Free vibration analysis of composite and sandwich plates by alternative hierarchical finite element method based on Reddy's C^1HSDT

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Abstract

This paper presents the free vibration analysis of composite thick rectangular plates, based on Reddy's higher order shear deformation theory (HSDT). The plate theory ensures a zero shear-stress condition at the top and bottom surfaces of the plate and do not requires a shear correction factor. Although the plate theory is quite attractive but it could not be used in the finite element analysis. This is due to the difficulties associated with the satisfaction of the C^1 continuity requirement. To overcome this problem associated with Reddy's HSDT, a new C^1-HSDT p-element with eight degrees of freedom per node is developed and used to find natural frequencies of thick composite plates. The formulation is easily implemented into simple and efficient finite element programs in which the trigonometric hierarchical shape functions are used. A fast convergence and excellent agreement with the known results in the literature are obtained using only one element. Besides, the effects of the boundary conditions, core to face sheet thickness ratio, Young's modulus ratio on the natural frequencies are investigated through the analysis of these numerical results.