Free vibration and buckling of laminated beams via hybrid Ritz solution for various penalized boundary conditions

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Abstract

This paper presents an analytical solution for the buckling and free vibration analysis of laminated beams by using a refined and generalized shear deformation theory which includes the thickness expansion. The eigenvalue equation is derived by employing the Rayleigh quotient, and the Ritz method is used to approximate the displacement field. The functions used in the Ritz method are chosen as either a pure polynomial series or a hybrid polynomial-trigonometric series. The hybrid series are used due to the superior convergence and accuracy compared to conventional pure polynomial series for certain boundary conditions. The boundary conditions are taken into account using the penalty method. Convergence of the results is analyzed, and numerical results of the present theory is compared with other theories for validation. Nondimensional natural frequencies and critical buckling loads are obtained for a variety of stacking sequences. The effect of the normal deformation on the fundamental frequencies and critical buckling loads is also analyzed.

3 Figures