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Out-of-Plane Vibration Analysis of Multiple-Stepped Circular Rods

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Stepped circular rods are widely used in various engineering fields. Thus, studying the free vibration characteristics of those structures is an essential subject of research. The unified approach of the Complementary Functions Method (CFM) and the Laplace transform is employed in this paper to examine the out-of-plane free vibration response of the circular Timoshenko beams with multiple cross-section steps. The proposed procedure can be used to investigate the natural frequencies of circular rods consisting of an arbitrary number of steps through the curvature. The material of the rod is considered to be isotropic, homogeneous and elastic. By considering the effects of shear deformation and rotary inertia, the equations of motion of the circular rods are introduced. Obtained equations are transformed to the Laplace domain and solved numerically by the CFM. Comparisons of the present results with those of ANSYS show that the suggested scheme is applicable and of high precision for out-of-plane free vibration analysis of multi-stepped circular rods.

Keywords: Out-of-Plane free vibration; Multi-Stepped Circular Rods; Laplace Transform.