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THE GENERATION OF WATER WAVES BY TRAVELLING PRESSURE DISTURBANCES

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This thesis presents several original results concerning the generation of waves by travelling pressure distributions and their application to certain problems in physical oceanography.

The response of the East Australian continental shelf to pressure disturbances travelling parallel to the coast, is considered in Chapter II. Using an exponential model of the shelf, the linearized shallow water equations yield solutions in the form of Bessel functions of the first kind. Zero forcing solutions are calculated and dispersion curves of the first few trapped modes are given. The response to a sinusoidal disturbance is studied and it is found that resonance is possible only if the wavenumber of the disturbance matches the wavenumber of one of the infinite number of trapped modes. Finally, using a Fourier transformation, the response to a travelling pressure front is computed. Numerical results indicate that the front may be followed by a wake of substantial edge waves, the periods of which depend on the speed of the disturbance.

Chapter III is concerned with the generation of three-dimensional waves by an oscillating point pressure source travelling with uniform velocity, and its application to the generation of waves by an intense

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tropical cyclone. The linearized wave equations in water of infinite depth are solved using a two dimensional Fourier transform, and asymptotic expansions of the wave amplitude are obtained by means of residue theory and the method of stationary phase. The expansions are then studied for values of the source frequency near a critical point where the group velocity of the waves equals the source speed and a resonant behaviour is expected. Using an approximation to the wavenumber curve, a solution is found in terms of modified Bessel functions of the second kind, which is uniformly valid near this critical point. The results in this chapter are shown to be in agreement with observations of waves from cyclone Pam, of February 1974.

Finally, the last two chapters are concerned with the generation of three-dimensional waves by a point source which is oscillating exactly at the critical frequency. In Chapter IV the initial value problem of a pressure source which is applied at a finite value of time, is investigated. By using an approximation to the wavenumber curve, a resonant solution is obtained which increases logarithmically with time. In Chapter V, the effects of friction on the resonance of the surface waves are considered. A linear term proportional to the value of the velocity potential at the fluid surface is introduced into the equations of motion, and the results confirm the studies made in Chapter III on observations of waves generated by cyclone Pam.

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