THERMAL AND MECHANICAL ANALYSIS OF FGM BEAM USING GENERALIZED THEORY

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Abstract

A generalized beam theory is developed and used to study the linear-static behavior of an Aluminum-Zirconia Functionally Graded (FG), simply-supported beam subjected to transversely distributed sinusoidal load and non-uniform temperature rise across the thickness of the beam. The Young's modulus and thermal expansion coefficient of the beam are assumed to vary as per the gradation laws (exponential/power-law) through the thickness, and the Poisson ratio is held constant. The current study is carried out using the developed and properly validated MATLAB codes based on the present formulation. Comparative studies are conducted to examine the effects of various beam theories (i.e., EBT,TBT and RBT derived as especial cases of the generalized beam theory), different material gradation laws and different temperature variations across the thickness of the beam on the stresses and/or displacements of the FGM beam. It is observed that on the contrary to homogeneous beams, thermal stresses in the FGM beam are not zero for the linear variation of temperature along the thickness and these stresses are found to be very much influenced by material distribution laws and indistinguishable for EBT, TBT and RBT. It is also concluded that unlike the corresponding homogenous constituents (i.e., pure ceramic and pure aluminum), the variation of mechanical axial stresses in FGM beam across its thickness is non-linear.

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