

# **Lecture Notes in Mechanical Engineering**

### *About this Series*

Lecture Notes in Mechanical Engineering (LNME) publishes the latest developments in Mechanical Engineering—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNME. Also considered for publication are monographs, contributed volumes and lecture notes of exceptionally high quality and interest. Volumes published in LNME embrace all aspects, subfields and new challenges of mechanical engineering. Topics in the series include:

- Engineering Design
- Machinery and Machine Elements
- Mechanical Structures and Stress Analysis
- Automotive Engineering
- Engine Technology
- Aerospace Technology and Astronautics
- Nanotechnology and Microengineering
- Control, Robotics, Mechatronics
- MEMS
- Theoretical and Applied Mechanics
- Dynamical Systems, Control
- Fluid Mechanics
- Engineering Thermodynamics, Heat and Mass Transfer
- Manufacturing
- Precision Engineering, Instrumentation, Measurement
- Materials Engineering
- Tribology and Surface Technology

More information about this series at <http://www.springer.com/series/11236>

Alexander Kravcov · Elena B. Cherepetskaya  
Vaclav Pospichal  
Editors

# Durability of Critical Infrastructure, Monitoring and Testing

Proceedings of the ICDCF 2016

 Springer

*Editors*

Alexander Kravcov  
Department of Construction Technology  
Czech Technical University  
Prague  
Czech Republic

Vaclav Pospichal  
Faculty of Civil Engineering  
Czech Technical University in Prague  
Prague  
Czech Republic

Elena B. Cherepetskaya  
MISiS  
National University of Science  
and Technology  
Moscow  
Russia

ISSN 2195-4356                      ISSN 2195-4364 (electronic)  
Lecture Notes in Mechanical Engineering  
ISBN 978-981-10-3246-2            ISBN 978-981-10-3247-9 (eBook)  
DOI 10.1007/978-981-10-3247-9

Library of Congress Control Number: 2016959396

© Springer Nature Singapore Pte Ltd. 2017

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, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This Springer imprint is published by Springer Nature  
The registered company is Springer Nature Singapore Pte Ltd.  
The registered company address is: 152 Beach Road, #22-06/08 Gateway East, Singapore 189721, Singapore

# Preface

The International Conference on Durability of Critical Infrastructure, Monitoring and Testing (ICDCF 2016) is a conference intended to be a forum for researchers in all related fields, in addition to those listed under the conference topics and case studies describing practical experiences as well. The conference is aimed at engineers, scientists, field researchers, managers and other specialists involved in the theoretical and practical aspects in the fields of safety, sustainability and durability of the critical infrastructure against impact of all hazards on a project of the objects of critical infrastructure: natural, criminal, terrorist, and accidental, that in fact is a multi-hazard approach for modern security design.

The topics of the conference include risk analysis and risk management; safety material engineering; integrated safety design process; natural disaster management; emergency response; critical infrastructure protection; risk analysis, assessment and management; diagnosing and testing of materials; new materials for safety engineering; modelling and experiments; construction safety and security; safety of users in evacuation; emergency and crisis management; explosive engineering; underground structures and tunnels; new standards on security engineering.

This issue contains selected papers from the ICDCF 2016, which took place in Šatov, a beautiful region of South Moravia, from December 6 to December 12.

Finally, as guest editors, we would like to express our sincere appreciation to the members of the editorial committee and the advisory board for giving an opportunity to work with us. We are grateful to all the authors and reviewers of the manuscripts, and especially Prof. Vladimír Křístek, Conference Chairman, for his valuable advice and his support team from the University of Defence in Brno.

We thank the generous support by National University of Science and Technology MISiS, Willenberg Foundation for their enthusiasm and help with the organization of the conference and we thank the office of the Springer Inc. for assistance with editorial matters.

Elena B. Cherepetskaya  
Vaclav Pospichal  
Alexander N. Kravcov

# Contents

<b>Study of the Internal Structure of Isotropic Pyrolytic Graphite by Broadband Ultrasonic Spectroscopy</b> . . . . .	1
Anton S. Bychkov, Elena B. Cherepetskaya, Adam Konvalinka, Alexander A. Karabutov, Alexander Kravcov, V.A. Makarov, Elena A. Mironova, and Nikolay A. Morozov	
<b>Assessment of Protective Structures on the Basis of Their Acceleration Caused by Blast Wave</b> . . . . .	8
Jiří Štoller and Branislav Dubec	
<b>The Possible Means Suggested for Improvement of Evaluation of Low Endurable Terrain</b> . . . . .	17
Klára Cibulova, Matouš Formanek, and Martin Priesner	
<b>Neural Networks in Back Analysis of Tunnels</b> . . . . .	27
Pruška Jan	
<b>Some Design Considerations of a Fire Within a Sub-surface Railway Switches and Crossings</b> . . . . .	35
Aaron McDaid and Nicole Hoffmann	
<b>Replacement of Permanent Bridges After Floods in 2013</b> . . . . .	47
Martin Benda	
<b>On Utility Assessment of Building Projects</b> . . . . .	56
Čeněk Jarský	
<b>Design Tool for Static Design and Evaluation of Steel, Wood, Concrete and Masonry Members in Buildings</b> . . . . .	65
Jan Holub and Pavel Maňas	

<b>Measurement of Residual Stresses in Alloys Using Broadband Ultrasonic Structuroscopy</b> . . . . .	75
Alexander A. Karabutov, Elena B. Cherepetskaya, Alexander Kravtsov, Vladimir A. Makarov, Elena A. Mironova, Dmitry V. Morozov, and Pavel Svoboda	
<b>Mathematical Formulation of Innovation of Production Process</b> . . . . .	82
Popenková Miloslava	
<b>The Influence of Subsoil on Electromagnetic Detection</b> . . . . .	91
Ondřej Kašpar	
<b>On Calculation of the Bearing Capacity of Self-opening Ground Anchors Using PLAXIS 2D Software Package</b> . . . . .	104
Ivan E. Sas, Dmitry V. Morozov, and Nikolay A. Morozov	
<b>Experimental Ballistic Loading of Steel Fiber Reinforced Concrete Slabs and Unreinforced Concrete Slabs by Plastic Explosives</b> . . . . .	110
Jiří Štoller and Petr Dvořák	
<b>Analysis of the Different Approaches to Protection of Critical Infrastructures in France and Slovakia</b> . . . . .	120
Figuli Lucia, Kavický Vladimír, and Picot Sylvain	
<b>Experimental Studies of Blast Pressure Due to Vented Explosion of Methane-Air System</b> . . . . .	129
Alexander N. Kravtsov, Jacob Zdebski, Vaclav Pospichal, and Petr Šelešovský	
<b>Theoretical Aspects of Critical Infrastructure Protection</b> . . . . .	139
Ladislav Hofreiter and Zuzana Zvaková	
<b>Different Approaches to Setting the Blast Load of Structure</b> . . . . .	148
Figuli Lucia, Jangl Štefan, and Picot Sylvain	
<b>Pressure Wave Propagation and Interaction with Structures</b> . . . . .	156
Zdeněk Hejmal	
<b>Laser-Ultrasound Imaging for the Investigation of Heterogeneous Media</b> . . . . .	166
Alexander A. Karabutov, Elena B. Cherepetskaya, Anton S. Bychkov, and Nikolay A. Morozov	
<b>Designing Military Constructions During Crisis Situation and New Elevation Data of the Czech Republic</b> . . . . .	173
Jan Sobotka and Klára Cibulová	
<b>Engineer Construction of Provisional Bridges in the Army of Czech Republic</b> . . . . .	183
Jindřich Holopírek and David Lysoněk	

<b>The Dynamic Modulus of Elasticity as an Important Parameter for Military Use of Constructions</b> . . . . .	191
Eva Zezulová	
<b>Design and Assessment of Shape of Protective Structure by Usage of CFD Software Environment Ansys Fluent</b> . . . . .	200
Jiří Štoller and Branislav Dubec	
<b>The Basic Properties of Materials Suitable for Protective Structures and Critical Infrastructure</b> . . . . .	211
Jiří Štoller, and Eva Zezulová	
<b>Laser-Ultrasonic Monitoring of the Critical Structure Objects Produced from CRFC</b> . . . . .	222
Alexander A. Karabutov, Elena B. Cherepetskaya, Yulia G. Sokolovskaya, Elena A. Mironova, Dmitry V. Morozov, and Pavel Svoboda	
<b>New Trends Used for Negotiation Untrafficable Terrain</b> . . . . .	230
Klára Cibulova and Jan Sobotka	
<b>The Protection of Critical Infrastructure Objects – Technical Principles</b> . . . . .	239
Pavel Maňas	
<b>Using of Intelligent Transport Systems to Elimination of the Negative Effect on the Transport Security</b> . . . . .	249
Michal Ballay, Lucia Figuli, and Zuzana Zvaková	
<b>Author Index</b> . . . . .	261