ABSTRACT

The non-linear static and dynamic instability analyses of composite skew plates and shell panels subjected to non-uniform in-plane mechanical (parabolic, partial and concentrated) and localized thermal (partial rectangular, central and dome shape) loadings are studied in this thesis. The laminated composite skew plates and rectangular plates are modeled based on first order shear deformation theory (FSDT) incorporating von Kármán non-linearity. Love's shell theory incorporating FSDT and von Kármán type of non-linearity are used to model the composite cylindrical and conical shell panels.

The prebuckling stresses developed within the skew plates and the shell panels, subjected to non-uniform in-plane mechanical and localized thermal loadings, are not known a *priori*. In order to estimate the critical bucking load/temperature of the plate and shell panel, two step approach is adopted – (i) the prebuckling stress distributions within the plates and the shell panels are first evaluated by solving the in-plane elasticity/thermoelasticity problem and (ii) using these prebuckling stress distributions the governing partial differential equations describing the static and dynamic instability behavior of composite skew plates and shell panels are derived via Hamilton's principle. Using either generalized differential quadrature method or Galerkin method, the non-linear static stability of plates and shell panels are studied. The critical buckling load/temperature of plates and shell panels is obtained by solving the associated eigenvalue problem and the postbuckling equilibrium paths are traced using modified Newton-Raphson method in conjunction with Riks approach. The Bolotin method is adopted to trace the boundaries of instability regions. The nature of instability regions are studied by plotting dynamic responses in stable and unstable regions via Newmark's method. The dynamic buckling load of imperfect composite plate subjected to in-plane pulse loading is computed based on the Tsai-Wu failure criterion. The effects of plate and shell geometric parameters, damping, and various types of mechanical and thermal loadings, boundary conditions and influence of initial geometric imperfections on the static and dynamic instability behaviour are studied.

ABSTRACT

The load carrying capacity of thin shell panels reduces drastically in the presence of imperfections. In this investigation, the local imperfections present in shells are identified based on a simple, yet robust, penalty based inverse approach within the framework of geometric nonlinear finite element method. Using the present algorithms, single and multiple dent type imperfections were identified based on sparse displacement measurements. After identifying the local imperfections, the load carrying capacity of shell panels are estimated.

Keywords: *Composite skew plates, Composite shell panels, Buckling, Postbuckling, Postbuckled vibration, Dynamic instability, Dynamic buckling, Non-uniform mechanical loading, Localized thermal loading, Initial geometric imperfection*