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Hydrodynamic Induced by the Interaction between Water Waves and Two Blocks of Wavy Surfaces: Characterization of the Reflected Energy

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Extended Abstract

Along the line coast, there are human settlements were fishing, tourism and industrial activities are carried out, which must be protected with breakwaters to due to the erosive action of water waves. Breakwaters are seen as coastal structures that reduce the wave energy downstream of the structure and therefore reduce the coastal erosion and providing safe harbourage. Breakwaters can be classified as: 1) offshore platforms, islands, breakwaters and floating structures, Floating structures are also used as bridges. In this context, based on linear water waves, [1] studied analytically the hydrodynamics behavior beneath a pontoon-type breakwater. In this context, using a spectral decomposition technique, [2] obtained the reflection coefficients for a horizontal double plate system. In the analysis of the interaction between water waves and breakwaters, the fundamental phenomena that are studied are the reflection and transmission coefficients together with the evolution, in space and time, of the water free surface elevation. Regarding with the reflection of the water waves, it has been identified that wavy sea bottoms can induce wave resonance, a condition that occurs when the wavelength of the water waves is twice the wavelength of the wavy surface, this interesting phenomenon is well known as the Bragg resonance. In particular, [3] studied the interaction between a submerged floating breakwater of wavy surface and long waves. In this work, we carried out an asymptotic analysis up to the second order in a regular expansion, of the interaction between linear long waves and two submerged breakwaters of wavy surfaces, which obey a sinusoidal profile. The effects on the reflection coefficient for different water waves conditions of the geometry of the two structures are analyzed. The governing equations are expressed in its dimensionless version. Because the boundary conditions at the surfaces of the breakwaters are non-homogeneous, they are linearized using the domain perturbation method. The wavy surfaces of the breakwaters generate larger values of the reflection coefficient than those obtained for breakwaters with flat surfaces, and the largest values of this coefficient are obtained when the length of the breakwater is of the same order of magnitude as the wavelength. The asymptotic solution is compared with classical analytical solutions and the results are in good agreement. The present mathematical model was compared with the formulas reported in the specialized literature and the results were in good agreement. In addition, because the analyzed problem is a conservative system the formulas for the reflection and transmission coefficients were also verified by considering an energy identity, which was found to be satisfied to very good accuracy. We identify that for a breakwater with a length of the same order of magnitude than the wavelength, the reflection coefficient increases. This asymptotic solution can serve as a reference for selecting the geometric configuration of a submerged floating breakwater under shallow flow conditions.

References

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