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Thermoelastic Vibration and Stability of Temperature-Dependent Carbon Nanotube-Reinforced Composite Plates

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Abstract

The present article investigates the thermoelastic vibration and stability characteristics of carbon nanotube-reinforced composite (CNTRC) plates in thermal environment. The CNTRC plates are made up of four different types of uniaxially aligned reinforcements. The single-walled carbon nanotubes (SWCNTs) reinforcement is either uniformly distributed (UD) or functionally graded (FG) according to linear functions of the thickness direction. The material properties, of both matrix and CNTs, are temperature-dependent and the effective elastic coefficients are evaluated by using a micromechanical model. The governing equations (GEs) are derived in their weak-form by using Hamilton's Principle in conjunction with the method of the power series expansion of the displacement components. The Ritz method, based on highly stable trigonometric trial functions, is used as solution technique. Convergence and stability of the proposed formulation have been thoroughly analyzed by assessing many higher-order plate models. Thermal and mechanical pre-stresses are taken into account. Moreover, the effect of significant parameters such as length-to-thickness ratio, volume fraction, aspect ratio, loading-type, CNTs distribution as well as boundary conditions is discussed.

Keywords: Quasi-3D plate theories, Thermoelastic Vibration, Elastic stability, FG-CNTRC plates, Temperature-dependent materials, Ritz method.

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