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MODIFICATION OF 30 GT FISHING VESSELS USING HULL VANE NACA 2408 TYPE FOR REDUCING SHIP RESISTANCE

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ABSTRACT

With the territory of Indonesia which is mostly waters, fishing vessels are an important transportation tool in Indonesia to support the economic needs of the community, especially in coastal areas. When a ship sails, ship resistance will occur, and to achieve high effectiveness, the goal of all ship design processes is to obtain as little obstacles as possible. Modifications to the ship by adding Hull Vane mounted under the hull of the ship is done so that at high speed, Hull Vane can produce lift that can reduce obstacles that occur on the ship. This study uses a computer program based on Computational Fluid Dynamic (CFD). Based on this study shows that fishing vessel with the addition of hullvane with a variation of NACA 2408 on 2 ° angle of attack with Fn 0.527 can reduce resistance about 51.53% from the ship without hullvane.

Key words: Hullvane, Fishing Vessel, and Ship Resistance.

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1. INTRODUCTION

Ships are an important means of transportation to support the needs of community registration. In the application of fishing technology, the ship is used as a fishing gear. In Indonesia, the use of fishing vessels is very important for fishermen because it is used as a transportation tool which is very important for fishing activities. According to KKP data (Ministry of Maritime Affairs and Fisheries) in 2017 ships will be made with a total of 1068 units with the provisions of 449 units under 5 GT, 498 units of 5 GT, 92 units of 10 GT, 3 units of 20 GT, 20 units of ships measuring 30 GT, and 3 units of vessels measuring 100 GT, and 3 units of vessels measuring 120 GT [1]. Although in modern times there are still many fishermen who use traditional boats because the manufacturing procedures are cheaper than steel vessels. In the development of an increasingly modern era many needs to be achieved, in terms of function, accommodation and time. Therefore a strong, economical and fast ship is needed. One aspect that is needed is a ship with high speed and small obstacles. One form of application to reduce obstacles in shipping technology is the addition of hull vane to the hull of the ship.

Small ship obstacles make the ship's engine work more efficiently so as to obtain optimal speed. Therefore, to get a minimum ship resistance, hull vane research is needed on the ship's resistance. Hull vane can be installed in new or old shipbuilding. The hull vane is located at the rear of the ship close to the propeller. The installation of hull vanes on ships is intended to reduce the running trim on high-speed vessels, causing the pitching motion of the ship to decrease. The reduced pitching motion of the ship can also make the total resistance of the ship also reduced [2].

Previous research on 750 DWT pioneer vessels using foil type NACA 2414, NACA 2410, NACA 1412, and NACA 1410, the lowest total resistance value occurred in the hull vane model NACA 1410 angle -5°. The reduction of total resistance in the model is 11,839% compared to the original ship. Treatment at an angle of 5° has the optimum results [3, 4].

This research is needed to get a good ship's performance against the ship's resistance at a smaller angle. This research was conducted using the CFD method with variations in the type of foil NACA 2408 and the hull vane position at the stern of the ship, as well as varying the number and angle of the hull vane.

2. METHOD OF RESEARCH

The foil used is the foil series NACA 2408 in Figure 1, with the specifications max thickness 8% at 29.9% chord and max chamber 2% at 40% chord.

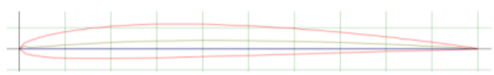

Figure 1. Foil NACA 2408

The selection of NACA 2408 was chosen based on a thinner thickness factor than the NACA that has been studied in previous studies, with a thinner thickness expected to produce optimal resistance. In this simulation, the width of the foil is equated with the width of the ship, for chord foil using 0.28 m according to the calculation.

Determination of the hull vane model is placed at the rear of the stern of the ship as previously carried out research. Figure 2 shows the hull vane model for the modification of the 30 GT Fish vessel.

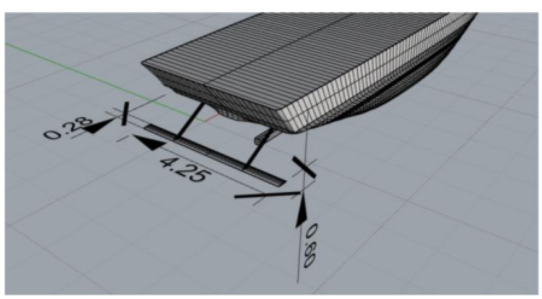

Figure 2. 30 GT Fish Boat Model with hull vane

The angle variations were taken based on previous research, the angle variations used were 5˚, 0˚, 2˚, and -5˚. The variations in the height of the foil hull vane used are: the height of the foil hull vane taken on a ship laden wl 0.3 m; 0.6 m, and 0.9 m. Intake is to look for obstacles that are more optimal. Figure 3 shows the variation in hull vane height on a ship.

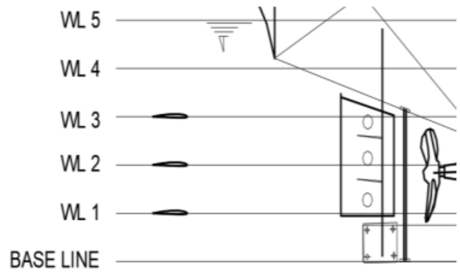

Figure 3. Variation in the height of the foil hull vane.

Ship resistance is a force that works in such a way as to inhibit the rate of the ship both being submerged in water and the hull that is above the surface of the water that is blocked by the wind [5, 6, 7]. Total ship resistance consists of:

a. Wave Resitance(Rw) are ship resistance caused by two or more objects rubbing together and the direction opposite to the direction of the object's motion.

$$Rw = 1/2\ \rho.Cw.s.v^2 \quad (1)$$

where :

Cw : wave resitance coefficient

s : wet surface area of ship

v : ship speed (m/sec^2)

b. Viscosity Resistance (Rv) are ship resistance that occur due to the effect of fluid viscosity. This means that each fluid will produce drag when the fluid is moving or when other objects are moving against the direction of fluid flow.

$$Rvis = 1/2\ \rho.Cv.s.v^2 \quad (3)$$

where :

Cv : viscosity resistance coefficient.

3. RESULTS AND DISCUSSIONS

CFD method is applied to analyze the resistance of the original ship (without hullvane) and modified ship using hull vane. 3D ship model and mesh are needed as an input to CFD calculation. The ship will be analyzed on NACA and angle variations, height laden 0.3m; 0.6m; and 0.9m, to compare the performance of each ship. Ship models use a scale of 1:10 by real ship. For a ship validation without hull vane use the empirical method and be compared with CFD method can be seen in Table 1. In all Fn values show that the results of empirical method and CFD method are obtained closed value and almost no differences.

Table 1 Validation of total ship resistance

Fn	Empirical method (KN)	CFD method (KN)	Diff. (%)
0.307	5.57	5.6181	0.0086
0.395	14.23	14.185	0.0032
0.527	41.40	41.271	0.0031

The resistance values of a 30 GT fishing vessel using hullvane are obtained by twice stages of CFD calculation. First stage is used to get the lift value and the moment of trim of ship. Then the second stage calculates the ship resistance when the ship is lifted and has a trim position. The total resistance of the ship is obtained from the sum of two components of the total resistance, that is viscosity resistance as well as wave resistance.

Table 2. Total resistance of ship with hull vane angle 0° (KN)

Fn	Model	Model with hullvane		
	Without hullvane	1	2	3
0.307	5.6183	7.9730	7.2946	8.0906
0.395	14.1854	12.2349	14.328	12.861
0.527	41.2723	22.097	21.854	22.26

Table 2 shows the total resistance value with hull vane angle 0^0. The total resistance value at Fn 0.307 has the highest value about 8.0906 KN for model 3 while the smallest value is 7.2946 KN for model 2. At the Fn 0.395, the highest value is 14,328 KN for model 2 while the smallest value is 12,861 KN for model 3. At the Fn 0.527, the highest value is 22.26 KN for model 3 while the smallest value is 21,854 KN for model 2.

Table 3. Total resistance of ship with hull vane angle 2° (KN)

Fn	Model	Model with hullvane		
	Without hullvane	1	2	3
0.307	5.6183	7.5484	7.3852	8.4783
0.395	14.1854	13.491	13.353	13.313
0.527	41.2723	22.616	22.022	20.006

Table 3 shows the total resistance value with hull vane angle 2^0. The total resistance value at Fn 0.307 has the highest value about 8.4783 KN for model 6 while the smallest value is 7.3852 KN for model 5. At the Fn 0.395, the highest value is 13,491 KN for model 4 while the smallest value is 13,313 KN for model 6. At the Fn 0.527 the highest value is 22,616 KN for model 4 while the smallest value is 20,006 KN for model 6.

Table 4. Total resistance of ship with hull vane angle 5° (KN)

Fn	Model	Model with hullvane		
	Without hullvane	1	2	3
0.307	5.6183	7.9178	7.9306	7.9593
0.395	14.1854	13.583	14.928	12.894
0.527	41.2723	22.988	22.693	22.166

Table 4 shows the total resistance value with hull vane angle 5^0. The value of total resistance in the Fn 0.307 has the highest value about 7.9593 KN at model 9 while the smallest value is 7.9178 KN at model 7. At the Fn 0.395 the highest value is 14,928 KN at model 8 while the smallest value is 12,894 KN fort model 9. At the Fn 0.527, the highest value is 22,988 KN at model 7 while the smallest value is 22,166 KN at model 8.

Table 5. Total resistance of ship with hull vane angle -5° (KN)

Fn	Model	Model with hullvane		
	Without hullvane	1	2	3
0.307	5.6183	5.9918	7.0269	8.3797
0.395	14.1854	11.961	12.893	12.025
0.527	41.2723	21.166	21.849	21.929

Table 5 shows the total resistance value with hull vane angle -5^0. The value of total resistance in the Fn 0.307 has the highest value about 8.3797 KN at model 12 while the smallest value is 5.9918 KN at model 10. In the Fn 0.395, the highest value is 13,025 KN at model 12 while the smallest value is 11,961 KN at model 10. In the Fn 0.527, the highest value is 21,929 KN at model 12 while the smallest value is 21,582 KN at model 10.

Figure 8 dan Figure 9 show the wave pattern in original ship model and modified ship model using hullvane on angle of attack 2^0 at Fn 0.527.

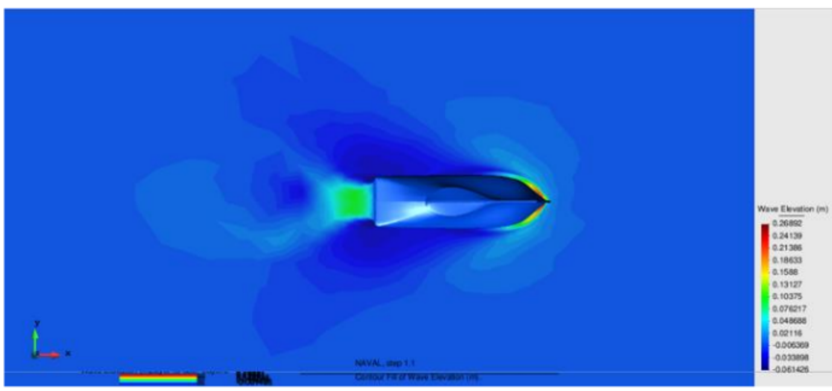

Figure 8. The wave pattern of original ship model in Fn 0.527

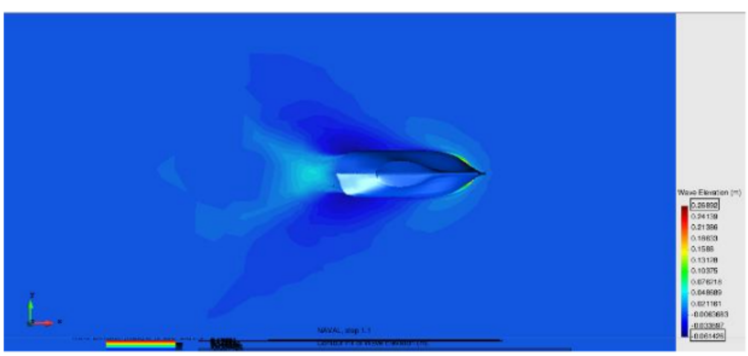

Figure 9. The wave pattern of hullvane ship model with angle of attack 2^0 at Fn 0.527

4. CONCLUSION

Adding hullvane in 30 GT fishing vessel at low speed can increase total resistance. While the addition of hullvane at high speed can reduce total resistance because the surface area of the ship which is immersed in water is getting smaller which is influenced by the trim and heave forces on the ship.

The lowest total resistance value occurs in the angle of attack 2° for position of hullvane at fishing vessel. The reduction of total resistance on this ship is reduced by 51.53% for Fn 0.527.

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2. Modification of 30 Gt Fishing Vessels Using Hull Vane Naca 2408 Type For Reducing Ship Resistance

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