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Modeling of dynamic responses of CNT-reinforced composite cylindrical shells under impact loads

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Abstract

This paper investigates the impact responses of carbon nanotube (CNT) reinforced functionally graded composite cylindrical shells. The effective material properties of the CNT-reinforced composite cylindrical shell are modeled by the extended rule of mixture. Reddy's high-order shear deformation theory is employed in the modeling, in which thermal effects are taken into account. In order to simulate the contact load, a linearized contact law is used to obtain a linearized contact coefficient. Fourier series expansion and Laplace transforms are utilized during the solving process. The analytical expression of transverse displacement is furnished, and the impact responses of CNT-reinforced composite cylindrical shell are analyzed. From the numerical results, it is observed that the amplitude of the impact responses of FG-X CNT-reinforced composite cylindrical shell is lower than that of the shell with FG-O and UD CNT-distributions. The increase in CNT volume fraction reduces the amplitude of the impact response. Meanwhile, temperature change affects both the material properties and stiffness of the structure. It is also observed that with an increased temperature, the impact amplitude of the cylindrical shell increases.

Keywords: CNT-reinforced composite cylindrical shell; functionally graded composite; higher-order shear deformation theory; impact response

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