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EDITORIAL

# Preface to the special issue: structural integrity

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This themed issue is dedicated to highlighting scientific issues associated with the design, safety, reliability, and integrity of materials and structural components. The special collection is focused on issues related to structural integrity, durability, safety, probabilistic approaches, mathematical problems, loading effects, fatigue, fracture mechanics, damage mechanics, analytical and numerical simulation, experimental observations, and other related areas. The manuscripts of this themed issue are from engineers, metallurgists, and structural scientists, among others, that allowed a very multidisciplinary discussion. Twenty scientific papers, including three review papers are published in this special volume.

Zakavi et al. (2021a) presented a brief overview of three-dimensional linear-elastic fracture mechanics (3D LEFM). In this review, the classical linear elastic fracture mechanics (LEFM), which largely relies on plane stress or plane strain simplifications, is approached and discussed. Additionally, the fundamental results in 3D LEFM, which are largely based on dimensionless and energy considerations, are also reviewed and discussed.

Zhu et al. (2021) presented a review of the recent advances on the size effect in metal fatigue under defects. Three types of size effects (statistical, geometrical, technological) as well as their recent advances in metal fatigue, aiming to provide a guide for fatigue strength assessment of engineering

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components containing defects, inclusions, and material inhomogeneity, are approached.

Vantadori et al. (2021) suggested an experimental campaign performed on shot-peened Ti6Al4V specimens under fretting fatigue, available in the literature, is simulated by using the Carpinteri criterion. In this study, the fretting loading is a combination of low-cycle fatigue and high-cycle fatigue, where the corresponding stress field is determined by a finite element analysis. The relaxed residual stress produced by shot peening treatment and fatigue loading was considered by means of a theoretical law.

Zakavi et al. (2021b) presented an analytical approach to simulate the fatigue growth of surface cracks in round bars subjected to cyclic tension and/or bending. In their proposed approach, a part-elliptical crack front shape is assumed, and it is capable to incorporate plasticity-induced crack closure models. The results obtained from the fatigue crack growth simulations based on the proposed approach are compared with published experimental and theoretical studies.

Álvarez and Muñiz-Calvente (2021) studied the fatigue life estimation of pre-corroded 42CrMo4 subjected to accelerated pitting corrosion method. In this investigation, the experimental results obtained from the fatigue testing of the pre-corroded specimens are analysed and compared with fatigue predictions based on fracture mechanics.

Shen et al. (2021) proposed a new fatigue life estimation method by means of the volume stress gradient method (VSGM), considering the stress gradient into the volume determined by the critical distance theory (TCD). In this study, the authors proved that the characteristic length of VSGM is variable with fatigue life, stress ratio, and geometry of notch.

Mehari and Han (2021) evaluated ductile fracture during the partial heating roll forming processes of DP980 high strength steel. For this, the authors assessed the instability and fracture strains from the uniaxial, plane-strain, and shear tensile tests at different temperatures.

Ayatollahi et al. (2021) presented a review of the crack tip asymptotic fields in generic plane anisotropic media, rigorously categorising about 400 studies devoted to the determination of the asymptotic coefficients, also referred to as crack tip parameters.

Macek (2021) suggested a study of the distribution of the fracture surface roughness of notched 2017A-T4 aluminium alloy after bending fatigue using an optical focus-variation surface measurement technique by applying the fracture zone concept, where the effects of stress level at the notch root and the load ratio on fatigue crack growth and fracture surfaces are analysed.

Chales et al. (2022) presented a study on the behaviour of constitutive models from slow strain rate tests of maraging 300 and 350 steels performed in several environmental conditions. The authors demonstrated that the models can be used with good accuracy to describe the plastic deformation response of high strength values on maraging 300 and 350 steels.

Dai et al. (2021) investigated the characterizations of the material constraint effect for creep crack in center weldment under biaxial loading, where the possibility of the material constraint effect characterization based on higher-order term solutions is discussed. These authors proposed an empirical formula that was verified with fine accuracy.

Esmaeili et al. (2022) presented a study to extract mixed-mode stress intensity factors (SIFs) and T-stress in off-axis laminated composites using the digital image correlation (DIC). In this paper, the authors sought to optimize the number of terms used in the multiparameter stress function and the size of the extraction area. In this investigation, the finite element simulation is employed to carry out a comparative study.

Duda et al. (2021a) approached the determination of mode I fracture energy in the inverse fiber metal laminates using an experimental–numerical methodology, where the process of determination of some fracture parameters is described. The numerical simulations were carried out using cohesive elements and cohesive surfaces approach.

Barcikowski and Rybkowska (2022) suggest that the Mode II fracture characterization of toughened epoxy resin composites involves(?) two issues: the efficient increase in the toughness of the resin without impacting significantly other properties, and the measurement of the toughness in composite materials. In this work, the authors present an investigation of the use of the end-notched flexure test as a method for the assessment of toughening efficacy of RLP modification of glass–epoxy laminated composites.

Duda et al. (2021b) investigated the fatigue crack development under mixed-mode I + II and I + III in heat-treated 42CrMo4 steel through experimental procedures, focusing on fatigue crack growth rate curves for this material and loading conditions. This research is supported by fracture analysis results of fatigue crack path development.

Ye et al. (2022) studied the fatigue life prediction of notched components under-size effect using a stress gradient-based approach. In addition, these authors proposed a new stress gradient-based method for notch fatigue analysis by coupling the Weibull model with critical distance theory.

Ning et al. (2021) studied the effects of temperature, strain rate, and dissolved oxygen (DO) on fatigue life of Chinese A508-3 steel of AP1000. Besides, in this research, probabilistic fatigue studies are done to describe the dispersion of the life model, important for the engineering application of experimental data.

Saha and Vidya Sagar (2022) reported on a statistical analysis of acoustic emission (AE) avalanches generated during the compressive and mode I fracture processes in cementitious composites. In this study, the definition of the AE aftershocks only considers the energy of the main shock as a criterion.

Fu et al. (2022) proposed a 3D non-local lattice bond model to model fracturing behaviour of materials, where the formulations and detailed derivation for three-dimensional non-local lattice bond models are obtained by comparing the strain energy stored in a discrete lattice with the classical continuum strain energy.

In the last paper of this special issue, Ren et al. (2022) suggested an investigation on the fracture mechanics-based residual life prediction of railway heavy coupler made of cast steel with initial defects with measured load spectrum. In their research work, a testing campaign has been carried out to determine high cycle fatigue strength, fatigue crack growth rate, threshold, and fracture toughness.

The Guest Editors for this thematic issue are pleased with the final result of the published papers and hope that these scientific works can be useful to researchers, engineers, designers, and other colleagues involved in different thematic aspects of the structural integrity, fracture, and fatigue of materials and structural components.

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