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Calibration and Validation of a Continuum Damage Mechanics Model in Aid of Axial Crush Simulation of Braided Composite Tubes

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Abstract

We present the details of a combined experimental and numerical study used to calibrate the parameters of a macro-mechanical damage model that is incorporated as a user material model in the explicit finite element program, LS-DYNA, to represent the progressive damage behaviour of composites at the level of the representative volume element. Specifically, the model parameters defining the transverse tensile and axial compressive response of a triaxially-braided carbon fibre/epoxy composite are determined based on results from notched tensile, 4-point bend and eccentric compression tests. To demonstrate the validity of the material model and its calibrated input parameters, the response of notched tensile coupon and eccentric compression tests are simulated and shown to correlate well with experimental measurements. Further validation of the model is provided here and in Ref. [1] through successful simulation of the axial crushing of square tubes made of the same material.

Keywords: Braided Composite Tubes; Progressive Crushing; Model Calibration; Finite Element Analysis (FEA); Damage Mechanics; Fracture Tests

1 Introduction

Composite tubes for energy absorption have received considerable amount of attention in the past few decades due to their high specific properties with the potential for weight savings in aerospace and automotive applications. One of the biggest obstacles to the successful integration of these components