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Wave Attenuation Using the Mangrove Avicenia marina as an Element of Waterfront Construction ABSTRACT The researches on wave attenuation in the past has been carried out on several types of mangroves. The researches were either conducted in the laboratory or done using mathematical models. Therefore, this research with the object Avicenia marina mangrove was conducted in the field. The aim of this research was to determine how much mangrove Avicenia marina dampens wave energy. The Research was done at a location within the Indah Kapuk Coastal Area of Jakarta, Indonesia by dividing it into based on the width of the mangrove groves i.e. , 5, 10, 15, 20 and 30 m. Wave measurement was carried out using the SBE26 type wave gauge.

Gauges were mounted in front of the mangrove groves and behind the mangrove groves. The raw data obtained from observations were processed using FFT, MATLAB program and statistics. Attenuation by mangroves with 5 m width was 22.268 (m sec-1)2/c 2 min-1), 15 m thickness 8.698 (m sec-1)2/c 2 min-1) and 30 m thick 5.878 (m sec-1)2/c 2 min-1). The wave attenuation formula obtained as the relationship between the thickness of the mangrove and energy was Y (Energy) = 0.003xs+0.208x2-4.620x+40.29. The conclusion was that the thicker the mangrove groves, the greater the energy muted. Key words: Avicenia marina mangrove, wave attenuation, energy, water front construction INTRODUCTION Waves generated by wind are one of the main sources of the energy transfer to coastal areas and they are major factor in the process of coastal change (Dean and Dalrymple, 1984) . The waves that generate flows parallel to the shoreline cause movement of materials along the coast resulting in erosion or accretion.

To overcome this problem, coastal protection such as breakwaters or sea walls is usually built (Horikawa,

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1988; Triatmodjo, 1999). In terms of economic and environmental sustainability, the utilization of mangroves as a coastal protection is very effective. Mangroves are one of the options for coastal protection. Because of the strength of the roots, mangroves are a very effective buffer against the brunt of waves, especially in the Rhizophora mangrove (Mazda and Magi, 1997). Research on the ability of mangroves to dampen waves was widely done by Mazda et al. (1995, 2003, 2006) in various countries with some types of mangrove. Research was done in the laboratory or used mathematical models to observe the hydrodynamics, the shearing force and the types of mangrove that were adapted to field conditions.

However, quantitative evaluation of the ability of mangroves in reducing waves is still being researched but not yet well formulated (Latief et al., 2000; Halide et al., 2000), so there are no references available on the effectiveness of mangrove vegetation in reducing waves. Therefore, it is important to research the magnitude and attenuation capability of the mangroves, both through physical models in a marine laboratory and mathematical models (Quartel et al., 2007; Yanagisawa et al., 2009). Research has been done with some types of mangroves and coastal morphological conditions in the field and has been well verified in the field.

Research was done with the variables of the physical characteristics of the mangrove as the diameter of the trunk, the density and the thickness of the forest. From this simulation, the optimal configuration of mangrove forests in reducing wave energy can be obtained (Massel et al., 1999). Very little research about this has been conducted, especially research done directly in the field (Manca et al., 2012). Therefore, this research was done by directly measuring the wave energy attenuation of Avicenia marina mangroves in the field that were used as field laboratory models. This research focused only on one type, the Avicenia marina mangrove (Noor et al., 1999) which is grows at the sites of the research. The purpose of this research is to discover the Avicenia ryiarina mangrove s ability in attenuating wave energy.

MATERIALS AND METHODS Selection of the observation station locations: The study locations included from Muara Angke Wildlife Sanctuary (Piinando et al ., 2010), Protected Forests, Angke Kapuk Park(TWA) and Muara Kamal. Geographically, they lie between the ordinates of 6 5'31,27 S, 106 43'33,70 E and 6 6'1,54 S, 106 45'59,43" E. See the map in Fig. 1 depicting the 5 observation point stations. Selection of the point of wave measurement stations is done by assessing mangrove groves which function as wave absorbers (Mazda et al. , 1995; Quartel et al., 2007; Yanagisawa et al., 2009). Table 1 describes the position of each station. Wave attenuation characteristics on Avicenia marina mangrove groves: Mangrove groves are a unique ecosystem which grows in the intermediate region between seaand land above the mud substrate.

This gives the mangrove groves multiple important roles in terms of ecological, socio-economic and physical protection of coastal areas (Abdullah, 1988; Bengen, 2002). In terms of the physical protection of coastal areas (Latief, 2000; Massel, 1996; Mazda et al., 2003; Table 1: Width of the Avicenia marina mangrove groves in each station Width of mangrove Station Ordinate 1 S: 6 5'31.70" E: 106 43 37.70" grove (m) Observation 30 The position is near the Muara kamal river. The Avicenia marina mangroves seem to thrive.

Mangroves grow in small groups. No barriers found for incoming 2 S: 6 5'33.10" waves. The width of the mangrove grove for Sta 1 and 2 are around 60-70 m E: 106 43'38.10" 10 and 40-50 m, respectively. At low tide, the width which is still under water (around 70 cm is only 30 m for Sta. 1 and 10 m for Sta. 2) 3 S: 6 6'13.70" E: 106 4533.50" 4 S: 6 6'13.40" E: 106 4536.50" 5 S: 6 6'13.60" E:106 4538.83" 20 There are no barriers found between the mangroves in the Stations 3, 4 and 5 and the incoming waves. The width of the mangroves for these stations is 15 relatively similar at 40-50 m.

Avicenia marina mangroves look lush even though the condition of the water filled with garbage and mud. At low tide, parts of 5 mangrove grove width which are still under water (around 70 cm) are 20, 15 and 5 m for Sta. 3, 4 and 5, respectively. The mangroves at Sta. 4 and 5 formed their own clumps / Fig. 1: Map of the research location Salm et al., 2000), in this study the authors focused on wave attenuation by Avicenia marina mangroves. Figure 2 below illustrates the process of wave attenuation by Avicenia marina mangroves. The density of mangrove vegetation determines wave attenuation. For that reason, this study will investigate the relationship among the factors affecting wave attenuation through a simulation technique. As illustrated in Fig.

2, the factors of bathymetry, water depth, wave height, width/spacing of wave propagation and the overall mangrove factors are interrelated factors that determine wave attenuation (Mclvor et al ., 2012). According the study conducted by Anna Mclvor, Iris Moller, Tom Spencer and Mark Spalding, waves can be characterized by their Height (H) (which is twice of their Amplitude (a), their Length (L) (the distance from peak to peak or trough to trough) and their steepness, defined as H/L (as shown in Fig. 3) (Park, 1999; Masselink et al., 2011) . The time between two successive peaks passing a given point is called the period (T) and the number of peaks (or troughs) passing a given point in a given time is known as the Frequency (1). The sinusoidal waveform shown in Fig.

3c is an idealized, monochromatic (single frequency) wave. In reality, waves vary in their height and length and sea waves are usually made up of many component waves with different frequencies and amplitudes. A wave spectrum can be used to represent this mix (Park, 1999; Masselink et al., 2011). To characterize real waves, the significant wave height HV& or Hs is often used which is calculated as the average height of the highest one-third of all waves occurring in a particular time period (Park, 1999). / Fig. 2: Wave attenuation process by mangrove groves / Fig. 3(a-c): (a) Circular oscillatory motion when the wave is not depth-limited, (b) Elliptical oscillatory motion in a wave which is depth-limited. Adapted from Anderson et al.

(2011) and (c) Vertical profile of an idealized (monochromatic) ocean wave, showing the linear dimensions and sinusoidal shape (adapted from Park, 1999) Waves propagate energy, rather than water, across space. While the water itself moves orbitally (Fig. 3a, b) , the waves propagate horizontally, carrying wave energy with them. The energy of a monochromatic wave is related to the square of its height: / where, E is the energy per unit surface area (J m-2), H is the wave height (m), p is the water density (kg m-s) and g is the acceleration due to gravity (m sec-2) (Dean and Dalrymple, 2002) . The rate at which energy is supplied at a particular location (e.g. , a beach) is called wave power, or energy flux which is a product of wave energy E and wave group speed eg (Park, 1999).

Wave attenuation occurs when waves lose or dissipate energy, resulting in a reduction in wave height (Park, 1999). When wind waves approach the shore, the change in depth causes them to shoal, i.e., they increase in height, maintaining their wave period but getting steeper. Advancing wave crests are slowed down more than successive crests until at some point, the waves break onto the shore, dissipating the energy in the wave. Waves become depth-limited when the depth of the water is approximately half the wavelength of the wave. At this point, the oscillatory motion of the water changes from circular oscillations to elliptical oscillations (Fig. 3b) . As depth-limited waves approach the shore (before breaking), the only loss of energy occurs through bottom friction.

In the absence of vegetation or an uneven substrate and in the presence of the shoaling process which increases wave height, bottom friction over a smooth bed (substrate) is not usually enough to cause a net reduction in wave height (i.e., wave attenuation). The presence of vegetation results in a drag force which greatly enhances wave attenuation compared to a smooth bed. Mangrove vegetation causes wave attenuation because it acts as an obstacle for the oscillatory water flow in the waves, creating drag: as the water flows around the mangrove vegetation, it has to change direction and do work against the friction of the mangrove surface. This dissipates some of the energy of the waves, thereby reducing wave height, as shown in Fig.

3: The rate of wave height reduction (r) per unit distance in the direction of wave propagation is defined as the reduction in wave height (AH) as a proportion of the initial wave height (H) over a distance (Ax) travelled by the wave (Mazda et al., 2006): r = (2) H Ax The units of r are m or m-1. For example, if wave height is reduced by 1% over a distance of 1 m, then r = 0.01 m-1: Hx = H0.e<~> (3) where, H0 is the incident wave height (cm) and Hx is the wave height (cm) after the wave has travelled x meters (Mazda et al., 2006): A similar equation can be derived from wave theory (Han Winterwerp, pers. comm.) : Hz = H 0 .elk where, k; is the imaginary wave number. When this number is negative, the waves are being damped (i.e., they are reducing in height) while if this number is positive, waves are increasing in size.

From the results of this analysis, relationships between multiple variables measured with variable wave mangroves will be observed, related to coastal engineering and the relationship between Mangrove Ecosystems and Coastal Engineering will be sought for its association with environmentally friendly coastal engineering. Furthermore, the mangrove management pattern and sustainability will be observed. Methods: This study measures the waves the moment the waves collide with the mangroves and after leaving them. Data collection is focused on the wave attenuation caused by Avicenia marina mangroves. Look at illustration in Fig. 4. / Fig. 4 : Collection of wave data in the Avicenia marina mangroves The steps for data collection and analysis are as follows: Preparation from the ordinate station which include: Transportation, equipment needed, technicians, field personnel and also OSH (Occupational Health and Safety) equipment Collection of the mangrove vegetation data. This study uses two methods for data collection: The squared-transect and the spot-check methods: Squared-transect method: In this method, a perpendicular line to the coast is depicted.

A series of 10x10 m squares are then placed along this line. The distance between squares is determined systematically based on the vegetation structure. For each square, the data of vegetation including the number of trees for each type (old, young and sapling) , the diameter and height were collected (Wantasen, 2002) Spot-check method: This method is used for providing complementary information such as the species composition, species distribution and the general condition of the mangrove ecosystem which are not observed in the squared-transect method. This method is conducted by observing and examining specific zones in the mangrove ecosystem which have special characteristics.

Information obtained through this method is descriptive Pre survey: Preliminary data were collected with assistance from the wave measuring equipment technician Time for implementation: May 16, 2013 was chosen as the starting date for observations For each station, data were collected with the duration of at least 12 h in order to obtain data for both low and high tides Implementation: Measurements were taken using 2 units of the Seabird SBE26 (Sea-Bird Electronics 26) . The setting up of the equipment was done by 2 technicians and 2 field personnel. The steps for measurement are as follows: Setting up the SBE26 gauges (conducted by technicians) Testing equipment in order to make sure the equipment is working properly Setting up the equipment, so that the equipment can bedirectly installed Going to the observation station using boat Installation of the SBE26 in front of and behind the mangrove grove Measurement and data storage Retrieving tools and uploading wave measurement data Preparation for the next station Simulation and compilation of data collected is then done using the features of this tool in order to get raw data (RAWDATA) The wave data from each station were processed and analyzed using FFT, the Matlab program (MATLAB Version 7.0.1)

(MATLAB, 2004) and a statistical program (Statistica version 7.0.61.0) (Stat Software, 2004) RESULTS Mangrove density: The density values for the Avicenia marina mangrove groves are illustrated in Fig. 5 below. The density at stations 1, 2 and 3 were seen only in small clusters. At station 4 and 5 they were very dense because they were not split into small groups. The images can be seen in Fig. 6. When viewed separately, the Avicenia marina mangrove groves which were chosen as research objects were all in the categoiy of very dense. In Fig. 6a (stations 1 and 2) , the density of mangroves was in the sparse category due to the sparse population and separation from other groups because of the mangrove marshes.

There was abrasion and the quality of the environment was low, seen from the presence of garbage and the foetid smell. Figure 6b (Station 3) is categorized as sparse because it is situated in the outermost part and is separate from coastal mangrove groves. Station 3 was selected because the mangroves were still natural and they functioned as wave breakers while other mangroves were in contact with mainland and were dirty. Figure 6c (stations 4 and 5) were categorized as very dense and the mangroves seem to be thriving and are still blended in with other mangrove groves, signifying that wave attenuation was still in operation. In general, very few mangrove groves / Fig. 5: Mangrove density graphs at each station / Fig. 6(a-c): (a) Station 1 and 2, (b) Station 3 and (c) Station 4 and 5 viewed from above points were selected as wave attenuation; however, the density was found to be adequate.

The density of species of each station was the single species density, the Avicenia marina mangrove alone. Wave energy that occurred: The results of the calculation of the waves at each station using the FFT, the MATLAB (MATLAB Version 7.0.1) (MATLAB, 2004) and the statistical programs (Statistica version 7.0.61.0) (Stat Software, 2004) are as follows. At station 1 with a mangrove grove width of 30 m, measurements were taken on 20 May 2013 from 09:12:16 a.m. to 09:13:20 p.m. The summary below shows the equipment event records which are: the magnitude of the maximum wave height recorded on the device placed in front of the mangroves was 0.77 m. The wave energy delta was in the range of 5.886 ((m sec-1)2/c 2 min-1) with a 2-8 min period. At station 2 with a mangrove grove width of 10 m, measurements were taken from 20-21 May 2013 from 11:29:52 p.m. until 11:07:28 a.m.

The summary below shows the equipment event records which are: the magnitude of the maximum wave height recorded on the device placed in front of the mangroves was 0.72 m. The wave energy delta was in the range of 10.893 ((m sec-1)2/c 2 min-1) with a 2-24 mm period. At station 3 with a mangrove grove width of 20 m, measurements were taken from 18-19 May 2013 from 07:52:16 p .m. to 07:10:40 a.m. The summary below shows the equipment event records which are: the magnitude of the maximum wave height recorded on the device placed in front of the mangroves was 0.27 m. The wave energy delta was in the range of 8.698 ((m sec-1) 2/c 2 min-1) with a 2-6 min period. At station 4 with a mangrove grove width of 15 m, measurements were taken from 19-20 May 2013 from 09:40:00-06:15:12 a.m.

The summary below shows the equipment event records which are: the magnitude of the maximum wave height recorded on the device placed in front of the mangroves was 0.41 m. The wave energy delta was in the range of 5.878 ((m sec-1)2/c 2 min-1) with a 2-6 min period. At station 5 with a mangrove grove width of 5 m, measurements were taken from 21-22 May 2013 from 02:19:28 p .m. to 07:59:44 a.m. The summary below shows the equipment event records which are: the magnitude of the maximum wave height recorded on the device placed in front of the mangroves was 0.49 m. The wave energy delta was in the range of 22.268 ((m sec-1) 2/c 2 min-1) with a 2-10 min period. Wave attenuation at research points location: From Fig.

7, the charts above, it can be seen that the delta energy that the Avicenia marina mangrove groves with a width between 5 m and 30 m can attenuate seems to have a tendency to recede. At station 5, having 5 m wide mangrove groves, the magnitude of attenuation was up to 40 ((m sec-1)2/c 2 min-1) with a stacking period of between 2 and 10 min. At station 2, 10 m having wide mangrove groves, the delta energy accumulated in the range of 20 ((m sec-1) 2/c 2 min-1) with a period of between 2 and 24 min. Next, at station 4, having 15 m wide mangroves groves and station 3, having 20 m wide mangrove groves, the results declined even more.

The delta energy in station 1, having 30 m wide mangrove groves , the range was 10 ((m sec-1) 2/c 2 min-1) with a period of 2-8 min. In general, it can be concluded that with large periods, the delta attenuation will also be large at each mangrove grove width . / Fig. 7: Continue / Fig. 7(a-e): Graph of each station s wave energy delta (the difference between the incoming and outgoing wave energy) (a) Station one, (b) Station two, (c) Station three, (d) Station four and (e) Station five DISCUSSION Energy attenuation by the Avicenia marina Mangrove: The Avicenia marina mangrove at the Indah Kapuk Coastal Area Research location, Jakarta, Indonesia is capable of attenuating wave energy. The denser the grove, the better the attenuation (Fig. 8). In Fig.

8, it is shown that for mangrove groves 5 m wide, the wave passing through the mangroves still appears to be larger compared to the wave passing through the grove 30 m wide. Wave attenuation by Avicenia marina mangroves is influenced by many factors, but the most influential ones are mangrove grove width, root density and trunk density. Other factors which influence the attenuation are sea depth, the bathymetric slope, the slope of the bathymetry, the amount of detritus httering the grove, etc. However, in this study, the effect of the other factors on wave attenuation has not yet been studied.

The circumference of the breathing roots is the determining factor for attenuation and tree trunk density; it can be seen that different circumferences of breathing roots (L5>L4>L3>L2>L1) clearly affected the waves passing through the grove (HA1>HA2>HA3>HA4>HA5) . / Fig. 8: Wave attenuation by Avicenia marina mangrove groves with five different widths, 5, 10, 15, 20 and 30 m / Fig. 9: Graph for the relationship between the width of Avicenia marina mangrove groves and energy attenuation / Fig. 10: Graph for the relationship between the width of Avicenia marina mangrove groves and the delta energy (difference between inc) The Correlation between Mangrove Grove Width and Wave Energy Attenuation: The attenuation by Avicenia marina mangrove groves with different widths can be seen in Fig. 9. From Fig. 9 , it can be seen that there is a definite trend where in the wider the grove is, the better it can attenuate waves. The graph was not linear.

It is demonstrated that the attenuation by the mangrove grove 5 m wide was 22.268 ((m sec-1)2/c 2 min-1), the grove 15 m wide 8.698 ((m sec-1)2/c 2 min-1) and the grove 30 m wide 5.878 ((m sec-1)2/c 2 min-1) ; therefore, the graph was not linear but polynomial. A formula to calculate the wave attenuation by Avicenia marina mangroves in relation to the width of the grove was discovered, i.e. : Y (Energy) = 0.003x3+0.208xz-4.620x+40.29 From Fig. 10, it can be seen that there is a definite trend wherein the narrower the mangrove grove, the greater the energy (the energy difference between the energy in front of and behind the mangroves); thus, the wider the mangrove grove, the greater the ability to attenuate, so the delta energy is smaller. The resulting graph was also polynomial. It can be seen that the 5 m wide mangrove grove was less able to absorb wave energy, so the delta wave was 1.927 ((m sec-1) 2/c 2 min-1) .

For the 15 m wide grove, the delta was tempered down to 4.497 ((m sec-1)2/c 2 min-1) whereas the delta for the grove 30 m wide was reduced to 4.728 ((m sec-1)2/c 2 min-1). The equation obtained for calculating the delta wave attenuation by Avicenia marina mangroves is the relationship between the width of the mangrove grove and the delta energy. The equation is: Y (Delta Energy) = 0.005x2+0.359x+0.287 CONCLUSION Wave attenuation by the Avicenia marina mangrove is affected by these factors: The width of the Avicenia marina mangrove grove, the root density, trunk density and breathing roots. In addition, other factors are sea depth, the bathymetric slope, detritus, etc. However, this research has not researched these wave attenuation factors.

The graph obtained for delta wave attenuation by mangroves Avicenia marina as the relationship between the thickness of the mangrove and delta energy is: Y (Delta Energy) = 0.005x2+0.359x+0.287 For the relationship between the thickness of the mangrove and energy is: Y (Energy) = 0.003x3+0.208xz-4.602x+40.29 The wider the mangrove grove, the greater the ability to attenuate waves. ACKNOWLEDGMENTS This research was supported by the Navy DISHIDROS Jakarta and Department of Management Coastal Resources and Marine BAU (Bogor Agricultural University/IPB). We say thank you to those who support the together in this research. REFERENCES Abdullah, A. , 1988. Conservation and management of mangrove ecosystems in Indonesia. Galaxea, 7: 297-301. Bengen , D.G. , 2002. Introduction and Management of Mangrove Ecosystems. Center for Coastal and Marine Resources Studies.

Bogor Agricultural University, Indonesia. Dean, R.G. and R.A. Dalrymple, 1984. Water Wave Mechanics for Engineers and Scientists. Prentice-Hall, New Jersey, USA., Pages: 353. Dean, R.G. and R.A. Dalrymple, 2002. Coastal Processes with Engineering Apphcations. Cambridge University Press, Cambridge, UK. Halide, H. , R.M. Brinkman and P. Ridd, 2000. Designing Bamboo Wave Attenuators for Mangrove Plantations. James Cook University, Townsville, Australia. Horikawa, K, 1988. Nearshore Dynamic and Coastal Processes. University of Tokyo Press, Japan, Pages: 522. Latief, H. , 2000. Study on tsunamis and their mitigation by using a green belt in Indonesia. Ph.D. Thesis, Tohoku University, Sendai, Japan. Latief, H. , K. Harada and F. Imamura, 2000. Experimental and Numerical Study on the Effect of mangrove to Reduce Tsunami. Tohoku University, Sendai, Japan, pp: 6. MATLAB, 2004. MATLAB Version 7.0.1. The Math Work Inc. , USA. Manca, E., I. Caceres., J.M. Alsina, V. Stratigaki, I. Townend and C.L.

Amos, 2012. Wave energy and wave-induced flow reduction by full-scale model Posidonia oceanica seagrass. Cont. Shelf Res., 50-51: 100-116. Massel, S.R. , 1996. Ocean Surface Waves: Their Physics and Prediction. World Scientific, Singapore, pp: 491. Massel, S.R. , K. Furukawa and R.M. Brinkman, 1999. Surface wave propagation in mangrove forests. Fluid Dyn. Res., 24: 219-249. Masselink, G. , M.G. Hughes and J. Knight, 2011. Coastal Processes and Geomorphology. Hodder Education, London, UK. Mazda, Y. and M. Magi, 1997. Mangrove Coastal Protection from Waves in the Tong King Delta. Kluwer Academic Publisher, Netherlands. Mazda, Y. , E. Wolanski and P.V. Ridd, 2003. The Role of Physical Processes in Mangrove Environments. Terrapub Publisher, Japan. Mazda, Y., M. Magi, Y. Ikeda, T. Kurokawa and T. Asano, 2006. Wave reduction in a mangrove forest dominated by Sonneratia sp. Wetlands Ecol. Manage., 14: 365-378. Mazda, Y., N.

Kanazawa and E. Wolanski, 1995.

Tidal asymmetry in mangrove creeks. Hydrobiologia, 295: 51-58. Mclvor, A. , I. Moller, T . Spencer and M.M. Spalding, 2012. Reduction of wind and well waves by mangroves. Natural Coastal Protection Series, Report 1 Cambridge Coastal Research Unit Working Paper 40. Noor, Y.R., M. Khazali and I. N.N. Suryadiputra, 1999. Guide Introduction Mangrove Indonesia. PKA/WI-IP, Bogor, Indonesia. Park, D. , 1999. Waves, Tides and Shallow-Water Processes. Elsevier, Amsterdam, Netherlands. Prinando, M. , R. Nurlinda, R.F.A. Manan, G. Puspitasari and S. Concerned et al., 2010. [Analysis of environmental services wildlife in asylum]. Analsisi Jasa Lingkungan di Muara Angke. Quartel, S. , A. Kroon, P.G.E.F. Augustinus, P. Van Santen and N.H. Tn, 2007. Wave attenuation in coastal mangroves in the Red River Delta, Vietnam. J. Asian Earth Sci. , 29: 576-584. Salm, R.V. , J. R.

Clark and E. Simla, 2000. Marine and Coastal Protected Areas: A Guide for Planners and Managers. 3rd Edn., IUCN, Switzerland, pp: 370. Stat Software, 2004 . Statistica Software, Version 7.0.61.0. Stat Software Inc., USA. Triatmodjo, B., 1999. Coastal Engineering. Beta Offset, Yogyakarta, Indonesia. Wantasen, A., 2002. Resource potential assessment of mangrove forest in Talise village, Minahasa regency, North Sulawesi, http://www.ipb.ac.id/ Yanagisawa, H., S. Koshimura, K. Goto, T. Miyagi, F. Imamura, A. Ruangrassamee and C. Tanavud, 2009. The reduction effects of mangrove forest on a tsunami based on field surveys at Pakarang Cape, Thailand and numerical analysis. Estuarine Coastal Shelf Sci., 81: 27-37.