

Applied Methods of the Analysis of Static and Dynamic Loads of Structures and Machines

Edited by
Pavel Polach



TRANS TECH PUBLICATIONS



ISBN-13: 978-3-03835-413-0

Applied Mechanics and Materials Vol. 732

Electronically available at <http://www.scientific.net>

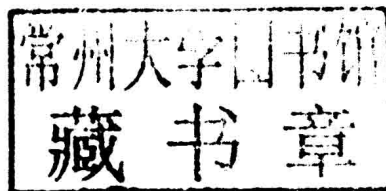
Applied Methods of the Analysis of Static and Dynamic Loads of Structures and Machines

Pavel Polach



Applied Methods of the Analysis of Static and Dynamic Loads of Structures and Machines

Special topic volume with selected papers from the
52nd International Scientific Conference on Experimental
Stress Analysis (EAN 2014),
June 2-5, 2014, Mariánské Lázně, Czech Republic



Edited by

Pavel Polach



Copyright © 2015 Trans Tech Publications Ltd, Switzerland

All rights reserved. No part of the contents of this publication may be reproduced or transmitted in any form or by any means without the written permission of the publisher.

Trans Tech Publications Ltd
Churerstrasse 20
CH-8808 Pfaffikon
Switzerland
<http://www.ttp.net>

Volume 732 of
Applied Mechanics and Materials
ISSN print 1660-9336
ISSN cd 1660-9336
ISSN web 1662-7482

Full text available online at <http://www.scientific.net>

Distributed worldwide by

Trans Tech Publications Ltd
Churerstrasse 20
CH-8808 Pfaffikon
Switzerland

Fax: +41 (44) 922 10 33
e-mail: sales@ttp.net

and in the Americas by

Trans Tech Publications Inc.
PO Box 699, May Street
Enfield, NH 03748
USA

Phone: +1 (603) 632-7377
Fax: +1 (603) 632-5611
e-mail: sales-usa@ttp.net

printed in Germany

Applied Methods of the Analysis of Static and Dynamic Loads of Structures and Machines

Edited by
Pavel Polach

Preface

The publication consists of selected conference papers from the 52nd International Scientific Conference on Experimental Stress Analysis (EAN 2014). The conference was held from the 2nd to the 5th June 2014 in Mariánské Lázně in the Czech Republic. The Conference was organized by Výzkumný a zkušební ústav Plzeň s.r.o. (Research and Testing Institute Plzeň) under the auspices of Mayor of Mariánské Lázně and Managing Director of the Research and Testing Institute Plzeň.

The conference with a long-term tradition is an opportunity to meet for specialists and professionals from universities, research institutes and industrial companies. Previous experience shows that the thematic scope comprising experimental stress analysis in machinery construction, building industry, biomechanics, verification of numerical and analytical solutions by experiments stimulates a wide exchange of opinions among the specialists from different branches close to topics of the conferences subject.

The publication includes the following issues:

- Residual stresses – measurement methods and analysis
- Development of experimental methods in mechanics
- Development of experimental methods in biomechanics
- New methods and application of deformation and stress analysis of machinery construction
- New methods and application of deformation and stress analysis of building and other constructions
- Experiment as a tool of verification of analytical and numerical methods
- Experimental research and prediction of construction and device strength, durability and reliability
- Monitoring the operational load and operational state of constructions and devices
- Methods and instruments for the teaching of experimental methods

On behalf of the Conference Scientific and Organizing Committees



Pavel Polach

Conference Scientific Committee

Chairman

- Pavel Polach (Research and Testing Institute Plzeň)

Members

- Karel Doubrava (Czech Technical University in Prague)
- František Fojtík (VŠB – Technical University of Ostrava)
- Nikolaj Ganev (Czech Technical University in Prague)
- František Holešovský (Jan Evangelista Purkyně University in Ústí nad Labem)
- Stanislav Holý (Czech Technical University in Prague)
- Lubomír Houfek (Brno University of Technology)
- Miroslav Hrabovský (Palacký University Olomouc and AS CR)
- Josef Jíra (Czech Technical University in Prague)
- Aleš Lufinka (Technical University in Liberec)
- Jozef Melcer (University of Žilina)
- Tomáš Návrat (Brno University of Technology)
- Pavel Padevět (Czech Technical University in Prague)
- Luboš Pazdera (Brno University of Technology)
- František Plánička (University of West Bohemia in Pilsen)
- Milan Růžička (Czech Technical University in Prague)
- Josef Soukup (Jan Evangelista Purkyně University in Ústí nad Labem)
- Libor Topolář (Brno University of Technology)
- František Trebuňa (Technical University of Košice)
- Jaroslav Václavík (Research and Testing Institute Plzeň)
- Miloš Vlk (Brno University of Technology)

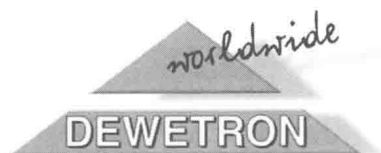
Organizing Committee

- Miroslav Hejzek (Research and Testing Institute Plzeň)
- Marie Koptíková (Research and Testing Institute Plzeň)
- Lenka Lopatková (Research and Testing Institute Plzeň)
- Jana Miksanová (Research and Testing Institute Plzeň)
- Lukáš Stuna (Research and Testing Institute Plzeň)

Institutional Sponsors



Commercial Sponsors



Media Partner



Table of Contents

Preface	v
Committees and Sponsors	vi

Chapter 1: Residual Stresses - Measurement Methods and Analysis

Utilisation Possibilities of PhotoStress Method in Determination of Residual Stresses P. Frankovský, F. Trebuňa, O. Ostertag, P. Šarga, I. Delyová and J. Kostka.....	3
2D Residual Stress and Hardness Maps in Steel Laser Weld with Filler Wire K. Kolařík, K. Trojan, J. Čapek, J. Sís, O. Řídký, L. Zuzánek and N. Ganey.....	9
Neutron Diffraction Studies of Residual Stress Distribution in the Vicinity of the Single Pass Fillet Steel Welds L. Mráz, L. Karlsson, M. Vrána and P. Mikula	13
Analysis of Differential Method Used for the Evaluation of Uniform Residual Stresses by the Ring-Core Method P. Šarga, F. Menda, F. Trebuňa and L. Kováč.....	20
Uncertainties of the Evaluation of the Hole Drilling Residual Stress Measurement According to the ASTM E837 Standard M. Švantner and J. Skála.....	24
Residual Stress Analysis in Containers for Transport of Radioactive Materials F. Trebuňa, F. Šimčák, M. Pástor and P. Šarga	28
Theory of Hole-Drilling Strain-Gage Method for the Using of Semiconductor Strain Gauges K. Vitek.....	32

Chapter 2: Development of Experimental Methods of Analysis in Mechanics of Materials

Experimental Investigation of Mechanical Properties of Textile Glass Reinforcement T. Bittner, P. Bouška, M. Kostelecká and M. Vokáč.....	45
Numerical and Experimental Analysis of Multilayer Mine Protection J. Buchar, R. Řídký, M. Drdlová and J. Trnka.....	49
Experimental Analysis of Hydrothermal Curing Influence on Properties of Fiber-Cement Composite O. Holčapek, P. Reiterman and P. Konvalinka.....	55
Experimental Determination of Mechanical Properties for the Purposes of Numerical Simulations of Car Bumper Tests P. Horník.....	59

Effectiveness of the Modified Fatigue Criteria for Biaxial Loading of Notched Specimen in High-Cycle Region	
Š. Major, Š. Hubálovský, V. Kocour and J. Valach.....	63
Wiles of Using Hollow Specimens for Fatigue Tests	
J. Papuga, M. Vargas and M. Růžicka.....	71
Digital Image Correlation as a Measurement Tool for Large Deformations of a Conveyor Belt	
I. Petrikova, B. Marvalova, S. Samal and M. Cadek	77
Development of Mechanical Properties of Cement Paste with Different Addition of Polyvinyl Alcohol	
J. Topič, P. Tesárek, V. Nežerka, Z. Prošek and T. Plachý	81
Experimental and Numerical Investigation of Critical Buckle Load of Composite Specimens	
L. Bek, R. Kottner, J. Krystek and T. Kroupa	85
Experimental and Numerical Study of Uniaxial and Multiaxial Stress-Strain Behaviour of R7T Wheel Steel	
R. Halama, M. Šofer, F. Fojtik and A. Markopoulos.....	91
Experimental Analysis and Numerical Modelling of Interphase Interfaces of New Environmental Low-Energy Composites	
M. Petrů, O. Novák, P. Lepšík and D. Myšáková.....	95
Experimental and Numerical Investigation of Sheet Metal Behavior under Cyclic Tension-Compression Loading	
J. Slota, M. Jurčišin, E. Spišák and I. Gajdoš	99
Mechanical Properties of New and Recycled PIM Feedstocks	
J. Huba, D. Sanétník, E. Hnátková and B. Hausnerová.....	103
Influence of Combined Mean Stresses on Lifetime under High-Cycle Fatigue	
J. Janoušek, M. Balda and M. Chocholoušek	107
Effects of High Temperature Treatment on the Mechanical Properties of Basalt Fiber Reinforced Aluminous Composites	
M. Jogl, P. Reiterman, O. Holčápek and J. Koťátková.....	111
Micromechanical Properties of Spruce Tissues Using Static Nanoindentation and Modulus Mapping	
Z. Prošek, J. Topič, P. Tesárek, K. Indrová, V. Nežerka, P. Klapálek and V. Králík	115
Performance of Stabilized and Non-Stabilized PVA Nanofiber Textiles Subjected to Tension	
Z. Rácová, Z. Prošek, J. Topič, P. Tesárek, K. Indrová, V. Nežerka and P. Ryparová.....	119
Impact of Anisotropy on the Elastic Modulus of Basic Woven Fabric Structure	
D. Šimić Penava, Ž. Penava and Ž. Knezić	123
The Analyses of Pure Shear Behaviour of E-Glass Woven Fabrics by Picture Frame Test	
D. Šimić Penava, Ž. Penava and J. Krolo	127
A Semi-Analytical Prediction of Wear Rate of an Inductively Hardened Wheel Steel under Rolling Contact	
M. Šofer, R. Halama and R. Fajkoš	131
Experimental Study of Mechanical Behavior of HPL Composites	
M. Žaludek, S. Rusnáková, L. Fojtl and V. Rusnák	139

Stress-Controlled Fatigue Testing of E-Glass Epoxy Composite: Monitoring of Micro-Damage

P. Měšťánek and V. Laš 143

Chapter 3: Development of Experimental Methods of Analysis in Biomedical Engineering

Characteristics of PU Foam at Long Term Static and Dynamic Loading

V. Fliegel and R. Martonka 149

About the Verification of External Fixators Applied in Traumatology and Orthopaedics

K. Frydryšek, F. Fojtík, O. Učeň, G. Theisz, V. Ječmínek, V. Bajtek, K. Čech
Barabaszová, K. Dědková and J. Kukutschová 153

Effect of Polyvinyl Alcohol Concentration on the Mechanical Properties of Collagen/Polyvinyl Alcohol Blends

J. Vesely, L. Horny, H. Chlup, M. Beran, M. Krajicek and R. Zitny 161

FEM Modelling and Experimental Analysis of Mechanical Properties of Artificial Blood Vessel

J. Vosáhlo, O. Novák, M. Petrů and P. Lepšík 165

Chapter 4: Methods and Means of Analysis the Static and Dynamic Loads of Mechanical Structures and Machines

Estimation of Crack Depth and Profile Using DCPD Method in Full Scale Railway Axle Loaded by Rotating Bending

I. Černý 171

Static and Dynamic Experimental Stress-Strain Analysis of Axles Loaded by Rotation Bending

I. Černý and M. Čipera 175

The Influence of Facet Size and Filtering on the Results of Strain Fields' Investigation Performed on Small Surfaces Using Digital Image Correlation

M. Hagara, R. Huňady and M. Kalina 179

Identification of Coupled Mode Shapes Based on Complex Mode Indicator Function

R. Huňady, M. Hagara and M. Schrötter 183

Creep Deformation of High Pressure Steam Turbine Part

F. Straka, P. Albl and P. Pánek 187

Driver Seat Differential Pneumatic System with Air Damping

O. Kohl, L. Pešík and A. Skarolek 191

Experimental Analysis of the Operational Loads on Agricultural Machine

P. Syrovátka and V. Dynybyl 195

Comparison of Various Means of Attachment of High Temperature Strain Gauge

J. Cagán, J. Rosa and F. Rösler 199

Experimental Determination of Wheel and Guiding Forces on the Tracks	
L. Pazdera, J. Smutny and L. Topolar.....	203
Damage and Localized Corrosion in Steam Turbines	
M. Cerny	207
Development of the Bus Sandwich Roof Experimental and Numerical Approach	
K. Doubrava and C. Novotný.....	211
Analysis of the Operational Loading of the Strip Mine Conveyer Drive	
J. Václavík and P. Bohdan	215
Numerical Modelling and Experimental Measurement of Lifting Platform Construction for Car Relocation	
M. Petrů, P. Lepšík, O. Novák and A. Lufinka.....	219
Stress and Motion Analysis of Tram Gearbox Hinge	
M. Dub, J. Kolář, F. Lopot, V. Dynybyl and O. Berka.....	223
Measurement of Aircraft Propeller Dynamic Loading	
J. Rosa and J. Cagán.....	227
Experimental Analysis of Gear Loading in Planetary Transmission	
O. Berka, F. Lopot and M. Dub	231
Analysis of the Tailgate Frame Composite Tube Mechanical Properties	
A. Lufinka and M. Petrů	235
Experimental and Numerical Investigation of Response of Sandwich Composite Beam Subjected to Low-Velocity Impact	
T. Mandys, V. Laš, T. Kroupa and R. Zemčík.....	239
Modal Parameter Analysis for Underdamped Mechanical Systems	
F.N. Nangolo and F. Klimenda.....	247
Vibroisolation of Vibratory Conveyors	
M. Pešík and P. Němeček	253
Experimental Tests and FEM Simulations of Flank Breakage on Tooth of Gears with Respect to Different Nitrided Depths	
K. Petr, V. Dynybyl and J. Křepela	257
Experimental and Numerical Analysis of Vibration of the Test Stand	
M. Petrů and L. Ševčík.....	261
Investigation of the Dynamic Behaviour of Fibres Using Simple Mechanical Systems	
P. Polach and J. Václavík.....	267
Use of MBD Programs in Solving General Unbalance Simple Mechanical System	
M. Svoboda, J. Soukup and A. Petrenko	275
Design and Implementation of Testing Stand for Gearboxes of Railway Vehicles	
J. Chmelař, K. Petr, V. Dynybyl and J. Křepela	283
Dynamic Operational Testing of Agricultural Trailer on a Testing Polygon	
P. Mossóczy, R. Uhlř and P. Malý.....	287
Vibration and Noise Reduction Analysis of Sheet Metal Structures with Damping Layer	
J. Petřík, P. Kulhavý, M. Pašek and J. Šašek	291
Assessment of Reliability and Overall Life-Time of the Turbo Generator in the Kamýk Power Station	
P. Tej, A. Tejová and J. Marková	297

Assessment of Reliability and Overall Life-Time of the Turbo Generator in the Lipno Power Station

P. Tej, A. Tejová and J. Marková	301
On the Performance of Single-Lap Bonded Joints with Embedded Optical Fibers	
M. Dvořák and M. Růžička.....	305
Failure Probability of Structure and its Model	
P. Kesi and F. Plánička	309
Probabilistic Verification of Structures with Respect to Durability	
J. Marková.....	313

Chapter 5: New Methods of Researching and Designing in Structural Mechanics and Mechanics of Constructions

Non-Destructive Testing of Composite Gypsum Material Properties – Long Time Measurement

T. Plachý, T. Svoboda, J. Topič, Z. Prošek, V. Nežerka and P. Tesárek	321
Probabilistic Parametrical Assessment of FRC Specimens	
M. Šolc and P. Brož	325
Non-Destructive Testing during the Hardening of Alkali-Activated Slag	
L. Topolář, P. Rypák, K. Šamárková and P. Rovnaník	329
Experimental Evaluation of Tensile Forces in Short Steel Rods	
M. Polák and T. Plachý.....	333
Use of Digital Image Correlation to Track Strain Evolution in Compressed Masonry Piers	
J. Antoš, V. Nežerka and P. Tesárek.....	337
Flexural Strength of Float Glass	
P. Bouška, T. Bittner, M. Eliášová, M. Špaček, M. Vokáč and T. Mandlík.....	341
Experimental Verification of a Computing Model	
J. Melcer.....	345
Do we still Need an Experiment at All?	
S. Holý and Z. Hrubý	349
Dependence of Load Bearing Capacity on Homogeneity of Steel Fiber Distribution	
M. Rydval, P. Huňka and J. Kolísko.....	353
Finite Element Transient Dynamic Analysis of Laminated Composite Plates	
M. Žmindák, J. Soukup, L. Rychlíková and J. Skočilas	357
Effect of Distribution of Knots on the Strength of the Glued Laminated Timber Beams	
P. Klapálek and L. Melzerová.....	365
Methods of Non-Destructive Assessment of Timber	
P. Klapálek and L. Melzerová.....	369
Influence of Adhesive Type on Flexural Properties of Sandwich Structures	
L. Fojtl, S. Rusnáková, M. Žaludek and V. Rusnák	373

Characteristics of Fiber Reinforced Cementitious Composites in Dependence on Casting Direction	
J. Fornůšek and M. Tvarog	377
To Monitoring the Degradation of UHPC Boards with Textiles Armatures	
M. Kostelecká	381
Creep of Cement Pastes with Content of Fly Ash one Year Old	
P. Padevět and P. Bittnar	385
Determination of Permeability Properties of Concrete Surface Modified by CPF	
P. Reiterman	389
Compression Testing of Gypsum-Based Composite Reinforced by Recycled Wires from Automobile Tires	
P. Tesárek, L. Novák, J. Topič, Z. Prošek, V. Nežerka and M. Lidmila	393
Cohesion of Composite Reinforcement Produced from Rovings with High Performance Concrete	
T. Vlach, M. Novotná, C. Fiala, L. Laiblová and P. Hájek	397
Experimental Study of Primary Lining Tunnel Concrete after Thirty Years of Operation	
F. Vogel, R. Sovják, O. Holčápek, L. Mařík and J. Šach	403
Optimization of Fly Ash Properties for the Use in Cement and Concrete	
O. Zobal, P. Padevět and V. Šmilauer	407
Estimation of Water Absorption Capacity of Hardened Concrete with Recycled Aggregate Based on Experimental Determination	
T. Pavlů and M. Šefflová	411

Chapter 6: Innovation in Teaching of Applied Structural Mechanics

New Ways of Teaching Statics and Applied Structural Mechanics to Architects	
M. Pospíšil, M. Vavrušková and E. Veřtátová	417
Keyword Index	421
Author Index	425