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Mechanical buckling of functionally graded plates using a refined higher-order shear and normal deformation plate theory

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Abstract. Mechanical buckling of a rectangular functionally graded plate is obtained in the current paper using a refined higher-order shear and normal deformation theory. The impact of transverse normal strain is considered. The material properties are microscopically inhomogeneous and vary continuously based on a power law form in spatial direction. Navier's procedure is applied to examine the mechanical buckling behavior of a simply supported FG plate. The mechanical critical buckling subjected to uniaxial and biaxial compression loads are determined. The numerical investigation are compared with the numerical results in the literature. The influences of geometric parameters, power law index and different loading conditions on the critical buckling are studied.

Keywords: functionally graded plates; a refined higher-order normal and shear deformation theory; Navier's procedure; mechanical buckling analysis

1. Introduction

Functionally graded materials (FGMs) are advance composite materials were discovered by Japanese scientists in 1984. The material properties microscopically inhomogeneous and differ continuously in spatial direction which lead to uniform stress distribution. FGMs are a blend of metal and ceramic can be made in different order. The ceramic well known of its high-temperature resistance also play a major role in the prevention of oxidizing process of the metal whereas the metal helps stiffen the structure. FGMs help to solve some of the conventional materials problems such as matrix cracking, stress concentrations and interfacial debonding. There are diverse range of applications of FGM in astronautics, energy, biomedical and nuclear sectors.

The buckling analysis of FGM exposed to different loads conditions has been examined by many researchers such as Reddy (1997), Feldman and Aboudi (1997), Thai and Vo (2013), Yang *et al*. (2005), Neves *et al*. (2013), Fekrar (2012), Saha and Maiti (2012) and Mozafari and Ayob (2012). Huang and Li (2010) analyzed the mechanical buckling of FGM columns exposed to uniform compression and taking shear deformation into account and compared it with three columns theories. Kiani and Eslami (2010) examined the buckling temperature of FG columns in

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