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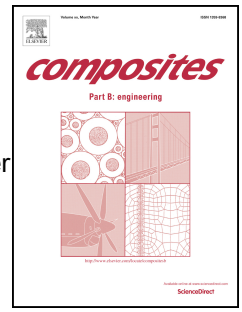

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Vibration and stability analysis of functionally graded sandwich beams by a multi-layer finite element

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Abstract

This paper presents a finite element model based on the first-order shear deformation theory for free vibration and buckling analyses of functionally graded (FG) sandwich beams. The present element has $3N+7$ degrees-of-freedom for an N-layer beam. Lagrange's equations are employed for derivation of the equations of motion. Two types of FG sandwich beams are considered: (a) Type A with FG faces and homogeneous ceramic core, and (b) Type B with homogeneous ceramic and metal faces and FG core. Natural frequencies and buckling loads are calculated numerically for different boundary conditions, power-law indices, and span-to-height ratios. Accuracy of the present element is demonstrated by comparisons with the results available, and discussions are made on the results given in graphs and tables for the sandwich beams considered.

Keywords: Functionally graded material; Finite element method; Free vibration; Buckling; First-order shear deformation theory

1. Introduction

Functionally graded materials (FGMs) are special composites in which two or more materials varies spatially to have a desired property gradation. Due to their superior

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