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The Effect of Waves of Buton Strait Towards the Coastal Abration in Raha City, Southeast Sulawesi

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***Abstract*— *The shoreline change is a continuous process through various processes of both abrasion and accretion caused by sediment movement, longshore current, wave action and land use. This study aimed to determine(1) the characteristics of the waves on the coast of Raha and (2) an effective coastal protection system to protect the beach against abration. The study of wave characteristics was obtained from the secondary data. The calculation of the extreme wave height during certain repetition could be known using the distribution method of Gumbel and forthe fluctuation effect of sea water surface was analyzed using the admiralty method. For the coast observation a study was carried out empirically and mathematical model simulation using the Software Surface – Water Model System (SMS) Version 8.1. The research results indicated that the characteristics of the maximum waves came from the southeast with coming angle ofthe waves of 72o with the height and significant period of the waves was 2.19 meters and 8.03 meters second respectively, while the length of the waves was 100.6 meters. Thus, the alternative coastal building was based on the assessment criteria comprising groin, revetment and detached breakwater. Therefore, the result of the research revealed that the effective coastal building is the groin.*

***Keywords*— *Abrasion, Waves, Coastal Building.*

I. INTRODUCTION

Indonesia is an archipelagic country consisting of 5 (five) large islands and thousands of small islands, of which 1/3 are land areas and 2/3 are sea areas. The climate / weather (atmosphere) and sea (biosphere) conditions that accompany this evolution have an (exogenous) influence on the process of forming a landscape [4]. Coastal areas based on Law number 27 of 2007 is a transitional area between terrestrial and marine ecosystems which are affected by changes in land and sea, while the Coastal Borders are land along the sea shore whose width is proportional to the shape and physical condition of the coast, at least 100 (one hundred) meters from the highest tide point towards land. Waters is an area that is busy with marine tourism activities, industry, settlements, and others. This condition can cause negative impacts such as pollution, erosion, and other environmental problems [9]. In the coastal area there is a dynamic interaction between water, wind, and the constituent materials therein which makes the beach vulnerable to damage to coastal buildings and can cause changes in the coastline.

Shoreline change is a process that takes place continuously through various processes both erosion (abrasion) and addition (accretion) caused by sediment movement, longshore current, wave action and land use [10]. The study of changes in the coastline is very important to improve because the coastal area is an area that has a lot of potential natural resources that need to be maintained. In addition, the large number of infrastructure and settlements standing in coastal areas those are threatened with abrasion will make many parties worry about loss and damage to these facilities.

A wave that hits an obstacle, some of its energy will be destroyed through the process of friction, turbulence and breaking waves. The rest will be reflected and transmitted. The proportion of reflected (reflection), destroyed (dissipated) and transmitted (transmission) wave energy depends on the characteristics of the incoming waves (wave period and height), type of coastal protection (smooth or rough surface, water passing or not) and dimensions and geometry. protection (slope, elevation and width of obstacles) as well as local environmental conditions (water depth and coastal contours) [1]. Wave parameters based on Airy's theory are parameters developed based on the assumption of a harmonic sine curve [8], with several wave characteristics including wavelength.

Coastal abrasion is damage to the shoreline as a result of the release of beach material, such as sand or clay which is continuously hit by sea waves or due to changes in the balance of sediment transport in coastal waters [3]. Related parties have made several efforts to tackle abrasion and the retreat of the coastline, including making coastal structures to resist waves, but in fact the beach is still experiencing erosion.

II. METHODOLOGY

A. *Research sites*

The research was conducted in Raha City, Muna Regency, Southeast Sulawesi.

B. *Types of Research & Data Sources*

The research method for this research is secondary data processing analysis method [7] and model testing using computer / software applications.This study will use secondary data which is data obtained from the existing literature & research results. Secondary data used include waves, bathimetry and topography at Raha beach.

C. *The variables studied*

According to the aims and objectives of the formation of waves and tides, it is part of the research that is used to determine which buildings are effective as coastal protection. Hydrodynamics is a general numerical modeling system for simulating water levels and flows in estuaries, bays and beaches. This model can simulate a two-dimensional

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unsustainable flow in a vertically homogeneous one-layer fluid or in a three-dimensional flow.

D. Data analysis

The results of shoreline evolution modeling with buildings, were carried out by observing the sections on the beach that experienced more sand loss compared to other parts. Furthermore, efforts were made to secure the SMS model approach. This modeling functions to analyze waves more concisely and easier to understand [5].

III. RESULT AND DISCUSSION

A. Topographic and bathymmetric analysis

Topography and bathimetry are needed to determine the depth and wave conditions around the study site. Bathimetric and topographic data measurements were not carried out considering limited costs so that the data was taken from secondary data.

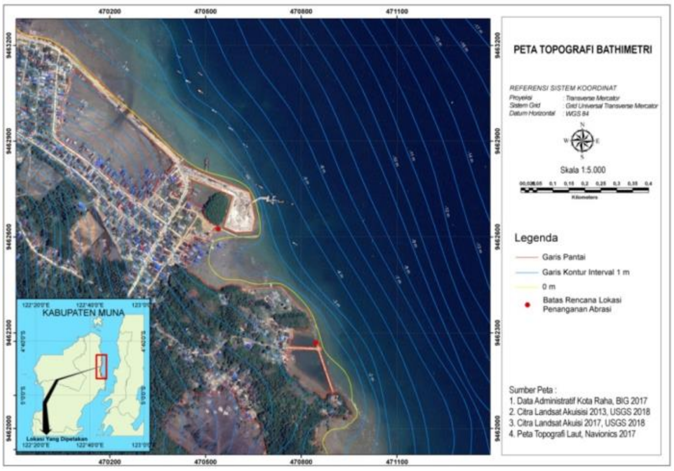

Fig. 1. Topographical and batimetric maps

Then In Figure 1 the topographic map is taken in the part that is close to the location of the coastal building plan, while the bathimetric map is up to -17 m deep.

B. Tide Analisys

Tide analysis is intended to determine the nature of the tides that occur. In general, the tidal properties of a waters can be classified based on its main components using the Formzahl value approach. Based on the Formzahl values obtained, the tidal type for the study area is mixed semi-diurnal tide with a value of F = 0.613. From the calculation, it can be seen that the tidal range is Mhws - Mlws = 93.00 cm - (-120.00 cm) = 212.00 cm, thus referring to mlws = 0.00, the mhws height is ± 212.00 cm.

C. Analysis of the design wave height

In wave analysis, H33 or the average of 33% of the highest recorded wave value is generally used, which is also known as a significant wave. Table 1 shows the calculation results obtained by a significant wave height value (H33%). From the value of the maximum significant wave height per year and per direction, then an extreme price analysis and a design wave frequency analysis were carried out using the Fisher Tippett Type 1 method. Table 2 shows the results of the calculation of the height and period of the wave with a certain return.

TABLE 1. Significant Waves

	Significant Waves Height (H33)							
	PERIOD (s)				HEIGHT (m)			
YEAR	NORTH	NORTHEAST	EAST	SOUTHEAST	NORTH	NORTHEAST	EAST	SOUTHEAST
2005	7.66	6.17	6.78	6.15	0.52	0.50	1.36	1.18
2006	5.84	7.06	6.71	6.84	0.49	0.39	1.45	1.40
2007	7.27	6.92	7.42	7.28	0.67	0.43	1.57	1.59
2008	6.68	8.00	7.61	6.95	0.54	0.50	1.57	2.07
2009	6.99	7.84	7.78	7.11	0.33	0.35	1.26	1.22
2010	5.33	6.87	6.64	7.30	0.73	0.56	1.36	1.36
2011	6.24	7.27	7.55	6.95	0.37	0.25	1.51	1.49
2012	5.80	6.56	8.60	6.94	1.74	0.48	1.19	1.53
2013	5.07	6.74	7.10	6.99	0.60	0.37	1.61	1.50
2014	6.44	6.58	7.12	6.16	0.38	0.34	1.55	1.29

TABLE 2. Waves Period Return

Return	North		Northeast		East		Southeast	
Period	H	T	H	T	H	T	H	T
2	0,58	6,22	0,40	6,92	1,42	7,25	1,43	6,81
5	1,07	7,23	0,52	7,61	1,60	7,97	1,73	7,30
10	1,40	7,90	0,59	8,06	1,71	8,45	1,93	7,62
25	1,81	8,74	0,68	8,64	1,86	9,05	2,19	8,03
50	2,12	9,37	0,75	9,06	1,97	9,50	2,38	8,33
100	2,42	9,99	0,82	9,48	2,07	9,94	2,56	8,63

From the calculation results, the wave height with the greatest value is the wave height in the Southeast direction, for the simulation input data will be used the design wave height for a 25 year period of 2.19 meters.

D. Wave Breaking

The waves that propagate from the deep sea towards the coast change shape with the peak of the waves getting sharper until they finally break at a certain depth. Figure 2 shows the breaking wave height based on the sea slope and the breaking wave height (Hb) is 1.987 m with a breaking wave depth (db) of 2.55 m.

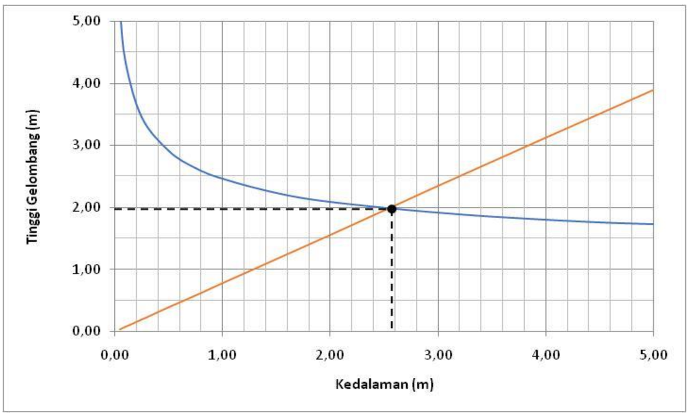

Fig. 2. Broken Wave Chart

E. Wave Simulation with SMS Program

Waves that propagate from the high seas (deep water) to the coast change shape caused by transformation processes such as diffraction and shoaling due to the influence of the depth of the sea. Reduced sea depth causes a decrease in the length and speed of waves and an increase in wave height. The wave transformation pattern of the study area was created using the STWAVE sub-program SMS software which is used to model steady-state spectral waves, which are visualized in the form of an image. Shows the transformation of waves from the high seas generated by winds from the north, northeast, east, and southeast. From the simulation results carried out in several directions the largest wave heights come from the southeast. Fig. 3 shows the simulation results for the existing conditions at the study location and Fig. 4 the simulation results for the conditions after the beach building.

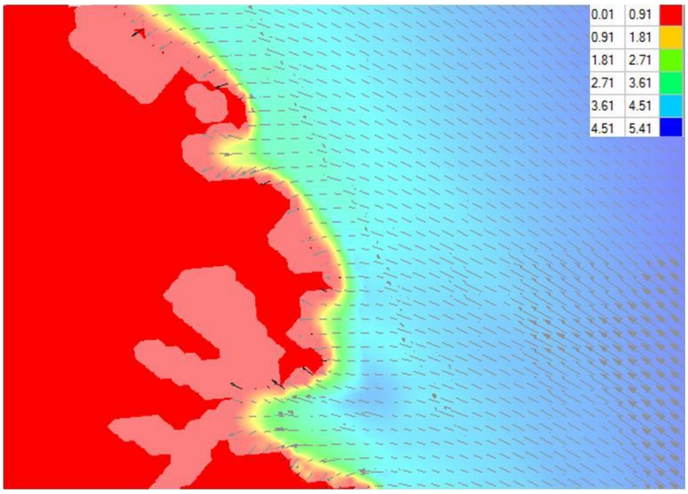

Fig. 3. SMS 8.1 simulation results from the southeast

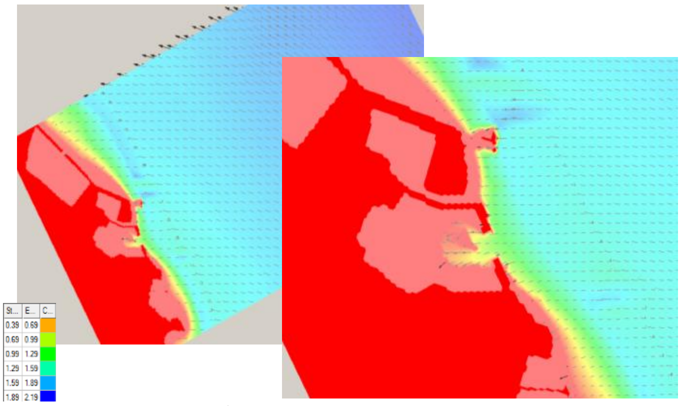

Fig.4. Result of simulation analysis with groyne building

Based on the analysis of coastal problems in the study location, the main problem in the study location is coastal erosion which causes the coastline to retreat. Information about the factors that cause erosion can be obtained from interviews with the local community, local government and by analyzing environmental data and coastal conditions. Based on the conditions, after performing a wave simulation to determine the causes of abrasion on the coast of Raha city, a beach building proposal is made that will be used to overcome several problems that exist around the coast of Kota Raha, including (1) wave attacks on settlements, public facilities and infrastructure (2) Coastal abrasion which causes shoreline changes and damage to buildings around the coast (3) Landing and protection of fishing boats / boats during a storm. Before selecting an alternative coastal protection structure for a structural approach, first the value of each alternative is determined based on predetermined criteria. Based on the matrix for selecting alternative coastal protection constructions, the alternative treatments chosen are protection using groynes, revetmetn and deteached breakwaters. Based on the results of wave analysis and simulation results of SMS 8.1 software, it is found that groyne as an alternative building is in accordance with the problems that occur at Raha beach.

IV. CONCLUSION

The main problems on the Kota Raha coast are erosion or retreating of the coastline, the threat of sea waves and the absence of mooring places for community boats. Based on data collection, evaluation of existing conditions, analysis of problems along the coast, and wave simulation results with the SMS program, one building type is determined to solve the coastal problem in the study location. So that in the direction of coastal building planning can be taken into consideration.

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