WAVE CHARACTERISTICS ANALYSIS OF PERAK WATERS SURABAYA

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ABSTRACT

This research was intended to understand the wave's characteristics of the study area. Wave's parameters that were observed in this research including wave period (T), wave length (L), wave height (H), wave velocity (C) and wave energy (E). Another objective of this study was also to produce a topographic map of the sea floor for the study area. Wave's data of this study was gain from an electronic sensor called MAWS (Marine Automatic Wave Sensor). This sensor is located in a Naval Base of Surabaya. Result of this study showed that the Perak Port was located in a relatively shallow waters area, with maximum water depth approximately 27 meters. The average of observed wave length and wave period during the study was 2.005 meters and 1.0875 seconds. Moreover, this study was also observed that the average of wave height of the area 0.2375 meters, with wave velocity just about 1.6975 m/s.

Key Words : wave period , wave length, wave height, wave velocity, wave energy

INTRODUCTION

The Perak Port is one of the largest harbours in Indonesia. It has become the centre of economic and transportation activities for the eastern part of Indonesia. Administratively, this harbour is located in East Java province. The geographic location of the area is $7^0$10'00" – $7^0$12'18'' South and $112^0$40'42'' – $112^0$45'120" East. The total area of the location is approximately 1,5743 km^2 and is divided into two regions, which are the West area and the East Area.

Altough the study area has been developed as an important area to support the transportation and economic activities, not many researchs on oceanographic characteristics of the area were published. Oceanographic data of the area were only used and obtained by several government bodies such as the Harbour administrative office, the Navy and the Office of Meteorology. Therefore, to develop understandings of oceanographic phenomena as well as to add the publication of oceanographic papers in a local journal of our university, a moderately straightforward study was needed.

According to Parnell (2008) ocean waves can be classified based on the generating energy, for example: wind wave, tidal wave, tsunami wave and waves that are generated by ship's movement. Understanding wave characteristics is important to support our knowledge in coastal processes. Waves can create a significant amount of energy to shape beaches (Smithers and Parnell, 2007). Waves can also generate longshore currents, which are caused sediment transport (Hidayah, 2008; Parnell, 2007). Moreover, Triatmodjo (1999) explain that, understanding waves characteristics is the key for engineer to build coastal structures such as harbours, ship's deck and bridges.

This study was conducted in 2006. In addition, this study was only focused on the analysis and determination of the wave parameters, such as wave period (T), wave length (L), wave height (H), wave velocity

(C) and wave energy (E). An electronic sensor was employed for this study, the sensor called MAWS (Marine Automatic Wave Sensor) which used ultarasonic frequencies of sound waves. This equipment was able to identify the height of water level. Moreover, wave height and wave period can also be measured by this sensor. The MAWS was deployed in a Naval Base of Surabaya. Observation data from the sensor was then transmitted to the Office of Meteorology. Furthermore, by means of wave height and wave period, other wave parameters can be determined using mathematical equations. Another data for this study came from the bathymetri map. This map was employed to produce a contour map and 3D profile of the sea floor.

METHODS

As it mention before, this study took place in Perak Port of Surabaya, East Java. Data was collected using MAWS sensor. This study was conducted using oceanographic data from the year 2005. Data analysis was done in April – June 2006.

The MAWS sensor was able to detect wave height and wave period. In order to determine other wave parameters, several mathematical equations were used. Calculation of wave parameters was conducted using CEDAS (Coastal Engineering Data Analysis System) software. The equations are:

1. Wavelenght (Lo) = $1.56.T^2$. Using this equation wavelength in a specific depth can be measured L = $\frac{gT^2}{2\pi}\tanh\frac{2\pi d}{Lo}$ (Triatmodjo, 1999).
2. Wave velocity (C) = $\frac{gT}{2\pi}\tanh\frac{2\pi d}{L}$ (Triatmodjo, 1999).
3. Wave energy (E) = $\frac{\rho g H^2}{8}$ (Triatmodjo, 1999).

After all wave parameters have been measured, a contour map was produced using Kringing interpolation. This contour map was made by means of Golden Surfer Software version 8 (Hidayah, 2009). In addition, using the same software, a 3D topographic map was also produced based on water depth.

RESULTS AND DISCUSSION

Based on the bathymetric map, water depth of the study area ranges from 8.3 meters to 26 meters, with average depth approximately 13.18 meters. This water depth data was then used to produced a contour map and a 3D topographic profile of the study area (Figure 1 and Figure 2)

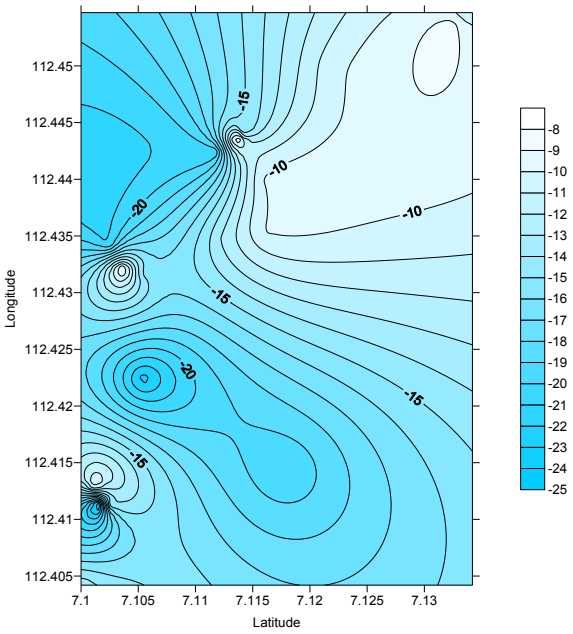

Figure 1. Contour Map of the Study Area

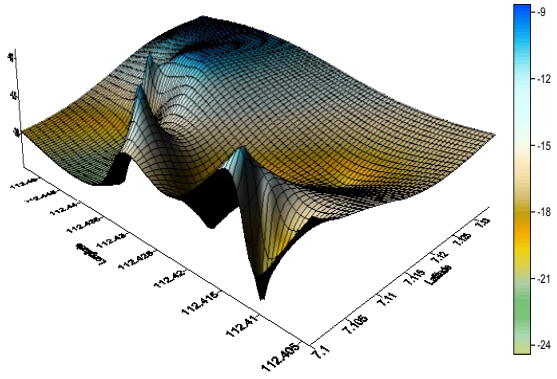

Figure 2. 3D Topograhic Map of the Study Area

Based on the charts above, Perak waters can be divided into two different regions according to their depth. The first part is the western area. This area was the main transportation chanel, with average depth ranges from 9.7 meters to 12 meters. The length and width of this area was 25 miles and 100 meters respectively. The second part was the eastern area. This region can be classified as shallow waters, with average depth 2.5 meters to 5 meters. The length of the area was 22.5 miles and the width was just about 100 meters. As it mention before, Perak waters can be categorized as shallow water. Therefore, with its depth vary from 8.3 meters to 26 meters, it can be argued that the waves on the area was mostly generated by wind.

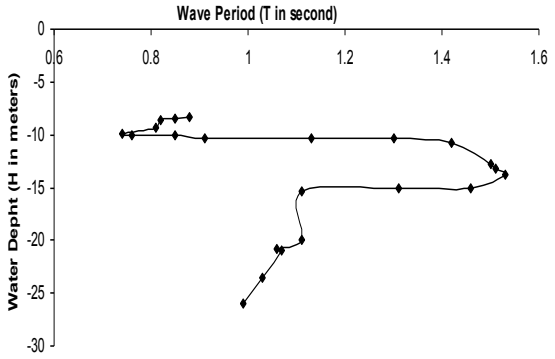

Figure 2. Wave Period (T) on Specific Water Depht

As can be seen from Figure 2, wave period (T) varies in depth. From the depth of 8 – 10 meters, wave period ranges from 0.74 – 0.85 seconds. Whereas on the depth of 10 to 15 meters wave period increased to 1.3 to 1.51 seconds. As the water depth continuosly decresing, the waves period seemed steady in the range of 1.0 to 1.2 seconds.

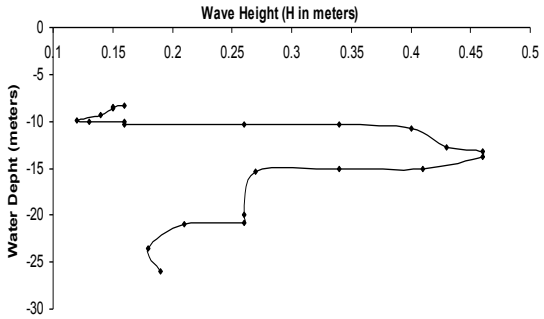

Figure 3. Wave Height (H) on Specific Depht

Figure 3 showed that wave height distribution on different water depth had similar profile compare to the wave period (Figure 2). Generally, wave height decreased as the water became deeper, except between 10 -15 meters where wave height increased from about 0.17 meters to 0.45 meters.

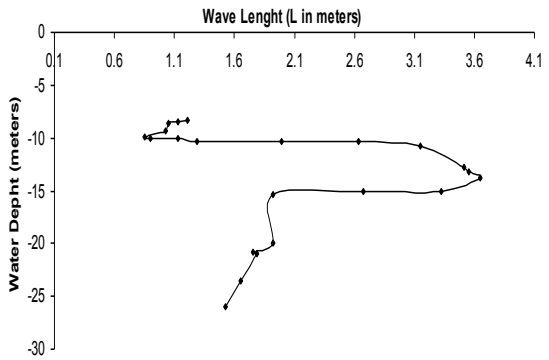

Figure 4. Wave Lenght (L) on Specific Depht

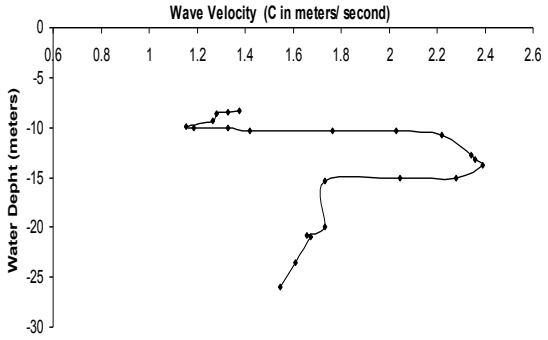

Figure 5. Wave Velocity (C) on Specific Depht

Wavelenght (L) and wave velocity (C) showed similar profile. For the depth of 5 – 10 meters, wavelenght ranges from 1.1 to 0.8 meters. Whereas on the depth of 10 - 15 meters, wave velocity was 1.4 – 2.2 m/s. As water depth increased, both parameters showed stability. The similarity of the profiles could happen because all equations which are used to calculate wavelength and wave velocity employed wave height and wave period as their main components.

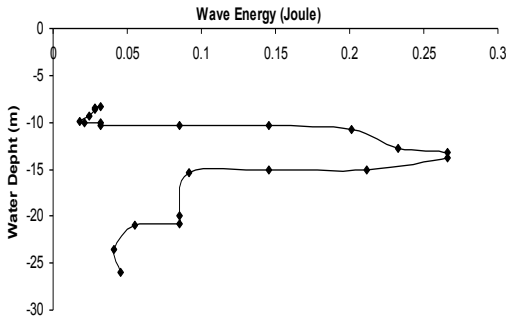

Figure 6. Wave Energy (E) Profile

Ocean wave moves from deeper part of the sea to the shallow water. When the wave reaches shallow water the peak of the wave become steeper and finally break. Moreover, as wave moves to shallow waters wave height will decrease as well as wave velocity.

However, this study cannot support the theory. It happened because there were anomalies of the measurement. All profile showed that in the depth of 10 – 15 meters, there were increases of parameter's value. If we ignored parameter's value on those depths, this study was inline with and could support the simple ocean wave theory.

The difference of the study's result and theory could happen because of inaccuracies in observing the MAWS data. The lack of understanding in analyzing and plotting the data into graphs could also be a drawback of this study. However, this study is quite useful in providing waves information. It is need to remember that not all of the profiles were incorrect. The misleading notion of this reseach occurred only on certain depth scales, which were 10 -15 meters. Other data and profiles can be argued to be reasonably suitable with the simple wave's theory.

CONCLUSIONS

Perak waters can be categorized as shallow waters with maximum depth of 26 meters. The measurement of several waves' parameters showed inconsistency with the simple wave's theory. The anomaly occurred on the measurent of parameters in depth of 10-15 meters. It might happen because of inaccuracies in observing and analyzing MAWS data.

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