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Enhancing Stability and Reduce Damage in Rubble-Mound Reshaping Breakwaters by Using Obstacles in Front of the Structure

Strengthening breakwaters can reduce the damages that lead to hydraulic instability. Aiming to enhance the stability of reshaping breakwaters, this experimental study presents a method for controlling and reducing structural damages against waves by attaching a submerged obstacle to the structure toe and installing a floating wave barrier at a certain distance. In the tests, the breakwater was exposed to a total of 3000 random waves based on the JONSWAP spectrum. By generating an integrated 3D digital model of the structure using close-range photogrammetry, the displacement of armour units was recorded, and the damage parameter was calculated. Moreover, a comparison of the results between reinforced and simple breakwater indicated that the damage parameter was reduced by 37.19 and 34.14 percent by, respectively, attaching the submerged obstacle and installing the floating wave barrier, which confirms the good performance of the proposed models. Breakwater reinforcement with the submerged obstacle and the floating wave barrier simultaneously reduced the damage parameter by 51.79 percent, which was the highest efficiency among the different models. Also, the results show that with increasing the stability number, the damage parameter also increases, and the interaction between the wave steepness and the damage parameter indicates that the damage parameter decreases with increasing the wave sharpness values.

Keywords: Random Waves, Damage Parameter, Stability, Rubble-Mound Breakwater, Submerged Obstacle.

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