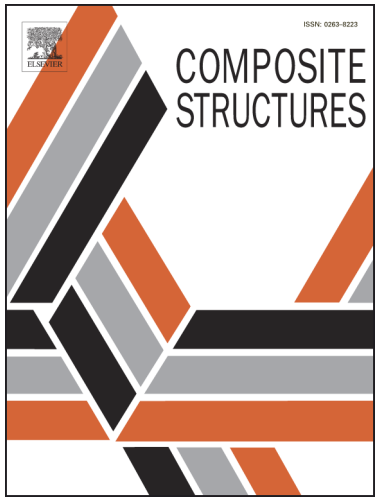

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An exact solution for the free vibration analysis of laminated composite cylindrical shells with general elastic boundary conditions

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Abstract

A unified and exact solution method is developed for the free vibration analysis of composite laminated cylindrical shells with general elastically restrained boundaries and arbitrary lamination schemes. Each of the shell displacements, regardless of boundary conditions, is constructed as a standard Fourier cosine series supplemented with auxiliary functions introduced to eliminate all the relevant discontinuities with the displacement and its derivatives at the edges and accelerate the convergence of series representations. Mathematically, such series expansions are capable of representing any functions (including the exact displacement solutions). Rayleigh-Ritz procedure is employed to obtain the exact solution based on the energy functions of the shell. The current method can be universally applicable to a variety of boundary conditions including all the classical cases, elastic restraints and their combinations. Several numerical examples are presented to validate the excellent accuracy and reliability of current solutions, and the effects of boundary restraining stiffnesses and lamination schemes on frequency parameters are illustrated. New results for different lamination schemes with elastically restrained edges are presented, which may serve as benchmark solutions.

Keywords: composite cylindrical shells; vibration; elastically restrained ends; lamination

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