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Innovation Design Roughness on Slope to Reduce Storms at Curved Seawall In Canggu Beach Bali

Nalarsih, Yuwono, Darsono

Abstract: Seawall or revetment has been designed to preserve coastline erosion from waves. The seawall system or revetment could protect against powerful wave, reduce hydraulic power in underling material and contribute to wave reflection. The result of survey show that seawall system have to be repeatedly observed to maximize seawall action to produce a modification of seawall design. In this research, hydrodynamic seawall action is conducted by employing its curve, slope and roughness. It is investigated by using physical modeling in 2D Laboratory of Coastal Dynamics Institute Yogyakarta, Indonesia. Type of wave used in this study is Regular wave within one period of time. Wave experiment is examined in 30° of its slope, constant water depth is 0.4 m and roughness on its slope using two types of sequential block position and zig zags. This research results in the significant Reflection Coefficient (Kr) which is 0.141 produced by design 1 compared to the previous research is 0.16923. Therefore, it can be concluded that design 1 is more reliable in reducing reflection wave.

Index Terms: Seawall, reflection coefficient, slope, roughness.

I. INTRODUCTION

Nearly 90% hydro-meteorological disaster occurs in around the world such as el nino, la nina, landslides, cold waves, heat waves, global warming, and a powerful storm wave including massive environmental damage as the effect of declining support capacity and environmental capacity. Therefore, coastal protection from erosion and abrasion grow to be the challenging issues. In today's era, various types of coastal protection structures are used worldwide such as seawall, groyne, offshore to stabilize the shore from erosion by dampening waves.

Whenever coastal protection is naturally absent, artificial coastal protection can be structured in order to protect artificial shoreline related to the waves. It can be conducted by reducing the wave energy by establishing a parallel wave building-breaker, reinforcing seawall protector and revetment as is resistant to wave collision.

Seawall or revetment has been designed to protect coastline erosion against the powerful wave. The seawall or revetment system must resist direct wave attacks, reducing hydraulic forces to underling material and contribute for dissipating wave energy.

Several studies have been conducted to look for coastal protection solutions of various forms of seawall, and they examine seawall with one of the major slopes being a 30-pound beam or rough surface in the form of a large dentated seawall surface and on the contrary the surface of a small four teeth that stands out (serrated seawall). The result shows that the serrated laying beam placed on the 30° seawall has the smallest reflection coefficient so that it can be said to be very effective in reducing wave energy.

Methods of wave reflection analysis with various types of structures, such as softness, softness and revetment of coral (permeable and impermeable), say that the reflection coefficient depends on the factor of hardness and the slope of the revetment.

Based on revetment research, it is divided into two groups: permeable revetment and impermeable revetment, including permeable revetment group is open filter material (rip-rap), stone pitching, and concrete block. While the group includes impermeable revetment is asphalt revetment and bitument grouted stone concrete block.

Further development of seawall is a flaring seawall structure of highly curved cross-section, with a maximum sea level of design (HWL) of 4.50 and has a reflector tip as a wave crusher

The study used a concrete cube as a single layer of protection against a sloping wall of a sea wall. The block model is placed diagonally on the slopes of models 2 and 4, placing each block only between the previous two, then the block model parallel to the axis of the slope. It was obtained from the test that the sequence of placements had much effect, with the cube variable being placed in a 45° (α) angle, the water depth should be no more than 10 Dcubes, and the highest water level in the last block position

The waves used in this study use a regular wave, expressed in constant altitude over time, period and phase. The recorded data in time series is then read using MIKE 21, then the data recorded by the time domain is converted into frequency domain then analyzed. It is known that the water level actually has a height at different times and different direction combinations [8].

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This research is a follow-up of previous research Nalarsih, 2015, using approach in the field of seawall at Canggu Bali, which is located according to the map in



wave in front of the seawall structure is very important that is to identify the characteristics of the wave, so as to obtain information magnitude wave number as a benchmark performance of reliable seawall is the smallest reflection coefficient generated from two model seawall.

Based on the above references, the reason for using the 30° tilt seawall, with the beam as roughness in the incline, and the pattern of placement of roughness and curvature above the inclined plane is used as the variable in this study.

The novelty in this study compared to previous research is, the combination of variabel slope, roughness and curvature in one seawall model, so that the results of the model in reducing wave reflection more leverage. This study was conducted only in relation to wave Reflection, since wave reflection is used as an important parameter in determining seawall performance.

Characteristics of seawall at Canggu Bali, the sloped seawall that has been held is used to withstand high waves especially during storms, wave data is obtained during the morning, day and night surveys, including full moon waves. The wave characteristics include transitional sea. Figure 2 shows that the seawall structure is not able to withstand wave attacks with hollow leg conditions and some of the structures collapse.



Figure 2. SeawallCrumblingon Canggu Beach, Bali,Indonesia (Nalarsih, 2016)

The Canggu Bali Beach Approach model has a 240 cm height dimension, 38° slope, 20 cm curved reflector, 80 cm transverse. Based on the results of previous research used 30° experimental slope, curved reflector 15 cm, obtained the reflection coefficient 0.16923 [15]. (Nalarsih 2015).

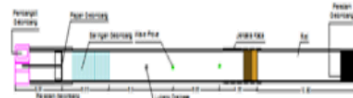


FIG. 3 is a probe placement work in accordance with a predetermined distance, in this study using 6 probes, the location of the installation is right in front of the 5 and 6 seawall models, then probe 3 and 4 and the next is probes 1 and 2. The model is made with a scale of 1: 16, water with dimensional revetment block 4.8x4.8x2.4cm, curved reflector 15cm, wide transverse 80cm, 240cm height according to

Figures 4 and 5.



Figure 4. Design roughness 1



Figure 5. Design roughness

II. METHODS OF THE STUDY

The first stage is to calibrate the wave generator to find the relationship between the variables into the pool, the excentrisitas wave generator, stroke, variator, the wave period and the resulting wave height. Implementation of calibration is done after the model inside the finished wave channel. The second stage is the wave sensor calibration aims to find the relationship between the change in the length of the sensor electrode dipped in water with the voltage changes recorded on the recorder. The third stage is the calibration of the model in the wave channel is done in addition to the above also to know the exact location of the wave sensor, so the results obtained can illustrate the phenomena that occur in the model in accordance with Figure 6.

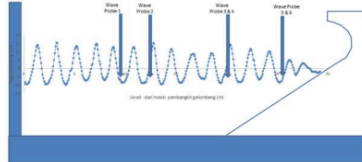


Figure 6. Schematic of hydraulic experimental model

III. RESULTS AND DISCUSSIONS

A. Results of regular wave investigations

The experiments were performed on both design with wave period parameter (T) = 1.8 s, water depth (d) = 0.5 m, slope (α) = 35°, curvature 15 cm, and block dimension (a) = 4.

8x4.8x2.4 cm3, different only the roughness position model, in doing the running for 30 seconds, obtained 602 data. The data is recorded on each sensor, for example from sensor 1 to sensor 6, for example the waveform elevation data on sensor 1 like Figure 7 and Figure 8 is the wave height graph with respect to time, y axis is wave height and x is time, for design 1 shows the results of the wave height coming marked with blue (Hi) and reflection wave height data



(Hr) characterized by red, with wave height results in Table 1 and Table 2.

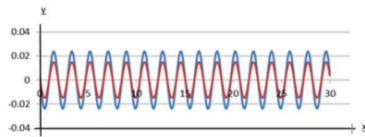


Figure 7. Hi and Hr surface elevation on sensor 1

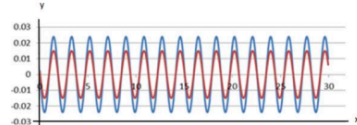


Figure 8. Hi and Hr design surface elevation 2 (Analysis Result, 2017)

No	Hi	Hr	eta_max	eta_min
(m)	(m)	(m)	(m)	(m)
S 1-2	0.0433	0.0431	2	0.000
S 1-3	0.0601	0.0635	8	-0.00
S 1-4	0.0600	0.0613	65	0.00
S 1-5	0.0476	0.0313	45	0.008
S 1-6	0.0478	0.0299	85	0.008

Table 1. Wave height and water level in design 1

No	Hi	Hr	eta_max	eta_min
(m)	(m)	(m)	(m)	(m)
S1-2	0.0433	0.0431	0.0432	0.0001
S1-3	0.0601	0.0635	0.0618	-0.0017
S1-4	0.0600	0.0613	0.0607	-0.0006
S1-5	0.0476	0.0313	0.0394	0.0082
S1-6	0.0478	0.0299	0.0389	0.0090

Table 2. Height of wave and water surface on design 2

Data processing performed for regular waves in the form of waveform profiles actually have higher harmonics in the form of composite waves according to equation 2, the results of running data read with MIKE 21, then in calibration based on each design, followed by extract into composite waveform obtained the incident wave and reflected wave are analyzed by using FFT and Matlab curve fitting obtained by constant A1 B1 A2 B2 so that without using equation 4, 5, 6, 7 and 8 to get the envelope wave of this wave specified Hmax and Hmin then analyzed using equation 9 and 10 followed by an analysis of equations 11 and 12.

B. Analysis of wave height design 1 and design 2

The wave height analysis at each installed sensor distance starts from sensor 1 to 2 in obtaining wave height (Hi1) and reflection wave height (Hr1), sensor 1 to 3 at high wave coming (Hi2) and reflection wave height (Hr2), sensor 1 to 4 at high wave coming (Hi3) and reflection wave height (Hr3), sensor 1 to 5 at get high coming wave (Hi4) and reflection wave height (Hr4) and sensor 1 to 6 in get high data the coming wave (Hi5) and the reflection wave height (Hr5) in Table 1. Then in the analysis using equation 2 we get the wavefront

The result of compilation of water surface elevation data from Fig. 5, at each distance from sensor 1 to 2 and so on obtained wave height (Hi) and reflection wave height (Hr), Max maximum water level (η) Max and minimum water level (η) Min corresponds to table 1.

The result of compilation of water surface elevation data from Fig. 6, at each distance from sensor 1 to 2 and so on got the wave height Hi and reflection wave height (Hr), Maximum water level (η) Max and minimum water level (η) Min corresponds to Table 2. Analysis is continued to obtain maximum Maximum water level (η) Max and minimum water level (η) Min using equations 11 and 12 produce as in Tables 1 and 2 for each design.

C. Waveform Formation Envelope design 1

Based on Maximum water table height (η) Max and minimum water level (η) Min for generating incoming waves and reflections forming envelope in Figure 9 of design 1,

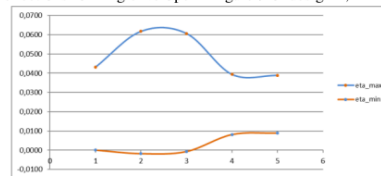


Figure 9. Envelope Wave design 1

Results of envelope waveform design 1, it is known that Hmaximum is 0.0635, and Hminimum is 0.0478, Hi is 0.05565, and Hr is 0.00785 so that the Reflection Coefficient (Kr) is 0.141.

D. Envelope design calculation 2

The result of envelope waveform design 2, it is known that Hmaximum is 0.0635, and Hminimum is 0.0300, Hi is 0.0467, and Hr is 0.0167 so that the Reflection Coefficient (Kr) is 0.3582.

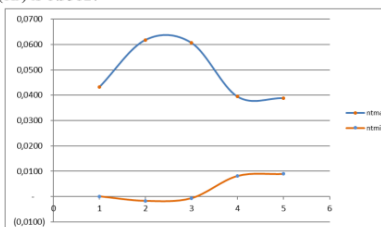


Figure 9. Envelope Wave design 1

IV. CONCLUSION

Based on the experiments and analysis of wave height data in design 1, the reflection coefficient of 0.141 and design 2 reflection coefficient of 0.3582 means that the coefficient of reflection (K_r) produced by design 1 is smaller than design 2, so it can be concluded that design 1 is more reliable in reducing reflection wave.

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