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Abstract

Single row of segmented artificial reefs were suggested to be installed in the coastal region to protect the coast from the attack of incident waves and meanwhile to keep the coastal environmental conditions less changed.

To get insight into the mechanism of wave transmission and reflection on such reefs, we choose an ideal case, i.e. wave reflection and transmission on an infinite single row of segmented artificial reefs near a vertical wall with normal wave incidence, to develop an analytical method, based on the method of separation of variables and the technique of fluid region matching.

The vertical wall is assumed to be rigid. The infinite row of artificial reefs is uniformly distributed on a straight line parallel to the vertical wall with constant distance. The artificial reefs are assumed to be rigid, thin, impermeable and vertically located in water of constant depth. All the reefs are in the same size, and the separation distance between adjacent reefs is also the same. The reef can be either bottom mounted and free surface piercing or submerged. Here, we treat the bottom mounted and free surface piercing reefs (or call them breakwaters).

A regular, monochromatic, small amplitude incident wave train of amplitude A and frequency OMEGA propagating normally from right infinity is considered. As usual, the fluid is assumed to be inviscid, incompressible and the flow irrotational. The fluid motion may then be described in terms of the velocity potential governed by the Laplace equation and corresponding boundary conditions.

Since the reefs are periodically distributed, we may choose only the strip region between two imaginary vertical surfaces normal to the wall for consideration. The fluid domain is divided into two sub-regions by imaginary interface at the reef position. The velocity potential in each sub-region is expanded by eigenfunctions.

By satisfying the corresponding boundary conditions and matching conditions in and between sub-regions, a set of linear algebraic equations can be obtained to determine the unknown coefficients for the eigenfunction expansions in each sub-region. Some preliminary discussions on the mechanism of the wave reflection and transmission characteristics are given in the paper. By the analytical solution, we hope to get a clear view of the mechanism of wave transmission and reflection on reefs and the influence of the reef parameters, and meanwhile, the computational results may also offer a comparison base for more general numerical codes.