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WAVE PRESSURES ACTING ON THE PAVEMENT BEHIND THE SLOPING REVETMENT

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ABSTRACT

A physical experiment was performed to seek an empirical equation predicting the wave force acting on the upper surface of the pavement behind the revetment parapet due to wave overtopping as well as the uplift force acting on the underlayer of the pavement induced by the wave pressure passing through the core layers of the revetment. The experiment was carried out by installing pressure transducers along the upside and downside of the pavement with different configuration of the parapet, water depth, relative freeboard, and armor layer thickness. Then, the wave pressure and force on the pavement was analyzed under various incoming wave conditions. Based on the analysis results, major parameters affecting the wave forces were identified and an empirical equation for evaluating the forces on the pavement is suggested.

KEYWORDS: sloping revetment, pavement, overtopping, uplift pressure, physical experiment

1 INTRODUCTION

A sloping revetment needs to be designed to satisfy the stability of the structure itself against waves and to prevent coastal erosion and inundation to roads and buildings on the hinterland as well. Regarding the stability of the sloping revetment, several research have been conducted that suggest a method for estimating the wave load on the front face of the crest wall (*e.g.* Pedersen, 1996; Nørgaard et al., 1983). However, there have been few studies that address the wave load on the pavement behind the wall. Although the wave force on the pavement is likely to be smaller compared to that on the front face, it needs to be dealt with importantly in design because people perform various activities in the hinterland of the revetment. In view of these circumstances, physical experiments have been carried out to figure out the wave forces acting on the pavement behind a sloping seawall. Based on the analysis of the experimental data, empirical expressions of the wave force on the pavement were sought.

2 EXPERIMENTS

Physical experiments were conducted in a wave flume with 50 m long, 1.2 m wide, and 1.6 m high. As shown in Figure 1, the sloping revetment was installed at 33.3 m from the upstream end of the flume. The crown wall and the pavement were manufactured with acrylic plate and placed on top of the rubble mound. The front face of the mound was covered with Tetrapods of 250 g, which were placed on the underlayer of 30 g rubble stones. As shown in Figure 2, the width of the crown wall (C_w) was 0.10 m, the width of the pavement (D_w) was 0.30 m, the shoulder width (G_w) was 0.078 m, and the height of the underlayer (U_t) was 0.012 m. In addition, the water depth (h), the crest height (A_c), the pavement width (D_w), and the free board (R_c) were varied differently.

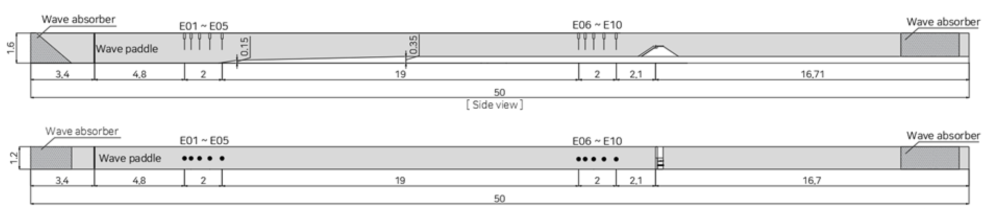

Figure 1. Schematic diagram of the wave flume and the experimental setup.

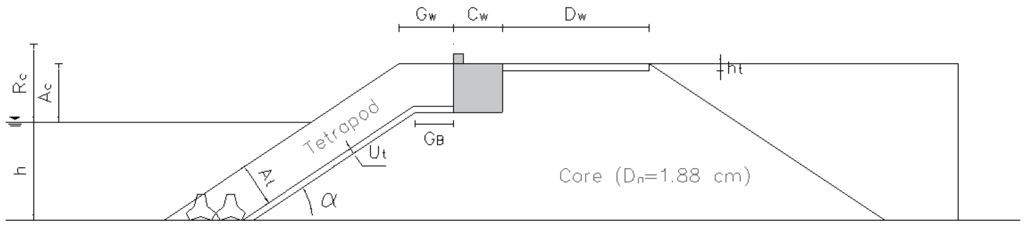

Figure 2. Definition of the geometrical parameters of the model.

Irregular waves were generated following the JONSWAP spectrum with a peak enhancement factor (γ) of 3.3, and the total number of generated waves (N) was set to 1000. The significant wave period (T_s) was ranged from 1.4 to 2.2 s, whereas the significant wave height (H_s) was varied from 0.08 m to 0.14 m. The incident waves were measured by wave gauges that were installed near the wave board (E01-E05) and in front of the model (E06-E10). Pressure transducers were placed on the front and bottom face of the crown wall as well as the top and bottom surface of the pavement plate. The sampling interval of the pressure transducers was 200 Hz.

3 RESULTS

Figure 3 shows maximum pressure distributions with three different wave height (H_s = 0.08, 0.12, and 0.14 m) under two different water depths (h = 0.40 m and 0.45 m). The horizontal and uplift wave pressure on the front face of the crown wall increases with the wave height. Similar trend was observed for the pressure acting on the pavement as well. When compared the left and right panels in the figure, the magnitudes of the maximum pressure were larger when the water depth was deeper.

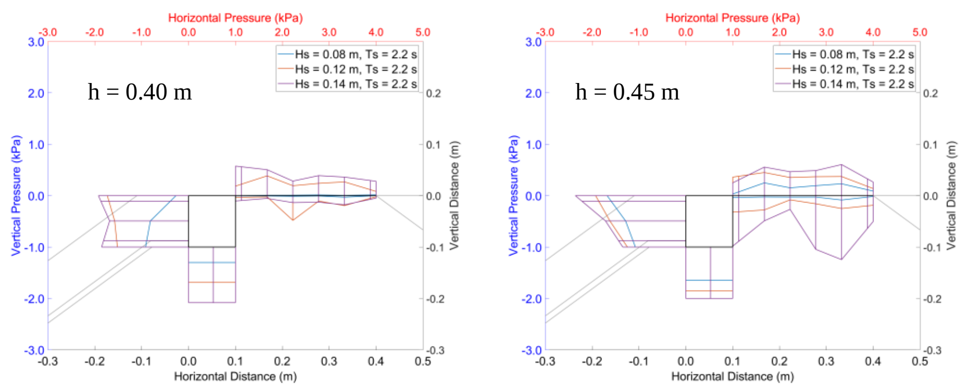

Figure 3. Comparison of the maximum wave pressure distribution with different water depths.

4 CONCLUSIONS

Based on the analysis of the experimental data, it was confirmed that the pressures acting on the pavement behind the sloping revetment significantly increase according to increase of the significant wave height and period, and the water depth. For quantitative estimation of the wave forces on the structure, dimensionless analysis was carried out to seek an empirical expression, which will be presented at the conference.

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