Jurnal Teknik Sipil & Perencanaan Vol. 20 No. 1 2018 p.41-46

JURNAL TEKNIK SIPIL & PERENCANAAN

http://journal.unnes.ac.id/nju/index.php/jtsp/index

Alternative Preventive Measures of Seashore Abrasion in Bungin Village Luwuk Sub-District Banggai Regency

Sri Susilawati and Desi Mefianti [1, a)]

[1] *Department of Civil Engineering , Faculty of Engineering, Tompotika University Luwuk*
[a)] *corresponding author: susilawatisri71@yahoo.co.id*

Abstract. This study is aimed at determining the most effective preventive measure in protecting and controlling seashore abrasion in Bungin village, Luwuk Sub-district, Banggai regency. The data were gathered using observation and tidal data to determine the elevation of design ater level and the high water level and wind data. The results of the analysis showed that the wave at the Bungin village was not too high, the significant height of the wave = 0, 4553 m with the wave period = 2.6754 seconds. Although the wave was not too high, it also needs attention because the village is situated near the seashore. The riparian area of seashore which is the residential area and road is expected to be built near the coastline. The alternative seashore protection measure which is considered effective and efficient is revetment. The high water level = +2,214 , the design water level = + 0.914 and the building elevation = -0,850 with the height of the building = 4, 20 m and the length of seawall = 2188.225 m. The height of the seawall = 0, 75 m and the width = 2, 20 m with 0.028 tons of stones.

Keywords : Abrasion, Beach, Waves

INTRODUCTION

Indonesia as an archipelagic country that has more than 17,508 islands and coastal areas along ± 81,000 km, and sea area of about 3.1 million km 2 (0.3 million km 2 territorial waters, and 2.8 million km 2 waters of the archipelago). Coastal areas are areas that are often used for human activities such as central government, settlement, port, industry or tourist attractions and other infrastructure development including road infrastructure.

The increasing use of coastal areas for human activities leads to more problems. The problems that often occur in coastal areas include tidal waves or storm waves, erosion and / or coast abrasion, and etc.

The retreat process of the shoreline from its original position or erosion is generally caused by the weakness of the coastal material's endurance, the force generated by waves and currents, and the imbalance between the incoming and outgoing sediments in a coastal balance system. In normal wave conditions, the coast can adjust its form so that it can reduce wave energy. When the natural defence of the coast is unable to withstand large wave energy, there will be coastal erosion / abrasion.

Coastal abrasion will destroy residential areas with shoreline retreats, which can occur naturally by wave attacks or due to human activities such as mangrove logging, coral theft, harbor construction and other coastal buildings and other activities undertaken which disregard coastal areas.

Recent coastal abrasion issues tend to increase in various regions including Bungin village, Luwuk Sub-district, Banggai District. A quite damaging abrasion has occurred at Bungin village caused by the land degradation along ± 2 km of the shoreline. The potential resources at the coastal areas is great. Therefore, it requires protection. To protect the coastal area, it is necessary to devise an effective system coastal protection which is appropriate to the natural conditions.

Based on the problem above, this study is aimed to examine the alternative protection system used to tackle coastal abrasion in Bungin Urban District Luwuk Banggai District. The aim of this study is aimed to devise the most effective alternative counter measures for protecting and controlling abrasion along the shoreline in the village of the District Bungin Luwuk Banggai.

RESEARCH METHOD

This coastal abrasion study was conducted in Bungin Sub-District, Luwuk District, Banggai Regency using quantitative descriptive research method [1]. This review examines alternatives that can be used to tackle coastal abrasion in Bungin Sub-District, Luwuk District, Banggai District.

Secondary data collection was conducted by visiting institutions or agencies involved as a source of data for questioning to gather more data related to this study. The primary data survey was conducted to collect the primary data through the direct survey in the field to obtain accurate data that occurred at the study site .

Analysis of data for the alternative countermeasure of the coastal abrasion in Bungin Sub-District, Luwuk District, Banggai District included: tidal data analysis, wind data analysis and soil mechanical data analysis.

Tidal data analysis was used to determine the highest high water level (HHWL), the lowest low water level (LLWL), and the mean sea level (MSL).

Wind data analysis included: a. the length of fetch was one of the factors that influenced the formation of the wave. Therefore, the fetch length was calculated as follows: 1) setting up a map with a certain scale; 2) creating a perpendicular coastal line then divided with the angle of 5° on both sides of the wind (perpendicular) until the angle reached 35°; 3) determining the fetch length and then measuring from the wave observation point to the end of the fetch. b. the conversion of the wind recording included: 1) wind data that was analysed was the magnitude of the monthly maximum wind speed and direction with a time interval of 10 years (2005-2014), 2) wind –stress factor calculation ; the existing wind data must be corrected for elevation, stability, effects of the location, and coefficient drag to get wind stress factor (U A). c. Wave analysis included: 1. The forecast of the height and period of the wave; 2. significant wave height ; 3. Refraction coefficient and Shoaling

Analysis of soil mechanics data included: 1. Tidal data, the tidal data were used to determine the design water level and dimension of coastal building; 2. The design Waves; 3. Water level Fluctuation.

RESULT AND DISCUSSION

Result

Analysis of data for the alternative countermeasure of the coastal abrasion in Bungin Sub-District, Luwuk District, Banggai District included: tidal data analysis, wind data analysis and soil mechanical data analysis.

Tidal data analysis was used to determine the highest high water level (HHWL), the lowest low water level (LLWL), and the mean sea level (MSL).

Wind data analysis included: a. the length of fetch was one of the factors that influenced the formation of the wave. Therefore, the fetch length was calculated as follows: 1) setting up a map with a certain scale; 2) creating a perpendicular coastal line then divided with the angle of 5 ° on both sides of the wind (perpendicular) until the angle reached 35°; 3) determining the fetch length and then measuring from the wave observation point to the end of the fetch. b. the conversion of the wind recording included: 1) wind data that was analysed was the magnitude of the monthly maximum wind speed and direction with a time interval of 10 years (2005-2014), 2) wind –stress factor calculation ; the existing wind data must be corrected for elevation, stability, effects of the location, and coefficient drag to get wind stress factor (U A). c. Wave analysis included: 1. The forecast of the height and period of the wave; 2. significant wave height ; 3. Refraction coefficient and Shoaling

Analysis of soil mechanics data included: 1. Tidal data, the tidal data were used to determine the design water level and dimension of coastal building; 2. The design Waves; 3. Water level Fluctuation.

The results of analysis showed the height of elevation as follows:

Mean High Water Level, MHWL = + 0.833 meters
Mean Sea Level, MSL = + 0.000 meters
Lowest Low Water Level, LLWL = - 0.950 meters

During the journey to the coast, the height and direction of the waves changed caused by the influence of the refraction and shoaling process and the breaking waves that depended on the bathymetry and wave characteristics in the deep water. The wave height at the building site was calculated based on refraction and shoaling analysis. Therefore, the wave height at the building location was 0.3845 meters.

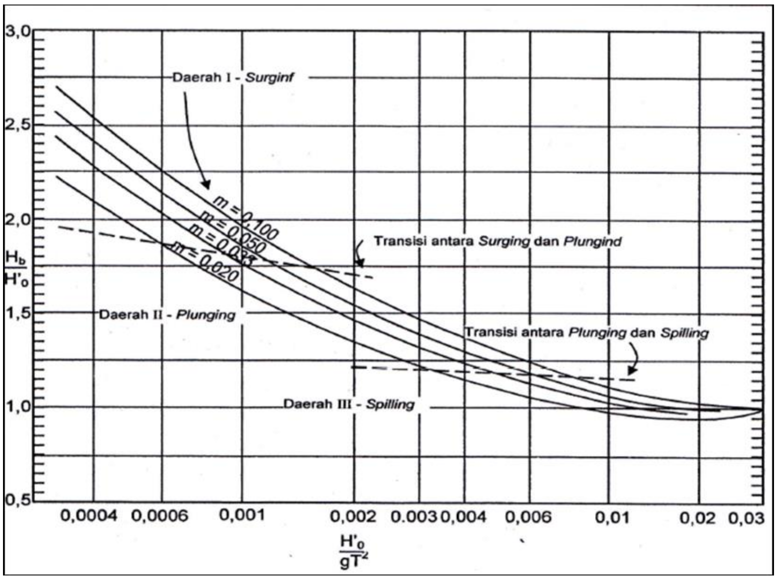

FIGURE 1. Determination of High Wave Break [2]

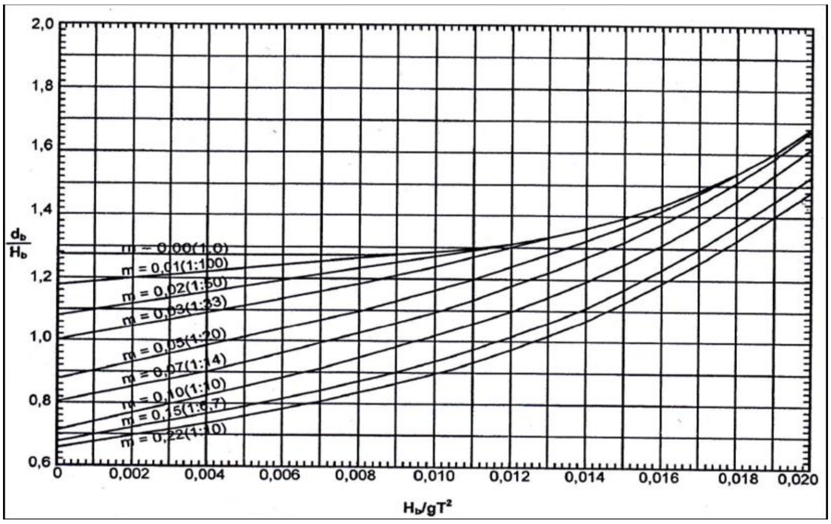

FIGURE 2. Determination of Depth of Broken Waves [2]

To determine the height of the breaking wave, Figure 1 shows the relationship between Hb/H'o and H'o/gT^2. Next, use Figure 2 to find the depth of the breaking wave. Therefore, the height of the breaking wave is 0.5713 meters and the depth of the breaking wave is 0.6284 meters.

The design water level elevation depends on the tide, wave set-up, tsunami and global warming. In the design of this seawall (Figure 3) did not included all parameters considering that the possibility for the simultaneous occurrence of parameters is very small. Therefore, based on the above three factors, the design water level is as follows:

DWL = M HWL + Sw + Δh
DWL = + 0, 833 + 0.081 + 0,00015
DWL = + 0.914 meters

The high elevation or the peak of the planned shoreline is calculated based on the water level of the plan, run-up and height of the guard. If the height of the guard is taken at 0.6 then:

The high elevation = DWL + Ru + the height of the freeboard
The high elevation = + 0.914 + 0 , 70 + 0.60
The high elevation = + 2,214 meters

The right form or type of building is revetment. Because the revetment is able to protect the land and infrastructure from wave flooding and overtopping and can strengthen the coastal profile section. Therefore, by using revetment, the shore line will not retreat.

Construction of toe protection in the building was intended to reduce the pressure of the waves that hit the building and keep the toe protection to make it withstand erosion. Natural stone is the main choice in this planning because the price was cheaper when compared with other materials such as concrete cube, tetrapod, qudripod and others.

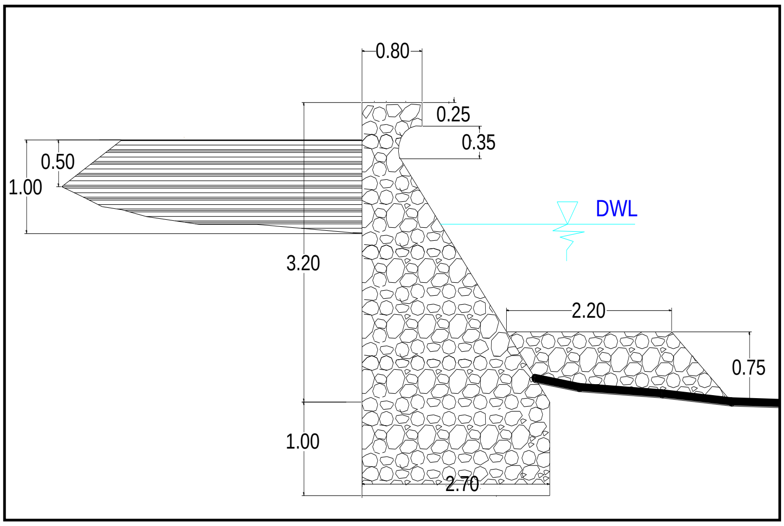

FIGURE 3. Seawall

Discussion

This study showed that the shoreline retreat occurred when geomorphological processes that occur on each part of the coast exceeded the process that usually occurred. Geomorphology process included: Waves occur through a process of movement of water mass formed in general by wind blow perpendicular to the coastline. Dahuri [3] states that ruptured waves in coastal areas are one of the main causes of erosion and sedimentation processes in the beach.

The coastal area is an area at the edge of the water which is affected by the high and low tide [2]. The coast is the border between land and water where the land area located above and below the land starting from the highest tidal line. The ocean region is an area located above and below sea level starting from the sea side at the lowest tide, including the seabed and the earth beneath it.

Generally Wibowo [4] explains that the coastal area is an area which expands from the lowest point of sea water at low tide to inland until it reaches the effective boundary of the wave. While the shoreline is the line between the seawater with the land whose position changes according to the position at the time of the tidal, the influence of waves and currents.

At the time of the wave heads to the coastal area by forming an angle to the shoreline then the wave rises to the coast (uprush) which also forms an angle accompanied by the transport of sediments in a direction along the coast. While, the sediment transport generated by currents along the coast is generated by breaking waves that occur in the surf zone [2].

The coastal sediment equilibrium is used to evaluate the incoming and outgoing sediments of a shoreline. Therefore, it may be predicted that coastal areas experience abrasion or accretion (sedimentation). Accretion or sedimentation is silting or addition of coastal land caused by sediment deposition brought by sea water. If the value of zero equilibrium then the beach is in stable condition (steady), if coastal accretion positively occurs, coastal abrasion does not, then sediment equilibrium analysis can used to estimate the effect of constructing a building at the coastal area.

To reduce the impact of abrasion, the countermeasure action must be conducted immediately according to the regulation about coastal areas development. In coastal areas, the pattern of coastal spatial planning is strongly influenced by the division of very strict protection zones because the characters of coastal area are very dynamic but vulnerable to changes. This dynamic condition has led to the need to find an appropriate approach for coastal spatial structuring, a coastal sediment cell approach is one of the approaches that can be used as a reference for spatial structuring of coastal areas.

Sea tide is a wave that is generated by the interaction between sea, sun and moon. The peak of the wave is called the high tide and the wave valley is called the low tide. The vertical difference between high and low tides is called the tidal range. Tidal period is the time between the peak or valley of the wave to the top or the valley of the next wave. The tidal period varies between 12 hours 25 minutes to 24 hours 50 minutes.

The height and period of the waves are influenced by wind speed, the length of wind, the wind direction, and the fetch [2].

Waves at sea can be divided into several kinds depending on the generator. These waves are wind waves, tidal waves, tsunami waves, and so forth.

To overcome the problem of coastal abrasion, the first step that must be done is to find the cause of the abrasion. By knowing the cause, it can then be determined how to overcome it, which usually is by making a coastal protection building to protect the coast against damage caused by wave and current attacks. There are several ways that can be done to protect the beach, namely [2]:

1. Reinforcing / protecting the shore to be able to withstand wave attacks.
2. Change the rate of sediment transport along the coast.
3. Reduces wave energy reaching shore.
4. Reclamation by adding sediment supply to the beach.

In accordance with its function as such, coastal buildings can be classified into three groups namely [2]:

1. Construction built on the coastal area and parallel to the coastline.
2. Construction built approximately perpendicular to the coastal area and connect to the coastal area.
3. Construction built offshore and approximately parallel to the shoreline.

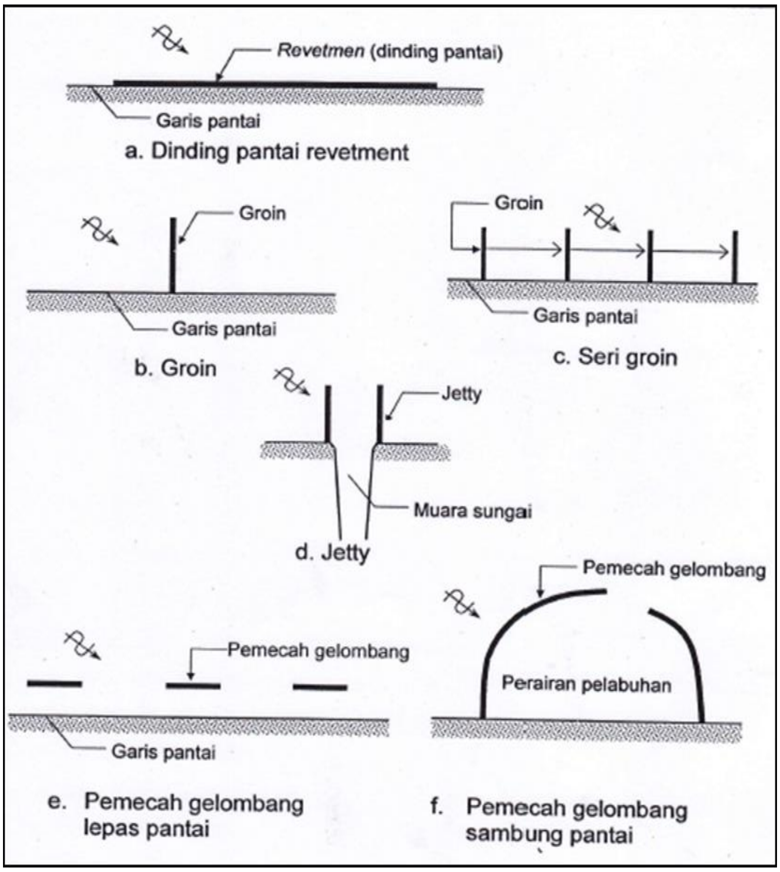

FIGURE 4. Types of Coastal Protection Building [2]

Buildings that belong to the first group are coastal or revetment walls built on shoreline or on land used for coastal protection directly from waves (Figure 4a). The second group includes groin and jetty. The groin is a protruding structure from the coast to the sea that is used to withstand sedimentary motion along the coast so that sediment transport along the coast is reduced or stopped (figure 4b).Usually groin is made in series, for example some groins are made with a gap between certain groins along a protected coast (figure 4c). Jetty is a perpendicular building of shoreline placed on both sides of the river mouth (figure 4d). The building is used to withstand sediments that move along the coast enter and deposit in the mouth of the river.

The third group is the breakwater, which is divided into two types: the offshore breakwater (Figure 4e) and the coastal breakwater (Figure 4f). The first type of building is widely used as a coastal area protector against abrasion by destroying wave energy before protecting the harbor from wave interference so that ships can move to the dock to unload the goods and the passengers.

Sea wall or revetment is a construction that separates land and coastal waters, which mainly serves as a coastal guard against erosion and overtopping to land. The protected area is the land right behind the construction. The construction is located parallel to or almost parallel to the shoreline, and can be made of stone, concrete, concrete pipe, plaster, wood or stone piles.

In revetment planning, it is necessary to review the function and shape of the building, location, length, height, stability of the building and foundation soil, water level elevation both in front and behind the building, the availability of building materials and so on.

Waves and currents that hit shoreline construction can cause erosion of the foundation soil in front of the toe of the construction. For that need to be given the protective foot of the building [2] :

- The width of the toe protection
  $B = 2H - 3H$
- Thickness of the toe protection
  $t_1 = 1H - 1.5H$

As a foundation, shore construction of concrete blocks, concrete pipe are placed on top of a pile of stones. While the pile of stone used as a foot protector placed in front of the construction serves to protect the foundation soil against the wave. The stability of a construction depends on the ability of the foundation to withstand erosion caused by large waves. The design water level is used to calculate the weight of foundation stone and foot protector which is similar as the ones used for the planning of the building [2].

SUMMARY

The results of the analysis showed that waves that occur at the shore of Bungin Village was not too big, where the significant wave height (Hs) is 0.4553 m with wave period (Ts) is 2.6754 seconds. Although the wave is not so big, but it still needs to be considered. The coastal border area is a residential area and a highway w will be built on the location, it is located in close proximity with the coastline.

The alternative of coastal protection system in Kelurahan Bungin which is considered effective and efficient is revetment. With elevation of +2,214, water level + 0,914 and building elevation -0,850 with building height 4,20 meter and coastal protection building length 2188,225 meters. The height of coastal protection layer is 0.75 meters and width of 2.20 meters with a protective stone weight of 0.028 tons.

To maintain the stability of coastal protection structures to survive in the event of a wave it is advisable to add a protective layer at the front of the building with a pile of stones.

REFERENCES

[1] Sugiyono, *Metode Penelitian Pendidikan Pendekatan Kuantitatif Kualitatif dan R&D*. Bandung: Alfabeta, 2010.

[2] B. Triatmodjo, *Teknik Pantai*. Yogyakarta: Beta Offset, 1999.

[3] R. Dahuri, *Pengelolaan Sumber Daya Wilayah Pesisir dan Lautan Secara Terpadu*. Jakarta: PT. Pradnya Paramita, 2008.

[4] Y. A. Wibowo, “Studi Perubahan Garis Pantai di Muara Sungai Porong,” Universitas Hang Tuah Surabaya, 2012.