TRACK_A: ANALYTICAL AND NUMERICAL TOOLS		13
3892	VIBROACOUSTICS OF NEW GENERATION AVIATION ENGINES AND FLIGHT SAFETY. <i>V. Baklanov.</i>	15
3895	PARAMETRIC EXCITATION OF PLATES WITH CUTOUTS. <i>A.K.L. Srinivasa.</i>	17
3903	GAS TURBINE HEALTH CLASSIFICATION USING A HYBRIDIZED OPTIMIZATION ALGORITHM. <i>Mike J.W. Riley, Michael Gallimore, Chris Dingham, Jill Stewart.</i>	19
4312	VIBRATION MODAL ANALYSIS OF ROLLING ELEMENT BEARING. <i>Elayed S. Elayed, Ahmed Elkhoch, Mostafa Youssef.</i>	21
4660	RELIABILITY ESTIMATION OF AIRCRAFT STRUCTURAL COMPONENTS WITH SELECTED FAILURE MODELS. <i>Noof Zurek, Henryk Tomaszek, Zbigniew Smolko, Marion Zaja.</i>	23
4681	THE CALIBRATION OF NONLOCAL COUPLED DAMAGE-PLASTICITY MODEL FOR DUCTILE METAL ALLOYS. <i>Alexander Krasinskiy, Jonathan P. Selman.</i>	25
4698	NEW CONCEPT DEVELOPMENT FOR CARRYING IDLERS MANUFACTURED THROUGH MECHANIC FORMING AND VALIDATED BY MATHEMATICAL MODELING. <i>Gilmar C. Silva, Thiago H.A. Souza, José R.G. Camargo.</i>	27
3822	BUCKLING AND POST-BUCKLING ANALYSIS OF THIN-WALLED STRUCTURES BASED ON LARGE ROTATION FIRST-ORDER SHEAR DEFORMATION THEORY. <i>S. Q. Zhang, R. Schmidt.</i>	29
3963	MATHEMATICAL MODELING OF A HIGH-SPEED DEFORMATION OF A VISCOPLASTIC PLATE. <i>Volodymyr Hutsyluk, Heorhii Salym, Ievgen Pasternak, Igor Turchyn.</i>	31

3999	COMPARATIVE ASSESSMENT OF FRP'S AND STEEL BARS APPLIED ON THE REINFORCEMENT OF CONCRETE STRUCTURES. Sérgio Pinho, Sara Nave, Sobel Rana, Raul Figueira, Luis Bragança, Ricardo Matos.	719
4011	VARIOUS CONTROL METHODS DEVELOPED FOR FIBRE- CONCRETE STRUCTURES. Leonard Holba, Petr Bilek.	721
4036	DEVELOPMENT AND MECHANICAL CHARACTERIZATION OF BIO-COMPOSITES FOR APPLICATION IN LIGHT-WEIGHT CONSTRUCTION. A. Alves, J. Veloso, S. Pinho, S. Rana, R. Figueira.	723
SYMP_27: STRUCTURAL HEALTH MONITORING OF ADVANCED STRUCTURES		725
3907	VIBRATION BASED HEALTH MONITORING AND DAMAGE DIAGNOSIS OF COMPOSITE BEAM STRUCTURE. Ekiner Jacob Joy, Arun Kumar Saha.	727
3911	IN-SITU STRUCTURAL INTEGRITY EVALUATION FOR A HIGH POWER PULSED SPALLATION NEUTRON SOURCE. Masaoaki Futakawa, Takashi Wakai, Makoto Teshigahara, Takashi Naga.	729
3924	A DSP SYSTEM APPLIED TO ELECTROMECHANICAL IMPEDANCE-BASED SHM ARCHITECTURE. Carlos A. Gallo, Amosio C. Oliveira Jr, Roberto M.F. Neto.	731
3990	IMPACT & DAMAGE LOCATION IN COMPOSITE STRUCTURES BY SPATIAL SIGNAL CORRELATION ANALYSIS. Jairo C. Vianna, Nelson J. Ferreira, Paulo J. Amores, Gustavo B. Dias.	733
4122	DEVELOPMENT OF INTELLIGENT HEALTH MONITORING SYSTEM FOR ROTATING MACHINERY AND STRUCTURAL COMPONENTS. A.A. Lakis, Ali Mahvash, M.H. Toorani.	735
4642	MODELING OF GUIDED WAVE INTERACTION WITH DISHONDS IN HONEYCOMB COMPOSITE SANDWICH PLATES SUBJECT TO PBT EXCITATIONS. Pol Chandrakant, Bhanoojee Sarvik.	737
SYMP_28: FIRE AND STRUCTURAL ENGINEERING		739
3890	FIRE ANALYSIS OF REINFORCED CONCRETE TUNNEL LINING. Giovanni Lillo, Alberto Moda.	741
3953	QUANTITATIVE EVALUATION OF FIRE SAFETY FACTORS INFLUENCE FOR BUILDINGS USING COGNITIVE MAPS AND ANP APPROACH. Gregoire Gindl, Markus Malak.	743
4041	FIRE BEHAVIOUR OF COMPOSITE STEEL TRUSS AND CONCRETE BEAM. Paulo A.G. Pilão, Sérgio P.P.A. Roque, Paulo M.M. Vila Real, Giovanni A. Pilozzi.	745
4653	FIRE RESISTANCE TEST AND THE CRITICALNESS OF CONCRETE SPALLING REGARDING SAFETY. Alexander Karim, Volker Weyrig.	747
4729	EXPERIMENTAL ANALYSIS OF REVERSE CHANNEL JOINT COMPONENT AT ELEVATED TEMPERATURES. Pedro Barata, Alina Santiago, João P. Rodrigues.	749
SYMP_29: METROLOGY, QUALITY CONTROL AND RELIABILITY		751
4640	INTEGRATION OF ROBUST DESIGN AND STATISTICAL PROCESS CONTROL (SPC). Helena V.G. Neves, José G. Roquejo.	753
4673	MANAGEMENT SYSTEM FOR MONITORING AND MEASURING EQUIPMENT. José Barradas.	755

EDITORS PREFACE

As the engineering community continues to cross the boundaries of known practices, materials and manufacturing techniques into the frontiers of new functional materials, environments and applications, the opportunities for catastrophic failures will inevitably increase. If our knowledge of how to engineer systems, structures and components to minimize or prevent catastrophic failure is to keep pace with modern manufacturing technologies, the demanding applications, and the intolerance of a safety conscious society, we must continue our efforts to develop and use superior materials, apply reliable analytical techniques and validate these with sound experimental tools. It is with this in mind that this series of conferences was organised.

The objectives of this gathering are to provide a forum for the discussion and dissemination of recent advances in assessing the integrity, reliability and failure of engineering structures, components, and assemblies, foster research in these areas, and promote international co-operation among scientists and engineers in the field. The goal is to enable concerned researchers and scientists from all over the world to exchange ideas on mechanics, materials and design as they relate to system integrity and reliability.

This fourth international conference, which is sponsored by the University of Porto, the University of Toronto and the University of Madeira, is part of a prestigious series of Integrity Reliability and Failure conferences coordinated by the International Scientific Committee on Mechanics and Materials in Design. The conference attracted over 300 participants with 380 accepted submissions from 45 different countries around the world. These papers were presented in June 23-27, 2013 in the magnificent city of Funchal, Madeira. The conference themes which address integrity, reliability and failure focused on Analytical and Numerical tools, Testing and Diagnostics, Surface and Interface Engineering, Sensors and Instrumentation, Tribology, Mechanical Design and Prototyping, Modes of Failure, Composite Materials, Nanotechnologies and Nanomaterials, Biomechanics, Energy and Thermo-Fluid Systems, Impact and Crashworthiness and Case Studies.

We are particularly indebted to the authors and special guests for their plenary lectures and presentations. Each of the more than 380 contributions offered opportunities for thorough discussions with the authors. We acknowledge all of the participants, who contributed with innovations, new research approaches, novel modeling and simulation efforts, and invaluable critical comments. We are also indebted to the outstanding plenary lecturers who highlighted the conference themes with their contributions: Professor Xiong Zhang (Tsinghua University, P. R. China), Professor E.A. Elshayed (Rutgers University, USA) and Professor Noritsugu Umezawa (Nagoya University, Japan). We also take this opportunity to thank the members of the International Scientific Committee and reviewers for their time and effort.

Last but by no means least, we offer our sincere gratitude to the symposia organisers for their contribution to the success of the event and the local organising committee for attending to many aspects of the conference demands. For all of them, we are truly very grateful.

Shaker A. Meguid and J.F. Silva Gomes

Funchal / Madeira, June 2013

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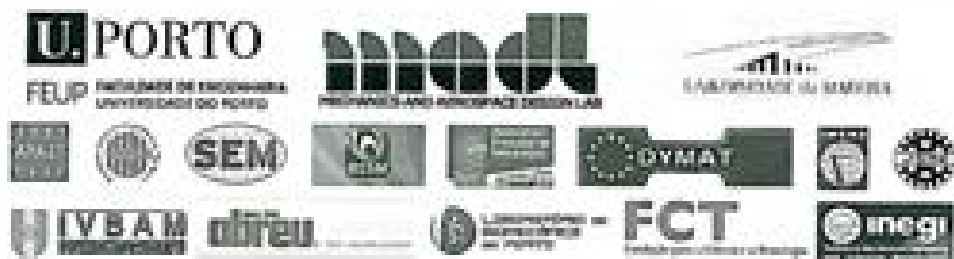
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APAET-Portuguese Association for Experimental Mechanics
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FIRE BEHAVIOUR OF COMPOSITE STEEL TRUSS AND CONCRETE BEAM

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ABSTRACT

This work compares the thermal behaviour on four different Composite Steel Truss and Concrete Beam (CSTCB), when submitted to two fire conditions (one side and four sides). This analysis aims to be a preliminary assessment of a series of experimental tests. CSTCB with pre-cast plate delay temperature evolution on the steel truss and reinforcement, increasing fire resistance.

Keywords: fire, numerical analysis, composite beam, steel truss and concrete.

INTRODUCTION

The prefabricated concrete trussed beams (CSTCB) are composite elements designed to resist to bending, consisting of a steel truss encased in concrete, casted in place, with different typologies and a steel base plate or pre-casted concrete plate, encased partially or totally in casted concrete. These beam elements present a wide variety of building solutions, being characterized by two constructive stages. The first stage considers the element made only by the self-supported steel truss, assuming the beam as simple supported. This structure is able to support its own weight and the weight of the slabs without any provisional supports. The design should follow the general rules for steel structures (CEN a, 2005). In the second stage, truss is encased by concrete and behaves similarly to a reinforced concrete (RC) beam (Quaranta et al., 2011).

Longitudinal reinforcement at the bottom and at the upper side depends in the chosen configuration. Usually two upper bars require one plane steel truss, while three or four upper rebars require two or three plane steel truss, respectively (Quaranta et al., 2011), see Figure 1.

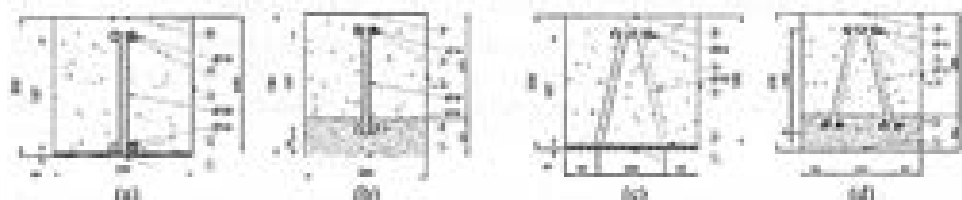


Fig. 1 - Different typologies to be analysed. (a) Type I steel plate; (b) Type I pre-cast plate; (c) Type II steel plate; (d) Type II pre-cast plate

These building elements have been widely used in Italy in particular for important structures (Leopoldo, 2009).

RESULTS AND CONCLUSIONS

A three-dimensional model was defined with unsteady nonlinear material thermal analysis to evaluate temperature on the CSTCR. The standard fire curve ISO 834 was applied in one side and in four sides, using the traditional convection and radiation parameters. The material behaviour was defined according to the European standards (CEN b, 2005; CEN, 2004).

Figure 2 represents a numerical comparison between the cross section type I (a) and type I (b) with fire from one side (bottom). There is a substantial difference between the temperature values of the bottom cord for the longitudinal reinforcement (see point 2 in Figure 1).

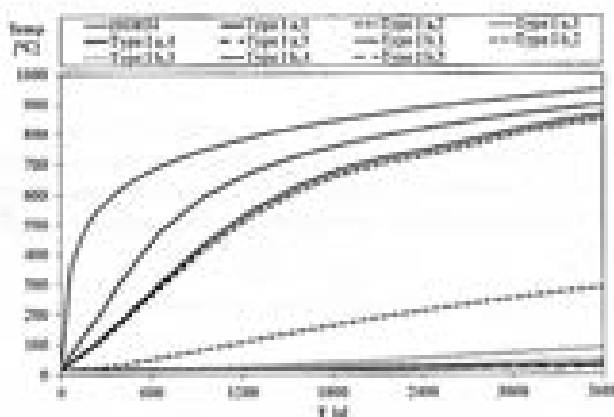


Fig. 2 - Numerical results for cross section Type I (a and b)

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