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PARAMETRIC EXCITATION OF PLATES WITH CUTOUTS

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ABSTRACT

Stiffened plates are structural components consisting of plates reinforced by a system of ribs to enhance their load carrying capacities. Cutouts in aerospace, civil, mechanical and marine structures are inevitable mainly for practical and design considerations. The present paper deals dynamic instability analysis of eccentrically stiffened plates with cutout subjected to harmonic in-plane partial edge load using Bolotin's method and Hill's infinite determinants. Finite element formulation is applied to study the effects of different boundary conditions, aspect ratios, cutout size, various partial edge loading position.

Keywords: excitation frequency, stiffened plates, cutouts.

INTRODUCTION

The stiffened plates are often subjected to dynamic in-plane loads of varying magnitude and complexity. Cutouts in aerospace, civil, mechanical and marine structures are inevitable mainly for practical and design considerations. The instability effects are improved with the provision of stiffeners. The dynamic instability of stiffened plates with cutout subjected to uniform and non-uniform in-plane edge loadings are of considerable importance. Stiffened plates subjected to dynamic in-plane loading may undergo unstable transverse vibrations for certain combinations of the values of the load parameters. The present paper deals dynamic instability analysis of eccentrically stiffened plates with cutout subjected to harmonic in-plane partial edge load using Bolotin's method and Hill's infinite determinants. Parametric instability characteristic of rectangular plates with localized damage subjected to in-plane periodic load is studied.

In the present analysis, the plate is modelled with nine noded isoparametric quadratic element where the contributions of bending and membrane actions are taken into account. One of the advantages of the element is that it includes the effect of shear deformation and rotary inertia in its formulation. Thus the analysis can be carried out for both thin and thick plates. Moreover, it can be applied to a structure having irregular boundaries with some modifications. The formulation of the stiffener is done in such a manner that it may lie anywhere within a plate elements . In order to maintain compatibility between the plate and the stiffener, the interrelation functions used for the plate are used for the stiffeners also

RESULTS AND CONCLUSIONS

The effect of cutout size on the instability region of the simply supported stiffened square plate at load position c/b = 0.4 is studied from 0.0 (no cutout) to cutout ratio (ratio of size of cutout to length of plate) 0.8 at an interval of 0.2 in figure 1.

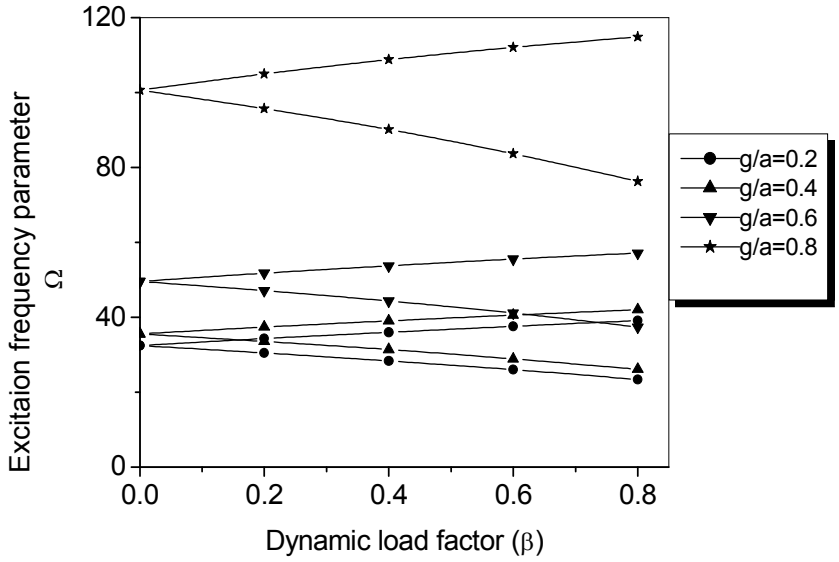

Fig. 1- Effect of cutout size (g/a) on dynamic instability region of a simply supported stiffened square plate having one central stiffener with cutout subjected to partial edge load at one end. α = 0.2, c/b = 0.4

It can be observed that the width of instability regions increases with the increase of cutout size (g/a) and the onset of instability occurs with lower excitation frequencies for small cutout.

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