

FSB 100



100 Years of Faculty of
Mechanical Engineering
and Naval Architecture
University of Zagreb



STRUCTURAL INTEGRITY AND DURABILITY

Faculty of Mechanical Engineering
and Naval Architecture

Zagreb
May 7, 2019



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 a special attention will be given to survey of thin-walled structures to ensure the safety of a structure and the assessment of service life. NDT Engineering methods and their significance for structural integrity assessment of the component will be presented. Finite element structural analysis of real cases by using ANSYS software for fatigue life analysis will be given.

Examples of fatigue crack propagation, fatigue life analyses and integrity assessment of thin-walled structures such as ship and off-shore structures, car and train frame structures, internal combustion engines and power plants will be demonstrated.

GUEST SPEAKER

Dr. Laszlo Molnar
eCon Engineering, Budapest

Laszlo Molnar is the Head of Software Distribution of eCon Engineering from Budapest. He studied mechanical engineering at the Technical University of Budapest and received his MSc Diploma for Mechanical Engineer-Applied Mathematics in 1997. In 2002 he received his PhD degree from Technical University of Budapest with the thesis title „Numerical modeling of silicone based precision mechanical elements and constructions“. He was an associate professor at the Technical University of Budapest until 2010. He is one of the cofounders of eCon Engineering founded in 2002. Currently he is the Head of Software Distribution of the eCon Engineering responsible for customer support and sales.

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 topic.

WORKSHOP COORDINATOR

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

- **VENUE:** Faculty of Mechanical Engineering and Naval Architecture in Zagreb
- **DATE AND TIME:** May 7, 2019; 08:00-17:00
- **PARTICIPATION FEE:** 1100 Kn + VAT (25 %) Please transfer the fee to the following account: Zagrebačka banka: IBAN HR7623600001101430801 Payment purpose: INTEGRITET KONSTRUKCIJA Reference number: 1906
- Registration form and payment confirmation should be sent via e-mail: CTT@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 May 3, 2019
- For further information please contact CTT: phone: +385 16168567 or e-mail: CTT@fsb.hr
- Printed materials will be provided for the workshop participants. The participation fee includes lunch and refreshments during coffee breaks.

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 – 08:45 Registration

08:45 – 09:00 Welcome message

Mr. sc. Nina Antičić dipl. oec., Director of CTT
Prof. dr. sc. Dubravko Majetić, Dean of FMENA

09:00 – 10:00 OPENING LECTURE

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

An Overview of Fatigue and Fracture Models

Methods and concepts commonly used for structural integrity and durability assessment will be presented. Power law models such as Paris-Erdogan equation and other models commonly used for crack growth prediction are discussed. Micro-mechanics fatigue damage models developed for crack initiation simulation are presented. The effects of residual stresses on fatigue life of structures will be demonstrated. Examples of elastic-plastic fracture mechanics (EPML) analysis and integrity assessment of damaged thin-walled structures will be shown.

10:00 – 11:00

Prof. dr. sc. Damir Semenski
University of Zagreb,
Faculty of Mechanical Engineering and Naval Architecture,
Department of Applied Mechanics

Risk Assessment of Structural Components

Structural life management requires the integration of design and analysis, materials behavior and structural testing. The survey of the offshore platforms is a request to ensure the safety of a struc-



ture and the assessment of service life. Preselecting of areas to be surveyed should be based on an engineering evaluation of areas particularly susceptible to structural damage, or to areas where repeated inspections are required in order to monitor their integrity over time.

11:00 – 11:30 Coffee break

11:30 – 12:30

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

NDT Engineering as a Basis for Structural Integrity Assessment

The objective of NDT Engineering is to detect flaws and/or to characterize material degradation of structural components during their lifetime. Structural integrity assessment of the component is based on the results obtained by the non-destructive testing and / or evaluation methods. Hence, emerging techniques and concepts will be presented and discussed regarding the reliability of non-destructive inspection.

12:30 – 14:00 Lunch break

14:00 – 14:40

Krešimir Šalamon, dipl. ing.
Končar – Electric vehicles
Stevo Pribić, dipl. ing.
Končar – Electric vehicles

Design, Development, Fatigue Strength Analysis, and Experimental Validation of Low-Floor Train Bogie Frames

The bogie frame structure of the electric train vehicle is subject to cyclic loading in service and the structure have to meet rigorous requirements for safety, endurance and vehicle reliability, prescribed by standards. The current standard, EN 13749, proscribes methodology of testing and defines the load type but is not always explicit in terms of load amount. For the analysis of integrity and durability of the structure it is necessary to be familiar with object lifetime, load cases, and possible unforeseen boundary conditions. Therefore, one has to carefully define complex 3D finite element models and critically review all of the boundary conditions, possible NDT inaccuracies, and technological imperfections. Finally, object has to undergo strict fatigue load test in some of the certified laboratories, in order to get all necessary approvals from relevant domestic and European bodies.

14:40 – 15:20

Nedjeljko Bužak, dipl. ing. mechanical engineering
AVL-AST – Zagreb
Mr. sc. Nikola Naranča, dipl. ing. shipbuilding
AVL-AST – Zagreb

Structural Evaluation of Large Diesel Engine EGR-Cooler for Locomotive Application

Due to the increasing demands to limit values of emissions from IC engines, the challenges for the development of the engines and the components used are constantly increasing. Shorter development times, increasing cost pressure and higher loads on materials also require effective analysis and validation methods for the individual components. Due to thermomechanical loads, cracks occur in the welding regions within the EGR-cooler of a large diesel engine for locomotive application. In order to investigate mechanics that causes those cracks and to improve the current design, thermomechanical analysis was carried out. The main focus is the weld integrity assessment, based on the EN-13445 Standard.

15:20 – 15:50 Coffee break

15:50 – 16:50 INVITED LECTURE

Dr. Laszlo Molnar
eCon Engineering, Budapest

Mechanical Simulation Overview in ANSYS World – Fatigue and Crack Analysis in Heavy Industry Application

For nearly 20 years, eCon Engineering has been a successful supplier to small businesses and multinational companies. More than 80 engineers give our company stability and ensure the satisfaction of our customers. The mission of eCon Engineering is to distribute the world's leading ANSYS simulation technology on the market. This distribution is not just a sales activity, but we help our customers with trainings, individual improvements, everyday support, and occasionally mechanical-, fluid dynamical-, thermal- and electromagnetic analysis, which together ensure the success of our customers. The presentation will focus on giving an overview about the simulation driven product development in mechanical applications provided by ANSYS.

Knowing the stress distribution about a design structure is not enough today. We have to be aware of the fatigue strength and durability of our design to be able to keep the warranty conditions and to ensure the safe operation of our products. A heavy industry fatigue application will be highlighted and the crack propagation will be considered.

16:50 – 17:00 Certificate award to the participants