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ORIGINAL PAPER

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Assessment of the effect of the materials composition on the bending response of FG plates lying on two models of elastic foundations in thermo-hygro-mechanical environments

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Abstract This study fulfils a thermo-hygro-mechanical analysis of the bending behavior of FG plates resting on different elastic foundation models. A quasi-3D high-order shear deformation theory with five unknowns is used herein to perform this analysis. The impact of shear deformation and stretching effect are included in the formulation of the used approach. The result of the change in material characteristics and the volumetric fraction of components on the bending response of FG plates in a thermo-hygro-mechanical environment is analyzed and discussed. The principle of virtual displacements is used to obtain the equilibrium equations, and the Navier-type solution is applied to solve the resulting equations. The results show that the increase in thermal load and moisture concentration causes a rapid deflection increase. Furthermore, the Winkler parameter influences the shear stresses more than the deflections.

1 Introduction

Technological developments have introduced a new generation of composite materials called functionally graded materials (FGMs). They are widely used in diverse areas such as aerospace, nuclear reactors, power sources, biomechanical, optical, civil, automotive, electronic, chemical, and mechanical engineering. It is basically due to their capability to ensure a continuous variation in thermo-physical properties. The mechanical characteristics such as material density, Young's elastic modulus, and Poisson's ratio change gradually in one or more directions based on the volume fraction of their component materials. The progressive variation of mechanical characteristics is relevant because it prevents material discontinuities and abrupt changes in the

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