Abstract

The work presented in this dissertation describes the buckling, postbuckling and small amplitude vibration behavior about the prebuckling and postbuckling equilibrium states of laminated composite plates and shallow shell panels, subjected to thermal and mechanical compressive edge loads. The structural model used in the present study is based on a higher-order transverse shear deformation theory of shallow shells that includes the von kármán-type geometric nonlinearities and initial geometric imperfections. The present higher-order formulation is based on the displacement field that accounts for parabolic distribution of the transverse shear strains through thickness of the shell and tangential stress-free boundary conditions on the boundary surfaces of the shell.

The objective of the present study is to investigate the postbuckling and postbuckled vibrations of laminated composite plates and shells, and to obtain accurate analytical results using multi-term Galerkin's method for a wide range of loading and structural parameters.

The solutions to the governing nonlinear partial differential equations are sought using the multi-term Galerkin's method. A convergence study has been carried out by taking various numbers of terms in the displacement field approximation. The equilibrium configurations for a given plate or shell panel are obtained using a Newton-Raphson procedure or Newton-Raphson procedure in conjunction with arc-length procedure. The small amplitude free vibration frequencies in prebuckling and in postbuckling range of a plate/shell panel are obtained solving the associated linear eigenvalue problem. Results are presented for different simply supported laminated composite plates and shell panels, illustrating the influence of temperature field, lateral pressure loads and mechanical edge loads on the static response and vibration behavior.