ANALYSIS OF STABILITY, RESISTANCE AND SEAKEEPING ACCORD TO DIMENSION AND FORM OF FISHING VESSEL 30 GT

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ABSTRACT

Fishing vessels are used to catch and to gather resources from the sea have to pass some of the regulations from International Maritime Organization (IMO) for sea-worthiness of the vessel especially about stability, resistance and propulsion to acquire the highest velocity possible, and the vessel's motion. This research discuss the effect of the vessel's dimension and the hull shape by using the stability standard from IMO. The simulations are approached by utilizing method from IMO.

The result shows that the ratio of the breadth - draught which meets the stability criteria is 2.50 with the ratio of the center of gravity and the height of the vessel is 0.65, with the assumption that the center of gravity and the height of the vessel are more than 0.70, so the ratio of the freeboard and the breadth of the vessel is not more than 0.14. Whereas if the resistance ratio B/T is big, then the resistance for the vessel will be relatively smaller. In terms of the vessel motion, a vessel with U-type hull will be much better than the V-type hull in the roll and pitch motion.

Keywords: Fishing Vessel, Stability, Resistance, Vessel Motion, Hull Type

INTRODUCTION

Fishing vessels are ships used in fisheries activities that include capture or collection activities of aquatic resources, management of aquatic resources, and use in research work, training and inspection of water resources (Nomura & Yamazaki, 1977). In an effort to preserve fish resources and sustainability of fishing business, Indonesia is committed to implement Code of Conduct for Responsible Fisheries (CCRF).

In the early stages of designing the determination of principal dimension and geometric characteristics related to performance problems (resistance and propulsion) as well as those related to safety issues (stability, strength and maneuvering) should be predictable. Preliminary predictions can be made based on the ship's ratio (Phoels, 1979). Fishing vessels in Indonesia have a different form. Theoretically, the waters where the vessel will be operated and the method of operation of the fishing gear operated by the vessel very affects the form of the ship's. For example, fishing vessels that operate fishing gear with static operation, are more useful if they have a U-type. This is caused when the ship begin operation, ships more in a state of silence in the middle of the waters. This condition resulted in the influence of external factors, in this case ocean waves, very dominating the variety of ships in the sea. Therefore, ships that operate static fishing gear need high stability.

It can be said that the form of hull is one of the technical factors that contribute to the success in the operation of ships at sea. In addition to note some aspects of one important that needs to be considered is about the ability of movement due to sea water waves in the waters traversed. This relates to the motion of the ship which is the response from the outside forces acting on the vessel. Movements caused by outer forces that work or sea water waves will affect the safety and comfort of the crew of the fish itself.

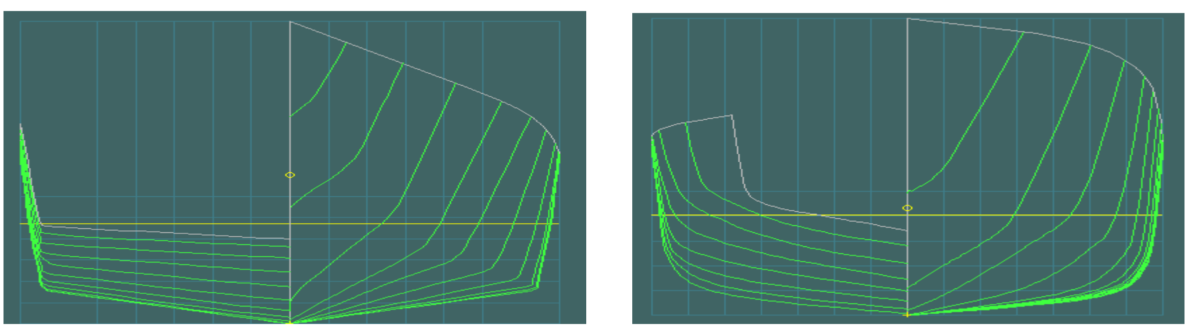
EXPERIMNETARL SET UP

This study uses fishing vessel samples that have different hull forms.

Table 1. The Main Dimension of Fishing Vessel Sample

No.	Main Dimension	Unit	30 GT
1	Loa	M	20
2	B	M	4,3
3	High	M	2
4	Draft	M	1,35
5	Fb	M	0,65
6	Coefficient block (Cb) U/V	-	0,61/0,551
7	B/T	-	3,18
8	Fb/B	-	0,15
9	Crue	Orang	12
10	Velocity (Vs)	Knot	9

In order to observe the effect of the ratio between the width and draft to the stability, the draft are varied with a fixed width. Variations of ships are carried out by taking 2 (two) smaller draft design and bigger draft design



(a) (b)

Figure 1. *Body Plan* 30 GT (a) V- Type (b) U- Type

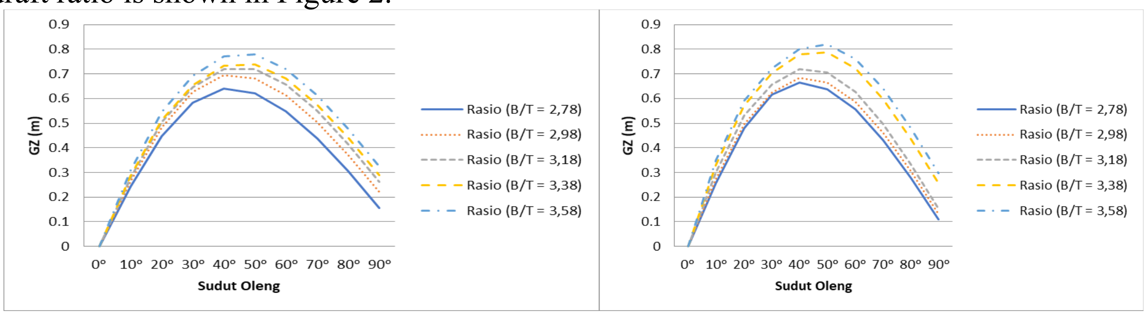
The same method is carried out to observe the effect of comparison between freeboard and the width of the ship. At each variation of the ratio, the ship's stability arm is calculated and evaluated by IMO stability criteria (IMO, 2008).

The influence of superstructure on the arm of stability is not calculate. Based on the results of stability arm calculations and evaluation results on the IMO stability criteria, changes in characteristics of arm stability as a function of two major size comparisons can be obtained. The effect of the crew moment, the moment of the cycles, and the likelihood of a load shift when a ship with a large angle is calculate into this analysis

RESULT AND DISCUSSION

Ratio Width and Draft

The result of the arm stability calculation for the sample vessel at each width and draft ratio is shown in Figure 2.



(a) U- Type (b) V-Type

Figure 2. Arm Stability of 30 GT U and V

The figure above shows the arm stability movement for the 30 GT vessels of U and V type from the smallest to the largest ratio. On type U the ratio of small arm stability is at the bottom of 2.78, while for the largest ratio is 3.58. A large B / T ratio has a large area of arm stability arm compared to a small B / T ratio as shown in FIG. 2.

Of the five ratios for the 30 GT U type, the best performs in catching performance is at a ratio of 3.58. While the stability arm movement for the 30 GT U-type vessels stability arm ratio is small at 2.78, while for the largest ratio is 3.58. A large B / T ratio has a large stability arm area compared with a small B / T ratio. Of the five ratios for the best 30 GT V-type vessels in the catching performance are at a ratio of 3.58 as shown in Fig. 2. So the larger the width and the draft ratios, the greater the stability arm. This is similar to what is said by Daeng Paroka (2012).

The smaller of draft, the angle of the tilt until the edge of the deck sinks into the water will also increase. The width of the water line of the vessel will increase with increasing angle to the slope angle where the edge of the deck is immersed in water. In general, the area under the arm curve of stability for all width and draft ratio satisfies the criteria of IMO stability.

Compared Stability between U and V Type

The ratio used for this type of vessel is at the time of maximum draft design when the ship is sailing.

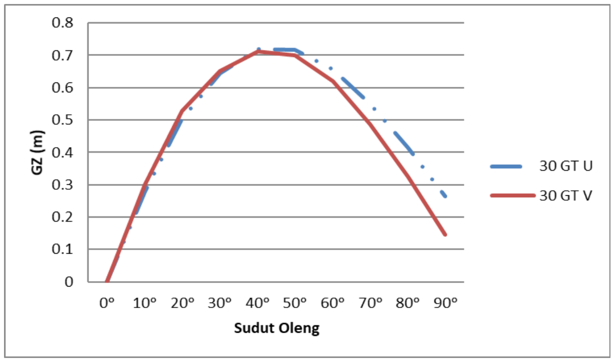


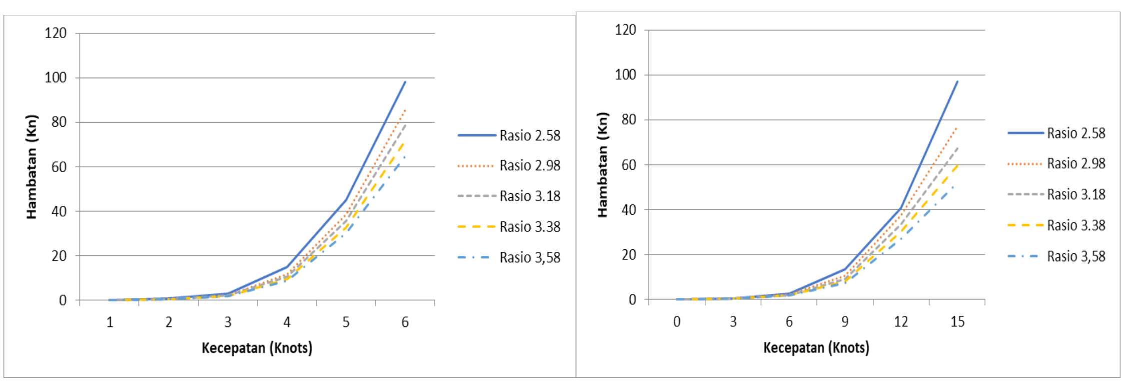
Figure 3. Compared arm stability of 30 GT

Figure 3 shows that stability with hull U Type is better than V Type. Arm Stability for U type vessels has a larger area compared to V-type vessels. This is due to the different shape of the cross section where the shape of the cross section U is wider than the shape of the cross section V. Therefore the value of BM or radius metacentre at a certain angle becomes greater who conduce resulting in the arm stability becomes greater. The value of the BM is influenced by the moment of greater inertia at a certain angle that causes the BM value to be large.

Influence of Width and Draft Ratio to Resistance

The results of the arm stability calculation for the sample vessel for each width and draft ratio are shown in Figure 4. From both figures shows the smallest ratio has a small resistance. This means that the larger the width and draft ratio, the less resistance the ship will experience. Therefore, the small resistance of the vessel will make the vessel more efficient in conducting fishing operations.

This is due to the effect named Wet Surface Area of the ship (Wetted Surface Area) becomes smaller along with the large ratio of width and draft.



(a) (b)

Figure 4. Resistance Vs Speed Curve on 30 GT (a) U Type and (b) V Type

If the WSA is small then the ship's resistance will be small and otherwise if the WSA is big then the ship's resistance will get bigger. The size of the WSA is affected by the freeboard from the ship itself. If the freeboard arise large, so WSA will be small but if the freeboard arise small then WSA will get bigger. This is also found in the formula developed by Holtrop, where WSA or S affects the value of the total resistance of the vessel itself.

Compared Resistance U-Type and V-Type

Figure 5 shows that the resistance of type U hull is larger than type V. This is due to the difference in cross-sectional shape in which the shape of the U-section is wider than that of the V cross section.

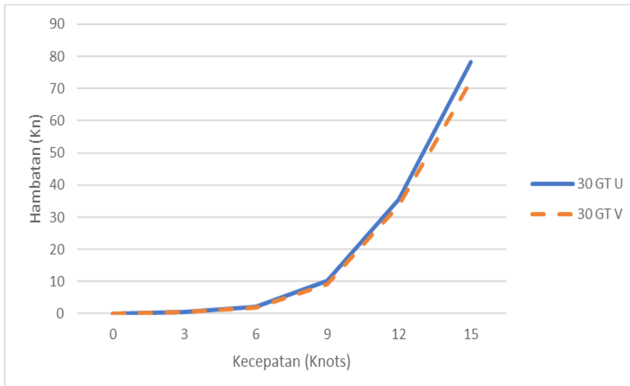


Figure 5. Compared Resistance Ships 30 GT

Therefore the value of WSA becomes bigger which resulted in resistance to be even greater. In addition to the WSA factor, the hull of a V-type ship is slimmer than that of type U. That is why WSA V-type is smaller than that of a U-type ship. So in the case of resistance, vessels with V-type is more suitable for catching operations considering this type more efficient than type U Because it can save fuel.

Seakeeping Analysis

The table below shows the performance on the 30 GT GT type U and type V

Table 2. Seakeeping of 30 GT (U) for *Following Seas*

Wave High (m)	RMS of Vertical Acceleration (at Working Deck AP & FP)	RMS of Lateral Acceleration (at Working Deck Ap & FP)	RMS of Pitch	RMS of Roll	Status
0,5	0,032 & 0,032	0	0,6	0	Pass
1	0,063 & 0,064	0	1,19	0	Pass
1,5	0,095 & 0,096	0	1,79	0	Pass
2	0,127 & 0,128	0	2,39	0	Pass
2,5	0,159 & 0,160	0	2,99	0	Pass
3	0,190 & 0,192	0	3,58	0	Fail

In following seas condition, the ship is only capable of operating well at a maximum wave height of 2.5 meters because the RMS of Pitch at an altitude above 2.5 meters exceeds the standard.

Table 3. Seakeeping of 30 GT (U) for *Beam Seas*

Wave High (m)	RMS of Vertical Acceleration (at Working Deck AP & FP)	RMS of Lateral Acceleration (at Working Deck Ap & FP)	RMS of Pitch	RMS of Roll	Status
0,5	0,151 & 0,091	0,325	0,29	1,66	Pass
1	0,302 & 0,183	0,649	0,57	3,33	Pass
1,5	0,452 & 0,274	0,974	0,86	4,99	Pass
2	0,603 & 0,366	1,298	1,14	6,66	Fail
2,5	0,754 & 0,457	1,623	1,43	8,32	Fail
3	0,905 & 0,549	1,947	1,72	9,98	Fail

At the moment the beam seas condition of the vessel is only capable of operating well at an altitude below 1.5 meters because the RMS of Roll at an altitude above 1.5 meters exceeds the standard

Table 4. Seakeeping of 30 GT (U) for *Head Seas*

Wave High (m)	RMS of Vertical Acceleration (at Working Deck AP & FP)	RMS of Lateral Acceleration (at Working Deck Ap & FP)	RMS of Pitch	RMS of Roll	Status
0,5	0,234 & 0,375	0	1,48	0	Pass
1	0,468 & 0,749	0	0,95	0	Pass
1,5	0,703 & 1,124	0	1,43	0	Pass
2	0,937 & 1,5	0	1,9	0	Pass
2,5	1,171 & 1,873	0	2,38	0	Pass
3	1,405 & 2,248	0	2,86	0	Fail

In the condition of head seas, RMS of Vertical Acceleration with wave height above 2.5 meters is in critical condition. From the above description it can be concluded that the fish ship 30 GT type U is able to operate well in waters in Indonesia whose high waves ranged from 0.5 to 1.5 m

Table 5. Seakeeping of 30 GT (V) forr *Following Seas*

Wave High (m)	RMS of Vertical Acceleration (at Working Deck AP & FP)	RMS of Lateral Acceleration (at Working Deck Ap & FP)	RMS of Pitch	RMS of Roll	Status
0,5	0,033 & 0,034	0	0,68	0	Pass
1	0,067 & 0,068	0	1,27	0	Pass
1,5	0,100 & 0,101	0	1,9	0	Pass
2	0,133 & 0,135	0	2,54	0	Pass
2,5	0,167 & 0,169	0	3,17	0	Fail
3	0,2 & 0,203	0	3,51	0	Fail

Table 6. Seakeeping of 30 GT (V) for *Beam Seas*

Wave High (m)	RMS of Vertical Acceleration (at Working Deck AP & FP)	RMS of Lateral Acceleration (at Working Deck Ap & FP)	RMS of Pitch	RMS of Roll	Status
0,5	0,155 & 0,129	0,271 & 0,339	0,33	1,68	Pass
1	0,311 & 0,166	0,542 & 0,678	0,66	3,35	Pass
1,5	0,466 & 0,386	0,813 & 1,071	0,99	5,03	Pass
2	0,621 & 0,514	1,084 & 1,356	1,32	6,71	Fail
2,5	0,776 & 0,643	1,355 & 1,695	1,65	8,38	Fail
3	0,932 & 0,772	1,626 & 2,034	1,98	10,06	Fail

Table 7. Seakeeping of 30 GT (V) for *Head Seas*

Wave High (m)	RMS of Vertical Acceleration (at Working Deck AP & FP)	RMS of Lateral Acceleration (at Working Deck Ap & FP)	RMS of Pitch	RMS of Roll	Status
0,5	0,211 & 0,412	0	0,52	0	Pass
1	0,422 & 0,824	0	1,04	0	Pass
1,5	0,634 & 1,236	0	1,56	0	Pass
2	0,845 & 1,649	0	2,08	0	Pass
2,5	1,056 & 2,061	0	2,60	0	Fail
3	1,267 & 2,473	0	3,12	0	Fail

From the three tables above for the 30 GT vessel V-type is found that some do not meet the criteria of Tello. In following condition the vessel is only capable of operating either on the High Wave below 2 meters because the RMS of Pitch at an altitude above 1.5 meters exceeds the standard. When the beam seas conditions wave conditions above 1.5 meters, roll motion does not meet the criteria that required. According to Tello, roll motion should be below 6 degrees, but in this condition the ship exceeds the standard and only able to operate well at an altitude below 1.5 meters. In the condition of head seas, RMS of Vertical Acceleration with wave height above 2 meters exceeds the standard set by Tello.

From the above description it can be concluded that the fishing vessel 30 GT type V is able to operate well in waters in Indonesia whose wave height ranges from 0.5 to 1.5 meters.

If seen from the results of the above analysis shows that seakeeping vessel 30 GT U as well as the type V. Performance type U is the same as type V because it can sail well at 2 meters wave height. Seakeeping hull U type vessels is better than type V. Because the shape of the hull U type is superior to the stability of type V. This can be seen in the Table, although it operates in the same wave high roll motion and the pitch motion of type U is smaller than the type V. This meaning that motion and motion pitch motion of type U is better than type V

CONCLUSION

1. Stability hull U- Type is better than V-Type
2. Seakeeping hull U-Type is better than V-Type
3. Resistance with U-type is bigger than V-type

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