Design of Fishing Vessel 5 GT for Traditional Fishing Community Activities

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Abstract.
Develop of fishery port area in the Semarang city, therefore need improve for a fishing vessel design that inaugurated the representative of the port area Tambak Lorok. The vessel was also not equipped with hydrostatic calculations, stability and so on, then most fishermen in Indonesia use wood as a material for the creation of fishing vessels. The purpose of this research is to get design criteria and dimension of fishing vessel and determine the construction design criteria of the right fishing vessel performance in the Tambak Lorok sea area Semarang accordance with IMO (International Marine Organization) standard. Designation of the method as the efforts to produce optimization design output and meet the various criteria required with comparison method using the 5-size main ship dimension, as well as for the design and calculation of criteria with ship design software. This design method requires average size comparative vessel capable of developing and influence the size and speed of 5 GT ship model. The results this design method requires a comparative vessel capable of developing and influence the size and speed of 5 GT ship model. Analysis results of designing fishing vessel show the development of best ideal size on 5 GT ship class to operate in the cruise area shallow water. Practical stability and resistance diagrams to predict ship performance and provides the prediction procedure showing how to develop such diagrams using the available main dimension ship data.

1. Introduction
The city of Semarang is the capital of Central Java province, Indonesia. Semarang region has an exotic topography of mountains and coastal areas that are often referred to as the top area Semarang and Semarang below area. Such conditions are very conducive to the development of tourism, including coastal tourism. Part of Semarang serves as a coastal area and fishing is the area of Tambak Lorok. On the other under Law No. 45 year 2009 about the amendment to law number 31-year 2004 about fisheries, it is mentioned that small fishermen are the ones whose livelihood does the fishing to fulfill the needs of everyday life that use a fishing vessel is the greatest of 5 GT. One of the vessels that are many in the area of Tambak Lorok Semarang is a fishing vessel, the vessel is built by the people's shipyard that its construction without being equipped with the planning and general requirements are determined beforehand. So there needs to be a curve or table that describes the type of small ship in a cruise area [1]. Several parameters have been developed to get a basic design that adopts the optimization of the previous fishing vessel [2,3]. The construction of the ship usually uses pictures of skeet or images of the module hereditary inheritance from generation to generation or in other words do not have a standard design such as general arrangement, lines plan, midship section, and
construction profile as one of the technical requirements that must be met in the acceptance of new ship class. Construction design affects the stability of the vessel that is seen from the relationship between the burden inflicted with the intact stability occurring [4,5]. The construction of the building on the vessel determines the performance of the wind resistance that is affected when the ship maneuver [3,6]. The vessel was also not equipped with hydrostatic calculations, stability and so on. Indonesia there are many forest results that can be used, then most fishermen in Indonesia use wood as a material for the creation of fishing vessels. Making wooden fishing vessel aims to reduce the cost of production and maintenance of timber vessels more economical than ships with the main material manufacture with others, such as FRP (Fiber Reinforced Plastic), GRP (Glass Reinforced Plastic). Wood can be said to be a fairly good composite material. Wood comes from nature and existed since the first. Therefore need segmentation used to determine the included in the cluster where the ship design is integrated with the demand in the market [7,8]. The city government of Semarang has made Tambak Lorok area has a small jetty as a place for fishing boats. The existence of this small port for the anchoring-mooring boat trip is an important infrastructure to take the fishery port area Tambak Lorok. The current condition of the vessel does not reflect the type of representative transport of the fish to develop the fishery port area in the city of Semarang [9]. Therefore, to improve the need for a fishing vessel design that inaugurated the representative of the port area Tambak Lorok. The presence of a wave barrier in this port area provides other benefits for fishermen, which can be able to fish along the wave barrier of the port pool that makes marine transportation services grow in the form of fishing vessels that turn into a type of transportation to serve the tourists fishing. The wave currents are quite calm making the area easy and accessible by ships with a size of 5 GT (Gross Ton). The cruise distance for the fishing vessel is to follow the area of the fish. So, for the minimal cruise distance itself it can operate from the jetty to the breakwater pool in the port area of the Tanjung Emas Semarang. The maximum wave around the outer threshold is 1.5 m and in the area of the port pool and anchored approximately 0.5 m. Average wind speed of 12 knots, depth 8 to 10 meters. The traditional fish ship is made of timber which has since been used by fishermen on the beach as the main means of fish in the sea, the traditional vessels are very diverse, this can be seen almost every coastal region. The character of this ship is to have a very good stability due to its dynamic sports that show this ship to be able to follow the movement of fish or fishing ground.

The previous study using a fish-ship approach in South Korea explaining the shape of the fish hull planning can determine the stability characteristics of the vessel and it can be analyzed using the line Bonjean curve. In his studies of various types of fishing vessels in the South Korean region combined with its hydrostatic curve, so it can know the boundaries for the extent and shape of fishermen's ship from a region in South Korea. However, the ship that is poured in the study is a fish vessel with a weight above or equal to 30 GT-made plate so that if applied very precisely to the fish-making vessel of the ocean cruise or the Loose Seas. And the calculation is still using empirical approaches and vessel classes used using data vessels with a length of 22 meters. In addition to the typical tropical sub-sea the characteristic of the ship has a difference when compared to vessels in the tropical waters of Indonesia [10]. It is in line with the design of Ro-ro vessels where the designs can be optimized based on the abbreviation of several sample vessels with the algorithm method approach obtained a point-point with the curve that represents the design model [11]. So, if doing further search this research can draw opportunities for engineering designers in Indonesian sea. Given the many areas on the coast of Indonesia which has the characteristic of the type of each fishing vessel. Previous research for the area in the area of Tambak Lorok, the result is a design sopek boat to improve tourism and fishing activities in the Semarang sea area. Mono hulls vessels that have a modified shape on the upper building so comfortable and can be used for fishing activities. The results of technical and economical study resulted in this ship can represent tourist boat in the area and increase tourism in Semarang. Nevertheless, if the fishermen have a relatively high price for the manufacturing process, the fishermen tend to want a more convenient and practical ship design [12]. Also, studies conducted around the northern coast of Java resulted in some of the main sizes of the most representative vessels of this fishing vessel. The results show that the ship is designed to have a length between vertical lines (LPP): 15.4 meters, Width (B): 6 meters, Height (H): 2 meters, and Loaded (T): 1 meter with speed: 9 knots. It is a ship that is designed to operate for the shipping area in the Jepara sea area. However, it is also not possible to use in the Semarang sea area, considering the size that can still be received by the
Port of fisheries Tambak Lorok Semarang. Based on the that research gap then how to design the ship for the waters in the Tanjung Emas Semarang area compared to the previous depiction of traditional Asian ships.

The purpose of this research is to get design criteria and dimension of fishing vessel and determine the construction design criteria of the right fishing vessel performance in the Tambak Lorok sea area Semarang accordance with IMO (International Marine Organization) standard. Designation of the method as the efforts to produce optimization design output and meet the various criteria required with comparison method data, as well as for the design and calculation of criteria with ship design software. This design method requires a comparative vessel capable of developing and influence the size and speed of 5 GT ship model.

2. Method

Design method of designing is needed to obtain the most optimal product design. In a product design need to have a comparison of the criteria in accordance with the requirements. The proper development methods used in the design of the ship designs can be depicted in the research method. The procedure consists design method. The general procedure is shown in figure 1.

![Figure 1. Fishing Vessel 5 GT design procedure](image)

Based on the flow diagram Figure 1 the first step is arrange the needs identification aims to make accurate product specifications for the design of a product's design, in designing the designer the boundaries of the target are to be achieved, but these limits should not be too narrow, because specifications that are too broad will lead to improper solutions. The length of the vessel has an influence on the speed and elongated power vessels[13,14]. The addition of the vessel length in the condition of displacement and fixed volume will reduce the vessel resistance at a fixed speed as well as stability but add longitudinal bending stress [2]. The concept of the ship design is not detached in the design of the spiral, that a vessel to be made to full fill all aspects of the building in spiral design, so very complexity in designing ship, because the reconsideration of the design is very important, the ship is a product that cannot be made in the field of many, there is an aspect that is why a ship is made: to full fill owner in the supply of the amendment of goods, materials, or people. So for the creation of a ship should consider the aspects of the shipping area, the condition of the water, load capacity, this is why the vessel is manufactured in a number of limits [15]. Ship stability is an area of vital importance for the design and operation of ships and other floating structures. Thus, it is a subject of continuous and extensive research aiming at enhancing safety. In a study of accidents estimation calculation occurring on sea transportation very often occurs from the stability and hydrodynamic models [16,17]. The International Conference on the Stability of Ships and Ocean Vehicles ,held every three years, and the International Ship Stability Workshop (ISSW), held annually between the STAB conferences, cover the key research topics related to the stability of ships, providing significant contributions to the maritime community [3,10]. The ship is a form of construction model that can float water and has the nature of buoyancy to load passengers or goods whose movements can be with paddles, winds, or machinery. Stability is a key requirement of every buoyancy's design, but for a fishing boat it's more important than another because a fishing vessel should always work with heavy stability loads. The stability of the vessel can be articulated as the ability of a vessel to get back to its original position (upright) after it becomes skewed due to the style of the outside and style of the vessel or after experiencing temporal moments. Initial stability is the stability of the angle of the swerved between 10°-15°. This stability is determined by 3 dots which are the gravity points (centre of gravity), the
floating point (centre of buoyancy), and the metacentre point. As a result, for each generic calculation of stability (GM area), the corresponding partial attained index can be determined simply as:

\[ GM = (MB + KB) - KG \]  \hspace{1cm} (1)

Where GM is the distance of gravity point to metacentre point, and MB is the point distance of buoyancy to metacentre, and KB is the point distance of keel to buoyancy, and Point KG is the point distance of keel to gravity. Then if used to calculate the righting arm moment at a certain angle can be multiplied by the weight of the ship's condition can be determined simply as:

\[ S(n^0) = w \cdot MG \sin(n^0) \]  \hspace{1cm} (2)

Where w is weight of ship's condition, and use certain angle degree (\(n^0\)). In the study of the ship, the movements reviewed were movements that were only able to be responded by the ship, namely rolling, heaving, pitching. The movement of the ship is due to the outside factor especially by waves. In obtaining the treatment of the ship waves have 2 types of movements. Rotation movement, this motion is round motion include: rolling, pitching. Linear movement, this motion is a straight-down motion in accordance with. Its axis include: surging, swaying, heaving.

3. Results and Discussion

In the planning of the fishing vessel for the Tambak Lorok sea area it uses a comparison ship with a type of hull and stomach shape that is close to the same. The comparative ship technical data obtained from the study of literature. The main size of the comparison vessel is used as a reference in determining the main size of the ship. This optimization uses a regression method, hence the main obtained a new main size, is as follows:

| No | Dimension | Value  |
|----|-----------|--------|
| 1  | Lpp       | 12.56  |
| 2  | B         | 3.02   |
| 3  | T         | 1.7    |
| 4  | H         | 2.17   |
| 6  | Vd        | 3-5 (knot) |

The main size of the comparison vessel is used as a reference in determining the main size of the vessel. This optimization uses a regression method, hence the main obtained a new main size. Then the data is analysed and modelling by using ship design software. So can get representation the main size of the ship lines plan and model 3D of ship.
hydrostatic curve. From the results of the calculations obtained displacement vessel is 51.6 tons with Coefficient Block 0.53. Ship stability is analyzed with large angle stability analysis based on IMO and. Before the stability analysis is calculated, LWT components and DWT components must be known. Analysis with variation 10 conditions. And analysis of ship movement with water conditions that ship will pass the Java Sea water with a maximum wave height of 3 m, see figure 3.

![Stability value diagram](image)

**Figure 3. Stability value diagram**

![Resistance and speed analysed diagram](image)

**Figure 4. Resistance and speed analysed diagram**

Results of analysis showed at a maximum speed of 5 knots ship require a power of 65.28 hp and the maximum resistance that the ship received at a speed of 5 knots amounted to 63.4 kN, see Figure 4. technical information as main size L = 12.56 m, B = 3.02 m, H = 2.17 m, T = 1.70 m, Vs = 5 knots, Cb = 0.53 , displacement 41.63 tons, LWT = 1.20 tons, DWT = 40.43 tons , ship resistance 63.4 kN with Max engine power 65.28 BHP , the highest GZ value is 1.27 m in 5th condition , the smallest GZ value is 0.67 m 1st condition in the angle max GZ of mono hull criteria.
4. Conclusion
Firstly, this design method requires a comparative vessel capable of developing and influence the size and speed of 5 GT ship model. Size scale comparison and depiction of model geometry greatly affect the external outcome of the results of analysis. Calculation of vessel stability calculations using a style point layout approach that works when the vessel operates providing additional information about the development of the vessel. If see previous research, can compared the results and the analysis of ship stability and the connection of resistance and speed of vessels. Based on graphs formed can show the perform of ship modelling relationships with the influence of ship stability.

Analysis results of designing fishing vessel show the development of best ideal size on 5 GT ship class to operate in the cruise area shallow water. The main advantage of the proposed diagrams is can make as a consideration and a factor in planning the ideal design for shallow water. So that the cost arises from planning is not too swollen and reduces the production time that is experiencing delays in the pre-planning part. Therefore, it becomes very practical to calculate the effect of a range of representative design construction of hull ship and characteristic of ship, include stability and resistance of small ship traditional.

The results propose practical stability and resistance diagrams to predict ship performance and provides the prediction procedure showing how to develop such diagrams using the available comparative main dimension ship data. However, additional resistance diagrams presented in this study did not consider the details of the ship's shape on other resistance components (e.g. viscous pressure resistance and wave-making resistance) regardless of friction resistance. In addition, the friction resistance is predicted based on a simple form of representation, and increased friction resistance will not be the same for the 3D hull. Other than that, the graphic stability is assumed only on certain conditions of the vessel.

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