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Buckling of functionally graded graphene reinforced conical shells under external pressure in thermal environment

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Abstract

In the present research, buckling analysis of composite laminated conical shells reinforced with graphene sheets is investigated. Graphene sheets as reinforcements are distributed in each lamina. Volume fraction of graphene in each layer may be different which results in a piecewise functionally graded conical shell. First order shear deformation shell theory, Donnell kinematic assumptions and von Kármán type of geometrical non-linearity are used to establish the governing equations of the conical shell and the associated boundary conditions. The pre-buckling forces of the shell are obtained employing a membrane analysis. The linear stability equations are developed using the adjacent equilibrium criterion. These equations are discreted by means of the generalised differential quadratures across the shell length and Fourier expansion through the circumferential direction. An eigenvalue problem is obtained which yields the critical buckling pressure of the conical shell in thermal environment and the circumferential mode number at the onset of buckling. Comparison studies are provided for graphene reinforced and conventional composite laminated cylindrical shells and also isotropic conical shells with and without thermal environment. Afterwards parametric studies are given for buckling of functionally graded graphene reinforced composite laminated conical shells in thermal environment with different boundary conditions. It is shown that, temperature elevation decreases the critical buckling pressures of the conical shell significantly. Also buckling pressure of the shell may be enhanced through a piecewise functionally graded distribution of volume fraction of reinforcements.

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Keywords

Linear buckling; Functionally graded; Graphene reinforced composite; Generalised differential quadrature; Conical shell

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