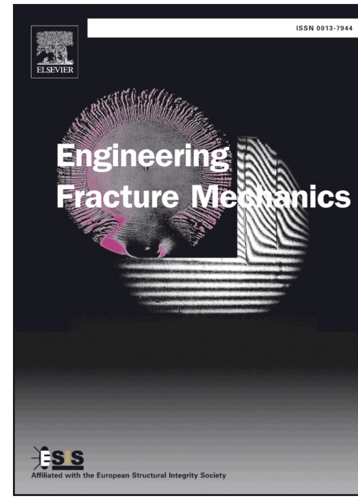

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Finite-thickness cohesive elements for modeling thick adhesives

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Abstract

A new cohesive element formulation is proposed for modeling the initial elastic response, softening, and failure of finite-thickness adhesives. By decoupling the penalty stiffness of the cohesive zone model formulation and the physical adhesive modulus, the new formulation ensures proper dissipation of fracture energy for opening and shear loading modes and mixed-mode loading conditions with any combination of elastic and fracture material properties. Predictions are made using the new element formulation for double cantilever beam, end-notched flexure, mixed-mode bending and single lap joint specimens with varying adhesive thicknesses. Good correlation between all predictions and experimental results was observed.

Keywords: Cohesive zone modeling, Damage mechanics, Mixed-mode fracture, Debonding, Adhesive joints

1. Introduction

The need to produce lightweight composite structures has also increased the use of adhesive joints in their assembly. Compared to mechanically fastened joints, adhesive joints lower stress concentration areas, provide better strength-to-weight ratios and, at the same time, reduce the manufacturing processes required, resulting in cost savings [1]. In the framework of finite element analyses, cohesive elements excel at modeling damage evolution

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