Numerical simulation of delamination in laminated structures

I.Kaleel[1], M. Petrolo[1], E. Carrera[1]

[1] MUL[2] Group, Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Italy

The paper presents an efficient computational strategy to model delamination in laminated structures. The numerical framework is a class of refined beam models based on Carrera Unified Formulation (CUF), a generalized hierarchical formulation which provides refined structural theories through a variable kinematic description [1]. Within CUF, the governing equations are formulated in terms of fundamental nuclei, which remain independent of the choice of the structural theory and the finite element order. The Component-Wise approach (CW), a recent extension of one-dimensional CUF models, is utilized to model the laminates within the structure. Delamination is modelled using higher-order interface elements in combination with cohesive-zone models [2]. The constitutive relation for the interface element is governed by the traction-separation law. A dissipation-based arc-length scheme is implemented within the CUF framework to trace the equilibrium path [3]. The arc-length constraint introduced is based on the energy dissipated during the delamination process. The predictive capabilities of the proposed framework are assessed through benchmark delamination problems under quasi-static loading conditions. Results are compared against solutions from the literature and commercial finite element software tools. The applicability and computational efficiency of the proposed framework to capture the delamination growth are highlighted.

References

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