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The generation and propagation of waves in an ocean of variable depth

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There are many types of waves which are generated in the ocean. One type of wave which can be particularly devastating is the tsunami. This thesis is concerned with waves which are generated and propagated in a manner similar to tsunamis. The first chapter contains the derivation of the relevant equations and boundary conditions for the two approximate theories to be used in later chapters. Chapter two is based on the small amplitude assumption and a solution for a constant depth is given. Some asymptotic results are obtained and it is shown that reflected waves could change the form of a tsunami considerably. The solutions for a small perturbation from a constant depth are presented for the first and second orders and a possible interpretation of the resultant integrals is given, also the effect on the reflected wave is found. Some graphical results for the shape of waves generated by specific generating mechanisms and for specific small perturbations from a constant depth are given. To conclude the chapter the formal solution for waves generated on a beach of constant slope is obtained.

The long wave small amplitude assumption forms the basis for the results in chapter three and in the first section a justification for using this assumption for tsunamis is given. The solution for the long wave equations is derived then for any depth profile and this general solution is applied for particular depths. An asymptotic form for waves generated on a depth of the type $h(x) = x^p$ (for $0 \leq p < 2$) is obtained for both one and two horizontal space dimensions. The range of validity of the

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results for this type of depth is also determined. A depth of the form $h(x) = h_0(1-e^{-\alpha x})$ is also examined and finally the generation of waves on a parametrically defined depth is considered and asymptotic forms for the resultant wave elevations obtained.

The trapping of waves in a rotating ocean is considered in chapter four and an analytic solution is found for a particular depth profile. The results verify those conclusions drawn by Longuet-Higgins [1] for the general profile for waves trapped over an internal shelf. Also the dispersion relation is found for waves trapped on a beach and approximate solutions for the dispersion relation are used to construct the dispersion curves.

Reference

[1] M.S. Longuet-Higgins, "Double Kelvin waves with continuous depth profiles", *J. Fluid Mech.* **34** (1968), 49-80.

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