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Edited by
Željko Božić, Željko Domazet, Robert Basan, Milan Vrdoljak and Marijan Andrić

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Organization

The 24th European Conference on Fracture (ECF24) is organised by the European Structural Integrity Society (ESIS) and by the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb.

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Mozaik Event Center
Slavonska avenija 6/2,Zagreb, Croatia

August 26–30, 2024

`https://mozaik-grupa.hr/`

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Preface

The 24th European Conference on Fracture, ECF24, was held at the Mozaik Event Center in Zagreb, Croatia, from 26 - 30 August 2024. The ECF24 Conference was organised by the European Structural Integrity Society (ESIS) and by the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb. ECF24 managed to bring together scientists and engineers from 54 countries from around the world to discuss how to characterize, analyse, predict and asses the integrity, fatigue and fracture of structural materials and components.

The ECF24 Conference was a forum for discussion of the present and future trends in experimental, analytical and numerical fracture mechanics, fatigue, structural integrity assessment, failure analysis, and other important topics in the field. The participants of the ECF24 Conference had the opportunity to interact and exchange ideas with leading researchers across a wide range of disciplines and get acquainted with the state of the art in the theory and applications of fatigue and fracture mechanics.

I take this opportunity to thank to all participants of the ECF24 Conference for their contribution and many high-quality abstracts. I am very much indebted to the Scientific Committee Members for their invaluable help, suggestions and advice in the Conference organization. Many thanks to organizers of the Thematic Symposia who helped to structure ECF24 as an efficient and smooth-running event.

I would like to thank to ESIS ExCo Members, to all my colleagues and all persons who have been involved in the organization of the ECF24 Conference in various ways. Particularly, I wish to thank to the Organizing Committee Members for their great effort, support and commitment.

The ECF24 Conference is supported by the Ministry of Science, Education and Youth of the Republic of Croatia. The support of ESIS is gratefully acknowledged.

Željko Božić
ECF24 Conference Chair
Zagreb, August 2024

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ON ANALYTICAL MODEL OF INTERFACE CRACK IN BONDING QUASI-BRITTLE MATERIAL BETWEEN DISTINCT ELASTIC MEDIA

M. Dudyk [1,*], A. Kaminsky [2], Yu. Resitnyk [1], Yu. Chornoivan [2]
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The purpose of this work is to build an analytical model of an interfacial crack in piecewise homogeneous elastic bodies to predict the conditions of its initiation. The treatment is based on the concept of the process zone, which takes into account the existence of a local region with a high level of stresses and strains in the bonding material before the crack front. In the process zone, a quadratic strength criterion of the Mises-Hill type is assumed. The use of this criterion provides consideration of the quasi-brittle mechanism of the bonding material fracture. Using the Mellin integral transformation, the problem of calculating the parameters of the process zone in the bonding material at the tip of the interfacial crack within the framework of the proposed model is reduced to a vector functional equation, for which an exact analytical solution was found using the Wiener-Hopf method. From the solution found, a closed system of transcendental equations and relationships is derived for determining the length of the process zone, the phase angle of the load, and the energy release rate in the zone and the opening of the crack at its tip, which form an accessible algorithm for estimating the limit loads that precede propagation of the crack along the interface. Numerical analysis of the developed model is performed, and the possibility of its application in fracture studies of some composite materials is demonstrated.

The developed model of the process zone in the bonding material of a piece-homogeneous body, which is based on the model of an open interfacial crack in combination with the elements of the Barenblatt, Leonov-Panasyuk, Dugdale models and the Mises-Hill type strength criterion, has a number of important advantages over other models, namely: 1) the final calculation formulas for determining the length of the process zone, the phase angle of the load and the rate of energy release in the zone and the opening of the crack at its tip can be presented as a closed system of transcendental equations and ratios, the solution of which does not require the cumbersome calculations using heavy mathematical software packages; 2) the use of the strength criterion of the Mises-Hill type allows the application of the model for the analysis of the conditions of propagation of interfacial cracks in bonding materials with a quasi-brittle mechanism of fracture; 3) specifying the external load through the stress intensity factor near the tip of the crack makes the obtained solution general, not tied to a specific type of load. At the same time, this ensures the suitability of the model for studying the parameters of the process zone under conditions of mixed loading; 4) the obtained accurate analytical solution of the problem gives an accessible and effective algorithm for estimating the critical loads that precede the propagation of the crack along the interface.

Prospects for further development of the model are also seen. In particular, the method described in this paper for obtaining an analytical solution to the problem of the process zone can be implemented for other strength criteria. In addition, the developed model allows its use for study the delamination or the fracture of piece-homogeneous bodies along the interface when treating the input material constants as tensile and shear strengths and the fracture toughness of a diffusion joint or the adhesive bond of an adhesive with an adherent.

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