Flexural Analysis of Symmetric Laminated Composite Timoshenko Beams under Harmonic Forces: An Analytical Solution

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Abstract : The flexural dynamic response of symmetric laminated composite beams subjected to general transverse harmonic forces is investigated. The dynamic equations of motion and associated boundary conditions based on the first order shear deformation are derived through the use of Hamilton's principle. The influences of shear deformation, rotary inertia, Poisson's ratio and fibre orientation are incorporated in the present formulation. The resulting governing flexural equations for symmetric composite Timoshenko beams are exactly solved and the closed form solutions for steady state flexural response are then obtained for cantilever and simply supported boundary conditions. The applicability of the analytical closed-form solution is demonstrated via several examples with various transverse harmonic loads and symmetric cross-ply and angle-ply laminates. Results based on the present solution are assessed and validated against other well established finite element solutions and exact solutions available in the literature.