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عنوان مقاله:

Exact solution for stability of functionally graded nanocomposite beams reinforced by single-walled carbon nanotubes

محل انتشار:

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خلاصه مقاله:

In this paper, exact analytical solutions for post-buckling analysis of functionally graded carbon nanotube-reinforced composite (FG-CNTRC) beams are presented. Two different distribution patterns of single-walled carbon nanotubes (SWCNTs) in the matrix are considered, namely uniformly distributed (UD) and functionally graded (FG) distributed. It is assumed that the material properties of the FG beams vary gradually along the thickness direction of the beam. The refined rule of mixture is employed to predict the effective material properties of the nanobeam. The Euler-Bernoulli beam theory together with Hamilton's principle is utilized to derive the related governing equation. Also, by applying von Kármán relations, the geometric nonlinearities are taken into consideration. The exact closed form solutions for buckling mode shapes of the CNTRC beam with different boundary conditions are developed and consequently, analytical expressions for buckling and post-buckling loads are found. The present post-buckling load results are compared with the ones reported in the literature and the comparisons demonstrate an excellent agreement between the solutions for different boundary conditions and prove the accuracy and reliability of the current method. Eventually, the numerical results are provided to discuss the effects of CNTs distribution, CNTs volume fraction, slenderness ratio, maximum deflection of the beam and boundary conditions on the post-buckling characteristics of the CNTRC beam.

کلمات کلیدی:

Post-buckling analysis- Nanocomposite beams- Functionally graded materials- Exact solution

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