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INVESTIGATION ON THE COMPRESSIVE PROPERTIES OF THE 4D IN-PLANE BRAIDED C/C COMPOSITES

Abstract

The compressive mechanical properties of 4D in-plane braided C/C composites are of key concern for design in actual engineering application. A representative Volume Cell is established to investigate the progressive damage and failure mechanism of the 4D in-plane C/C composites under unidirectional compression. The fiber longitudinal compressive damage, fiber bulking, fiber horizontal compressive damage, matrix damage and fiber longitudinal shear nonlinearity are considered in the computation model. The Murakam damage theory is utilized to indicate the anisotropic damage, by which the elastic modulus is degraded. The damage evolution of the constituents is based on the fracture energy, local strain and element characteristic length. With periodic boundary conditions imposed on, the meso-scopic damage initiation, development and failure are accomplished numerically by Abaqus UMAT codes, and the effect of longitudinal shear nonlinearity of fiber bundle on the compressive property is evaluated. The numerical results basically agree with experimental results. The numerical results indicate that fiber longitudinal shear failure is the major failure mode of the 4D in-plane C/C composites under compression, and the axial compressive strength is larger than the radical compressive strength, while the axial compressive modulus is closer to the radical onewhile the compressive strength is larger than the tensile strength, the compressive modulus is lower than the tensile modulus.