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Buckling analysis of higher order graded smart piezoelectric plates with porosities resting on elastic foundation

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Abstract

In this study, examination of buckling behavior of functionally graded piezoelectric (FGP) plates with porosities is conducted employing a refined four-variable plate theory. By capturing shear deformation effects, the present inverse trigonometric theory is needless of shear correction factor. Electro-elastic material properties of porous FGP plate vary across the thickness based on modified power-law model. Implementing an analytical approach which satisfies different boundary conditions, governing equations derived from Hamilton's principle are solved. The obtained results are compared with those provided in literature. It is indicated that the buckling behavior of piezoelectric plates is significantly influenced by elastic foundation parameters, external voltage, porosity distribution, power-law index, boundary conditions and aspect ratio

Keywords: Electro-mechanical buckling, Four-variable plate theory, Functionally graded piezoelectric plate, Porosities, Analytical method.

1. Introduction

Multi-phase composite materials, which are known as functionally graded materials (FGMs) possess spatially graded microstructure to achieve particular mechanical properties to suit the functionality of structures. The gradually composition variations of the material constituents from one surface to another provide a proper solution to the problem of induced transverse shear stresses due to the two bonded dissimilar materials with high difference in material properties. Also, due to containing outstanding mechanical properties, FGMs are appropriate for design of engineering structures. Moreover, piezoelectric materials are known as a type of smart structures