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Free Vibration Analysis of FG Nanocomposite Sandwich Beams Using Various Higher-Order Beam Theories

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Abstract : In this paper, free vibrations of Functionally Graded Sandwich (FGS) beams reinforced by randomly oriented Single-Walled Carbon Nanotubes (SWCNTs) are investigated. The Eshelby–Mori–Tanaka approach based on an equivalent fiber is used to investigate the material properties of the structure. The natural frequencies of the FGS nanocomposite beam are analyzed based on various Higher-order Shear Deformation Beam Theories (HSDBTs) and using an analytical method. The verification study represents the simplicity and accuracy of the method for free vibration analysis of nanocomposite beams. The effects of carbon nanotube volume fraction profiles in the face layers, length to span ratio and thicknesses of face layers on the natural frequency of structure are studied for the different HSDBTs. Results show that by utilizing the FGS type of structures, free vibration characteristics of structures can be improved. A comparison is also provided to show the difference between natural frequency responses of the FGS nanocomposite beam reinforced by aligned and randomly oriented SWCNT.

Keywords : sandwich beam, nanocomposite beam, functionally graded materials, higher-order beam theories, Mori-Tanaka approach
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