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Improved Design 5 (GT) Boat for Traditional Community Activities

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ABSTRACT: *Construction design can make affects the stability of the vessel that is seen from the relationship between the burden inflicted with the intact stability occurring .The purpose of this research is to get obtain stability data from the development of traditional fishing boat models with various standard sizes and produce optimization design output. This design method requires a comparative vessel and calculated the stability and resistance calculations of the ship on the comparison of traditional fishing boat models. The results this design method requires a comparative vessel capable of developing and influence the size and speed of traditional ship model is represented in model 4th. Model and analysis results of fishing vessels show the best ideal size in the TambakLoroksea to operate in shallow water shipping areas. The results show that the stability with the highest righting arm value 0,86 meters with on angle 50 degrees. These results still include the ship's height range in the main size of the ship so that it is still safe in operation.*

NOMENCLATURE

Symbol	Description	Unit
GM	Gravity to Metacentra	*m*
MB	Metacentra to Bouyancy	*m*
KB	Keel to Bouyancy	m
KG	Keel to Gravity	*m*
w	Weight / Displacement	*Ton*
$S(x^0)$	Momen (Degree)	*Ton.m*
G-G'	Distance Gravity to new Gravity	*m*
Lwl	Length of Water Line	*m*
B	Breath	*m*
T	Draught	*m*
CB	Block Coefisien	
L/B	Ratio Length and Breath	
B/T	Ratio Breath and Draught	

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I. INTRODUCTION

One of the appropriate means of transportation to support coastal activities is a ship. Many of the coastal communities are interested in marine activities, one of which is in the TambakLorok Semarang area. Several parts of the city of Semarang have received support from the government to support community activities in coastal areas, one of which is fishing, as shown in Figure 1 [1] . The need for ship development to increase maritime activities in several coastal areas such as the development of rolling and pitching motion designs, or the performance of ship propulsion systems[2]. As is the case with ship performance for a representative design concept.Allows convenience to take priority over speed, as well as more convenient load levels, and operational access. A design can be seen from the shape of the curve or hydrostatic table which describes the types of fishing vessels in a shipping area[3]. The description of several parameters has been developed to obtain a basic design that adopts the optimization of previous fishing vessels[4]. As for a construction design, it can affect the stability of the ship as seen from the relationship between the weight of the construction and the load caused by the rollout of the ship that occurs [3,5–7]. The shape of the superstructure construction of the ship's superstructure determines the performance of the total resistance that affects when the ship is maneuvering at sea [8–10].

Figure 1. Traditional Fishing Boats

According to a previous study entitled "estimation of drafts and metacentric heights of small fishing vessels according to loading conditions" on fishing boat objects, it shows the behavior of shallow water fishing vessels and the influence of the width of the hull on the obstacles that occur on fishing vessels[7]. As well as in the study entitled "on the development of a small catamaran boat" there is a link between the comparison of simulation results with hydrostatic experiments on prototype ships and towing tanks. The simulation results reach 24 knots while for the prototype 22 knots the influence of construction design has a difference of 19%. However, the analysis was carried out on the catamaran hull class and is limited to a length of less than 13 meters and a weight of less than 10 tons, so research on monohull vessels under 5 GT needs to be discussed further[11].

This is in line with the optimization of the design of high-speed ro-ro passenger ships in the study entitled "multiple criteria optimization applied to high-speed catamaran preliminary design" which explains the comparison between monohull and twin-hull ship designs. With the method used is the GA algorithm optimization method, the 4 best design rankings are obtained with the main size of the ship represented in the distribution of spots/dots indicating design possibilities [12]. However, by using only 3 speed variables, with an interval of 5 knots, additional comparisons are needed to represent the ship speed ratio. Then the calculation of the object does not include the equipment on the ship, it can affect the criteria for the shape of the ship. In a previous study entitled "an analysis of fishing vessel accidents", for small fishing vessels according to loading conditions, it describes a curve that represents the estimated metacenter height of the vessel and also the vessel displacement on various types of fishing vessels. As with gill nets, long liners, jigging in the seas of the South Korean region under various conditions they are compared and made into one curve[13].

The correlation and relationship with previous research is quite evident from this study, namely the effect of changes in the shape of the hull on the stability and resistance performance of the ship on fishing vessels. This formulates a temporary hypothesis that design optimization describes the characteristics of shallow waters in the north coast of Java, especially Semarang in TambakLorok. Likewise with previous studies related to the design and form of ship optimization in certain areas. Broadly speaking, the limitations of the problem in this paper are that calculations are only carried out on stability calculations from conditions 0^0 - 90^0 and ship resistance according to the resistance experienced, displacement calculations on fully loaded ship conditions, using data from 5 comparison ships, wave conditions are in accordance with the average waters TambakLorok Semarang, the weather when operating is quite sunny. The aim of this 5 GT fishing boat design development research for traditional community activities is to obtain the development of traditional fishing boat models with various standard sizes compared to previous research in an effort to produce optimal design outputs and meet the various criteria needed with comparative data, as well as for designing and calculation of criteria with computing software.

The ship is a construction model that can float on water and has the characteristics of buoyancy or buoyancy to load passengers or goods whose motion depends on the type of water it passes[14]. Stability is one of the main design requirements of every floating device, but for fishing boats it is more important than others because a fishing boat must always work with a fairly good stability load. Ship stability can be defined as the ability of a ship to be able to return to its original position (upright) after tilting due to external and internal forces or after experiencing a temporal moment[15,16]. Comparison of the calculation of ship stability values from variations in ship model development. The value of stability is a concern that needs to be considered considering that this fishing boat has a fairly slim hull shape. From the results of the comparison, the ship stability results will be compared according to the most optimal conditions for the shipping area [17,18].From the results of the calculation of the ship's stability, it is necessary to pay attention to the weight of the ship, so that the calculation of the ship's turning arm approach is obtained, as an example in equation 1:

$$\mathrm{GM} = (\mathrm{MB} + \mathrm{KB}) - (\mathrm{KG}) \quad (1)$$

Where GM is the distance from the point of gravity to the point Metasentra, w is the displacement weight of the ship, MB is the distance from the point Metasentra to Bouyancy (upward buoyancy), KG is the distance from the keel point of the ship (Keel) to the point of gravity of the ship, KB is the distance from the Keel of the Ship (Keel) to the Bouyancy point, x is the angle formed from the angle of the ship's roll. As for the value of the coupling arm or arm used for the ability of the ship to return to its original position, it can be done to carry out further calculations. The calculation is by calculating the Coupling Moment (Inertia Stability Moment) which is adjusted to the degree of rollout of each condition on the ship. So if written as in equation 2:

$$S(x^0) = w\,.\,GM\sin(x^0) \quad (2)$$

Where S(x0) is the righting arm/returning moment for a certain angle, GM is the distance from the Gravity point to the Metasentra point, w is the weight of the displacement of the ship, x0 is the angle formed from the angle of the ship's roll. So that it can be interpreted in finding the value of GG" or GZ using the approach in equation 3:

$$GZ = GM\sin(x^0) \quad (3)$$

One of the product design developments can be reviewed through standard measurements of the geometry that may be formed from the design. In this case the design concept of the ship is adequately represented by the stability forces that occur due to shifting of the righting arm. Where is the point of gravity as a reference for determining the ship's ability to return to its original position properly and comfortably.

II. EXPERIMENTAL SETUP

In this research process data is needed from the object to be analyzed. The data collection process is divided into several stages. In this study the authors carried out several stages of field studies and interviews directly with parties related to this research and aimed to complete the data requirements in carrying out this research, while the field studies included:

1. Retrieval of Research Data

The data needed in the processthis research include:

a. Primary data

b. Secondary data

2. Data Collection Method

In the data collection process, there are several methods used in data collection, including:

a. observation method

b. Interview method

3. PlaceThis research was conducted at TambakLorok Semarang fishing port area.
4. Study the systematics of previous research which will be put forward from various kinds of references in the form of books, magazines, articles, journals and via the internet.
5. After observing and collecting data in the field, the data is then analyzed and discussed.
6. All the results of data processing are in the form of analytical presentation, a summary ofthe results of the analysis that occurs is then grouped so that it is easy to prepare reports,etc.

The ships used are boats with traditional fishermen. Where this type of ship has been widely operating in shallow sea waters and is the most economical for fishermen to operate, conditions where the height of the waves is below 2 meters. This type of ship has a mono hull shape and is slimmer. This data was obtained using survey methods, direct measurements in the field The main dimensions of this traditional fishing boat, see table 1. And the shape of the ship line plan is see figure 2

Table 1. Principal Dimention

Dimension	Value
Lwl	12.58 m
B	3.02 m
T	1.7 m
Wetted Area	184.358 m2
Displacement	35,05 ton
Volume (Displacement)	34.20 m3
CB	0.53
L/B	4.16
B/T	1.77

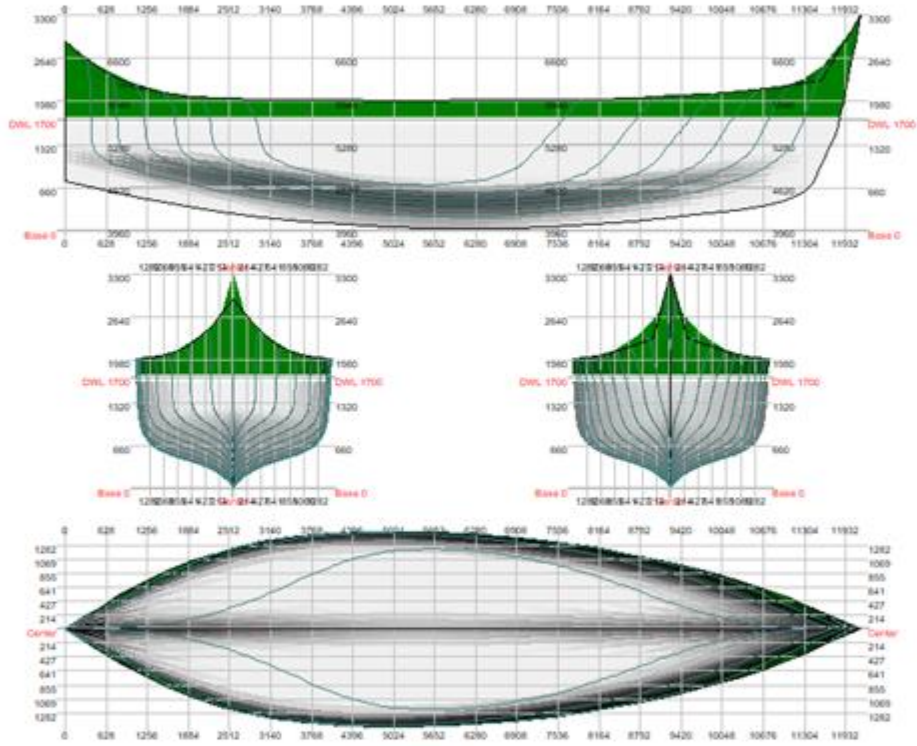


Figure 2 Lines Plan of ship desing at tabel 1

The method used in this study is the calculation of the stability and engine power of the ship with a comparison of traditional fishing boat models. Calculations using computer software for equations 1 and 2, then the results that appear are grouped in graphical form to make it easier in the process of natural analysis. The parameters used in the calculation are the size of the shape of the ship and the angle of the ship, in this case it is assumed that the angles formed are 10^0, 20^0, 30^0, 40^0, 50^0, 60^0, 70^0, 80^0, 90^0. This represents each process of fishing activities by traditional fishermen , where it is assumed that the largest angle is 90^0 which is considered to have a critical point in the ship's ability to return to its original position.

III. RESULTS AND DISCUSSION

In the planning of fishing vessels for the TambakLorok sea area using a comparison boat with almost the same hull type and hull shape. Comparison vessel technical data obtained from literature studies. The main size of the comparison ship is used as a reference in determining the main size of the ship. Several comparisons of the main ship sizes are presented in the form of curves, then the size closest to the squared curve is chosen. The figure shows the relationship between the width of the ship and the carrying capacity that can be accommodated, see figure 3.

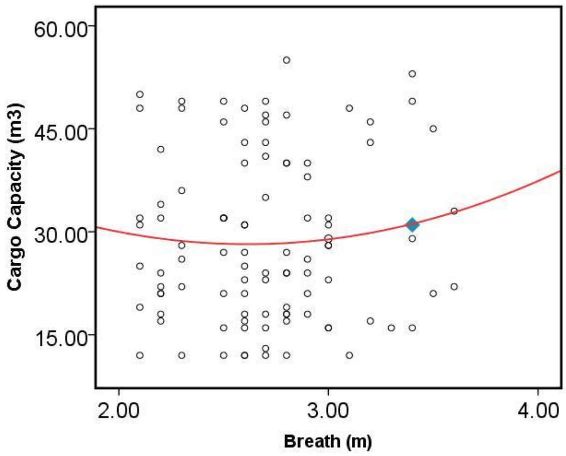


Figure 3. Distribution of ship width and load capacity

Of the several main dimensions of the ship that most closely match the ideal on the quadrant line, simulation calculations are carried out using mathematical formulas basically use equation 3 , in order to obtain a comparison between estimates and calculations of the distance between points of gravity and gravity after experiencing rollover (G-G') working on the ship (Lee, Lee, and Kim 2007), see figure 4:

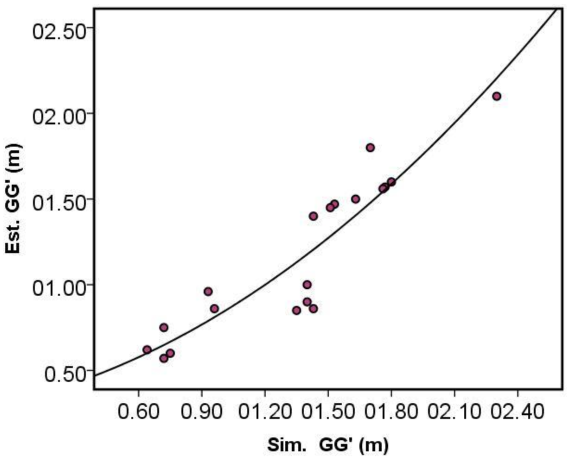
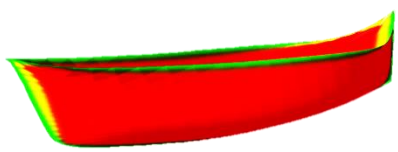


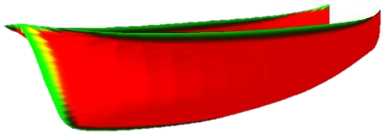
Figure 4. Comparison of G-G' values

GG' value is the distance of the reversal arm. Where after multiplied by the weight according to the agreement 2 , then there are several models that show from the plot points above that look close to the mean range of results. So that when compared to the 5 ship models obtained see figure 4, each has the size and stability of the ship and the resistance of the ship.

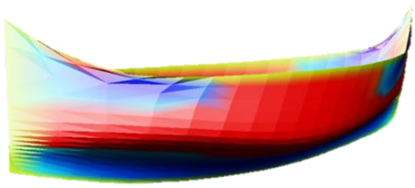
Model 1



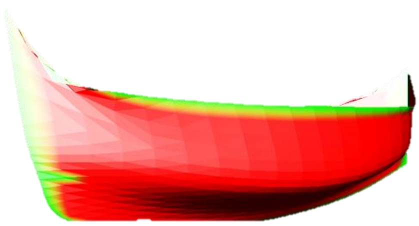
Model 2



Model 3



Model4



Model 5

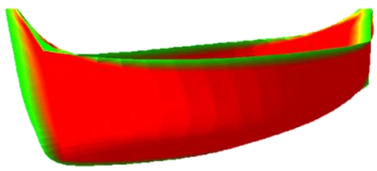


Figure 5. Comparison of the ship model

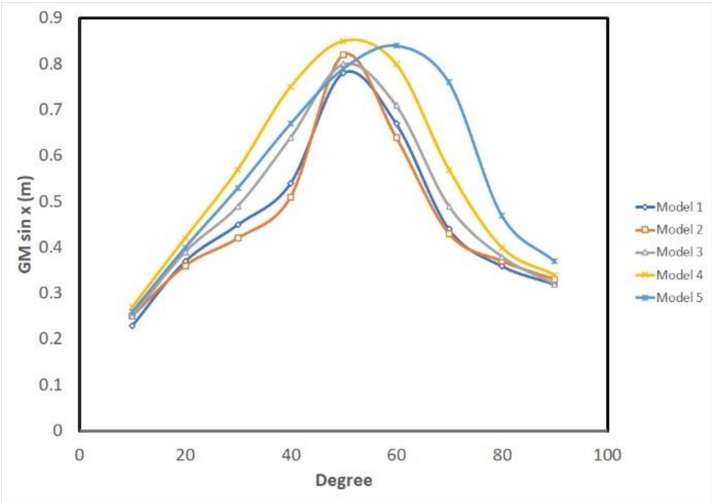


Figure 6. Comparison of the value of righting arm stability on 5 ship models in each corner condition

From the research results, see Figure 6 shows the ship's stability curve with the highest turning arm value of 0.86 meters with an angle of 50 degrees. These results still include the ship's height range on the main size of the ship so that it is still safe in operation. From the shape of the curve it can be seen that the value spikes increase regularly and stably as shown in the 4th model.

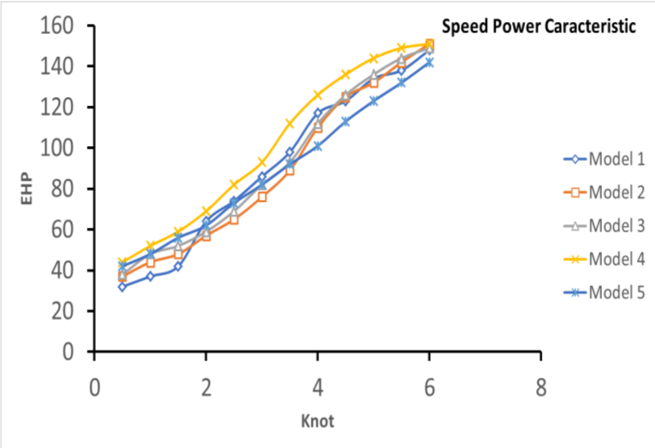


Figure 7.Comparison of the value of the speed and the value of the effective power of the engine on 5 ship models.

As a result, see figure 7 of the curve above which shows the comparison between the ship's speed and the power required by the ship's engine. From the calculated data, it can be seen that each model of the ship's shape produces a different form of power according to the resistance received by the ship's hull. The larger the shape of the hull, the higher the power needed for the hull to rub against sea water. From the results of optimizing the shape of the hull, a new size will be obtained, see figure 8. Changes in ship size make the B / L ratio increase so that the stability capability is better than the initial design. It can be seen in the decrease in color which shows the highest level of friction in the red color of the ship's hull. This shows that the cross-section has the shape of a curved hull consisting of polylines. The optimization model formed is to increase cargo capacity and make the ship more stable

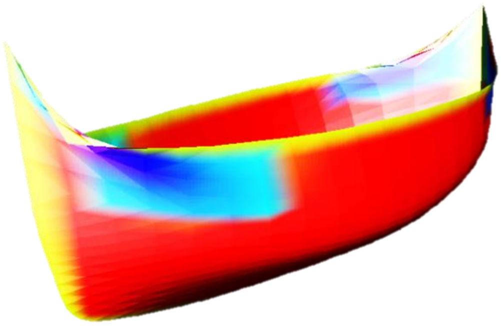


Figure 8.Optimization of ship hull design.

IV. CONCLUSION

Calculation of ship stability by calculating the ship's force points acting when the ship is operating provides additional information about the development of the ship. If you look at previous research, you can compare the results and analysis of ship stability and the relationship between resistance and ship speed. Based on the graph formed, it can be seen that the relationship between ship modeling and the influence of ship stability shows the ship stability curve with the highest turning arm value of 0.86 meters at a roll angle of 50 degrees.

The results of the model and analysis of fishing vessels show that the best ideal size is based on stability calculations in TambakLorok waters, namely in the 4th model. The diagram shows that there are several considerations and factors in planning an ideal design for shallow waters, such as the ability to stabilize the ship and the maximum speed. effective for fishing activities. From the shape of the hull, the costs arising from the planning are not too high and provide the effectiveness of production time in pre-planning. So it is necessary to know the effect of various representative hull construction designs on shallow waters, including the stability and resistance of traditional fishing boats. The results showed that the stability diagram and the effective power of the engine can predict the performance of the ship and provide an optimization model to predict the design of traditional ships in shallow waters.

A ship will experience disturbances, especially when the operational process is above an angle of 15 degrees, at least this can affect the operational work of fishermen in finding fish and for their livelihoods. Within the limitations of the problem, this study is concerned with static stability and a concept for an ideal design in terms of the shape of a fishing boat hull, for the optimization process of existing fishing boats. The approach taken is not too detailed, but nevertheless it can be a reference literature for writers in future research.

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