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Analysis Design Results of Kort Nozzle on Yamaha 15 HP Outboard Motor Propulsion System Towards Increasing Ship Speed

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***Keywords*— Kort Nozzle, Propulsion, Yamaha Outboard Motor.**

***Abstract*—** *Use of Yamaha outboard motors There are very many small farmers (tuna fishermen) with a capacity of 1.5 GT in the Leahari country, South Leitimur sub-district, Ambon city. Apart from being used for fishing, it should also be used to sell the catch to the receiving company, but in reality the sales process to the company uses a rental motorcycle taxi. One of the factors that need to be considered in the process of planning and building a ship is a good propulsion system, the propulsion system itself is Propeller design planning. Propeller is one aspect that must be planned properly in order to achieve the purpose of the ship's function in terms of speed. Propeller that uses a kort nozzle is called a ducthed propeller. The phenomenon that occurs in propeller enclosed in a tube (kort nozzle) is that the velocity of the water flow inside the tube is faster than the flow of water outside the tube resulting in lower pressure inside the tube than the pressure outside the tube. . This pressure difference results in an additional thrust (thrust). In this study, the method used is experimental and statistical tests in which the author will examine the use of a kort nozzle on the Yamaha 15 HP outboard motor propulsion system which is expected to increase the speed of the ship so that fishermen can use vessel to sell their tuna catches to receiving companies.*

I. INTRODUCTION

The use of a Yamaha 15 HP outboard motor on small fishing vessel (tuna fishermen) with a capacity of 1.5 GT (Leahariccountry, South Leitimur sub-district, Ambon city is very much in meet. Apart from being used for fishing, it should also be used to sell the catch to the receiving company, but in reality, because the location of the company is quite far away, the sales process to the company uses a rental motorcycle taxi.

In the process of planning and building a ship, several factors need to be considered in order to achieve shipbuilding goals. Important factors in order to achieve the desired maximum speed of the ship are hull planning, engine systems, safety systems, and good propulsion systems.[5]

The propulsion system it self is the propeller design plan. Propeller is one aspect that must be planned properly in order to achieve the purpose of the ship's function in terms of speed. The speed of the ship is inseparable from a good propeller design in order to get the thrust generated by the propeller motion.[7]

Propellers that use a nozzle nozzle are called ducted propellers. kort nozzle wrapper propeller in the form of a foil-shaped plate.[1]

High thrust loads provide low efficiency, whereas low thrust loads provide high efficiency. Thus, the efficiency

of the propeller can be increased, which means an increase in the propulsive quality of the ship, by reducing the thrust load.[5]

Phenomenon that occurs in propeller enclosed in the tube (kort nozzle) is the speed of water flow inside the tube faster than the flow of water outside the tube resulting in lower pressure inside the tube than outside the tube. This pressure difference results in an additional thrust (thrustt), with the installation of a nozzle nozzle on the propeller, there can be an increase in thrust or thrust.[6]

In this study, the author will examine the use of the nozzle nozzle outboard motor propulsion system Yamaha which is expected to increase the speed of the ship so that fishermen can use the ship to sell their tuna catch to receiving companies.

II. RESEARCH METHODS

The method used in this research is field testing or experiments conducted on 10 -12 May 2022 in Negeri Leahari country, South Leitimur sub-district, Ambon city, Maluku province. The tests carried out include speed testing and thrust testingona Yamaha 15 HP engine that uses a kort nozzle and does not use a kort nozzle.

Tools and materials used in this study include:

Tools :

- Tuna Boat (1.5 GT)
- Yamaha Outboard Motor 15 HP
- Kort Nozzle
- Stop Watch
- Weights and Buoys
- Digital hanging scales and load belts
- "L" wrench
- Ples screwdriver
- Mines screwdriver
- Field Roll Meter (100 Meters)
- Digital Tachometer

Material :

- 12” Nylon rope
- Fuel
- 2T Mediterane Oil
- Majun

III. RESULTS AND DISCUSION

Propulsion

System The propulsion system on ships is generally divided into 3 main components, namely : the main engine, the transmission system and the propulsor (movement equipment). These three main components are an integral part of the planning process that cannot be reviewed separately. Errors in the design, will have very large consequences for the following conditions:

1. Not achieving the planned service speed of the ship
2. Fuel oil consumption is not efficient
3. The economic value of the ship decreases
4. Influence on the level of vibration that occurs on the hull.

The way the ship propulsion system works is the main engine as the main power provider which then provides power to the transmission system. The amount of power received by the transmission system depends on the efficiency of the main engine. The power that enters the transmission system will be forwarded again to the propulsor, so that the propulsor which functions as a ship propulsion device will move due to the Effective Horse Power received from the transmission system.

Vessel and Engine

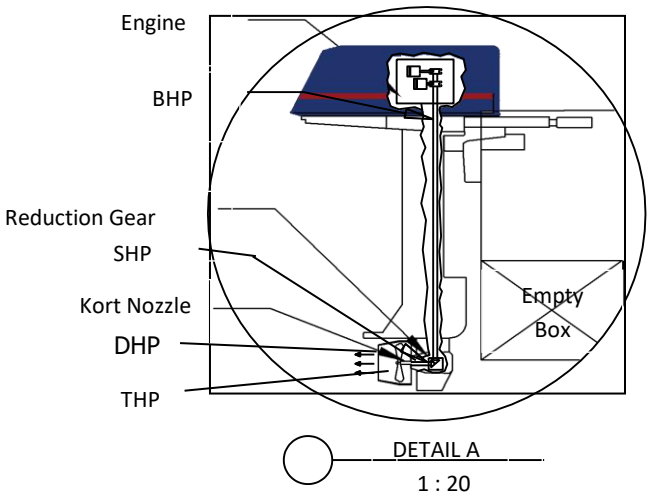

Figure 1. Ship Propulsion System

Engine Data

Brand	: YAMAHA
Type	: FMH
Power	: 15 HP
Output Power	: 11 KW
Weight	: 36 – 38 Kg
Diameter x Step	: 56.0 mm x 50.0 mm

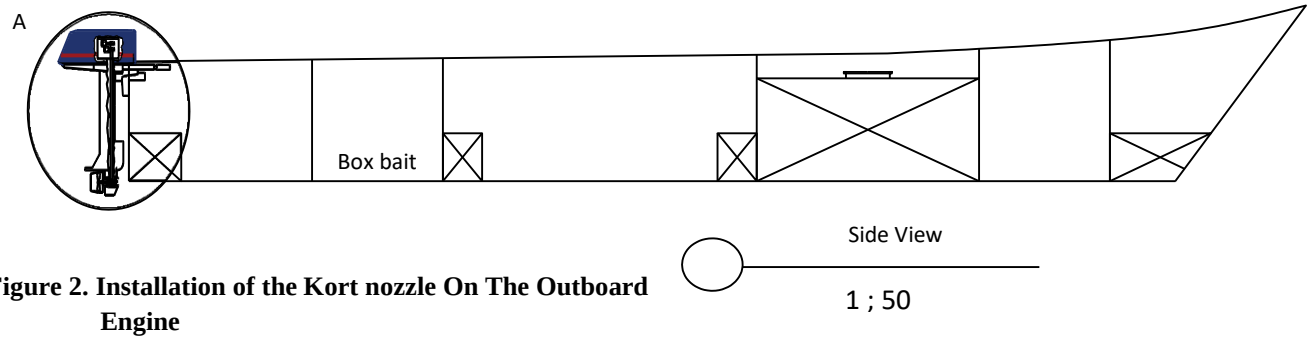

Figure 2. Installation of the Kort nozzle On The Outboard Engine

Data Vessel Data

Length (LOA)	: 09.00 m
Waterline Length (LWL)	: 08.55 m
Overall Width (B)	: 01.25 m
Deck Height (H)	: 00.75 m Draft
Height (T)	: 00.60 m
Gross Weight (GT))	: 01.50

Power Calculation – Power on Ship Propulsion System

a. EHP (Effective Horse Power)

Effective Horse Power or effective thrust of the ship can be calculated by the formula[6] as follows:

EHP = R_T x V_S (HP)

Where :

EHP = Effective

power R_T =Total Resistance, (Kg)

V = Vessel service speed, (m/s)

b. THP (*Thrust Horse Power*)

thrust *propeller* can be calculated by the formula[6] as follows :

THP = T x VA (HP)

Where :

THP = Thrust

T = Thrust

VA = Advance velocity of fluid flow in the *propeller* disc (m/sec).

c. *DHP (Delivered Horse Power*)

Delivered Horse Power or power delivered to the *propeller*, can be calculated by the formula[6] as follows :

DHP = EHP/PC, (HP)

Where : PC = *efficiency Propulsive*,

which can be calculated by the following formula :

PC = _0.η_R.η_H

Where :

O = *Propeller efficiency*

H = rotative efficiency, the value is taken from 1.

Relative = Efficiency of the hull which can be calculated by the formula:

H = (1-t)/(1-w)

d. SHP (*Shaft Horse Power*)

Shaft Horse Power (SHP) is the power measured up to the area in front of the*stern tube*bearing of the ship propulsion shaft system. *Shaft Horse Power* (SHP) can be calculated by the formula[6] as follows:

SHP = DHP/η_S, (HP)

Where :

DHP = Power supplied to the propeller, (HP)

S = Efficiency on the propeller shaft

e. BHP (*Brake Horse Power*)

BHP or brake power measured at the flange between the *gearbox* and *thrust_* bearing is calculated by the formula[6] as follows:

BHP = DHP/(η_S . _gear), (HP)

Where :

S = Efficiency on propeller shaft

gear = Efficiency of reduction gear

f. *Speed of Advance* (V_A)

Speed of Advance or advance speed can be calculated by the formula[6] as follows:

V_A = V (1-w), (m/sec)

Where : V = Vessel Speed, (m/s)

W = current fraction with

g. T (*Thrust*)

A ship with a good thrust value can make a ship run better in terms of speed when compared to a bad thrust value under the same conditions of horse power and rpm.[4]

Thrust or *propeller* can be calculated by the formula[6] as follows:

T = R_T/1-t, (Kg)

Where : R_T = Total ship resistance, (Kg)

t = thrust fraction

Test Results and Statistical Analysis

Paired t-test (paired t -test) is a method of testing the hypothesis where the data used is not independent (in pairs). The characteristics that are most often found in paired cases are that one individual (object of research) gets 2 different treatments. Even though using the same individual, the researcher still obtained 2 kinds of sample data, namely data from the first treatment and data from the second treatment.[3]

This method was also used by the author in testing hypotheses on the sample data obtained. Both for speed and thrust.

The Trust

Table 1. Result of Trust Tes Without Kort Nozzle

No	Machine RPM (RPM)	Trust Result (Kg)/Repeat			
		1	2	3	4
1	2000	42 ,3	42.1	42.4	42.3
2	2500	51.5	51.4	51.6	51.4
3	3000	73.2	73.3	72.9	73.5
4	3500	111	111, 2	111	111. 3

Table 2. Result of Trust Tes Kort Nozzle

No	Machine RPM (RPM)	Trust Result (Kg)/Repeat			
		1	2	3	4
1	2000	45 ,5	45.4	45.2	45.2
2	2500	54.5	56,6	54.6	55
3	3000	77.5	77.3	77.4	77.6
4	3500	115. 6	115. 8	115. 4	115. 5

The results of the statistical analysis of Paired T test are as follows :

Sig 0.00

: T statistic (20.515) > t table (2.11991)

Speed Test

Table 4. Speed Test Result Without Using Kort Nozzle

No	Machine RPM (RPM)	DISTANCE	Time			
			1	2	3	4
1	2000	100	0.4979	0.4982	0.4977	0.4983
		200	1.3687	1.3691	1.3689	1.3701
		300	2.2537	2.2539	2.2536	2.254
2	2500	100	0.4100	0.4102	0.4101	0.4102
		200	1.2218	1.2220	1.2218	1.2221
		300	2.0179	2.0177	2.018	2.0179
3	3000	100	0.3384	0.3385	0.3383	0.3385
		200	1.0513	1.0512	1.0514	1.0517
		300	1.3778	1.3777	1.3780	1.3780
4	3500	100	0.284	0.2843	0.2846	0.2842
		200	0.5519	0.5521	0.5518	0.5516
		300	1.2247	1.2248	1.225	1.2248

Table 4. Speed Test Result using Kort Nozzle

No	Machine RPM (RPM)	DISTANCE	Time			
			1	2	3	4
1	2000	100	0.4591	0.4589	0.4591	0.459
		200	1.3013	1.301	1.301	1.3012
		300	2.1985	2.1984	2.1985	2.1985
2	2500	100	0.3991	0.3992	0.399	0.399
		200	1.1594	1.1594	1.1593	1.1593
		300	1.5419	1.542	1.5419	1.5418
3	3000	100	0,306	0.3058	0.3059	0.306
		200	1.0303	1.0301	1.0303	1.0302
		300	1.3534	1.3533	1.3534	1.3534

4	3500	100	0.2625	0.2625	0.2524	0.2522
		200	0.5171	0.517	0.5169	0.5168
		300	1.2025	1.2024	1.2024	1.2022

Results Statistical analysis of Paired T test as follows

Sig : 0.00

Calculation (4,071) > t table (2.01174)

Calculation of Speed and Thrust Addition of Ships Using Nozzle Kort and Not Using Nozzle Kort

Based on the experimental results and the results of statistical tests, it can be calculated the increase in speed and*thrust* for ships using *kort. nozzle* whencompared with ships that do not use *a nozzle* as follows :

Increase in Speed

Known ;

a. = Average speed of ships using *kort nozzle* = 9771.00000

b. = Average speed of ships that do not use kort nozzle = 10499.6667

c. = the difference between a and b = - 728.66667

So the increase in speed of

c / bx is 100% = 728.66667 / 10499.6667

= 6.9 or rounded to 7 %.

There is an increase in speed of 7% for ships that use the *kort nozzle* when compared to those that do not.

Calculating the travel time of ships that do not use Kort Nozzle

$$Traveling\ Time = \frac{Distance}{Speed}$$

Known :

Fishing Ground Distance to Receiving Company = 14.5 NM

Speed 7 Knots

Then :

Travel Time $= \frac{14.5\ NM}{7\ Knots}$

= 2.07 hours (124.2 minutes)

Calculating the Travel Time of a Ship Using Kort Nozzle

$$Travel\ Time = \frac{Distance}{Speed} - 7\%$$

Then :

Time $= \frac{14,5\ NM}{7\ Knot} - 7\%$

= 2.07 – 0.1449 = 1.925 hours (115.5 Minutes)

The difference in travel time for ships that use kort nozzle and those that do not use kort nozzle are :

Time using kort nozzle – time not using kort nozzle

In hours = 2.07 hours – 1,925 hours = 0.145 hours

In minutes = 124.2 minutes – 115.5 = 8, 7 minutes

Speed Test Results Without Using Kort Nozzle

Speed = $\frac{Distance}{Time}$

Then :

Speed $= \frac{14.5\ NM}{2.07}$

= 7 Knots

Speed Test Results Using Kort Nozzle

Speed = $\frac{DIstance}{Speed} + 7\%$

Then:

Speed $= \frac{14.5}{2.07} + 7\%$

= 7 + 7 % = 7.49

= 7.5 Knots

The difference in the speed of ships using a nozzle kort with those not using a kort nozzle is :

Speed using a kort nozzle – Speed not using a kort nozzle
The difference in speed = 7.5 knots – 7 = 0.5 Knots

Added Thrust

Known ;

a. = Average thrust of ships using *kort nozzle* = 73.362

b. = Average thrust of ships that do not use kort nozzle = 69,525

c. = the difference between a and b = 3.837

So the additional thrust is : c / bx 100 = 3.837 / 69.525 = 5.5%.

There is an increase in thrust of 5.5% for ships that use the *kort nozzle* when compared to those that do not.

From the results of the calculation of the speed obtained an increase in speed of 0.5 knots (926 m) so that the travel time is reduced by 8.7 minutes, although the increase in speed is not too large, the use of ships to carry the catch is still recommended to be used because the quality of the catch is maintained properly because it does not occur. repeated handling processes and on return can bring more ice.

IV. CONCLUSION

1 From the results of experiments and statistical tests carried out, there is a 7% difference in speed between ships that use a kort nozzle and those that do not use a kort nozzle.

2. With the addition of speed, it can increase the travel time to the recipient company even though it is not too big.

3. From the results of experiments and statistical tests carried out, there is a difference in thrust of 5.5% between ships that use the kort nozzle and those that do not use the kort nozzle.

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