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A plane strain elasticity model for the acoustical properties of rib-stiffened composite plates. (English) Zbl 1406.74457

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Summary: A theoretical elasticity model is established to study the noise reduction performance of a compliant coating layer that is attached to a periodically rib-stiffened plate under time-harmonic mechanical excitation. The general case of the structure immersed in two different fluids is considered so as to accurately simulate the interior and exterior fluid media of hull structures in underwater environment. The theory of plane strain elasticity is employed to model the dilatational and shear motions of the compliant coating layer and the elastic plate, while the scalar Helmholtz equation is adopted to describe the motions of the two fluids. Vibroacoustic coupling is realized by enforcing displacement and stress continuity at adjacent layer interfaces, with the reaction forces of the rib-stiffeners accounted for by introducing them as discretely distributed stresses. The resultant boundary value equations of the system are solved by applying the Fourier transform technique, based upon which the noise reduction due to the compliant coating layer can be favorably calculated. Numerical investigations are implemented to explore the effects of coating thickness, coating material properties, radiation angle, and excitation location on noise reduction. The theoretical results presented in this study provide valuable guidance for experimental research and structural design related to the decoupling effects of coating layers affixed to elastic structures in underwater environment.

MSC:

74K20 Plates
74H45 Vibrations in dynamical problems in solid mechanics
74E30 Composite and mixture properties

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plates; vibration; analytical modeling

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