Failure Prediction in Adhesive Joints with Composites Using Stress Singularities

Alberto Barroso Caro, University of Seville (Spain)

When dealing with adhesive joints between dissimilar materials, points where geometry and materials properties change abruptly often appear. These “multimaterial corners” are critical points where failure can initiate. From a linear elastic point of view, the numerical analysis of these points gives rise to unbounded stresses (stress singularities). Although, in real structures, singularity stresses do not really exist, an approach similar to that used in Linear Elastic Fracture Mechanics has been followed, to try to predict the onset of failure arising at these points. The talk reviews the research and developments during the last years regarding this topic. Analytical, numerical and experimental evidences will be briefly reviewed.

The local singularity stress field has been fully characterized by using Stroh formalism of anisotropic elasticity. Numerical analyses using FEM and BEM have provided the Generalized Stress Intensity Factors. Finally, experimental testing has been carried out to obtain allowable values of the Generalized Thoughness, demonstrating the influence of these stress singularities in the failure of adhesive joints, and composite samples where stress singularities appear. The development of a tool for this stress characterization has also allowed reviewing standard testing of composite materials where premature failures typically occur at multimaterial corners, to suggest slight geometrical changes to remove the local stress singularities and obtain more realistic strength values of the materials.
Alberto Barroso Caro
Associate Professor, Department of Continuum Mechanics, Group of Elasticity and Strength of Materials, University of Seville (Spain)

Short CV
20 years of teaching in the Department of Continuum Mechanics, in the Group of Elasticity and Strength of Materials of the University of Seville. I have mainly developed my research career in the field of adhesive joints from a mechanical point of view. Since the fundamentals of the stress characterization using anisotropic elasticity and complex variable, to the experimental evidences in laboratory, passing through numerical simulations using FEM and BEM. Other research topics in which I am interested are: Composite Materials, Anisotropic Elasticity, Stress singularities, Welding, Fracture Mechanics, Riveted joints, Experimental Testing.

- 29 JCR papers, 3 Book chapters and 2 Encyclopedia entries.
- H-index = 10 (Scopus) / 13 (Google Scholar).
- Principal Investigator (PI) of 4 projects.
- 3 Six-years research periods, and 1 Six-years transfer of knowledge period.
- General Secretary of the European Society of Composite Materials (ESCM) 2014-2016.
- General Secretary of the Spanish Association of Composite Materials (AEMAC) 2009-2013.
- 3 patents, and several research contracts with enterprises.

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ORCID: https://orcid.org/0000-0003-4011-3379
Researcher ID: http://www.researcherid.com/rid/E-7106-2010
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Informações: Prof. Nuno Maia