VERTICAL SEA WALL CREST MODIFICATIONS FOR OVERTOPPING

Dogan Kisacik, Dokuz Eylul University, dogan.kisacik@deu.edu.tr
Gulizar Ozyurt Tarakcioglu, Middle East Technical University, gulizar@metu.edu.tr
Cuneyt Baykal, Middle East Technical University, cbaykal@metu.edu.tr
Gokhan Kaboglu, Dokuz Eylul University, gokhan.kaboglu@deu.edu.tr

Crest modifications such as a storm wall, parapet or a bullnose are widely used to reduce the wave overtopping over coastal structures where spatial and visual demands restrict the crest heights, especially in urban areas. Although reduction factors of these modifications have been studied for sloped structures in EurOtop Manual (2016), there is limited information regarding the vertical structures. This paper presents the experimental set-up and first results of wave overtopping tests for a vertical wall with several different super structure types: a) seaward storm wall, b) sloping promenade, c) landward storm wall, d) stilling wave basin (SWB), e) seaward storm wall with parapet, f) landward storm wall on the horizontal promenade with parapet, g) landward storm wall with parapet, h) stilling wave basin (SWB) with parapet, under breaking wave conditions (Figure 1). The SWB is made up of a seaward storm wall (may be a double shifted rows) , a sloping promenade (basin) and a landward storm wall. The seaward storm wall is partially permeable to allow the evacuation of the water in the basin.
To investigate the effect of all superstructures on the volume of overtopped water, physical model tests have been carried out in the wave flume of Middle East Technical University (Turkey). The wave flume is 26 m in length, 6 m in width and 1.0 m in depth. An inner channel (18.00 m in length, 1.50 m in width) is constructed of glass in the wave flume to reduce the size of the cross-section and the reflection effects occurring due to side walls. A piston type wave maker is placed at the other end of the wave flume which is capable of generating irregular waves. Each time series of the experiments contained 500 irregular waves with Bretschneider spectrum. The Froude model scale was set as 1:16 after considering tolerable water depth in the flume and wave maker capacity to ensure correct reproduction of all wave processes. The model was instrumented with ten sets of wave gauges, and three sets of video cameras were used to capture the wave overtopping process.
The models were located 16 m away from the wave paddle on a uniform foreshore slope, $1/s_f = 1/20$. The models were built from wooden and plastic materials. The incident waves at the location of the structure i.e. undisturbed wave conditions generated using the setup without the structure were used to calculate the wave overtopping. The incident spectral significant wave heights (H_{m0}) were measured at wave gauges by utilizing the standard 3-gauge-procedure of Mansard & Funke, (1980), while L was determined by linear wave theory for any depth. The undisturbed incident wave characteristics (H_{m0}, T_p and H_{m0}/L) were determined at the location of the structure, where H_{m0} is the spectral wave height, T_p is the peak period and H_{m0}/L is the wave steepness based on spectral wave height and peak period. The tests were carried out for six different water depths, a range of wave heights, $H_{m0} = 1.07 - 1.82$ m and wave steepness, $H_{m0}/L = 0.040 - 0.047$.

The overtopped water was collected over a specific crest width that drained into a tank down a chute. The accumulated water in the tank was measured at the end of each test and the mean wave overtopping discharge q ($m^3/s\ per\ m$ width) was calculated.

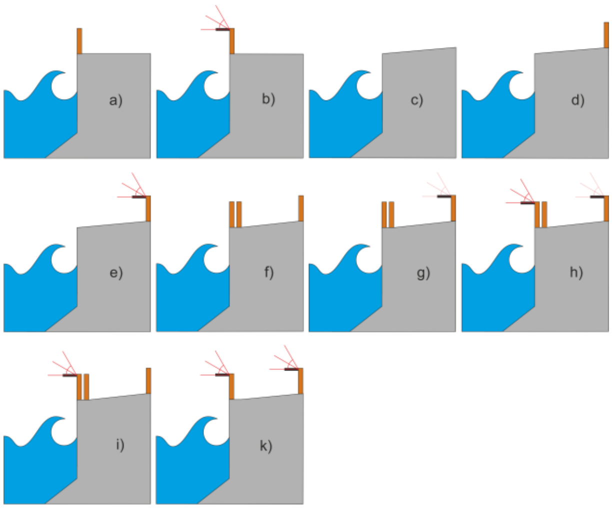

Figure 1. Ten different super structure types

A reduction factor for each crest type, γ is determined for the finalized design for a broader spectrum of hydraulic boundary conditions (e.g. from small to large wave periods, different water levels) of impulsive wave breaking in the range of $0.26 < R_c/H_{m0} < 1.91$. Some of the results are:

- The reduction of vertical wall with a parapet (a) of low crest is very similar to the reduction of a long sloping promenade (c).
- Combination of a sloping promenade and a landward storm (d) reduces the overtopping almost by 50%. The sloping promenade diminishes the wave energy and the low crested storm wall is capable of blocking these low energy waves. The addition of bullnose to the storm wall decreases the overtopping further by 5%.
- SWB combined with bullnose on each storm walls (h) performs the best with reduction factors around 70%.

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