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STABILTY OF CONCRETE ARMOR UNIT (TETRAPOD) ON REAR SIDE OF RUBBLE MOUND STRUCTURES WITH RECTANGULAR SUPER STRUCTURE

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The coastal structures allow the wave overtopping within a certain quantity. However the extreme wave overtopping could cause the damage of coastal structures. The most of the previous researches for the stability of armor unit were performed about the armor units placed on sea side of coastal structures. A rubble-mound structure is normally composed of a bedding layer and a core of quarry-run stone covered by one or more layers of larger stone and an exterior layer or layers of large quarry stone or concrete armor units. Coastal Engineering Manual (USACE, 2006) suggested the design figures without super structures and showed the ratio of the armor weight for each location of rubble mound structures and it could be known that the same weight ratio was needed to the sea side and harbor side slope of rubble mound structures. In this design figure, the filter rule is applied to the design figures of CEM, that is, the weight ratio for under layer is W/10 for the main armor weight ratio (W) to prevent smaller rocks in the under layer from being pulled through an over layer by wave action

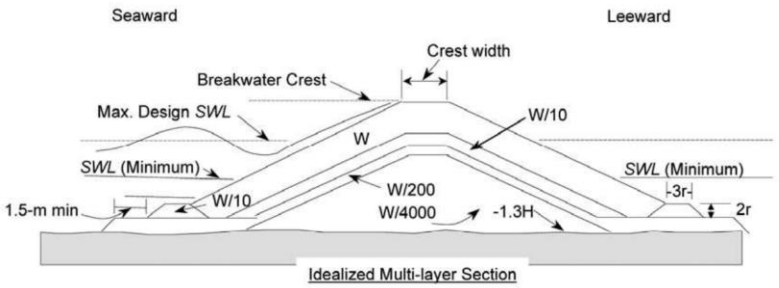

Figure 1. Rubble mound section for wave exposure with moderate wave overtopping (USACE, 2006)

van Gent (2007) performed the experiments about the stability of the rock material on the rear side slope of rubble mound structures with L-shaped crest elements and suggested the stability formula using 1% fictitious wave run-up height and showed that for rubble mound structures with crest elements it is possible to use smaller rock material at the rear side than at the seaward side.

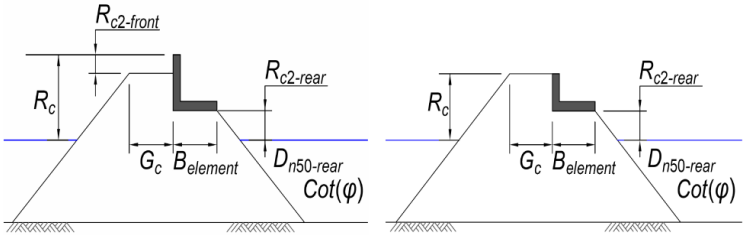

Figure 2. Stability of rock material on the rear side slope with L-shaped crest element (van Gent, 2007)

In this study, two dimensional hydraulic model tests were performed to investigate the stability of concrete armor units covered on harbor side slope of rubble mound structures. The rectangular shaped crest elements were commonly applied to the design process of rubble mound structures in Korea. The tetrapods were placed on harbor and see side of the rubble mound structures. The weight of tetrapods on harbor side slope were changed and the stability were investigated using the damage level (N_{od}=0.2). The various relative freeboard ($R=R_c/H_s$) was applied to the tests. When the scale factor is 1/40, the weight of armor unit (tetrapod) at sea side slope is 25 ton (W, 359g in model) and that at rear side slope is varying from 3.2 ton (45g in model) to 25 ton. The design wave height for 359g Tetrapod at harbor side slope is about 16 cm. The weight ratio for rear side against sea side is about 0.1W ~ 1.0W. The duration for wave attack is 1,000 waves for each wave periods. The armor unit weight ratio for the rear slope of rubble mound structures needed 0.8 times of that for sea side slope. The stability number (N_s) according to relative freeboard and wave steepness was analyzed.

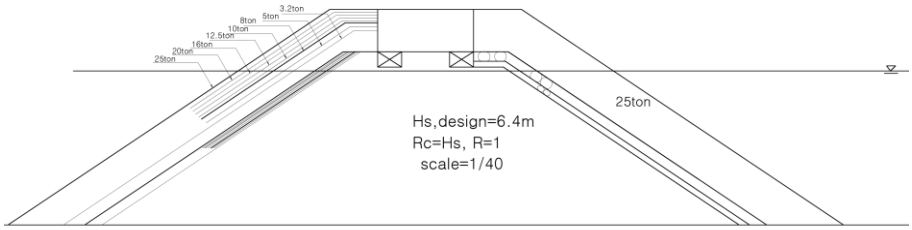

Figure 3. Schematic sketch of test model for R=1

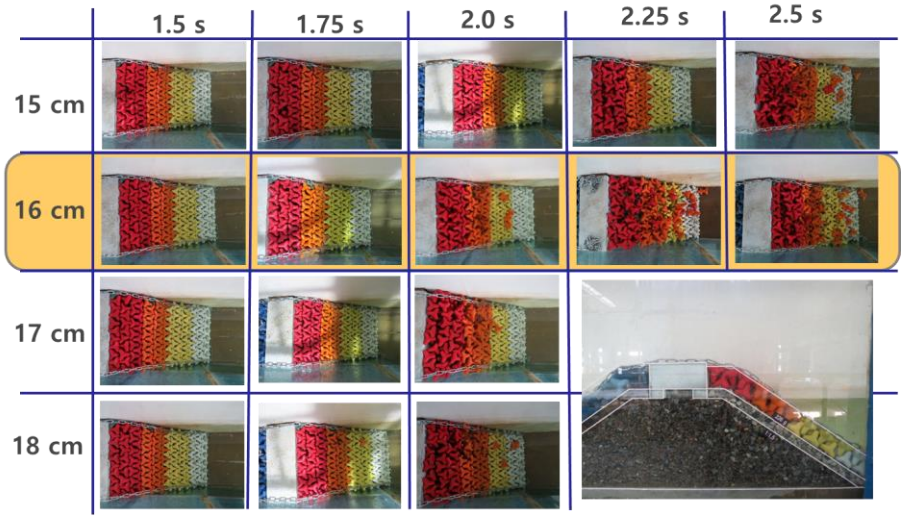

Figure 4. Example of test results for stability of armor unit (tetrapod) on rear side slope

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