Study of Maninjau Lake Tourism Design Using Fiberglass-Based Catamaran Flow Type

Ar Trisyaldi, Syahril, Purwantono, Waskito and Primawati
Jurusan Teknik Mesin, Fakultas Teknik, Universitas Negeri Padang, Indonesia

Article Info

Article history:

Received Jan 09th, 2019
Revised March 21th, 2019
Accepted May 22th, 2019

Keywords:

Multi-Hull
Catamaran
Resistance
Stability
Seakeeping

ABSTRACT

Ships used by the Maninjau Lake community are designed in a simple way without experiencing significant changes. This lag is caused by design methods that are based on hereditary knowledge, so ships that are made tend to have the same shape and size. Innovations are needed to get a higher level of efficiency and effectiveness on a ship to be used on Lake Maninjau. The innovation that needs to be done is the design of ships with a double hull shape or catamaran. The pre-design of the catamaran hull is based on using the experimental method and the comparison vessel method as the dimension ratio of the ship, so that the dimensions of the vessel are LWL = 4 m; LPP = 3.96 m; B = 1.7 m; B1 = 0.36 m; D = 0.7 m; d = 0.307 m. The analysis carried out on the same displacement is equal to 0.448 tons with the Flat Inside Symmetry model; Flat Symmetry Outside; and Asymmetry. Test data shows the catamaran ship with the Flat Inside Symmetry board is more suitable for Lake Maninjau tourism. Testing at the speed of 6 Knots produces a resistance of 302.81 N so that it requires the power of 0.932 kWatt.

Corresponding Author:

Ar Trisyaldi
Jurusan Teknik Mesin, Fakultas Teknik, Universitas Negeri Padang
Jln. Prof. Dr. Hamka Air Tawar, Padang (25131), Sumatera Barat, Indonesia
Email: trizyaldi@gmail.com

1. INTRODUCTION

A ship is a construction that can float in water and has the character of loading in the form of passengers or goods which in motion can be in the presence of paddle force, wind or engine power [1]. The ships used by the Maninjau lake community are generally traditional, both in terms of manufacture, material and type of ship. The community makes a ship using only the experience and knowledge that has been handed down from generation to generation by only building ships with examples of ships that have ever existed before. So that the design of the ship did not experience much change towards development. Catamaran ships are vessels that are unique from other vessels because this type of ship uses two hulls, namely on the left and right sides. Separate hull configuration will provide a large moment of inertia which will provide good stability with a small rolling movement acceleration angle [2]. The use of catamaran vessels is still not common in Indonesia, both for use as tourist ships, passenger ships and even for fishing vessels. Shipping technology innovation can be done by replacing the moho-hull stomach type to the catamaran stomach.

Technology in the material field develops very rapidly along with the need for certain field characteristics [3]. Changes in shipbuilding can also be done by replacing wood material to the ship with fibreglass material. The use of fibreglass materials as a substitute for wood material will certainly be able to overcome or reduce deforestation. Another advantage is having a lighter ship weight so that fuel consumption will be more economical. Comparison of the skin weight of a ship's hull made of wood is 20 Kg / m2, while a fibreglass material vessel has a weight of 14 Kg / m2 [4]. The nature of lightweight fibreglass we can make a strong reason to choose fibreglass as an innovation in technological developments in the field of shipping. This material is widely used for maritime needs because it has mechanical properties that are better than metal, has a power that is capable of regulated height (tolerability), has good fatigue, and is easily formed [5].

A study of the design of the hull shape with the type of catamaran made from fibreglass is necessary. Based on the background that has been stated, the researcher wants to analyze the shape of the catamaran hull with fibreglass material with the title "Study of the Design of Lake Maninjau Tourist Vessels Using Fiberglass Catamaran Hull Types". The purpose of this research is to get the best catamaran hull model so that it can be used as a means of transportation and tourism in the waters of Maninjau lake.

2. METHOD

The experimental method is part of the quantitative method, has its own characteristics, especially with the presence of control groups [6]. In the field of science and technology, research can use experimental design because variables can be selected and other variables that can influence the experimental process can be tightly controlled. Computational simulation in this study uses the help of computer software for the calculation of a ship to be designed. Perform computer-assisted simulations to obtain computer CAD-based ship models. To get an analysis of barriers (resistance), stability (stability), and motion (seakeeping) using software (ship) software analysis. The design method of the ship used is the Complex Solution Method, which uses a combination of ship comparison methods and trial and error [7]. The comparison method is to use a comparison ship to get the main standard size.

The trial and error method is a trial method of several samples to get better results, namely ships with the same main size but with different hull shapes. The design of the hull model begins with planning the main size chosen as a comparison ship. Looking for some ship data as a comparison to be able to choose the appropriate size of the ship, then the ship hull modelling is done using the Maxsuft Modeller ship design software for 3 types of hull shapes. Modelling is done based on the shape of the hull in different forms. Data on ships that were used as comparable vessels were selected and one size of the ship was most suitable for the waters of Lake Maninjau. In taking the size of the ship, it is necessary to use the ratio of the ship between the main measures, namely L / B, B / T, L / H. [8] said that the parameter ratio is the relationship between the main dimensions of the ship in the form of L / B, L / D, B / T, D / T that reflect ship characteristics and affect ship performance such as stability, seakeeping, and other capabilities. A good ship dimension ratio will also give the performance of the ship. Based on the data of the comparison vessel, the size of the ship to be designed is as follows: LWL = 4 m; LPP = 3.96 m; B = 1.7 m; B1 = 0.36 m; D = 0.7 m; d = 0.307 m. Variations are carried out on the ship's Kosko section which can be seen in the view section of the ship's plan, and the streamlined shape can be seen in the body plan section. The difference in the shape of the catamaran shipboard is to see and analyze each hull shape when analysis of resistance, stability, and seakeeping ships later. The difference in the shape of the mid ship's is divided into three basic forms of a ship with a catamaran hull type, namely:

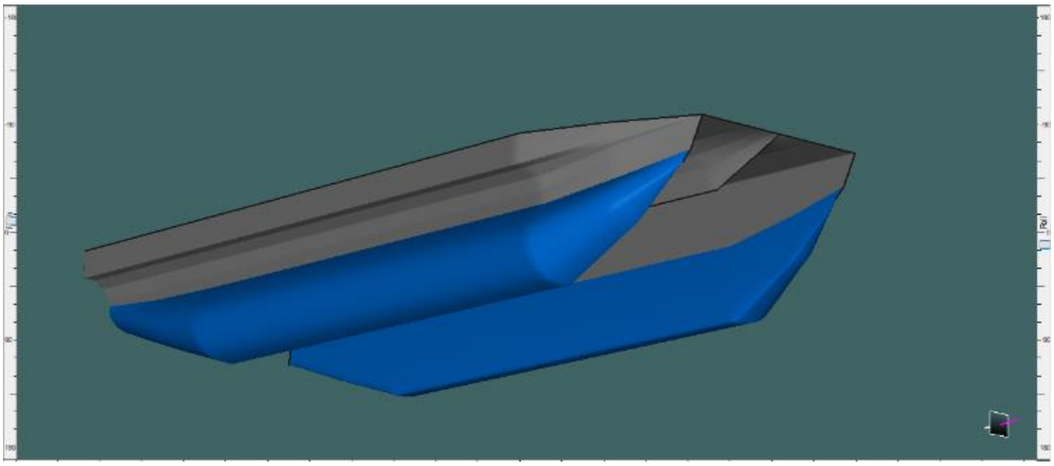


Fig. 1. Catamaran Simetri Flat Inside Ship

The catamaran ship Model I (Flat Inside Symmetry) has gastric construction with a curved pattern on the outer wall, but the inner wall looks flat. The two hulls are connected by sturdy bridging.

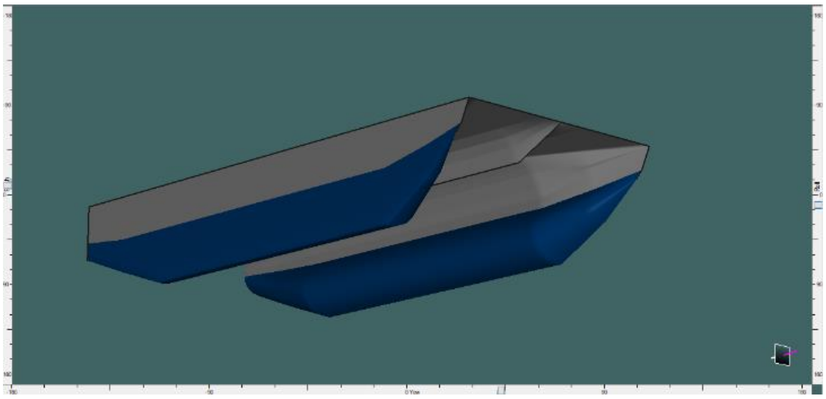
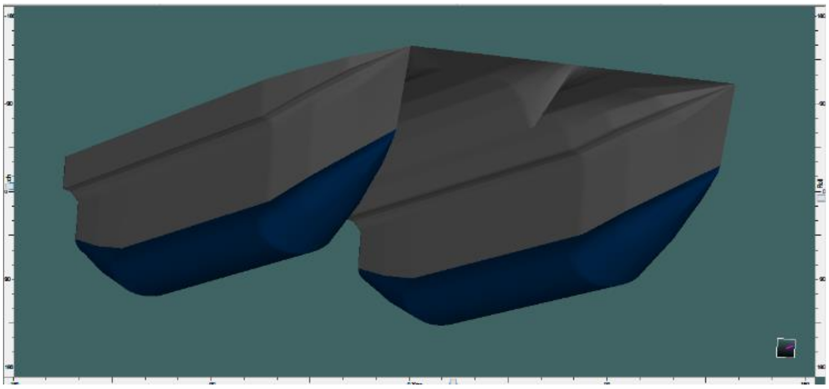


Fig. 2. Flat Outside Symmetry Catamaran Ship

Catamaran ship Model II (Flat Inside Symmetry) has gastric construction with a pattern that has a curved pattern on the outer wall, but the inner wall looks flat. The two hulls are connected by sturdy bridging.



Gambar 3. Kapal Catamaran Asimetri

The catamaran ship Model III (Asymmetry) has a mid-ship hull construction that has the same curved pattern on the left and right stomach.

3. RESULT AND DISCUSSION

3.1 Resistance

Obstacles are fluid forces acting on a ship in such a way that it opposes the movement of the vessel, where the resistance is the same as the component of the fluid force acting parallel to the axis of the ship's movement [9]. Getting the resistance value of the three types of catamaran hulls requires a number of inputs, including the opening of the file design of the catamaran hull design that has been designed, and inputting some values of the speed of the Vs of the ship model.

Table 1. Shipbuilding Prisoners

Speed (Knot)	Holtrop Resistance (N)	Holtrop Power (N)
1	6,22	0,003
2	21,94	0,023
3	47,3	0,073
4	97,52	0,201
5	179,28	0,461
6	302,81	0,935

DOI: *https://doi.org/10.24036/tm.v2i2.2372*

3.2 Stability

Stability on a ship is the ability of an object to float or float and tilt to return to its original or upright position [10]. Calculation of stability requires some input data that must be entered, such as the model of the ship that has been designed, the density of water (freshwater), the wave of water, the corners of the ship, and the goods and supplies of a ship. The weight of a ship's equipment is named Load Case on the Maxsurf Stability Software input. The measurement is carried out with two Load Case variations, while the variations used are as follows:

Table 2. Empty Load Condition Case

Kriteria	Value	Actual	Unit
Area 0°-30°	3,151	7,829	m.deg
Lengan Stabilitas GZMax	>10°	22,7°	deg
GM	-	1,987	m

Table 3. Full Load Ship Load Case

Kriteria	Value	Actual	Unit
Area 0°-30°	3,151	4,218	m.deg
Lengan Stabilitas GZMax	>10°	28,2°	deg
GM	-	0,725	m

4 DISCUSSION

Referring to the test data with the Maxsurf Resistance software, the ship with the catamaran hull type requires two driving motors, namely on the left and right side of the hull. Based on the data above, the power needed for hull model I is 2 x 0.466 kWatt, Model II is 2 x 0.339 kWatt, and Model III is 2 x 0.386 kWatt. The period of a ship will affect the stability of a ship, where the shaking period, which ranges from 30-35 second, is said to have rigid ship stability. Whereas if the ship has a shaky period below 8 seconds it is said to be rigid so that it will have an impact on the comfort of passengers inside. For ships fulfilling the requirements, the bias is to have a period of 20-25 seconds. Referring to the above requirements, it can be seen that the ships in the model I have advantages over other shaky period models with a value of the shaking period of 23.55 second, and this value is included in the requirement between 20-25 seconds so that the hull has the stability well.

5 CONCLUSION

The conclusions that can be drawn from this catamaran hull research are as follows: This catamaran vessel is very effective to be used as a tourism vessel in the waters of Maninjau lake which tends to be bumpy and calm. The main size of Maninjau lake tour boat is: LWL = 4 m, B = 1.7 m, B1 = 0.36 m, D = 0.7 m, and d = 0.307 m which can accommodate 6 passengers and 2 crew members. Ship model I (Flat Inside Symmetry) is a catamaran vessel with the best characteristics compared to models II and III.

REFERENCES

[1] Chandra Ahmad Venzias, Samuel Aritonang, and Parlindungan Manik. Perancangan Kapal Wisata Kapasitas 30 Penumpang Sebagai Penunjang Pariwisata di Kepulauan Seribu. *Jurnal Teknik.* 2014. pp. 1–8.
[2] Candra Dwi Putro. Analisi Hambatan Total Pada Kapal Model Monohull Dan Katamaran Konfigurasi S/L Dengan Displacemen Yang Sama. *Laporan Penelitian.* Universitas Indonesia. 2012.
[3] Hendri Nurdin, Yolli Fernanda, and Meisuri Handayani. Analisys of Tensile Strength Fiber Bagase Particle Board with Resin Adhesives. *Teknomekanik.* 2018. vol. 1, no. 1, pp. 1–5.
[4] Nurhasanah .Evaluasi Perbandingan Draft Kapal Ikan Fiberglass Dan Kayu Berdasarkan Skenario Loadcase, Studi Kasus Kapal Ikan 3GT.” *Jurnal Ilmu Pengetahuan dan Teknologi Kelautan.* 2016. vol. 13, no. 2, pp. 55–60, 2016.
[5] Daniel Sahala Putra Panggabean, Ahmad Fauzan Zakki, and Berlian Arswendo. Perbandingan

Penggunaan Material Isotropi Dan Orthotropi Pada Metode Elemen Hingga Untuk Analisa Kekuatan Kapal Fiberglass. *Jurnal Teknik Perkapalan.*2015. vol. 3, no. 2, pp. 263–272.
[6] Moh. Nazir. *Metode Penelitian*. Bogor: Ghalia Indonesia. 2011.
[7] Santoso. *Perancangan Kapal*. Institut Teknologi Sepuluh November. 1999.
[8] Soegeng Hardjono. Identifikasi Rasio Parameter Kapal Penumpang Catamaran Berbahan FRP." *Jurnal Sains dan Teknologi Indonesia.* 2010. pp. 159–165.
[9] S. A. Harvald. *Tahanan Dan Propulasi Kapal*. Surabaya. 1992
[10] Tri Nanda Citra Bangun, T.N.C., Ali Muntaha, and Sunardi. Stabilitas Kapal Ikan Katamaran Sebagai Pengganti Kapal Purse Seine di Kabupaten Pamekasan Madura Jawa Timur. *Jurnal Penelitian Perikanan Laut.* 2017. vol. I, no. 1, pp. 13–21.