Wave Structure Interaction : Kinematics Properties of Wave Overtopping Breakwaters and Its Impacts in Harbor Regions

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Abstract:

Computational Fluid Dynamics (CFD) simulations are conducted on the flow field generated by interaction of a nonlinear solitary wave with a submerged breakwater as well as a breakwater with zero freeboard. Experimental data is used to validate the simulation results of particle velocities and water surface elevations in the vicinity of breakwater as well as to find the best turbulence modeling approach for the wave-breakwater interaction problem. For this purpose the Standard K-Epsilon, the SST-K-Omega, and the inviscid models with first and second order solvers available in the CFD software are employed in simulations. Comparing the experimental data and CFD results shows that CFD is capable of reproducing the overall pattern of the wave interacting with the breakwater and different processes such as wave reflection, wave breaking, and vortical flow motions in the vicinity of breakwater. CFD results are also used to predict sediment particle movements due to overtopping with zero freeboard, as an example, for a harbor basin with a depth of 40 ft. The acceptable agreement between the CFD results and the experimental data suggests that CFD is a promising tool for design of breakwaters and other marine structures subject to waves.