

COMPARISON OF SILL AND REVETMENT IN REDUCING SHORE EROSION AND WAVE OVERTOPPING

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INTRODUCTION

Sills (low-crested rubble mounds) are constructed to protect eroding bluffs and planted marshes in living shoreline projects (<http://mycopri.org>). Revetments are conventionally used to protect eroding shores and reduce wave overtopping and damage to backshore areas. However, revetment construction may result in loss of buffering wetlands. On the other hand, no established method exists to design the sill geometry (crest height, width and side slopes) and its distance from the eroding shore. This study compares the efficacies of the two different rubble structures with the same number of stones in order to clarify their similarity and difference for the purpose in reducing shore erosion and wave overtopping.

EXPERIMENT

An experiment was conducted in a wave flume that is 30 m long, 1.15 m wide and 1.5 m high (Figure 1). The sand beach in the flume consists of fine sand with a median diameter of 0.18 mm. A 400-s run of irregular waves with a TMA spectrum was generated in a water depth of 88, 92 or 96 cm. The spectral significant wave height and peak period were approximately 19 cm and 2.6 s. Eight wave gauges (WG1-WG8) were used to measure the free surface elevation from outside the surf zone to the swash zone. The fluid velocities in the surf zone were measured by three velocimeters (ADV and Vectrinos). The wave overtopping rate and sand overwash rate over the landward vertical wall were measured by collecting overtopped water and sand in a collection basin and a sand trap during each 400-s run. The beach profile was measured using a laser line scanner system.

The first test was conducted to quantify shore erosion for the case of no (N) structure. During the first 10 runs in the 88 cm water depth, the foreshore and berm were eroded but no wave overtopping occurred. During the second 10 runs, the still water level (SWL) was increased by 4 cm to initiate wave overtopping. The foreshore erosion continued slowly under the condition of minor wave overtopping and overwash. The increase of the SWL by additional 4 cm resulted in the increase of the wave overtopping and overwash rates by a factor of 10. The foreshore erosion reached the vertical wall after 10 runs.

The initial beach profile was rebuilt and a stone structure was placed on polyester fabric mesh with an opening of 0.074 mm. The mesh edges were buried well into the sand to prevent sand undermining below the fabric mesh. The location and geometry of the placed sill (S) and revetment (R) are shown in Figure 2. The stone structures with stone diameters of about 4 cm were stable under wave action during the S and R tests. The SWL elevation was 0, 4 and 8 cm with 10 runs for each SWL as in the N test. The sill crest was emerged, at SWL, and submerged for the 0, 4, and 8 cm SWL, respectively. The revetment toe was above SWL initially and became submerged for the

last 10 runs. The emerged sill was effective in reducing transmitted waves and shore erosion. Its effectiveness decreased significantly with the increase of the SWL and transmitted waves. The measured wave overtopping and overwash rates for the last 10 runs were similar to those in the N test.

The revetment placed directly on the eroding foreshore remained effective in the entire R test apart from minor scour at the toe and crest of the revetment.

Analyzed data will be presented at the conference. The initial profile of N, R and S tests are illustrated in Figure 2.

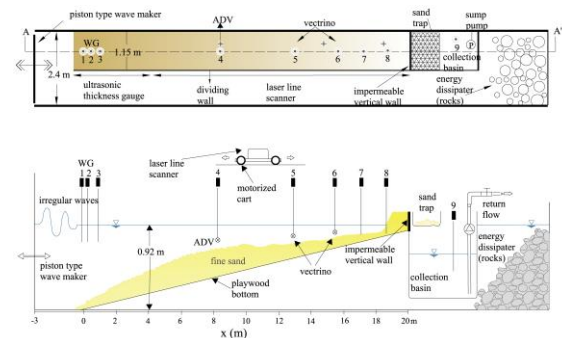


Figure 1 - Top View and Cross Section View of Experimental Setup and Initial Profile with No (N) Structure

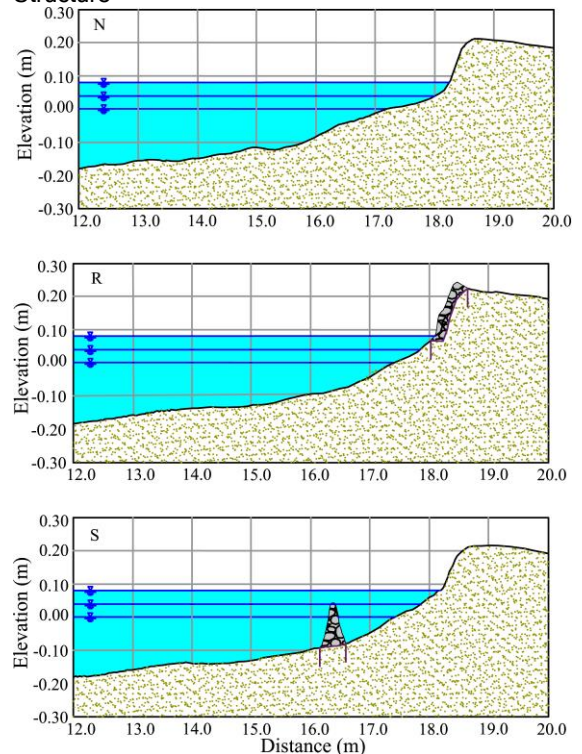


Figure 2 - Initial Profiles of No Structure (N), Revetment (R) and Sill (S) Tests with Still Water Level of 0, 4, and 8 cm