# LAMPIRAN

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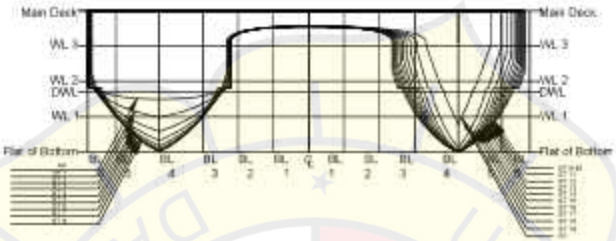
LAMPIRAN O Perhitungan *Seakeeping*

# LAMPIRAN A

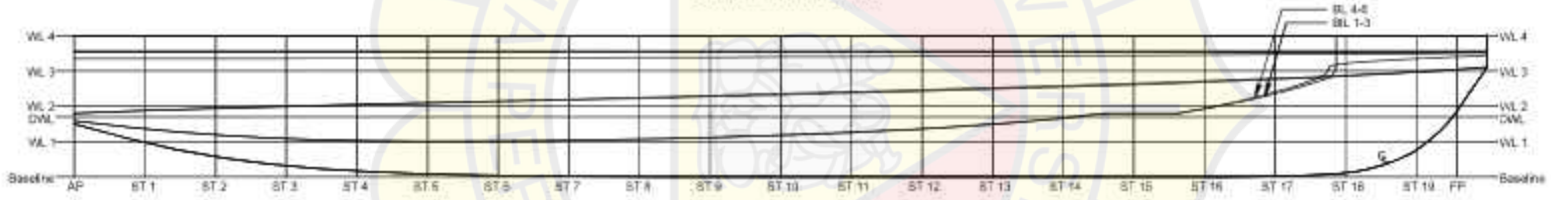
*LINES PLAN*

# LINES PLAN

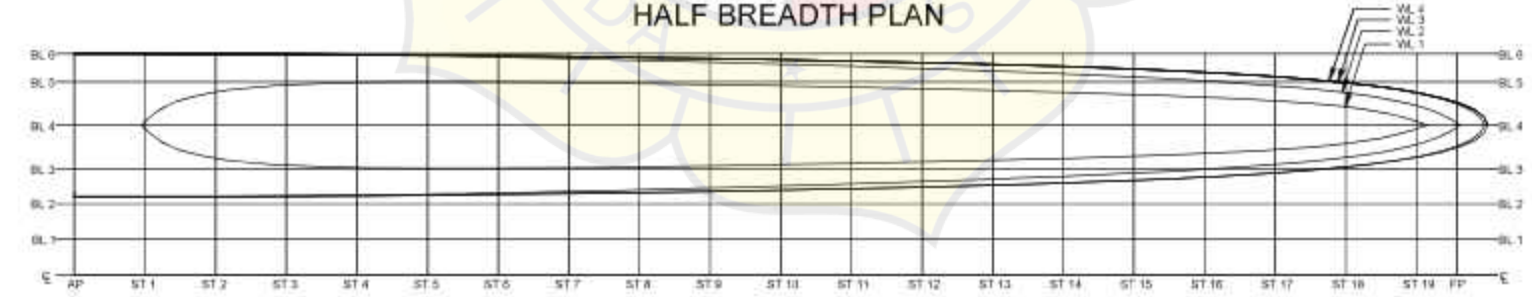
## BODY PLAN




## SHEER PLAN




## HALF BREADTH PLAN




| MAIN DIMENSIONS |
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HS. BANDA NEIRA

LINES PLAN

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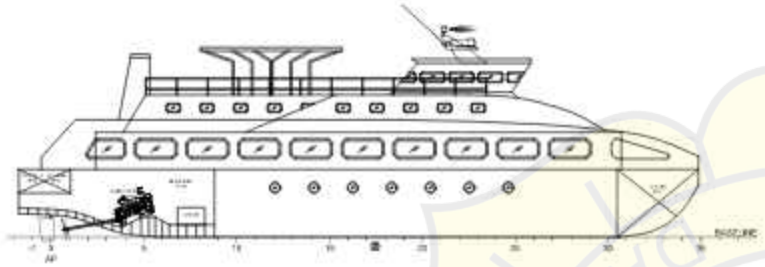
# LAMPIRAN B

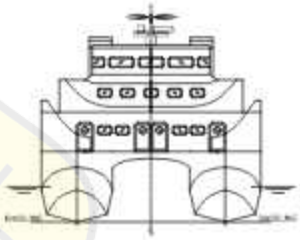
*GENERAL ARRANGEMENT*

# GENERAL ARRANGEMENT

SIDE VIEW

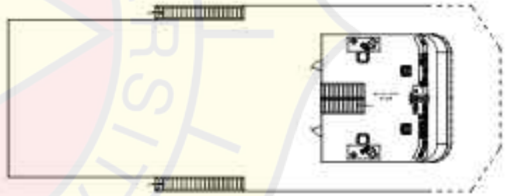


FRONT VIEW

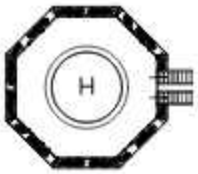


MAIN DECK

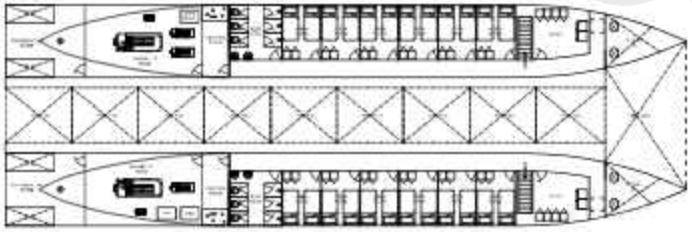
NAVIGATION DECK



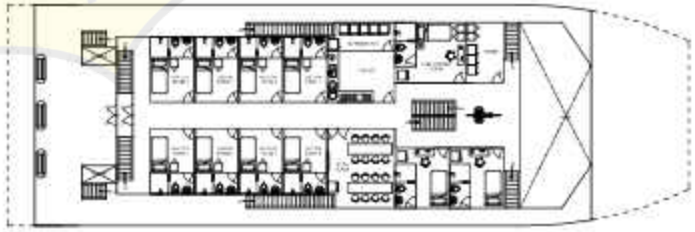
HELIDECK




UPPER BOTTOM DECK



ACCOMODATION DECK



| MAIN DIMENSIONS |
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HS. BANDA NEIRA

GENERAL ARRANGEMENT

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# LAMPIRAN C

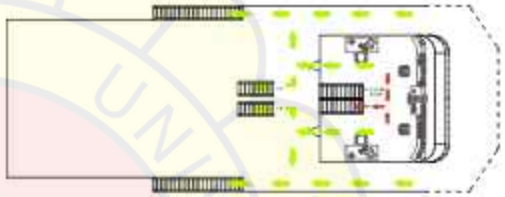
## *ESCAPE ROUTE PLAN*

# ESCAPE ROUTE PLAN

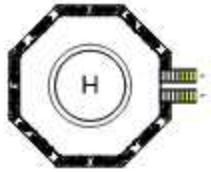
| SYMBOL | DESCRIPTION |
|---|---|
| | PRIMARY ROUTE |
| | SECONDARY ROUTE |
| | MUSTER POINT |

MAIN DECK

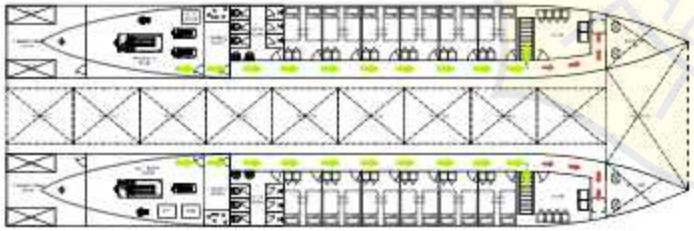
NAVIGATION DECK



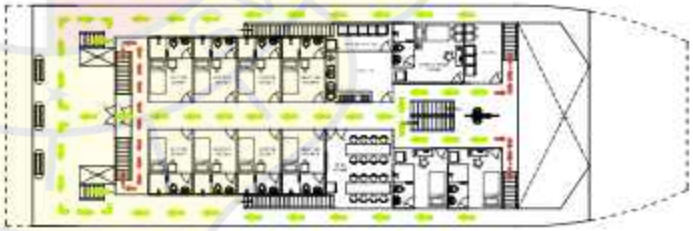
HELIDECK




UPPER BOTTOM DECK



ACCOMODATION DECK



| MAIN DIMENSIONS | |
|---|---|
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ESCAPE ROUTE PLAN

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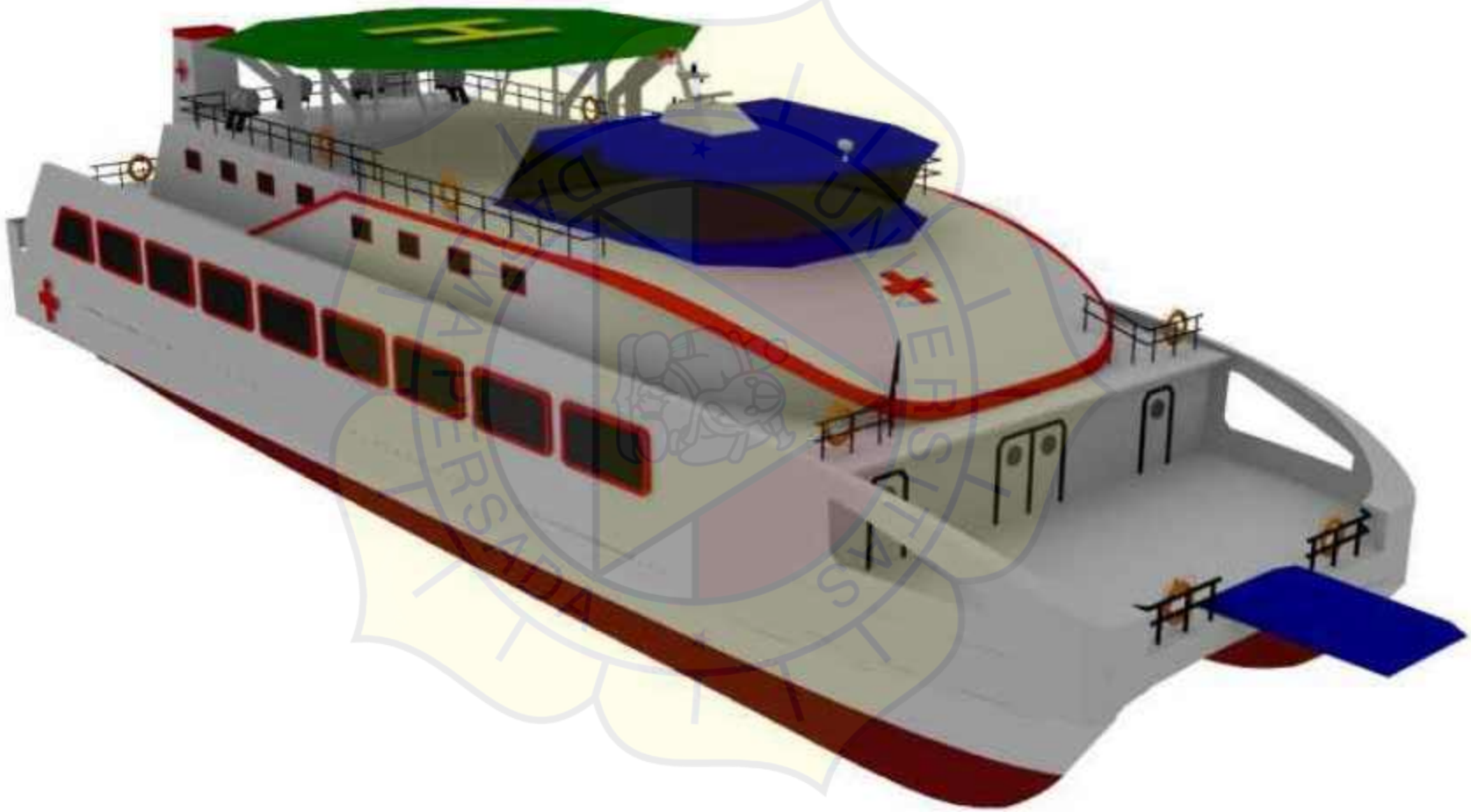
# LAMPIRAN D
# 3D MODEL



# LAMPIRAN E

# PERHITUNGAN DAYA *MAIN ENGINE*

# Main Engine Power Calculation

## A. Required Value

| | | | |
|---|---|---|---|
| **Rt** | = | 127100 | N |
| **Vs** | = | 9.26 | m/s |
| **Cb** | = | 0.43 | |
| **Cv** | = | 0.002 | |

## B. Definition

| | | | |
|---|---|---|---|
| D | = | 1 m | ; Diameter (0.6 s.d. 0.65) · T |
| $\eta_b$ | = | line bearing efficiency | |
| $\eta_c$ | = | electric transmission/power conversion efficiency | |
| $\eta_g$ | = | reduction gear efficiency | |
| $\eta_g$ | = | en electric generator efficiency | |
| $\eta_h$ | = | hull efficiency = (1 – t)/(1 – w) | |
| $\eta_m$ | = | electric motor efficiency | |
| $\eta_o$ | = | propeller open water efficiency | |
| $\eta_p$ | = | propeller behind condition efficiency | |
| $\eta_r$ | = | relative rotative efficiency | |
| $\eta_s$ | = | stern tube bearing efficiency | |
| $\eta_t$ | = | overall transmission efficiency | |

## C. Effective Horse Power

| | | | | |
|---|---|---|---|---|
| **EHP** | = | Rt x v/1000 | | ***(parametric design hal 11-27)*** |
| | = | 1176.844 | **KW** | |
| | = | 1578.15 | HP | |

## D. Thrust Horse Power

| | | | | |
|---|---|---|---|---|
| **THP** | = | TVA / 1000 | | ***(parametric design hal 11-27)*** |
| **T** | = | Rt/ (1 - t) | | |
| | = | 135888.5949 | | |
| $V_A$ | = | V (1 - w) | | ***(parametric design hal 11-27)*** |
| | = | 7.840374906 | | |
| **Cv** | = | 0.002 | | ***( ship resistance - maxsurf )*** |
| **w** | = | 0.3 Cb + 10 Cv Cb - 0.1 | | ***( PNA vol 2 hal 163 )*** |
| | = | 0.153234091 | | *; twin screw* |
| **t** | = | 0.064675 | | ***( PNA vol 2 hal 163 )*** |
| **ηh** | = | (1 - t)/(1 - w) | | ***(parametric design hal 11-29)*** |
| | = | 1.104585092 | | |
| **THP** | = | 1065.42 | **KW** | |

| E. Delivery Horse Power | | | | |
|---|---|---|---|---|
| DHP | = | PT /$\eta_p$ | | *(parametric design hal 11-29)* |
| $\eta_o$ | = | 0.56 | | *(propeller B-series = 0.5 - 0.6 )* |
| $\eta_r$ | = | 0.95 | | *( PNA vol 2 hal 163 )* |
| $\eta_p$ | = | $\eta_o\eta_r$ | | *(parametric design hal 11-27)* |
| $\eta_p$ | = | 0.533877606 | | |
| DHP | = | 1995.62 | KW | asumsi berdasarkan hasil percobaan open water test propeller pada umumnya |

| F. Shaft Power Horse | | | | |
|---|---|---|---|---|
| SHP | = | PD/($\eta_b\eta_s$) | | *(parametric design hal 11-29)* |
| $\eta_b\eta_s$ | = | untuk mesin aft | | *(parametric design hal 11-31)* |
| | = | 0.98 | | |
| SHP | = | 2036.35 | KW | |

| G. Brake Power Horse | | | | |
|---|---|---|---|---|
| BHP | = | PS/ ($\eta_T$) | | *(parametric design hal 11-29)* |
| $\eta_T$ | = | ;low speed diesel | | *(parametric design hal 11-33)* |
| | = | 0.98 | | |
| BHP | = | 2077.91 | KW | |

| H. Maximum Continues Rates | | | | |
|---|---|---|---|---|
| MCR | = | BHP + service margin 15 % | | *(parametric design hal 11-30)* |
| MCR | = | 2389.59 | KW | |
| | = | 3204.44 | HP | |

| I. Engine Power Requirement | | | | |
|---|---|---|---|---|
| Main Engine Power | = | 2389.59 | KW | 3204.44 HP |

# LAMPIRAN F

# PERHITUNGAN KEBUTUHAN ELEKTRIK

## Electrical Requirement Calculation

### Assumption

| | |
|---|---|
| System Voltage | 120 V |
| Current | AC |

### Conversion

| | | | |
|---|---|---|---|
| 1KVA | = | 0.800 | KW |
| KVA | = | Maximum Total Leg Amps. x System Voltage/1000 | |

### 1. General elecric Equipment of Ship

Ref : https://www.sailboat-cruising.com/boat-electrics.html

| Peralatan Listrik | | Ampere |
|---|---|---|
| Anchor Light | = | 0.9 |
| Anchor windlass | = | 80.0 |
| Autopilot | = | 4.0 |
| Bilge Pump | = | 40.0 |
| Cabin Lights | = | 1.8 |
| Chart Plotter/GPS | = | 0.8 |
| Chart Table Light | = | 0.3 |
| Cockpit Instruments | = | 0.3 |
| Cockpit Light | = | 1.0 |
| Compass Light | = | 0.2 |
| Deck Light | = | 1.7 |
| Distribution Panel & DCM | = | 0.1 |
| Fresh Water Pump | = | 4.0 |
| Fridge | = | 4.0 |
| Masthead Light | = | 0.9 |
| Navigation Lights | = | 3.7 |
| Navtex | = | 0.4 |
| Radar (Standby) | = | 1.0 |
| Radar (Transmit) | = | 2.5 |
| SSB (Standby) | = | 1.0 |
| SSB (Transmit) | = | 25.0 |
| Stereo | = | 1.0 |
| Ventilation Fans | = | 1.0 |

| | | | |
|---|---|---|---|
| VHF (Standby) | = | 0.3 | |
| VHF (Transmit) | = | 1.2 | |
| Fire Fighting Pump | = | 120.0 | |
| Electric Winch | = | 300.0 | |
| Total | = | 597.1 | A |
| | | | |
| Watt | = | 57321.6 | |

| **2. Penentuan jumlah titik lampu dalam ruangan** | | |
|---|---|---|
| N | = | Jumlah titik lampu |
| E | = | Kuat penerangan/ target penerangan yang dicapai (lux) |
| L | = | Panjang ruangan (m) |
| W | = | Lebar ruangan (m) |
| Ø | = | Total lumen lampu (*lamp luminous flux)* |
| LLF | = | *light loss factor* ( faktor cahaya rugi) |
| CU | = | *Coeficient of utilization* (Faktor pemanfaatan (50%-65%)) |
| n | = | Jumlah lampu dalam 1 titik lampu |

| **2.1 Ruang Machinery Room and Accomodation (Secod Deck)** | | | |
|---|---|---|---|
| menggunakan lampu LED | | 30 | Watt |
| E | = | 250 | Lux |
| L | = | 40 | m |
| B | = | 7 | m |
| Ø | = | 2000 | |
| LLF | = | 0.8 | (0,7-0,8) |
| CU | = | 65% | (50%-65%) |
| n | = | 1 | |
| Jumlah Ruangan | = | 1 | |
| N | = | E x L x W / Ø x LLF x CU x n | |
| | = | 67.31 | titik lampu |
| | = | 67 | titik lampu |
| Jumlah Lampu | = | 67 | Lampu |

| **2.2 Ruang Medical Treatment (Main Deck)** | | | |
|---|---|---|---|
| menggunakan lampu LED | | 30 | Watt |
| E | = | 250 | Lux |
| L | = | 30 | m |
| B | = | 11 | m |
| Ø | = | 2000 | |
| LLF | = | 0.8 | (0,7-0,8) |
| CU | = | 65% | (50%-65%) |
| n | = | 1 | |

| | | |
|---|---|---|
| Jumlah Ruangan | = | 1 |
| N | = | E x L x W / Ø x LLF x CU x n |
| | = | 79.33 titik lampu |
| | = | 79 titik lampu |
| Jumlah Lampu | = | 79 Lampu |

| **2.3 Ruang Accomodation** | | |
|---|---|---|
| menggunakan lampu LED | | 30 Watt |
| E | = | 250 Lux |
| L | = | 25 m |
| W | = | 11 m |
| Ø | = | 2000 |
| LLF | = | 0.8 (0,7-0,8) |
| CU | = | 65% (50%-65%) |
| n | = | 1 |
| Jumlah Ruangan | = | 1 |
| N | = | E x L x W / Ø x LLF x CU x n |
| | = | 66.11 titik lampu |
| | = | 66 titik lampu |
| Jumlah Lampu | = | 66 Lampu |

| **2.4 Ruang Navigation** | | |
|---|---|---|
| menggunakan lampu LED | | 30 Watt |
| E | = | 250 Lux |
| L | = | 8 m |
| W | = | 8 m |
| Ø | = | 2000 |
| LLF | = | 0.8 (0,7-0,8) |
| CU | = | 65% (50%-65%) |
| n | = | 1 |
| Jumlah Ruangan | = | 2 |
| N | = | E x L x W / Ø x LLF x CU x n |
| | = | 15.38 titik lampu |
| | = | 15.38 titik lampu |
| Jumlah Lampu | = | 15 Lampu |

| **3. Air Conditioning** | | |
|---|---|---|
| **Air Handling Unit** | | |
| Jumlah | = | 3 |
| Watt | = | 58000 |

## 4. Refrigerator

**Kulkas**

| | | |
|---|---|---|
| Jumlah | = | 3 |
| Watt | = | 500 |

## 5. Medical Equipmet

https://esource.bizenergyadvisor.com/article/hospitals

| | | |
|---|---|---|
| Watt | = | 31000 |

## Kebutuhan Listrik

| Item | | Kapasitas (w) | Kapasitas (kw) |
|---|---|---|---|
| General Ship Equipment | = | 57321.6 | 57.3 |
| Lighting | = | 6843.8 | 6.8 |
| Air Conditioning | = | 58000.0 | 58.0 |
| Refrigerator | = | 1500.0 | 1.5 |
| Medical Equipment | = | 31000.0 | 31.0 |
| | **Total kW** | | 122.2 |
| | **Total kW Contingency 100%** | | **244.3** |

# LAMPIRAN G

# SPESIFIKASI *MAIN ENGINE*

## MAIN ENGINE CHOOSING

### A. Engine Requirement

| | | | |
|---|---|---|---|
| Engine Power Requirement | = | 2389.59 | kW |
| | | 3204.44 | HP |
| Generator Power Requirement | = | 244.33 | kW |
| | | 327.65 | HP |
| Emergency Genset | = | 122.17 | KW |
| | | 163.82 | HP |

### B. Engine Choosen

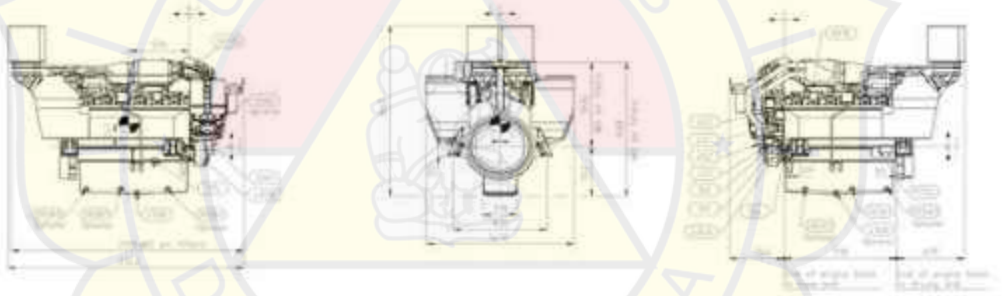
| | | | | |
|---|---|---|---|---|
| Engine Type | = | Wartsila 14 | @ 2 | |
| Max.Power | = | 1340.00 | kW | 1 M.E |
| | | 1796.00 | HP | |
| | | 2680.00 | | 2 M.E |
| | | 3592.00 | | |
| n(rpm) | = | 1900 | r/min | |
| Cylinder number | = | 16 | | |
| Fuel Oil Consumpsion | = | 205 | g/kWh | |
| Lube Oil Consumption | = | | g/kWh | |
| Dimension | | | | |
| Length | = | 2601 | mm | |
| Width | = | 1451 | mm | |
| Height | = | 1019 | mm | |
| Weight | = | 3.8 | ton | |


**THE WÄRTSILÄ 14 HIGH-SPEED ENGINE – A LIGHTER AND GREENER ALTERNATIVE FOR MARINE OPERATIONS**

## Technical specifications

| Wärtsilä 14 | | IMO Tier II or III | |
|---|---|---|---|
| Cylinder bore | 135 mm | Fuel specification:<br>Light fuel oil, maximum sulphur content 0.5%<br>ISO 8217, category ISO-F-DMX, DMA,DMZ<br>SFOC 205,0 g/kWh at ISO condition | |
| Piston stroke | 157 mm | | |
| Cylinder configuration | | 12V | 16V |
| Nominal power (kWm) | | 749–1005 | 1005–1340 |
| Nominal power (kWe) | | 675–865 | 900–1155 |
| Nominal speed (rpm) | | 1500–1900 | 1500–1900 |

| Engine dimensions (mm) and dry weight without air filter (tonnes) | | | | | |
|---|---|---|---|---|---|
| Engine type | A | C | B | F | Weight |
| 12V14 | 2842 | 1470 | 926 | 542 | 2.8 |
| 16V14 | 2601 | 1451 | 1019 | 525 | 3.8 |



## C. Generator Choosen

| | | | |
|---|---|---|---|
| Generator Type | = | DCEC Cummins 6ZTAA13-G3 | |
| Max.Power | = | | kVA |
| | | 300 | KW |
| n(rpm) | = | 1500 | r/min |
| Cylinder number | = | 6 | |
| | | | |
| Fuel Oil Consumpsion | = | 198 | g/kWh |
| Lube Oil Consumption | = | | g/kWh |
| | | | |
| Dimension | | | |
| Length | = | 3250 | mm |
| Width | = | 1200 | mm |
| Height | = | 1800 | mm |

Weight = 3.85 ton

## DCEC Cummins Technical Parameters(350-400KW)

| | | | | |
|---|---|---|---|---|
| Genset | Model | ADC350S | ADC400S | ADC450S |
| | Rated Power(KW/KVA) | 350/437 | 360/450 | 400/500 |
| | Standby Power(KW/KVA) | 380/475 | 400/500 | 450/562 |
| | Rated Current(A) | 631 | 649 | 721 |
| | weight(kg) | 3650 | | |
| | Size(mm) | 3250*1200*1800 | | |
| Diesel Engine | **Model** | **6ZTAA13-G2** | **QSZ13-G2** | **QSZ13-G2** |
| | **Manufacturer** | **Cummins** | | |
| | Continuous Power(KW) | 350 | 400 | 450 |
| | Standby Power(KW) | 415 | 440 | 470 |
| | Number of Cylinders | 6 | | |
| | Cylinder Diameter*Stroke(mm) | 114*145 | | 130*165 |
| | Cylinder Arrangement | In line | | |
| | Compression Ratio | 17 | | |
| | Displacement(L) | 13 | | |
| | Intake Type | Exhaust gas turbocharger | | |
| | Cooling Type | Tank fan cooling | | |
| | Rated Speed(rpm) | 1500 | | |
| | Fuel Consumption(g/kwh) | ≤198 | | |
| | Discharge Temperature(℃) | 580 | | |
| | Unpitched Sound(db) | 104 | | |
| | Speed Regulation | Electronic Speed Regulation | | |
| | Nominal Voltage(V) | 400/230 | | |

## D. Emergency Generator Choosen

| | | |
|---|---|---|
| Generator Type | = | DCEC Cummins 6ZTAA13-G3 |
| Max.Power | = | kVA |
| | | 300 KW |
| n(rpm) | = | 1500 r/min |
| Cylinder number | = | 6 |
| | | |
| Fuel Oil Consumpsion | = | 198 g/kWh |
| Lube Oil Consumption | = | g/kWh |
| | | |
| Dimension | | |
| Length | = | 3250 mm |
| Width | = | 1200 mm |
| Height | = | 1800 mm |
| Weight | = | 3.85 ton |

DCEC Cummins Technical Parameters(350-400KW)

| Model | | | |
|---|---|---|---|
| Rated Power(KW/KVA) | | | |
| Standby Power(KW/KVA) | | | |
| Rated Current(A) | | | |
| weight(Kg) | | | |
| Size(mm) | | | |
| **Model** | 6ZTAA13-G2 | 6BZ13-G2 | 6BZ13-G2 |
| **Manufacturer** | Cummins | | |
| Continuous Power(KW) | 350 | 400 | 480 |
| Standby Power(KW) | 415 | 440 | 470 |
| Number of Cylinders | 6 | | |

| | | |
|---|---|---|
| Cylinder Diameter*Stroke(mm) | 114*145 | 130*165 |
| Cylinder Arrangement | In-line | |
| Compression Ratio | 17 | |
| Displacement(L) | 19 | |
| Intake Type | Exhaust gas turbocharger | |
| Cooling Type | Twin fan cooling | |
| Rated Speed(rpm) | 1500 | |
| Fuel Consumption(g/kwh) | 1796 | |
| Exhaust Temperature(°C) | 683 | |
| Unpitched Sound(dB) | 104 | |
| Speed Regulation | Electronic Speed Regulation | |
| Nominal Voltage(V) | 400/230 | |

# LAMPIRAN H

# PERHITUNGAN BERAT BAJA

## PERHITUNGAN BERAT BAJA KAPAL

**Input data**

| | | | |
|---|---|---|---|
| **Lpp** | = | 40.90 m | |
| **Lwl** | = | 40.90 m | |
| **B** | = | 12.50 m | |
| **H** | = | 4.18 m | |
| **T** | = | 2.00 m | |
| **Δ** | = | 279.80 ton | |
| **Ñtot** | = | 272.998 $m^3$ | |
| **$C_B$** | = | 0.43 | |
| Po | = | $2,1.(C_B + 0,7).$ Co . CL .f .$C_{RW}$ | [kN/m2] |
| $C_0$ | = | ; untuk L < 90 | |
| $C_0$ | = | 4.302 | |
| f | = | 1.00 pelat | |
| f | = | 0.75 penegar | |
| f | = | 0.60 penumpu | |
| $C_L$ | = | (L/90)^2 L < 90 m | |
| | = | 0.674 | |
| Crw | = | 0.75 *; pelayaran lokal* | |
| Po1 | = | 2.6(Cb+0.7).Co.Cl | [kN/m2] |
| $P_0$ | = | 5.17 $kN/m^2$ | ,Untuk pelat kulit, geladak cuaca |
| Po1 | = | 8.527991489 | |

**Harga CF dapat di cari dari tabel dibawah ini**

| | Range | | Factor $c_D$ | | Factor $c_F$ | |
|---|---|---|---|---|---|---|
| | $0 \leq x/L < 0,2$ | | 1,2 - x/L | | 1,0 + 5/Cb [0,2 - x/L] | |
| **A** | x/L = | 0.07 | $C_D$ = | 1.13 | $C_F$ = | 2.47 |
| | $0,2 \leq x/L < 0,7$ | | 1.00 | | 1.00 | |
| **M** | x/L = | 0.19 | $C_D$ = | 1.00 | $C_F$ = | 1.00 |
| | $0,7 \leq x/L \leq 1$ | | 1,0 + c/3 [x/L - 0,7] | | $1+ 20/Cb [x/L - 0,7]^2$ | |
| **F** | x/L = | 0.29 | c = 0,15. L - 10 | | | |
| | | | $L_{min}$ = 100 m | | | |
| | | | $C_D$ = | 1,524 | $C_F$ = | 8.672 |

**Beban pada sisi kapal pada pelat dapat dihitung sebagai berikut:**

**daerah 0 ≤ x/L < 0.2**

| | | |
|---|---|---|
| Ps | = | 10 (T - Z) + Po x Cf x (1 + Z / T) |
| Ps1 | = | $Po_1.(20/(5+Z-T))$ |

| | | |
|---|---|---|
| Z | = | 1.195 m |
| Ps | = | 27.75 kN/m$^2$ |
| $P_{s1}$ | = | 40.66 kN/m$^2$ |

**daerah 0.2 ≤ x/L < 0.7**

| | | |
|---|---|---|
| Ps | = | 11.24 kN/m$^2$ |
| $P_{s1}$ | = | 40.66 kN/m$^2$ |

**daerah 0.7 ≤ x/L < 1**

| | | |
|---|---|---|
| Ps | = | 97.44 kN/m$^2$ |
| $P_{s1}$ | = | 40.66 kN/m$^2$ |

## Beban Pada Dasar Kapal ( PB )

**daerah 0 ≤ x/L < 0.2**

| | | |
|---|---|---|
| $P_B$ | = | $10 . T + P_o . C_F$ |
| $P_{B1}$ | = | $10 . T + P_{o1} . 2 . \|y\|/B$ |
| y | = | 4.05 m |
| $P_B$ | = | 32.76 kN/m$^2$ |
| $P_{B1}$ | = | 25.53 kN/m$^2$ |

**daerah 0.2 ≤ x/L < 0.7**

| | | |
|---|---|---|
| $P_B$ | = | 25.17 kN/m$^2$ |
| $P_{B1}$ | = | 25.53 kN/m$^2$ |

**daerah 0.7 ≤ x/L < 1**

| | | |
|---|---|---|
| $P_B$ | = | 64.80 kN/m$^2$ |
| $P_{B1}$ | = | 25.53 kN/m$^2$ |

## Beban Pada Geladak Cuaca (Pd)

**daerah 0 ≤ x/L < 0.2**

| | | |
|---|---|---|
| Pd | = | (Po x 20 x T x Cd) / ((10 + Z - T)H) |
| Pd | = | 4.57 kN/m$^2$ |
| Pdmin | = | 16 . f atau 16 kN/m2 |

Pdmin 0.7 . P0 = 3.62 kN/m2

**daerah 0.2 ≤ x/L < 0.7**

Pd = 4.06 kN/m²

**daerah 0.7 ≤ x/L < 1**

Pd = 6.18 kN/m²

## Beban Pada Geladak Bangunan Atas

$P_{DA}$ = $P_D$ n kN/m²

n = 1 – [(z – H)/10] ; nmin = 0,5

$P_{DA\ min}$ = 4 kN/m²

**Passenger Deck**

h poop = 2 m

# z = 3.18 m

n = 1-((z-H)/10)

= 1.1 $n_{min}$ = 0.5

$P_{DA}$ = 17.6

## Perhitungan Tebal Pelat

**Tebal Pelat Sisi**

**daerah 0 ≤ x/L < 0.2**

t = 1.9 . Nf . a (ps.k)^0.5 +tk

= 8.77 mm ≈ 9 mm

**daerah 0.2 ≤ x/L < 0.7**

t = 1.9 . Nf . a (ps.k)^0.5 +tk

= 8.77 mm ≈ 9 mm

**daerah 0.7 ≤ x/L < 1**

t = 1.9 . Nf . a (ps.k)^0.5 +tk

= 12.75 mm ≈ 13 mm

**Tebal Pelat Bottom**

**daerah 0 ≤ x/L < 0.2**

t = 1.9 . Nf . a . (Pb . K)^0.5 +tk

= 9.02 mm ≈ 10 mm

**daerah 0.2 ≤ x/L < 0.7**

t = 1.9 . Nf . a . (Pb . K)^0.5 +tk

= 8.76 mm ≈ 9 mm

**daerah 0.7 ≤ x/L < 1**

t = 1.9 . Nf . a . (Pb . K)^0.5 +tk

= 11.18 mm ≈ 12 mm

**Tebal Pelat Geladak**

**daerah 0 ≤ x/L < 0.2**

t = 1.9 . Nf . a . (Pd . K)^0.5 +tk

4.904 mm ≈ 5 mm

**daerah 0.2 ≤ x/L < 0.7**

t = 1.9 . Nf . a . (Pd . K)^0.5 +tk

4.904 mm ≈ 5 mm

**daerah 0.7 ≤ x/L < 1**

t = 1.9 . Nf . a . (Pd . K)^0.5 +tk

4.904 mm ≈ 5 mm

## Tebal Pelat Bangunan Atas

**Passenger Deck**

t = 0.9 x a x (P x k)^0.5 + tk

= 2.27

= tk = 1.5 mm untuk t' < 10 mm

= 3.77 mm

t = C a √(P.k) + tk

= 4.545740895 mm ≈ 5 mm

atau

t = (5,5 + 0.02L)√k

= 5.852 ≈ 6 mm

## Perhitungan Berat

Perhitungan luasan, dihitung menggunakan *software Maxsurf*

### 1. Lambung

| | | |
|---|---|---|
| Luas | = | 893.50 $m^2$ |
| Tebal | = | 0.010 m |
| p Material Baja | = | 7.85 $ton/m^3$ |
| Berat | = | 70.14 ton |

| **2. Main Deck** | | | | |
|---|---|---|---|---|
| Luas | = | 476.00 | $m^2$ | |
| Tebal | = | 0.006 | m | |
| p Material Baja | = | 7.85 | $ton/m^3$ | |
| Berat | = | 44.84 | ton | |

| **4. Accomodation Deck** | | | | |
|---|---|---|---|---|
| Luas | = | 350.20 | $m^2$ | |
| Tebal | = | 0.005 | m | |
| p Material Baja | = | 7.85 | $ton/m^3$ | |
| Berat | = | 27.49 | ton | |

| **5. Accomodation Wall** | | | | |
|---|---|---|---|---|
| Luas | = | 757.30 | $m^2$ | |
| Tebal | = | 0.004 | m | |
| p Material Baja | = | 7.85 | $ton/m^3$ | |
| Berat | = | 47.56 | ton | |

| **6. Konstruksi** | | | | |
|---|---|---|---|---|
| Berat konsrtuksi, menurut pengalaman empiris 20% -30% dari berat lambung kapal | | | | |
| (diambil 20%) | | | | |
| Sehingga, | | | | |
| Berat | = | 28.49 | ton | |

| **7. Helideck** | | | | |
|---|---|---|---|---|
| Berat | = | 5.00 | ton | |

| **8. Total** | | | | |
|---|---|---|---|---|
| Berat Total | = | 223.52 | ton | |
| VCG | = | 4.70 | m | |
| LCG | = | 19.71 | m | (dari maxsurf) |

# LAMPIRAN I

# PERHITUNGAN BERAT PERMESINAN

## Machinery Weight Calculation

### Input Data

| | | | | |
|---|---|---|---|---|
| LWL | = | 39.23 | m | |
| T | = | 2.00 | m | |
| CB | = | 0.43 | | |
| RT | = | 91.50 | kN | |
| D | = | 1.20 | m | ; Diameter (0.6 s.d. 0.65) · T |
| nrpm | = | 1900 | rpm | |
| nrps | = | 31.67 | rps | |
| P/D | = | 1 | | ; Pitch Ratio (0.5 s.d. 1.4) |
| z | = | 4 | blade | ; Jumlah Blade |
| AE/A0 | = | 0.4 | | ; Expanded Area Ratio |

### 1. Main Engine

| | | | | |
|---|---|---|---|---|
| We | = | 7.6 | ton | ; dari katalog |

### 2. Shafting

| | | | | |
|---|---|---|---|---|
| M/l (t/m) | = | $0.081\ (PD/n)^{2/3}$ | | ; untuk tensile strength ***( Ship Design for Efficie*** |
| lp | = | 4 | m | ( asumsi panjang shaft 4 meter ) |
| n | = | 110 | rpm | ( asumsi rpm propeller ) |
| PD | = | 2676.13 | HP | |
| M/l (t/m) | = | 0.68 | ton/m | |
| Wshaft | = | 2.72 | ton | |

### 4. Propeller

| | | | | |
|---|---|---|---|---|
| Wp | = | $D^3.K$ | | ; untuk material berbahan 'mangar ***( Ship Design for Efficie*** |
| K | = | 0.18 AE/AO - (z-2)/100 | | |
| | = | 0.74 | | |
| D | = | 1.20 | | |
| Wp | = | 1.27 | ton | ***( Ship Design for Efficiency & Econ*** |

## 5. Electricity

| | | | |
|---|---|---|---|
| $W_{genset}$ | = | 3.85 ton/genset | |
| $W_{emergenset}$ | = | 3.85 ton | |
| n Genset | = | 2 | ; asumsi menggunakan 1 genset utama + 1 genset cadangan + genset emergency |
| $W_{agg\ tot}$ | = | 11.55 ton | |

## 6. Other Weight

| | | | |
|---|---|---|---|
| M | = | 0.4P | |
| P | = | 7.60 ton | dari main engine |
| M | = | 3.04 ton | |

## 7. Total Machinery Weight

| | | | |
|---|---|---|---|
| $W_{m\ total}$ | = | 26.18 ton | |

## 8. CoG of Machinery

| | | | |
|---|---|---|---|
| hDB | = | 1.50 m | ***(parametric design hal 11-30)*** |
| D' | = | tinggi kamar mesin | |
| | = | 4.18 | |
| VCG | = | hDB + 0.35 (D' - hBD ) | |
| | = | 2.44 m | |
| LCG | = | titik berat berada di ujung belakang mesin utama | |
| | = | Lpp-(Lcb + Lshaft) | |
| | = | 7.34 m | ***(parametric design hal 11-30)*** |

# LAMPIRAN J

# PERHITUNGAN PERLENGKAPAN KAPAL

## OUTFITTING CALCULATION

### 1. Peralatan Keselamatan (*Life Jacket, Life Buoy*)

SOLAS Chapter III Part B and LSA Code Chapter II

**· *Life Jacket***

| | | | |
|---|---|---|---|
| Jumlah penumpang dan kru kapal | = | 44 | orang |
| Life jacket yang dibutuhkan | = | 44 | buah |
| Berat 1 unit *life jacket* | = | 0.740 | kg |
| Berat total | = | 32.560 | kg |
| | = | 0.033 | ton |

**Marine SOLAS Life Jakcet**

| | | | |
|---|---|---|---|
| DY-A4 | Adult life jacket |  | *comform to SOLAS 74/96,MSC.201(81) MSC.81(70) MSC.200(80)<br>* certification: CCS/EC<br>*Material:Cover:PU & Polyester compound<br>*inside: EPE foam<br>*Size:length 550mm width:270mm<br>*Weight:0.74kg<br>*Buoyancy: >147N |

**· *Life Buoy***

| | | | | |
|---|---|---|---|---|
| Life buoy yang dibutuhkan | = | 8 | buah | *; for ship with L < 60 m* |
| Berat 1 unit *life buoy* | = | 14.5 | kg | |
| Berat total | = | 116 | kg | |
| | = | 0.116 | ton | |

SIMA
Marine & Industry equipment

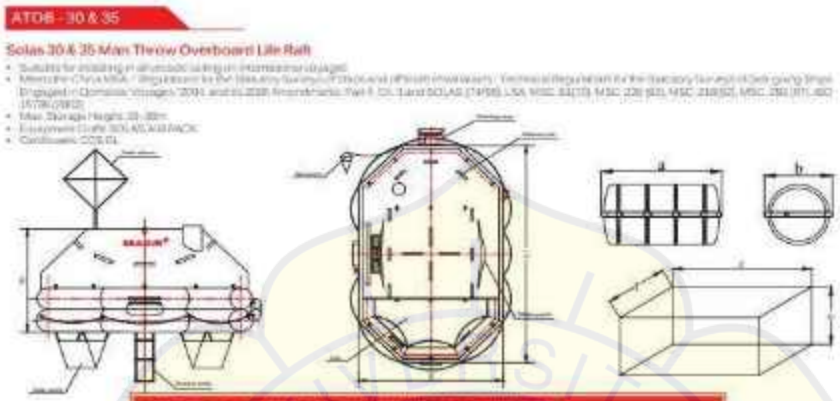
**Bouée couronne / Lifebuoy**

| | |
|---|---|
| Description | Bouée couronne standard approuvée SOLAS |
| Matière | Coque polyéthylène traité anti-UV, mousse polyuréthane |
| Normes | Conforme à la convention SOLAS 74 |

| Réf. / Code | Flottabilité / Floatability (kg) | Ø extérieur / Outer Ø (mm) | Ø intérieur / Inner Ø (mm) | Épaisseur / Width (mm) | Poids / Weight (kg) |
|---|---|---|---|---|---|
| 201.775 | 14,5 | 740 | 430 | 80 | 2,7 |

· ***Life Raft***

| | | | | |
|---|---|---|---|---|
| Tipe | = | ATOB - 30 | | |
| Life raft yang dibutuhkan | = | 2 | buah | 67.5 |
| Berat 1 unit *life Raft* | = | 205.0 | kg | |
| Berat total | = | 410 | kg | |
| | = | 0.410 | ton | |




**SOLAS 30 & 35 MAN THROW OVERBOARD LIFE RAFT**

| Type | | ATOB - 30 | ATOB - 35 |
|---|---|---|---|
| Shape | | Rectum Octagon | |
| Capacity (Persons) | | 30 | 35 |
| Dimensions (L x W x H) mm | | | |
| Cylinder (L) | | | |
| Container Dimensions (mm) | Solas A Pack (L x W) | | |
| | Solas B Pack ( L x W) | | |
| Packing Dimensions (mm) | Solas A Pack (L x W x H) | | |
| | Solas B Pack (L x W x H) | | |
| Required Ballast Full (Kg) | For 20knot speed | | |
| | For 36knot speed | | |
| | Weight (kg) | | |

## 2. Anchor

Pemilihan jangkar mengacu pada Z Number

$$Z = \Delta^{(2/3)} + 2hB + 0.1A$$

Dimana

| | | | | | |
|---|---|---|---|---|---|
| Z | = | Z number | | | |
| Δ | = | Moulded Displacement | = | 279.80 | ton |
| h | = | Freeboard | = | 2.18 | m |
| B | = | Lebar | = | 12.50 | m |
| **A** | = | Luasan diatas sarat | = | 453 | sqm |
| Z | = | 26195.813 | | | |

Anchor Weight = 3 ton

## 3. Medical Equipment

| item | Weight (kg) | Qty. | Total Weight (ton) |
|---|---|---|---|
| Hospital Bed | 95 | 20 | 1.90 |
| X-ray Machine | 150 | 1 | 0.15 |
| Exam table | 40 | 15 | 0.60 |
| Exam seating | 15 | 15 | 0.23 |
| Digital neonatal scale | 60 | 3 | 0.18 |
| Phleobotomy cart | 8 | 15 | 0.12 |
| Interpretive ECG machine | 5 | 2 | 0.01 |
| Medical cart | 10 | 15 | 0.15 |
| Medical cabinet | 30 | 25 | 0.75 |
| Medical Transport Stretchers | 80 | 4 | 0.32 |
| Medical Sink | 40 | 10 | 0.40 |
| Medical Bin | 2 | 30 | 0.06 |
| Wheel Chair | 15 | 8 | 0.12 |
| Medical Standard Cribs | 15 | 4 | 0.06 |
| Other Medical Stuff 30% of Total | 169.5 | 1 | 0.17 |
| | | **Total =** | **5.21** |

## 4. Total Weight and CoG Outfitting

$W_{outfitting}$ = 8.77 ton

CoG

VCG = 6.68 m

LCG = 20 m Assumption 1.5 above M.D

# LAMPIRAN K

# PERHITUNGAN BERAT *CONSUMABLE*

## Perhitungan DWT

**Input data**

| | | | |
|---|---|---|---|
| **Lpp** | = | 40.90 | m |
| **Lwl** | = | 40.90 | m |
| **B** | = | 12.50 | m |
| **H** | = | 4.18 | m |
| **T** | = | 2.00 | m |
| **displacement** | = | 279.80 | ton |
| **volume** | = | 273.00 | $m^3$ |
| **$h_{DB}$** | = | 1.50 | m |
| **crew** | = | 34 | orang |
| **Passanger** | = | 20 | orang |

**1. Konsumsi Bahan Bakar Mesin Induk (*Fuel Oil Consumption*)**

| | | | | | |
|---|---|---|---|---|---|
| BHP | = | 2390 | kW | | |
| S | = | 49.00 | km | | |
| V | = | 18.00 | knots = | 9.26 | m/s |
| Fuel Consumption | = | 205.00 | g/kWh | | |

| Waktu Operasional | Medical Operational | Rute Perjalanan | Voyage Radius (km) | Bahan Bakar M.E (ton) |
|---|---|---|---|---|
| Rute 1 | | | | |
| Senin | Pulau Banda Neira | Hatta - Banda Neira | 23 | 0.34 |
| Selasa | Pulau Ai | Banda Neira - Ai | 15 | 0.22 |
| Rabu | Pulau Run | Ai - Run | 12 | 0.18 |
| | | **Total** | **50** | **0.73** |
| | | | **Total Untuk 2 Engine =** | **1.47** |

| Waktu Operasional | Medical Operational | Rute Perjalanan | Voyage Radius (km) | Bahan Bakar M.E (ton) |
|---|---|---|---|---|
| Rute 2 | | | | |
| Kamis | Pulau Banda Utara | Run - Banda Utara | 25 | 0.37 |
| Jumat | Pulau Banda Selatan | Banda Utara - Pisang | 7 | 0.10 |
| Sabtu | Pulau Pisang | Pisang - Banda Selatan | 8 | 0.12 |
| Minggu | Pulau Hatta | Banda Selatan - Hatta | 11.5 | 0.17 |
| | | **Total** | **51.5** | **0.76** |
| | | | **Total Untuk 2 Engine =** | **1.51** |

| | | | | |
|---|---|---|---|---|
| **VCG** | = | 3.25 | m | (dari maxsurf) |
| **LCG** | = | 1.50 | m | |

## 2. Konsumsi Bahan Bakar Generator (*Fuel Oil Consumption*)

| | | | |
|---|---|---|---|
| BHP | = | 300 | kW |
| Fuel Consumption | = | 198.00 | g/kWh |
| Operational Time | = | 24.00 | hrs |

Assumption, due to lack of shore electrical facility, all operational power taken from ship, eventough during berthing.

| Waktu Operasional | Medical Operational | Rute Perjalanan | Voyage Radius (km) | Bahan Bakar A.E (ton) |
|---|---|---|---|---|
| Rute 1 | | | | |
| Senin | Pulau Banda Neira | Hatta - Banda Neira | 23 | 1.43 |
| Selasa | Pulau Ai | Banda Neira - Ai | 15 | 1.43 |
| Rabu | Pulau Run | Ai - Run | 12 | 1.43 |
| | | **Total** | **50** | **4.28** |

| Waktu Operasional | Medical Operational | Rute Perjalanan | Voyage Radius (km) | Bahan Bakar A.E (ton) |
|---|---|---|---|---|
| Rute 2 | | | | |
| Kamis | Pulau Banda Utara | Run - Banda Utara | 25 | 1.43 |
| Jumat | Pulau Banda Selatan | Banda Utara - Pisang | 7 | 1.43 |
| Sabtu | Pulau Pisang | Pisang - Banda Selatan | 8 | 1.43 |
| Minggu | Pulau Hatta | Banda Selatan - Hatta | 11.5 | 1.43 |
| | | **Total** | **51.5** | **5.70** |

| | | | | |
|---|---|---|---|---|
| **VCG** | = | 3.25 | m | (dari maxsurf) |
| **LCG** | = | 1.50 | m | |

## 2. Crew and Effect

| | | | | |
|---|---|---|---|---|
| $W_{C\&E}$ | = | 0.09 | ton/person | |
| | = | 3.06 | ton | |
| **VCG** | = | 6.50 | m | (dari maxsurf) |
| **LCG** | = | 20.00 | m | |

## 3. Passanger and Effect

| | | | | |
|---|---|---|---|---|
| $W_{PASS}$ | = | 0.09 | ton/person | |
| | = | 1.80 | ton | |
| **VCG** | = | 6.50 | m | (dari maxsurf) |
| **LCG** | = | 20.00 | m | |

## 3. Fresh Water

Ship Design and Construction, ch. 11 pg. 26

$W_{FW1}$ = konsumsi air tawar crew and passanger

= 0.06 t/(person • day) (kebutuhan per hari)

= 3.24 ton

| Waktu Operasional | Medical Operational | Rute Perjalanan | Voyage Radius (km) | Fresh Water (ton) |
|---|---|---|---|---|
| Rute 1 | | | | |
| Senin | Pulau Banda Neira | Hatta - Banda Neira | 23 | 3.24 |
| Selasa | Pulau Ai | Banda Neira - Ai | 15 | 3.24 |
| Rabu | Pulau Run | Ai - Run | 12 | 3.24 |
| | | **Total** | **50** | **9.72** |

| Waktu Operasional | Medical Operational | Rute Perjalanan | Voyage Radius (km) | Fresh Water (ton) |
|---|---|---|---|---|
| Rute 2 | | | | |
| Kamis | Pulau Banda Utara | Run - Banda Utara | 25 | 3.24 |
| Jumat | Pulau Banda Selatan | Banda Utara - Pisang | 7 | 3.24 |
| Sabtu | Pulau Pisang | Pisang - Banda Selatan | 8 | 3.24 |
| Minggu | Pulau Hatta | Banda Selatan - Hatta | 11.5 | 3.24 |
| | | **Total** | **51.5** | **12.96** |

**VCG** = 3.25 m (dari maxsurf)

**LCG** = 1.50 m

## 4. Provision

Ship Design and Construction, ch. 11 pg. 26

$W_{PR}$ = 0.01 ton/person.day

= 0.54 ton

**VCG** = 9 m (dari maxsurf)

**LCG** = 30 m

## Total

DWT = 25.58 ton

## Titik Berat DWT

VCG = 4.81 m

LCG = 10.22 m

# LAMPIRAN L

# PERHITUNGAN TONASE KAPAL

## Tonnage Calculation

(*According to: International Convention Tonnage Measurement 1969*)

### Input Data

| | | | |
|---|---|---|---|
| $H$ | = | 4.2 m | |
| $T$ | = | 2.00 m | |
| $V_{DH}$ | = | 1219 $m^3$ | |
| $V_{hull}$ | = | 918 $m^3$ | |
| $N_1$ | = | 10 orang | ;asumsi jumlah penumpang dalam kabin |
| $N_2$ | = | 34 orang | |

### Gross Tonnage

| | | | |
|---|---|---|---|
| $V$ | = | $V_U + V_H$ | ;total volume ruang tertutup |
| | = | 2137.00 $m^3$ | |
| $K_1$ | = | 0.2695 | ;from Appendix 2 |
| GT | = | $V \cdot K_1$ | |
| | = | **575.92 GT** | |

### Net Tonnage

| | | | |
|---|---|---|---|
| $V_{R'}$ | = | 918 $m^3$ | ; total volume ruang muat |
| $K_2$ | = | $0.2 + 0.02 \cdot \log_{10} V_{R'}$ | |
| | = | 0.26 | |
| $K_3$ | = | $1.25^{\frac{GT+10000}{10000}}$ | |
| | = | 1.27 | |
| a | = | $K_2 \cdot V_{R'} \cdot \left(\frac{4 \cdot T}{3 \cdot H}\right)^2$ | |
| | = | 96.86 | |
| NT | = | $a + K_3 \cdot \left(N_1 + \frac{N_2}{10}\right)$ | |
| | = | **132.13 NT** | |

# LAMPIRAN M

# PERHITUNGAN FREEBOARD

# FREEBOARD

*( Load Lines ,International Convention on Load Lines,1966 and Protocol of 1988, as amended in 2003 )*

| **Input Data** | | |
|---|---|---|
| $L_{PP}$ | = | 40.9 m |
| $L_{WL}$ | = | 39.2 m |
| B | = | 12.5 m |
| H | = | 4.2 m |
| T | = | 2.0 m |
| V | = | 918.0 cm |
| $D_{moulded}$ | = | 4.2 m |
| 0.85 $D_{moulded}$ | = | 3.6 m |

| **Length ( L )** | | |
|---|---|---|
| L | = | 96 % LWL at 0.85 $D_{moulded}$ |
| LWL at 0.85 $D_{moulded}$ | = | 39.23 m |
| L | = | 37.66 m |
| L | = | Lpp |
| | = | 40.90 m |
| L diambil maximum, | | 40.90 m |

**Cb at 0.85 $D_{moulded}$**

$$Cb = \frac{V}{L\ B\ 0.85D_{moulded}} = 0.51$$

**Koreksi Freeboard**

| **Koreksi jenis kapal** | | |
|---|---|---|
| Untuk Kapal Tipe B | | (*International Convention of Load Lines 1966* ) |
| L | = | 40.90 m |
| Fmin | = | 344.00 mm |

**koreksi Cb**

koreksi Cb = $\frac{Cb + 0.68}{1.36}$

= 0.87

F = 299.83 mm

**koreksi Depth**

| | | | |
|---|---|---|---|
| L / 15 | = | 2.73 | |
| D | = | 4.18 | |
| D > L / 15 | ; maka ada koreksi depth | | |
| Fb | = | R.(D-(L/15)) | |
| R | = | L/0,48 | ;untuk L<120 |
| R | = | 85.2 | |
| F | = | 123.8 | |
| F | = | 423.7 mm | |

**koreksi posisi deckline**

diasumsikan sisi atas deckline < D

tinggi deckline = 25.00 mm

F = 398.67 mm

**koreksi bangunan atas**

| L [ m ] | Standart Height [ m ] | |
|---|---|---|
| | Raised Quarterdeck | Other Superstructure |
| 30 or less | 0.9 | 1.8 |
| 75 | 1.2 | 1.8 |
| 125 or more | 1.8 | 2.3 |
| 40.90 | 0.791 | 1.459 |

hss = 2.5 status **ok**

hdh = 2.75 status **ok**

panjang bangunan atas < 1 L

| total effective length of superstructures and trunks | 0 | 0.5 L | 0.6 L | 0.7 L | 0.8 L | 0.9 L | 1 L |
|---|---|---|---|---|---|---|---|

| percentage of deduction for all types of superstructures | 0 | 41 | 52 | 63 | 75.3 | 87.7 | 100 |
|---|---|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| Lpoop | = | 80 % Lpp | |
| | = | 32.72 | m |
| | = | 0.80 | L |
| Lforcesatle | = | 80% LPP | |
| | = | 32.72 | m |
| | = | 0.80 | L |
| total effective length | = | 1.60 | L |
| pengurangan | = | 87.7 | % |
| F | = | $F_{koreksi}$ - deduction | |
| | = | 310.97 | mm |
| | = | 0.31 | m |

**Pengecekan Tinggi Freeboard dan Bow Height**

| | | | |
|---|---|---|---|
| Bow height Required | = | $\frac{56\ L\ (1 - L / 500)\ (\ 1.36\ )}{CB + 0.68}$ | |
| | = | 2412.86 | mm |
| | = | 2.41 | m |
| bow height | = | $F + h_{FC}$ | |
| | = | 4.7 | m |
| bow height | = | accepted | |
| Freeboard Required | = | 0.31 | m |
| Freeboard Design | | | |
| H - T | = | 2.2 | m |
| Freeboard | = | ACCEPTED | |

# LAMPIRAN N

# PERHITUNGAN *MOTION SICKNESS INCIDENT*

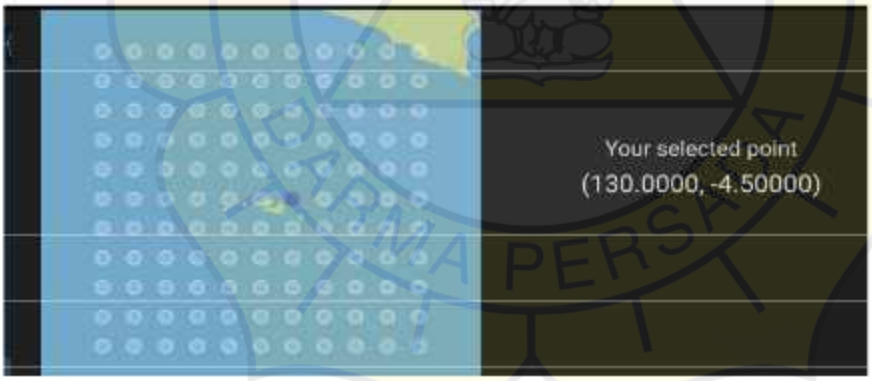
| MSI (Motion Sickness Incident) |
|---|

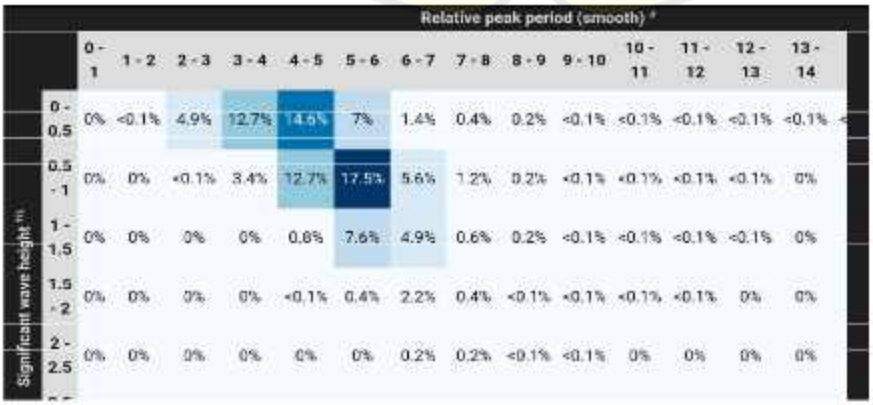
**Analysis Theory =** Strip Theory Method

## 1. Wave

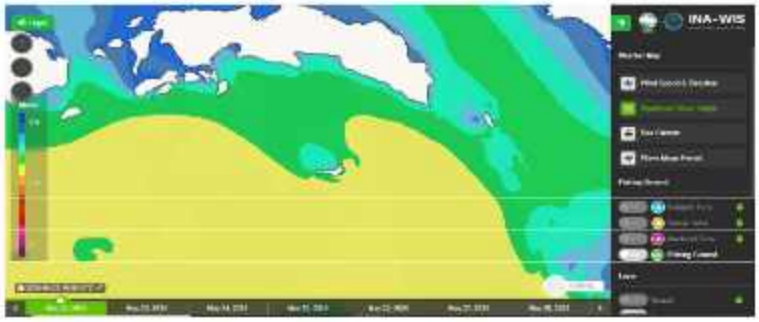
| Input Wave | Sig. Wave (m) | Period (s) |
|---|---|---|
| Hindcast ECMWF | | |
| - Probability 14.5% Occurance | 0.5 | 4 |
| - Probability 17.5% Occurance | 1 | 5 |
| BMKG 7 day data | 2 | 3 |

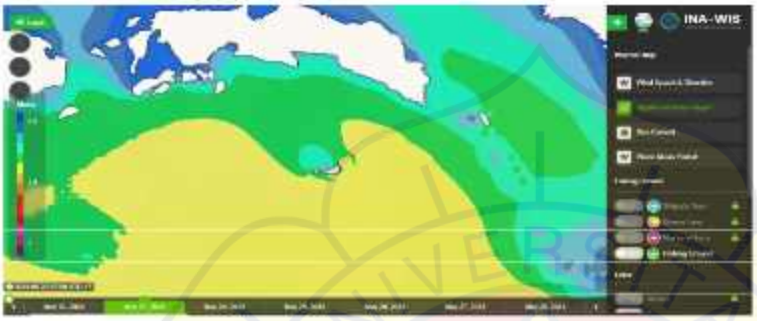
**Hindcast ECMWF Wave Data 1949-2017**

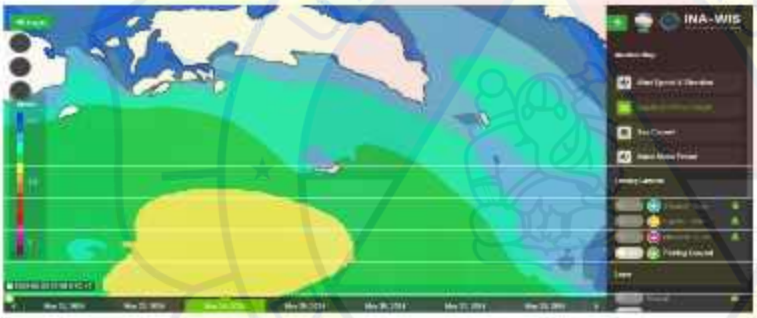



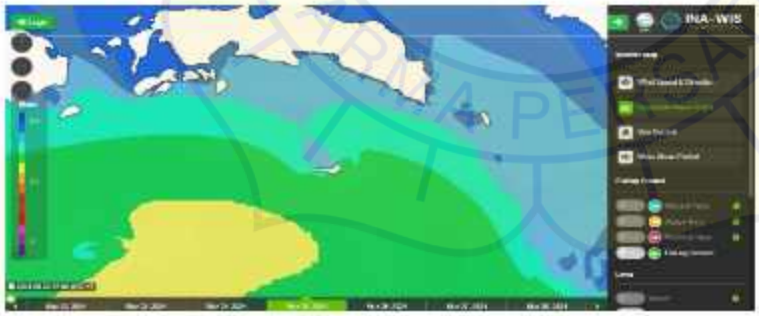



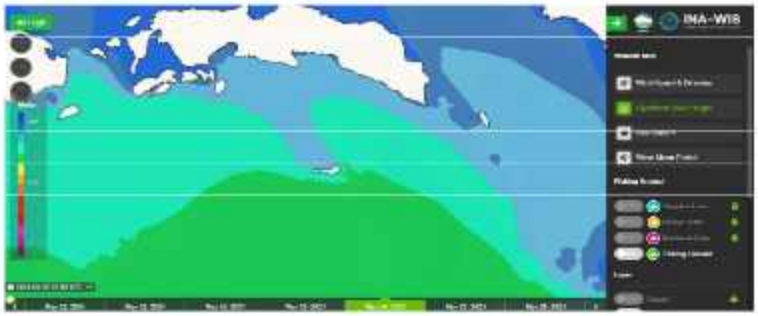
**BMKG Wave Data 7 Days**

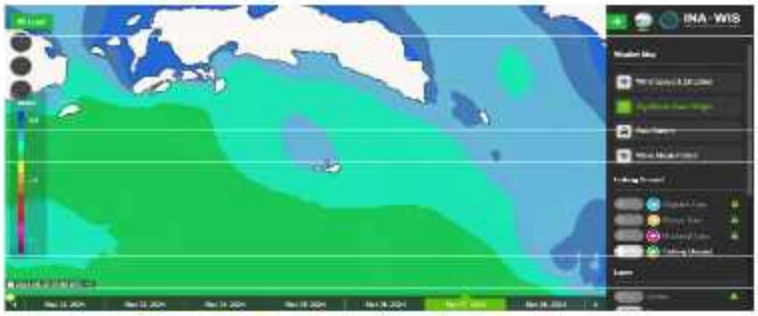


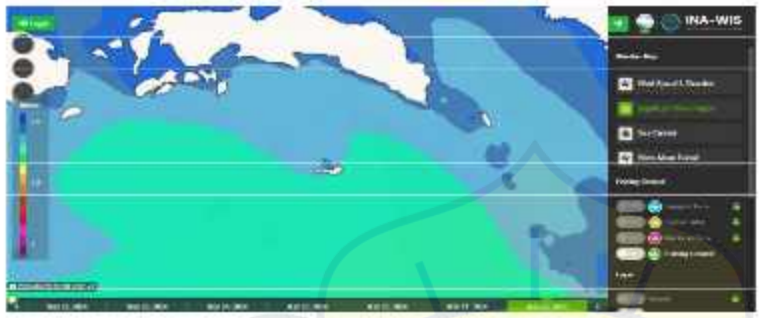







## 2. Speed

**Speed** 20 knot

## 3. Location

Main Deck

Passanger Deck

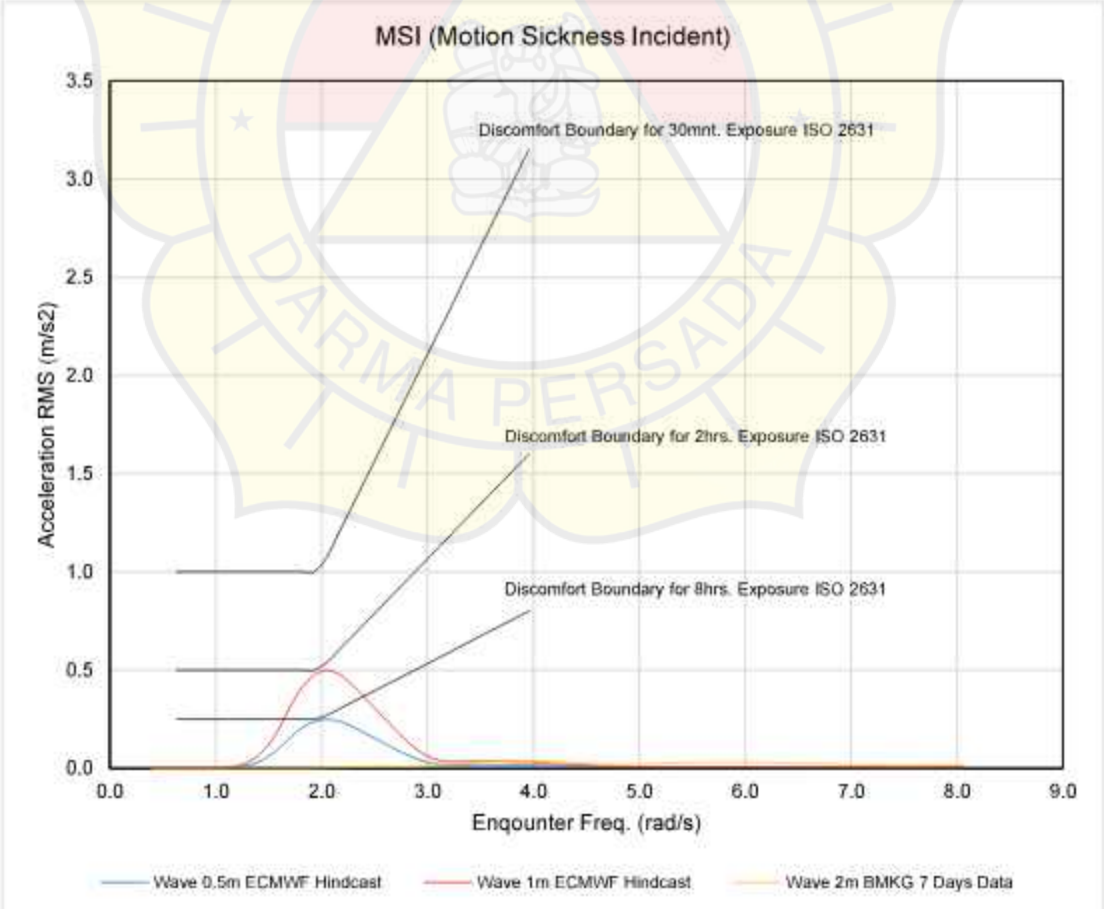
## 4. MSI Result

**Passanger 100%**

| Wave Encounter Freq. | Acceleration RMS ($m/s^2$) | | |
|---|---|---|---|
| | Wave 0.5 m | Wave 1 m | Wave 2 m |
| 0.40 | 0.00 | 0.00 | 0.00 |
| 0.52 | 0.00 | 0.00 | 0.00 |
| 0.64 | 0.00 | 0.00 | 0.00 |

| | | | |
|---|---|---|---|
| 0.75 | 0.00 | 0.00 | 0.00 |
| 0.87 | 0.00 | 0.00 | 0.00 |
| 0.99 | 0.00 | 0.00 | 0.00 |
| 1.11 | 0.00 | 0.00 | 0.00 |
| 1.22 | 0.01 | 0.01 | 0.00 |
| 1.34 | 0.02 | 0.04 | 0.00 |
| 1.46 | 0.05 | 0.10 | 0.00 |
| 1.58 | 0.09 | 0.18 | 0.00 |
| 1.70 | 0.15 | 0.31 | 0.00 |
| 1.81 | 0.21 | 0.41 | 0.00 |
| 1.93 | 0.24 | 0.48 | 0.00 |
| 2.05 | 0.25 | 0.50 | 0.00 |
| 2.17 | 0.24 | 0.48 | 0.00 |
| 2.28 | 0.21 | 0.43 | 0.01 |
| 2.40 | 0.18 | 0.36 | 0.01 |
| 2.52 | 0.15 | 0.29 | 0.01 |
| 2.64 | 0.11 | 0.23 | 0.01 |
| 2.76 | 0.08 | 0.16 | 0.01 |
| 2.87 | 0.05 | 0.11 | 0.01 |
| 2.99 | 0.03 | 0.06 | 0.01 |
| 3.11 | 0.02 | 0.04 | 0.02 |
| 3.23 | 0.02 | 0.03 | 0.02 |
| 3.34 | 0.02 | 0.04 | 0.03 |
| 3.46 | 0.02 | 0.04 | 0.03 |
| 3.58 | 0.02 | 0.04 | 0.04 |
| 3.70 | 0.02 | 0.04 | 0.04 |
| 3.82 | 0.02 | 0.03 | 0.04 |
| 3.93 | 0.02 | 0.03 | 0.04 |
| 4.05 | 0.01 | 0.03 | 0.04 |
| 4.17 | 0.01 | 0.02 | 0.03 |
| 4.29 | 0.01 | 0.02 | 0.03 |
| 4.40 | 0.01 | 0.02 | 0.03 |
| 4.52 | 0.01 | 0.01 | 0.03 |
| 4.64 | 0.01 | 0.01 | 0.02 |
| 4.76 | 0.00 | 0.01 | 0.02 |
| 4.88 | 0.00 | 0.01 | 0.02 |
| 4.99 | 0.00 | 0.01 | 0.02 |
| 5.11 | 0.00 | 0.01 | 0.02 |
| 5.23 | 0.00 | 0.01 | 0.03 |
| 5.35 | 0.00 | 0.01 | 0.03 |
| 5.46 | 0.00 | 0.01 | 0.03 |
| 5.58 | 0.00 | 0.01 | 0.03 |
| 5.70 | 0.00 | 0.01 | 0.03 |
| 5.82 | 0.00 | 0.01 | 0.03 |

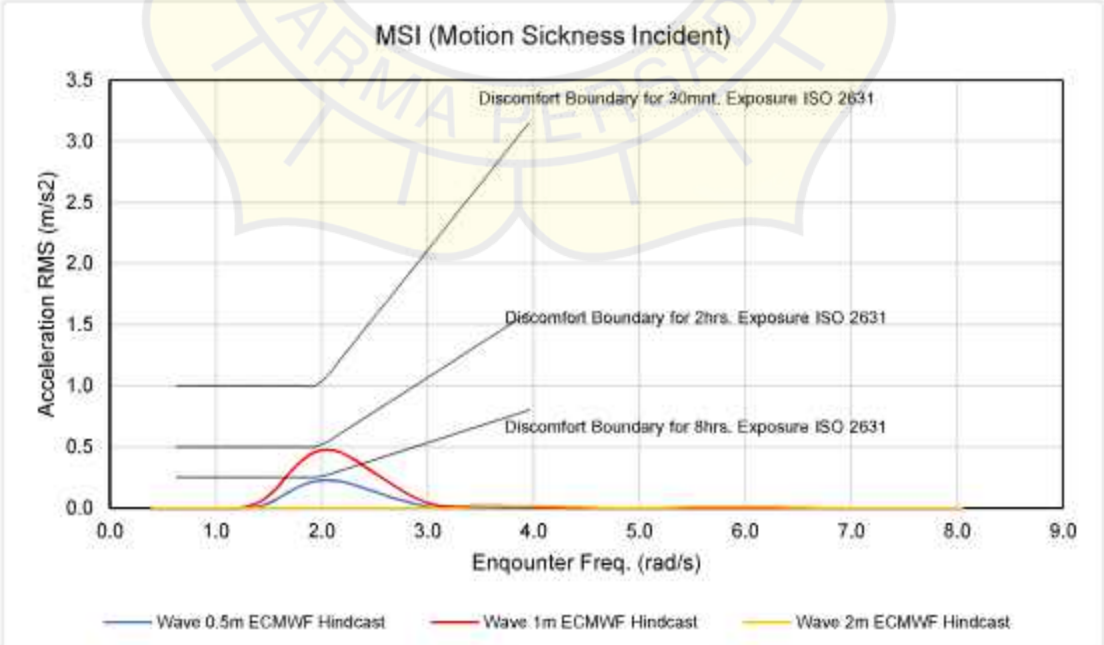
| | | | |
|---|---|---|---|
| 5.94 | 0.00 | 0.01 | 0.03 |
| 6.05 | 0.00 | 0.01 | 0.03 |
| 6.17 | 0.00 | 0.01 | 0.03 |
| 6.29 | 0.00 | 0.00 | 0.03 |
| 6.41 | 0.00 | 0.00 | 0.03 |
| 6.52 | 0.00 | 0.00 | 0.03 |
| 6.64 | 0.00 | 0.00 | 0.02 |
| 6.76 | 0.00 | 0.00 | 0.02 |
| 6.88 | 0.00 | 0.00 | 0.02 |
| 7.00 | 0.00 | 0.00 | 0.02 |
| 7.11 | 0.00 | 0.00 | 0.02 |
| 7.23 | 0.00 | 0.00 | 0.02 |
| 7.35 | 0.00 | 0.00 | 0.02 |
| 7.47 | 0.00 | 0.00 | 0.02 |
| 7.58 | 0.00 | 0.00 | 0.02 |
| 7.70 | 0.00 | 0.00 | 0.02 |
| 7.82 | 0.00 | 0.00 | 0.02 |
| 7.94 | 0.00 | 0.00 | 0.02 |
| 8.06 | 0.00 | 0.00 | 0.02 |



**Passanger 50%**

| Wave Encounter Freq. | Acceleration RMS ($m/s^2$) | | |
|---|---|---|---|
| | Wave 0.5 m | Wave 1 m | Wave 2 m |
| 0.40 | 0.00 | 0.00 | 0.00 |
| 0.52 | 0.00 | 0.00 | 0.00 |
| 0.64 | 0.00 | 0.00 | 0.00 |
| 0.75 | 0.00 | 0.00 | 0.00 |
| 0.87 | 0.00 | 0.00 | 0.00 |
| 0.99 | 0.00 | 0.00 | 0.00 |
| 1.11 | 0.00 | 0.00 | 0.00 |
| 1.22 | 0.00 | 0.00 | 0.00 |
| 1.34 | 0.00 | 0.02 | 0.00 |
| 1.46 | 0.03 | 0.08 | 0.00 |
| 1.58 | 0.07 | 0.16 | 0.00 |
| 1.70 | 0.13 | 0.29 | 0.00 |
| 1.81 | 0.19 | 0.39 | 0.00 |
| 1.93 | 0.22 | 0.46 | 0.00 |
| 2.05 | 0.23 | 0.48 | 0.00 |
| 2.17 | 0.22 | 0.46 | 0.00 |
| 2.28 | 0.19 | 0.41 | 0.00 |
| 2.40 | 0.16 | 0.34 | 0.00 |
| 2.52 | 0.13 | 0.27 | 0.00 |
| 2.64 | 0.09 | 0.21 | 0.00 |
| 2.76 | 0.06 | 0.14 | 0.00 |
| 2.87 | 0.03 | 0.09 | 0.00 |
| 2.99 | 0.01 | 0.04 | 0.00 |
| 3.11 | 0.00 | 0.02 | 0.00 |
| 3.23 | 0.00 | 0.01 | 0.00 |
| 3.34 | 0.00 | 0.02 | 0.01 |
| 3.46 | 0.00 | 0.02 | 0.01 |
| 3.58 | 0.00 | 0.02 | 0.02 |
| 3.70 | 0.00 | 0.02 | 0.02 |
| 3.82 | 0.00 | 0.01 | 0.02 |
| 3.93 | 0.00 | 0.01 | 0.02 |
| 4.05 | 0.00 | 0.01 | 0.02 |
| 4.17 | 0.00 | 0.00 | 0.01 |
| 4.29 | 0.00 | 0.00 | 0.01 |
| 4.40 | 0.00 | 0.00 | 0.01 |
| 4.52 | 0.00 | 0.00 | 0.01 |
| 4.64 | 0.00 | 0.00 | 0.00 |
| 4.76 | 0.00 | 0.00 | 0.00 |
| 4.88 | 0.00 | 0.00 | 0.00 |
| 4.99 | 0.00 | 0.00 | 0.00 |

| | | | |
|---|---|---|---|
| 5.11 | 0.00 | 0.00 | 0.00 |
| 5.23 | 0.00 | 0.00 | 0.01 |
| 5.35 | 0.00 | 0.00 | 0.01 |
| 5.46 | 0.00 | 0.00 | 0.01 |
| 5.58 | 0.00 | 0.00 | 0.01 |
| 5.70 | 0.00 | 0.00 | 0.01 |
| 5.82 | 0.00 | 0.00 | 0.01 |
| 5.94 | 0.00 | 0.00 | 0.01 |
| 6.05 | 0.00 | 0.00 | 0.01 |
| 6.17 | 0.00 | 0.00 | 0.01 |
| 6.29 | 0.00 | 0.00 | 0.01 |
| 6.41 | 0.00 | 0.00 | 0.01 |
| 6.52 | 0.00 | 0.00 | 0.01 |
| 6.64 | 0.00 | 0.00 | 0.00 |
| 6.76 | 0.00 | 0.00 | 0.00 |
| 6.88 | 0.00 | 0.00 | 0.00 |
| 7.00 | 0.00 | 0.00 | 0.00 |
| 7.11 | 0.00 | 0.00 | 0.00 |
| 7.23 | 0.00 | 0.00 | 0.00 |
| 7.35 | 0.00 | 0.00 | 0.00 |
| 7.47 | 0.00 | 0.00 | 0.00 |
| 7.58 | 0.00 | 0.00 | 0.00 |
| 7.70 | 0.00 | 0.00 | 0.00 |
| 7.82 | 0.00 | 0.00 | 0.00 |
| 7.94 | 0.00 | 0.00 | 0.00 |
| 8.06 | 0.00 | 0.00 | 0.00 |



# LAMPIRAN O

# PERHITUNGAN *SEAKEEPING*

| Ship Seakeeping |
|---|

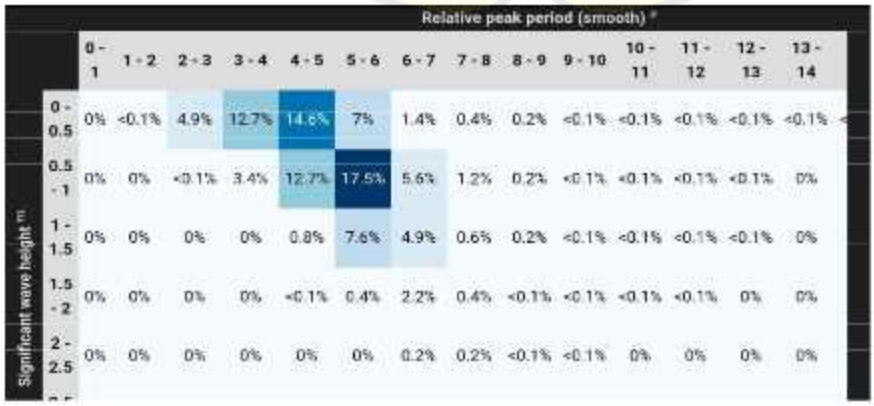
**Analysis Theory =** Strip Theory Method

## 1. Wave

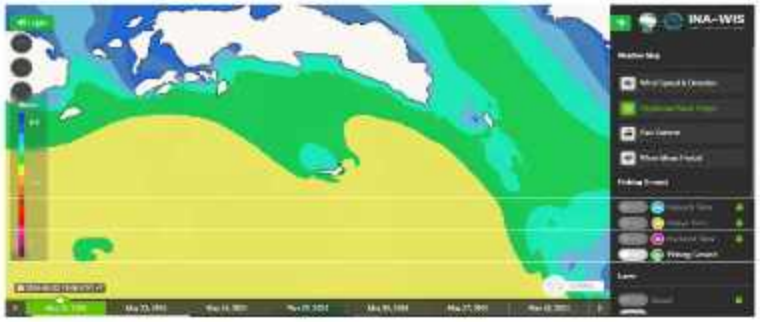
| Input Wave | Sig. Wave (m) | Period (s) |
|---|---|---|
| Hindcast ECMWF | | |
| - Probability 14.5% Occurance | 0.5 | 4 |
| - Probability 17.5% Occurance | 1 | 5 |
| BMKG 7 day data | 2 | 3 |

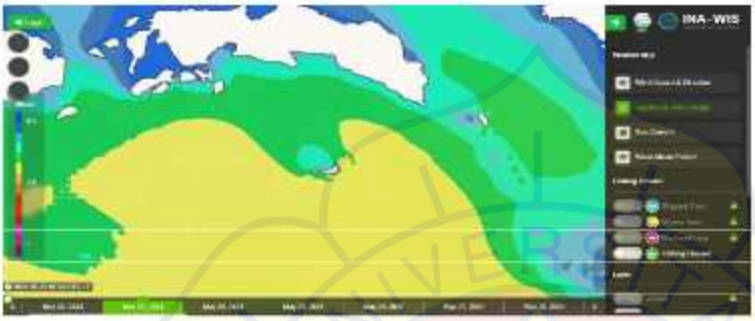
**Hindcast ECMWF Wave Data 1949-2017**

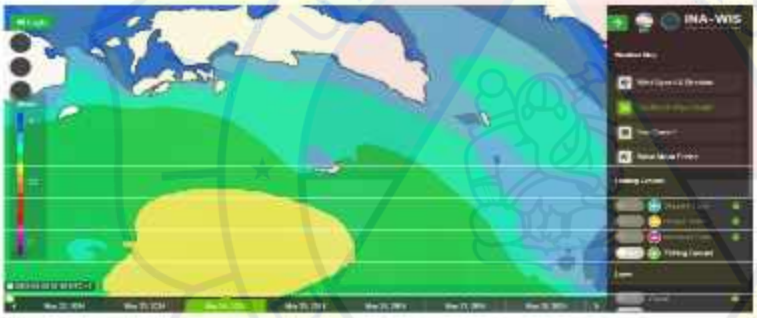


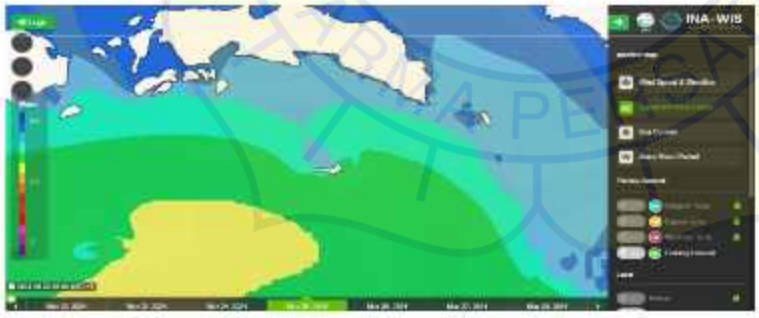


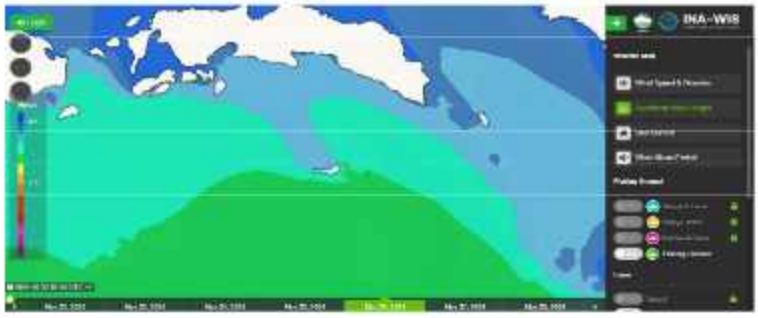
**BMKG Wave Data 7 Days**

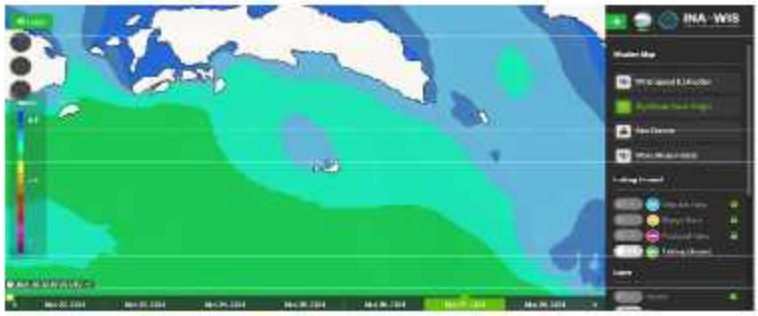


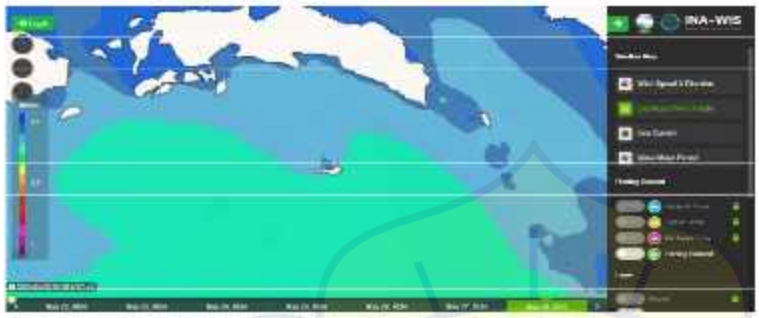







## 2. Speed

**Speed** 20 knot

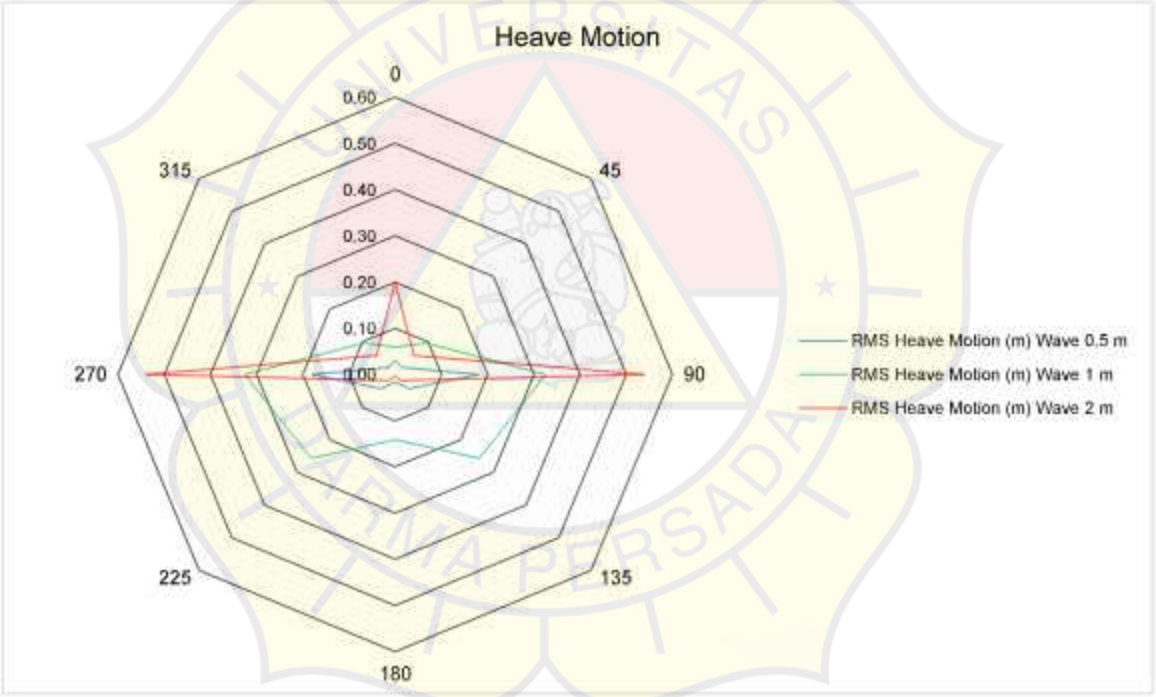
## 3. Heading

| Name | Heading (deg) |
|---|---|
| Follow Sea | 0 |
| Quarter Sea | 45 |
| Beam Sea | 90 |
| Quarter Sea | 135 |
| Head Sea | 180 |
| Quarter Sea | 225 |
| Beam Sea | 270 |
| Quarter Sea | 315 |

## 4. Seakeeping Result

### HEAVE

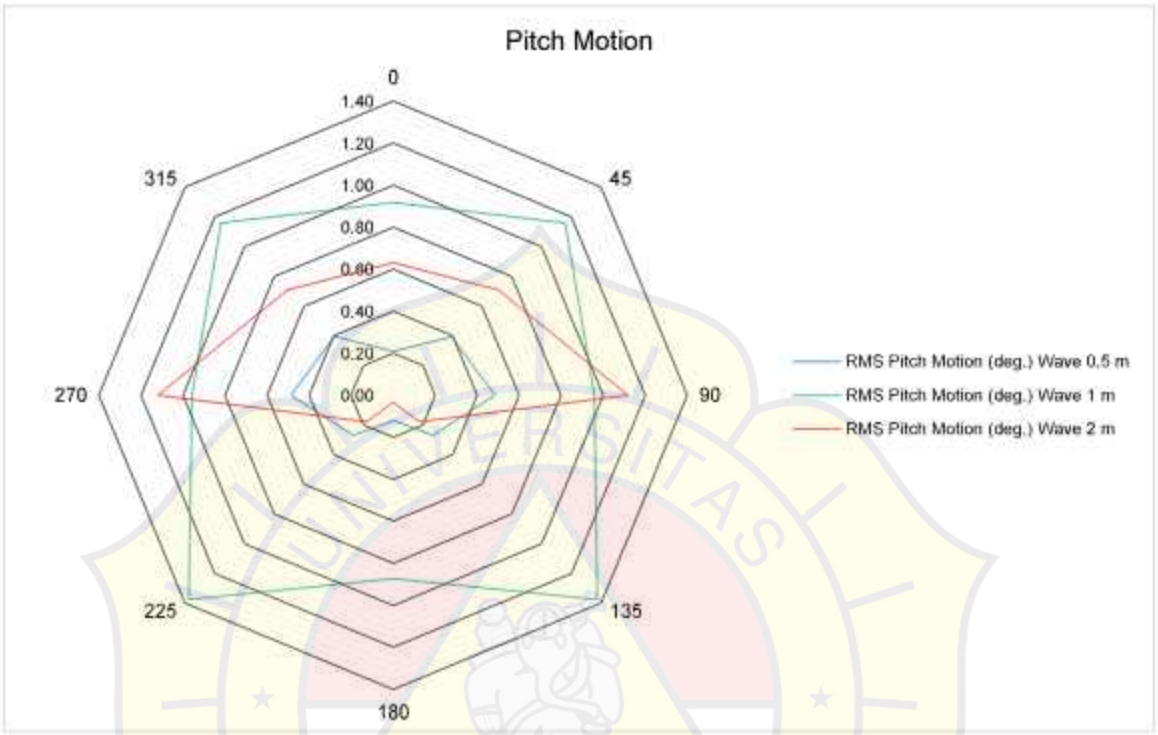
| Heading (deg.) | RMS Heave Motion (m) | | |
|---|---|---|---|
| | Wave 0.5 m | Wave 1 m | Wave 2 m |
| 0 | 0.03 | 0.06 | 0.20 |
| 45 | 0.02 | 0.10 | 0.06 |
| 90 | 0.18 | 0.33 | 0.54 |
| 135 | 0.04 | 0.26 | 0.02 |
| 180 | 0.02 | 0.14 | 0.00 |
| 225 | 0.04 | 0.26 | 0.02 |
| 270 | 0.18 | 0.33 | 0.54 |
| 315 | 0.02 | 0.10 | 0.06 |
| 360 | 0.03 | 0.06 | 0.06 |




### PITCH

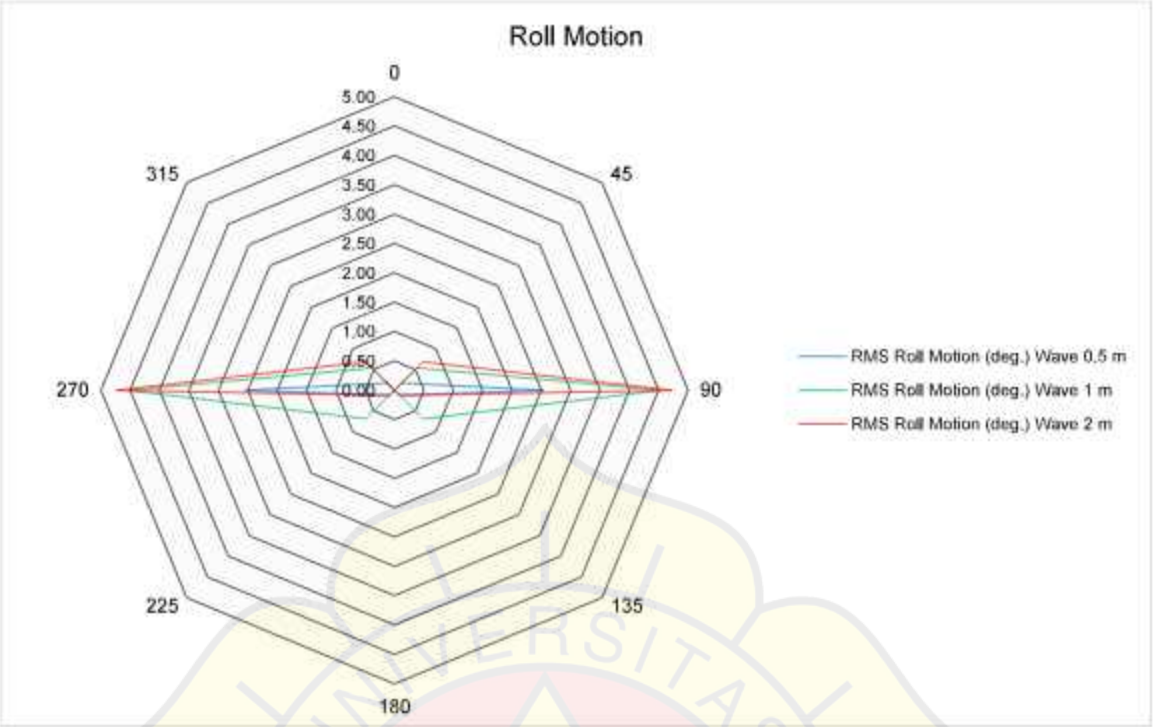
| Heading (deg.) | RMS Pitch Motion (deg.) | | |
|---|---|---|---|
| | Wave 0.5 m | Wave 1 m | Wave 2 m |
| 0 | 0.21 | 0.92 | 0.63 |
| 45 | 0.40 | 1.16 | 0.71 |
| 90 | 0.48 | 0.96 | 1.12 |
| 135 | 0.27 | 1.37 | 0.18 |

| | | | |
|---|---|---|---|
| 180 | 0.12 | 0.87 | 0.03 |
| 225 | 0.27 | 1.37 | 0.18 |
| 270 | 0.48 | 0.96 | 1.12 |
| 315 | 0.40 | 1.16 | 0.71 |
| 360 | 0.21 | 0.92 | 0.63 |




## ROLL

| Heading (deg.) | RMS Roll Motion (deg.) | | |
|---|---|---|---|
| | Wave 0.5 m | Wave 1 m | Wave 2 m |
| 0 | 0.00 | 0.00 | 0.00 |
| 45 | 0.18 | 0.54 | 0.69 |
| 90 | 2.55 | 4.54 | 4.73 |
| 135 | 0.12 | 0.69 | 0.12 |
| 180 | 0.00 | 0.00 | 0.00 |
| 225 | 0.12 | 0.69 | 0.12 |
| 270 | 2.55 | 4.54 | 4.73 |
| 315 | 0.18 | 0.54 | 0.69 |
| 360 | 0.00 | 0.00 | 0.00 |




## 5. Seakeeping Criteria Check

| Item | Criteria (deg.) | Actual (deg.) | Check |
|---|---|---|---|
| **NORDFORSK 1987** | | | |
| Roll | 6.00 | 4.73 | **Pass** |
| **USCG** | | | |
| Roll | 8.00 | 4.73 | **Pass** |
| Pitch | 3.00 | 1.37 | **Pass** |

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