

Advanced Plate Theory with Four Variables for Analyzing Bending in Functionally Graded Sandwich Plates Subjected to Thermomechanical Effects

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Abstract

The thermal mechanical bending behavior of functionally graded sandwich plates was studied using the recently developed four variable refined plate theory. What makes this theory different from other theories is that only four functions are used as variables for analysis as compared to five functions used in other shear deformation theories. The current theory is variational in nature, does not involve shear correction factor, and generates transverse shear stress distribution in such a manner that the transverse shear stresses vary parabolically across the thickness to satisfy shear stress free boundary conditions at surfaces. Functionally gradient material distribution is taken as the combination of two constituents for which the properties of elastic modulus, Poison's ratio, and thermal expansion coefficient are varied according to the power law model based on the volume fractions of constituents. For the core region of the sandwich plate, a homogeneous isotropic ceramic material has been considered. The validation of the current theory has been done using comparison of the results with other plate theories. Effects of the transverse shear deformation effect, temperature effects, aspect ratio of the plate, slenderness ratio, and variation in volume fractions on the responses are investigated. The numerical results of the displacements and stresses of functionally graded sandwich plates are analyzed. The new theory could provide reliable and efficient solutions to the problem of the thermomechanical bending of functionally graded plates.