Abstract

Carbon nanotubes (CNTs) are cutting-edge materials that offer great mechanical features like high strength, high stiffness, and high durability. As a result of these exceptional qualities, CNTs have been widely used as a reinforcing material. The mechanical characteristics of carbon nanotube reinforced composites (CNTRC) depend on a number of factors, including volume fraction of CNTs, orientation, matrix's characteristics, loading conditions, and side-to-thickness ratio. It is necessary to understand the complex behaviour of the interaction between the soil and the structure, which goes hand in hand with the structural investigation of these materials. Hence, in this work, an effective analytical and finite element (FE) model is developed in this work to investigate the structural behaviour of a CNTRC plate resting on Pasternak's elastic foundation, which includes bending, free vibration, and buckling analysis, within the context of various non-polynomial shear deformation theories based on secant function and inverse hyperbolic sine function. Further, in this work, different types of carbon nanotube reinforced distributions and stacking sequences are also considered. Here, an optimal configuration for the functionally graded CNTRC plate is sought out in order to achieve precise static, buckling, and free vibration responses. The analytical and FE techniques are used in order to carry out a detailed parametric study of functionally graded CNTRC plates with a wide range of material characteristics, stacking configurations, span thickness ratios, core to face sheet thickness ratios, and loading conditions. The FE based results in the form of deflection, stresses, natural frequency and buckling loads are obtained using in house generalized MATLAB code. In order to develop an improved comprehension of carbon nanotubes as a structural material, some new results are also been obtained.

Keywords: Non-polynomial shear deformation theory; Analytical method; Finite Element method; Composites plate; Sandwich structure; Elastic foundation