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Free vibration analysis of joined spherical-cylindrical shells by matched Fourier-Chebyshev expansions

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Abstract

A free vibration analysis of joined spherical-cylindrical shell structures is presented. The effects of transverse shear and rotary inertia are taken into account. The deflections and the rotations of spherical and cylindrical shells are represented by the expansions of Chebyshev polynomials in the colatitudinal and axial directions and Fourier functions in the circumferential direction. When the open ends of two hemispheres face each other the opposed circumferential directions should be taken into account in the governing equations and in the continuity conditions. The equations of motion are collocated to yield the system of equations that correspond to the circumferential wave number. To satisfy the continuity conditions the expansions are matched at the junctions of the substructures. The number of collocation points is chosen to be less than the number of expansion terms, and the set of algebraic equations is condensed so that the number of expansions matches the number of degrees of freedom of the problem. Numerical examples are provided for full sphere, bell structure and hermetic capsule.

Keywords: collocation; free vibration; joined shells; matched Fourier-Chebyshev expansion; spherical-cylindrical shell