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三维编织复合材料渐进损伤的非线性模型及强度分析

A nonlinear progressive damage model and strength analysis for 3D braided composites

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中文摘要:

建立了考虑周期性位移边界条件的细观体胞模型,对三维编织复合材料的渐进损伤过程进行数值模拟。采用Eshelby-Mori-Tanaka方法计算含损伤裂纹的材料的刚度矩阵,并将元网格尺寸和单元裂纹尺寸引入损伤演化方程,有效地降低了模拟结果对有限元网格的依赖程度。通过计算得到了材料应力应变的非线性关系和失效时的极限强度,并分析了材料的理。结果表明,大编织角材料的破坏模式主要是基体失效与纤维横向拉剪破坏,模拟计算结果与文献中的实验值吻合较好。

英文摘要:

A representative volume unit cell for 3D four-step braided composites with the periodic boundary condition was established to simulate the progressive damage behaviors.The Eshelby-Mori-Tanaka method was applied to calculate the stiffness matrix of damaged materials.In order to alleviate the mesh dependence size of the finite element and the crack were considered in the damage evolution equation.The non-linear stress-strain relationship and the critical tensile strength were obtained through numerical simulation,and the failure mechanism of composites with large braiding angle was also discussed.It is shown that th failure modes of composites with large braiding angle are matrix cracking,transverse tensile and shear failure of yarns.The results in the paper agree well the experiments in the literature.

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