Accepted Manuscript

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PII: S1359-8368(18)30485-2

DOI: 10.1016/j.compositesb.2018.04.028

Reference: JCOMB 5636

To appear in: *Composites Part B*

Received Date: 9 February 2018

Revised Date: 29 March 2018

Accepted Date: 9 April 2018

Free Vibration of FG-CNT Reinforced Composite Skew Cylindrical Shells using the Chebyshev-Ritz Formulation

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Abstract

In the present research, the free vibration characteristics of a skew cylindrical panel made of functionally graded carbon nanotube reinforced composites (FG-CNTRCs) is investigated. A dual distribution of CNTs is considered across the panel thickness, namely a uniform and a nonuniform distribution. A refined rule of mixtures approach is applied to estimate the mechanical properties of the composite body, by means of the introduction of some efficiency parameters. A first order shear deformation shell theory (FSDT) is also combined with the Donnell's kinematic assumptions to determine the basic governing equations of the problem for thin-to-moderately thick shells. The governing equations are here referred to an oblique coordinate system, in order to handle any kind of boundary conditions. With the aid of the Ritz method, a system of homogeneous equations governs the eigenvalue problem, whose shape functions are built on Chebyshev polynomials. This system allows to compute the natural frequencies of the shell. A comparative evaluation of the formulation is performed to demonstrate its accuracy and efficiency. Further parametric studies are aimed at exploring the sensitivity of the response to some reinforcement parameters, as the volume fraction or the distribution of CNTs within the matrix.

Keywords: Carbon nanotube; Functionally Graded material; Ritz method; Skew cylindrical Shell.

1 Introduction

With the development of a novel class of composites, known as functionally graded carbon nanotube reinforced composites (FG-CNTRCs), a large number of researches has been devoted to the study of the mechanical response of nanocomposite materials [1–8]. For this type of composites, CNTs are distributed as reinforcement within a metallic or polymeric matrix. Moreover, the volume fraction of CNTs may be distributed uniformly on the surface of a composite structure, which results in a FG medium. An interesting

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