Two-phase modeling of wave induced scour around the vertical submerged breakwaters

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Abstract

Submerged breakwaters have been noticed as a good alternative for coastal stabilization structures in recent years. What makes them different from emerged breakwater is that waves can propagate over them. Therefore unlike the emerged breakwaters, scouring can occur on both sides of them.

Because of the importance of scouring in breakwaters stability, in this study, the two-phase Euler-Lagrangian model of Hajivalie et al. (2012) was redeveloped to simulate and study of scouring process around submerged breakwaters. This two-phase model can simulate the interaction of fluid and granular bed using the Navier-Stokes and movement equations. These equations are solved in two individual models.

In this two-phase model, fluid phase was simulated using a two-dimensional finite difference model developed based on RANS equations. In this model the turbulence effect was taken into account using the standard k-ε model. The free surface configuration is tracked down using VOF method. The wave hydrodynamics around the submerged breakwater is simulated accurately using this model and the computed velocities then are applied in sediment phase model.

The adopted model for simulating of granular bed is a so-called MBS model. In this model the bed particles move under action of both fluid flow forces as well as interaction between

the particles. The model results have been compared with Lee & Mizutani (2008) and Young and Testik (2009) experiments to assure the accuracy of the model. This comparisons show good agreement between numerical and experimental results. The resulted redeveloped model thus can be used to simulate and study of scouring around submerged breakwaters.

Keywords

RANS equations, k-ε model, VOF method, Vortices