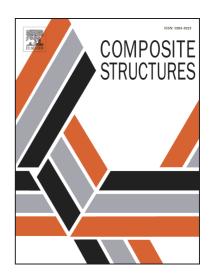
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Multiscale Investigation of Micro-scale Stresses at Composite Laminate Free Edge

Christopher R. Cater¹, Xinran Xiao¹ and Robert K. Goldberg², Xiaojing Gong³

¹Department of Mechanical Engineering, Michigan State University, Lansing, MI 48910, USA

²Ceramic and Polymers Composites Branch, NASA Glenn Research Center, Cleveland, OH 44135, USA

³Université de Toulouse, ICA (Institut Clément Ader), CNRS UMR 5312, UPS, France

ABSTRACT

The free edge effect is well understood at the laminate and lamina scale. The influence of the microstructure on micro-scale stresses and free edge cracking, however, is less known. This work aims at a better understanding of the effect of microscopic features on micro-scale stresses and the tendency of initial micro-cracking at the laminate free edge. To this end, a two-scale finite element (FE) modelling approach is developed. It consists of a meso-scale model to capture the laminate stacking sequence and the global stress field under a given loading condition, and a micro-scale model to predict the local constituent level stresses at the free edge. The two models were coupled one-way through a strain localization rule. A procedure to determine the boundary conditions for micro-scale FE models containing a free edge was proposed. The model was used to examine the 90/90 interface in [25_N/-25_N/90N]_S IM7/8552 carbon/epoxy composite laminates. The effects of thermal and tensile loading were investigated independently to understand the influence of the interlaminar microstructure on micro-scale stresses at free edges during manufacture and under mechanical loading. The results agreed with the trend of free edge pre-cracks and progressive damage observed in experiments.

Keywords: Laminate; Free edge; Multiscale modelling; Interlaminar microstructures.

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