MODELING OF PROGRESSIVE CRUSHING IN ALIGNED AND RANDOMLY ORIENTED CHOPPED FIBER POLYMERIC COMPOSITES

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ABSTRACT

Based on micromechanical formulation and a combination of micromechanical and macromechanical damage criteria, damage constitutive models are presented to predict progressive damage in aligned and random fiber-reinforced composites. Progressive interfacial fiber debonding and microcrack-weakened models are considered in accordance with a statistical function to describe the varying probability of damage. Emanating from an effective elastoplastic constitutive damage model for aligned fiber-reinforced composites, micromechanical damage constitutive models for two- and three-dimensional random fiber-reinforced composites are developed. The constitutive relations and overall yield function for aligned fiber orientations are averaged over all orientations to obtain the corresponding relationships of two- and three-dimensional, random fiber-reinforced composites. The present damage models are implemented numerically and compared with experimental data to illustrate the progressive damage behavior of random fiber-reinforced composites. Finally, the damage models are implemented into a finite element program to illustrate the dynamic inelastic behavior and progressive crushing in composite structures under impact loading.

Keywords: Damage constitutive models, aligned and random fiber composites, progressive crushing, finite element implementation