Abstract

NONLINEAR VIBRATIONS OF AXIALLY-LOADED ANTI-SYMMETRIC CROSS-PLY CYLINDRICAL SHELLS

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The present research investigates the free nonlinear vibrations of axially loaded anti-symmetric cross-ply cylindrical shells.

On basis of the Timoshenko-Mindlin's kinematical hypothesis, the von Karman-Donnell's nonlinear theory is extended to improve the von Karman-Donnell's nonlinear theory for axially loaded anti-symmetric cross-ply cylindrical shells to accommodate the shear deformation and rotary inertia. By applying the Hamilton's principle, the governing equations for the axially loaded nonlinear vibrations are formulated and expressed in terms of the Airy stress function, two rotations and the transverse deformation. Presently, there are two boundary conditions under consideration: all-simply-supported and all-clamped end conditions. After we assume the solutions as series, Galerkin's Method and Harmonic Balance Method are employed to solve those partial differential equations. After applying these methods, those partial differential equations will be transferred to a series of nonlinear algebraic equations, which could be solved by the nonlinear equation solver.

Based on vast calculations, effects of the axial load on the free nonlinear vibrations of anti-symmetric cross-ply cylindrical shells are investigated extensively under all kinds of geometrical conditions and also for two different boundary conditions. For general amplitude-frequency responses with both softening and hardening nonlinearity, the axial load will not change the nature of responses, but will always reduce the frequency. For larger axial load, the amplitude-frequency responses show the hardening nonlinearity at smaller amplitude and show stronger hardening nonlinearity too. Details of the analysis and conclusions are presented in this thesis.