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Vibration of thermally postbuckled sandwich plates with nanotube-reinforced composite face sheets resting on elastic foundations

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Abstract

This paper investigates the small- and large-amplitude vibrations of thermally postbuckled sandwich plates with carbon nanotube-reinforced composite (CNTRC) face sheets resting on elastic foundations. Two types of CNTRC face sheets, namely, uniformly distributed (UD) and functionally graded (FG) reinforcements, are considered. The material properties of FG-CNTRCs are assumed to be graded in the thickness direction, and are estimated through a micromechanical model. The material properties of both CNTRC face sheets and homogeneous core layer are assumed to be temperature-dependent. The motion equations are derived based on a higher order shear deformation plate theory. The nonlinearity effect is taken into account in the sense of von Kármán nonlinear kinematic assumption. The plate-foundation interaction and the initial deflection caused by thermal postbuckling are also included. The numerical illustrations concern small- and large-amplitude vibration characteristics of thermally postbuckled sandwich plates with CNTRC face sheets under uniform temperature field. The effects of CNT volume fraction and distribution pattern of face sheets, the core-to-face sheet thickness ratio as well as foundation stiffness on the vibration characteristics of sandwich plates are examined in detail.

Keywords: Nanocomposites; Functionally graded materials; Temperature-dependent properties; Plates; Vibration

1. Introduction