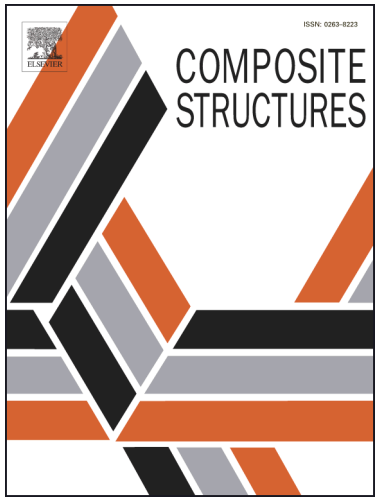

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Vibration analysis of pre-twisted functionally graded carbon nanotube reinforced composite beams in thermal environment

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Abstract

As a first endeavor, the free vibration behavior of the pre-twisted functionally graded carbon nanotube reinforced composite (FG-CNTRC) beams in thermal environment is studied. The governing equations are derived based on the higher-order shear deformation theory of beams by considering the temperature dependence of material properties and the initial thermal stresses. The free vibration eigenvalue equations are extracted by using the Chebyshev–Ritz method. In this regard, Chebyshev polynomials together with appropriate boundary functions are utilized as admissible functions of the Ritz method, which enables one to handle the problem with different sets of boundary conditions. The fast rate of convergence of the method is demonstrated numerically and its accuracy is verified by comparing the results in the limit cases with existing solutions in the literature. The effects of pre-twist angle together with carbon nanotubes (CNTs) distribution in thickness direction, the temperature dependence of material properties, the temperature rise, the geometrical shape parameters and boundary conditions on the frequency parameters are investigated. It is shown that the effects of the pre-twist angle on the natural frequencies depend on the beam boundary conditions and also the mode number.

***Keywords*:** Vibration; pre-twisted beams; functionally graded; carbon nanotube reinforced composite; thermal environment; Chebyshev–Ritz method

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