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Large amplitude free vibration of a shear deformable laminated composite parabolic plate with parabolically orthotropic plies

Abstract

The large amplitude free vibration of a laminated composite parabolic plate with parabolically orthotropic plies is investigated for the first time. The effects of out-of-plane shear deformations, rotary inertia, and geometrical nonlinearity are taken into account. The geometry of the plate is described, and the analysis performed in the parabolic coordinate system. The problem is solved numerically using a new parabolic hierarchical finite element. The nonlinear equations of free motion are mapped from the time domain into the frequency domain using the harmonic balance method. The resultant nonlinear equations are solved iteratively using the linearized updated mode method. Results for the fundamental linear and nonlinear frequencies are obtained for symmetric and antisymmetric laminates with clamped and simply supported edges. Comparisons are made with the finite element method for clamped and free isotropic parabolic plates and show excellent agreement. The aspect ratio, thickness ratio, moduli ratio, number of plies, layup sequence, and boundary conditions are shown to affect the hardening behavior.