Modeling and Simulation of Delamination in Composite Laminates using Hybrid Brick Elements - CFRAC 2019

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ABSTRACT

Delamination is the most dominant failure mode in composite structures which can occur due to manufacturing defects and impact loads. Cohesive zone model (CZM) is the commonly used technique to simulate the delamination in composite laminates. A fine mesh is required in the cohesive zone to simulate delamination initiation and propagation[1] which is a limitation of the CZM approach. In the present work, a new modeling approach based on hybrid brick elements is proposed to study the delamination failure in composite laminates. Hybrid brick elements are formulated based on two-field variational formulation involving displacement and stress interpolation. The stress solution computed using hybrid elements are more accurate and less prone to locking problems than the displacement brick elements[2]. User element (UEL) subroutine for 8-node and 27-node hybrid brick elements is implemented in the Abaqus finite element software to model the composite laminates. Later, a continuum damage material model is implemented in a hybrid brick element framework to simulate the delamination in laminates. The proposed approach is used to simulate the delamination failure modes observed under Double cantilever beam (DCB), End notch flexure (ENF) and Mixed mode bending (MMB) tests. The simulation results are then compared with the existing cohesive zone model using displacement brick elements.

Keywords: Delamination, Hybrid brick elements, Continuum damage model, Cohesive zone model

REFERENCES

[1] A. Turon, C.G. Davila, P.P. Camanho, J. Costa. An engineering solution for mesh size effects in the simulation of delamination using cohesive zone models. *Eng Fract Mech* (2007) **74**:1665-1682.

[2] C. S. Jog. Improved hybrid elements for structural analysis. *J. Mech. Mater. Struct.* (2010) **5(3)**:507-528.