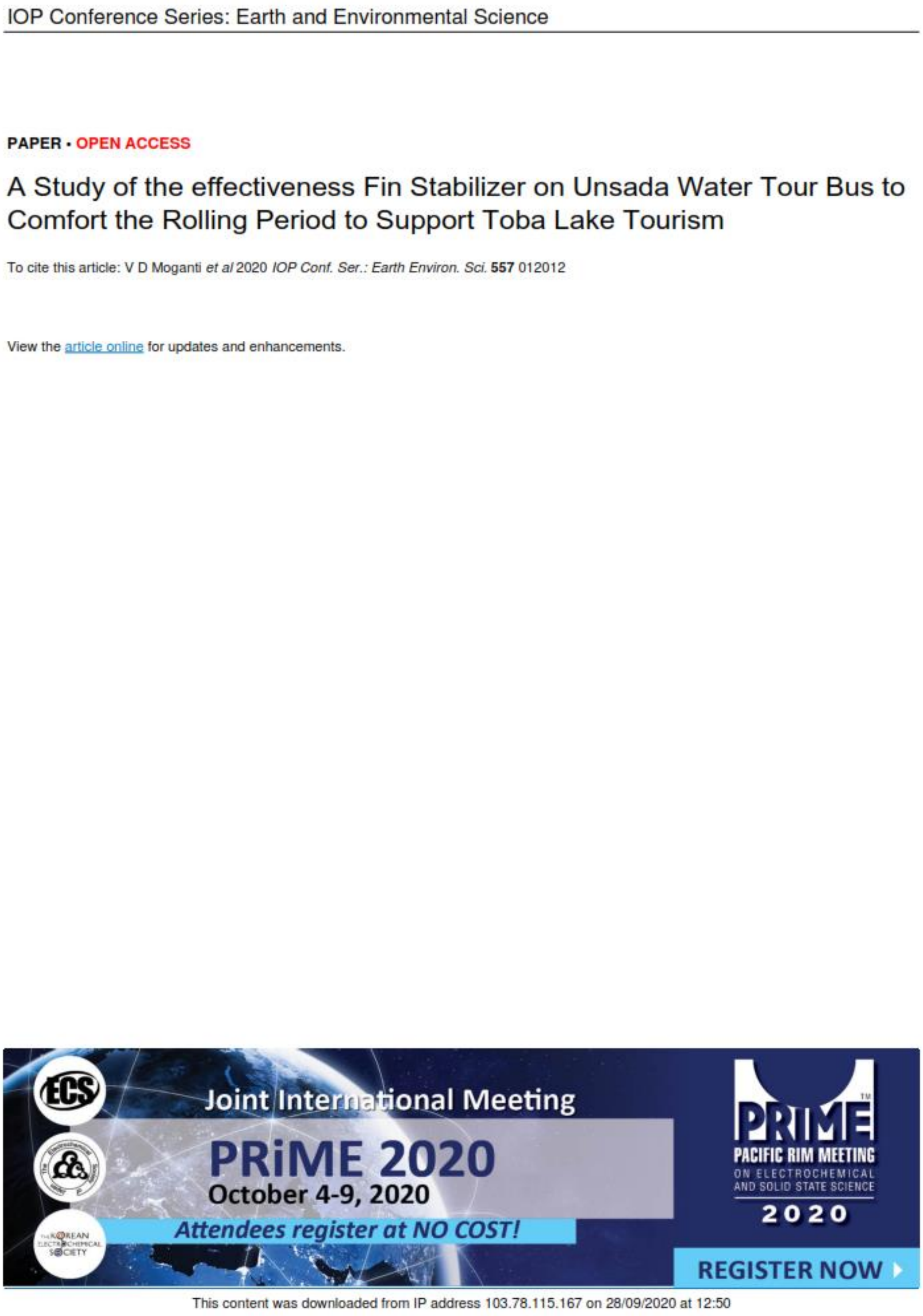
# DAFTAR LAMPIRAN

## Lampiran 1. Jurnal Penelitian Tugas Akhir MASTIC 2020



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### A Study of the effectiveness Fin Stabilizer on Unsada Water Tour Bus to Comfort the Rolling Period to Support Toba Lake Tourism

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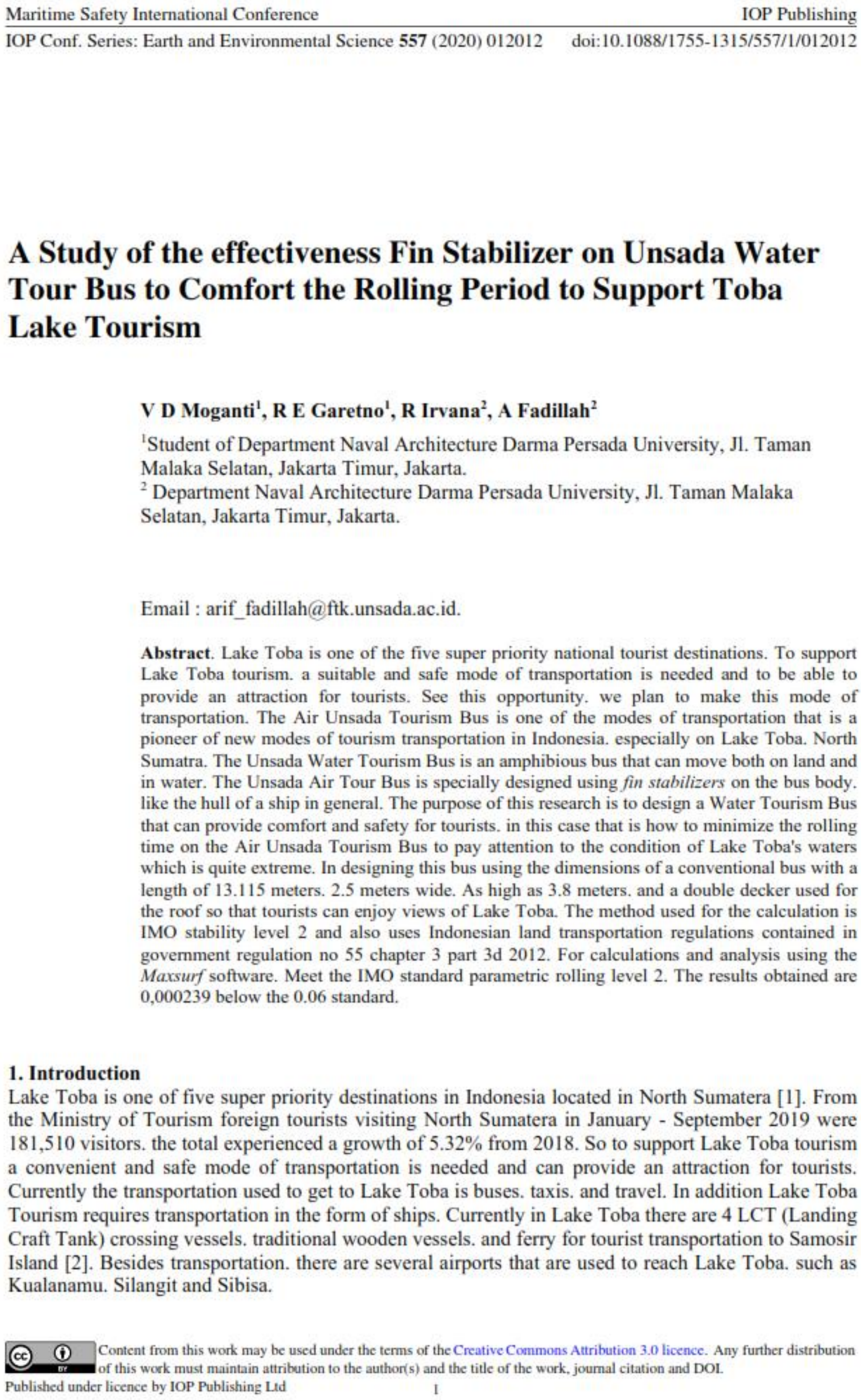

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# A Study of the effectiveness Fin Stabilizer on Unsada Water Tour Bus to Comfort the Rolling Period to Support Toba Lake Tourism

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**Abstract**. Lake Toba is one of the five super priority national tourist destinations. To support Lake Toba tourism. a suitable and safe mode of transportation is needed and to be able to provide an attraction for tourists. See this opportunity. we plan to make this mode of transportation. The Air Unsada Tourism Bus is one of the modes of transportation that is a pioneer of new modes of tourism transportation in Indonesia. especially on Lake Toba. North Sumatra. The Unsada Water Tourism Bus is an amphibious bus that can move both on land and in water. The Unsada Air Tour Bus is specially designed using *fin stabilizers* on the bus body. like the hull of a ship in general. The purpose of this research is to design a Water Tourism Bus that can provide comfort and safety for tourists. in this case that is how to minimize the rolling time on the Air Unsada Tourism Bus to pay attention to the condition of Lake Toba's waters which is quite extreme. In designing this bus using the dimensions of a conventional bus with a length of 13.115 meters. 2.5 meters wide. As high as 3.8 meters. and a double decker used for the roof so that tourists can enjoy views of Lake Toba. The method used for the calculation is IMO stability level 2 and also uses Indonesian land transportation regulations contained in government regulation no 55 chapter 3 part 3d 2012. For calculations and analysis using the *Maxsurf* software. Meet the IMO standard parametric rolling level 2. The results obtained are 0,000239 below the 0.06 standard.

## 1. Introduction

Lake Toba is one of five super priority destinations in Indonesia located in North Sumatera [1]. From the Ministry of Tourism foreign tourists visiting North Sumatera in January - September 2019 were 181,510 visitors. the total experienced a growth of 5.32% from 2018. So to support Lake Toba tourism a convenient and safe mode of transportation is needed and can provide an attraction for tourists. Currently the transportation used to get to Lake Toba is buses. taxis. and travel. In addition Lake Toba Tourism requires transportation in the form of ships. Currently in Lake Toba there are 4 LCT (Landing Craft Tank) crossing vessels. traditional wooden vessels. and ferry for tourist transportation to Samosir Island [2]. Besides transportation. there are several airports that are used to reach Lake Toba. such as Kualanamu. Silangit and Sibisa.

Based on this background. an alternative mode of transportation is needed that can be used is the Unsada Water Tour Bus. Unsada Water Tour Bus is an amphibious vehicle in the form of a bus that is specially designed by using a *fin stabilizer* on the body of the bus such as a ship's hull in general and a double decker that is used for a rooftop so that tourists can enjoy views of Lake Toba. Unsada Water Tour Bus can also function as a means of water tourism such as Lake Toba. for example. which uses this transportation to surround the lake for tourists who want to enjoy the natural scenery of the area in addition to crossing the island of Samosir.

Some of the objectives of this research are to get the best design that can provide comfort and safety for tourists in this case and to figure out how to minimize the rolling period on the Unsada Water Tour Bus to see the condition of Lake Toba's waters is fairly extreme. In designing this bus using the dimensions of a conventional bus with a length of 13.115 meters. a width of 2.5 meters. a height of 3.8 meters and redesigning the *fin stabilizer* will add to the rolling period of Unsada Water Tour Bus.

**Figure 1.** Toba lake tourism location.

### *1.1. Toba Lake*

Lake Toba is located in Bukit Province of North Sumatra. with a geographical position between 2º 21'32" – 2º 56' 28" North Latitude and 98º 26 '35 "- 99º 15 '40" East Longitude. The distance is approximately 176 km south of the city of Medan. the capital of North Sumatra Province. The lake is bordered by seven regency government areas namely Samosir. Toba Samosir. Simalungun. North Tapanuli. Humbang Hasundutan. Dairi and Karo. Lake Toba's surface area is 1,124 km$^2$ which is the largest lake in Asia. The land area of the Catchment Area is 2,486 km$^2$. Lake surface at an altitude of 903 m above sea level (surface above the sea). The maximum length is approximately 50 km and the maximum width is around 27 km

The maximum depth of Lake Toba is 508 m (which is the 9th deepest lake in the world) including the northern basin. while the maximum southern basin reaches 420 m. The approved depth is 228 m. The total water volume of the lake is estimated at 256.2 km$^3$. In the middle of Lake Toba. including

Samosir Island with an area of 630 $km^2$. which is the largest island in the world that is in an island. the outflow is around 100 $m^3$ / s. so that it can be estimated that the retention time or time needed to flush the entire lake volume is around 81 years. which is quite long compared to other lakes in Indonesia.

The annual rainfall in the Lake Toba Air Catchment area ranges from 1,700 to 2,400 mm / year. while the peak of the rainy season occurs in November - December with rainfall between 190 - 320 mm / month and the peak of the dry season occurs during June - July with rainfall falling 54 - 151 mm / month [3].

## 2. Methodology

*Maxsurft* Stability is used to calculate the stability of the Air Unsada Water Tour Bus and check using the *IMO Stability Level 2* [4] method. In addition to using IMO regulations, Unsada Water Tour Bus also use Indonesian land transportation regulations contained in government regulation no 55 chapter 3 part 3d 2012.

### *2.1 Stability*

Maxsurft Stability is used calculating the stability of the Unsada Water Tour Bus and checking using the method of IMO *Stability Level* 2 [4].

$$C2 \leq R_{PRO} \qquad (1)$$

Where :

$$C2=\frac{\left[\sum_1^3 C2_H(Fn_i)+0.5C2_h(0)+\sum_1^3 C2_f(Fn_i)+0.5\,C2_f(0)\right]}{2N+1} \qquad (2)$$

$R_{PRO}$ = 0.06

$C2_h(Fn_i)= \sum_{i=1}^{N} W_iC_i$ with the ship in head waves with a speed equal to $V_i$;

$C2_f(Fn_i)= \sum_{i=1}^{N} W_iC_i$ with the ship in following waves with a speed equal to $V_i$;

$C_i = \begin{cases}1\\0\end{cases}$ if max roll amplitude exceeds 25 deg. else

N = total number of waves cases for wich the maximum roll angle is evaluated for a combination of speed and ship heding

$Fn_i = V_i / \sqrt{(Lg)}$;

$V_i$ = $V_s$ $K_i$ means the ship speed (m/s)

$V_s$ = ship service speed (m/s) ;

g = gravity ;

L = Length of ship

$$K_i \begin{cases} 1.0 & i=1\\ 0.866 & i=2\\ 0.5 & i=3 \end{cases}$$

### *2.2 Design*

In designing Unsada Water Tour Bus using *Maxsurf* software. For the size used is the size of conventional buses with the bus brand is Mercedes-Benzn Tourismo M/2 [5] and according to Indonesian land transportation standards. For *fin stabilizers* use the size of Kongsberg products Aquarius A25 type [6]. Laying *fin stabilizers* are on both sides of the bus left and right. The stabilizer fin is 7.5 m from the back of the bus. Precisely between the front and rear wheels.

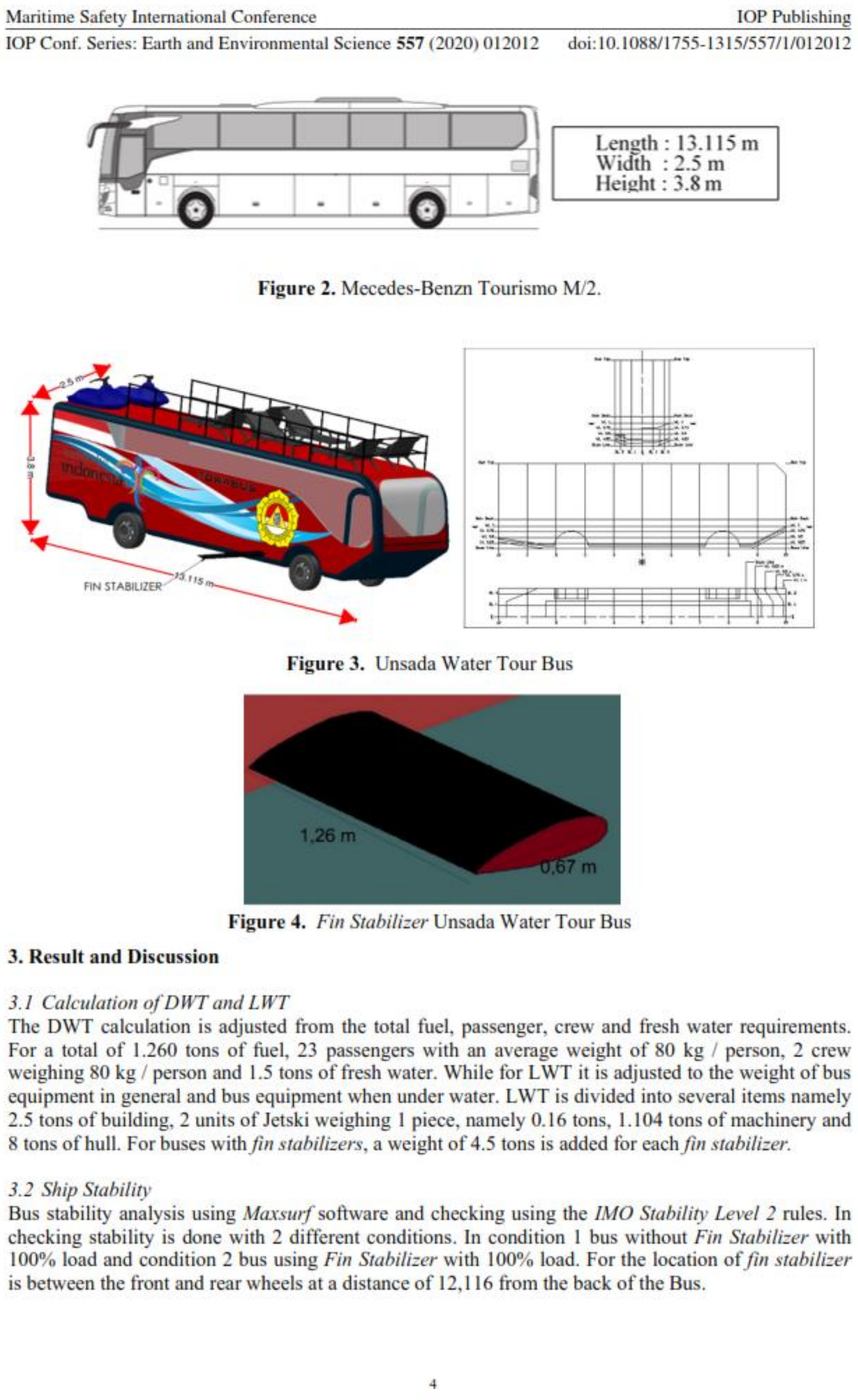

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**Figure 2.** Mecedes-Benzn Tourismo M/2.

**Figure 3.** Unsada Water Tour Bus

**Figure 4.** *Fin Stabilizer* Unsada Water Tour Bus

## 3. Result and Discussion

### *3.1 Calculation of DWT and LWT*

The DWT calculation is adjusted from the total fuel, passenger, crew and fresh water requirements. For a total of 1.260 tons of fuel, 23 passengers with an average weight of 80 kg / person, 2 crew weighing 80 kg / person and 1.5 tons of fresh water. While for LWT it is adjusted to the weight of bus equipment in general and bus equipment when under water. LWT is divided into several items namely 2.5 tons of building, 2 units of Jetski weighing 1 piece, namely 0.16 tons, 1.104 tons of machinery and 8 tons of hull. For buses with *fin stabilizers*, a weight of 4.5 tons is added for each *fin stabilizer*.

### *3.2 Ship Stability*

Bus stability analysis using *Maxsurf* software and checking using the *IMO Stability Level 2* rules. In checking stability is done with 2 different conditions. In condition 1 bus without *Fin Stabilizer* with 100% load and condition 2 bus using *Fin Stabilizer* with 100% load. For the location of *fin stabilizer* is between the front and rear wheels at a distance of 12,116 from the back of the Bus.

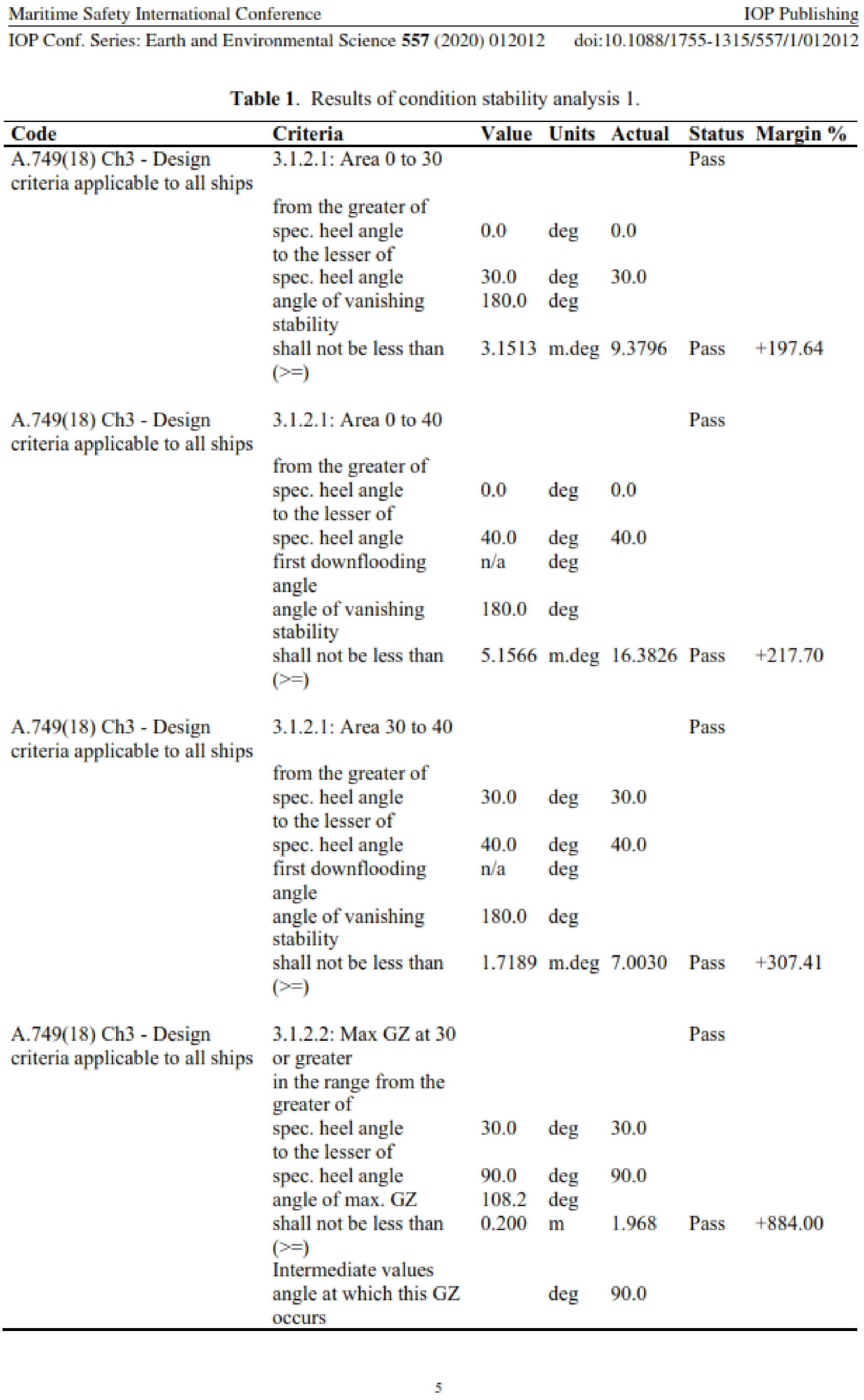
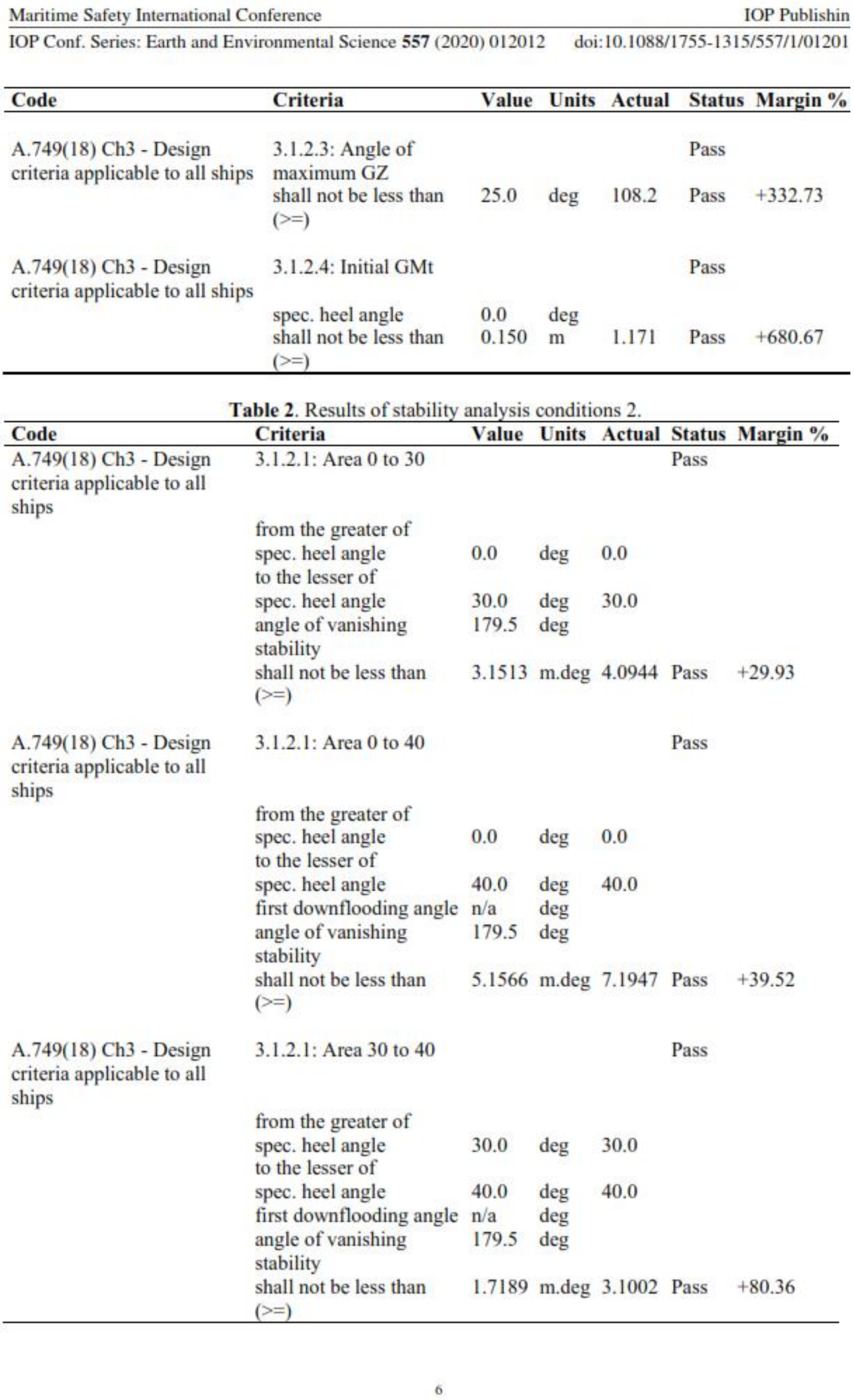


**Table 1.** Results of condition stability analysis 1.

| Code | Criteria | Value | Units | Actual | Status | Margin % |
|---|---|---|---|---|---|---|
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.1: Area 0 to 30 | | | | Pass | |
| | from the greater of | | | | | |
| | spec. heel angle | 0.0 | deg | 0.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 30.0 | deg | 30.0 | | |
| | angle of vanishing stability | 180.0 | deg | | | |
| | shall not be less than (>=) | 3.1513 | m.deg | 9.3796 | Pass | +197.64 |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.1: Area 0 to 40 | | | | Pass | |
| | from the greater of | | | | | |
| | spec. heel angle | 0.0 | deg | 0.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 40.0 | deg | 40.0 | | |
| | first downflooding angle | n/a | deg | | | |
| | angle of vanishing stability | 180.0 | deg | | | |
| | shall not be less than (>=) | 5.1566 | m.deg | 16.3826 | Pass | +217.70 |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.1: Area 30 to 40 | | | | Pass | |
| | from the greater of | | | | | |
| | spec. heel angle | 30.0 | deg | 30.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 40.0 | deg | 40.0 | | |
| | first downflooding angle | n/a | deg | | | |
| | angle of vanishing stability | 180.0 | deg | | | |
| | shall not be less than (>=) | 1.7189 | m.deg | 7.0030 | Pass | +307.41 |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.2: Max GZ at 30 or greater | | | | Pass | |
| | in the range from the greater of | | | | | |
| | spec. heel angle | 30.0 | deg | 30.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 90.0 | deg | 90.0 | | |
| | angle of max. GZ | 108.2 | deg | | | |
| | shall not be less than (>=) | 0.200 | m | 1.968 | Pass | +884.00 |
| | Intermediate values | | | | | |
| | angle at which this GZ occurs | | deg | 90.0 | | |



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| **Code** | **Criteria** | **Value** | **Units** | **Actual** | **Status** | **Margin %** |
|---|---|---|---|---|---|---|
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.3: Angle of maximum GZ | | | | Pass | |
| | shall not be less than (>=) | 25.0 | deg | 108.2 | Pass | +332.73 |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.4: Initial GMt | | | | Pass | |
| | spec. heel angle | 0.0 | deg | | | |
| | shall not be less than (>=) | 0.150 | m | 1.171 | Pass | +680.67 |

**Table 2**. Results of stability analysis conditions 2.

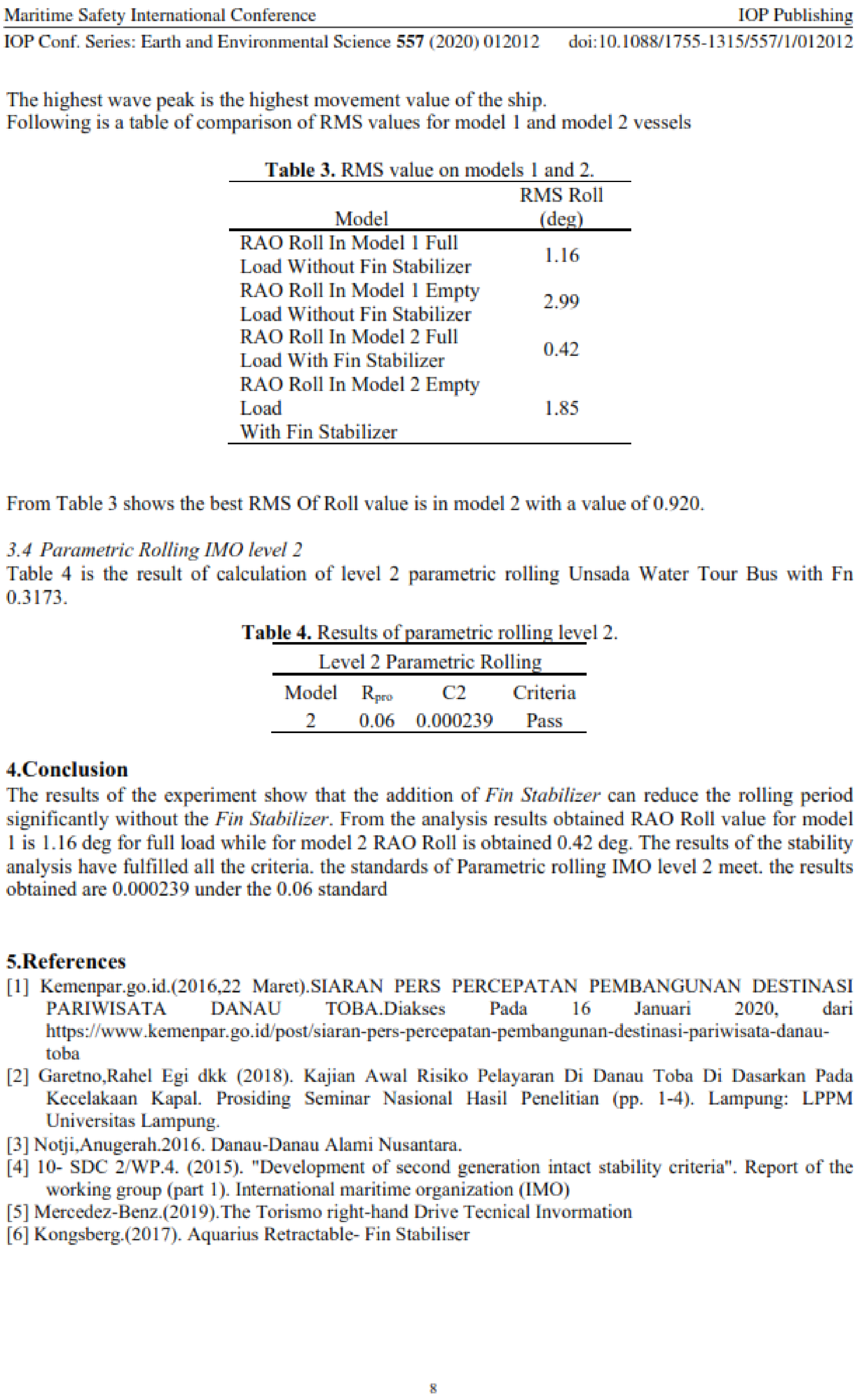
| **Code** | **Criteria** | **Value** | **Units** | **Actual** | **Status** | **Margin %** |
|---|---|---|---|---|---|---|
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.1: Area 0 to 30 | | | | Pass | |
| | from the greater of | | | | | |
| | spec. heel angle | 0.0 | deg | 0.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 30.0 | deg | 30.0 | | |
| | angle of vanishing stability | 179.5 | deg | | | |
| | shall not be less than (>=) | 3.1513 | m.deg | 4.0944 | Pass | +29.93 |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.1: Area 0 to 40 | | | | Pass | |
| | from the greater of | | | | | |
| | spec. heel angle | 0.0 | deg | 0.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 40.0 | deg | 40.0 | | |
| | first downflooding angle | n/a | deg | | | |
| | angle of vanishing stability | 179.5 | deg | | | |
| | shall not be less than (>=) | 5.1566 | m.deg | 7.1947 | Pass | +39.52 |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.1: Area 30 to 40 | | | | Pass | |
| | from the greater of | | | | | |
| | spec. heel angle | 30.0 | deg | 30.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 40.0 | deg | 40.0 | | |
| | first downflooding angle | n/a | deg | | | |
| | angle of vanishing stability | 179.5 | deg | | | |
| | shall not be less than (>=) | 1.7189 | m.deg | 3.1002 | Pass | +80.36 |

| Code | Criteria | Value | Units | Actual | Status | Margin % |
|---|---|---|---|---|---|---|
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.2: Max GZ at 30 or greater | | | | Pass | |
| | in the range from the greater of | | | | | |
| | spec. heel angle | 30.0 | deg | 30.0 | | |
| | to the lesser of | | | | | |
| | spec. heel angle | 90.0 | deg | 90.0 | | |
| | angle of max. GZ | 112.7 | deg | | | |
| | shall not be less than (>=) | 0.200 | m | 1.271 | Pass | +535.50 |
| | Intermediate values | | | | | |
| | angle at which this GZ occurs | | deg | 90.0 | | |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.3: Angle of maximum GZ | | | | Pass | |
| | shall not be less than (>=) | 25.0 | deg | 112.7 | Pass | +350.91 |
| A.749(18) Ch3 - Design criteria applicable to all ships | 3.1.2.4: Initial GMt | | | | Pass | |
| | spec. heel angle | 0.0 | deg | | | |
| | shall not be less than (>=) | 0.150 | m | 0.434 | Pass | +189.33 |

### *3.3 Parametric Rolling*

Ship motion analysis using the *Maxsurf Software*. This analysis uses 2 Unsada Water Tour Bus models. The first model is a bus without *fin stabilizers*. The second model is a bus with *fin stabilizers*. In this test the speed data is entered 0 knots. For wave height taken 1.5 m. In the experiment each bus is analyzed in two conditions, namely condition one with a full load and condition two a bus without a load. The following are the results of RAO graph analysis on 900 waves on all models

**Figure 5.** RAO rolling on all models and conditions.



The highest wave peak is the highest movement value of the ship.
Following is a table of comparison of RMS values for model 1 and model 2 vessels

**Table 3.** RMS value on models 1 and 2.

| Model | RMS Roll (deg) |
|---|---|
| RAO Roll In Model 1 Full Load Without Fin Stabilizer | 1.16 |
| RAO Roll In Model 1 Empty Load Without Fin Stabilizer | 2.99 |
| RAO Roll In Model 2 Full Load With Fin Stabilizer | 0.42 |
| RAO Roll In Model 2 Empty Load With Fin Stabilizer | 1.85 |

From Table 3 shows the best RMS Of Roll value is in model 2 with a value of 0.920.

### *3.4 Parametric Rolling IMO level 2*

Table 4 is the result of calculation of level 2 parametric rolling Unsada Water Tour Bus with Fn 0.3173.

**Table 4.** Results of parametric rolling level 2.

| Level 2 Parametric Rolling | | | |
|---|---|---|---|
| Model | $R_{pro}$ | C2 | Criteria |
| 2 | 0.06 | 0.000239 | Pass |

## 4.Conclusion

The results of the experiment show that the addition of *Fin Stabilizer* can reduce the rolling period significantly without the *Fin Stabilizer*. From the analysis results obtained RAO Roll value for model 1 is 1.16 deg for full load while for model 2 RAO Roll is obtained 0.42 deg. The results of the stability analysis have fulfilled all the criteria. the standards of Parametric rolling IMO level 2 meet. the results obtained are 0.000239 under the 0.06 standard

## 5.References

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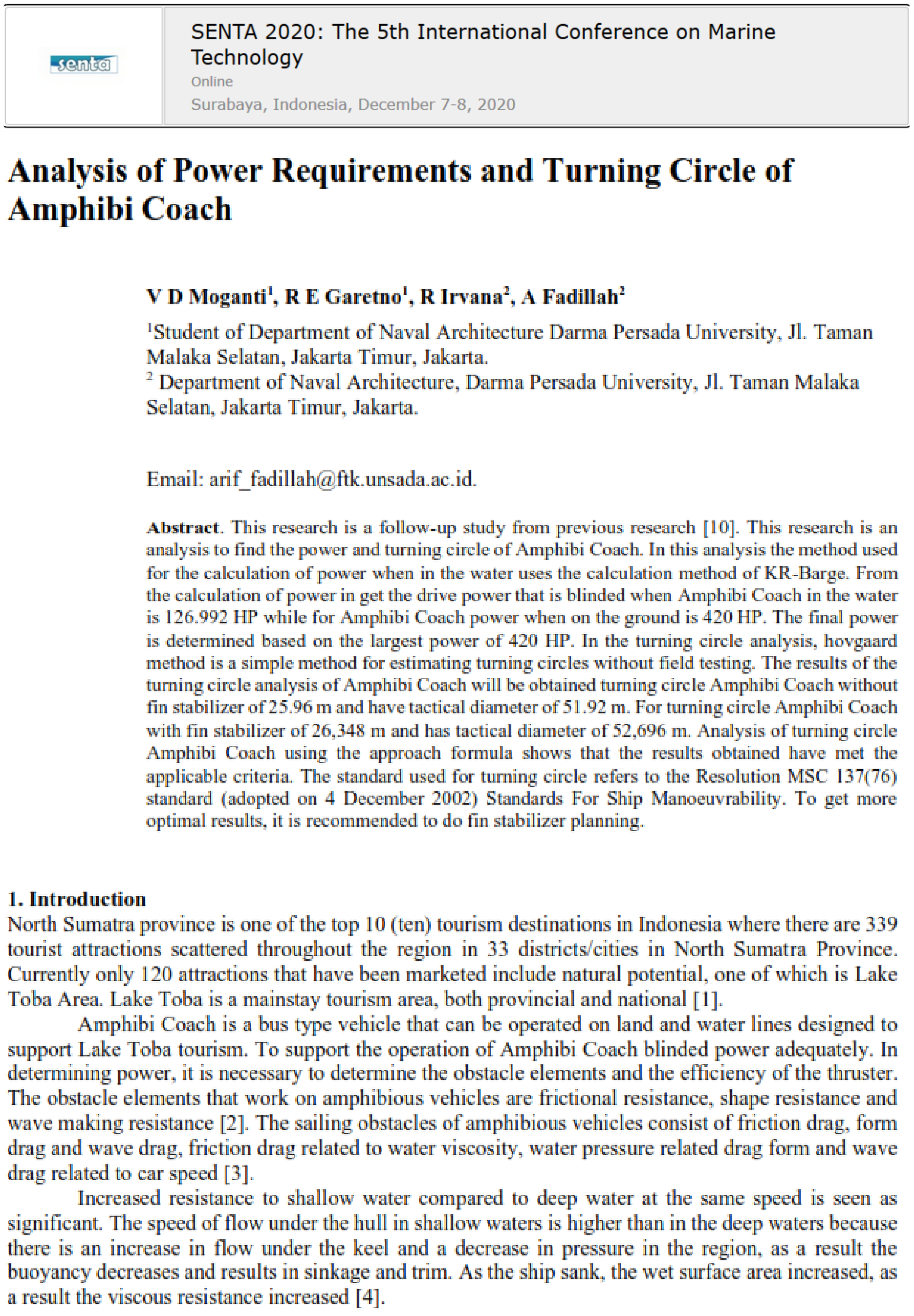
# Lampiran 2. Jurnal Penelitian Tugas Akhir SENTA 2020



SENTA 2020: The 5th International Conference on Marine Technology
Online
Surabaya, Indonesia, December 7-8, 2020

## Analysis of Power Requirements and Turning Circle of Amphibi Coach

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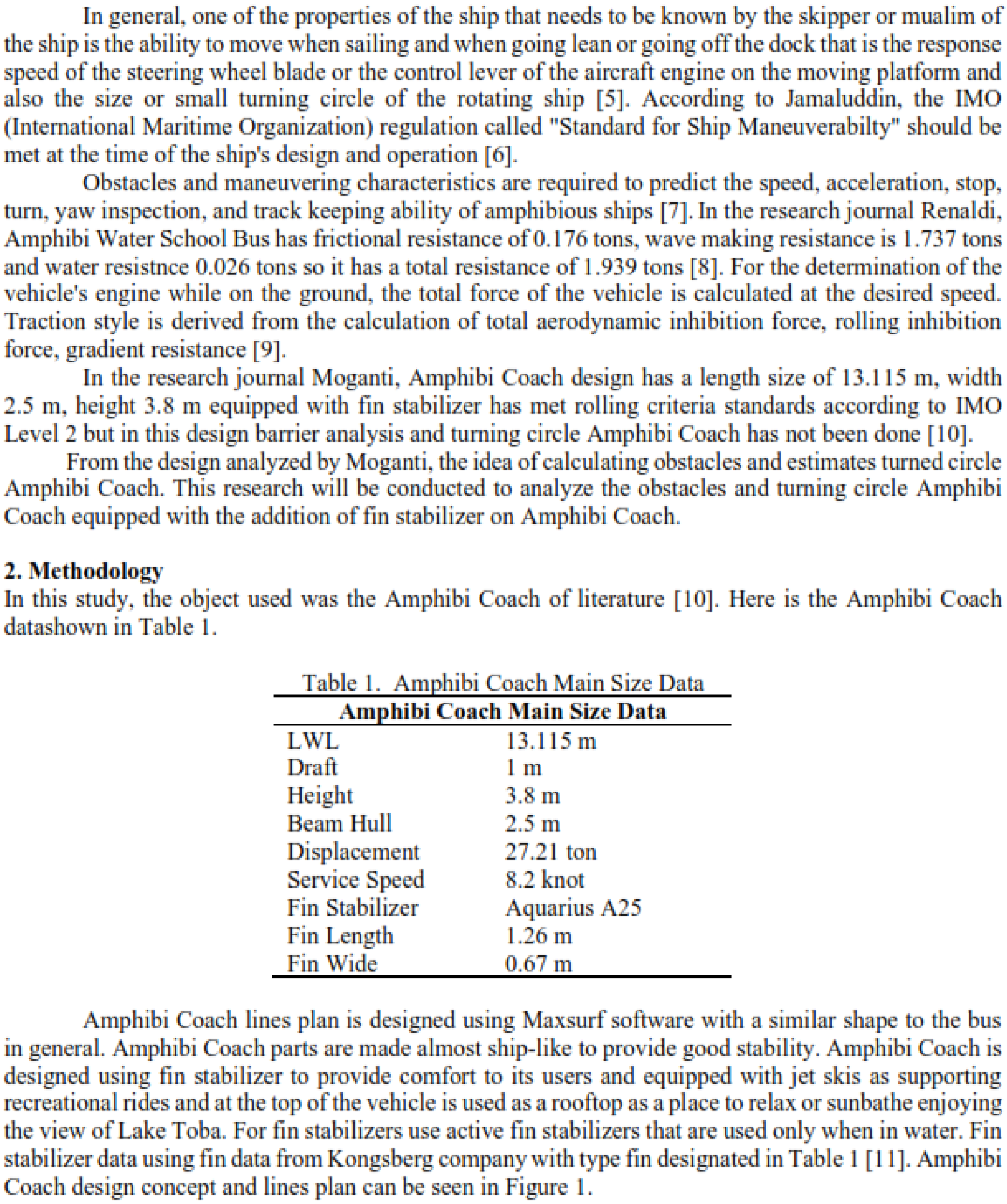
**Abstract**. This research is a follow-up study from previous research [10]. This research is an analysis to find the power and turning circle of Amphibi Coach. In this analysis the method used for the calculation of power when in the water uses the calculation method of KR-Barge. From the calculation of power in get the drive power that is blinded when Amphibi Coach in the water is 126.992 HP while for Amphibi Coach power when on the ground is 420 HP. The final power is determined based on the largest power of 420 HP. In the turning circle analysis, hovgaard method is a simple method for estimating turning circles without field testing. The results of the turning circle analysis of Amphibi Coach will be obtained turning circle Amphibi Coach without fin stabilizer of 25.96 m and have tactical diameter of 51.92 m. For turning circle Amphibi Coach with fin stabilizer of 26,348 m and has tactical diameter of 52,696 m. Analysis of turning circle Amphibi Coach using the approach formula shows that the results obtained have met the applicable criteria. The standard used for turning circle refers to the Resolution MSC 137(76) standard (adopted on 4 December 2002) Standards For Ship Manoeuvrability. To get more optimal results, it is recommended to do fin stabilizer planning.

### 1. Introduction

North Sumatra province is one of the top 10 (ten) tourism destinations in Indonesia where there are 339 tourist attractions scattered throughout the region in 33 districts/cities in North Sumatra Province. Currently only 120 attractions that have been marketed include natural potential, one of which is Lake Toba Area. Lake Toba is a mainstay tourism area, both provincial and national [1].

Amphibi Coach is a bus type vehicle that can be operated on land and water lines designed to support Lake Toba tourism. To support the operation of Amphibi Coach blinded power adequately. In determining power, it is necessary to determine the obstacle elements and the efficiency of the thruster. The obstacle elements that work on amphibious vehicles are frictional resistance, shape resistance and wave making resistance [2]. The sailing obstacles of amphibious vehicles consist of friction drag, form drag and wave drag, friction drag related to water viscosity, water pressure related drag form and wave drag related to car speed [3].

Increased resistance to shallow water compared to deep water at the same speed is seen as significant. The speed of flow under the hull in shallow waters is higher than in the deep waters because there is an increase in flow under the keel and a decrease in pressure in the region, as a result the buoyancy decreases and results in sinkage and trim. As the ship sank, the wet surface area increased, as a result the viscous resistance increased [4].



In general, one of the properties of the ship that needs to be known by the skipper or mualim of the ship is the ability to move when sailing and when going lean or going off the dock that is the response speed of the steering wheel blade or the control lever of the aircraft engine on the moving platform and also the size or small turning circle of the rotating ship [5]. According to Jamaluddin, the IMO (International Maritime Organization) regulation called "Standard for Ship Maneuverabilty" should be met at the time of the ship's design and operation [6].

Obstacles and maneuvering characteristics are required to predict the speed, acceleration, stop, turn, yaw inspection, and track keeping ability of amphibious ships [7]. In the research journal Renaldi, Amphibi Water School Bus has frictional resistance of 0.176 tons, wave making resistance is 1.737 tons and water resistnce 0.026 tons so it has a total resistance of 1.939 tons [8]. For the determination of the vehicle's engine while on the ground, the total force of the vehicle is calculated at the desired speed. Traction style is derived from the calculation of total aerodynamic inhibition force, rolling inhibition force, gradient resistance [9].

In the research journal Moganti, Amphibi Coach design has a length size of 13.115 m, width 2.5 m, height 3.8 m equipped with fin stabilizer has met rolling criteria standards according to IMO Level 2 but in this design barrier analysis and turning circle Amphibi Coach has not been done [10].

From the design analyzed by Moganti, the idea of calculating obstacles and estimates turned circle Amphibi Coach. This research will be conducted to analyze the obstacles and turning circle Amphibi Coach equipped with the addition of fin stabilizer on Amphibi Coach.

## 2. Methodology

In this study, the object used was the Amphibi Coach of literature [10]. Here is the Amphibi Coach datashown in Table 1.

Table 1. Amphibi Coach Main Size Data

| **Amphibi Coach Main Size Data** | |
|---|---|
| LWL | 13.115 m |
| Draft | 1 m |
| Height | 3.8 m |
| Beam Hull | 2.5 m |
| Displacement | 27.21 ton |
| Service Speed | 8.2 knot |
| Fin Stabilizer | Aquarius A25 |
| Fin Length | 1.26 m |
| Fin Wide | 0.67 m |

Amphibi Coach lines plan is designed using Maxsurf software with a similar shape to the bus in general. Amphibi Coach parts are made almost ship-like to provide good stability. Amphibi Coach is designed using fin stabilizer to provide comfort to its users and equipped with jet skis as supporting recreational rides and at the top of the vehicle is used as a rooftop as a place to relax or sunbathe enjoying the view of Lake Toba. For fin stabilizers use active fin stabilizers that are used only when in water. Fin stabilizer data using fin data from Kongsberg company with type fin designated in Table 1 [11]. Amphibi Coach design concept and lines plan can be seen in Figure 1.

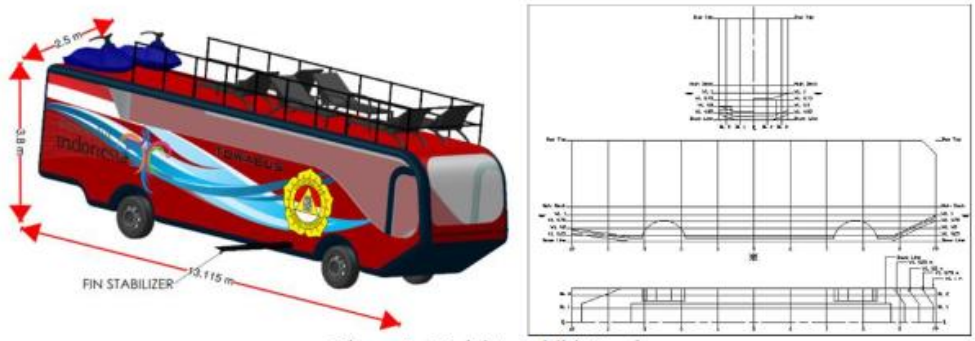


Figure 1. Model Amphibi Coach

Amphibi Coach drive power analysis is an analysis of the calculation of power while on land and in water. The method of calculating the drive power when in the water is the KR Barge method [12]. This method is used because it sees the shape of the Amphibi Coach that almost resembles a barge.

$$R_t = R_f + R_w + R_a \tag{1}$$

Where
$R_t$ = total resistance (ton).
$R_f$ = frictional resistance (ton).
$R_w$ = wave making resistance (ton).
$R_a$ = air resistance (ton).

For analysis of power while on land used the calculation formula as follows [13].

$$F_{tot} = F_{Ro} + F_{Ae} = F_{Cl} \tag{2}$$

Where
$F_{Ro}$ = Rolling resistance (N)
$F_{Ae}$ = Aerodinamic Resistance (N)
$F_{Cl}$ = Climbing Resistance (N)

$$T_{aw} = F_{tot} \text{ x rolling radius (m)} \tag{3}$$

Where
$T_{aw}$ = Torque at the wheel (N m)

$$\text{b.p.} = \frac{2\pi TN}{60000} \tag{4}$$

Where
b.p. = brake power (kW)
$\pi$ = 3.142
T = engine torque (N m)
N = crankshaft speed (rev/min)

For turning circle calculations Amphibi Coach is done when Amphibi Coach uses fin and without using fin. This calculation uses a formula from Teguh Sastrodiwongso which is the development of the Hovgaard formula[5]. This formula is a simple way of estimating turning circles. Turning circle calculation stipulated by equation (5) :

$$\rho = K_3 \frac{\nabla}{\mathrm{Cn.\,A\,cos\,a}} \tag{5}$$

For $K_3$ is a coefficient obtained from table 2.

Table 2. Coefficient $K_3$

| $\nabla$/S.L | $K_3$ | $\nabla$/S.L | $K_3$ |
|---|---|---|---|
| 0.050 | 1.140 | 0.10 | 0.460 |
| 0.055 | 1.285 | 0.11 | 0.400 |
| 0.060 | 1.100 | 0.12 | 0.370 |
| 0.065 | 0.960 | 0.13 | 0.355 |
| 0.070 | 0.845 | 0.14 | 0.345 |
| 0.080 | 0.670 | 0.15 | 0.340 |
| 0.090 | 0.550 | | |

Formula for calculating normal style coefficient (Cn) is shown in equations (6) using the Joessel formula.

$$\mathrm{Cn} = \frac{0.811\,\sin a^{o}}{0.195 + 0.305\,\sin a^{o}} \tag{6}$$

Where
$\nabla$ = volume displacement ($m^3$)
A = rudder area ($m^2$)
S = the area of the middle field extends the ship ($m^2$).
L = ship waterline length (m).
$\alpha$ = maximum steering leaf angle (35° ~ 37°).

Advance calculation (7) or distance traveled by the ship in its original direction, measured from the point when the rudder was first applied at the turn and Transfer (8) is the distance of the ship's center of gravity from the original trajectory line when the ship's header is $90^0$. It can be calculated using the formula contained in the journal Vessel Maneuverability American Bureau of Shipping (ABS).

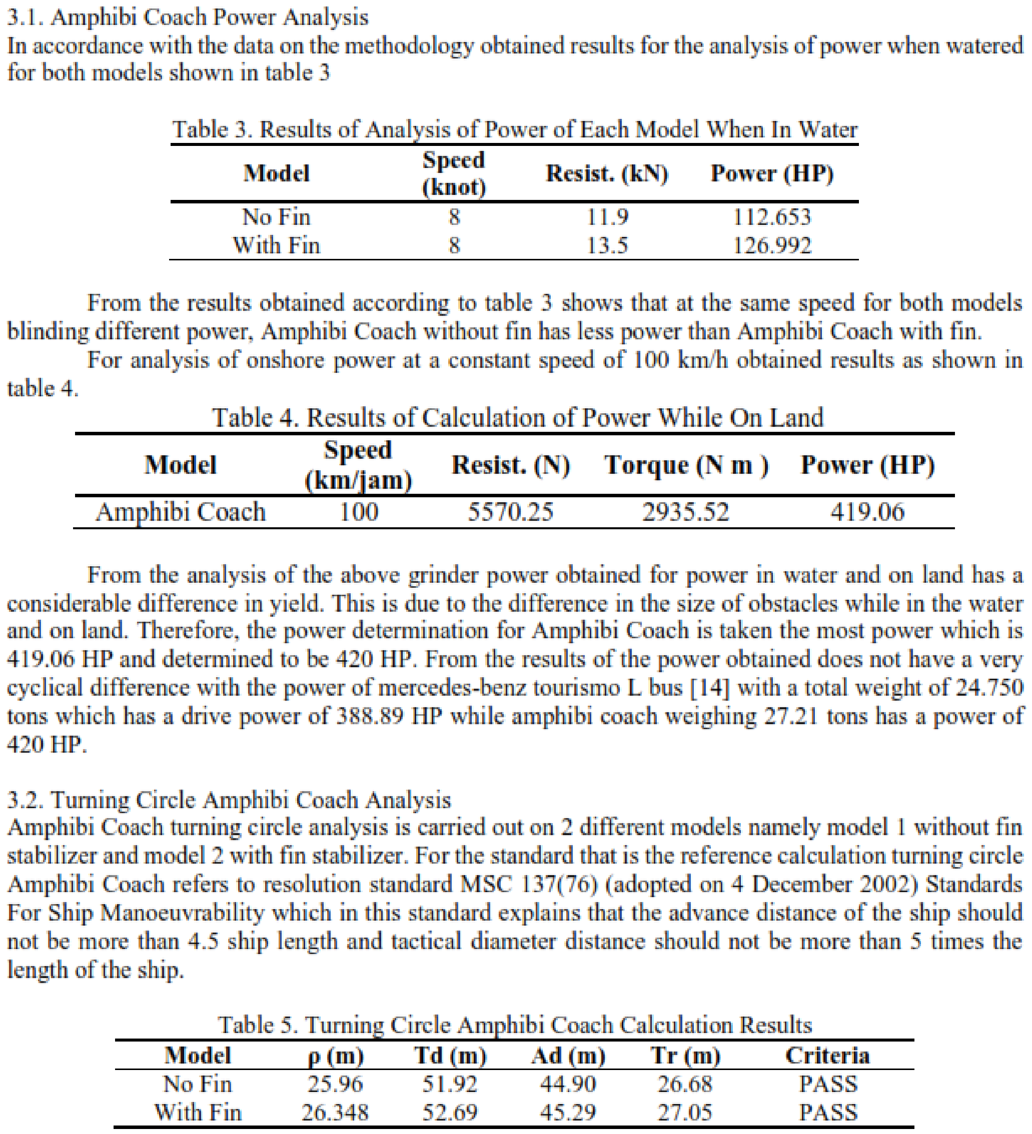
$$\frac{\mathrm{Ad}}{\mathrm{L}} = 0.519\,\frac{\mathrm{Td}}{\mathrm{L}} + 1.33 \tag{7}$$

$$\frac{\mathrm{Tr}}{\mathrm{L}} = 0.497\,\frac{\mathrm{Td}}{\mathrm{L}} + 0.065 \tag{8}$$

Where
Ad = Advance distance (m)
Td = Tactical Diameter distance (m)
Tr = Transfer distance (m)
L = ship waterline length (m)

## 3. Result And Discussion

In this study, the power analyzed was power when in the water with a speed of 8 knots with an efficiency of 60% with 2 models and power when on land with a maximum speed of 100 km/h. For water power is analyzed on 2 models namely Amphibi Coach without fin stabilizer and Amphibi Coach using Fin Stabiliizer.



### 3.1. Amphibi Coach Power Analysis

In accordance with the data on the methodology obtained results for the analysis of power when watered for both models shown in table 3

Table 3. Results of Analysis of Power of Each Model When In Water

| Model | Speed (knot) | Resist. (kN) | Power (HP) |
|---|---|---|---|
| No Fin | 8 | 11.9 | 112.653 |
| With Fin | 8 | 13.5 | 126.992 |

From the results obtained according to table 3 shows that at the same speed for both models blinding different power, Amphibi Coach without fin has less power than Amphibi Coach with fin.

For analysis of onshore power at a constant speed of 100 km/h obtained results as shown in table 4.

Table 4. Results of Calculation of Power While On Land

| Model | Speed (km/jam) | Resist. (N) | Torque (N m ) | Power (HP) |
|---|---|---|---|---|
| Amphibi Coach | 100 | 5570.25 | 2935.52 | 419.06 |

From the analysis of the above grinder power obtained for power in water and on land has a considerable difference in yield. This is due to the difference in the size of obstacles while in the water and on land. Therefore, the power determination for Amphibi Coach is taken the most power which is 419.06 HP and determined to be 420 HP. From the results of the power obtained does not have a very cyclical difference with the power of mercedes-benz tourismo L bus [14] with a total weight of 24.750 tons which has a drive power of 388.89 HP while amphibi coach weighing 27.21 tons has a power of 420 HP.

### 3.2. Turning Circle Amphibi Coach Analysis

Amphibi Coach turning circle analysis is carried out on 2 different models namely model 1 without fin stabilizer and model 2 with fin stabilizer. For the standard that is the reference calculation turning circle Amphibi Coach refers to resolution standard MSC 137(76) (adopted on 4 December 2002) Standards For Ship Manoeuvrability which in this standard explains that the advance distance of the ship should not be more than 4.5 ship length and tactical diameter distance should not be more than 5 times the length of the ship.

Table 5. Turning Circle Amphibi Coach Calculation Results

| Model | ρ (m) | Td (m) | Ad (m) | Tr (m) | Criteria |
|---|---|---|---|---|---|
| No Fin | 25.96 | 51.92 | 44.90 | 26.68 | PASS |
| With Fin | 26.348 | 52.69 | 45.29 | 27.05 | PASS |

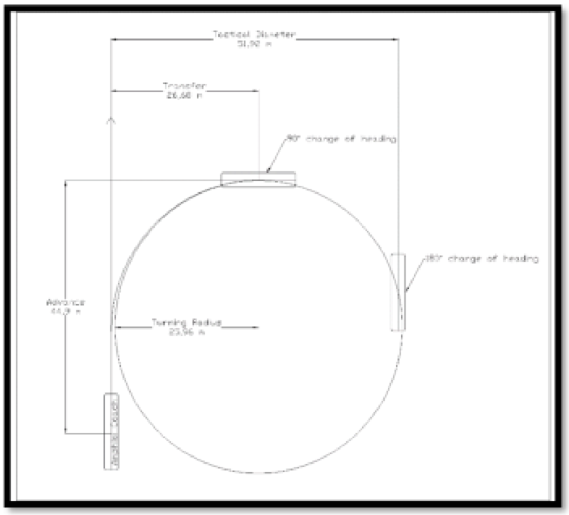


Figure 2. Turning Circle Amphibi Coach Without Fin Stabilizer

From the analysis turning circle Amphibi Coach obtained turning circle Amphibi Coach without fin stabilizer of 25.96 m and has tactical diameter of 51.92 m.

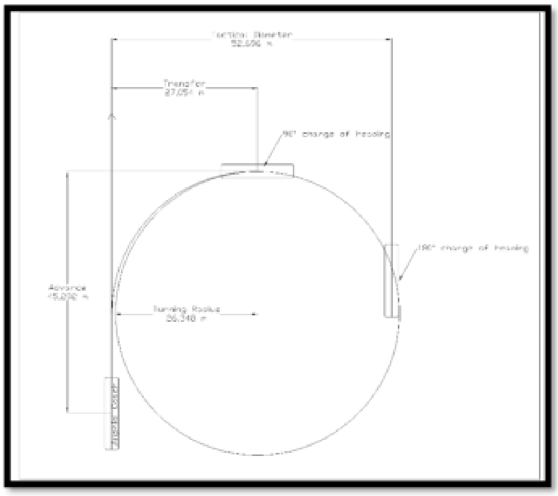
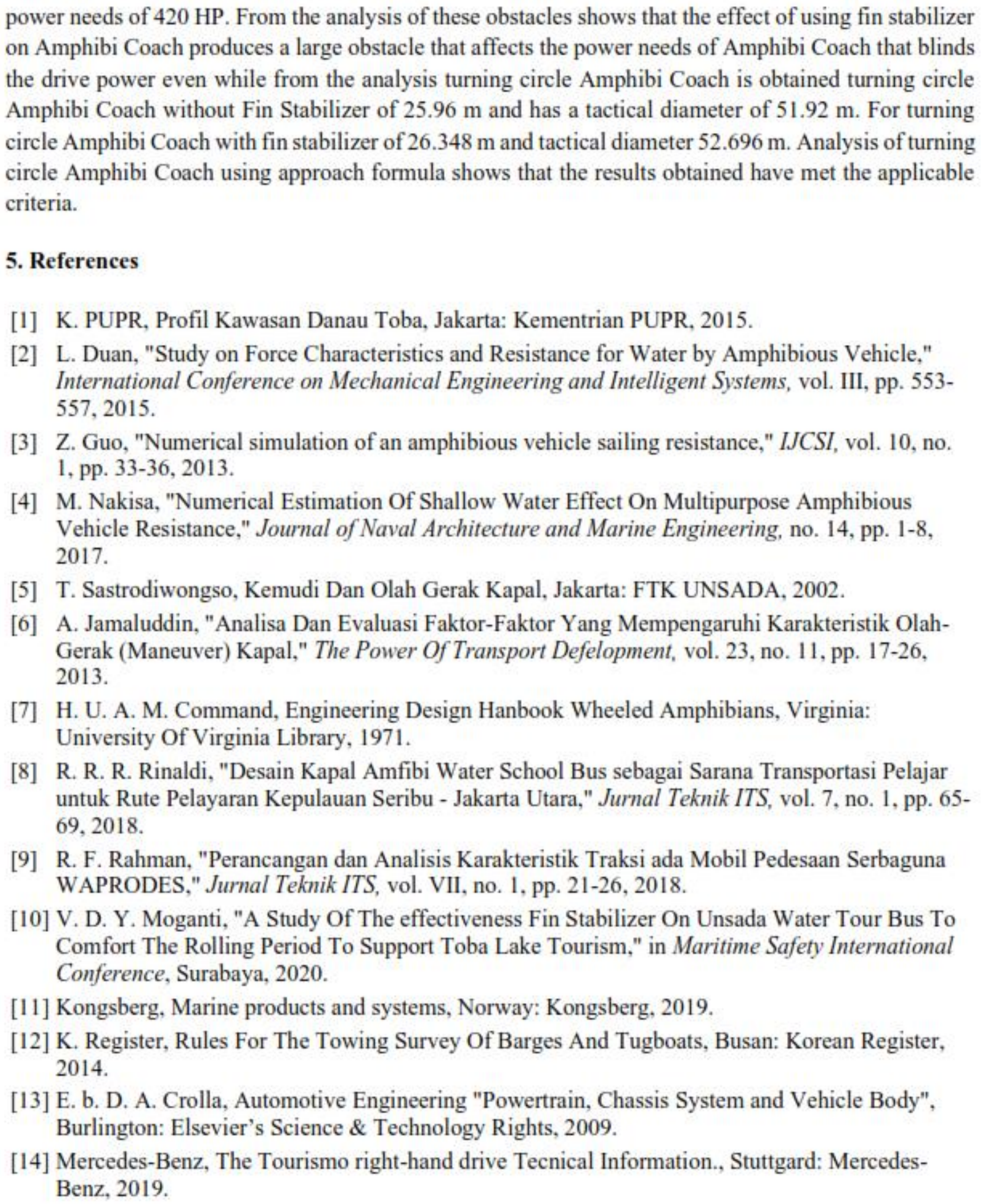


Figure 3. Turning Circle Amphibi Coach With Fin Stabilizer

Turning circle Amphibi Coach with fin stabilizer of 26.348 m and tactical diameter of 52.696 m. From the results obtained shows that Amphibi Coach with fin stabilizer has a turning circle larger 0.388 m than Amphibi Coach without fin stabilizer.

## 4. Conclusion

From the results of the resistance analysis shows that Amphibi Coach with fin stabilizer blinded the power of 126.992 HP while Amphibi Coach without fin stabilizer blinded the power of 112.653 HP. For power that is blinded while on land is 420 HP. The determination of power is taken based on the larger



power needs of 420 HP. From the analysis of these obstacles shows that the effect of using fin stabilizer on Amphibi Coach produces a large obstacle that affects the power needs of Amphibi Coach that blinds the drive power even while from the analysis turning circle Amphibi Coach is obtained turning circle Amphibi Coach without Fin Stabilizer of 25.96 m and has a tactical diameter of 51.92 m. For turning circle Amphibi Coach with fin stabilizer of 26.348 m and tactical diameter 52.696 m. Analysis of turning circle Amphibi Coach using approach formula shows that the results obtained have met the applicable criteria.

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# Lampiran 3. Spesifikasi Bus Mercedez-Benz Tourismo M/2 (16 RHD-2, C 410.555-23)

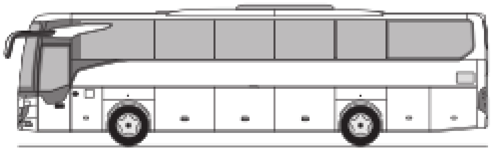
The Tourismo right-hand drive.

Technical information.

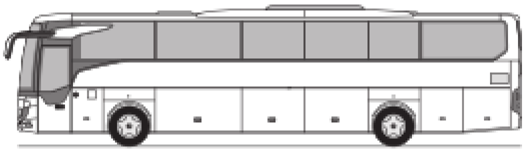
Mercedes-Benz
The standard for buses.

## Model designations

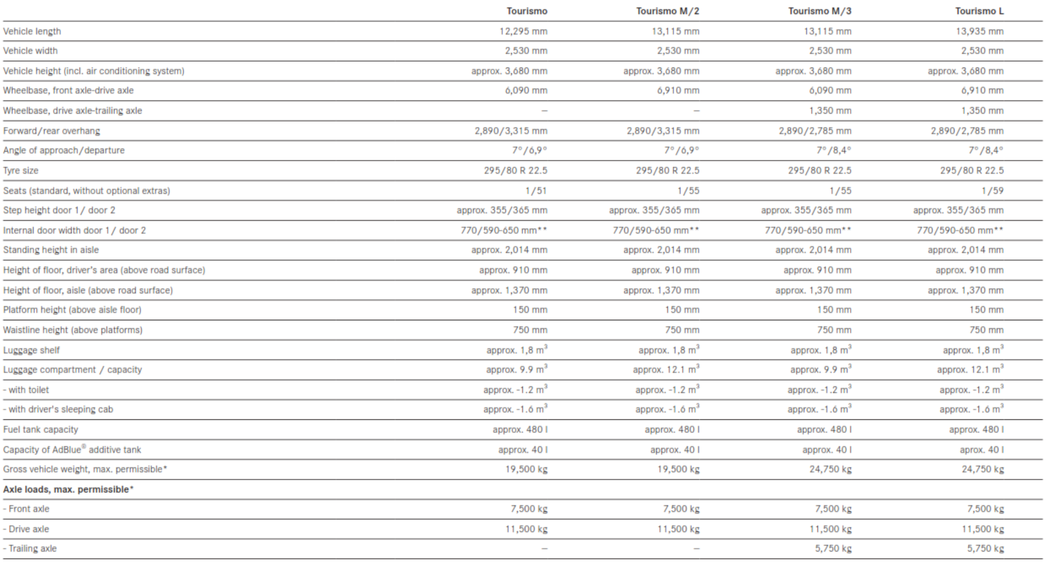
Tourismo (15 RHD, C 410.545-23)



Tourismo M/2 (16 RHD-2, C 410.555-23)



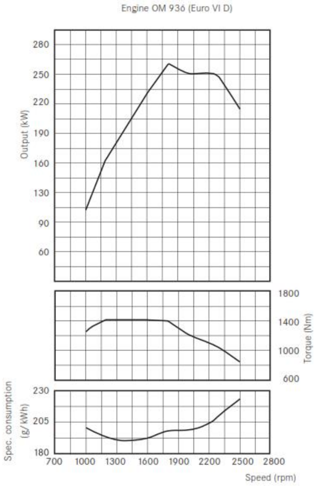
## Dimensions and weights



| | Tourismo | Tourismo M/2 | Tourismo M/3 | Tourismo L |
|---|---|---|---|---|
| Vehicle length | 12,295 mm | 13,115 mm | 13,115 mm | 13,935 mm |
| Vehicle width | 2,530 mm | 2,530 mm | 2,530 mm | 2,530 mm |
| Vehicle height (incl. air conditioning system) | approx. 3,680 mm | approx. 3,680 mm | approx. 3,680 mm | approx. 3,680 mm |
| Wheelbase, front axle-drive axle | 6,090 mm | 6,910 mm | 6,090 mm | 6,910 mm |
| Wheelbase, drive axle-trailing axle | – | – | 1,350 mm | 1,350 mm |
| Forward/rear overhang | 2,890/3,315 mm | 2,890/3,315 mm | 2,890/2,785 mm | 2,890/2,785 mm |
| Angle of approach/departure | 7°/6,9° | 7°/6,9° | 7°/8,4° | 7°/8,4° |
| Tyre size | 295/80 R 22.5 | 295/80 R 22.5 | 295/80 R 22.5 | 295/80 R 22.5 |
| Seats (standard, without optional extras) | 1/51 | 1/55 | 1/55 | 1/59 |
| Step height door 1/ door 2 | approx. 355/365 mm | approx. 355/365 mm | approx. 355/365 mm | approx. 355/365 mm |
| Internal door width door 1/ door 2 | 770/590-650 mm** | 770/590-650 mm** | 770/590-650 mm** | 770/590-650 mm** |
| Standing height in aisle | approx. 2,014 mm | approx. 2,014 mm | approx. 2,014 mm | approx. 2,014 mm |
| Height of floor, driver's area (above road surface) | approx. 910 mm | approx. 910 mm | approx. 910 mm | approx. 910 mm |
| Height of floor, aisle (above road surface) | approx. 1,370 mm | approx. 1,370 mm | approx. 1,370 mm | approx. 1,370 mm |
| Platform height (above aisle floor) | 150 mm | 150 mm | 150 mm | 150 mm |
| Waistline height (above platforms) | 750 mm | 750 mm | 750 mm | 750 mm |
| Luggage shelf | approx. 1,8 $m^3$ | approx. 1,8 $m^3$ | approx. 1,8 $m^3$ | approx. 1,8 $m^3$ |
| Luggage compartment / capacity | approx. 9.9 $m^3$ | approx. 12.1 $m^3$ | approx. 9.9 $m^3$ | approx. 12.1 $m^3$ |
| - with toilet | approx. -1.2 $m^3$ | approx. -1.2 $m^3$ | approx. -1.2 $m^3$ | approx. -1.2 $m^3$ |
| - with driver's sleeping cab | approx. -1.6 $m^3$ | approx. -1.6 $m^3$ | approx. -1.6 $m^3$ | approx. -1.6 $m^3$ |
| Fuel tank capacity | approx. 480 l | approx. 480 l | approx. 480 l | approx. 480 l |
| Capacity of AdBlue® additive tank | approx. 40 l | approx. 40 l | approx. 40 l | aprox. 40 l |
| Gross vehicle weight, max. permissible* | 19,500 kg | 19,500 kg | 24,750 kg | 24,750 kg |
| **Axle loads, max. permissible*** | | | | |
| - Front axle | 7,500 kg | 7,500 kg | 7,500 kg | 7,500 kg |
| - Drive axle | 11,500 kg | 11,500 kg | 11,500 kg | 11,500 kg |
| - Trailing axle | – | – | 5,750 kg | 5,750 kg |

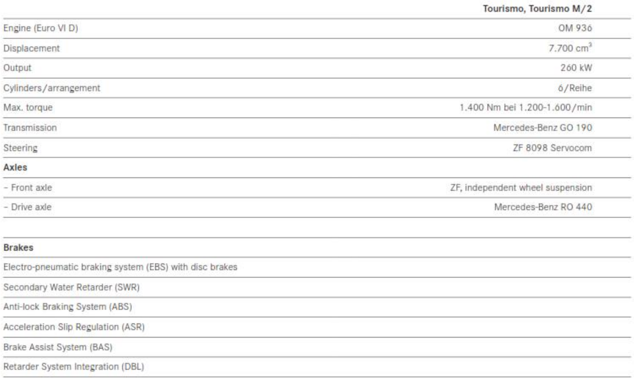
* Depends on country of registration (example is for Great Britain) **depending on seating arrangement

## Drive train/Technology



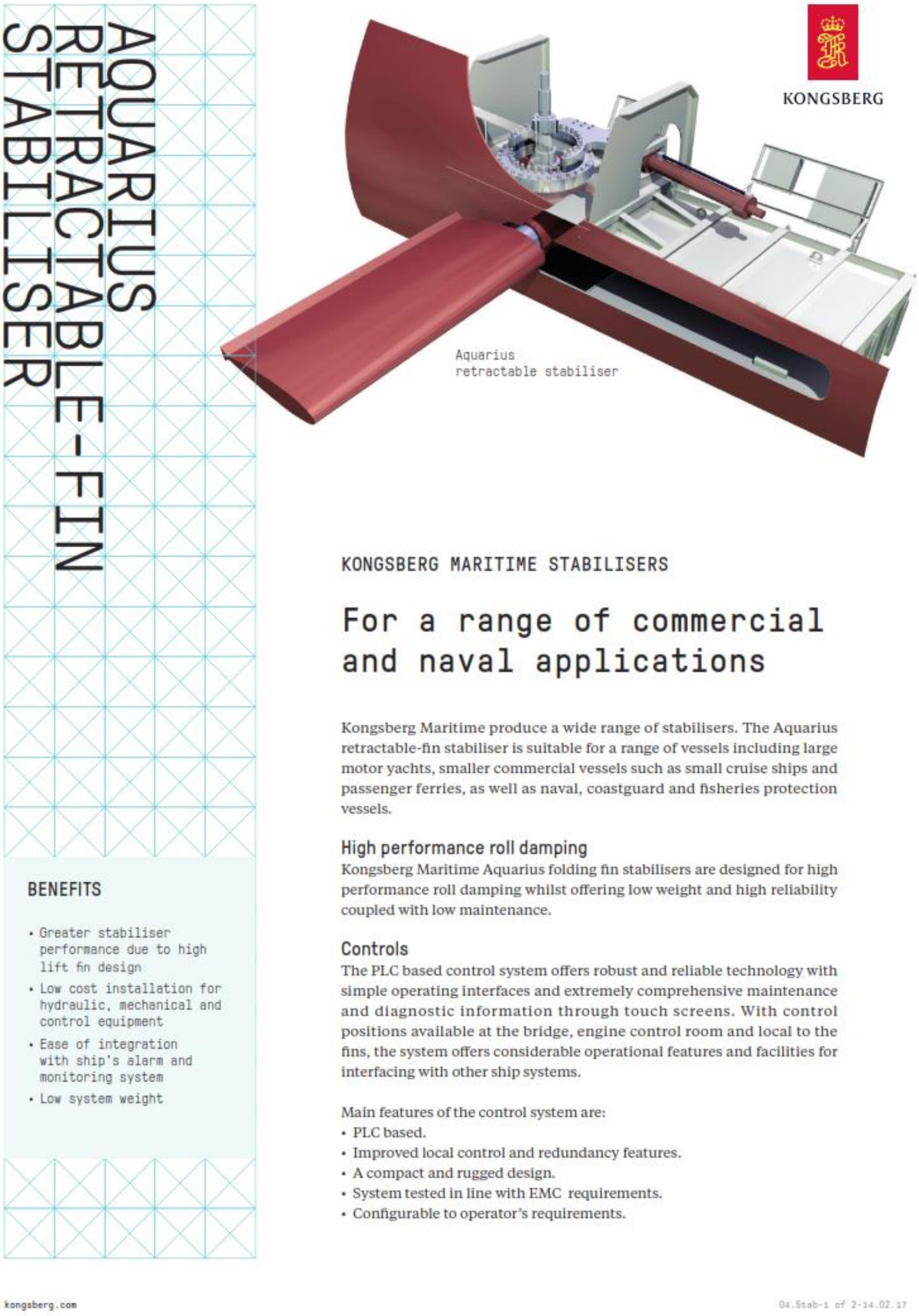
$P_{max}$ 260 kW at 1,200 rpm (80/1269/EEC)
$T_{max}$ 1,400 Nm at 1,200-1,600 rpm

Steady-state full-load curves



| | Tourismo, Tourismo M/2 |
|---|---|
| Engine (Euro VI D) | OM 936 |
| Displacement | 7.700 $cm^3$ |
| Output | 260 kW |
| Cylinders/arrangement | 6/Reihe |
| Max. torque | 1.400 Nm bei 1.200-1.600/min |
| Transmission | Mercedes-Benz GO 190 |
| Steering | ZF 8098 Servocom |
| **Axles** | |
| – Front axle | ZF, independent wheel suspension |
| – Drive axle | Mercedes-Benz RO 440 |
| | |
| **Brakes** | |
| Electro-pneumatic braking system (EBS) with disc brakes | |
| Secondary Water Retarder (SWR) | |
| Anti-lock Braking System (ABS) | |
| Acceleration Slip Regulation (ASR) | |
| Brake Assist System (BAS) | |
| Retarder System Integration (DBL) | |

## Lampiran 4. Spesifikasi Fin Stabilizer Aquarius Model 25



AQUARIUS RETRACTABLE-FIN STABILISER

KONGSBERG

Aquarius retractable stabiliser

**BENEFITS**

- Greater stabiliser performance due to high lift fin design
- Low cost installation for hydraulic, mechanical and control equipment
- Ease of integration with ship's alarm and monitoring system
- Low system weight

KONGSBERG MARITIME STABILISERS

### For a range of commercial and naval applications

Kongsberg Maritime produce a wide range of stabilisers. The Aquarius retractable-fin stabiliser is suitable for a range of vessels including large motor yachts, smaller commercial vessels such as small cruise ships and passenger ferries, as well as naval, coastguard and fisheries protection vessels.

#### High performance roll damping

Kongsberg Maritime Aquarius folding fin stabilisers are designed for high performance roll damping whilst offering low weight and high reliability coupled with low maintenance.

#### Controls

The PLC based control system offers robust and reliable technology with simple operating interfaces and extremely comprehensive maintenance and diagnostic information through touch screens. With control positions available at the bridge, engine control room and local to the fins, the system offers considerable operational features and facilities for interfacing with other ship systems.

Main features of the control system are:
- PLC based.
- Improved local control and redundancy features.
- A compact and rugged design.
- System tested in line with EMC requirements.
- Configurable to operator's requirements.

kongsberg.com

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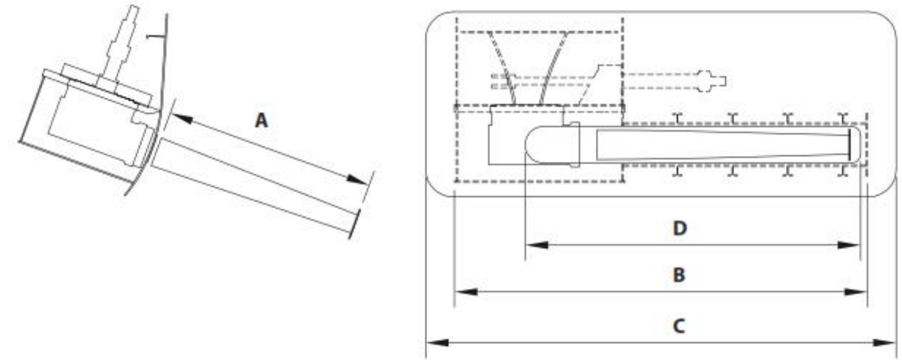
## Sectioned view of the Aquarius stabiliser

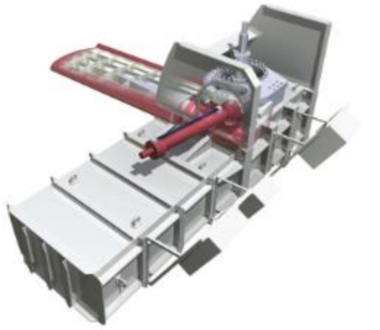


### TECHNICAL DATA

| MODEL | FIN AREA (M2) | A | B MIN | C | D | E MIN | F | G MIN | H | J | K | APPROX WEIGHT /SHIP SET (TONNES) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SIZES (METRES) | | | | | | |
| 25 | 1.06 | 1.26 | 1.08 | 0.64 | 1.17 | 2.59 | 1.77 | 3.19 | 0.3 | 2.04 | 0.53 | 9.7 |
| | 1.41 | 1.68 | | | | 3.01 | | 3.61 | | 2.44 | | 10.0 |
| | 1.76 | 2.1 | | | | 3.43 | | 4.03 | | 2.84 | | 10.3 |
| | 2.05 | 2.44 | | | | 3.77 | | 4.37 | | 3.14 | | 10.8 |
| 50 | 1.82 | 1.65 | 1.41 | 0.845 | 1.41 | 3.4 | 2.2 | 4 | 0.4 | 3.09 | 0.68 | 19.3 |
| | 2.42 | 2.2 | | | | 3.95 | | 4.55 | | 3.55 | | 19.8 |
| | 3.03 | 2.75 | | | | 4.5 | | 5.1 | | 4.18 | | 20.3 |
| | 3.51 | 3.19 | | | | 4.94 | | 5.54 | | 4.66 | | 20.8 |
| 100 | 4.21 | 2.9 | | 1.2 | 1.83 | 5.09 | 2.7 | 5.69 | 0.56 | 3.92 | 0.85 | 35.5 |
| | 4.73 | 3.26 | | | | 5.45 | | 6.05 | | 4.28 | | 37.0 |
| | 5.26 | 3.63 | | | | 5.82 | | 6.42 | | 4.65 | | 39.0 |
| | 5.78 | 3.99 | | | | 6.18 | | 6.78 | | 5 | | 40.2 |

All data subject to change without prior notice.

| | |
|---|---|
| Fin unit | • Simplified crux design<br>• Single top bearing design<br>• Vertical linkage for fin tilt<br>• Composite fin shaft bearing<br>• Triple seal arrangement<br>• Small hull aperture |
| Fin | • One piece construction<br>• Tip fence |
| Power unit | • Package unit including all components for ease of installation |



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