HYDRAULIC TESTS ON A XBLOCPLUS ARMOURED COASTAL REVETMENT

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INTRODUCTION

In this study, the hydraulic tests performed on a XBlocPlus® armoured coastal revetment structure to be constructed at the mid-western Black Sea coast of Turkey are presented. The revetment structure protects a reclaimed area next to a thermal power-plant. The tests include measurements regarding i) the stability of the armour layer, ii) mean and individual wave overtopping iii) wave loads on the crown wall, and iv) overtopping induced scour at the lee-side. The revetment structure has an approximate length of 1 km. The toe depth varies between -7 m to -17 m (mean sea level, MSL). The design high water level (HWL) corresponding to 100-yr return period is calculated as +0.95 m. The nearshore bottom slope is around 1:30. The design significant wave height and the peak period at the toe of the structure with a 100-yr return period are given as H_{m0} = 8.53 m and T_s = 9.91 s at the deepest section of the structure. The volume of the blocks used in the armour layer of the revetment varies as 6 m^3, 14 m^3 and 18 m^3 from the shallowest region to the deepest section. The study covers the experiments performed for the section with 18 m^3 blocks and a toe depth of -17 m (MSL).

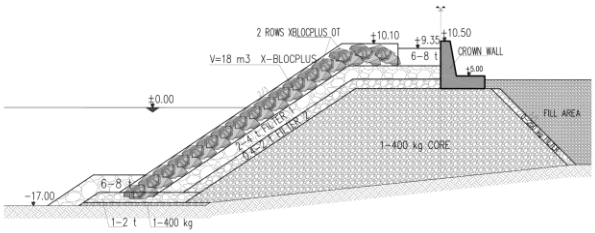

Figure 1 - Test section with 18 m^3 XBlocPlus® blocks.

EXPERIMENTS

The physical model experiments are conducted in the wave flume of Middle East Technical University (METU), Department of Civil Engineering, Coastal and Ocean Engineering Laboratory. The flume is 28.9 m long (with a useful length of 20.6 m), 0.9 m wide, and 1.0 m deep, equipped with a piston-type random wave generation and a passive wave absorption system. The model length scale is determined as λ_L = 1:65.604 applying Froude similarity. The experimental setup is given in Figure 2. The cross section (Figure 1) is subject to a total of irregular 6 wave sets composed of various combinations of water levels (between low and high-water levels) and return periods (10 hours/year, 50 year and 100 year). Each wave train is 8 to 10 hours long in prototype and generated using the JONSWAP spectrum (with a peak enhancement factor of γ=3.3).

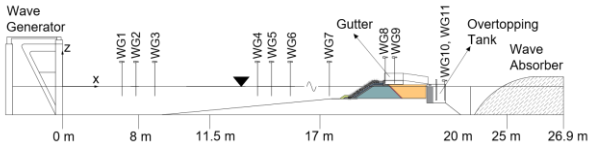

Figure 2 - Experimental setup.

The section is not repaired in between the wave sets to observe cumulative damage development. The rocking and dislocation of the armour units are tracked with a camera system. The method used by Koosheh et al. (2022) is used for determining the individual wave overtopping events and corresponding individual volumes using the wave gauges placed in series over the gutter and in the tank. Four KISTLER Type 601 C Piezoelectric Pressure Sensors are used in the experiments to measure wave pressures on the vertical front and horizontal slab faces of the crown wall (Demir, 2023). The location of the sensors for front and bottom face pressure measurements are given in Figure 3. The lee-side bed evolution is measured over 11 profiles after each wave set using a bottom profiler equipped with Banner® brand LTF24IC2LDQ model laser sensor. The profile measurements start from the crest and extending along the fill area (Yıldırım, 2021). A priori each wave set, the surface of the fill area is levelled to a horizontal plane, compacted by hand with a flat board, and then watered to aid compaction.

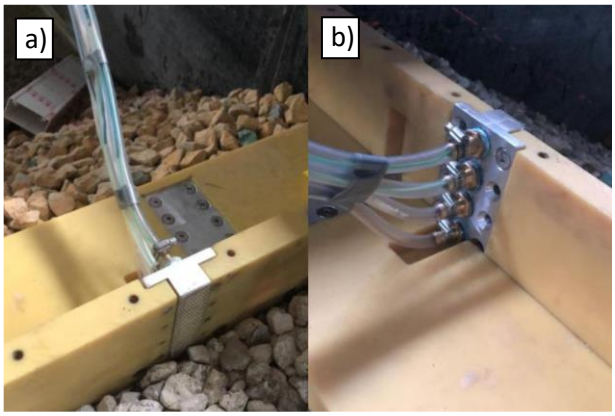

Figure 3 - Pressure sensors on the crown wall; a) view from sea-side, b) view from lee-side, (Demir, 2023).

FUTURE WORK

The study is currently under operation. Following the completion of tests and the analyses of the test results, the observations on the stability of armour and toe layers will be presented. The mean and individual overtopping performances (i.e. number of overtopping events relative to number of waves and the maximum individual overtopping volumes) of the sections and the wave forces measured on the crown-wall will be assessed in comparison with the literature (Bakker et al., 2023; Nørgaard et al., 2013). The test results on the lee-side scour will be evaluated in comparison with the earlier work of Yıldırım (2021), where a rubble mound revetment structure with a I-shaped crown wall is considered. The present study stands out as a rare case study where the XBlocPlus® armour blocks are being tested under such high design wave conditions.

ACKNOWLEDGEMENT

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