Abstract

The present thesis deals with a class of problems associated with gravity wave interaction with porous and flexible structures having wide application in Coastal Engineering. In the present study, emphasis is given

- to determine the solution, with suitable modification/generalisation of the methods used for wave interaction with rigid structures, for a class of problems associated with gravity wave interaction with porous and flexible structures, and
- to study the effect of various physical parameters on the scattering and trapping of gravity waves by porous and flexible structures.

The class of problems analyzed in the present study are based on suitable applications of the eigenfunction expansion method, method of least square approximation, mild-slope approximation, boundary element method, Green's function technique and complex function theory. The problems are studied under the assumption of small amplitude water wave theory and shallow water approximation in single layer fluid and in two-layer fluid having a free surface and an interface in water of uniform and varied bottom beds. Various physical processes emphasized include wave scattering and trapping by complete and partial structures. Both the cases of vertical and horizontal structures are considered in different cases. In case of wave trapping by porous barriers near a wall, one of the objectives is to find the optima in wave reflection and load on the barrier/rigid wall with suitable combination of the physical parameters. In the wave-structure interaction problems investigated, the reflective and dissipative characteristics of the flexible and porous structure are studied by analyzing the reflection and transmission coefficients. Further, wave elevation on both sides of the structure and wave load on the structures are analyzed due to variations in different physical parameters. Unlike the case of single layer fluid, in case of two-layer fluid, effects of wave motion in both surface and internal modes on physical quantities such as reflection and transmission coefficients, surface and interface elevations are analyzed. Further, in the study on wave-structure interaction problem having undulated bed, effects of different types of bed profiles are analyzed in trapping the incoming waves. For most of the physical problems studied in the thesis, numerical convergence of the solution are analyzed and the computational results are validated with known results in the literature.
Keywords: Eigenfunction expansion; least square approximation; Green's second identity; mild-slope approximation; boundary element method; Bessel function; surface gravity waves; shallow water approximation; porous and flexible structures; wave scattering and trapping.