Journal of Theoretical and Applied Mechanics, Sofia, Vol.54 (2024) pp. 89-102
SOLID MECHANICS

QUASI-3D ANALYTIC MODEL FOR FREE VIBRATION ANALYSIS OF SIMPLY SUPPORTED FUNCTIONALLY GRADED PLATES (SS-FGP)

SALAH REFRAFI[1], ABDELAZIZ BOUTRID[1],
ABDELHAKIM BOUHADRA[1,2*], ABDERRAHMANE MENASRIA[1,2],
BELGACEM MAMEN[1,2]

[1]*University of Abbes Laghrour Khenchela,*
Faculty of Sciences & Technology, Civil Engineering Department, Algeria
[2]*Materials and Hydrology Laboratory, University of Sidi Bel Abbes,*
Faculty of Technology, Civil Engineering Department, Algeria

[Received: 23 November 2022. Accepted: 9 March 2023]

doi: https://doi.org/10.55787/jtams.24.54.1.089

ABSTRACT: This paper uses a quasi-3D shear deformation theory accounting for integral terms and including the stretching effect to study the free vibration of FG plates with simply supported edges. A new function shape is used to show the variation of tangential stresses through the z-direction of the plate. Poisson's ratio is supposed to be constant, but Young's modulus and densities are assumed to be graded in the thickness direction according to the power law function. The present plate theory satisfies the zero tension on the upper and lower surfaces of the FG plate without using shear correction factors. The equations of motion are obtained via Hamilton's principle and solved using Navier's solution type. The present natural frequencies correspond with the ones in many publications; the outcomes of geometrical ratio, side to thickness ratio, and the material index on the natural frequencies of SS-FGP are investigated.

KEY WORDS: SS-FGP; quasi-3D model; stretching effect; free vibration; Hamilton's rule; Navier's solution.

1 INTRODUCTION

Functionally graded materials (FGMs) are advanced composite materials that have a continuous variation of material properties from one surface to another, thus eliminating the stress concentration found in laminated composites. The concept of FGMs was first proposed in 1984 by a group of material scientists in Japan, Koizumi [1]. FGMs offer great promise in applications where the operating conditions are severe.

*Corresponding author e-mail: abdelhakim.bouhadra@univ-khenchela.dz