

Structural Integrity

Volume 8

Series Editors

José A. F. O. Correia, Faculty of Engineering, University of Porto, Porto, Portugal
Abílio M. P. De Jesus, Faculty of Engineering, University of Porto, Porto, Portugal

Advisory Editors

Majid Reza Ayatollahi, School of Mechanical Engineering, Iran University of Science and Technology, Tehran, Iran

Filippo Berto, Department of Mechanical and Industrial Engineering, Faculty of Engineering, Norwegian University of Science and Technology, Trondheim, Norway

Alfonso Fernández-Canteli, Faculty of Engineering, University of Oviedo, Gijón, Spain

Matthew Hebdon, Virginia State University, Virginia Tech, Blacksburg, VA, USA

Andrei Kotousov, School of Mechanical Engineering, University of Adelaide, Adelaide, SA, Australia

Grzegorz Lesiuk, Faculty of Mechanical Engineering, Wrocław University of Science and Technology, Wrocław, Poland

Yukitaka Murakami, Faculty of Engineering, Kyushu University, Higashiku, Fukuoka, Japan

Hermes Carvalho, Department of Structural Engineering, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

Shun-Peng Zhu, School of Mechatronics Engineering, University of Electronic Science and Technology of China, Chengdu, Sichuan, China

The *Structural Integrity* book series is a high level academic and professional series publishing research on all areas of Structural Integrity. It promotes and expedites the dissemination of new research results and tutorial views in the structural integrity field.

The Series publishes research monographs, professional books, handbooks, edited volumes and textbooks with worldwide distribution to engineers, researchers, educators, professionals and libraries.

Topics of interested include but are not limited to:

- Structural integrity
- Structural durability
- Degradation and conservation of materials and structures
- Dynamic and seismic structural analysis
- Fatigue and fracture of materials and structures
- Risk analysis and safety of materials and structural mechanics
- Fracture Mechanics
- Damage mechanics
- Analytical and numerical simulation of materials and structures
- Computational mechanics
- Structural design methodology
- Experimental methods applied to structural integrity
- Multiaxial fatigue and complex loading effects of materials and structures
- Fatigue corrosion analysis
- Scale effects in the fatigue analysis of materials and structures
- Fatigue structural integrity
- Structural integrity in railway and highway systems
- Sustainable structural design
- Structural loads characterization
- Structural health monitoring
- Adhesives connections integrity
- Rock and soil structural integrity

Springer and the Series Editors welcome book ideas from authors. Potential authors who wish to submit a book proposal should contact Dr. Mayra Castro, Senior Editor, Springer (Heidelberg), e-mail: mayra.castro@springer.com

More information about this series at <http://www.springer.com/series/15775>

Emmanuel E. Gdoutos
Editor

Proceedings of the Second International Conference on Theoretical, Applied and Experimental Mechanics

 Springer

Editor

Emmanuel E. Gdoutos
Office of Theoretical
and Applied Mechanics
Academy of Athens
Athens, Greece

ISSN 2522-560X

Structural Integrity

ISBN 978-3-030-21893-5

<https://doi.org/10.1007/978-3-030-21894-2>

ISSN 2522-5618 (electronic)

ISBN 978-3-030-21894-2 (eBook)

© Springer Nature Switzerland AG 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This volume contains 50 six-page papers and 16 two-page abstracts presented at the “Second International Conference on Theoretical, Applied and Experimental Mechanics” (ICTAEM_2) held in Corfu, Greece, June 23–26, 2019. The papers/abstracts are arranged in three topics and one special symposium with 35 and 31 papers/abstracts, respectively. The papers of the tracks have been contributed from open call, while the papers of the symposium have been solicited by Prof. Roman Kushnir to whom I am greatly indebted.

ICTAEM_2 will focus in all aspects of theoretical, applied, and experimental mechanics including biomechanics, composite materials, computational mechanics, constitutive modeling of materials, dynamics, elasticity, experimental mechanics, fracture, mechanical properties of materials, micromechanics, nanomechanics, plasticity, stress analysis, structures, and wave propagation.

The attendees of ICTAEM_2 will have the opportunity to interact with the most outstanding world leaders and get acquainted with the latest developments in the area of mechanics. ICTAEM_2 will be a forum of university, industry, and government interaction and exchange of ideas in an area of utmost scientific and technological importance.

I am sure that besides the superb technical program, the attendees of ICTAEM_2 will enjoy the majestic town of Corfu with its unique beaches and scenic beauty, many areas of historical interest and archeological importance, the delicious local cuisine, and the traditional Greek hospitality.

More than a hundred participants attended ICTAEM_2. The participants of ICTAEM_2 came from 18 countries. Roughly speaking 18% came from Europe, 17% from the Far East, 5% from the Americas, and 60% from other countries. I am happy and proud to have welcomed in Corfu well-known experts who came to discuss problems related to the analysis and prevention of failure in structures. The tranquility and peacefulness of this small town provided an ideal environment for a group of scientists and engineers to gather and interact on a personal basis. Presentation of technical papers alone is not enough for effective scientific communication. It is the healthy exchange of ideas and scientific knowledge, formal and informal discussions, together with the plenary and contributed papers that make a

fruitful and successful meeting. Informal discussions, personal acquaintance, and friendship play an important role.

I am proud to have hosted ICTAEM_2 in the beautiful town of Corfu and I am pleased to have welcomed colleagues, friends, old and new acquaintances.

I very sincerely thank the authors who have contributed to this volume, the symposium/sessions organizers for their hard work and dedication, and the referees who reviewed the quality of the submitted contributions. The tireless effort of the members of the Organizing Committee as well as of other numerous individuals, and people behind the scenes is appreciated. I am deeply indebted to Dr. Stavros Shiaeles for his hard work and dedication in the organization of the conference. Finally, a special word of thanks goes to Dr. Maria Shiaeles for her continuous collaboration and support.

Athens, Greece
March 2019

Emmanuel E. Gdoutos

Contents

Part I Materials: Properties, Manufacturing, Modelling

Role of Compactness on Hardness and Reduced Modulus of Vaterite Determined with Nanoindentation	3
Radek Ševčík and Vladimír Hrbek	
Approximate Mode Shape for Damped Structures	9
Wasiu A. Oke, Oluseyi A. Adeyemi, Kazeem A. Bello, and Adewale Adegbenjo	
Deformation Behavior of Ferrite/Austenite Duplex Stainless Steel in Hot Compression Processing	15
Hezong Li, Suxia Huang, Qiusheng Li, Xiaopin An, Facai Ren, and Simon S. Wang	
Material Strength Degradation Experiment and Statistical Expression Under Cyclic Loading	21
Liyang Xie, Hongyi Ma, and Guoliang Xu	
Study of Effect of Phase Separation on Pores Orientation of Electrospun Nanofibre	27
S. O. Alayande, E. O. Dare, J. N. Edokpayi, O. A. Adeyemi, Adewale Adegbenjo, and T. A. M. Msagati	
Deformation Model of $[\pm 45]_s$ Cross-Ply Fiber Reinforced Plastics Under Tension	29
V. N. Paimushin, R. A. Kayumov, D. V. Tarlakovskii, and S. A. Kholmogorov	
Segregation Resistance, Stiffness and Toughness of CNT Nanomodified Self Compacted Concrete	36
Myrsini Maglogianni, Panagiotis A. Danoglidis, Maria G. Falara, and Maria S. Konsta-Gdoutos	

High Temperature Creep Properties of Cast Cobalt-Based Superalloys: A Comparison	39
Marie Kvapilova, Vaclav Sklenicka, Petr Kral, and Jiri Dvorak	
Sub-grain Plastic Strain Localization in CoCrNi Medium Entropy Alloy at Cryogenic Temperatures	45
Wael Abuzaid and Luca Patriarca	
Effects of Treatment on Microstructure and Deformation Behavior of Dissimilar Welded Joint Between Single Crystal and Polycrystalline Superalloy	48
Yang Liu, Lei Wang, Xiu Song, Taosha Liang, and Guo Hua	
Improved Post-crack Energy Absorption Capability of Cementitious Composites Reinforced with CNTs and PPs	54
Panagiotis A. Danoglidis, Maria S. Konsta-Gdoutos, and Emmanuel E. Gdoutos	
Molecular Dynamics Investigation of Dislocation Slip in Pure Metals and Alloys	59
Alexander E. Mayer and Vasilij S. Krasnikov	
Development and Validation of 3D DIC Based Residual Stress Testing Method	65
Tomasz Brynk	
Monogenic Filtering Based Automatic Defect Detection from a Single Fringe Pattern	71
Rishikesh Kulkarni and Pramod Rastogi	
Enhanced Post-crack Load Carrying Capacity of Nano and Micro Scale Carbon Fiber Reinforced Mortars	75
Maria G. Falara, Maria S. Konsta-Gdoutos, and Emmanuel E. Gdoutos	
Two-Point Bending Stress Determination of Ultra-Thin Glass Plates ...	80
Po-Chi Sung, Wei-Chung Wang, and Yu-Wei Kuo	
Investigation of Grating Collimation of Coherent Gradient Sensing Technique	84
Po-Yu Chen and Wei-Chung Wang	
The Mechanism of Grain Boundary in Hydrogen Embrittlement of Inconel 690 Alloy	87
Lei Wang, Yang Liu, Cheng He, and Xiu Song	
Determining Object Motion by Digital Image Correlation Method with Camera-Array Composed Cameras of Normal Frame Rate	94
Chi-Hung Hwang, Tzu-Yu Kuo, and Wei-Chung Wang	

Part II Fracture

Configurational Stability of a Crack Propagating in Mixed-Mode I + II + III 101
 Jean-Baptiste Leblond, Alain Karma, Laurent Ponson, and Aditya Vasudevan

Limiting Equilibrium of Interfacial Shear Cracks at the Corner Point of the Media-Separating Boundary of the Piece-Homogeneous Isotropic Plane 106
 V. M. Nazarenko and A. L. Kipnis

An Approach to Analysis of Fracture of Semi-bounded Body Under Compressing Along Interfacial Near-Surface Crack 110
 V. L. Bogdanov and A. L. Kipnis

Fracture of Composite Material at Compression Along Near-Surface Crack 114
 Mykhailo Dovzhyk, Vyacheslav Bogdanov, and Vladimir Nazarenko

Statistical Distribution of Pores in Solid and Molten Metals at Dynamic Tensile Fracture 119
 Polina N. Mayer and Alexander E. Mayer

Fatigue and Deformation of Light Magnesium Alloys 126
 Daolun Chen

Part III Miscellaneous (Biomechanics, Computational Mechanics, Dynamics, Nanomechanics, Plasticity, Structures, Wave Propagation)

Research on Contact Pressure of Friction Pair Based on Finite Element Method 135
 Changlu Wang, Long Wu, Zichun Xu, Yaping Zhang, Hao Gao, and Yanzhong Wang

Noise and Vibration Analysis of a Flux Switching Motor (FSM) with Segmental Rotor 142
 Hedduri Sanket, M. N. Kishore, and Nagesh Suresh

Quenching of Non-stationary Wave Due to Structural Transformation of Material 148
 D. A. Indeitsev, B. N. Semenov, D. Yu. Skubov, and D. S. Vavilov

Algorithms for System Identification 154
 Todor Zhelyazov, Rajesh Ruphakety, and Simon Olafsson

Mechanics of Earthquake Source Processes: Insights from Numerical Modeling 156
 Nadia Lapusta

Strategies to Improve Convergence After Degeneration of the Initial Finite Element Mesh	159
Todor Zhelyazov	
Parametric Study of Simulated Randomly Rough Surfaces Used in Contact Mechanics	162
Rafael Schouwenaars, Miguel Ángel Ramírez, Carlos Gabriel Figueroa, Víctor Hugo Jacobo, and Armando Ortiz Prado	
Simplified Analysis of the Early Stage Self-loosening of a Shear-Loaded Bolted Joint	169
Vincent Rafik, Alain Daidié, Bertrand Combes, and Clément Chirol	
Wave Scattering by Arrays of Shear Bands	176
Davide Bigoni, Domenico Capuani, and Diana Giarola	
Dynamic Failure of Granular Slopes: Due to Unidirectional Stress Transfer or Multi-dimensional Wave Propagation?	182
Koji Uenishi and Tsukasa Goji	
Part IV Symposium on: “Dynamic Response of Elastic and Viscoelastic Solids Elastostatic and Elastodynamic Problems for Thermosensitive and Nonhomogeneous Solids Dynamic Problems in Mechanics of Coupled Fields,” by Roman Kushnir	
Heat-Active Circular Interphase Inclusion in the Conditions of Smooth Contact with Half-Spaces	187
Oleksandr Kryvyi and Yurii Morozov	
Unsteady Elastic Diffusion Oscillations of a Timoshenko Beam with Considering the Diffusion Relaxation Effects	193
O. A. Afanasieva, U. S. Gafurov, and A. V. Zemskov	
Interphase Inclusion and Crack in an Inhomogeneous Anisotropic Plane	199
Kostyantyn Arkhypenko and Oleksandr Kryvyi	
Phenomenological Model of Pseudo-Elastic-Plastic Material Under Nonstationary Combining Loading	205
Pavel Steblyanko, Yuri Chernyakov, Aleksandr Petrov, and Volodymyr Loboda	
Plane Scattering Problem for an Inclusion of Non-classical Shape with a Thin Interphase Layer	209
Roman Kushnir, Yaroslav Kunets, Valeriy Matus, and Oleksandr Trofymchuk	

Stress State in a Finite Cylinder with Outer Ring-Shaped Crack at Non-stationary Torsion 215
 Oleksandr Demydov and Vsevolod Popov

Determination by Iterative Method of Diffraction Field at the Interaction Longitudinal Shear Wave with the System of Thin Rigid Inclusions 222
 Vsevolod Popov

Stress State Near Arbitrarily Oriented Cracks on the Continuation of a Rigid Inclusion Under Action of Longitudinal Shear Wave 229
 A. S. Misharin and V. G. Popov

Stress State of a Hollow Cylindrical Body with a System of Cracks Under Oscillations of Longitudinal Shear..... 236
 Olga Korylova and Vsevolod Popov

The Wave Field of a Twice-Truncated Elastic Cone Under Torsion Moment Impact 242
 K. Mysov and N. Vaysfel'd

To the Solving of the Nonstationary Spatial Lamb—Cerutti Problem..... 248
 D. Prikazchikov, Yu. Protserov, and N. Vaysfeld

The Model of Thin Electromagnetoelastic Shells Dynamics 254
 V. A. Vestyak and D. V. Tarlakovskii

Unsteady Electro-Magneto-Elastic Axisymmetric Oscillations of a Continuous Cylinder of Infinite Length..... 259
 Vladimir Vestyak and Vasily Scherbakov

Transient Spatial Motion of Cylindrical Shell Under Influence of Non-stationary Pressure 264
 Grigory V. Fedotenkov, Dmitry V. Tarlakovskii, and Andrey Yu Mitin

Nonstationary Dynamic Problems for Elastic and Viscoelastic Piecewise Homogeneous Bodies 270
 Pshenichnov Sergey

The Wave Field of a Layer with a Cylindrical Cavity 277
 Anna Fesenko and Nataly Vaysfel'd

Features of Subsonic Stage of Contact Interaction of Viscoelastic Half-Plane and Absolutely Rigid Striker 283
 Ekaterina Korovaytseva and Dmitry Tarlakovskii

The Unsteady Contact Interaction Problem of an Absolutely Rigid Body and a Membrane..... 289
 Elena Yu Mikhailova, Grigory V. Fedotenkov, and Dmitry V. Tarlakovskii

Static and Dynamic Models of Bending for Elastic Sandwich Plates . . .	294
M. Yu. Ryazantseva and E. I. Starovoitov	
Analysis of Vibration Insulation Properties of a Plate in an Elastic Medium Under the Influence of Different Types of Waves	298
N. A. Lokteva and D. V. Tarlakovskii	
Studying of Influence of the Material Anisotropy on the Limit State of an Orthotropic Plate Weakened by a Periodic System of Collinear Cracks Under Biaxial Loading	304
Olga Bogdanova	
The Boundary-Element Approach to Modeling the Dynamics of Poroelastic Bodies	311
Leonid Igumnov, Svetlana Litvinchuk, Aleksandr Ipatov, and Tatiana Iuzhina	
Modeling Surface Waves on a Partially Saturated Poroelastic Half-Space	316
Leonid Igumnov, Svetlana Litvinchuk, Andrey Petrov, and Igor Vorobtsov	
Part V Symposium on: “Elastostatic and Elastodynamic Problems for Thermosensitive and Nonhomogeneous Solids” by Roman Kushnir	
Residual Strength and Reliability of Corroded Pipelines—Monte-Carlo Approach for Consideration of Spatially Nonuniform Material Properties	321
Alexey Milenin, Elena Velikoivanenko, Galina Rozyinka, and Nina Pivtorak	
Actual Problems of Structural Integrity Assessment of WWER-1000 Pressure Vessel Internals	327
O. V. Makhnenko and S. M. Kandala	
Vibration of Titanium Blades of Turbomachines for Nuclear Power Plants with Erosive Damage	334
Yurii Vorobiov, Oleg Makhnenko, Nataliia Ovcharova, and Anton Olkhovskiy	
Influence of Residual Stresses in the Cladding Zones of RPV WWER-1000 on Integrity Assessment	341
Oleh Makhnenko and Elena Kostenevich	

Part VI Symposium on: “Dynamic Problems in Mechanics of Coupled Fields,” by Roman Kushnir

Damping of Hydroelastic Vibrations of the Plate Using Shunted Piezoelectric Element. Part I: Numerical Model 351
Sergey Lekomtsev, Dmitrii Oshmarin, and Natalya Sevodina

Damping of Hydroelastic Vibrations of the Plate Using Shunted Piezoelectric Element. Part II: Experiment 357
Maksim Iurlov, Alexander Kamenskikh, Sergey Lekomtsev, and Dmitrii Oshmarin

Stationary Dynamic Acoustoelasticity Problems of a Thin Plate in a Perfect Compressible Fluid, Taking into Account the Dissipation of Energy in the Plate and Liquid 364
V. N. Paimushin, R. K. Gazizullin, and D. V. Tarlakovskii

Dynamics and Elastic Stability of an Electrostatically Actuated Microbeam Under Ultrafast Laser Pulse 370
A. V. Lukin, D. A. Indeitsev, I. A. Popov, O. V. Privalova, and L. V. Shtukin

Author Index 377