Abstract

Structural components are often subjected to in-plane periodic loads, which may lead to dynamic instability, due to certain combinations of the applied in-plane forcing parameters and the natural frequency of the transverse vibration.

The work presented in this thesis is concerned mainly with the buckling, vibration and dynamic instability characteristics of stiffened plates with/without cutouts under various types of uniform and non-uniform in-plane edge loading.

A finite element formulation based on the Mindlin's plate theory is used to derive the governing equations for the dynamic behaviour of the stiffened plates. A nine noded isoparametric element, which is a well-established element, is employed in the present analysis with five degrees of freedom per node for the stiffened plate problem. The effect of transverse shear deformation is taken into account to Mindlin's hypothesis i.e., first order shear deformation theory. Element elastic stiffness matrices, mass matrices and geometric stiffness matrices for the elements are derived with the help of suitable interpolation functions (shape functions) within the elements and integrating various expressions over the element area by using the Gauss quadrature numerical integration technique. Since the stress field is non-uniform, due to arbitrary nature of the applied in-plane load, pre-buckling analysis is carried out using the finite element method to determine the stresses and these are used to formulate the geometric stiffness matrix. The global elastics stiffness, mass and geometric stiffness matrices are stored in single array using the skyline storage technique. The eigenvalues are obtained by the simultaneous iteration scheme of Corr and Jenning.

Qualitative results are presented to show the effects of geometry, boundary conditions, aspect ratios, static and dynamic load factors, load band width and stiffener parameters on the stability boundaries. The effects of different size of cutout on buckling, vibration characteristics and instability regions are presented. Conclusions are drawn highlighting the important findings of the study.

Thesis organization: The entire thesis is organized into **five** chapters.

The **chapter 1** includes the general introduction and the importance of the present studies. The general method of solving static and dynamic stability of stiffened plates with/without cutout have been briefly addressed in this chapter.

The review of related literature confining to the scope of the study has been presented in the **Chapter 2.** The various works done and the general method of solving dynamic stability of stiffened plates have been briefly addressed in this chapter. The objective and scope of the present investigations have been presented in this chapter.

The **Chapter 3** presents the finite element formulation, the governing equations and the method of solution for the problem under consideration. The analysis is focused mainly on the determination of the primary instability region, which is important in practical use.

Detailed results and discussions on the static stability (buckling) and dynamic stability characteristics of stiffened plates with /without cutout under in-plane loads are given in **Chapter 4**.The results have been compared with analytical and experimental values, wherever possible and the discrepancies, if any, have been discussed. Several new problems are solved and the results are discussed to study the effects of various parameters on buckling, vibration and dynamic stability of stiffened plates with and without cutouts.

Important conclusions drawn from the theoretical findings in the present investigation are listed in **Chapter 5**. Possible scope of extension of the present study has been appended to the concluding remarks. A list of references cited in the text is given after the end of the last chapter.
The computer programme and its features are explained with flow charts in the Appendix.

Key words: Dynamic stability, Parametric resonance, Dynamic instability regions, Stiffened plates, Finite element method, Non-uniform loading, Vibration, Buckling, Instability, Natural frequencies, In-plane loading and Cutouts.