Free vibration and post-buckling analyses of thin-walled beam and flexible plate structures through the Unified Formulation

By

Ehsan Daneshkhah

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In this research, refined structural and nonlinear theories are used in order to investigate the free vibration and post-buckling response of thin-walled beam and flexible plate structures. In this regard, the Unified Formulation is employed to obtain nonlinear governing equations of the finite beam and plate elements.

Then, various assessments are conducted related to the thin-walled beam and flexible plate structures. The free vibration response of thin-walled isotropic and composite beams is accurately evaluated, and the Vibration Correlation Technique is used in order to investigate the variations of natural frequencies in thin-walled laminated isotropic and composite beam structures under compression. The physically and geometrically nonlinear analysis of thin-walled beams is also investigated using Newton–Raphson linearization scheme with the path-following method based on the arc-length constraint.

The large-deflection and post-buckling of isotropic and composite plates under axial, in-plane shear and combined loadings are analyzed considering different strain-displacement assumptions, and the corresponding equilibrium carves and stress distributions are presented.

Furthermore, the effects of load and displacement boundary conditions in the post-buckled laminated composite plates are investigated, and the effects of stiffeners are assessed. The results show that the present method based on the Unified Formulation can be efficiently used for accurate structural analysis, including the free vibration and post-buckling of the thin-walled beam and flexible plate structures.