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Technical Analysis of Tambak Lorok Traditional Fishing Vessel Which has a Length of 5.5 Meters

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ABSTRACT
The majority of traditional fishing boats in the Tambak Lorok area are still built traditionally. Their knowledge is still derived from the benchmark of hereditary inheritance which allows for differences in characteristics from a technical point of view when viewed from an academic perspective. Therefore, it is necessary to review from the academic side by analyzing technical aspects which include resistance, stability, and ship motion. Before the analysis is carried out, conduct direct interviews with fishermen in Tambak Lorok and take measurements of the vessels to obtain some data. Furthermore, the data is inputted using the Maxsurf Modeller software to obtain the hull form model. Then analyze from a technical point of view including resistance, stability, ship motion using software Maxsurf Resistance, Maxsurf Stability, Maxsurf Motion. From the results of this study, the traditional fishing boat Tambak Lorok has a resistance value of 0.6 kN at a speed of 7 knots, has a fairly good stability value seen from the results that still meet the criteria determined by IMO, the ship's motion still meets the Tello 2009 standard which determined with the largest value for rolling at a speed of 0 knots and 7 knots at a heading angle of 900 at 4.54 deg, and the largest pitching value at a speed of 7 knots at a heading angle of 0 at 2.77 deg.

Keywords: Traditional Fishing Vessels; Resistance; Stability; Movement

1. INTRODUCTION

Tambak Lorok is a village or hamlet located in Tanjung Mas Village, North Semarang District, Semarang City, which is divided into two areas, namely Tambak Rejo and Tambak Mulyo. This village is located on the coast of the Java Sea, which makes fishermen the majority of the profession's source of economic income from residents. From this, Tambak Lorok has long been known as the largest fishing settlement in Semarang City. Which makes the Semarang City Government make it a Tambak Lorok Marine Village.

There are still many traditional fishing boats in Indonesia that use wood, which fishermen from all over the archipelago have used as a tool to catch fish at sea. The majority of traditional fishing boats at Tambak Lorok Semarang are still built in a traditional manner, whose knowledge still comes from hereditary standards, instincts, and learning from natural adaptations because the boats are built to adapt to local sea conditions. Although the shipbuilding does not use modern shipbuilding theory, the shape of the building design and the hull of the traditional Tambak Lorok fishing boat still looks physically identical to one another, only differing in scale. So it is necessary to take a certain approach and adjust to current technological developments to achieve better performance [1].

In 2020, research on the technical analysis of slerek-type fishing vessels will be conducted. At a maximum speed of 7 knots, the ship has a total drag of 12.3 kN. The results of the analysis of ship motion at an altitude of 0.75 meters, the greatest rolling and pitching values occurred at the angle of 90 and 180 of 2.18 deg and 0.84 deg. At a height of 1.25 m, the highest rolling and pitching values occur at angles of 90 and 180 of 3.61 deg and 1.39 deg. The results of the ship stability analysis show that the ship still has good stability which is explained by the GZ value that still meets the IMO criteria [2].

In another study, an analysis of ship motion with Criteria on Seakeeping Performance according to Tello explained that the rolling and pitching motions on ships met the maximum threshold of 6 degrees and 3 degrees [3]. Another study on analysis by the motion of traditional fishing vessels in Batang using the Tello criteria as the standard for maneuvering showed that the higher the ship's amplitude is directly proportional to the greater the possibility of water entering the ship's deck [4].

In research on the analysis of the effect of changing fishing gear on the Juwana trawler, it is known that the stability value of the trawler is still better than after changing fishing gear [5]. Furthermore, in another study regarding the analysis of the motion of PVC fishing boats, it is known that the largest rolling value at a heading angle of 900 is 5.81 deg, for the pitching value at 1800 with a value of 1.2 deg [6].

So based on the explanation above, this study will analyze the performance of the traditional fishing boats in Tambak Lorok from a technical point of view which includes resistance, stability, and ship motion to determine whether traditional fishing vessels in Tambak Lorok still meet the predetermined criteria or not.

2. METHOD

The method used in this research is to analyze the performance of the traditional fishing boat Tambak Lorok by paying attention to changes in the condition of the load, the speed of the ship, and the angle of the wave heading. The results of this study include resistance, stability, ship motion obtained from the analysis of the performance of the traditional fishing boat Tambak Lorok.

2.1. Ship Modelling

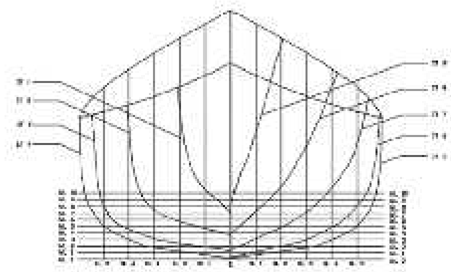
The object of this research is the traditional fishing boat Tambak Lorok with Gillnet Millennium fishing gear. Before modeling the ship for further analysis, it is necessary to measure the ship directly to get the main size of the ship. In the following Table 1 shows the dimensions of the ship obtained after measuring the ship directly on the spot.

Table 1. Principal Dimension

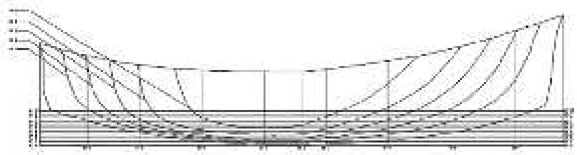
No	Principal Dimension	Value
1	*Length of Overall* (LOA)	5.5 m
2	*Breadth* (B)	1.68 m
3	*Depth* (H)	0.77 m
4	*Draft* (T)	0.36 m
5	*Speed* (Vs)	7 knot
6	*Coefficient Block (Cb)*	0.35

Figure 1 shows the Lines Plan of the ship, including the Body Plan, Sheer Plan, Half Breadth Plan, and also the ship model, and Figure 2 shows the traditional fishing boat of Tambak Lorok.

a). *Body Plan*



b). *Sheer Plan*



c). *Hal Breadth Plan*

d). Ship Modelling

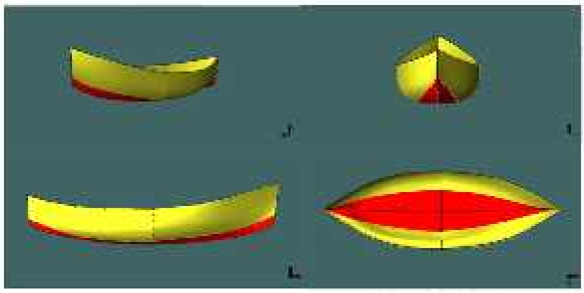


Figure 1. Lines Plan and Ship Model

Figure 2. Traditional Fishing Vessel of Tambak Lorok

2.2. Ship Resistance

The resistance in a ship's hull can be calculated by considering two components, namely frictional resistance and residual resistance. The two components differ in the scale of the frictional resistance for the hull which is geometrically similar in speed which is equal to the ratio of the displacements. Meanwhile, the residual resistance component can be estimated from the scale to the Reynolds number [7].

The method used for calculating ship resistance in this study is the Van Oortmersen method. This method is suitable for calculating the resistance of fishing vessels by showing a smaller error factor value compared to other methods. Maxsurf Resistance software is used as a tool in calculating ship resistance analysis.

2.3. Ship Stability

Ship stability is the ship's ability to return to its initial position after being swayed by external forces such as ocean waves and wind [8]. Maxsurf Stability software is used to analyze ship stability.

As a parameter, the variables used in the study are four loading conditions as follows:

1. Condition I: Assuming that the ship departs from the pier with 0% hatch condition and 100% consumable weight.
2. Condition II: Explains the condition of the ship when it is heading to the fishing ground with 50% hatch condition and 50% consumable weight.
3. Condition III: Describes when the ship returns from the fishing ground and arrives at the pier with a 100% full hatch condition and 10% consumable weight.
4. Condition IV: Assume the condition of the ship when the hatch is in full condition with 50% consumable weight.

As written in the International Marine Organization (IMO) Resolution A.749(18) Code on Intact Stability for All Types of Ships chapter 3, it explains that the ship's stability capability must meet the rules described in Table 2 which shows the minimum limit for stability values.

Table 2. IMO *Resolution* A.749(18)

Criteria	*Value*	*Unit*
Max Area of GZ 0 to 30	3.151	m.deg
Max Area of GZ 0 to 40	5.156	m.deg
Max Area of GZ 30 to 40	1.718	m.deg
Max GZ at 30 or greater	0.2	m
Angle of max. GZ	25	deg
Initial metacentric height	0.25	m

2.4. Ship Movement

Ship movement refers to the ship's capacity to remain at sea under any conditions while the ship is operating. So this capability is an important consideration in terms of ship design.

As a calculation medium, Maxsurf Motion software is used to analyze the calculation of ship motion in this study. As a parameter modifier, this study uses a variation of the angle of the wave heading at 0 , 90 , and 180 . For ship speed using 0 knots and 7 knots and using a wave height of 0.75 m which is the wave height in the waters of the North Java Sea. The output obtained from the analysis of ship movement is rolling, heaving, and pitching movements. The results of these calculations will be analyzed using predetermined criteria, namely the Criteria on Seakeeping Performance according to Standard Tello which is shown in Table 3 as follows:

Table 3. *Criteria on Seakeeping Performance*

No	Criteria	Maximum Limit
1	*Rolling*	6^o (rms)
2	*Pitching*	3^o (rms)
3	*Lateral acceleration*	0.1 g (rms)
4	*Vertical acceleration*	0.2 g (rms)

3. RESULT AND DISCUSSION

3.1. Ship Resistance Analysis

Analysis of ship resistance in this study using Maxsurf Resistance software. The ship hull form model that has been made is analyzed using the Van Ooortmerssen method with a speed of 0 – 9 knots. The results of the analysis of ship resistance can be seen in Figure 3 which shows at a service speed of 7 knots the value of the ship's resistance is 0.6 kN.

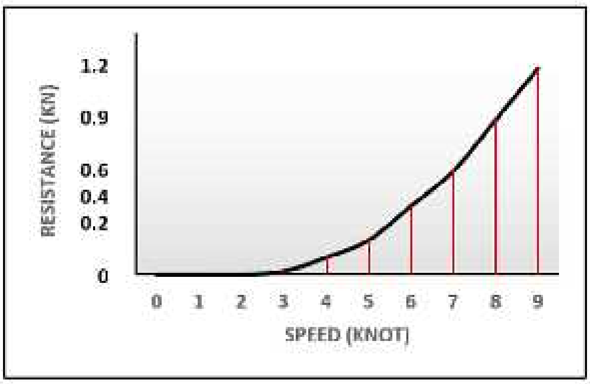


Figure 3. Graphic of Resistance vs Speed comparison

3.2. Calculation of Engine Power Requirements

In calculating the engine power requirement, one variable is used, namely the service speed of the ship of 7 knots or 3.60 m/s.

Perhitungan Daya Mesin:

EHP = Rt x V
= 0.60 x 3.60
= 2.16 kW
EHP = 2.16 kW x 1.34102
EHP = 2.896 HP
DHP = EHP / Pc
Pc = ηH x ηR x ηo
= 1.059 x 1.05 x 0.55
= 0.656
DHP = 2.896 / 0.656
= 4.415 HP
SHP = DHP / 0.98
= 4.415 / 0.98
= 4.50 HP
BHPscr = SHP / 0.98
= 4.50 / 0.98
= 4.59 HP ≈ 5 HP
BHPmcr = BHPscr / 0.8
= 5 / 0.8
= 6.25 HP ≈ 7 HP

It can be determined that the engine power required is 7 HP. From this value, there is a correlation with the actual situation in the field where the ship uses an engine with the Shangchai brand with an engine power of 7 HP.

3.3. Ship Stability Analysis

In calculating ship stability analysis, it is necessary to pay attention to the location of 3 points of concentration of forces acting on the ship, namely point G (center of gravity), point B (center of buoyancy) and point M (metacenter). This study uses the rules or regulations from IMO Resolution A.749 (18) and in its calculations, Maxsurf Stability software is used to analyze the stability of the ship.

Table 4. Ship Loading Weight

No	*Item*	*Unit Mass (tonnes)*
1	*Lightship*	0.64
2	*Main Engine*	0.103
3	*Hatch*	0.1688
4	*Fuel Oil Tank (FOT)*	0.0503
5	*Crew*	0.075

Table 5. Loading Conditions

Loadcase	*FOT*	*Hatch*	*KG*
Condition I	100%	0%	0.422
Condition II	50%	50%	0.402
Condition III	10%	100%	0.406
Condition IV	50%	100%	0.407

Table 4. and Table 5. show the weight of ship loading and loading conditions, both of which will be used as input data for running ship stability analysis on Maxsurf Stability software.

Table 6. Stability Calculation Analysis Results

No	Parameter	IMO	Unit	Condition I	Condition II	Condition III	Condition IV
1	*Max Area of GZ 0 to 30*	3.151	m.deg	3.7942	3.5794	3.7295	3.7044
2	*Max Area of GZ 0 to 40*	5.156	m.deg	6.2708	5.9014	6.1715	6.1344
3	*Max Area of GZ 30 to 40*	1.718	m.deg	2.4766	2.3221	2.4420	2.4300
4	*Max GZ at 30 or greater*	0.2	M	0.270	0.251	0.267	0.265
5	*Angle of max. GZ*	25	Deg	47.3	45.5	47.3	46.4
6	*Initial metacentric height*	0.15	M	0.545	0.516	0.534	0.539
	STATUS			***Pass***	***Pass***	***Pass***	***Pass***

Based on Table 6. it can be concluded that the stability of the Tambak Lorok traditional fishing vessel in conditions I, II, III, and IV has a value that has met the IMO criteria.

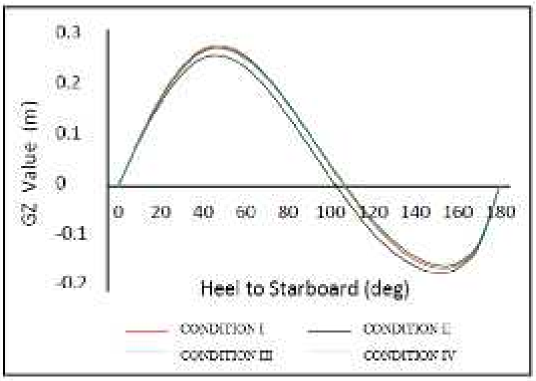


Figure 4. Graph of GZ value results in conditions I – IV.

Based on Figure 4. the traditional fishing boat from Tambak Lorok has similar graphic images from one condition to another.

3.4. Ship Movement Analysis

As a tool in the calculations, Maxsurf Motion software is used to analyze the results of ship motion, with the ship assumed to be in full load condition. This traditional fishing boat Tambak Lorok operates in the North Java Sea which has an average wave height of 0.75 m and a period of 7.5 s. Due to ships operating in Indonesian Sea waters that have similar characteristics to the North Sea, the JONSWAP (Joint North Sea Wave Project) spectrum was chosen for the type of wave spectrum. The speed of the ship using 0 knots and 7 knots, and the wave height used is 0.75 m. Table 7 shows the results of the calculation of the analysis of ship motion at a speed of 0 knots.

Table 7. Results of ship motion at a speed of 0 knots

Item	Wave Heading (deg)	Speed of 0 knot		
		Amplitudo	Velocity	Acceleration
Heaving	0	0.172 m	0.178 m/s	0.244 m/s2
	90	0.173 m	0.183 m/s	0.271 m/s2
	180	0.174 m	0.182 m/s	0.255 m/s2
Rolling	0	0.00 deg	0.00000 rad/s	0.00000 rad/s2
	90	4.54 deg	0.22702 rad/s	0.70201 rad/s2
	180	0.0000 deg	0.00000 rad/s	0.00000 rad/s2
Pitching	0	2.15 deg	0.08308 rad/s	0.24208 rad/s2
	90	1.01 deg	0.03875 rad/s	0.12577 rad/s2
	180	1.80 deg	0.06374 rad/s	0.18262 rad/s2

From the analysis of the ship's motion at 0 knots, it can be concluded that the heaving value of the ship at 0 knots is the largest at a heading angle of 180 . The ship's rolling value at 0 knots is the largest at a heading angle of 90 . And the largest pitching value is when the ship is at a speed of 0 knots is at a heading angle of 0 . According to the Criteria on Seakeeping Performance from Standard Tello, rolling and pitching movements still meet the specified criteria, namely 6 degrees and 3 degrees. Table 8 shows the results of the calculation of the analysis of ship motion at a speed of 7 knots.

Table 8. Results of ship motion at a speed of 7 knots

Item	Wave Heading (deg)	Kecepatan 7 knot		
		Amplitudo	Velocity	Acceleration
Heaving	0	0.184 m	0.111 m/s	0.068 m/s2
	90	0.191 m	0.201 m/s	0.300 m/s2
	180	0.195 m	0.311 m/s	0.845 m/s2
Rolling	0	0.00 deg	0.00000 rad/s	0.00000 rad/s2
	90	4.54 deg	0.22702 rad/s	0.70201 rad/s2
	180	0.00 deg	0.00000 rad/s	0.00000 rad/s2
Pitching	0	2.77 deg	0.03100 rad/s	0.03282 rad/s2
	90	1.66 deg	0.03923 rad/s	0.11168 rad/s2
	180	1.41 deg	0.09462 rad/s	0.46546 rad/s2

From the analysis of the ship's motion at a speed of 7 knots, it can be concluded that the largest heaving value when the ship has a speed of 7 knots is at a heading angle of 180 . For the rolling value of the ship at a speed of 7 knots, the largest is at a heading angle of 90 . As for the value of the largest pitching amplitude when the ship has a speed of 7 knots is at a heading angle of 0 . Based on predetermined criteria, the angle of the rolling and pitching motion still meets the criteria, namely below the maximum limit of 6 degrees and 3 degrees.

4. CONCLUSION

Based on the calculation of the analysis of the drag, stability, and movement of the ship, the following conclusions can be drawn:

The traditional fishing boat Tambak Lorok at a speed of 7 knots has a total resistance value of 0.6 kN using a propulsion engine of 7 HP. The results of the ship stability analysis show that the stability value has met the criteria indicated by the GZ value that has entered the IMO requirements. As for the results of the analysis of ship motion at a ship speed of 0 knots, the largest rolling at a heading angle of 90 is 4.54 deg. For the largest pitching value at the heading angle of 0 , which is 2.15 deg. Meanwhile, at a ship speed of 7 knots, the greatest rolling and pitching values are at heading angles of 90 and 0 of 4.54 deg and 2.77 deg.

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