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Three-Dimensional Thermoelastic Analalysis of Plain Weave Glass/Epoxy Composities with Cracks at Cryogenic Temperatures

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This paper examines the thermo-mechanical behavior of cracked G-11 woven glass/epoxy laminates with temperature-dependent material properties under tension at cryogenic temperatures. Three-dimensional finite elements are employed to model the architecture of the two-layer woven laminates. It is assumed that the cracks are confined to individual fiber bundles oriented transverse to the tensile load direction and span the thickness of the fiber bundles. The effects of residual thermal stresses caused by differences in the coefficients of thermal expansion of the composite constituents, and cracks on the mechanical behavior of two-layer G-11 woven laminates at cryogenic temperatures are explored. Numerical results for the Young's modulus and Poisson's ratio of the woven laminates are obtained and discussed. A discussion on the findings from the three-dimensional finite element analysis are also given, with particular focus on the stress distributions and concentrations inside the woven composites under combined mechanical and thermal loads.

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