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Effect of fiber packing on transverse shear modulus G_{23} of a unidirectional composite material Glass / Epoxy

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ABSTRACT

Composite materials are widely used in the manufacture of mechanical and civil engineering structures. These materials are characterized by heterogeneity and anisotropy, so they present a great challenge of the prediction of the mechanical characteristics of the matrix/fiber mixture and especially in the transverse plane (2-3). The values of the transverse shear modulus G_{23} are always interesting researchers because of the diversity of results obtained by several approaches (analytical, numerical) and this modulus is used to study the mechanical behavior of composites in 3D. The main objective of this study is the predicting of G_{23} values within a unidirectional composite material with 44.3% fibers by volume, and to study the effect of the random position of the fibers on the mechanical behavior in shear for ten representative square elementary volumes (RVEs). Each RVE is composed of 16 cells (fiber with matrix or matrix without fiber) with a side of 48 µm. The composite material used in the numerical modeling corresponds to a unidirectional ply (UD) based on epoxy resin and long glass fiber (E) with a circular section. The developed numerical model to determine the transverse shear modulus G_{23} is carried out using finite element software CASTEM. Ten calculation programs using the GIBIANE language were developed. The obtained results were compared with those obtained by analytical and other available numerical models.

Keywords: *Micromechanics analysis ; Composite material ; Transverse shear modulus; Prediction of properties; CASTEM; Arrangement of the fibers.*