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Abstract

Damage localization around stress raisers and material defects in laminated composites is studied using a discrete damage mechanics model augmented by a fiber damage model. The proposed formulation captures the damaging behavior of plates with initial defects and stress raisers such as holes, including damage initiation, evolution, and ultimate fracture of the specimen. It also helps explain the reduction of stress concentration factor when matrix and fiber damage develop. The state variables are the crack density and the fiber failure damage. The formulation is implemented as a material model in Abaqus applicable to laminated composite plates and shells. Material defects are simulated by inserting an initial crack density in a small region of the specimen. Stress raisers are simulated by an open hole. The predictions are shown to be insensitive to mesh density. Further, damage localizes near stress raiser and material defects, thus numerically demonstrating the objectivity of the proposed model. Qualitative and quantitative comparisons with experimental data are presented.

Keywords

A. Polymer-matrix composites (PMCs); B. Transverse cracking; C. Damage mechanics; C. Finite element analysis (FEA); Objectivity.

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