Interaction of Waves with a Floating Elastic Plate Under Delta-Function Forcing

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ABSTRACT

The study explores the interaction between waves and a finite floating elastic plate under delta-function forcing, considering different edge conditions: free, simply supported and built-in. The eigenfunction matching method is employed to solve the problem by dividing the fluid region into subregions. The separation of variables technique is subsequently applied, and the solutions are matched at the boundaries between these subregions. Numerical simulations are carried out with MATLAB to examine wave reflection, transmission and plate deflection. Time-domain simulations are also performed using Fourier transform to analyze the impact of a Gaussian force applied to the plate. The results reveal that for free edge condition, the reflection of the waves reduces as the length of the plate increases while a reverse pattern happens for simply supported and built-in edge conditions and it rises with angular frequency for all edge conditions. While, wave transmission shows an opposite trend to reflection. For plate deflection, the plate exhibits greater deflection near the point of force application for all edge conditions. Notably, for simply supported and built-in edge conditions, the maximum deflection occurs when the force is applied at the center of the plate. In time-dependent deflection, the amplitude of the deflection of the plate decreases and approaches nearly zero over time, regardless of the edge condition. The findings from the study will enhance understanding of how waves and plates respond to sudden, concentrated loads on the floating structures, which is crucial for designing these structures with precise specifications.

Keywords: Floating elastic plate, Eigenfunction matching method, Reflection coefficient, Transmission coefficient, Plate deflection, Time-domain

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