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Hydraulic Performance of Curtain Wall Breakwaters Based on Improved Moving Particle Semi-Implicit Method

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Abstract : This paper addresses the hydraulic performance of curtain wall breakwaters as a coastal structure protection based on the particles method modelling. The hydraulic functions of curtain wall as wave barriers by reflecting large parts of incident waves through the vertical wall, a part transmitted and a particular part was dissipating the wave energies through the eddy flows formed beneath the lower end of the plate. As a Lagrangian particle, the Moving Particle Semi-implicit (MPS) method which has a robust capability for numerical representation has proven useful for design of structures application that concern free-surface hydrodynamic flow, such as wave breaking and overtopping. In this study, a vertical two-dimensional numerical model for the simulation of violent flow associated with the interaction between the curtain-wall breakwaters and progressive water waves is developed by MPS method in which a higher precision pressure gradient model and free surface particle recognition model were proposed. The wave transmission, reflection, and energy dissipation of the vertical wall were experimentally and theoretically examined. With the numerical wave flume by particle method, very detailed velocity and pressure fields around the curtain-walls under the action of waves can be computed in each calculation steps, and the effect of different wave and structural parameters on the hydrodynamic characteristics was investigated. Also, the simulated results of temporal profiles and distributions of velocity and pressure in the vicinity of curtain-wall breakwaters are compared with the experimental data. Herein, the numerical investigation of hydraulic performance of curtain wall breakwaters indicated that the incident wave is largely reflected from the structure, while the large eddies or turbulent flows occur beneath the curtain-wall resulting in big energy losses. The improved MPS method shows a good agreement between numerical results and analytical/experimental data which are compared to related researches. It is thus verified that the improved pressure gradient model and free surface particle recognition methods are useful for enhancement of stability and accuracy of MPS model for water waves and marine structures. Therefore, it is possible for particle method (MPS method) to achieve an appropriate level of correctness to be applied in engineering fields through further study.

Keywords : curtain wall breakwaters, free surface flow, hydraulic performance, improved MPS method
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