Postprint: Nonlinear Post-buckling Analysis of Antisymmetrically Laminated Composite Plates

Authors: Yaqian Zhang, Yixuan Liu, Yongfu Wu, Fusong Jin, Jianghong Xue

Date: 2023-11-10T00:00:00+00:00

Abstract

Based on laminated plate and shell theory, and considering the stretching-bending coupling effect of antisymmetrically laminated plates and the nonlinear geometric deformation in the post-buckling process, the post-buckling governing equations for composite laminated plates expressed in terms of stress function and deflection were derived. Dimensionless parameters were introduced to nondimensionalize the governing equations and boundary conditions, so as to eliminate the influence of material parameters and geometric dimensions on the analysis results. The perturbation method was employed to expand the dimensionless nonlinear governing equations and boundary conditions into a series of nonhomogeneous linear perturbation equation sets, analyzing the construction of general and particular solutions for each order of perturbation equations and solving them sequentially, thereby establishing theoretical solutions for the critical buckling load and post-buckling equilibrium path of antisymmetrically laminated composite plates under unidirectional uniform pressure. Furthermore, finite element analysis of the buckling and post-buckling of composite laminated plates under in-plane compressive loading was conducted using ABAQUS software. The results demonstrate that the theoretical solutions are in close agreement with the ABAQUS results, verifying the correctness of the theoretical solutions. On this basis, the effects of ply angle, number of layers, and stretching-bending coupling effect on the post-buckling behavior of laminated plates were further discussed. The study reveals that the buckling load of laminated plates is significantly influenced by the ply angle and number of layers, while the stretching-bending coupling effect substantially reduces the post-buckling strength of the plates.

Full Text

22

MATH_{0003}

12

MATH_{0010}

11

MATH_{0011}

MATH_{0015}

MATH_{0016}

MATH_{0017}

MATH_{0019}

MATH_{0020}

MATH_{0021}

MATH_{0022}

MATH_{0023}

MATH_{0025}

MATH_{0030}

Note: Figure translations are in progress. See original paper for figures.