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Free Vibration Analysis of Conical Helicoidal Rods Having Elliptical Cross Sections Positioned in Different Orientation

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Abstract : In this study, the free vibration analysis of conical helicoidal rods with two different elliptically oriented cross sections is investigated and the results are compared by the circular cross-section keeping the net area for all cases equal to each other. Problems are solved by using the mixed finite element formulation. Element matrices based on Timoshenko beam theory are employed. The finite element matrices are derived by directly inserting the analytical expressions (arc length, curvature, and torsion) defining helix geometry into the formulation. Helicoidal rod domain is discretized by a two-noded curvilinear element. Each node of the element has 12 DOFs, namely, three translations, three rotations, two shear forces, one axial force, two bending moments and one torque. A parametric study is performed to investigate the influence of elliptical cross sectional geometry and its orientation over the natural frequencies of the conical type helicoidal rod.

Keywords : conical helix, elliptical cross section, finite element, free vibration
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