ICMAMS 2018
First International Conference on Mechanics of Advanced Materials and Structures
Turin, 17-20 June 2018
www.icmams.com

ACCURATE STRESS ANALYSIS OF BONDED JOINTS VIA HIGHER-ORDER MODELS

A.G. de Miguel[1], L. Rizzo[1], A. Catapano[2], E. Carrera[1], A. Pagani[1,*] and E. Panettieri[2]

[1] M ul 2 Team, Mechanical and Aerospace Engineering Department, Politecnico di Torino, Italy
[2] Bordeaux INP, Arts et Métiers ParisTech, Université de Bordeaux, I2M CNRS UMR 5295, France
[*] Corresponding author: alfonso.pagani@polito.it

Adhesive bonding techniques are increasingly being adopted in aerospace and mechanical engineering for composite applications due to their enhanced performance in comparison to mechanical joints, which provoke preliminary damage and local concentration of stresses. Still, the accurate evaluation of the stress fields that arise at the bonded areas is of paramount importance to predict the mechanical response of the structural component and the associated failure envelopes. In order to reduce the complexity and the computational size of the numerical simulation of adhesive joints, the present study proposes the use higher-order beam models based on the Carrera Unified Formulation (CUF). The idea is to reduce the 3D problem to a 1D analysis based on advanced beam elements which provide 3D-like stress solutions with reduced computational efforts. In the CUF framework, the three-dimensional displacements field is expressed as an arbitrary expansion of the generalized displacements over the cross-section coordinates. For the purposes of this study, a Legendre-based polynomial expansion, named as Hierarchical Legendre Expansion, is employed to interpolate the displacement unknowns over the domain, allowing the user to enrich the model locally in the bonded zone between adherents. The focus of this study is to compute the stress singularities that arise at the interfaces and free-edges of the adhesive. The numerical efficiency of the proposed methodology is assessed through comparison against references from the literature and commercial FEM codes.