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Virtual tests of elastodynamic response of natural fiber-reinforced orthotropic plates

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Abstract: Natural fiber-reinforced composite (NFRC) is a new type of environmental-friendly material for the excellent performance in natural degradation, low cost and rich sources. The mechanical parameters such as elastic modulus of NFRC material is intrinsically inhomogeneous, and a normal distribution model of Young's modulus of natural fibers combined with finite element method (FEM) was developed to investigate the elastodynamic response of NFRC plates. The FEM with heterogeneity material model allows every computation produces a different result, which thus can be taken as a virtual test for NFRC structures, and the statistical result can be obtained according to multiple computations. It is found that in-plane displacements of plate increase dramatically and cannot be rationally neglected even for a thin NFRC plate when the inhomogeneity of Young's modulus of natural fibers was considered. The displacement oscillation and deflection distortion were clearly observed during the impact response, where the high curvature of deflection contours indicated high deformation gradient and may cause the potential local damage. Also it is found that material inhomogeneity is the other important factor to excite dynamical rhythm response of NFRC plates.

Keywords: Natural fiber-reinforced composite; Orthotropic plate; Elastic modulus inhomogeneity; Virtual test; Dynamic response

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