INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
PhD-17 SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

This thesis presents a comprehensive investigation into the dynamic response of a floating ice sheet subjected to moving loads under diverse physical and environmental conditions. The study examines the effects of different sea-bed configurations--porous, undulating, flexible, and trench-shaped along with the presence or absence of uniform currents and variable-speed moving loads. The governing equations are formulated using linear potential flow theory, assuming an incompressible, inviscid, and irrotational fluid. Analytical and semi-analytical techniques, including Fourier transform, Laplace Fourier transform, and asymptotic methods, are employed to derive expressions for ice sheet deflection under concentrated and distributed loads. Dispersion relations are established to analyze the variations in phase and group velocities and to understand both steady and transient ice responses.

For porous sea-beds, permeability and internal stress significantly influence wave generation and propagation, leading to notable changes in dispersion characteristics and wave speeds. The long-time response reveals steady deflection in both subcritical and supercritical regimes, with amplified responses near critical speeds. In the case of undulating sea-beds, the interaction between the moving load and sinusoidal bottom topography, with ice deflection strongly dependent on load speed and bed geometry; increasing the number of ripples leads to the behavior toward that of a flat sea-bed. When a flexible sea-bed and uniform current are present, the coupling between current dynamics and sea-bed elasticity significantly alters wave propagation, dispersion, and ice deflection patterns.

The study also considers a finite-length moving load with harmonic time dependence traveling at variable speeds, including constant speed as well as uniform acceleration and deceleration. Ice deflection is obtained in an integral form, where singularities arise for constant-speed motion and dominate the response, while such singularities are absent under acceleration or deceleration, resulting in distinct deformation pat terns. Additionally, the response over a rectangular trench-shaped sea-bed is analyzed by dividing the fluid domain into multiple regions and solving the resulting system of equations numerically. The findings highlight the pronounced influence of trench geometry on wave formation and amplitude, providing deeper insight into ice–water interaction under complex environmental conditions.