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Micromechanical Investigation on the Influence of Thermal Stress on Elastic Properties of Fiber-Reinforced Composites

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Abstract : Due to its use in a broad range of temperatures, the prediction of elastic properties of fiber composite materials under thermal load is significant. Especially the transversal stiffness dominates the potential of use for fiber-reinforced composites (FRC). A numerical study on the influence of thermal stress on transversal stiffness of fiber-reinforced composites is presented. In the numerical study, a representative volume element (RVE) is used to estimate the elastic properties of a unidirectional ply with finite element method (FEM). For the investigation, periodic boundary conditions are applied to the RVE. Firstly, the elastic properties under pure mechanical load are derived numerically and compared to results, which are obtained by analytical methods. Thereupon thermo-mechanical load is implemented into the model to investigate the influence of temperature change with low temperature as a key aspect. Regarding low temperatures, the transversal stiffness increases intensely, especially when thermal stress is dominant over mechanical stress. This paper outlines the employed numerical methods as well as the derived results.

Keywords : elastic properties, micromechanics, thermal stress, representative volume element
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