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Dredging Analysis at Makassar New Port

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Abstract

Dredging is used to create new harbors, berths, or waterways or to deepen existing facilities to allow vessels with heavy drafts to access them. The dredging analysis at Makassar New Port aims to calculate how much the dredging volume. With this data, research can be used as a reference source and consideration for researchers and port authorities. The research method is descriptive, where the primary data is data obtained based on direct observation at the research location, while secondary data is researched and collected by related parties. Then an analysis is carried out to calculate the dredging volume at Makassar New Port. The analysis results concluded that dredging was carried out with a dredge volume reaching 1,953,764.47 m3, with a processing time of 349 days.

Keywords: dredging, dredge volume, port

1. Introduction

Makassar New Port is a planned port due to expanding a container ship port in the South Sulawesi area, precisely in Makassar [1]. Makassar New Port is one of the National Strategic Projects (PSN). This project is the work of the nation's children. Makassar New Port development itself was carried out in stages. Phase I A was built from 2015 to 2018. Meanwhile, the length of the Phase I A pier is 320 meters, with an installed capacity of 500,000 TEUs. In Phase I B, three piers are also built, which are 330 meters long with an installed capacity of 1 million TEUs. For Phase I C, the pier being built has a length of 350 meters, with an installed capacity of 1 million TEUs. Phase I D, the length of the pier is 1,043 meters. Makassar New Port Phase II development, with a pier length of 3,380 meters, will have an installed capacity of 5 million TEUs. Meanwhile, Phase III will also build a wharf with an altitude of 4,500 meters and an installed capacity of 10 million TEUs [1].

President Joko Widodo's speech while visiting the city of Maros quoted said that Makassar New Port (MNP) is also designated as a Hub Port or a portthat can accommodate ships with a draft of 15 meters. The existing depth in the Makassar New Port harbor pool is ± 16 meters (Bathymetry data analysis and Makassar New Port Company Profile). Theideal shipping channel depth is 10% -15% of the planned ship draft [2]. So the perfect depth for bringing in Post Panamax container ships is 17.25 or 18 m. This difference in existing depth and planning makes it impossible for Post Panamax container ships to berth at Makassar New Port. Therefore, a dredging analysis must be carried out at the Makassar New Port. Dredging is undertaken to create a new port, berth, or waterway or to deepen existing facilities to allow access to larger vessels at the Makassar New Port. Dredging analysis on the dredging work of the Ketapang CPO jetty pool to determine the volume of sediment to be dredged and an analysis of the cost of dredging has been carried out in 2019 [3], using the 2006 Dredging and Reclamation Technical guidelines by the Director General of Transportation. The analysis results show that the design depth plan is based on a draft value of 6.6 m for the most significant general cargo ship design, namely –7.5 mLWS. The volume of sediment dredging for CPO

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Jetty Ponds is based on design depth, slope, and addition of silation rate with an area of 2270 m^2 which is 7,713 m^3, and a total dredging cost of IDR 520,253,407. Based on the background and results of previous studies that have not analyzed the stages of dredging and the duration of dredging, it is necessary to research to analyze dredging and the total dredging time in the Makassar New Port pond.

2. Materials and Methods

The research location was at the Makassar New Port Office in Kaluku Badoa Village, Tallo District, Makassar City, South Sulawesi Province. Based on the approach of the maximum container storage capacity at Makassar Port, the Makassar New Port was designed as a solution for developing container storage capacity. The executing agency for the Makassar New Port development was PT—Indonesian Harbor (PELINDO) IV. Makassar New Port was also part of the Sea Highway planning proposed by the President of the Republic of Indonesia, Joko Widodo. Makassar New Port was planned to increase the container capacity by 500,000 container boxes. The data collection time forthis final assignment is two weeks.

Fig.1. Makassar New Port. [4]

Some of the steps that will be taken in processing data or analyzing data include:

1. Look for problems in the analysis that will be carried out and add various reference sources that have similar research.
2. We are identifying the problem of dredging depth at the Makassar New Port pool to bring in generation 4 container ships (Post Panamax).
3. Literature Review to collect various formulas and theoretical foundations that support the objectives to be achieved in research.
4. Data collection was carried out in this study by taking primary and secondary data.

a. Retrieval of bathymetry data. This bathymetry data collection aims to determine the contours of the soil in the ponds of the Makassar New Port. This data can be retrieved by selecting the designated Makassar New Port pool area. They are conducting a bathymetry survey using an echosounder tool.

b. Secondary data collection. Then, data was collected through interviews with the authorities at Makassar New Port.

c. Tidal Data Collection. Retrieval of tidal data to determine the average sea level at the Makassar New Port harbor pool. The tools used are measuring tanks.

d. The data that has been processed is then analyzed using methods selected from various literature taken as research reference materials.

3. Results

In calculating the sediment or dredging volume, bathymetry data, soil data, ship data, and so on are needed. Once obtained, calculations will be carried out, such as dredging volume. This calculation uses AutoCAD 2018, AutoCAD Civil 3D, and Microsoft Excel software.

The dredging volume calculation can also be calculated using the grid method in AutoCAD Civil3D software. The dredging volume obtained using the

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grid method is 2,100,000 m3. This writing uses the cross-section method because the use of the cross-section method is accurate for volume calculations.

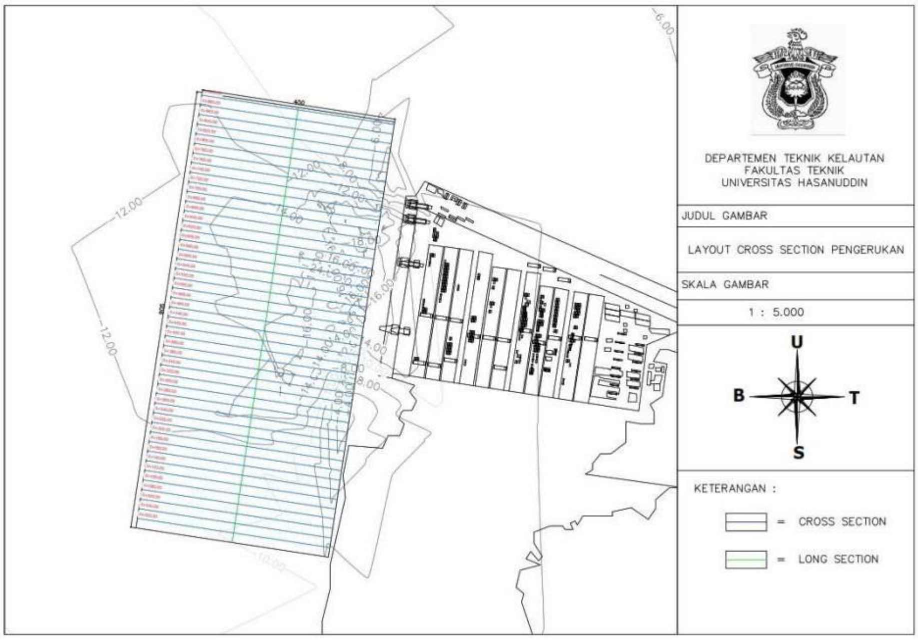

Fig.2. Dredging Area

After obtaining the cross-sectional area, the next step that needs to be done is to record the location of each cross-section area. Then look for the sediment volume based on the existing sites using Equation (2.32) or Simpson's Equation. It is because the number of sections is even. The area of each section starts from section 0+020 to section 0+900. In this final project, the calculation of sediment volume is assisted by Ms. software: Excel and AutoCAD Civil 3D 2018.

Section 0+020 has an area of 3,251.44 m2, and the location of the other sections can be seen in Table 4.1. Referring to Table 4.1, the total area multiplied by the Simpson factor from section 0+020 to section 0+900 is 293,064.671. After knowing the whole area multiplied by the Simpson factor, the total dredge volume in the following equation,

$$V = \frac{h}{3} x \sum A \quad (1)$$

$$V = \frac{20}{30} x 293.064,671\ m^2$$

$$V = 1.953.764,473\ m^3$$

The volume to be dredged for the ship berth area is 1,953,764.473 m3.

To determine the dredging method that can be applied at the Makassar New Port there are several factors to consider, namely soil data and the condition of the dredging area. The soil data is obtained from soil penetration test results using the Standard Penetration Test (SPT) method. The following is the soil penetration test data.

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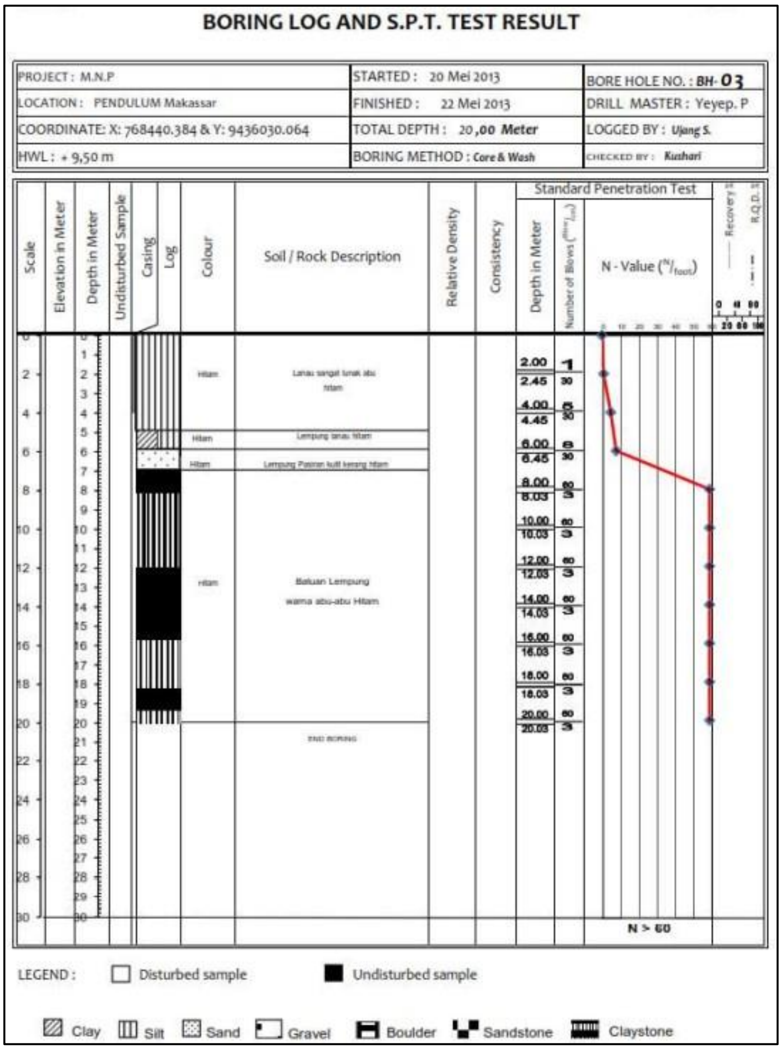

Fig.3. Makassar New Port soil test data

In Figure 3, the BH (boring hole) 03 soil data shows the UTM drilling coordinate points (x: 768440,384 and y: 9436030, 064), and the total boring depth is 20 m. It can be seen that the n-value of the soil, when dredged to a depth of ± 2 meters, is a type of silt soil (silts).

4. Discussion

Based on the calculation results of the dredge volume and the dredger capability criteria table (table 1), the selected dredger is the DAMEN Deep Cutter Suction Dredger 500 (DCSD500) dredger, as shown in Figure 4.

Table 1. Types of Dredgers and Types of Soil That Can Be Dredged (International Association of Dredging Companies)

Type of Soil			Type of Dredger				
Classification	State	N Soil	CSD	TSHD	Grab	Bucket	Dipper
Clay	Soft Mud	-4					
	Soft	4-10					
	Medium	10-20					
	Hard	20-30					
	Harder	30-40					
	Hardest	40-50					
Sand	Soft	-10					
	Medium	10-20					
	Hard	20-30					
	Harder	30-40					
	Hardest	40-50					
Clay with Gravel	Soft	-30					

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Rock	Hard	30-40		
	Softer	40-50		
	Soft	50-60		
	Medium			
	Hard			
	Hardest			
Gravel	Loose			
	Packed			

Fig.4. DCSD500 DAMEN ship

The following are the ship's specifications to be used for dredging, namely DCSD500 DAMEN.

Table 2. DAMEN DCSD500 Boat Specifications.

Name	DCSD 500		
Type	Deep Cutter Suction Dredger		
Dimension	Length Over All	46	m
	Length Over Pontons	28.5	m
	Beam O.A	9	m
	Draught	1.2	m
Dredger Features	Max. Dredging Depth	25	m
	Dredging Width	44	m
	Max. Mixture Capacity	4000	m

After the type of dredger is determined and the environmental conditions in the dredging area are known, then the dredging stages are planned. The dredging stages are as follows:

1. Determine the dredging flow to be carried out.
2. The dredger is brought to the location to be dredged.
3. Implement dredging by transporting material from the dredging area onto the ship to be channeled into a disposal pipe or collected in a hopper.
4. Dredged material is distributed to the dumping area, either using a pipe or a hopper.
5. The barge (hopper) will dispose of the dredged material at the disposal site using a discharge pipe, split barge, or the assistance of heavy equipment.
6. Conduct Post-Dredged Sounding. After the overall dredging is estimated to be complete, a bathymetry survey must be carried out in the dredging area. It is done to determine whether the dredging work is as planned.

After planning the dredging stages, then determine the dredging productivity. The productivity that will be considered is the dredger's productivity and the split hopper barge (SHB) or

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barge with an open storage tank. Several things, namely determine the calculation of the productivity of the dredger:

1. Determine Bulking Factor (bulking factor).
2. Determine the capacity of the dredger.
3. Determining Nominal Productivity (Pnom).
4. Calculate the factors that affect the dredger.
5. Total final productivity.

In dredging with a hydraulic dredger, the soil is mixed with water to become a slurry (soil slurry). Likewise, the ship used in this dredging, where the percentage of water content is 60% and the dredged soil content absorbed is 40%. So the productivity of the dredger is:

Productivity = Dredge capacity x dredged soil content (2)
= 4.000 x 40%
= 1.600 m^3 /hour

The variation in the dredging depth determines the productivity of the Cutter Suction Dredger(CSD), so a variable dredging depth (f_f) factor is needed. As for determining the amount of f_f, the calculation will be carried out as follows:

$$\frac{\text{working depth (d)}}{\text{max. depth for dredger } (d_{max})} = \frac{18\text{ m}}{25\text{ m}} = 0.72 \quad (3)$$

$$\frac{\text{working face (z)}}{\text{min. face } (h_{min})} = \frac{2\text{ m}}{1.5\text{ m}} = 1.9$$

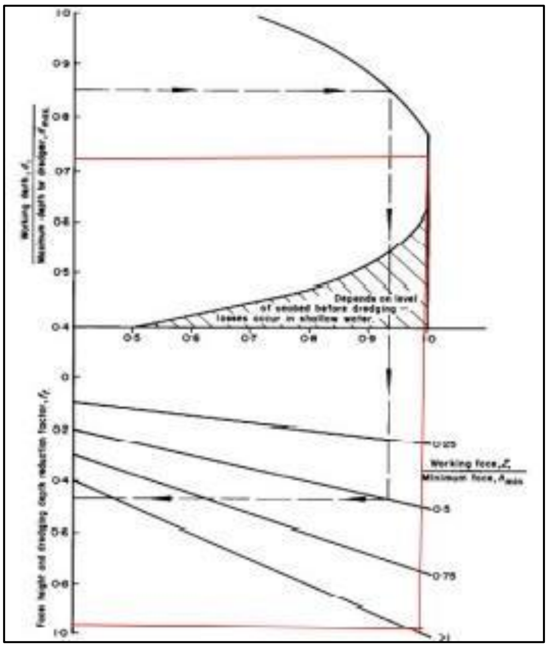

Fig.5. The Factor of Various Dredging Depth (f_f) [5]

Based on Figure 5, the graph of the Various Dredging Depth Factors (f_f), a value of 0.95 is obtained. So that the value of Nominal Productivity (P_{nom}) is:

P_{nom} = f_f x productivity
= 0,95 x 1.600
= 1.520 m3 /hour

Based on the above calculation, a P_{nom} value of 1520 m3/hour is obtained. To obtain the value of the delay factor due to anchor displacement (f_a) and the delay factor due to spud displacement (f_p), it must be multiplied by the P_{nom} value. The value of the delay factor due to spud removal and the delay factor due to the displacement of the anchor on the cutter suction dredger can be calculated as follows:

(4)

Where:
t_a = anchor transfer time (0,33 m)
z = anchor displacement distance
(80 m)p = the average dredging thickness
(2 m)b = dredge width (30 m)

Barge productivity is determined by the time cycle of dredging, namely loading time, traveling time, unloading time, and return time. The following is the productivity calculation of the split

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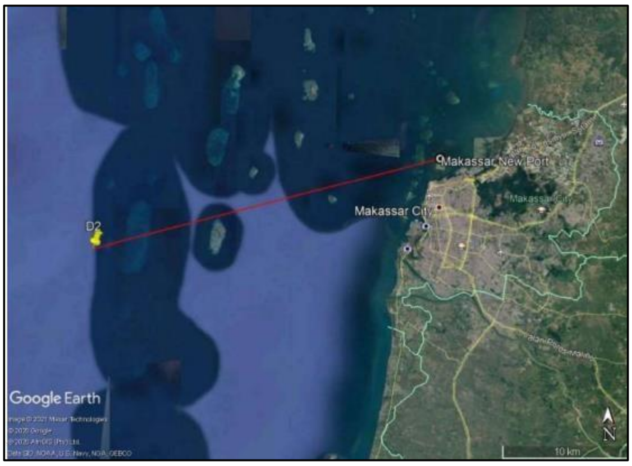

Fig.6. Dumping Area Location Point. (Google Earth)

The distance from the dredging location to the dumping area is 27 km. It has a speed of 10 knots (5.14 m/s) and assumes 5 knots (2.57 m/s) when the barge fully loads. So that the obtained traveling time is equal to.

1. Unloading Time
   According to the International Association of Dredging Companies, a split hopper barge works like a bottom door on a typical TSHD. Material removal time is carried out for 5-10 minutes. Discharge time 6 minutes (0.1 hours).
2. Return Time Calculation of return time is influenced by the distance to the dumping area and the barge's speed when it has no cargo. So the calculation of return time is:

So that the total cycle time required for the split hopper barge during dredging is:

Cycle Time = loading time + traveling Time + unloading time + Return Time
= 3,2 + 2,91 + 0,1 + 1,45
= 7,67 hour

In one cycle, there is some time when the dredger is not operating because it only uses one split hopper barge. So calculations are needed so that the dredger can function optimally. The analysis of the number of barges required for one dredger is as follows.

3. Conclusions

Based on the results of research and discussion, it can be concluded that:

1. The total volume dredged in the Makassar New Port pond is 1,953,764.47 m3.
2. The dredging method applied based on the analysis results is the Cutter Suction Dredger (CSD).The ship used is the Damen Deep Cutter Suction Dredger (DCSD) 500.
3. The total time required for dredging Makassar New Port is 349 days.

References

[1] Bray, R.N. Dredging: A Handbook for Engineers. Bedford Square, London. Edward Arnold Ltd, 1979.

[2] https://inaport4.co.id/branch/read/1/29, diakses pada tanggal 12 Juli 2020, Pukul 16.52 WITA.

[3] https://katadata.co.id/pingitaria/berita/60534 8e0ed33e/jokowi-dorongpembangunan makassar-new-port-jadi-hub-indonesia-timur, diakses pada tanggal 7 Juni 2021, pukul 02.37 WITA.

[4] Oktafiany, Devi,et.al. Analisis Volume dan Biaya Pengerukan Kolam Dermaga CPO (Crude Palm Oil) Ketapang Pelabuhan Pangkal Balam, Prosiding Seminar Nasional Penelitian dan Pengabdian Kepada Masyarakat, Fakultas Teknik Universitas Bangka Belitung, 2019.

[5] Triatmodjo, Bambang. Perencanaan Pelabuhan. Yogyakarta. Beta Offset Yogyakarta, 2009.

[6] Sahu, A. K., & Ingole, N. D. Numerical Modeling of Port Dredging and Impact Assessment on Estuarine Circulation. Ocean Engineering, 156, 141-157, (2018).

[7] Jay, D. A., Geyer, W. R., & Wiberg, P. L. The Influence of Tidal Range on Dredging in Estuaries. Estuarine, Coastal and Shelf Science, 85(2), 217-228, (2009).

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