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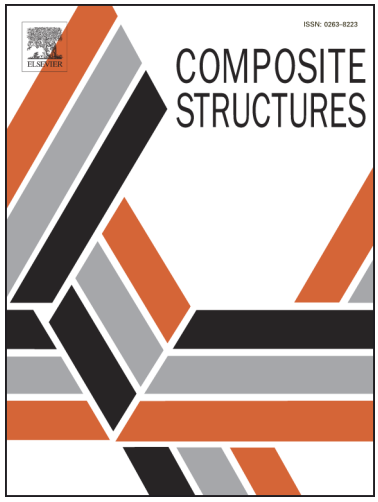

Nonlinear analysis of functionally graded fiber reinforced composite laminated beams in hygrothermal environments, Part I: Theory and solutions

Hui-Shen Shen

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Nonlinear analysis of functionally graded fiber reinforced composite laminated beams in hygrothermal environments, Part I: Theory and solutions

Hui-Shen Shen *

School of Aeronautics and Astronautics, Shanghai Jiao Tong University, Shanghai 200240, People's Republic of China

Abstract

This paper investigates the large amplitude vibration, nonlinear bending and thermal postbuckling of anisotropic laminated beams resting on an elastic foundation in hygrothermal environments. The beam is made of fiber reinforced composites (FRCs) with the reinforcement being distributed either uniformly (UD) or functionally graded (FG) of piece-wise type along the thickness of the beam. The motion equations are based on a higher order shear deformation theory with a von Kármán-type of kinematic nonlinearity. The beam-foundation interaction and hygrothermal effects are also included, and the material properties of FRCs are estimated through a micromechanical model and are assumed to be temperature dependent and moisture dependent. A two-step perturbation technique is employed to determine the nonlinear to linear frequency ratios of beam vibration, the load-deflection curves of beam bending, and thermal postbuckling equilibrium paths of FRC laminated beams.

Keywords: Laminated beam; Functionally graded materials; Bending; Buckling; Vibration; Elastic foundation

* Corresponding author. E-mail address: hsshen@mail.sjtu.edu.cn (H-S Shen)

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