Accepted Manuscript

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PII: S1359-8368(15)00304-2

DOI: 10.1016/j.compositesb.2015.05.010

Reference: JCOMB 3597

To appear in: *Composites Part B*

Received Date: 14 November 2014

Revised Date: 7 April 2015

Accepted Date: 5 May 2015

Please cite this article as: Alinaghizadeh F, Shariati M, Geometrically non-linear bending analysis of thick two-directional functionally graded annular sector and rectangular plates with variable thickness resting on non-linear elastic foundation, *Composites Part B* (2015), doi: 10.1016/j.compositesb.2015.05.010.

Geometrically non-linear bending analysis of thick two-directional functionally graded annular sector and rectangular plates with variable thickness resting on non-linear elastic foundation

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Abstract

Non-linear analysis of two-directional functionally graded annular sector plates has not been performed yet. The present paper focuses on the non-linear bending analysis of variable thickness two-directional functionally graded circular/annular sector plates resting on the non-linear elastic foundation using the generalized differential quadrature (GDQ) and the Newton-Raphson iterative methods. The material properties vary simultaneously along transverse and radial directions according to a power-law distribution of the volume fraction of the constituents. Based on higher-order shear deformation theory (HSDT) with nine degree of freedom in the displacement field and von Kármán's non-linearity, the equilibrium equations are derived using the principle of minimum total potential energy. In order to eliminate the stretching-bending coupling, the concept of physical neutral surface is applied to the HSDT. The elastic foundation is modeled as shear deformable with hardening/softening cubic non-linearity. Rectangular plates are also analyzed based on the HSDT by a proper change in the geometry of annular sector plates. The results of present study are compared with those available in the literature and close agreement is observed. The effects of power-law indices, thickness variation, coefficients of foundation, various boundary conditions and geometrical parameters on linear and non-linear static behaviors of circular/annular sector plates

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