Research& Reviews

ISSN: 2319-9873

Research and Reviews: Journal of Engineering and Technology

Reshape of Wave Break Structure under Irregular Wave Attack

Alireza Bakhtiari*, and Manoochehr Fathi Moghadam

Department of Hydraulic Structures, School of Water Sciences Engineering, Shahid Chamran University, Ahwaz, Iran.

Article

Received: 29/03/2013
Revised: 04/04/2013
Accepted: 06/04/2013

***For Correspondence**

Department of Hydraulic Structures, School of Water Sciences Engineering, Shahid Chamran University, Ahwaz, Iran.

Keywords: Reshaping Seawall, Berm, Wave Parameters.

ABSTRACT

Experiments are conducted to investigate effects of irregular wave parameters on reshaping of seawall. Tests run in several water level conditions. The experiments and physical modeling are conducted in a combined flume at the Soil Conservation and Watershed Management Research Institute (SCWMRI). The energy spectrum of the applied waves is JONSWAP. The material of armour layer have been constructed with the scale of 1:25 model and grading class of D_{85}/D_{15}=1.82. Adequate number of waves was subjected to the structure to get enough data for analysis. The results showed that damages to the structure reduced by 85% as wave steepness increased by 82%. Also, damages to the structure reduced by 83% as wave height increased by %57.

INTRODUCTION

Seawalls are constricted in parallel near coastline to protect seaside buildings and installations. Seawalls are categorized according to their shape and materials, such as rubble mound seawalls. Rubble mound seawalls are also divided into two groups, statically stable non-reshaped and dynamically stable reshaped. Fig1 shows a sample of berm reshaping seawall.

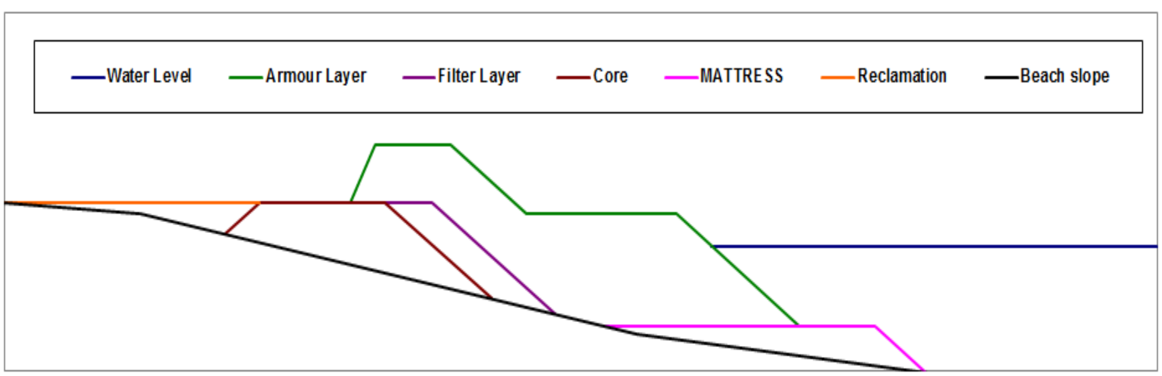

Figure 1: Design of the berm reshaped seawall

Using reshaping seawalls is prior to traditional seawalls because it's possible to use lighter materials and more expanded grading class to reshaping of the structure. Therefore it's practicable to use barrow materials so as to construct them. It's also possible to use simpler methods and lighter and more available tools.

There are several parameters to describe the behavior of structural damage, one of which is variable. damage parameter to be defined this way [1].

ISSN: 2319-9873

$$S_d = \frac{A_s}{D_{n50}^2}, \; D_{n50} = \left(\frac{W_{50}}{\rho_a g}\right)^{1/3}$$

In the above equation, A_s the surface is eroded and the D_{n50} nominal diameter of armour rock, W_{50} medium weight of unit given by 50% on weight distribution curve.

Stability parameter is the most important parameter that shows the relations between a seawalls structure and waves. Basically seaside structure such as breakwaters and seawalls categorized according to these parameters [2].

$$H_o T_o = \frac{H_s}{\Delta D_{n50}} \times T_m \times \left(\frac{g}{D_{n50}}\right)^{0.5}$$

Parameters of the above formula are

H_s = significant wave high

Δ= relative buoyant density of amour

ρ_a = mass density of rock

ρ = mass density of water

Research using numerous experiments on physical model in order to determine relations between distinguishing profile parameter and structural and hydraulic parameter so as to make breakwater model (a computer model) [3]. The reshaping profile of reshaped breakwaters by analyzed a series of physical model experiments. The results show that Iribarren number has a great effect on the profile [4]. Also extensive experiments were performed on that kind of breakwaters and Was presented a relation for receding rate (degree) of a berm in forming final stable profile. In the relations, some sentences including the effect of the grading coefficient and depth coefficient added to their relations [5]. Some researchers found out that as rubbles grow smaller, the amount of damage is more extensive. Using damage level and 10% and 30% reduction of rubble weight, they proved that there's a sight relation between the increasing of stability parameter and the increasing damage level [6]. An armour layer thickness design presented instruction on reshaping breakwaters [7]. The effects of reshaping breakwater berm width Studied on their final reshaping [8].

MATERIALS AND METHODS

Wave flume

The present research has been carried out using the results of hydraulic model tests accomplished in the wave flume of Soil Conservation and Watershed Management Center.

A large number of tests were performed in the wave flume and the wave basin of this laboratory. The wave flume of SCWMRI has a length of 33m, a width of 5.5m and a depth of 1.5m. This flume is divided into three parts longitudinally. The model tests were performed in the middle part of the flume. The wave basin of SCWMRI has a length of 27m, a width of 16m and a depth of 1m. All the tests were performed using irregular waves (JONSWAP). To conduct the experiments, four wave gauges, which have been fixed in different places, are used.

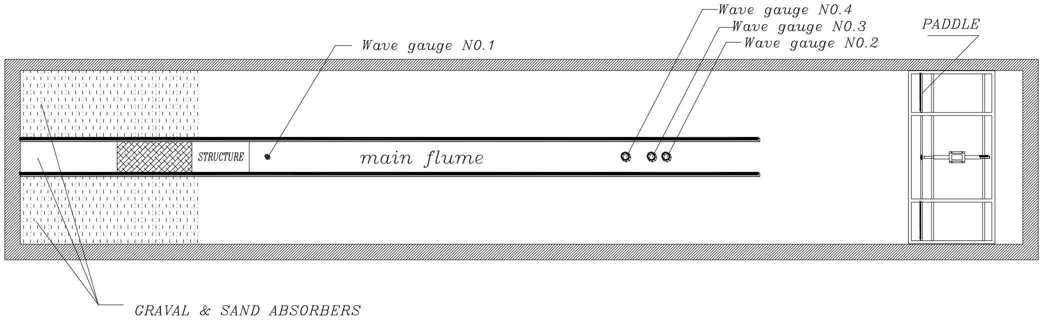

Figure 2: Plan view of the wave flume and setup of wave height meters

ISSN: 2319-9873

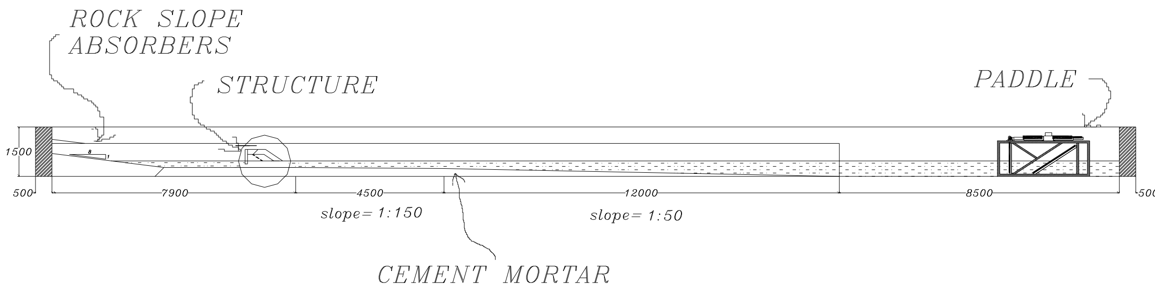

Figure 3: Cross section of the wave flume

Figure 4: Physical modeling of berm reshaping seawall

Test set-up

The wave height spread of between 8 and 14 and maximum period between 1.2 to 2.8 seconds have been used in the model. And totally 60 experiment, each of which and consists 3000 waves, have been conducted. In all experiments, structure profile has been recorded both the experiment and after the wave attack.

Table 1: Range of parameters available

Parameter	Symbol	Range
High wave	H_s	8-14(cm)
Maximum period wave	T_p	1.2-2.8(s)
Water level	D	18.2-20.8(cm)

Dimensional analysis

In order to achieve these goals, beginning to understand the various parameters that are effective in changing the structure of the action and overall relationship with the dimensional analysis of dimensionless parameters were extracted.

$$F(H_s, L_p, A_e, g, D_{n50}, V_w, \mu, \rho_a, \rho_w)$$

ISSN: 2319-9873

$$S_d = \frac{A_e}{D_{n50}^2} = f(\frac{H_s}{D_{n50}}, R_e, \frac{H_s}{L_p}, \frac{L_p}{D_{n50}}, H_o T_o)$$

RESULTS AND DISCUSSION

The results of tests after drawing diagrams, been analyzed and the effects of wave parameters on seawall reshaping of the profile is to be reviewed.

Damage parameter diagram are presented according to significant wave height in picture (5)

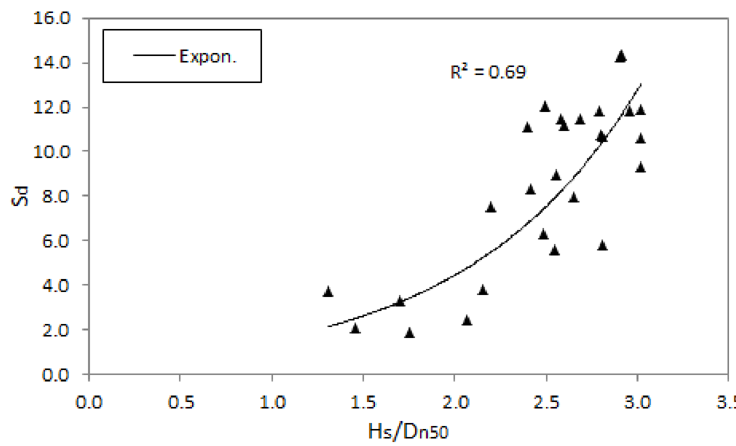

Figure 5: Damage parameter diagram against significant wave height

That it can be harvested with %57 increasing in wave height, the damage parameter %87 increases. In figure 6, Damage parameter diagram is draw against maximum length wave.

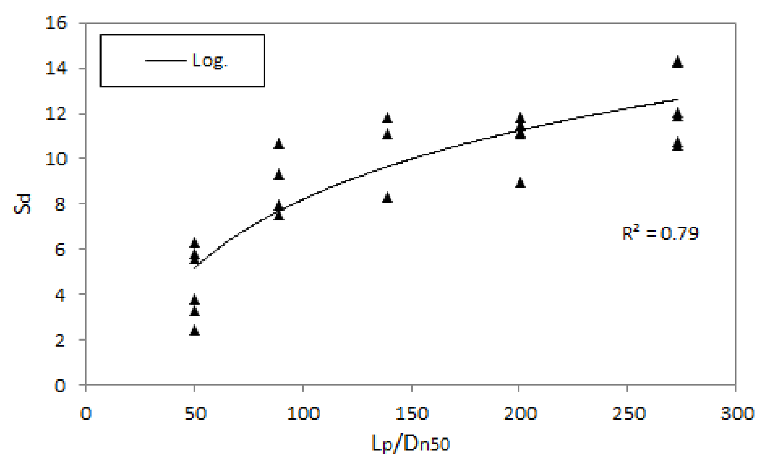

Figure 6: Damage parameter diagram against maximum length wave

That it can be harvested with %57 increasing in wave length, the damage will %83 increase. Figure 7 shows to relation between damage parameter and maximum wave steepness.

ISSN: 2319-9873

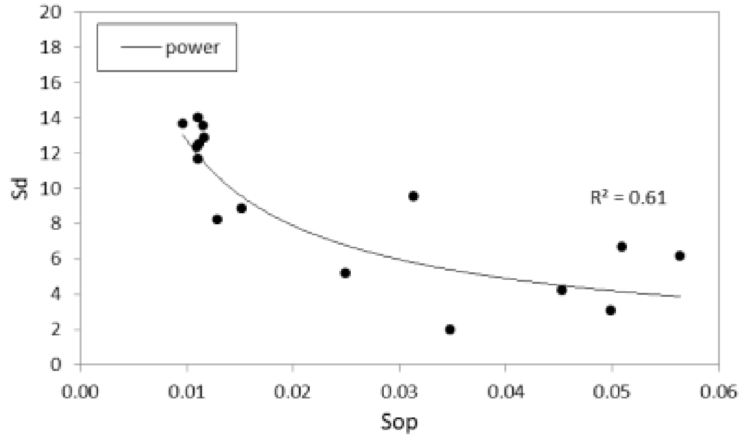

Figure 7: Damage parameter diagram against maximum wave steepness

That it can be harvested with %82 increasing in wave steepness, damage parameter %85 decreased.

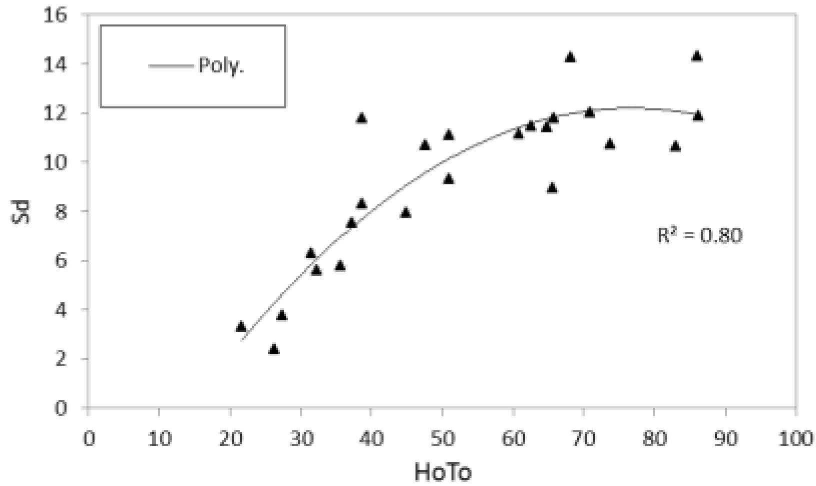

Figure 8: Damage parameter diagram against stability parameter

With increasing dynamical stability parameter, first damage parameter Increase then be fixed.

CONCLUSION

That can be harvested Damage parameters decrease with increasing wave steepness, with wave height and wave length increases damage parameter increases. Increasing wave height and wave length, the more energy the structures into which destroyed most of the structure and thus the damage parameter is increased. It can be stated that with increasing wave steepness, wave down before reaching structural damage to the structure is less.

With accordance dimensional analysis was performed, In order to study the effective interaction parameters are extracted on the eroded surface of provide a mathematical relationship between the expected values for the pre of using multivariate linear regression statistical software (Spss 18) was used and the following relationship was obtained after analyzing several.

$$S_d = -0.004(H_o T_o)^2 + 0.59 H_o T_o - 2.44 f_d$$

$$f_d = -0.16\frac{d}{D_{n50}} + 4$$

$$R^2 = 0.87$$

ACKNOWLEDGEMENTS

Authors would like to acknowledge Shahid Chamran University of Ahwaz and the Centre of Excellence on Operation Management of Irrigation and Drainage Networks for financial support and facilitation of the experiments.

REFERENCES

1. Baird WF, Hall KR. 1984, The design of breakwaters using quarried stone. 19th “International Conference on Coastal Engineering” (Houston, USA).
2. Van der Meer JW. 1988, Rock slopes and gravel beaches under wave attack. Doctoral Thesis, Delft University of Technology, Delft Hydraulics Communication No. 396.
3. Van der Meer JW. 1994, Conceptual design of rubble mound breakwaters. Delft Hydraulics Publication No. 483.
4. Kao JS, Hall KR. 1990, Trends in stability of dynamically stable breakwaters. ASCE. Proc. 22nd ICCE, Delft, Netherland.
5. Torum A, Kuhnen F, Menze A. 2002, On berm breakwaters, Stability, Scour, Overtopping, Coastal Engineering 49, 209-238.
6. Rao S, Pramod Ch, Rao B. Stability of berm breakwater with reduced armor stone weight, Technical Note. Ocean Engineering. 2003; 31:1577-1589.
7. Aghtouman P, Aliyari F, Aghtouman Z. 2011, Effect of berm width on reshaped profile of berm breakwaters. 5th “International Short Conference on Applied Costal Research” (Aachen, Germany, June 2011).
8. Aghtouman P, Chegini V, Shirian N, Hejazi M. 2005, Design of reshaping breakwater’s armor layer thickness. 2nd International “Coastal Symposium” (Hofn, Iceland, June 2005).