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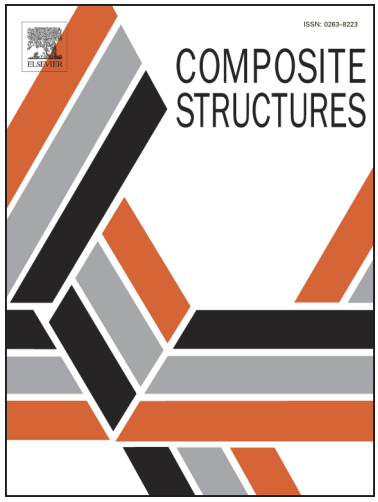

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Comparison of periodic mesh and free mesh on the mechanical properties prediction of 3D braided composites

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Abstract: Periodic unit-cells are the premises for applying the periodic boundary conditions in the meso-scale finite element analysis of textile composites. However, due to the extremely complicated microstructure, there is a conflict between high-quality quick mesh generation and efficient application of periodic boundary conditions. A freely generated mesh of the unit-cell combined with more general periodic boundary conditions is assumed to be a more practical approach. In this paper, the general periodic boundary conditions are imposed by establishing linear constraint equations between master surface nodes and slave surface nodes of the unit-cell on ABAQUS software platform. For the same unit-cell model of 3D braided composites with periodic mesh and free mesh, the deformation, stress distribution and the predicted stiffness and strength properties under typical loadings are compared. The numerical results obtained by means of free mesh unit-cell agree well with those using periodic mesh proving the effectiveness and practicability of the new approach. It can be remarked that the general periodic boundary conditions are suitable for the free mesh generation of unit-cells for a complicated microstructure reducing the difficulty of meshing and improving the quality of mesh generation.

Key words: 3D braided composites, unit-cell, periodic boundary conditions, textile composite, mesh generation, finite element analysis

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