The influence of geometrical parameters on the performance of perforated breakwater

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ABSTRACT

Wave loads are of great concerns of coastal and offshore structures due to safety and operational issues. In order to mitigate the hydrodynamic impact loads, wave breakers or breakwaters have been used worldwide as protection devices. Nevertheless, the optimal design of the breakwaters by considering the wave conditions and the tolerable loads of the protected installations or equipments of the coastal and offshore structures still remains as a challenge mainly in case of the floating structures, where the weight of the protection devices is of great concern. In the past, lightweight protection devices onboard the floating structures have been proposed, such as vane type devices and perforated plates [1,2]. However, there are relatively few literatures regarding the performances, as well as the influences of the geometrical parameters, of the devices [3,4] owing to complicated experimental settings and the limitation of the traditional mesh based Computer Fluid Dynamics (CFD) approaches for the modelling of the highly nonlinear hydrodynamic phenomena with large free-surface deformation and wave breaking associated with the complex geometry of the protection devices. In the present paper, overcome the shortcomings of the traditional CFD approaches, influence of geometrical parameters on the performance of a breakwater is investigated using a fully lagrangian meshless particle-based approach denominated Moving Particle Semi-implicit (MPS) method [5]. The lightweight protection device considered in the present study is a perforated plate. For sake of simplicity, the protected installation is modelled as a vertical wall. The incoming wave is approximated by a collapsing of a water column subjected to gravity and hits first the protection device, and later a vertical wall. At first, the convergence analysis is carried out to optimize the numerical modelling. After that, the influence of protection device shape and geometrical parameters, such as characteristic dimension of the holes, the ratio of perforated area and distance between the protection device and the protected wall, are investigated through a series of numerical simulations. As a result, impact loads and impulse on the vertical wall are compared for different geometrical configurations of the breakwater and possible correlations are discussed.

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