



**22<sup>nd</sup> European Conference on Fracture - ECF22**

# **LOADING AND ENVIRONMENT EFFECTS ON STRUCTURAL INTEGRITY**

## **Book of Abstracts**

Belgrade, Serbia, 26 - 31 August, 2018

This book is published with the financial support of the Ministry of Science of the Republic of Serbia

Published by the Society for Structural Integrity and Life – Prof. Dr Stojan Sedmak (DIVK)

© 2018, DIVK. All rights reserved.

This book may be available in digital format. For acquiring an electronic document copy please visit <http://www.ecf22.rs/> .

This work is protected under copyright by DIVK.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronically, mechanically, photocopying, recording or otherwise, without the prior written permission of the publisher DIVK.

The texts of the abstracts in this book are set individually by the authors.

First edition 2018

Circulation: 500 copies

Printed by the Faculty of Technology and Metallurgy, Research and Development Centre of Printing Technology, Karnegijeva 4, P.O. Box 3503, 11120 Belgrade, Serbia

To contact the Publisher

Prof. Dr Aleksandar Sedmak, Faculty of Mechanical Engineering, University of Belgrade

Kraljice Marije 16

11120 Belgrade 35, Serbia

Email: [asedmak@mas.bg.ac.rs](mailto:asedmak@mas.bg.ac.rs)

<http://divk.org.rs>

---

CIP – Каталогизacija у публикацији  
Народна библиотека Србије

620.172.24:62-112.81(082)

539.42(048)

**EUROPEAN Conference on Fracture (2018 ; Beograd) (22)**

Loading and Environment Effects on Structural Integrity = book of abstracts / 22nd European Conference on Fracture - ECF22, Belgrade, 26 - 31 August, 2018. - 1st ed. - Belgrade : DIVK, 2018 (Belgrade : Faculty of Technology and Metallurgy, Research and Development Centre of Printing Technology). – XXXIII, 582 str. ; 24 cm

Tiraž 500. - Str. VII: Preface / Aleksandar Sedmak. - Napomene i bibliografske reference uz tekst.

ISBN 978-86-900686-0-9

a) Металне конструкције – Интегритет – Апстракти

b) Механика лома – Апстракти

COBISS.SR-ID 269503244

---

## 22<sup>nd</sup> EUROPEAN CONFERENCE ON FRACTURE

### *Loading and environment effects on structural integrity*

#### **Conference Chairmen**

Aleksandar Sedmak (Belgrade, Serbia), the chairman  
 Zoran Radaković (Belgrade, Serbia), co-chairman  
 Snežana Kirin (Belgrade, Serbia), co-chairman  
 Miloš Milošević (Belgrade, Serbia), co-chairman

#### **Local Organizing Committee**

Prof. Dr Aleksandar Sedmak, University of Belgrade  
 Prof. Dr Zoran Radaković, University of Belgrade  
 Dr Snežana Kirin, Innovation Centre, FME  
 Dr Miloš Milošević, Innovation Centre, FME  
 Prof. Dr Marko Rakin, University of Belgrade  
 Prof. Dr Ljubica Milović, University of Belgrade  
 Milica Tošić, MA, DIVK Secretary  
 Branislav Đorđević, Innovation Centre, FME  
 Dr Uroš Tatić, Innovation Centre, FME  
 Simon Sedmak, Innovation Centre, FME  
 Dragana Perović, Innovation Centre, FME  
 Dr Jasmina Lozanović Šajić, Innovation Centre, FME  
 Dr Katarina Čolić, Innovation Centre, FME  
 Dr Igor Svetel, Innovation Centre, FME  
 Prof. Dr Miloš Đukić, University of Belgrade  
 Prof. Dr Gordana Bakić, University of Belgrade  
 Dr Zorana Golubović, University of Belgrade  
 Dr Ružica Nikolić, Zillinska univerzita, Slovakia  
 Dr Emina Džindo, Innovation Centre, FME  
 Filip Vučetić, Innovation Centre, FME  
 Ivana Cvetković, Innovation Centre, FME  
 Dr Nenad Mitrović, University of Belgrade  
 Nikola Milovanović, Innovation Centre, FME  
 Aleksa Milovanović, Innovation Centre, FME  
 Vuk Adžić, University of Belgrade  
 Mihajlo Arandelović, Innovation Centre, FME

#### **National Scientific Committee**

Aleksandar Grbović  
 Aleksandar Sedmak  
 Bojan Medjo  
 Branko Škorić  
 Dragomir Glisić  
 Dragoslav Šumarac  
 Gordana Bakić  
 Ivana Cvijovic Alagić  
 Jovo Jarić  
 Katarina Čolić  
 Ljubica Milović  
 Marko Rakin  
 Miloš Đukić  
 Miroslav Živković  
 Nenad Radović  
 Radivoje Mitrović  
 Radomir Folić  
 Ružica Nikolić  
 Vencislav Grabulov  
 Zijah Burzić  
 Zoran Radaković  
 Zorica Cijović

**International Advisory Board**

Abdel-Monem Elbataghy  
Andrea Carpinteri  
Andrzej Neimitz  
Antonio Alvaro  
Branko Popov  
Christopher Taylor  
Dan Eliezer  
Dražan Kozak  
Francesco Iacoviello  
Giuseppe Ferro  
Hiroyuki Toda  
Ihor Dmytrakh  
James Rice  
Jianying He  
Jose Antonio Correia  
Laszlo Toth  
Liviu Marsavina  
Markus Wilde  
Motomichi Koyama  
Neil James  
Otmar Kolednik  
Raj Das  
Reinhard Pippan  
Robert Akid  
Shinay Taketomi  
Solveig Melin  
Srdjan Nesic  
Tierry Palin-Luc  
Vadim Silberschmidt  
Vigdis Olden  
Youshi Hong  
Željko Božić

Afroz Barnoush  
Andrej Atrns  
Anton Hohenwarter  
Bamber Blackman  
Brian Somerday  
Claudio Geraldo Schon  
Dietmar Klingbeil  
Eiji Akiyama  
Gilbert Henaff  
Harry Bhadeshia  
Hryhoriy Nykyforchyn  
Ingo Scheider  
Jaques Besson  
John Landes  
Josef Vičan  
Leslie Banks Sills  
Mariano Lannuzzi  
Meinhard Kuna  
Muhamed Hadj Meliani  
Nenad Gubeljak  
Per Stahle  
Reiner Kirchheim  
Richard Gangloff  
Robert Ritchie  
Siegfried Schmauder  
Somnath Chattopadhyaya  
Takayuki Kitamura  
Uwe Zerbst  
Valery Shlyannikov  
William Curtin  
Yuri Lapusta  
Zhiliang Zhang

## Table of Contents

<b>Analysis of stress corrosion cracking in X80 pipeline steel: An approach from the Theory of Critical Distances</b> P. González, S. Cicero, J.A. Álvarez, B. Arroyo .....	1
<b>Embrittlement of RPV metal under long-term irradiation: state-of-the-art and challenges</b> Sergiy Kotrechko .....	2
<b>Effect of condensate corrosion on tensile and fatigue properties of brazed AISI 304L stainless steel joints using gold-base filler metal</b> Anke Schmiedt, Lars Lingnau, Matthias Manka, Wolfgang Tillmann, Frank Walther .....	3
<b>Lifetime assessment of additive manufactured polymer materials by means of the rolling ring test using cyclically loaded notched ring specimens</b> Ralf Lach, Andrea Monami, Sören Griefsbach, Volker Griefsbach, Wolfgang Grellmann.....	4
<b>Hard body impact on glass panes and the fracture energy equilibrium</b> Stefan Reich, M. Raghu Sagar Vanapalli.....	5
<b>Damage and fracture of ductile sheet metal: New biaxially loaded specimens for material parameter identification</b> Steffen Gerke, Moritz Zistl, Marco Schmidt, Michael Brüning .....	6
<b>Effect of gradient plasticity on crack initiation and propagation in the ductile-brittle transition region of ferritic steel</b> N.A. Giang, M. Kuna, G. Hütter .....	7
<b>Fracture behavior of rock plate under static and dynamic combined loads</b> Guiyun Gao .....	8
<b>Biaxial experiments on the effect of non-proportional loading paths on damage and fracture behavior of ductile metals</b> Moritz Zistl, Steffen Gerke, Michael Brüning .....	9
<b>Applicability of local approaches to assessment of cleavage fracture in complex constraint and load history cases</b> J. Beswick, D. Sarzosa, R. Savioli, P. James, C. Ruggieri, A.P. Jivkov .....	10
<b>Assessment of fatigue crack growth behavior of cracked specimens repaired by indentation</b> S.M.J. Razavi, M.R. Ayatollahi, F. Berto.....	11
<b>Fatigue strength of notched specimens made of Ti-6Al-4V produced by SLM technique</b> S.M.J. Razavi, F. Berto .....	12
<b>Determination of residual fatigue life of welded structures at bucket-wheel excavators through the use of fracture mechanics</b> Miodrag Arsić, Srđan Bošnjak, Nebojša Gnjatović, Simon A. Sedmak, Dušan Arsić, Zoran Savić.....	13
<b>Effect of hygrothermal environment on the fatigue behaviours of composite laminates</b> He Yuting, Feng Yu .....	14
<b>Identification of crack positions and crack loading quantities from strain gauge data by inverse problem solution</b> Ramdane Boukellif, Andreas Ricoeur.....	15
<b>The effect of negative stress triaxialities on ductile damage and fracture behavior in metal sheets</b> Marco Schmidt, Steffen Gerke, Michael Brüning.....	16
<b>INCEFA-PLUS (increasing safety in NPPs by covering gaps in Environmental Fatigue Assessment)</b> Isabela Procopio, Sergio Cicero, Kevin Mottershead, Matthias Bruchhausen, Sam Cuvilliez .....	17
<b>Application of the PAM method in the milk production sector</b> Ivana Franjić, Dubravka Živoder.....	18
<b>Computer simulation of cleavage fracture surface morphologies in steel plates</b> Taiko Aikawa, Shuji Aihara, Tomoya Kawabata, Fuminori Yanagimoto, Kazuki Shibamura .....	19
<b>Simulated running ductile fracture experiment using rubber tube<sup>20</sup></b> Yasuyuki Furuta, Yuki Nishizono, Shuji Aihara, Fuminori Yanagimoto, Tomoya Kawabata, Kazuki Shibamura, Carlos A. Oliveira, Armando H. Shinohara.....	20
<b>Investigation on brittle crack propagation and arrest behaviors under high crack driving force in steel<sup>21</sup></b> Fuminori Yanagimoto, Kazuki Shibamura, Teppei Okawa, Katsuyuki Suzuki, Shuji Aihara.....	21
<b>Testing of Brazilian disk specimens with a delamination between a transversely isotropic and a tetragonal composite ply<sup>22</sup></b> Mor Mega, Leslie Banks-Sills.....	22
<b>Application of singular integral equation to crack moving near an inclusion in two-dimensional infinite plate<sup>23</sup></b> Masayuki Arai, Kazuki Yoshida .....	23

# Determination of residual fatigue life of welded structures at bucket-wheel excavators through the use of fracture mechanics

Miodrag Arsić<sup>a,\*</sup>, Srđan Bošnjak<sup>b</sup>, Nebojša Gnjatović<sup>b</sup>, Simon A. Sedmak<sup>c</sup>,  
Dušan Arsić<sup>d</sup>, Zoran Savić<sup>a</sup>

<sup>a</sup>Institute for Materials Testing, 11000 Belgrade, Serbia,

<sup>b</sup>Faculty of Mechanical Engineering, 11120 Belgrade, Serbia,

<sup>c</sup>Innovation Centre of the Faculty of Mechanical Engineering, 11120, Belgrade, Serbia,

<sup>d</sup>Faculty of Engineering, University of Kragujevac, 34000 Kragujevac, Serbia,

---

## Abstract

This paper presents a methodological approach for the assessment of service life of vital welded structures of a bucket-wheel excavator Sch Rs 650/5x24 ('Thyssen Krupp', Germany) boom, subjected to cyclic loading with a variable amplitude through the use of experimental tests carried out in order to determine operational strength and growth of a fatigue crack. Realized researches and results presented in this paper offer great possibilities for the analyses of behaviour of vital welded structures of the bucket-wheel boom. By the application of the measurement device with 8 channels for registration and processing of electric signals HBM Spider 8 and measurement tapes HBM 6/350xXY31 deformations were measured at vital welded structures of the boom in the area of the bucket-wheel, made of steels St 37.2 and St 52.3 in accordance with standard DIN 17100, or steels S235J2G3 and S355J2G3 in accordance with standard EN 10025-2. The objective of the test is to determine if there is a possibility of occurrence of plastic deformations or initial cracks due to fatigue at vital welded structures. Tests that refer to the growth of the fatigue crack located at the welded joint have been carried out by bending at three points with asymmetric load  $R = 0.5$  ( $R = \sigma_{\min} / \sigma_{\max}$ ) at the specimen with a single edge notch. Tests were performed through the use of controlled force, ranging between  $F_{\max}$  and  $F_{\min}$  at the high-frequency pulsator 'Cracktronic', while obtainment of data regarding the crack growth was carried out through the use of measurement gauge ARM A-10.

Peer-review under responsibility of the ECF22 organizers.

*Keywords:* bucket-wheel excavator, stress condition, crack, service life

---

---

\* Corresponding author. Tel.: /  
E-mail address: miodrag.arsic@institutims.rs