THREE DIMENSIONAL SHEAR BUCKLING OF FG PLATES WITH VARIOUS BOUNDARY CONDITIONS

B. Uymaz* and M. Aydogdu†

* Namık Kemal Üniversitesi, Çorlu Mühendislik Fakültesi, Tekirdağ
e-mail: buymaz@nku.edu.tr, web page: http://www.nku.edu.tr

† Trakya Üniversitesi, Mühendislik-Mimarlık Fakültesi, Edirne
e-mail: metina@trakya.edu.tr, web page: http://www.trakya.edu.tr

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Summary. The shear buckling analysis of rectangular functionally graded plates under different boundary conditions is performed. The analysis is based on the small strain elasticity theory and the material properties of the plate vary through the thickness direction according to a simple power law. Three dimensional buckling solutions are obtained using the Ritz method with Chebyshev polynomials as assumed displacement functions. The convergence and comparison studies are presented and effects of the different material composition and the plate geometry (side-side, side-thickness) on the critical buckling loads and mode shapes are investigated.

1 INTRODUCTION

Functionally graded materials (FGM) are high advanced technology materials because of their microstructures produce continuously or discretely changing thermal and mechanical properties at the macroscopic or continuum scale. This property of FGMs makes it preferable for many applications ranging from thermal structures in advanced aircraft and aerospace engines to computer circuit boards involving severe thermal gradients [1]. Recently, many more applications can be found such kind of the solar energy conversion devices [2], dental implants [3] and naturally occurring biological FGMs [4,5].

Because of the usage of high strength materials on engineering structures, the structural elements such as beams, plates and shells are thinner and much more slender. However, safety of these kind of elements are restrained by the critical buckling load. The buckling behaviour of composite plates under axial, lateral and shear loading has been considered by many researchers during the recent years. Shear buckling was considered for isotropic plates by Southwell [6] and for orthotropic plates by Lekhnitskii [7]. Design of laminated composite plates for maximum shear buckling loads by the finite element method was studied by Chang et al. [8]. Closed-form exact solutions for the buckling problem of composite plates and orthotropic plates subjected to linearly varying axial compression are presented by Reddy [9,10] and Whitney [11]. In many studies, the interaction between the inplane shear and compressive loads and its influence on the buckling load of rectangular composite plates were analyzed with different numerical techniques [12-16].
Of particular interest in this paper is shear buckling behaviour of FG plates loaded by the uniformly distributed in-plane shear forces. Three dimensional buckling solutions are obtained using the Ritz method and assumed displacement functions are in the form of the triPLICATE series of Chebyshev polynomials multiplied by a boundary function. Considered boundary conditions are simply supported, at least, at their opposite two edges and can be subjected to any one of the free (F), simply supported (S) and clamped (C) edge boundary conditions at the remaining ones.

REFERENCES