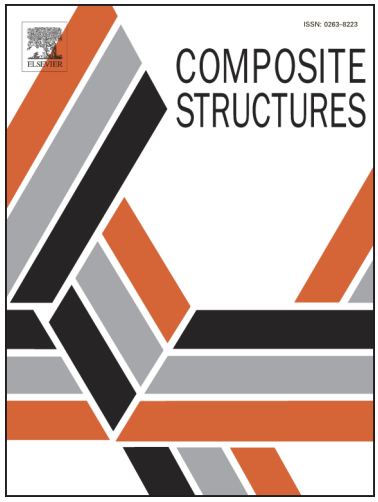

Thermo-mechanical bending of laminated composite and sandwich plates using layerwise displacement model

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THERMO-MECHANICAL BENDING OF LAMINATED COMPOSITE AND SANDWICH PLATES USING LAYERWISE DISPLACEMENT MODEL

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Abstract

The objective of this paper is thermo-mechanical bending of laminated composite and sandwich plates subjected to mechanical load and lineary varaying through the thickness temperature field. Mathematical model, based on layer-wise displacement field of Reddy, is formulated using small deflection linear-elasticity theory. The principle of virtual displacements (PVD) is used to obtain the strong and the weak form of the mathematical model. The weak form is discretized using the isoparametric finite element approximation, while the analytical solution is derived from the strong form. The originally coded MATLAB program is used to investigate the influence of plate geometry and degree of material orthotropy on thermo-mechanical response of laminate composite and sandwich plates. The accuracy of the numerical model is verified by comparison with the available results from the literature and some new results are presented.

Key words: *Laminates; Thermomechanical; Analytical modeling; Finite element analysis (FEM)*

1. Introduction

The thermal analysis of laminated composite and sandwich plates is of practical importance for structure operating at elevated temperatures, such as in aerospace applications, nuclear reactors and chemical plants. This has attracted considerable investigations of researchers in order to develop an accurate and efficient theoretical model being able to meet optimal design parameters.

From the theory of thermo elasticity it is known that thermal stresses will occur in one of the three following cases: first, if the plate experiences a nonuniform temperature filed, secondly, if the displacements are prevented from occurring freely because of the restrictions placed on the boundary even with a uniform temperature, and thirdly, if the materials displays anisotropy, even with uniform heating [1]. This implies that in composite laminates thermal stresses will occur both during fabrication as well as service life. Due to well-known layer-wise material inhomogeneity of composite materials, thermal stresses usually occur at interfaces between layers with different fiber orientation and thermal expansion coefficients, causing distorsion as well as stretching of normal to mid-surface. At certain level interlaminar stresses, severe wrapping and stretching of cross section may result in delamination of layers, fiber fraction or debonding of matrix. Therefore, accurate prediction of thermally induced deflection and stresses become a key issue for the analysis of laminate composite and sandwich plates in thermal environment.

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