

CONSTITUTIVE MODELING FOR IMPACT SIMULATION OF RANDOM FIBER COMPOSITE STRUCTURES

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ABSTRACT

A constitutive model for progressive crushing is presented to predict impact behavior and damage evolution in random carbon fiber polymer matrix composites (RCFPMCs). Based on the ensemble-volume averaging process and first-order effects of eigenstrains due to the existence of prolate fibers, an effective yield criterion is derived to estimate the overall elastoplastic damage responses. First, an effective elastoplastic constitutive damage model for aligned fiber-reinforced composites is proposed. A micromechanical damage constitutive model for RCFPMCs is then developed. The governing field equations and overall yield function for aligned fiber-orientations are averaged over all orientations to obtain the constitutive relations and effective yield function of RCFPMCs. Finally, the complete progressive damage constitutive model is implemented into finite element code DYNA3D to solve large scale problems such as automobile components and systems. An advantage of the progressive damage analysis is that the information from the progressive damage model can be implemented into finite element code as material input properties and thus the calculations required in the constitutive model can be greatly reduced.

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