Free vibration analysis of functionally graded quadrangle plates using second order shear deformation theory

ABSTRACT

A general approach for free vibration of functionally graded materials (FGMs) plates based on second-order shear deformation theory (SSDT) is presented. Material properties are assumed to be graded in the thickness direction by power law distribution in term of the volume fractions of the constituents. The equilibrium equations are derived by energy method and then solved analytically by applying Navier's method for a plate with simply supported boundary conditions. It is found that the fundamental frequencies versus side-to-side ratio for FG quadrangular plates are between full-ceramic plate and full-metal plate. It is shown that for the grading index smaller than two ($p<2$) the decreasing slope of the frequency is greater than that in other parts for all values of side-to-thickness ratio in square FG plate. Natural frequencies for different mode shape are compared and verified with the known results in the literature. It is seen that the results of the second-order theory are very close to the third-order reported in the literature.

Keyword: Functionally graded material; Second order shear deformation; Free vibration; Quadrangle plate