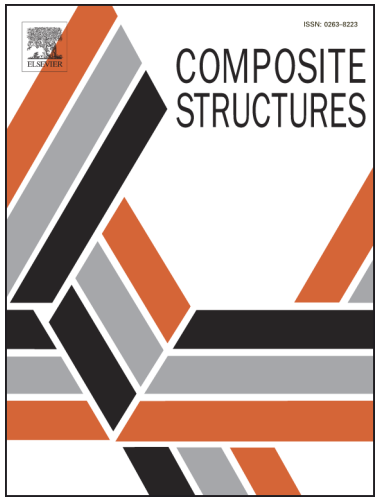

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PII: S0263-8223(15)00280-9
DOI: http://dx.doi.org/10.1016/j.compstruct.2015.04.010
Reference: COST 6357

To appear in: *Composite Structures*

Please cite this article as: Sreehari, V.M., Maiti, D.K., Buckling and Post buckling Analysis of Laminated Composite Plates in Hygrothermal Environment Using an Inverse Hyperbolic Shear Deformation Theory, *Composite Structures* (2015), doi: http://dx.doi.org/10.1016/j.compstruct.2015.04.010

Buckling and Post buckling Analysis of Laminated Composite Plates in Hygrothermal Environment Using an Inverse Hyperbolic Shear Deformation Theory

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ABSTRACT

The present study is an attempt to develop a finite element formulation for handling buckling and post buckling analysis of laminated composite plates subjected to mechanical and hygrothermal loads using the Inverse Hyperbolic Shear Deformation Theory. This theory satisfies zero transverse shear stresses conditions at the top and bottom surfaces of the plate and provides a non-linear transverse shear stress distribution. Geometric nonlinearity has been included in the von Karman sense. Mathematical formulation and programming in MATLAB environment have been done. Numerical results are presented. By this investigation, the validation of recently developed IHSDT has been proved for buckling and post buckling analysis in hygrothermal environment.

Keywords: Laminated plates; Non-linear; Finite element method; Shear deformation theory.

1. Introduction

Aerospace structures consist of a large number of plate type structural elements. Advances in the aircraft and spacecraft technology have motivated researchers to work on new structural materials such as composite materials which has improved the performance and reliability of structural system. Increased use of composite laminated plates in primary structures in the past few years necessitates the development of accurate theoretical models to predict their responses.

The transition of the structure from the stable state of equilibrium to the unstable one is referred to as buckling or structural instability. The smallest value of the load producing buckling is called the critical or buckling load. The use of an additional strength, due to the post buckling effects in plates, is of great practical importance in the design of aerospace structures. By considering the post buckling behaviour of plates, considerable weight savings can be achieved. A variety of plate theories have been developed by researchers. Equivalent Single Layer theories include Classical Laminated Plate Theory (CLPT), First order Shear Deformation Theory (FSDT) and higher order Polynomial and Non-polynomial Shear Deformation Theories (PSDT and NPSDT). As observed from recent literatures, the overall percentage error is less with new NPSDT's compared to other existing shear deformation theories. Composite laminates are subjected to changing environmental conditions like temperature and moisture. The effect of temperature is known as thermal effect and the effect of moisture absorption from the atmosphere is known as hygroscopic effect. The combined effect of temperature and moisture is known as hygrothermal effects. Hygrothermal effects induce a dimensional change in the laminate.

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