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Non-linear analysis of porous elastically supported FGM plate under various loading

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Abstract

In this paper, nonlinear transverse central deflection and stress analysis of a functionally graded porous material (FGPM) are investigated by higher order shear deformation theory (HSDT) based on multiquadrics radial basic function (MQ-RBF) meshfree method under various types of loadings and Elastic foundations. The material property of the FGM plate is assumed to vary in the thickness direction and is estimated through the modified Power law homogenization technique with three types of porosity distribution. The governing differential equations (GDEs) are derived from the energy principle containing the porosity effects with the aid of the von Kármán kinematic assumptions and linearized using quadratic extrapolation technique. Convergence and validation studies have been carried out to demonstrate the stability and efficiency of the present method. Numerical results for various types of load, grading index, porosity distribution, porosity index, different span to thickness ratios, and effect of the foundation have been presented.

Keywords: FGM plate; Meshfree method; Bending; Porosity volume fraction; Transverse loads; Elastic foundations

1. Introduction

Continuous improvement in the structural research in industry has imposed the need to upgrade conventional materials with advanced and modern ones wherever possible. FGM is one of the unique heterogeneous materials which was firstly proposed by a group of Japanese scientists in 1984 [1]. FGM is the nonhomogeneous materials in which two or more materials (mainly ceramics and metals) combine and the gradation of material properties vary from one phase to other phases by predetermined manner. Due to their unique functional properties such as the large mechanical strength, toughness, and high-temperature resistance with excellent corrosion resistance, it became demanding materials. FGM has been widely used in building structures, pressure vessels, marine ships, automobile industries, and other allied applications.

In most of the studies, many investigations have been examined the linear bending analysis of FGM plate with and without porous medium and elastic effects. Qian et al., [2] examined static and dynamic deformation of a square FGM elastic plate by using meshless local Petrov-Galerkin (MLPG) method. Ferreira et al., [3] used MQ-RBF based meshfree method for bending analysis of simply supported(SS) FGM plate. Bending analysis of SS FGM plate subjected to a transverse uniformly distributed load (UDL) was examined by Zenkour, [4]. The bending analysis of SS FGM plate resting on an elastic foundation by using proposed

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