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# Fish Terminal Design To Reduce Fishermen Operation Costs In Banda Island

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## Abstract

One of the islands in the Maluku province is a cluster of the Banda Islands. The Banda sea is known as the waters are very rich in various kinds of fish. The center for Economic Development-LIPI (1999) has calculated the average time fishermen go out to sea in a year as many as 200 days, that entire day, which allowed her to sea. Therefore, at the time of going to sea fishermen use the time optimally to work throughout the day so that it will drain the operational cost and energy fishermen to return to the coastal areas bring their catch to that required terminal of the fish. Terminal fish serves as a place of temporary suspension to raise and lower the catch fishermen so that it can maintain the quality of the catches of fishermen to the place of destination. The purpose of this study is to design the terminal of fish to help fishermen. Carried out technical calculations such as the determination of the payload, the volume of cargo space, electricity needs, trim, stability, and freeboard. As for the size of the main result is Lbp is 81,19 m, B is 15,00 m, H is 7,00 m, and T is 5,50 m, and the cost of the construction of the terminal fish Rp 85,053,530,160.11

**Keywords:** Terminal Fish, Design, Fishing, Operational Costs

## 1. Introduction

On the second pillar of the world maritime axis, which is committed to maintaining and managing marine resources with a focus on building seafood sovereignty through industrial development by placing fishermen as the main pillar.

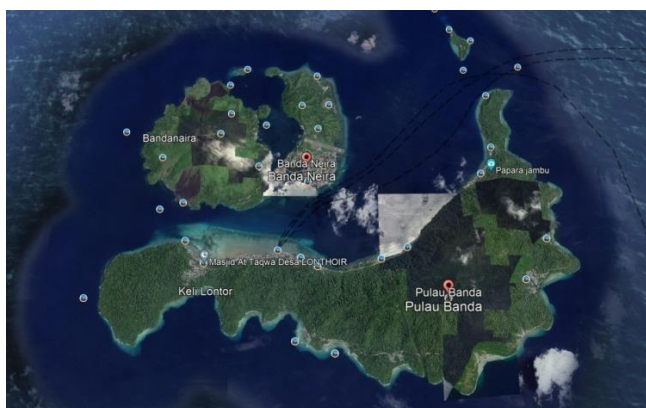
Based on Law no. 45 of 2009 is meant by fishermen are people whose livelihood is fishing. The Research and Development Center for Economics and Development-LIPI (1999) has calculated the average time fishermen go to sea in a year as much as 200 days, namely all days that allow them to go to sea. In general, fishermen go to sea for 5-6 hours in one trip (*one trip*). They leave at 05.00 am and return at 10.00-11.00 [1]. During the fishing season, fishermen can go to sea 2-3 times a day. On the other hand, fishermen usually don't go out to see when it's moonlit or the weather is bad.

Therefore, when fishing, fishermen use their time optimally to work all day so that it will drain operational costs and fishermen's energy to return to the coast with their catch. Not to mention if the catch is not on target or has not even caught fish at all, so fishermen go to sea again to other places whose distances cannot be determined according to the potential of each area.

Based on data from the Central Statistics Agency regarding capture fisheries production by province and type of capture (marine fisheries and public waters), Maluku province is in first place with a total in 2018 of 603,000 catches [2]. As an archipelagic province, Maluku has an area of 581,376 km<sup>2</sup> which consists of an ocean area of 527,191 km<sup>2</sup> and a land area of 54,185 km<sup>2</sup>. In other words, 90% of Maluku province is the ocean in which there is potential for fishery resources of 1,640,160 tons/year according to the results of a

study by the Marine and Fisheries Research Agency in collaboration with the Center for

Oceanology Research and Development of the Indonesian Institute of Sciences (LIPI) in 2001 [3].



**Fig. 1.** Map of Banda Islands [4]

One of the islands in Maluku province is the Banda Islands group. The Banda Sea stretches widely between a series of islands in Maluku and Sulawesi. The main livelihoods of the Banda people are fishermen, about 85% of the population. Luat Banda is known as water that is very rich in various types of fish.

To reduce operational costs while at sea and streamline the time and energy of fishermen, a fish terminal is needed. The fish terminal serves as a temporary stop for raising and lowering fisherman's catch to maintain the quality of fisherman's catch to their destination. In addition, it can reduce the operational costs of fishermen when they have to return to the coast.

The operational costs in question include the amount of expenditure needed by fishermen when going to sea, the need to support fishing activities. During the fishing season, fishermen can trip 2-3 times a day which of course requires even greater operational costs. Based on the problems above, the authors are interested in conducting research related to "Design of Fish Terminals to Reduce Fishermen's Operational Costs in the Banda Islands"[5][6].

## 2. Literature Review

### 2.1 Fishermen

Of Indonesian Capture Fisheries Statistics classifies fishermen based on the time used to carry out their fishing operations, namely as follows:

1) Full fishermen, namely fishermen whose entire working time is used to carry out fishing operations for fish/other aquatic animals/water plants.

2) Main part-time fisherman, namely fisherman whose most of his working time is used to carry out fishing operations for fish/other aquatic animals/water plants. In addition to doing fishing work, fishermen in this category can also have other jobs.

3) Additional part-time fishermen, namely fishermen who use a small part of their working time to do fishing work.

### 2.2 Terminal

The terminal is one of the components of the transportation system which has the main function as a temporary stop for public transportation to raise and lower passengers and goods so that they reach the final destination of a journey, as well as a place for controlling, supervising, regulating, and operating the flow system for passenger transportation and transportation. goods, besides that it also serves to expedite the flow of passenger or goods transportation (Ministry of Transportation, 1996).

### 2.3 Mooring System

A mooring system or mooring system is used to prevent ships or floating structures from moving freely at sea. There are several types of mooring systems, including [7]:

1. Spread Mooring System, which is a mooring system with more than one mooring point. The moorings can be directly attached to the ship, however, special mooring ropes and modifications of the hull construction are required for reinforcement of the parts connected by the mooring ropes.
2. Turret Mooring System is a system where there

turret that connects ships and mooring ropes to the seabed. the turret can rotate 360o' so the ship can rotate about the axis of the turret following the water current. The turret follows the water flow. The system can be installed inside the hull structure (internal turret) or at the bow of the ship above the waterline (external turret).

3. Tower Mooring System, is a system where there is a tower structure permanently moored to the seabed, then the ship is connected to the tower with a hawser or wishbone. The tower structure can rotate.

### 3. Research Methods

#### 3.1 Literature Study

Topics studied in the literature study were determining the dimensions of the building, designing a 3D floating fish terminal using SketchUp software, and calculating displacement using the Maxsurf Modeler.

#### 3.2 Data Collection The Data

Used for this design is secondary data. Secondary data is obtained from the internet, such as the website of the Central Statistics Agency and digital journals. This secondary data is used to determine the location of the fish terminal and its payload.

#### 3.3 Determination of Operation Location, Payload, And Main Size The

Collected data is processed to determine the operating location and ship payload. Determination of the location of operations in terms of the depth of the sea and the location of the nearest fishing center. Payload determination is done by forecasting the statistical data obtained. The main size is obtained by trial and error by making compartment planning and layout design that is adjusted to the payload, clan rules, and facility

specifications at the floating terminal.

#### 3.4 Technical and Regulatory

Analysis Technical analysis consists of three stages, namely coefficient calculation, powering calculation, LWT, and DWT. Regulatory checks consist of trim checks, stability checks, and freeboard checks.

#### 3.5 Design

The design phase in this research includes the design of Lines Plan, General Arrangement, and 3D models. Lines Plan and General Arrangement designs were made with the help of the AutoCAD Student Version application. The 3D models were created with the AutoCAD Student Version application and the layouts were created with Sketchup Free.

### 4. Overview Of Operating Areas

Geographically, the Banda Islands are located at coordinates 129° to 130° East Longitude and 5° to 6° South Latitude. The total area of the Banda Islands is 2,568 km<sup>2</sup>. With a land area of 180.59 km<sup>2</sup> and an ocean area of 2,387.51 km<sup>2</sup>. The Banda Sea stretches widely between a series of islands in Maluku and Sulawesi.

The location of terminals selected fish in the coordinates are 4°31'18.55"S and 129°53'54,30"T. the consideration of this location is the depth of the sea is a shallow sea (about 20-50) and is centered on fishing in the surrounding area.

### 5. Technical Analysis

#### 5.1 Payload Determination

The formula to get the payload is

$$\text{Payload} = \text{displacement} - \text{LWT} - \text{supply} \quad (1)$$

**Table 1.** The Calculation Of The Payload

Formula	Calculation
Displasment	5279,14
LWT	1369,14
Supply	232,29
Payload	3677,71

#### 5.2 Determination Of Initial Main Size

Based on the results of the dimensional determination analysis carried out, the following

results were obtained:

**Table 2.** Ship Design Data After Optimization

Layout	Dimensions	Size	Unit
Length	Lbp	81,19	m
Width	B	15,00	m
Ship Load	T	5,50	m
Height of Ship	H	7,00	m
Froude Number	Fn	0,219	m
Freeboard	Fb	1,50	m
Displament	Displ	5280,91	ton
Vessel Volume	V	5131,58	m <sup>3</sup>
	GRT	3910	ton
	Vs	12	Knot
	Lwl	83,22	m

### 5.3 Determination Of The Loading Space Volume

For the loading space volume obtained from the calculation results:

$$(C_b \times 0,85 \times H) = C_b + ((0,85 \times (H-T)) / (10-T)) \quad (1)$$

Where  $C_b$  is block coefficient,  $H$  is ship height and  $T$  is ship draft. So from the calculation of several components, the results are obtained as shown in table 3.

**Table 3.** Calculation of Loading Space Volume After Optimization

Room	Area	Unit
Area of the ship's center cross section	81,382	m <sup>2</sup>
Ivory distance Normal	0,6424	m
Bulkhead clearance Forepeak recesses from Forepeak	4,060	m
Recesses from Afterpeak	2,570	m
Length	9,0	m
Double bottom	1,03	m
Space length	31,19	m
Cargo area	103,58	m <sup>2</sup>
Double bottom area in the midship	15,17	m <sup>3</sup>
The Volume of cargo space	6237,22	m <sup>3</sup>

### 5.4 Weight and Center of Weight of Floating Fish Weight

Calculations were carried out to calculate the DWT (Deadweight Tonnage) and LWT (Lightweight Tonnage) of the fish terminal. The LWT weight consists of construction weight, machinery weight, and equipment and outfitting weight at the fish terminal. The weight of the DWT consists of the weight of the payload, crew, and consumables.

After the LWT and DWT weights are calculated, the next step is to correct the displacement. Displacement correction was carried out to confirm that the terminal fish could float with the difference

in weight between the amount of LWT + DWT and the displacement was still within the margin of 2% - 10% displacement. The results of the displacement correction can be seen in Table 4.

The terminal center of gravity of fish was calculated for each weight component of LWT and DWT. The calculated center of gravity distance is LCG (Longitudinal Center of Gravity) which is measured from the base of the fish terminal. The recapitulation of the center of gravity can be seen in Table 4.

**Table 4.** Recapitulation of Center of Weight

Item	Weight	Unit
Component LWT		
Weight of Steel	857,37	ton
Weight of Equipment and Equipment	375,58	ton

Item	Weight	Unit
Weight	136,20	ton
Component DWT		
Fuel Weight	135,1590	ton
Weight Lubricating Oil	0,474320	ton
Fresh Water Weight	67,90300	ton
Crew Weight	1,4250	ton
Provision Weight	0,600	ton
Diesel Oil Weight	27,031793250	ton

### 5.5 Trim Analysis

Trim optimization is one of the easiest and cheapest methods of optimizing marine building

performance. The analysis is as in the following table.

**Table 5.** Recapitulation of Center of Weight

Waterline	Lwl	Bwl	Twl	1	1'	1''
0	90,05 m	5,95 m	0,00 m	4,06 m	2,7 m	
1	89,2 m	7,43 m	0,92 m	4,06 m	1,30 m	1,00 m
2	90,45 m	7,45 m	1,83 m	4,06 m	1,60 m	1,28 m
3	90,65 m	7,45 m	2,75 m	4,06 m	1,88 m	1,10 m
4	91 m	7,45 m	3,67 m	4,06 m	2,05 m	1,10 m
5	93,1 m	7,45 m	4,58 m	4,06 m	2,23 m	1,95 m
6	96,89 m	7,45 m	5,50 m	4,06 m		1,20 m

### 5.6 Stability Analysis

Ship stability is calculated based on preliminary planning data or what is often known

as preliminary stability. The results of the analysis are shown in the following table.

**Table 6.** Recapitulation of Center of Weight

Criteria	Results	Unit
The point of Buoyancy (Buoyancy) of the Keel	3,00	m
Point Metacentra from A Buoyancy	2,96	m
High Point Metacentra of the Keel	5,95	m
Is the Weight of the Keel	4,76	m
High Point Metacentra from A Ship Weight	1,19	m
The Period Of Shaky	10,46	s

### 5.7 Freeboard Analysis

The corrections that apply to this ship are ship corrections for shipshape coefficient correction, namely block coefficient, midship coefficient,

waterline coefficient, and prismatic coefficient. Freeboard correction recapitulation can be seen in Table 7.

**Table 7.** Summary The Calculation Of Freeboard

Coefficient of Ship Shape	Dimension	Result
Block coefficient	Cb	0,75
coefficient Midship	Cm	0,99
coefficient Waterline	Cw	0,84
Prismatic coefficient	Cph	0,76
Prismatic coefficient	Cpv	0,89

### 5.8 Determination of the Mooring System The Mooring System chosen for the fish terminal is

the spread mooring system type. This type uses mooring devices placed around the perimeter of

the vessel to limit the movement of the fish terminal. The advantage of this mooring system is that its construction is easy and cost-effective.

The type of mooring system chosen is catenary with an 8-line symmetric spread mooring type arrangement. The selected mooring line is a steel chain and the selected mooring anchor is a stockless anchor type.

5.9 Final Main Size

After the technical analysis was carried out, the

final main size of the terminal fish was Lbp is 81.19 m, B is 15.00 m, H = 7.00 m, and T is 5.50 m.

5.10 3D Model

Design Making the design on the 3D model building above using the Sketchup software. The method of this research is to model the building and its facilities. Modeling is intended to provide visuals of 3D objects so that they resemble the original, using the Sketchup application modeling can be directly designed both interior and exterior.

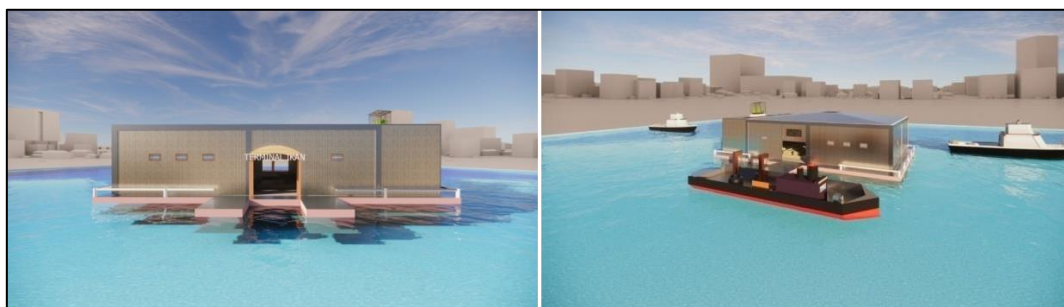


Fig. 2. Fish Terminal Design

5.11 Calculation of Development

Costs Operational costs in question include the amount of expenditure needed by fishermen when fishing, the need to support fishing activities. The operational costs per boat are around Rp.1,500,000 - 2,500,000 for the purchase of 150-200 liters of diesel per boat, the purchase of bait, and other unexpected costs.

The cost of machining, construction, and

outfitting is obtained by estimation. The price of other equipment is calculated by adding up the price of each unit. The total development cost is subject to 10% VAT and 15% PPh. In addition, it is assumed that the inflation adjustment value is 5%. The recapitulation of development costs can be seen in Table 8.

Table 8. Recapitulation

Total Building Cost	Rp 65,425,792,430.80
Value Added Tax (PPn) 10%	Rp 6,542,579,243.09
Income Tax (PPh) 15%	Rp 9,813,868,864.63
Inflation Rate	Rp 3,271,289,621.54
Total Adjustments	Rp 19,627,737,729.26
Grand Total	Rp 85,053,530,160.11

6. Conclusion

The conclusions obtained from the design of the fish terminal on Banda Island are as follows:

1. The fish terminal location is found at coordinates 4°31'18.55"S and 129°53'54.30"T
2. The final size of the fish terminal is Lbp is 81.19 m, B is 15.00 m, H is 7.00 m, and T is 5.50 m.
3. Obtained payload is 3677.71 and displacement is 5279.14
4. From the results of technical calculations, it is concluded that the operation of the fish terminal

meets the standard.

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