

Dredging and Reclamation in Makassar Port Development Project

Sumardi

Managing Director of PT. (Persero) Pelabuhan Indonesia IV Wahyono Bimarso Technical Director of PT. (Persero) Pelabuhan Indonesia IV Edy D.M. Nursewan Sub Directorate of Port Facilities of PT. (Persero) Pelabuhan Indonesia IV

Abstract

Makassar port was nominated as one of the four gateways ports of Indonesia, which covers the provinces of East Kalimantan, Sulawesi, Maluku, and Irian Jaya. Thus, the government of indonesia intend to develop this port by constructing a new wharf, including dredging and reclamation works. The dredging work under the project was to remove very soft marine deposit lying widely in the project site approximately up to -20 meters, which was unsuitable for foundation of the wharfs structures, and all the dredged materials were transported and disposed at the designated offshore dumping site. Except sand replacement area reclamation work was performed directly on the extremely soft marine clay of 8 meters thickness, and total reclamation height was about 17 meters above the soft clay.

<u>Résumé</u>

Le port de MACASSAR a été retenu comme l'un des quatre ports d'entreé en Indonésie. Il dessert la province de Bornéo est et les iles Celebes, les iles Mouluque et la Nouvelle Guinée ouest. L'Indonésie a l'intention de le développer en le dotant de nouveaux appontements, qui nécessitent des travaux de dragage et d'assèchement conséquents. Les dragages nécessaires au projet consistaient à enlever des sédiments marins de consistance très molle. Ceci interesse toute l'étendue d'implantation du site projeté, jusqu'à la cote – 20 mètres. Ceci ne convenaient pas pour les fondations de la structure des appontements. Les matériaux ainsi dragués étaient transportés et mis en dépôts sur un site d'accueil offshore.

Sauf pour les travaux d'assèchement de la zone où le sable est substitué qui sont réalisés directement sur la couche d'argille molle de 7 mètres, la hauteur nécessaires aux travaux d'assèchement étaient du 17 mètres au-dessus de la couche d'argile.

1. General description of port of makassar

Port of Makassar located in the province of South Sulawesi, is the main port under the authority of The indonesian port corporation IV. It is located between 05° 08'08" S and 119° 24'02" E. From domestic shipping line point of view, this is a very strategic location because it connects the western and the eastern part of Indonesia, while for outbound shipping line it will be quite prospective in the

future time since it is located in the south end of Makassar Strait which is one option for international ships sailing through it. (Figure 1).

Most of hinterland potential is still dominated by agricultural and wood products, yet in last several industrial sector was spurred through the existence of Makassar industrial zone (KIMA) and processing industries in some regencies in South Sulawesi. Rice, corn, beans, rattan, cocoa, flour are some of inter-island commodities move through Port of Makassar. Cocoa, sea product, plywood and cashew nuts are the dominant commodities directly exported to Japan, Singapore, China, Korea and India.

To anticipate increasing cargo loading and unloading volume in the port, especially containers it is necessary to keep improving port of Makassar's facilities and infrastructures. Currently, the port is being developed by construction of a 850 m full-container berth with container yard and its facilities, which is funded by OECF Japan. The project has been completed in October 1997 which can accommodate approximately 360,000 Teu's of containers.

The increase of development activities without considering meticulously environmental factors will induce cistly risk or damages to the environment. Imbalances in one or several environmental components may obstruct the ecosystem function entirely. Therefore the construction should be carried out judiciously in example by considering ecological principles and should be environmental concept.

The environmental concept development is expected not only beneficial at this moment, but also for the next future. Hence the expected development is a sustainable and harmonious development. The discretion of environmental concept development has been covered in the guidelines of state policy, it is stated that in the development, we expect that there will be a harmonious relationship between human and his environment. Studies of Port of Makassar concerning preliminary studies, environmental impact assessment, environmental impact management plan, environmental impact monitoring plan and environmental survey have been conducted in effort to cater the provisions of environmental laws and to achieve the environmental concept development.

2. Description of port of makassar activity

2.1. General Condition

2.1.1. Port working and interest area

Port of Makassar is supported by availability of land and waterways area determined by the decision of South Sulawesi Governor no. 27/KPPS/VIII/BKPMD/93, stated that the waterways area of Port of Makassar is 1,467.20 ha and the working area of Port of Makassar is 50.78 ha.

Port of Makassar consist of three quays, Soekarno Quay for general cargo, bulk cargo, multi purpose and passenger terminal, Hatta Quay for container and multi

purpose terminal (began in the middle of the year 1997), and local and traditional vessels are handled at Paotere Quay.

Also some industries are installed within port area, such as :

- a. Tonasa Packing Plant, having 4 silos each of which 6,000 ton capacity. The production is expected to reach 6,000 tons/year in the middle of the year 1997.
- b. Pertamina Oil Terminal, which is supplies the need of oil in South Sulawesi.
- c. Berdikari Flour Mill, to fulfil the domestic and export of flour that reach 175.000 tons/year.

2.1.2. Port facilities

The intensity of activity and capacity of port services will greatly be influenced by the condition of facilities owned by the port. The following tables contain the available facilities in the port of Makassar.

2.1.2.1. Soekarno quay facility

a. Main wharf	
- Depth	- 9 LWS (Low
	water spring)
- Elevation	+ 3.1 LWS
- Length	1,360 m
b. Stacking facility	
- Yard	
Hotmix construction	$17,786 \text{ m}^2$
Paving block construction	$25,737 \text{ m}^2$
- Shed	$4 X 3,800 m^2$
	$1 X 4,000 m^2$
c. Passenger terminal	3,619 m ²
d. Water Source	
- Loading Capacity	1,100 tons
- Supply Capacity	200 t/h

Table I : Soekarno quay facility

2.1.2.2. Hatta quay facility

a. Container wharf (caisson con	struction)
- Depth	- 12 LWS
- Elevation	+ 3.5 M LWS
- Length	490 m
b. Multi purpose wharf	
- Depth	- 12 LWS
- Elevation	+ 3.5 M LWS
- Length	360 m
c. Stacking facility	
- Yard	
Paving block construction	$75,000 \text{ m}^2$

Table II: Hatta Quay Facility

2.1.2.3. Paotere quay

- Depth	- 2.5 - 4 LWS
- Elevation	+ 2.5 - 3 m LWS
- Length	520.50 m

Table III : Paotere Quay

3. Development plan of port of makassar

3.1. Economic growth of South Sulawesi

Based on the sixth of five year development plan of indonesian government (PELITA VI), the economic growth of South Sulawesi yearly was predicted at least will be 7.13%, while the investment estimated approximately 15,776 trillion rupiahs or 18.45% increase.

The economic growth will be supported by the increasing of 12.24 % in industry sector, 7.12 % in trade sector, 6.81 % in transportation and communication sector per annum.

At the end of PELITA VI all of the sector's growth forecasting will become respectively 12.11%, 18.2% and 8.6%.

3.2. Master plan of Makassar Port

Master plan of Makassar Port is divided into 3 stages, which are :

Stage 1 : Year 1997 - 2003 Period (figure 2)

- (1) Optimalizing the existing condition of Makassar Port, at the end of the rehabilitation project.
- (2) Soekarno quay handle the general/bag cargo, dry bulk, passengers.
- (3) Hatta Quay handle the container cargo and multipurpose and ro-ro.
- (4) Preparation of in-land container depot (5 ha).

Stage 2 : Year 2003 - 2008 Period (figure 3a)

- (1) Prepare the area for industry estate by reclaimed from the Hatta Quay until Lae-Lae island with joining 3rd party.
- (2) Complete the facilities for the reclaimed area.
- (3) Build a new passenger quay along 400 meter with the passenger building and park area.

Stage 3 : Year 2008 - 2018 Period (figure 3b)

- (1) Build a new general cargo berth beside the passenger berth length of 600 meter at the reclaimed area (Lae-Lae island).
- (2) Build the support facility at the area of Lae-Lae island to support handling of general cargo activity.
- (3) Hatta quay to be a full container berth.

4. Makassar port development project

4.1. Scope of the work.

The Makassar port development project is called Ujung Pandang Port Urgent Rehabilitation Project, financed by OECF Loan IP-355. The project started on May 1994, has been completed on October 1997. The main major works of the project are as follows:

No	Items	Volume
1	Main quay wall (Concrete caisson type)	850 m in total
	consist of : - container berth	490 m
	- multipurpose berth	360 m
2	Small ship quay (Concrete block type)	154 m
3	Ro-Ro Berth (Concrete block type)	60 m
4	Revetment	283 m
5	Dredging	1,611,479 m ³
6	Sand replacement & reclamation	$2,148,000 \text{ m}^3$
7	Gantry crane rail	500 m
8	Rebuilt revetment	30 m
9	Building Works	
	- Container Freight Station	4000 m^2
	- Work shop (1 unit)	750 m^2
	- Administration Building (1 unit)	455 m^2
	- Container/cargo gates	800 m^2
	- Other Buildings (3 units)	256 m^2
10	Pavement works (Asphalt, cement	136,000 m ²
	concrete, interlocking concrete block)	
11	Utility works	
	- Water supply	
	- etc.	
	- Fire Fighting System	
	- Refers Container	
	- Sewerage System	
	- Power Supply & Yard Lighting	
	System	
	- Ship Bunkering System	
	- Telecommunication System	
	- Fire Alarm System	
12	Miscellaneous works	
1	- Fence	
	- Weight bridge	

Table IV : Scope of the works

4.2. Construction Method.

4.2.1. Dredging work

4.2.1.1. Dredged area

Dredged area in the project are small ship quay, ro-ro berth, main quay wall, caisson foundation (trench for transition rubble and sand replacement) and reclamation area.

4.2.1.2. Equipment

Grab dredger fleet	
- 1 unit grab dredger	18 m ³
- 1 unit pusher tug boat	250 GT - 3200 ps
- 2 units hopper barge	$1,200 \text{ m}^3 \text{ and } 1500 \text{ m}^3$
- 1 unit anchor boat	330 ps
- 1 unit survey and transport boat	

4.2.1.3. Execution

Upon completion of demolition work at small ship quay and ro-ro berth area, dredging work was began.

The concept plan of dredging work are :

- Dredging and disposal of spoils was 24 hours operation
- During dredging operation, safety measures such as marker buoys for identification of working area, safe guard was provided and maintained.
- Dredging operation was carried out to keep the area and depth to be dredged taking into consideration of tolerance as following.
- The dredging was performed to the levels and slopes within the following tolerances: Flat area (except level I dredging of -23 m): + 0 cm

- 70 cm

The dredging for level I (-23 m) was so performed as to remove all the soft materials recognised unsuitable for foundation material by the engineer, and scour the base rock.

The dredged material then have to be dumped to a chosen area, and during the dumping operation, following measures were taken

- a. The hopper barge was carefully operated to avoid the interference of the other navigational vessels. Route for navigation of hopper barge was decided under the consultation and order of the concerned navigational authority.
- b. Dumping of spoils was spread evenly as much as possible in the disposal area.
- c. Silt screen was considered to provide at the position of dumping site if necessary.
- d. During dumping operation, environmental monitoring was carried out periodically at the designated location where was approved by the engineer.

4.2.2. Reclamation Work

Reclamation work began after partially completion of dredging for small ship quay, ro-ro berth, and main quay wall, approx. 100 meters. North end of main quay wall was the first location and the work was towards to southern direction.

4.2.2.1. Sequence of Reclamation work :

After being taken from a proposed sand borrow area, the work then was divided into 3 major components which related to the other works such as dredging, transition rubble and main quay wall.

- 1) 1st step is following the sand replacement. Reclamation was carried out until certain level where level was determined by monitoring of sand shape after dumping to avoid any disturbance for backfilling and dredging.
- 2) 2nd step is after completion of backfilling, reclamation up to -3.5 m (determined by draft of hopper barge) was carried out.
- 3) 3rd step is from -3.5 m to final level was reclaimed by micro cutter suction dredger which handle the reclamation sand done by the second step. Then, final levelling was carried out (figure 4).

The following sequence was taken for reclamation work :

Selection of sand borrow area, soil investigation, sand material, transportation of borrowed sand, dumping borrowed sand to reclaimed area, direct dumping by hopper barge (dumping up to -3.5 m LWS), and suck up material by suction dredger (temporarily dumped in front of dredger, and reclaimed from -3.5 m to final)

4.2.2.2. Equipment

The following equipment employed :

1. Grab Dredger Fleet	
a. Grab dredger	8 m ³ - 1,200 ps
b. Tug boat	350 ps
c. Hopper barge	450 m ³ x 2
d. Anchor boat	260 ps
2. Cutter suction dredger fleet	
a. Cutter suction dredger	390 ps (main pump)
- Ø discharge pipe	300 mm
- max. discharge distance)	800 m (max. discharge distance)
b. Anchor boat	30 ps. 3 ton hoisting
3. On Land Equipment	
a. Bulldozer	21 ton and/or 16 class

b. Backhoe		0.4 m ³ class]
	Table IV : The	equipment employed	-

4.2.2.3. Execution

1) Selection of sand borrow area :

Prior to the beginning of reclamation work, intended sand borrow area was checked by soil investigation in order to the suitable material and quantity for reclamation.

Samples of material were tested in collaboration with an engineer. At the same time such samples and test data were submitted to the engineers for approval.

2) Dredging Operation :

Dredging operation started after obtaining the approval for the location of borrow area.

Dredging of borrow sand was 24 hours operation, during dredging operation, safety measures such as marker buoys for identification of working area, safety lighting system were provided and maintained.

Dredging operation was carried out in compliance with the specification so as to keep the area and depth to be dredged taking into consideration that avoiding over dredging of the area and depth given from soil investigation result in order to prevent the dredging of the unsuitable material.

3) Transportation and dumping of materials

Dredged material was loaded onto hopper barges having its capacity of 450 m³ towed by tug boat to the reclamation site. Dumping was started from north end of main quay wall to south.

4) Sequence of reclamation (Figure 5)

Materials so transported was dumped directly up to -3.5 meter C.D.L, because of the draft of hopper barges. Dumping of reclamation materials were spreaded evenly as much as possible in the reclamation area.

As a first step of reclamation, dumping was carried out from north end of reclamation area (at small ship quay side) towards the south revetment direction.

Upon finishing the first step of reclamation (up to -3.5 m; direct dumping by hopper barge), the final step was carried out so as to suck up to the material by cutter suction dredger positioned in the reclamation area.

Borrowed material was dumped just in front of suction dredger in order to dredge easily.

Operation at the mouth of discharge pipe (on land) was controlled by bulldozer and backhoe for prevention of overflow of material to the outside of the reclamation area, final levelling was carried out after the completion of reclamation work.

4.2.3. Reclamation monitoring

Reclamation monitoring was conducted by installing the settlement plates, which fabricated by steel plates and tube. Each plate was marked and large red flag and/or flashing light provided for securing and the data were taken at site once a week.

Inclinometers were installed at the location and depths directed by the engineer and were of the type approved by the engineer.

Detail of monitoring work was consulted with the engineer and submitted to the Engineer for approval prior to the beginning of the reclamation work.

Abbreviations and Symbols

GT	= Gross Tonnage
ps	= Power Source (± 1.1 Horse Power)
PELITA	= Pembangunan Lima Tahun (Five Year Development)
ro-ro	= Roll on roll off
LWS	= Low Water Spring
Teu's	= Twenty Equivalent Unit

Fig. 1 : Ujung Pandang project site





a) Existing : 1997



b) 2003 : Project

Fig. 2 : MASTER PLAN OF PORT OF MARASSAR PERIODE 1997 - 2003





Fig. 3 : MASTER PLAN OF PORT OF MAKASSAR PERIODE 2008 – 2018





