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Progressive damage and failure analysis of three-dimensional braided composites subjected to biaxial tension and compression

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Abstract

This paper investigates the failure behavior of three-dimensional (3D) braided composites subjected to biaxial tension and compression through an improved micromechanical computational method and the finite element (FE) method. The yarns and the out-of-yarn matrix in the composites are modeled by an extended Hashin criterion and an extended Drucker-Prager criterion, respectively. The uniaxial mechanical properties are analyzed based on the available experimental data as a verification of the models. The biaxial progressive damage and failure behavior are investigated using the models. The braiding structure, whose diversity results in the difference in failure modes during damage evolution, has significant influence on the biaxial failure correlation of the composites. The predicting formulae for failure envelopes are suggested in this study. The failure envelopes of 3D four-directional and five-directional braided composites can be described by quadratic tensor theories, and the envelopes of 3D six-directional and seven-directional braided composites can be predicted by the maximum strain criterion.

Keywords: Three-dimensional braided composite; Biaxial stress state; Meso-machanical method; Finite element method; Failure theory.

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