عنوان مقاله:

Free Vibration Analysis of Bidirectional Functionally Graded Conical/Cylindrical Shells and Annular Plates on Nonlinear Elastic Foundations, Based on a Unified Differential Transform Analytical Formulation

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خلاصه مقاله:

In the present research, a unified formulation for free vibration analysis of the bidirectional functionally graded conical and cylindrical shells and annular plates on elastic foundations is developed. To cover more individual cases and optimally tailored material properties, the material properties are assumed to vary in both the meridian/radial and transverse directions. The shell/plate is assumed to be supported by a non-uniform Winkler-type elastic foundation in addition to the edge constraints. Therefore, the considered problem contains some complexities that have not been considered together in the available researches. The proposed unified formulation is derived based on the principle of minimum total potential energy and solved using a differential transform analytical method whose center is located at the outer edge of the shell or plate; so that the resulting semi-analytical solution can be employed not only for truncated conical shells and annular plates, but also for complete conical shells and circular plates. Accuracy of results of the proposed unified formulation is verified by comparing the results with those of the three-dimensional theory of elasticity extracted from the ABAQUS finite element analysis code. A variety of the edge condition combinations are considered in the results section. A comprehensive parametric study including assessment of influences of the material properties indices, thickness to radius ratio, stiffness distribution of the elastic foundation, and various boundary conditions, is accomplished. Results reveal that influence of the meridian variations of the material properties on the natural frequencies is more remarkable than that of the transverse gradation.

کلمات کلیدی:

Free vibration, Bidirectional functionally graded, Conical and cylindrical shells, Annular plates, Non-uniform elastic foundationAnnular plates, Non-uniform elastic foundation