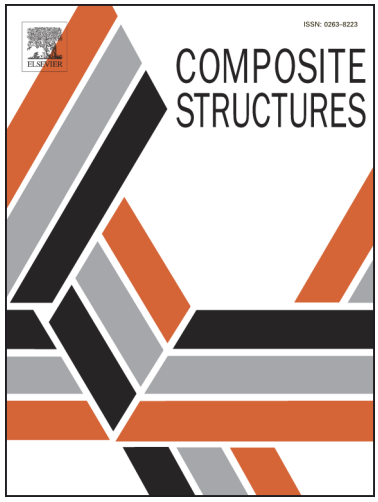

Free Vibration of Functionally Graded Carbon Nanotube Reinforced Composite Cylindrical Panels

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Free Vibration of Functionally Graded Carbon Nanotube Reinforced Composite Cylindrical Panels

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Abstract

In this study, free vibration characteristics of composite plates reinforced with single walled carbon nanotubes is investigated. Distribution of the carbon nanotubes through the thickness of the panel may be uniform or functionally graded. Properties of the composite media are obtained according to a refined rule of mixtures approach which contains the efficiency parameters. First order shear deformation shell theory and Donnell-type kinematic assumptions are used. To establish the eigenvalue problem of the system, the energy based Ritz method with Chebyshev polynomials as the basis functions is implemented. The resulting eigenvalue problem is solved to obtain the natural frequencies of the system as well as the associated mode shapes. After performing comparison studies for the simpler cases, numerical results are given for vibration characteristics of carbon nanotube reinforced cylindrical panels. Numerical results reveal that, frequencies of the panel are dependent to both, volume fraction of carbon nanotubes and their distribution pattern across the thickness. Increasing the volume fraction of carbon nanotubes increases the frequencies of the panel.

Keywords: Cylindrical panel, Functionally graded carbon nanotube reinforced composite, Ritz method, Chebyshev polynomials.

1 Introduction

Shell-like structures occupy a leadership position in many applications of mechanical, civil, aerospace, marine and architectural engineering. Shells give rise to optimum conditions in dynamic behaviour. As a results, studying the vibration characteristics of the shells and panels of any geometry is an important aspect in the successful applications of these structures.

As a type of novel materials with fascinating electro-thermo-mechanical properties, carbon nanotubes (CNTs) have attracted increasing attention in the past decades. CNTs stand as a promising candidate for reinforcement of the matrix phase in a composite. Kwon et al. [1] reported that, using a powder metallurgy fabrication process, carbon nanotube reinforced composites (CNTRCs) may be achieved with nonuniform distribution of CNTs through the media. This type of reinforced composite media is known as functionally graded carbon nanotube reinforced composite (FG-CNTRC). An overview

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