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Free vibration of functionally graded sandwich plates in thermal environment using a layerwise theory

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Abstract

In this work, a layerwise finite element formulation is presented for the first time for dynamic analysis of two types of functionally graded material (FGM) sandwich plates with nonlinear temperature variation along the thickness and the FGM having temperature dependent material properties. Natural frequencies of sandwich plates made of FGM in thermal environment are presented using a layerwise theory. Two configurations of sandwich plate, one with homogenous facesheets and functionally graded core and the second with functionally graded facesheets and homogenous core are considered. The material properties of both types of FGM sandwich plates are varied according to Mori-Tanaka (MT) scheme and the rule of mixture (ROM). The layerwise theory used in this work is based on the assumption of the first order shear deformation theory in each layer and the displacement continuity is satisfied at each layer interface. In the present investigation, it is seen that the natural frequencies converge with lesser number of elements and the results are found to be accurate. Natural frequencies are presented for FGM sandwich plates with different geometric and elastic properties, thermal load and boundary conditions.

Keywords: Free vibration analysis; Finite element formulation; FGM sandwich plates; Thermal environment; Layerwise theories.

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