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Effect of Temperature on Free Vibration of Functionally Graded Plate with Cut-out

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Abstract: Present article performs the parametric study on vibration characteristics of functionally graded (FG) plate with central hole in thermal environment. ANSYS Parametric Design language is used in developing Finite element model and discretization of the material is done using an eight-node serendipity shell element. Displacement field of the present model is developed using first-order shear deformation theory (FOSDT) with six degrees of freedom. Frequency responses are extracted using Block Lanczo's eigenvalue extraction method. To show the accurateness of the model developed convergence study is done for various mesh sizes to obtain the suitable mesh density. Present results which are computed are compared and validated with the previously reported results. Finally, the effect of temperature on various parameters like cut-out size to thickness ratio, cut-out size to side ratio, power law index, side to thickness ratio, boundary conditions are shown through various numerical illustrations.

Keywords: Free vibration, functionally graded plate, cut-out, ANSYS APDL

1. Introduction

Functionally Graded Materials (FGM) are a new class of materials which are tailored for the desired properties by varying their composition from one surface to another surface. In general, these FGM's are blend of ceramics and metals to obtain the paramount properties of its component. These materials can overcome the inter-laminar stress which cannot be avoided in a composite. These FGM's are widely used in aerospace, biomedical, space structures and in high temperature applications. This has created interest in many researchers and scientist during the past decade to study structural stabilities of FGM'S.

Consequence of different parameters like volume fraction exponent, support conditions, edge to depth ratio and cut-out size on natural vibration of FG square plate with triangular cut-outs using ANSYS was investigated in [1]. Experimentation was conducted under tensile loading on a Glass/Epoxy composite with circular and square cut-outs and found that circular cut-outs has more load carrying capacity [2]. Finite element method (FEM) is applied in extraction of free vibration of FG plates with multiple holes [3]. Mechanical, thermal buckling and free vibration

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