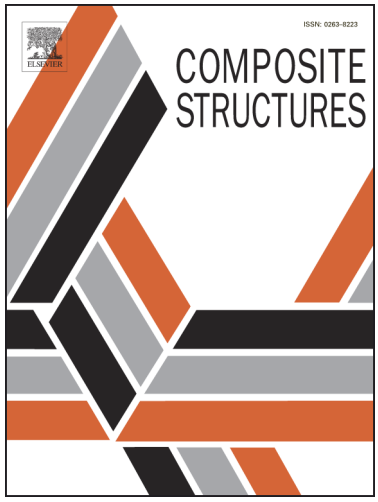

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MODELING OF THERMOPLASTIC POLYMER FAILURE IN FIBRE REINFORCED COMPOSITES

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Abstract

The paper proposes a material model that characterizes the plastic behavior and damage accumulation in thermoplastic matrix in dependence on the type of the stress state that the matrix undergoes during loading. The model is applied (1) to the case of transversal tension loading of periodic cells of unidirectional composites with random spacing of fibers and (2) to the analysis of interface failure during fiber pull out tests. The first case validates the theory on the base of the experimental data for PEEK carbon reinforced composites. In the second case it is shown that in the interface area, with increase of plasticity deformations, the matrix material displays strengthening effect due to changes of stress state type. All constants required for stress analysis are given in terms of standard models embedded in well-known commercial FEM suites.

Keywords: Thermoplastic composite, polyetheretherketone (PEEK), plasticity criterion, failure criterion

1. Introduction

Thermoplastic composites are gaining increasing popularity as a structural material in modern industry. A distinctive feature of such material is the ability to change its phase state, turning into a viscous, near liquid state under high temperature. All manufacturing processes of producing complex shaped components of thermoplastic composites are based on this effect of phase transition. The manufacturing process induces residual stresses that can cause the matrix failure during cooldown of