

Coupled Flexural-Lateral-Torsional of Shear Deformable Thin-Walled Beams with Asymmetric Cross-Section-Closed Form Exact Solution

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Abstract : This paper develops the exact solutions for coupled flexural-lateral-torsional static response of thin-walled asymmetric open members subjected to general loading. Using the principle of stationary total potential energy, the governing differential equations of equilibrium are formulated as well as the associated boundary conditions. The formulation is based on a generalized Timoshenko-Vlasov beam theory and accounts for the effects of shear deformation due to bending and warping, and captures the effects of flexural-torsional coupling due to cross-section asymmetry. Closed-form solutions are developed for cantilever and simply supported beams under various forces. In order to demonstrate the validity and the accuracy of this solution, numerical examples are presented and compared with well-established ABAQUS finite element solutions and other numerical results available in the literature. In addition, the results are compared against non-shear deformable beam theories in order to demonstrate the shear deformation effects.

Keywords : asymmetric cross-section, flexural-lateral-torsional response, Vlasov-Timoshenko beam theory, closed form solution

Conference Title : ICMMAE 2014 : International Conference on Mechanics, Mechanical and Aerospace Engineering

Conference Location : Istanbul, Türkiye

Conference Dates : December 22-23, 2014