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Numerical and Experimental Analysis of Free Vibrations of Thick-Walled Cylindrical Shell

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Abstract Free vibrations of an isotropic thick-walled circular cylindrical shell with one end rigidly clamped, and the other free, are investigated numerically and experimentally. The natural frequencies and corresponding mode shapes are determined using the finite element method within a three-dimensional elasticity formulation, employing solid finite elements. The article focuses on constructing a reliable finite element model, including selecting element types and mesh density based on accuracy, convergence, and computational efficiency. In the article, solve a test problem to verify the numerical model and present a detailed convergence analysis. An experimental study of free vibrations based on stroboscopic interferometry, which allows full-field visualization of vibration mode shapes and determination of natural frequencies with sufficient accuracy. A comparison between numerical and experimental results demonstrates good agreement, confirming the reliability of the proposed modeling approach. The research study has been used in the design and analysis of thick-walled cylindrical shell structures in engineering applications, as well as for validating numerical and analytical methods for the vibration analysis of shell systems.

Keywords **Author Keywords:** boundary conditions; comparative analysis; finite element method; free vibrations; stroboscopic interferometry method; thick-walled cylindrical shell
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