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ABSTRACTS OF AUSTRALASIAN PHD THESES

SOME STUDIES OF WAVE-SEABED INTERACTIONS

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In the four chapters of this thesis, four separate problems involving wave-seabed interactions are investigated. Common to the first two problems is the study of the influence of water waves on a permeable bed in the vicinity of offshore structures. In the last two problems the common theme is an analysis of the coupled interaction between water waves and a viscous or viscoelastic bed.

Waves are known to induce variations in pressure within a permeable bed. The problem of evaluating wave-induced pressures at a pipeline buried within a permeable bed forms the basis of Chapter 1. Using bipolar coordinates, the pressure field is determined from potential theory. The pressure at the external surface of the pipe is integrated to give a net seepage force which acts on the pipe. As each wave trough passes over the pipeline the seepage force acts vertically upwards and, when combined with the total bouyant force, this increases the likelihood of the pipeline being gradually forced up through the bed. In Chapter 2, the link between wave-induced pressures and seabed stability near offshore structures is studied. Given that a flat-based structure rests on the surface of a permeable bed, then there is a discontinuity in the boundary condition at the toe of the structure. By using the Riemann-Hilbert technique to solve this mixed boundary value problem, a singularity in the pressure is predicted at the toe. High fluid velocities in and out of the bed in the vicinity of the singularity cause large seepage forces on the soil

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skelton, leading inevitably to local bed instability and erosion.

In many coastal areas the seabed is not rigid in its response to water waves. Oscillations of the bed are generated by the propagating waves while the dissipation of energy within the bed causes the waves to be damped. Studies of interactions between waves and non-rigid beds are relevant to oceanographic predictions of wave height as well as to siting of offshore structures. Unusually dramatic rates of wave damping are observed every monsoon season at certain localities off the south west coast of India. Waves are said to "disappear" over a distance of four to eight wavelengths. In Chapter 3, after showing experimentally that the bottom mud at these localities has the properties of a viscous fluid, the linear long wave model is used to analyse the coupled water-viscous bed interaction. In comparison with other theories that have been used, the predictions of wave damping based on this model provide a more adequate explanation of the wave damping as observed off the Indian coast. In Chapter 4, a study is made of the coupled interaction between water waves and a bed which responds in both an elastic and a viscous manner. By using small amplitude wave theory, a dispersion relation is derived from which rates of wave attenuation and seabed deflections are calculated. Of particular interest is the role of the bed elasticity in restraining the motion of the bed and reducing the rate of wave attenuation. It is shown, however, that the wave attenuation can be of a larger order of magnitude than that due to bottom friction or percolation in a permeable bed.