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Hui-Shen Shen, Y. Xiang

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Nonlinear response of nanotube-reinforced composite cylindrical panels subjected to combined loadings and resting on elastic foundations

Hui-Shen Shen [1,*], Y. Xiang [2,3]

[1] School of Aeronautics and Astronautics, Shanghai Jiao Tong University, Shanghai 200240, People's Republic of China
[2] School of Computing, Engineering and Mathematics and [3] Institute for Infrastructure Engineering, University of Western Sydney, Locked Bag 1797, Penrith, NSW 2751, Australia

Abstract

This paper presents an investigation on the nonlinear behaviors of nanocomposite cylindrical panels subjected to the combined action of uniform lateral pressure and compressive edge loads. The panels may rest on elastic foundations and be in a varying temperature environment. The nanocomposite consists of reinforcing carbon nanotubes either uniformly distributed (UD) or functionally graded (FG) along the thickness direction of the panels. The two cases of nonlinear bending of initially compressed cylindrical panels and postbuckling of initially pressurized cylindrical panels are considered. A high-order shear deformation shell theory in association with von Kármán nonlinear strain-displacement relationships is applied to derive the governing equations for the carbon nanotube reinforced composite (CNTRC) panels. Furthermore, the effects of the panel-foundation interaction and the temperature variation are also included in the analysis and the material properties of CNTRC panels are assumed to be temperature-dependent. Numerical results are presented to illustrate the nonlinear bending responses and the postbuckling behaviors of CNTRC cylindrical panels resting on the Pasternak-type elastic foundations. The present solutions also highlight the effects of the CNT volume fraction, temperature rise, foundation stiffness as well as initial stress on the nonlinear behaviors of CNTRC cylindrical panels.

Keywords: Nanocomposites; Functionally graded materials; Cylindrical panel; Nonlinear bending; Postbuckling; Temperature-dependent properties

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