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ROB ANALYSIS ON THE COAST OF SEMARANG CITY ON MAY 23, 2022 BASED ON TIDAL DATA AND INUNDATION DISTRIBUTION

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Abstract
The coast of Semarang City every year always faces flood and tidal problems. Flooding is generally caused by the ongoing rainy season, while tidal flows are caused by rising Java Sea levels before the interseason change. This study aims to find the relationship between the tidal incident on May 23, 2022 on the coast of Semarang City with the tidal pattern at the Port of Semarang, and find out the distribution of tidal flows based on the height of inundation in the coastal area of Semarang City. The material used is daily tide data on May 23, 2022, monthly tide data April-May 2022. Data on the distribution of high inundation was obtained based on field surveys and interviews. The results showed that the peak of Java Sea level elevation occurred on May 23, 2022 with an altitude at the tide staff of 210 cm. Rob occurs almost evenly along the north coast of Semarang City with different heights. The largest tidal height occurred in the Semarang Port Area, which reached a puddle height of 100 cm. There are supposes that the amount of inundation at the site is related to the land subsidence at the site that continues to occur.

Keywords: *rob May 23, 2022; tide; coastal of Semarang City*

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1. INTRODUCTION

Rob or tidal floods is local name for routinely every year in a certain period hit the north coast of Java. The area along the north coast of Java is occupied by cities that are relatively densely populated, such as Jakarta, Semarang, Cirebon, Tegal, Pekalongan. These cities are directly facing the Java Sea, so that those related to the dynamics of the Java Sea will have a direct impact on their coastal areas. Tidal flooding caused by high tides and combined with land subsidence is a major problem for people living on urban coasts in Indonesia (Marfai & King, 2008). Floods that come from the sea known as tidal generally inundate land areas lower than sea level. Floods coming from the sea can be in the form of overflow or overtopping through seawater retaining walls, such as dike, seawall, beachridge, etc.

Based on topographical aspects, the Semarang City area can generally be divided into two parts, namely lowlands and highlands. The lowlands covering an area of 121 km2 or 32 percent of the total area of Semarang City, are in the northern part along the coast, with a slope of 0-2%, and altitudes varying between 0-25 m above sea level . The southern part is a hilly area, covering an area of 252 km2, with a slope of 2-40% and an altitude of between 25-200 m above sea level (Semarang City Government, 2014). The existence of several parts of coastal areas at an altitude of 0-1 m causes insecurity from flooding and tidal inundation.

The coastal city of Semarang is experiencing environmental pressures, such as an increasing population, dense and inadequate settlements, the location of the industry area that is concentrated in a place, dealing with flooding and tidal problems that routinely occur every year, as well as land subsidence. The problem of flooding and tidal flooding has so far caused a lot of material losses, transportation congestion, and adverse environmental impacts.

In the Semarang City area, almost all districts are prone to flooding even with a short duration, especially in the upper areas (hills). In the lower part (lowlands) the duration of inundation occurs longer considering the topographical shape of the land surface is relatively flat. Locations prone to flooding and tidal flooding include sub-districts: North Semarang, Gayamsari, and Genuk (Semarang City Government, 2014).

On May 23, 2022, the coast of Semarang City was shocked by a large tidal incident so that the sea embankment in the industry of Semarang Port became broken. Furthermore, the rob will continue to occur until the next few days (jateng.tribunnews.com; regional.kompas.com May 23, 2022). It was recorded that the height of the rob around the sea embankment was about 1 meter. The incident was considered very surprising considering that the rob caused large material losses and traffic jams in the area affected by the rob.

The rob incident on May 23, 2022 and the following days has actually been predicted through a rob disaster warning circular by BMKG. According to BMKG (2022) through an early warning of tidal floods for May 23-24, 2022, it will hit the north coast of Java which is expected to occur from 13.00 - 17.00. Tidal events will result in disruption of transportation activities around the port and coastal areas, activities of salt farmers and inland fisheries, and loading and unloading in the port. The rob incident on May 23, 2022 was finally proven and hit all throughout the north coast of Java, including rob hitting the coast of Semarang City.

2. RESEARCH OBJECTIVES

The objectives of the study were (1) to find a relationship between the tidal incident on May 23, 2022 on the coast of Semarang City with the tidal pattern at Semarang Port, (2) to find out the distribution of rob based on the height of inundation in the coastal area of Semarang City.

3. RESEARCH METHODOLOGY

a. Location and time

The research location is the coast of Semarang City, especially around Semarang Port with a geographical coordinate range of 6°56'47.12" S -6°57"42.15" S and 110°25'27.45"E - 110°27'46.56"E. The timing of the tidal data collection study was carried out for May 2022. The results of field observations and interviews were conducted on July 28-August 1, 2022.

b. Material

The main material in this study is media news about the rob dated May 23, 2022 and daily and monthly tidal data from the Semarang Port Maritime Meteorological Station. Annual tidal data were obtained based on previous research sources. The method developed is the correlation of an event as a fact with existing supporting data, which is to associate the tidal event dated May 23, 2022 with the daily tide chart in May 2022. The field survey was conducted by reviewing the wider distribution of rob to see the impact of the May 23, 2022 rob accompanied by interviews with rob survivors.

4. RESULTS AND DISCUSSION

Rob that occurred in Semarang City hit almost all of its coastal areas with the distribution shown in Figure 1. The distribution of floods on the coast of Semarang City has a wider area compared to the distribution of tidal events. The flood-prone area is 8,773 ha, while the tidal-prone area is 3,400 ha. It is shown in the distribution of floods and tidal floods that there are locations where floods and robs occur in the same area although they do not necessarily occur at the same time (Semarang City Government, 2014).

Based on the analysis of daily tide data dated May 23, 2022 (Figure 2 of the upper graph) shows a graph of the tide height of the water level since 00.00 starting to rise at a height of 112 cm and peaks at 15.00 and 16.00 with a height of 210 cm. Furthermore, in the following hours it moved down flattened and until 24.00 it was at a height of 145 cm. Based on media sources (jateng.tribunnews.com; regional.kompas.com on May 23, 2022) that the peak incidence of rob starting at 15.00 until near the evening of the rob is still high. As a result of the tidal, the sea embankment around the Lamicitra Nusantara Industrial Estate was broken so that the water flooded a wider area of the Semarang Port industry and its surroundings (Photo 1 and Photo 2). Based on an interview on July 28, 2022, the embankment broke due to the inability of the embankment section more than 1 m high to withstand the insistence of rising sea water.

Based on Pushidrosal's prediction (Figure 2 of the below graph) the largest tidal height is 110 cm which will occur at 14.00 – 16.00, based on the real time tidal height by the largest BMKG of 210 cm which occurs at 15.00 – 16.00. There is a difference of 100 cm between the two graphs. Visually, the two graphs have the same movement pattern, that is, almost the same up and down patterns.

Figure 3 shows a graph of pairs during the one-month period of April 24-May 24, 2022. Based on the chart, the pairs fluctuated normally, but on May 22-23 there were higher fluctuations than before. This condition also causes rob in Tayu, Pati (Faqi, 2022). This is in accordance with the chart of daily observations on May 23, 2022, that on May 23, 2022, there was a surge in high sea level rise.

Based on the results of field observations (Table 1) in several other locations such as in Kampung Bahari Tambakmulyo the height of the rob varies from 50-60 cm, while at the front of the entrance gate to Tambakmulyo there is no rob. The location at the northern end of Ronggowarsito Road was flooded by about 60 cm. The flooded location is generally in areas that have not been handled by the Semarang City Flood and Rob Control Project, while at the northern end of Ronggowarsito Road is a location under the North Arterial lay ang road which is not part of the elevated road so that the rob moves freely across it.

Based on Table 1 in other parts of the coast of Semarang City, the results of the tidal distribution field survey showed that in Kobong Market, Pengapon and along Kaligawe Street, at the location of observation points around Terboyo Terminal, there was no rob. Some of these observation locations before the construction of the seawall that covers part of the coastal area of Semarang City which is the result of the Semarang City Flood and Rob Control Project (2018-2019) are the guardians that are routinely hit by rob.

According to Habibie, et al (2012) based on tidal data analysis research during the 2006-2009 period at Semarang Port, it shows that the tidal chart has its peak in May-June. This condition does not seem to have changed its pattern, namely every time before May and June every year the sea level experiences a higher rise than other months periods, so that as a result, coastal areas, especially in Semarang City, cause tidal flows.

There is a relationship between the magnitude of flooding in one location and another and the rate of speed of land subsidence. According to Gaffara (2018) in general, the coast of Semarang City has experienced varying levels of land decline, including in Genuk District 8.1-15 cm / year, North Semarang District and West Semarang District 4.1-12 cm / year, the greatest land subsidence speed is found in the eastern Semarang Area. The load imposed by the building structures on it also accelerates the rate of land subsidence.

In the broken embankment area in Area Industri Lamicitra Nusantara, Semarang Port complex that the area and its surroundings have the largest tidal flooding reaching 100 cm, it turns out that the area has never experienced land elevation since it was built until now (based on field observations and interviews).

In some settlements around Semarang Port such as in Tambakmulyo the population has largely raised their homes by clearing land. Nevertheless, the height of tidal inundation reaches 50-60 cm. The location is at the northern end and directly opposite the sea. Around the overpass at the northern end of Ronggowarsito Road the height of the inundation reaches 50-60 cm. The location is located about 1 km from the coastline, but in some places it has subsidenced land, making it an entry point for the tidal to flow further towards the mainland to the south of it. The results of Kurniawan's research (2003) in Dadapsari Village, North Semarang District although the location is a bit far from the coast, but because it has a flat land surface, which is from 0 - 2.5 m, there are even some locations that have an altitude below the average sea level, almost all parts of the area are prone to tidal flooding. According to Nugroho's estimate (2013) the area of tidal inundation on the coast of Semarang City in 2013 reached 8,527.78 ha with the largest part being in Genuk District, which is 3,008.97 ha.

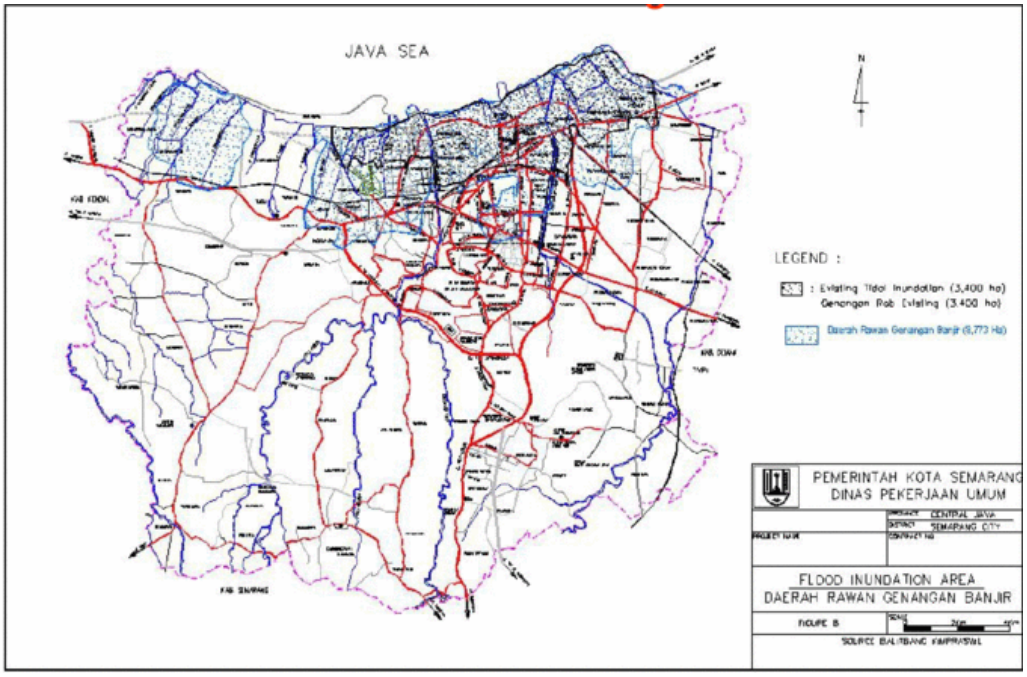

Figure 1. Distribution of flood and tidal inundation in Semarang City (Source: Pemkot Semarang, 2014)

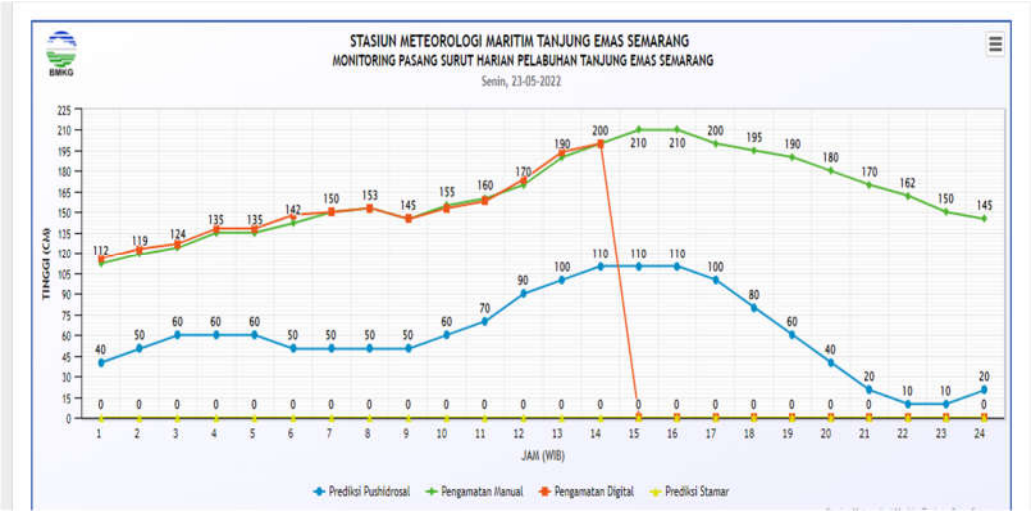

Figure 2. Graphic of the water level on May 23, 2022 at the Semarang Port Maritime Station. Graph over observation results, bottom graph forecasting results (Source: Maritime Station BMKG Semarang Port, 2022)

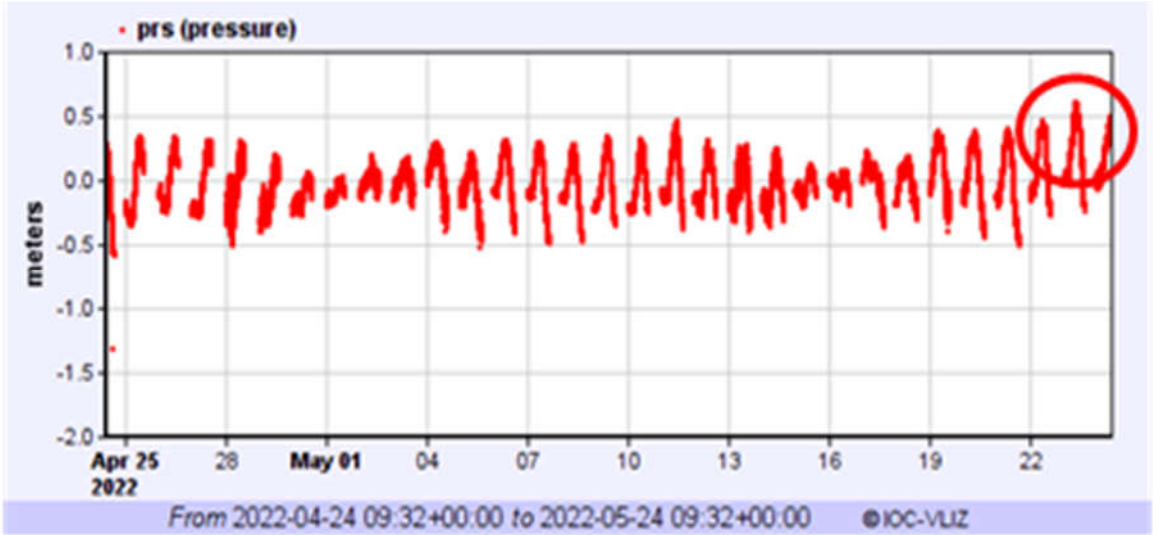

Figure 3. Tidal graph during the period 24 April-24 May 2022 at Semarang Port. The circled part is rob dated 23 May 2022 (Source: Faqi, 2022).

Table 1. Height survey at the time of the rob on May 23, 2022 in several locations in tidal disaster-prone areas on the coast of Semarang City

Number	Geography coordinates	Location	Rob height (cm)
1	6°56'47,12" S 110°25'59,26"E	Embankment broken Lamicitra	100
2	6°56'38,11" S 110°25'27,45"E	Container port	100
3	6°56'35,09" S 110°26'10,64"E	End of village Tambakmulyo	50-60
4	6°57'17,53" S 110°25'49,95" E	Under Road overpass Ronggowarsito	50-60
5	6°57"00,58" S 110°26'19,58"E	In front of the village gate Tambakmulyo	0 (no rob)
6	6°57"42,15" S 110°26'07,32"E	Pasar Kobong, Pengapon	0 (no rob)
7	6°57"20,25" S 110°27'46,56"E	Terminal of Terboyo, Kaligawe Street	0 (no rob)

Source: interviews and field observations

5. CONCLUSION

i. The tidal occur on May 23, 2022 at Semarang Port caused a rob, and the tide chart showed an upward movement with the position reaching its peak with a height of 210 cm.

ii. Rob occurs almost evenly along the north coast of Semarang City with different inundation heights. The largest tidal height occurs in the Semarang Port Area, which reaches a puddle height of 100 cm. There are estimates that the amount of inundation at the site is related to land subsidence at the site which continues to occur.

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Photo 1. Two people carrying motorbikes through a tidal puddle on May 23, 2022 around Semarang Port (Source: Medcom.id)

Photo 2. A worker pointed to the rob height dated May 23, 2022 on a concrete wall in the Semarang Port Area (Personal documentation July 28, 2022).