Stability Analysis Modification Fishing Boats Into Passenger Ship

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Abstract. A ferry boat is sea transportation that is used to carry out activities to take people from one place to another by boat. Bengkalis State Polytechnic has 1 fishing boat but it is not operated, so here we are modifying the fishing boat into a boat for crossing from Sei Pakning to to Bengkalis Island. A ship that makes changes or modifications will affect the stability of the ship. Ship stability is something that is mandatory for all ships, because whether the ship can sail well is a factor in ship stability which can maintain security and safety for passengers on the ship, so from this there must be standardization for ships whether they are seaworthy or not. IMO is a regulation that must be followed to determine the stability of the ship. This research uses simulations from the Maxsurf application. The results of the analysis of the MaxSurf application were obtained in full load conditions with a GZ value of 0.75 meters with a slope of 87.3 degrees with a response time of 0.75 seconds from The analysis results obtained meet IMO standardization.

Keywords: fishing boats, passenger ship, stability, IMO

1 Introduction

The island Bengkalis borders the Malacca Strait to the east, north and west, and the Bengkalis Strait to the south. The island has homogeneous contours and a large part is peatland. Vegetation is mostly tropical plants typical of peat forests. Mangrove-like trees, rattan and rubber are common. The beaches surrounding the island are muddy and are home to one of its special animals, the Oxudercinae fish (Tembakul). The origin of most of the water is "redang" water, which is water that is reddish in appearance due to the impact of the peat soil.

The inhabitants of Bengkalis Island are mostly gathered in Bengkalis City, which is locatedon the left side of the ferry exit, separated from Bengkalis Island by the Strait of Bengkalis and directly facing the Strait of Malacca. Others are spread evenly on Bengkalis Island, which consists of two sub-districts located on an island that has been connected using a fairly good road.

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Transportation facilities on this island are still limited, transportation to Bengkalis island can only be done by sea. The closest point to Bengkalis island is from the island of Sumatra, meaning the city of Sei. Pakning. Ro-Ro ships are available to connect these two cities and means the door for the people of Bengkalis to travel to Sumatra. For transportation facilities, there are regular fast boats that connect Bengkalis with other cities such as Tanjung Balai Karimun, Selat Panjang, Dumai, Pekanbaru and Batam. International crossing lines are also available in the form of regular fast ferries from Bengkalis to Malacca. There is also no airporton this island, air access can only be reached by using a helicopter. on holidays and on public holidays, it is generally required to cross the anteri sometimes up to two days due to the large number of people who want to cross.

Therefore, a ship is needed to cross from Sei Pakning to Bengkalis Island, here the author modifies the fishing boat into a passenger ship. Stabilitas is a mandatory thing for ships to be able to keep sailing (asea-going property of ship) [3], because otherwise the ship can sway andcan cause the head to sink. The author will conduct a technical analysis of the stability of the fishing boat that has been modified into a passenger ship so that the ship can still operate according to its capacity and can be driven comfortably, this stability analysis will refer to the International Maritime Organization (IMO) regulations [4].

2 Research Methods

The ship is said to be stable if it does not tilt right or left or also does not experience stern or bow trim, so if the ship gets an external force such as being hit by a wave it does not tilt the ship can return to normal state. one of the causes of ship accidents, which often occur on the high seas, is the role of the crew who do not pay attention to vessel stability calculation as a result can hamper the general equilibrium which as a result can cause fatal accidents such as theship cannot be controlled, lose equilibrium and even sink which in the end can harm the ship, human life and even themselves. Therefore, ship stability is very necessary in building new ships so that we can simulate when the ship is empty and when the ship is full so that safety andtranquility of sailing can be achieved.

In this study, the calculation of ship stability was carried out using Maxsurf stability, by modeling the ship in maxsurf modeler then inpute load case in maxsurf stability by taking into account International Maritime Organization criteria (IMO) regulations.

We can use the tilt period to calculate the stability measure. In addition, it is a reference that can be used to assess stability measures. The period of sway is related to the metacentric height. One complete period of tilt is the period of time required from when the ship is upright,tilts left, upright, tilted right until it returns to upright again illustrating the relationship betweenmetacentric height (GM).

$$Tr = \frac{2\pi \, x \, c \, x \, B}{\sqrt{g} \, x \, MG} \quad (1)$$

Good stability if the amount of metacentric height (GM) is positive [2]. To calculate the amount of GM can use the equation below

$$GM = CB + I/V - CG$$

Where:
CB : Center Of Bouyancy
I : Moment of Inertia of the Cross Section
V : Voume
CG : Center Of Gravity

2.1 Identification of problems

At this stage, observations are made on the fishing boat which will be modified into a passenger ship, which is very concerned, especially on the fish trunk which will be converted into a passenger seat and changes to the ship's building and the ship's engine is also changed using a Mitsubishi 4D56 engine.

Table 1. Main Data

Vessel type	Before modification Fish Vessel	After modification Passenger ship
Lpp	9.50	9.8
B	1.8	1.8
H	1	1
T	0.6	0.6
vS	15	20

2.2 Ship modeling

Ship modeling for general plans is done using Autocad software and for 3D models is done using maxsurf Modeler advanced software, the following images are before and after modification.

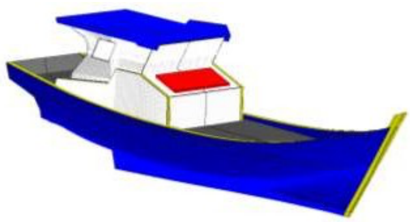

Fig. 1. 3D vessel before modification

Fig. 2. 3D vessel after modification

2.3 Vessel Stability Criteria

The ship stability analysis to be performed shall be in accordance with the stability criteria contained in IMO Code A 749 (18) Chapters 3 - Design Criteria for all ship, which requires thefollowing provisions

a. Part A.749 (18), Chapters 3.1.2.1
   - Value GZ at an corner of 0º-30º (deg) should not be less than or equal to 3.151meters. degrees.
   - Value GZ at an corner of 0º - 40º (deg) should not be less than or equal to 5.157meters. degrees.
   - Value GZ area at an angle of 30º - 40º (deg) shall not be less or equal to 1.719meters. degrees.

b. Part A.749 (18), Chapters 3.1.2.2: the max GZ value occurring at an corner of 30º-180º(degrees) shall not be less than or equal to 0.2 meters.

c. Part A.749 (18), Chapters 3.1.2.3: the corner at which the maximum GZ value occursshould not be less than or equal 25 (degrees).

d. Part A.749 (18), Chapters 3.1.2.4: initial GM value at corner of 0º (degrees).

3 Result and Discussion

After obtaining the main size of the ship, the new ship modeling will be carried out using the advanced maxsurf modeler software shown in Figure 3 above and also attempted to be precise with the old hull and the manufacture of the upper building with the new model, the main size of the ship is a consideration since the use of the ship to be built only focuses on the upper building model.

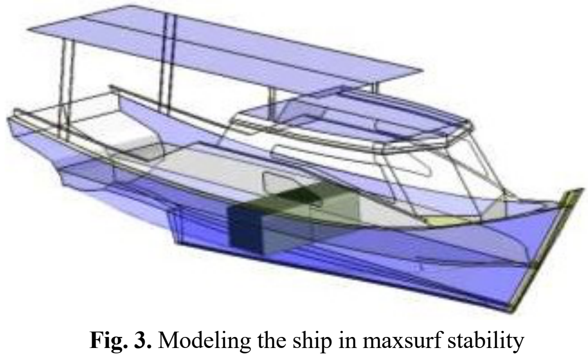

Fig. 3. Modeling the ship in maxsurf stability

Determination of the calculation of ship stability simulation for the first time is lightship or empty ship weight and ship equipment and then simulation for fullload or ship in full conditionwith fuel and passengers. Under lightship conditions, the results obtained from the total load case with a total mass of 2 tons, a long arm of 3.598 m, and a vertical arm of 0.004 m. While the results obtained from the VCG fluid on the vertical arm are 0.020 m. While in full load conditions the results of the total loadcase with a total mass of 2.8 tons, long sleeves of 2.986 meter, and upright axis of 0.063 meter are obtained. While the result obtained from the VCG fluid on the vertical arm is 0.063 meter.

3.1 Analysis of ship stability

From the calculation ship stability simulations use maxsurf stability software that has been carried out by varying the number of passengers and fuel, it shows that the stability of fishing boats that have been modified into passenger ships still meets the requirements of the qualifications of the International Maritime Organization (IMO).

In LWT conditions or in empty ship conditions is the condition of the ship where there is no cargo and there is only the weight of the ship's weight machine based on the simulation results obtained can be seen in Figure 4.

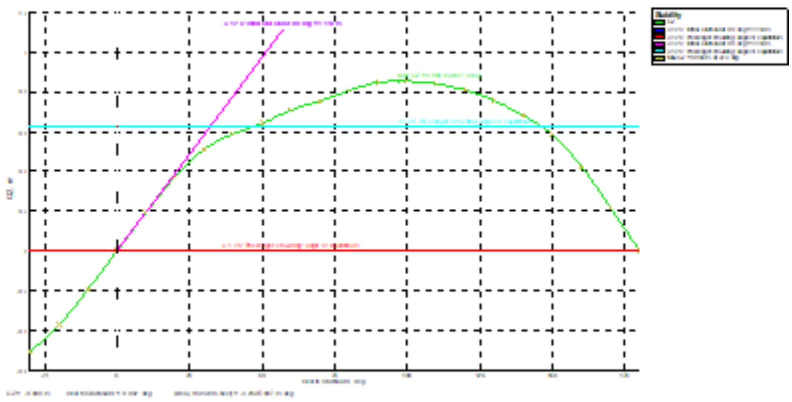

Fig.4. GZ graph of empty vessel condition

After that, the calculation of the ship's tilt period is carried out in LWT conditions or in empty ship conditions. Calculations are made using the following formulas

$$Tr = \frac{2\pi \; x \; c \; x \; B}{\sqrt{g} \; x \; MG}$$

$$= \frac{2\pi \; x \; 0.45 \; x \; 0.8}{\sqrt{9{,}81} \; x \; 1{,}19}$$

= 0.60 second

Furthermore, in Full load conditions or in full ship conditions is a ship condition where the ship is full of cargo based on the simulation results obtained can be seen in Figure 5.

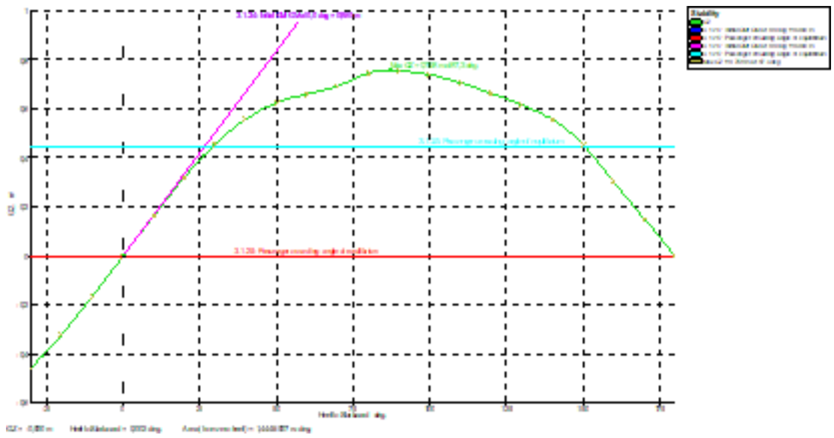

Fig. 5. Full ship condition GZ graph

After that, the calculation of the ship's tilt period is carried out in LWT conditions or in empty ship conditions. Calculations are made using the following formulas

$$Tr = \frac{2\pi \ x \ c \ x \ B}{\sqrt{g} \ x \ MG}$$

$$= \frac{2\pi \ x \ 0.45 \ x \ 0.8}{\sqrt{9{,}81} \ x \ 1{,}19}$$

= 0.75 second

3.2 Discussions

From the calculations that have been carried out in maxsurf stability the fishing boat that has been modified into a passenger ship still meets the qualification standards set by the International maritime organization (IMO) can be seen in tables 2 and 3.

Table 2. Analysis result on empty vessel

Criteria	Value standart	Unit	Actual	status
0 to 30	3,1513	m.dag	8,2894	passed
0 to 40	5,1566	m.dag	13,8288	passed
30-40	1,7189	m.dag	5,5394	passed
value GZ at 30^0	0,200	m	0,848	passed
Anggle Max GZ	25,0	dag	97,3	passed
Initial GMt	0,150	m	1,119	passed

Table 3. Analysis result at full ship

Criteria	Value standart	Unit	Actual	status

0 to 40	5,1566	m.dag	12,2842	passed
30-40	1,7189	m.dag	5,1092	passed
value GZ at 30^0	0,200	m	0,758	passed
Anggle Max GZ	25,0	dag	87,3	passed
Initial GMt	0,150	m	0,960	passed

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