University of Zagreb
Faculty of Mechanical Engineering
and Naval Architecture

Ctt
Center for Technology Transfer

STRUCTURAL INTEGRITY AND DURABILITY

Faculty of Mechanical Engineering
and Naval Architecture

Zagreb
February 20, 2018

STRUCTURAL INTEGRITY AND DURABILITY

The workshop "Structural Integrity and Durability" is organized by the Center for Technology Transfer (Ctt) and the Department of Aeronautical Engineering of the Faculty of Mechanical Engineering and Naval Architecture (FMENA), University of Zagreb. Distinguished scientists and researchers from academia and industry will present methods and models for the integrity assessment of structures and components subjected to mechanical and thermal cyclic service loads, laying special emphasis on practical applications in the industry.

Within the workshop special attention will be paid to fatigue life time assessment methods with emphasis on the effect of crack closure on the crack growth rate and the fatigue life. Importance of heat treatment and surface engineering in controlling and improving the mechanical properties and durability of structural components will be demonstrated. NDT engineering methods and their significance for structural integrity assessment of the component will be presented.

Examples of integrity and durability analysis and assessment of thin-walled ship and aircraft structures, car and train frame structures will be given.

GUEST SPEAKER

Prof. Dr. Reinhard Pippan
Erich Schmid Institute of Material Sciences of the Austrian Academy of Sciences and Department of Material Physics
Montanuniversität Leoben, Austria

Reinhard Pippan is vice director and a group leader at the Erich Schmid Institute. He studied mechanical engineering at a technical high school, then physics at the Technical University in Graz and received his PhD degree from the Montanuniversität Leoben in 1982. His scientific career is mainly connected with the Erich Schmid Institute of the Austrian Academy of Sciences. Pippan's research activities are focused on mechanical properties of metals, alloys and composites. The improvement of the basic understanding of the relations between the mechanical behaviour, the deformation processes, the fracture processes, and the micro- and nano-structure of the material is his aim. The activities with respect to the properties can be separated into three groups: plastic deformation, fatigue and fracture, and micro- and nanomechanics. The effect of severe plastic deformation on the structural evolution and the mechanical properties are now an additional research topic.

AIMS AND OBJECTIVES OF THE WORKSHOP

The workshop is intended for engineers and technicians from the industry involved in the development, design, manufacture and maintenance of structures. The workshop is also aimed at government institutions and university employees who are active in the field, and to all others interested in this field.

WORKSHOP COORDINATOR

Prof. dr. sc. Željko Božić

- **VENUE:** Faculty of Mechanical Engineering and Naval Architecture in Zagreb, East building, Plava dvorana
- **DATE AND TIME:** February 20, 2018; 08:00-17:00
- **PARTICIPATION FEE:** 1,100 Kn + VAT (25 %)
  Please transfer the fee to the following account:
  Zagrebačka banka: IBAN HR7623600001101430801
  Payment purpose: Structural Integrity and Durability
  Reference number: 1802
- For the participants who pay the fee abroad, outside Croatia:
  Zagrebačka banka, Savska cesta 66, Zagreb
  Account number: 2100036681; SWIFT: ZABAHR2X
  IBAN: HR7623600001101430801
  Registration form and payment confirmation should be sent via e-mail: melita.zrilic@fsb.hr or per post:
  Ctt – Center for technology transfer
  Ivana Lučića 5, 10000 Zagreb, Croatia
- Registration form and payment confirmation should be sent until February 16, 2018
- For further information please contact Mrs. Melita Zrilić:
  Phone: +385 16168567 or E-mail: melita.zrilic@fsb.hr
- Printed materials will be provided to all workshop participants. The participation fee includes lunch and refreshments during coffee breaks. All participants will receive a copy of the Book of Abstracts of the International Conference on Structural Integrity and Durability held in Dubrovnik, Croatia, 2017.

Name and family name of the participant

Company name and address

VAT

Tel./fax

E-mail

Date

Signature of the person in charge

WORKSHOP PROGRAM

08:00 – 08:40 Registration

08:40 – 09:00 Welcome message

Prof. dr. sc. Mladen Šercer, Director of CTT
Prof. dr. sc. Zvonimir Guzović, Dean of FMENA
Mr. Mario Antonić, State Secretary, Ministry of Economy, Entrepreneurship and Crafts

09:00 – 10:00 PLENARY LECTURE

Prof. Dr. Reinhard Pippan
Erich Schmid Institute of Material Sciences
The Austrian Academy of Sciences, Department of Material Physics
Montanuniversität Leoben, Leoben, Austria

Crack Closure: A Key Mechanism in Fatigue

Most of the research on crack closure has been devoted to fatigue crack propagation under small scale yielding. In this presentation, the effect of different length scale from micro-crack to long cracks and different loading conditions from low cycle fatigue, high cycle fatigue, to small scale yielding on crack closure are considered. The used examples will demonstrate the importance of crack closure for the life time prediction in all cases of fatigue loading.

10:00 – 11:00

Prof. dr. sc. Damir Markučič
University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Department of Quality

NDT Engineering for Structural Integrity Assessment

The objective of NDT engineering methods is to detect flaws and/or characterization of material degradations of structural components. Structural integrity assessment of the component is based on the results obtained by non-destructive testing and/or evaluation methods. Hence, emerging concepts will be highlighted, some cases presented and relevant parameters analysed regarding the reliability of non-destructive inspection.

11:00 – 11:20 Coffee break

11:20 – 12:20

Prof. dr. sc. Željko Božić
University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Department of Aeronautical Engineering

Fatigue and Fracture Modelling and Analysis

Fundamentals of Linear Elastic Fracture Mechanics (LEFM) and numerical determination of Stress Intensity Factor (SIF) values by using Finite Element Method (FEM) will be presented. Crack growth models such as the Paris-Erdogan, Elber, Schijve and other power laws commonly used for crack propagation simulation will be discussed. The effects of residual stresses on fatigue crack growth rate will be demonstrated. Basics of Elastic-Plastic Fracture Mechanics (EPFM) will be given. An example of nonlinear FE fracture analysis of damaged stiffened panels subjected to lateral pressure will be presented.

12:20 – 13:40 Lunch break

13:40 – 14:40

Prof. dr. sc. Božidar Matijević
University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Department of Materials

Heat Treatment and Surface Engineering

HEAT TREATMENT (HT) is the key technology in controlling and improving the mechanical properties of metallic alloys. Modern engineering components are increasingly characterised by 'graded properties', meaning that any given component can, and usually must, have distinct and sometimes quite different structural characteristics and functional properties in its bulk material and in its specific surfaces. This not only optimizes the total performance of a component in service, it can also rationalize and limit the consumption of higher-cost or scarce materials – the increasingly critical processes of SURFACE ENGINEERING (SE). Therefore heat treatment (HT) and surface engineering (SE) represent a perfect and essential symbiosis of two of the most powerful families of processes in industrial production. Advancing knowledge and close collaboration between scientific understanding and industrial practice are typical for heat treatment and surface engineering.

14:40 – 15:20

Damir Kovač, dipl. ing. mechanical engineering
AVL-AST – Zagreb
Mr. sc. Nikola Naranča, dipl. ing. nav. arch.
AVL-AST – Zagreb

Structural Evaluation of Electric Vehicle E-Motor in Climatic Chamber Conditions

Passenger car market is widely spread across all climatic regions. In some geographical areas car components can be significantly impacted by cold weather conditions. Crack may occur in assemblies with different thermal expansion/contraction due to the increase of stress conditions. For the purpose of electric vehicle E-Motor structural integrity assessment, housing-stator assembly was assessed under environmentally cold conditions. To validate simulation results, assembly components were manufactured and tested in a climatic chamber. Assessment and comparison of results will be demonstrated on one of the OEM's E-Motors.

15:20 – 15:40 Coffee break

15:40 – 16:30

Prof. dr. sc. Željko Božić
University of Zagreb,
Faculty of Mechanical Engineering and Naval Architecture,
Department of Aeronautical Engineering

Structural Integrity Assessment – Examples and Case Studies

Examples of structural integrity and durability assessment of a gas turbine housing and electric train car body structure will be presented. By redesigning the critical details of the inner housing supports, the required fatigue life of the component has been achieved. At an early development stage of the low-floor electric train car body the mechanical integrity and durability of the structure was analysed. The lifetime of the structure was assessed.

16:30 – 16:40 Certificate award to the participants