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Nonlinear Static Analysis of Laminated Composite Hollow Beams with Super-Elliptic Cross-Sections

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Abstract : In this paper geometrically nonlinear static behavior of laminated composite hollow super-elliptic beams is investigated using generalized differential quadrature method. Super-elliptic beam can have both oval and elliptic cross-sections by adjusting parameters in super-ellipse formulation (also known as Lamé curves). Equilibrium equations of super-elliptic beam are obtained using the virtual work principle. Geometric nonlinearity is taken into account using von-Kármán nonlinear strain-displacement relations. Spatial derivatives in strains are expressed with the generalized differential quadrature method. Transverse shear effect is considered through the first-order shear deformation theory. Static equilibrium equations are solved using Newton-Raphson method. Several composite super-elliptic beam problems are solved with the proposed method. Effects of layer orientations of composite material, boundary conditions, ovality and ellipticity on bending behavior are investigated.

Keywords : generalized differential quadrature, geometric nonlinearity, laminated composite, super-elliptic cross-section
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