

SHM - XX

YARD NO: 155

TRIM & STABILITY BOOKLET

DRG NO: SHM/MPT/28

REV. AOWNER

SHM SHIP CARE
DARUKHANA, MAZGAON,
Mumbai.

BUILDER

SHM SHIP CARE
GHODBUNDER
Mumbai.

PROGRAM USED

HYDROSTATICS, LOADING & DAMAGE PROGRAM SUITE
VERSION 10.08.15 FV 18.13.12.4

* See remarks in red on page no. 3, 4, 9, 23, 25 and 27

DEVELOPED BY

WOLFSON UNIT M.T.I.A
SOUTHAMPTON UNIVERSITY
ENGLAND



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GENERAL PARTICULARS

01. Vessel's Name : SHM - XX
02. Official Number : MOR - IV - 00603
03. Port of Registry : MUMBAI
04. Owner's Name and Address : SHM SHIP CARE
DARUKHANA, MAZGAON
Mumbai.
05. Builder's Name and Address : SHM SHIP CARE
GHODBUNDER,
Mumbai.
06. Yard No. : 155
07. Year of Built : 2016
08. Principal Dimensions
- a) Length O.A. : 15.370 m.
- b) Breadth moulded : 03.770 m.
- c) Depth moulded : 01.940 m.
- d) Draft (loaded) : 00.508 m.
09. Displacement (Loaded) : 14.326 tonnes
10. Deadweight : 2.406 tonnes
11. Main Engines : 2 Nos. Cummins
Model QSB6.7, each developing
305 BHP at 2600 RPM
12. Gear Boxes : 2 Nos. ZF 286A
with 1.962 : 1 Ratio.
13. Gross Tonnage : 25 Tons
14. Net Tonnage : 08 Tons
15. Sign Convension : Longitudinal Position (LCG, LCB, LCF etc)
are measured from midship 230mm fwd of (Fr
No. 08) Aft of Midship is considered -ve and
forward +ve
All vertical measurements (VCG, VCB etc)
are measured from baseline.
TCG are measured wrt Centerline Port -ve
Stbd +ve. Trim Aft + ve Trim Ford - ve
16. Classification Society : RINA, C*HULL ■MACH, special service;
sheltered area

INFORMATION TO MASTER

- A] A stamped approved copy of this Booklet must be kept on board the vessel at all times, be complete, legible, and readily available for use. If this Booklet should be lost, immediately inform the Owners or the Statutory Authority.
- B] This stability information shows that the ship complies with definite intact stability requirements in all designed conditions and gives the data deemed necessary for the calculation and evaluation of stability to the master in order that he can take suitable measures for securing the stability in any service condition.

C] **GENERAL PRECAUTIONS AGAINST CAPSIZING**

- a) Compliance with the required minimum stability criteria indicated in the following pages, does not ensure immunity against capsizing, regardless of the circumstances, or absolve the Master from his responsibilities. Masters should therefore, exercise prudence and good seamanship, having regard to the season of the year, weather forecasts and navigational zone, and should take appropriate action as to the speed and course warranted by the prevailing circumstances.
- b) Care should be taken to ensure that the cargo, allocated to the ship is capable of being stowed, so that compliance with the stability criteria can be achieved. If necessary, the amount of cargo should be limited to the extent that ballast weight may be required.
- c) Before a voyage commences, care should be taken to ensure that the cargo and sizeable pieces of equipment have been properly stowed and lashed, so as to minimize the possibility of both longitudinal and lateral shifting while at sea, under the effect of acceleration caused by rolling and pitching..
- d) In determining the sequence of tanks from which fuel oil and fresh water is to be consumed and those into which water ballast may be admitted during the voyage the Master must ensure, prior to departure, that the required minimum stability criteria will be maintained throughout the voyage after making due allowance for free surface effect as may be appropriate.
- e) Masters should note that stability can be adversely affected by such influences as beam wind on ships with large windage area, icing on top sides and deck cargo, water trapped on deck and in deck cargo, rolling characteristics and following seas.
- f) Access hatches, doors on upper and raised decks are to be secured closed at all time when the vessel is underway.

D] **STATUTORY REQUIREMENTS:**

No.	Criterion	Reqd. for monohull
* 1	When GZ Max. up to 15° Area under GZ curve up to 160 deg	≥ 0.07 m.rad
2	When GZ Max. between 15 to 30° Area under GZ curve at Max. GZ	≥ 0.055 to 0.001 (30 to 0 max) m.rad
3	When GZ Max. at 30° or above Area under GZ curve at 60 Deg	≥ 0.055 m.rad
4	GZ area 30 to 40° of downflooding 11 to 40°	≥ 0.03 m.rad
5	Minimum GZ at 30° or note 1	≥ 0.2 m
6	Min angle of Max GZ	15°
7	Minimum GM.	0.35 m

(*) For ships of length less than 24m, only the criterion mentioned below is to be complied with.
 -The initial metacentric height(GM0) is not less than 0.35 m

METRIC CONVERSIONS TABLE**METRIC EQUIVALENTS**

THE USE OF S.I (SYSTEM INTERNATIONALS) UNITS IS STRONGLY RECOMMENDED.

MULTIPLY BY BELOW	TO CONVERT FROM	TO OBTAIN	-
0.03937	Millimetres	Inches	25.400
0.3937	Centimetres	Inches	2.5400
3.2808	Metres	Feet	0.3048
2.2046	Kilogrammes	Pounds	0.45359
0.0009842	Kilogrammes	Tons (2240lbs)	1016.047
0.9842	Metric Tons (i.e.Tonnes of 1000 Kilos)	Tons (2240lbs)	1.016
2.4998	Metric Tons Per Centimetre Of Immersion	Tons Per Inch (Immersion)	0.4000
8.2014	Moment To Change Trim One Centimetre (Tonne Metre Units)	Moment To Change Trim One Inch (Foot Ton Unit)	0.122
187.9767	Metre Radians	Feet Degrees	0.0053
-	TO OBTAIN	TO CONVERT FROM	MULTIPLY BY ABOVE

RELATION BETWEEN WEIGHT AND VOLUME

1000 cubic millimeter	= 1 cubic centimetre
1 cubic metre	= 35.316 Cubic feet
1 cubic foot	= 0.0283 Cubic metres
1 cubic centimeter of freshwater (S.G. 1.0)	= 1 gramme
1000 cubic centimeters of freshwaters (S.G. 1.0)	= 1 kilogram (1000 grammes)
1 cubic metre of freshwater (S.G. 1.0)	= 1 Tonne (1000 Kilos)
1 cubic metre of saltwater(S.G.1.025)	= 1.025 Tonnes
1 tonne of saltwater (S.G. 1.025)	= 0.975 Cubic metres

NOTES ON USE OF FREE SURFACE MOMENTS

Provided a tank is completely filled with liquid, no movement of the liquid is possible and the effect on the ship's stability is precisely the same as if the tank contained solid materials.

Immediately a quantity of liquid is withdrawn from the tank, the situation changes completely and the stability of the ship is adversely affected by what is known as the "free surface effect". This adverse effect on the stability is referred to as a "loss in G.M." or as a "virtual rise in V.C.G." and is calculated as follows:

$$\begin{array}{l} \text{Loss in G.M. due to} \\ \text{Free Surface Effects} \\ \text{(in metres)} \end{array} = \frac{\text{Free Surface Moment (tonne - metre)}}{\text{Displacement of vessel (tonnes)}}$$

N. B.: The "Free Surface Effects" of a proportion of all oil, fuel, fresh water and service tanks should be taken into account in both the Arrival and Departure Conditions.

$$\begin{array}{l} \text{Free Surface Moment} \\ \text{(tonnes- metre)} \\ \text{of the liquid} \end{array} = \left\{ \begin{array}{l} \text{Free Surface Moment} \\ \text{at Sp. Gr. 1.0} \\ \text{(tonnes - metre)} \end{array} \right\} \times \left\{ \begin{array}{l} \text{Sp. Gr. of} \\ \text{liquid} \end{array} \right\}$$

NOTE:

- 1) In any condition where ballast has been taken, care must be taken to ensure that the tanks are fully pressed up to eliminate unnecessary Free Surface Effects.
- 2) Bunkers should be drawn from one respective tank so that other tanks are maintained in the pressed up condition.
- 3) Slack must not be kept in all tanks. It must be collected in one tank.

WORKED OUT EXAMPLE OF STABILITY CALCULATION

Calculations in this Booklet are performed by using program Hydrostatics & stability program suite Version 10.08.15 fv 18.13.12.4, Developed by Wolfson unit m.t.i.a Southampton university, England. Below mentioned loading sheet provides a simplified means of determining available GM and draft at various conditions of vessel loading. This sheet is largely self explanatory. After totaling various items of vessel loading as indicated by the loading tables shown, the vessel's draft and available (corrected) GM may be determined in a simple, direct and accurate manner.

LIGHT DEPARTURE CONDITION

A	B	C	D	E	F	G
LOCATION/ COMPARTMENT/TANKS	WEIGHT IN TONNES	LCG AT 230MM Ford of FR. No. 8 IN MTRS	LONGL Moment IN T-M	VCG@BASE IN MTRS	VERTL Moment IN T-M	F.S.M IN T-M
FUEL OIL TANK	1.156	-5.473	-6.33	0.678	0.78	0.090
FRESH WATER	0.250	0.135	0.03	0.512	0.13	0.040
8 NOS. PASSENGERS	0.000	0.000	0.00	0.000	0.00	0.000
4 NOS. CREW	0.300	0.487	0.15	2.790	0.84	0.000
STORES	0.100	1.500	0.15	0.560	0.06	0.000
LIGHTSHIP	11.920	-2.094	-24.96	1.519	18.11	0.000
	Σ Weights	D ÷ B	Σ LONGL. Mom.	F ÷ B	Σ VERTL. Mom.	Σ' F.S.M
	13.726	-2.255	-30.96	1.451	19.91	0.130

FROM HYDROSTATICS REPORT FOR CORRESPONDING DISPLACEMENT

DRAFT AT MIDSHIP	0.519	Mtrs.	TRIM LEVER = LCG - LCB	0.837	Mtrs.
LCB FROM MIDSHIP	-1.418	Mtrs.	TRIM MOMENT = DISPL. X TRIM LEVER	11.494	T- M
LCF FROM MIDSHIP	-1.145	Mtrs.			
LCG FROM MIDSHIP	-2.255	Mtrs.	TRIM BY AFT/FORD ON DRAFT MARKS=TRIM MOMENT / (MCTIcm x 100)	0.239	Mtrs.
MCTICM	0.48	T- M			
KMT	3.24	Mtrs.	TRIM AFT AT AP= {(6.185+ LCF) x TRIM }/12.968	0.093	Mtrs.
VCG	1.451	Mtrs.			
GMT Solid = KMT - VCG	1.789	Mtrs.	TRIM FORD AT FP = {(6.783 - LCF) x TRIM AFT }/12.968	0.146	Mtrs.
F.S. Corm. = Σ F.S.M ÷ Σ Weights	0.009	Mtrs.	DRAFT AFT AT AP= DRAFT LCF + TRIM AFT	0.612	Mtrs.
G.M.T Fluid = G .M.T Solid - F.S. Corm.	1.780	Mtrs.	DRAFT FORD AT FP = DRAFT LCF - TRIM FORD	0.373	Mtrs.

Note :

- If LCB is aft of LCG trim by ford & LCB is ford of LCG trim by aft
- If Trim is by aft then trim aft to be added to draught aft and minus to draught ford and vis a versa
- Distance Between Draft mark = 12.968 mtrs
- VCG to be in safe zone of maximum permissible KG V/s displacement curve
- The condition shown above is worked out using even keel Hydrostatic data. If any computed condition has trim Aft or Ford, the condition should be re-worked or using Hydrostatic data computed at the trim nearest to the one obtained

INSTRUCTION FOR USE OF LOADING SHEET

- Enter the Deadweight in Tonnes of liquids, Stores and crew carried in the various locations, compartments and tanks in column A. This breaks down the loading of the ship into the appropriate Zones.
- Enter Corresponding LCG & VCG W.R.T 230mm ford of Fr. No. 08 in column C & E respectively. Aft of 230mm ford of Fr No. 08 is -ve and Ford of 230mm ford of Fr. No. 08 is +ve
- Calculated Vertical Moments (ie Weight x VCG) & Longl. Moment (Weight x LCG)
- Add the entries in column B,D, F & G to obtain the DISPLACEMENT / Vertical Moment / Longl. Moment/F.S.Moment
Now that the Displacement is established, the draft & hydrostatic data from Hydrostatic Report for corresponding Displacement can be entered.
- GMT solid, GMT fluid, Trim Lever, Trim Moment, Trim by aft/ford and draught aft & ford to calculate as shown in the loading sheet
- The tabular GM in Loading sheet includes an allowance for slack tank free surface for each type of consumable liquid.

A GM available less than the GM required indicates insufficient stability.

DEFINITIONS, SYMBOLS AND SIGN CONVENTIONS

Midship at
Frame Spacing

230 mm Ford Fr. No. 08
Refer General Arrangement

List of Symbols

Symbol	Unit	Description
LOA	M	Length Overall
LWL	M	Length Waterline
B (Mid)	M	Moulded Breadth
D (Mid)	M	Moulded Depth
TPCm	T	Tonnes per 1 Cm immersion
MCTCm	T-M	Moment to change Trim by 1 Cm
Draught Aft	M	Draught at Fr. No. 15 WRT to Base Line
Draught Mid	M	Draught WRT to Base line at Midship for Hydrostatics
Draught Fwd	M	Draught at F. P. WRT to Base line
VCG, KG	M	Vertical Center of Gravity above Base line before correcting for free surface.
KGc	M	Vertical Center of Gravity above Base line after correcting for free surface.
KB	M	Vertical Center of Buoyancy above Base line
KMt	M	Transverse Metacenter above Base line
GoMt (Fluid)	M	Transverse Metacenter above KGc
GZ	M	Righting Arm
FSM	T-M	Free Surface Moment
Sp.Gr.		Specific Gravity

EXAMPLE SHOWING USE OF CROSS CURVES

The Purpose of Cross Cruves of Stability is to enable the Statical Stability cruves to be drawn for the ship in the sailing condition.

For example assuming the displacement of the ship to be 13.726 tonnes

The corrected Vertical Centre of Gravity "KGc" above Base line to be 1.460 mtrs

Procedure to obtain 'GZ' levers is as follows:-

Obtain 'KN' values for the displacement of 13.726 Tonnes for various angle of Heel from 0° to 80° at 10° interval.

Righting Lever $GZ = KN - KGc \sin \theta$

Where KN is Cross Curve ordinates in metres

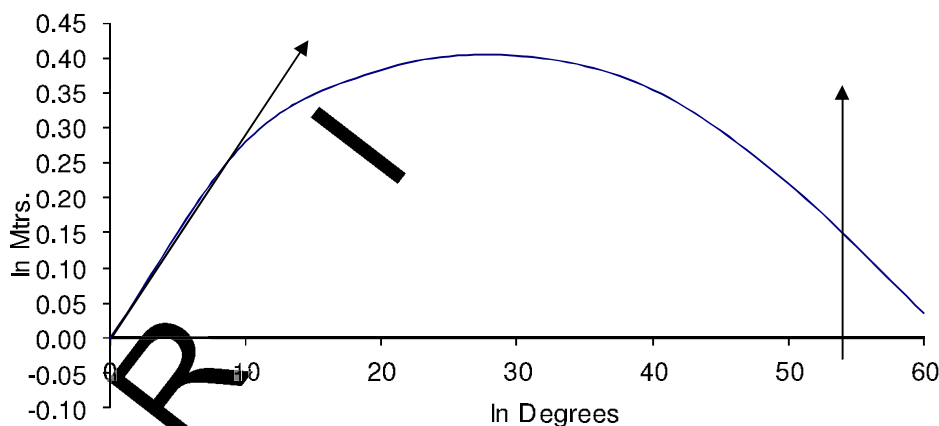
KGc is Centre of Gravity above base line corrected for the free surface effect in metres

And 'θ' is Angle of Heel in degrees

By Plotting GZ levers against angle of heel 'θ' the statical stability curves for the ship for any displacement can be plotted.

The table below illustrates the above calculation

IN DEGREES	0	10	20	30	40	50	60
SIN θ	0.000	0.174	0.342	0.500	0.643	0.766	0.866
KG SIN θ	0.000	0.254	0.499	0.730	0.939	1.118	1.264
KN	0.000	0.534	0.882	1.183	1.293	1.339	1.300
GZ = KN - KGc SIN θ	0.000	0.280	0.383	0.403	0.354	0.221	0.036



θf – Downflooding Angle

No.	Criterion	Reqd. for monohull
1	When GZ Max. up to 15° Area under GZ curve up to 15 deg	> 0.07 m rad
2	When GZ Max between 15 to 30° Area under GZ curve at Max GZ	> 0.05 m rad
3	When GZ Max at 30° or above Area under GZ curve at 30 Deg	> 0.05 m rad
4	GZ area 30° to 40° of downflooding is > 40%	> 0.03 m rad
5	Minimum GZ at 30° of heel	≥ 0.2 m
6	Min angle of initial GZ	15°
7	Minimum GM.	0.35 m

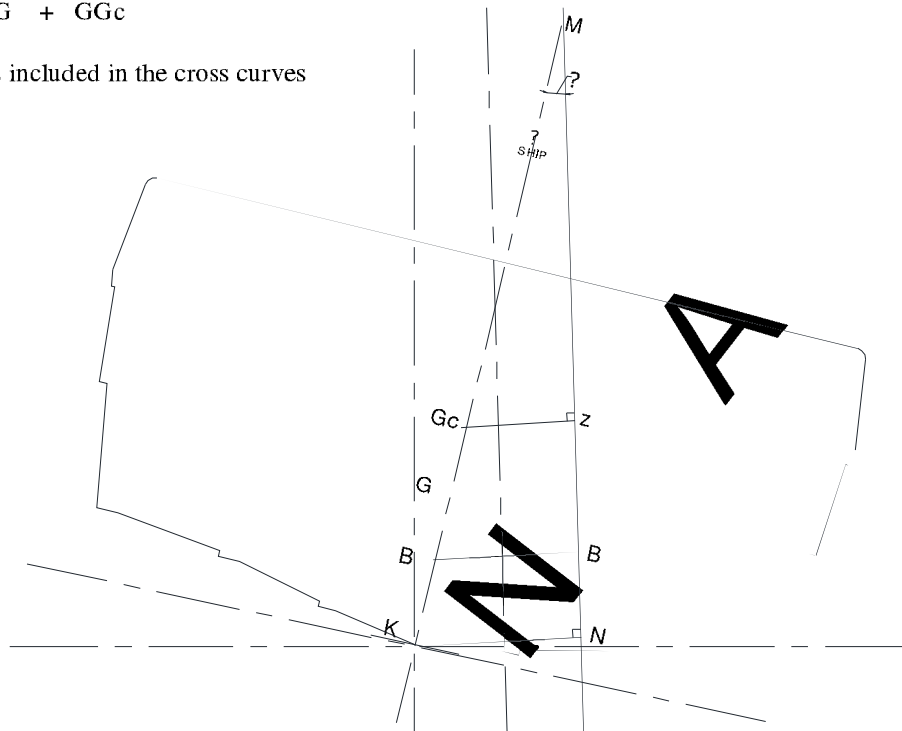
USE OF CROSS CURVES OF STABILITY

The Cross curves of stability have been calculated for centre of gravity w.r.t to baseline. In any condition, Where the centre of gravity is KG and free Surface Effects GGc, the righting lever.

$GZ = KN - KGc \sin \theta$, Where

$KGc = KG + GGc$

No Erections included in the cross curves

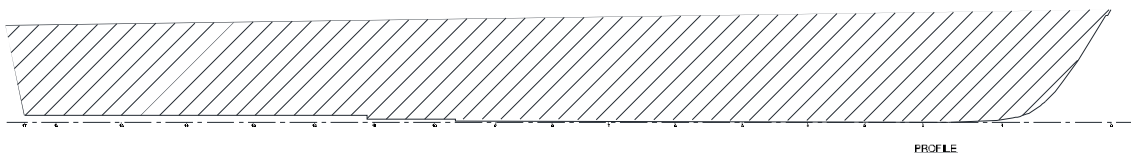


Note :-

1. KN is obtained from the Cross Curves for corresponding Displacement in tonnes.
2. KGc is vertical centre of gravity in the condition computed.

VOLUME USE FOR KN COMPUTATIONS

R

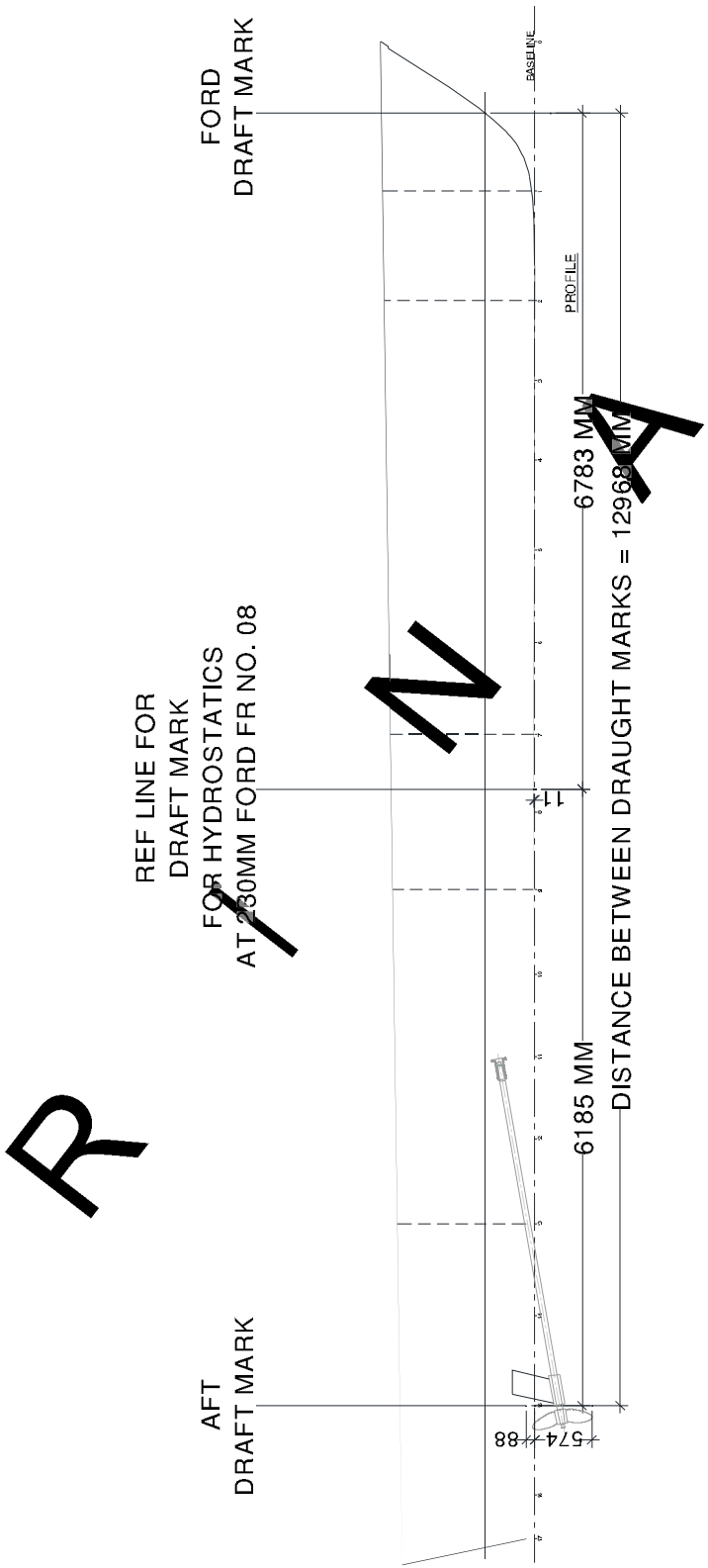


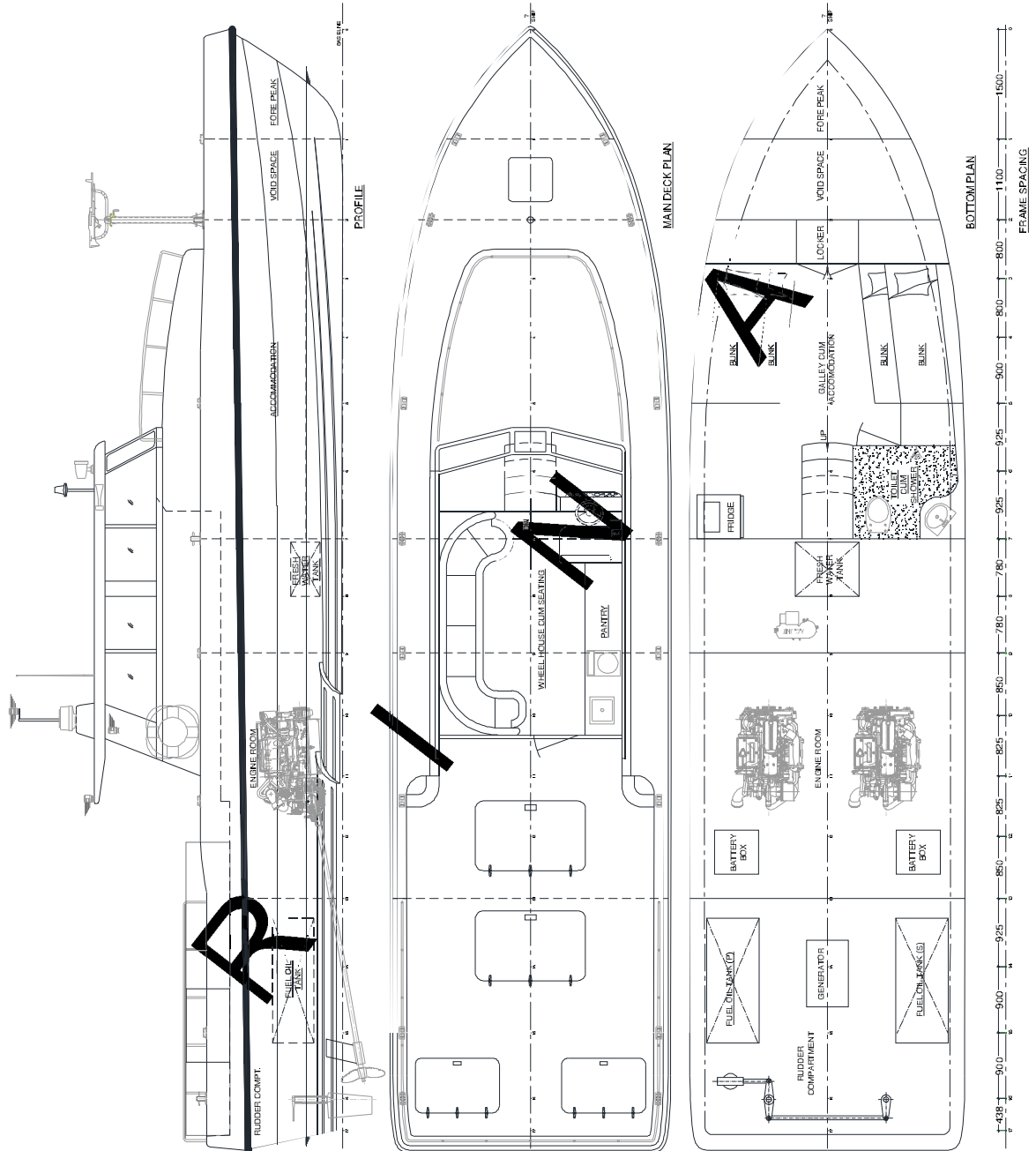
Frame Spacing

Frame Spacing

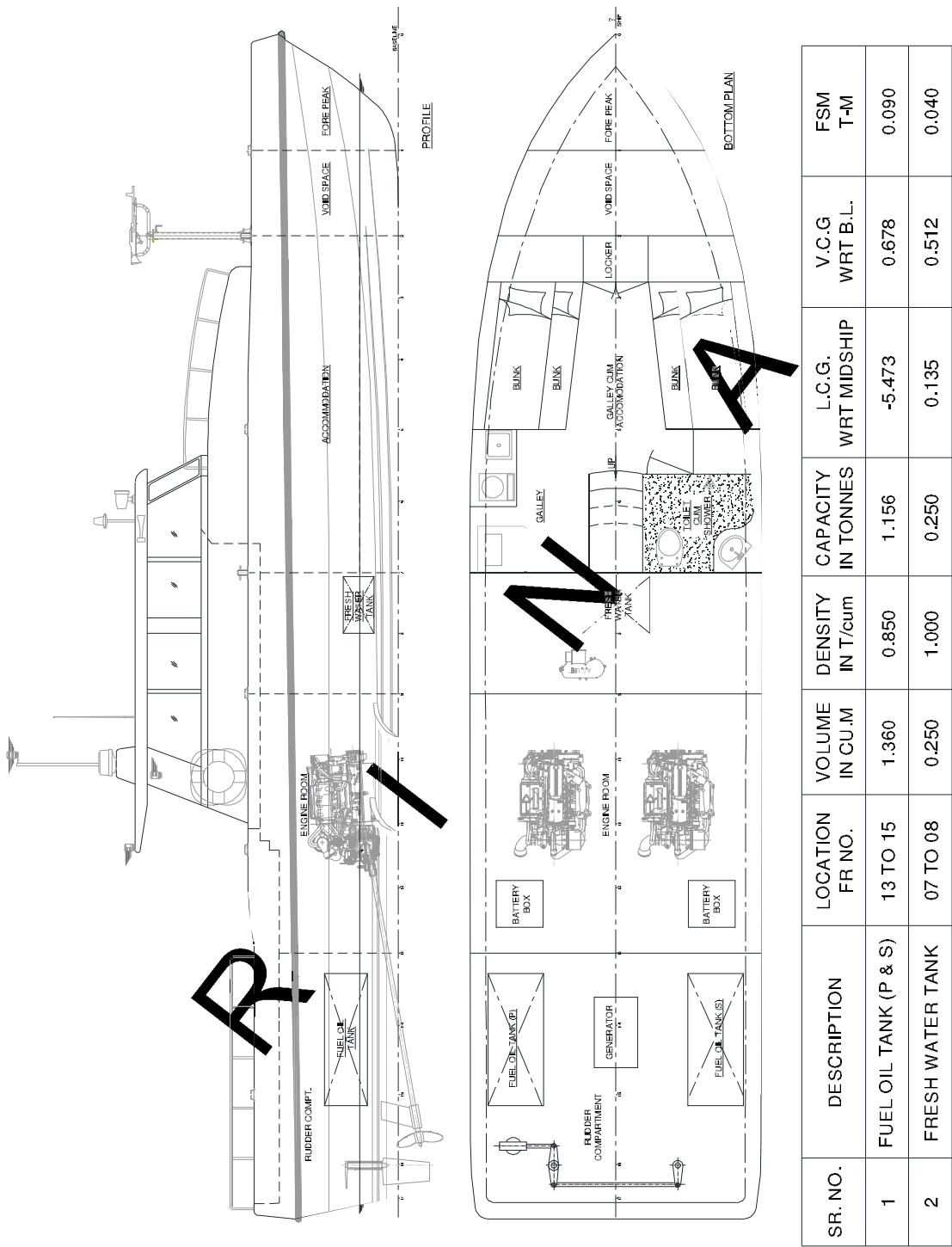
Refer General Arrangement

DRAFT MARKS LOCATION



GENERAL ARRANGEMENT

TANK CAPACITY PLAN



FRESH WATER TANK CAPACITY CHART			
FR. NO. 07 TO 08 (CENTER)			
DEDUCT SOUNDING BY 5.6 MM FOR EVERY 100MM TRIM BY AFT			
Sounding in Cms	Capacity in.Ltrs.	Sounding in Cms	Capacity in.Ltrs.
0.0	0	26.0	163
1.0	6	27.0	170
2.0	13	28.0	176
3.0	19	29.0	182
4.0	25	30.0	189
5.0	31	31.0	195
6.0	38	32.0	201
7.0	44	33.0	207
8.0	50	34.0	214
9.0	57	35.0	220
10.0	63	36.0	226
11.0	69	37.0	233
12.0	75	38.0	239
13.0	82	39.0	245
14.0	88	TK FULL	250
15.0	94		
16.0	101		
17.0	107		
18.0	113		
19.0	119		
20.0	126		
21.0	132		
22.0	138		
23.0	145		
24.0	151		
25.0	157		
L.C.G. W.R.T MIDSHIP = 0.135 M			
V.C.G. W.R.T BASELINE = 0.512 M			

FUEL OIL TANK CAPACITY CHART					
FR. NO. 13 TO 15 (PORT SHOWN STBD SIMILAR)					
DEDUCT SOUNDING BY 13.1 MM FOR EVERY 100MM TRIM BY AFT					
Sounding in Cms	Capacity in.Ltrs.	Sounding in Cms	Capacity in.Ltrs.	Sounding in Cms	Capacity in.Ltrs.
0.0	0	26.0	315	52.0	630
1.0	12	27.0	327	53.0	642
2.0	24	28.0	339	54.0	654
3.0	36	29.0	351	55.0	666
4.0	48	30.0	364	TK FULL	680
5.0	61	31.0	376		
6.0	73	32.0	388		
7.0	85	33.0	400		
8.0	97	34.0	412		
9.0	109	35.0	424		
10.0	121	36.0	436		
11.0	133	37.0	448		
12.0	145	38.0	460		
13.0	158	39.0	473		
14.0	170	40.0	485		
15.0	182	41.0	497		
16.0	194	42.0	509		
17.0	206	43.0	521		
18.0	218	44.0	533		
19.0	230	45.0	545		
20.0	242	46.0	557		
21.0	254	47.0	570		
22.0	267	48.0	582		
23.0	279	49.0	594		
24.0	291	50.0	606		
25.0	303	51.0	618		
L.C.G. W.R.T MIDSHIP = -5.473 M					
V.C.G. W.R.T BASELINE = 0.678 M					

Hydrostatics Report

SHM - XX

Ship Particulars

Waterline Length	14.390 metres		
Waterline Beam	3.434 metres		
Top of Keel	0.000 metres		
CP and CM referred to Section	230mm FORD OF FR NO.8: X=0 metres		
Specific Gravity of Water	1.0250		
Mean Shell Thickness	0.0000 metres		
Longitudinal Datum	230mm FORD OF FR NO.8 (7.523MTRS FROM TRANSOM)		
Vertical Datum	BASELINE		
Trim Length	12.968 metres		
Draught Marks	Name	X metres	Z metres
Aft Marks	FR. NO. 15	-6.185	0.000
Mid Marks	Midships	0.000	0.000
Fwd Marks	STEM	6.783	0.000



Trim Between Marks 0.000 metres

Draught at Mid Marks metres	Moulded Draught metres	Moulded Displacement tonnes	Full Displacement tonnes	LCB metres	LCF metres	Moulded VCB metres	Immersion tonnes/cm	WSA metres ²
0.300	0.300	4.641	4.641	-1.549	-1.570	0.209	0.346	35.97
0.320	0.320	5.356	5.356	-1.549	-1.528	0.223	0.368	38.37
0.340	0.340	6.113	6.113	-1.549	-1.508	0.236	0.388	40.53
0.360	0.360	6.919	6.919	-1.545	-1.515	0.249	0.409	42.87
0.380	0.380	7.745	7.745	-1.537	-1.433	0.262	0.416	43.98
0.400	0.400	8.583	8.583	-1.524	-1.373	0.275	0.422	44.94
0.420	0.420	9.432	9.432	-1.508	-1.317	0.287	0.427	45.83
0.440	0.440	10.290	10.290	-1.490	-1.270	0.299	0.431	46.64
0.460	0.460	11.156	11.156	-1.471	-1.235	0.311	0.434	47.38
0.480	0.480	12.028	12.028	-1.453	-1.204	0.322	0.437	48.09
0.500	0.500	12.906	12.906	-1.435	-1.167	0.334	0.441	48.85
0.520	0.520	13.791	13.791	-1.417	-1.144	0.345	0.443	49.52
0.540	0.540	14.680	14.680	-1.400	-1.120	0.356	0.446	50.19
0.560	0.560	15.576	15.576	-1.382	-1.086	0.367	0.449	50.94
0.580	0.580	16.476	16.476	-1.366	-1.072	0.378	0.451	51.56
0.600	0.600	17.380	17.380	-1.350	-1.058	0.389	0.453	52.18
0.620	0.620	18.289	18.289	-1.335	-1.038	0.400	0.455	52.85
0.640	0.640	19.201	19.201	-1.321	-1.027	0.411	0.457	53.45
0.660	0.660	20.116	20.116	-1.307	-1.016	0.422	0.459	54.05
0.680	0.680	21.035	21.035	-1.294	-1.005	0.433	0.460	54.66
0.700	0.700	21.958	21.958	-1.282	-0.984	0.444	0.463	55.33
0.720	0.720	22.885	22.885	-1.269	-0.976	0.454	0.464	55.92
0.740	0.740	23.815	23.815	-1.258	-0.968	0.465	0.466	56.52
0.760	0.760	24.747	24.747	-1.247	-0.961	0.476	0.467	57.11
0.780	0.780	25.683	25.683	-1.236	-0.953	0.487	0.469	57.70
0.800	0.800	26.622	26.622	-1.226	-0.940	0.497	0.470	58.33

Trim Between Marks 0.000 metres

Draught at Mid Marks metres	Moulded KMT metres	Moulded KML metres	MCT tonnes-metres/cm	CB	CP	CM	CW
0.300	5.119	87.483	0.313	0.305	0.694	0.440	0.682

0.320	5.226	82.774	0.342	0.330	0.697	0.474	0.727
0.340	5.249	78.406	0.370	0.355	0.704	0.504	0.767
0.360	5.305	74.670	0.398	0.379	0.715	0.531	0.807
0.380	4.921	69.255	0.414	0.402	0.725	0.555	0.822
0.400	4.577	64.322	0.426	0.424	0.735	0.577	0.833
0.420	4.272	60.177	0.438	0.443	0.744	0.596	0.843
0.440	4.003	56.482	0.448	0.462	0.752	0.614	0.851
0.460	3.766	53.100	0.457	0.479	0.759	0.631	0.858
0.480	3.559	50.092	0.465	0.495	0.766	0.646	0.864
0.500	3.388	47.585	0.474	0.510	0.772	0.660	0.871
0.520	3.230	45.150	0.480	0.524	0.778	0.673	0.875
0.540	3.092	42.991	0.487	0.537	0.783	0.686	0.880
0.560	2.976	41.243	0.495	0.549	0.788	0.697	0.887
0.580	2.864	39.350	0.500	0.561	0.793	0.708	0.891
0.600	2.764	37.645	0.505	0.572	0.797	0.718	0.894
0.620	2.677	36.209	0.511	0.582	0.801	0.727	0.899
0.640	2.596	34.755	0.515	0.592	0.805	0.736	0.902
0.660	2.524	33.428	0.519	0.602	0.809	0.744	0.905
0.680	2.458	32.212	0.523	0.611	0.812	0.752	0.909
0.700	2.400	31.250	0.529	0.619	0.815	0.760	0.913
0.720	2.346	30.171	0.532	0.628	0.818	0.767	0.916
0.740	2.296	29.174	0.536	0.635	0.821	0.774	0.919
0.760	2.251	28.249	0.539	0.642	0.824	0.780	0.922
0.780	2.210	27.388	0.542	0.650	0.826	0.787	0.925
0.800	2.173	26.649	0.547	0.657	0.829	0.793	0.929

R -

Free Trimming Cross Curve Data**SHM - XX****Specific Gravity of Water** 1.0250**Mean Shell Thickness** 0.0000 metres**Longitudinal Datum** 230mm FORD OF FR NO.8 (7.523MTRS FROM TRANSOM)**Vertical Datum** BASELINE**Trim Length** 12.968 metres**Draught Marks** **Name** **X metres** **Z metres**

Aft Marks FR. NO. 15 -6.185 0.000

Mid Marks Midships 0.000 0.000

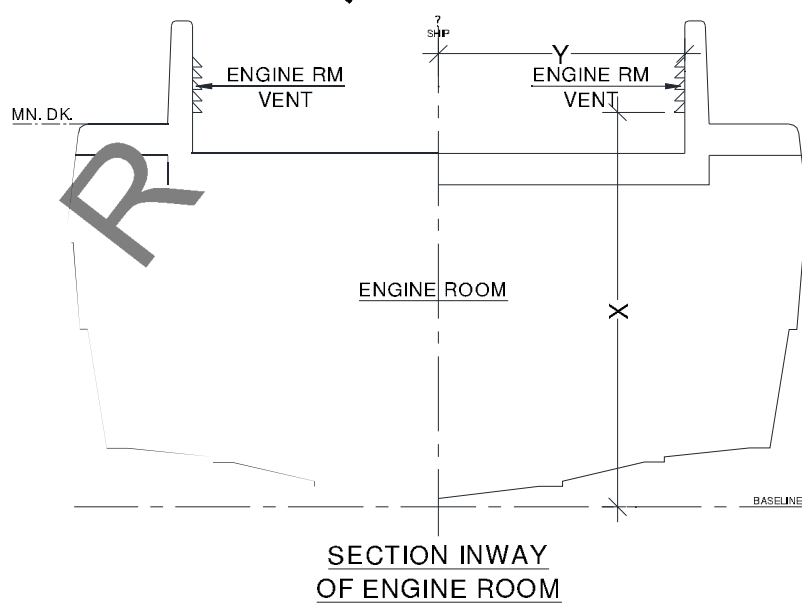
Fwd Marks STEM 6.783 0.000

Trim Between Marks 0.000 metres**Displacement****Heel Angle - Degrees / KN - metres**

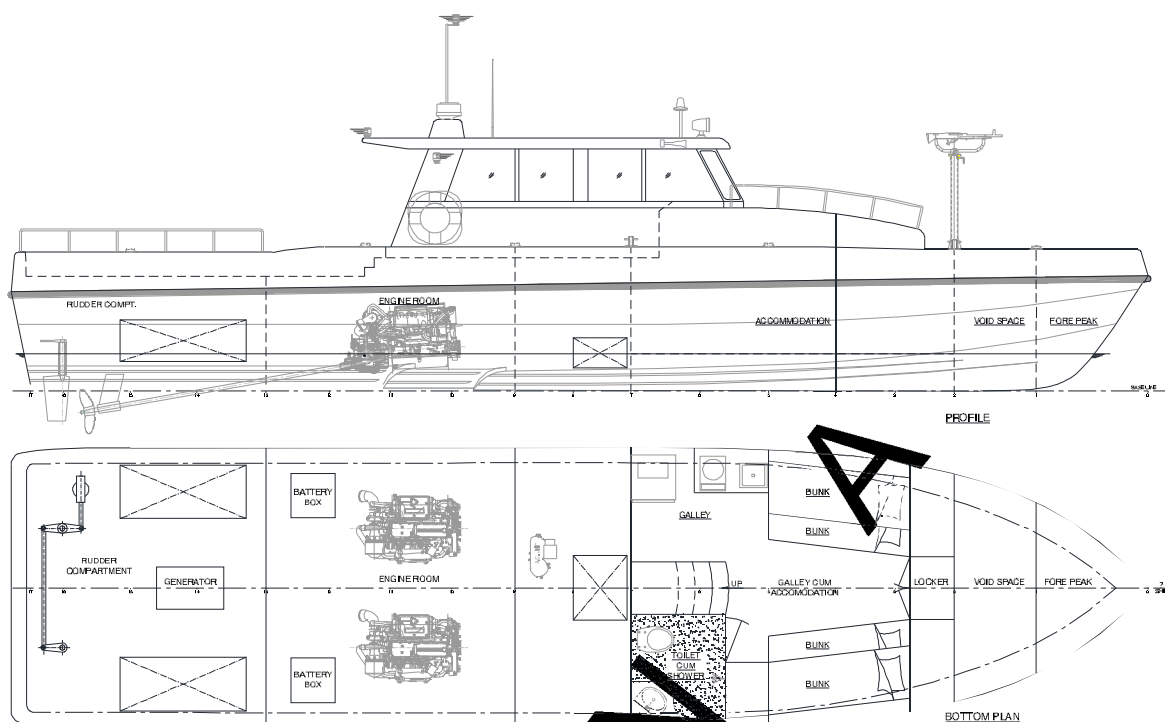
tonnes	0.00	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00
4.000	0.000	0.697	1.097	1.325	1.420	1.436	1.407	1.306	1.145	0.940
5.000	0.000	0.676	1.055	1.294	1.407	1.444	1.411	1.301	1.136	0.928
6.000	0.000	0.656	1.022	1.265	1.395	1.446	1.406	1.293	1.127	0.919
7.000	0.000	0.638	0.995	1.239	1.384	1.441	1.397	1.284	1.118	0.911
8.000	0.000	0.621	0.971	1.216	1.374	1.430	1.386	1.273	1.109	0.905
9.000	0.000	0.605	0.952	1.197	1.366	1.417	1.373	1.261	1.100	0.899
10.000	0.000	0.590	0.935	1.180	1.354	1.402	1.358	1.250	1.091	0.894
11.000	0.000	0.575	0.919	1.166	1.339	1.386	1.343	1.237	1.082	0.890
12.000	0.000	0.560	0.905	1.153	1.323	1.370	1.328	1.224	1.074	0.886
13.000	0.000	0.545	0.891	1.141	1.305	1.352	1.311	1.212	1.066	0.882
14.000	0.000	0.530	0.879	1.131	1.288	1.334	1.295	1.199	1.057	0.879
15.000	0.000	0.515	0.868	1.121	1.270	1.315	1.279	1.186	1.049	0.875
16.000	0.000	0.501	0.857	1.110	1.252	1.297	1.263	1.174	1.040	0.871
17.000	0.000	0.486	0.847	1.099	1.235	1.277	1.247	1.161	1.032	0.868
18.000	0.000	0.473	0.837	1.088	1.218	1.258	1.231	1.149	1.024	0.864
19.000	0.000	0.460	0.827	1.076	1.200	1.238	1.215	1.137	1.016	0.861
20.000	0.000	0.447	0.818	1.064	1.183	1.220	1.198	1.124	1.008	0.858
21.000	0.000	0.435	0.809	1.050	1.166	1.202	1.182	1.112	1.000	0.855
22.000	0.000	0.425	0.801	1.037	1.149	1.184	1.166	1.100	0.993	0.852
23.000	0.000	0.415	0.793	1.023	1.131	1.167	1.150	1.088	0.985	0.849
24.000	0.000	0.406	0.784	1.009	1.114	1.150	1.134	1.076	0.977	0.846
25.000	0.000	0.398	0.775	0.994	1.097	1.133	1.119	1.064	0.970	0.843
26.000	0.000	0.391	0.766	0.980	1.080	1.116	1.104	1.052	0.962	0.841
27.000	0.000	0.384	0.756	0.965	1.063	1.100	1.090	1.040	0.955	0.838
28.000	0.000	0.378	0.746	0.949	1.046	1.084	1.076	1.029	0.948	0.835
29.000	0.000	0.372	0.735	0.933	1.029	1.068	1.062	1.018	0.941	0.833
30.000	0.000	0.367	0.723	0.917	1.012	1.052	1.048	1.007	0.934	0.830

TABLE OF DOWN FLOODING ANGLE

LOCATION	ENG. ROOM EXHAUST VENT
HALF BREADTH (X)	1.250
HEIGHT (Y)	2.000
DRAFT IN MTRS	DOWN ANGLE FLOODING ANGLE IN DEG
0.400	52.00
0.410	51.83
0.420	51.65
0.430	51.47
0.440	51.30
0.450	51.12
0.460	50.93
0.470	50.75
0.480	50.57
0.485	50.47
0.490	50.38
0.493	50.33
0.500	50.19
0.508	50.04
0.510	50.01
0.520	49.82



Loading Conditions Data



Condition 1: LIGHTSHIP CONDITION

Item	Weight	LCG	LMom	VCG	VMom	TCG	FSM
FUEL OIL TANK (P&S)	0.000	--	--	--	--	--	0.000
FRESH WATER TANK	0.000	--	--	--	--	--	0.000
8 NOS. PASSENGERS	0.000	--	--	--	--	--	0.000
4 NOS. CREW	0.000	--	--	--	--	--	0.000
STORE	0.000	--	--	--	--	--	0.000
Deadweight	0.000	0.000	0.00	0.000	0.00	0.000	0.000
Lightship	11.920	-2.094	-24.96	1.519	18.11	0.000	0.000
Displacement	11.920	-2.094	-24.96	1.519	18.11	0.000	0.000

Draught Aft **0.544** metres

Mid **0.450** metres

Fwd 0.368 metres

Trim Between Marks 0.176 metres by the stern

GM Solid 2.002 metres

GM Fluid 2.002 metres

Effective VCG 1.519 metres

Moulded Displacement 11.920 tonnes

Waterline at LCF referred to hull definition datum 0.479 metres

LCF referred to hull definition datum -1.391 metres

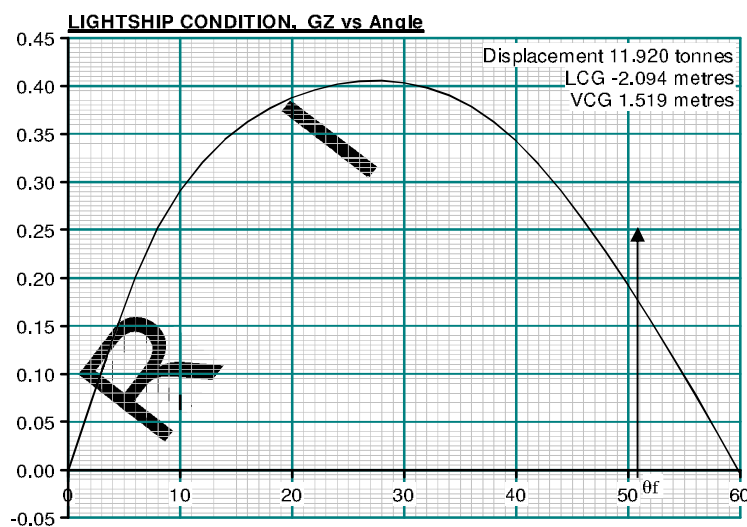
Heel Angle 0.00 degrees to starboard

Free Trimming Stability Data

LIGHTSHIP CONDITION

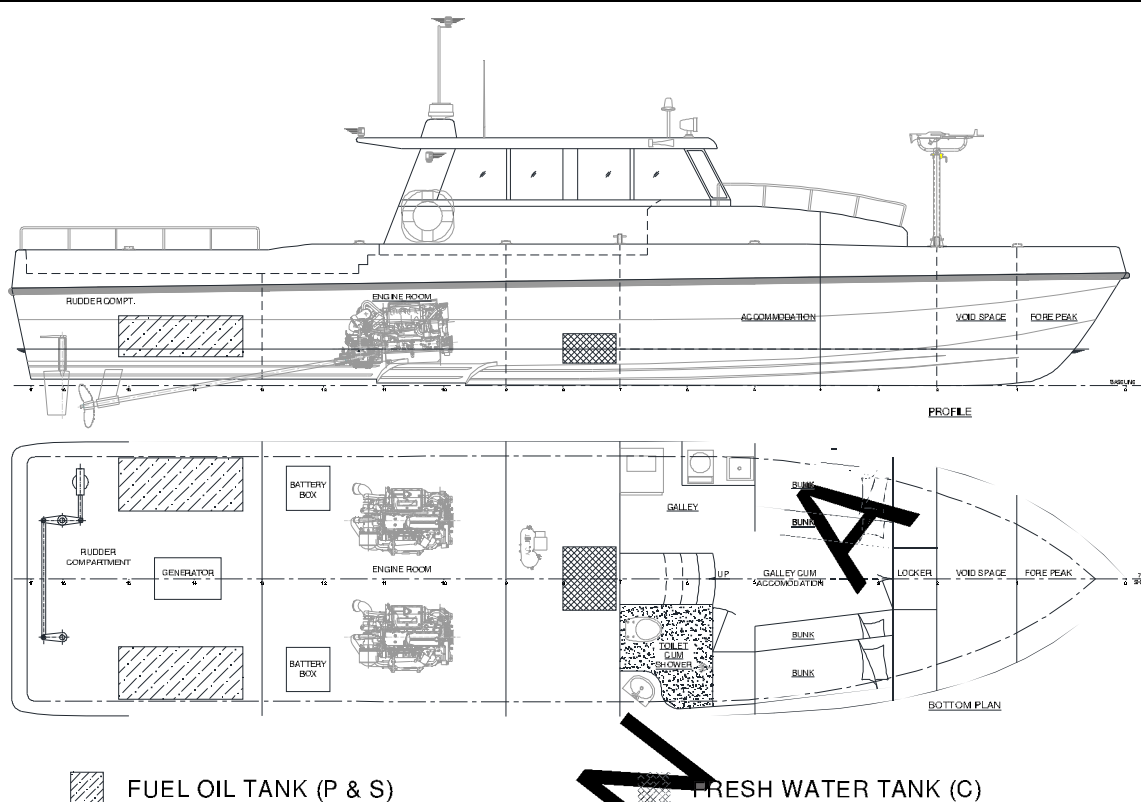
Displacement	11.920 tonnes
Longitudinal Centre of Gravity	-2.094 metres
Vertical Centre of Gravity	1.519 metres
Transverse Centre of Gravity	0.000 metres
Equilibrium GM	2.002 metres
Equilibrium Heel Angle	0.000 degrees to stbd
Equilibrium Draught	0.460 metres
Equilibrium Trim Between Marks	0.176 metres by the stern
Angle of Vanishing Stability	59.8 degrees
Maximum GZ	0.406 metres
Maximum GZ Angle	27.5 degrees

Heel Angle degrees	Righting GZ metres	Lever KN metres	Waterline metres	Trim metres	VCB metres	GZ Curve Area metres.rad
0.0	0.000	0.000	0.460	0.176	0.325	0.000
10.0	0.291	0.555	0.446	0.205	0.366	0.028
20.0	0.388	0.907	0.390	0.220	0.446	0.089
30.0	0.403	1.163	0.313	0.208	0.549	0.159
40.0	0.342	1.319	0.225	0.223	0.652	0.225
50.0	0.192	1.356	0.140	0.294	0.723	0.273
60.0	-0.004	1.311	0.074	0.376	0.773	--

DOWN ANGLE FLOODING, θ_f

50.93 Degrees

No.	Criterion	Reqd. for monohull	Actual
1	When GZ Max. at 30° or above Area under GZ curve at 30Deg	> 0.055 m.rad	0.159
2	GZ area 30° TO 40° or down flooding if < 40°.	> 0.03 m.rad	0.066
3	Minimum GZ at 30° or more.	≥ 0.2 m	0.403
4	Min. angle of max GZ	15°	27.5
5	Minimum GM.	0.15 m	2.002

**Condition 2: LOAD DEPARTURE CONDITION**

Item	Weight	LCG	LMom	VCG	VMom	TCG	FSM
FUEL OIL TANK (P&S)	1.156	-5.473	-6.33	0.678	0.78	0.000	0.090
FRESH WATER TANK	0.250	0.135	0.03	0.512	0.13	0.000	0.040
8 NOS. PASSENGERS	0.600	-0.920	-0.55	2.790	1.67	0.000	0.000
4 NOS. CREW	0.300	0.487	0.15	2.790	0.84	0.000	0.000
STORE	0.100	1.500	0.15	0.560	0.06	0.000	0.000
Deadweight	2.406	-2.722	-6.55	1.446	3.48	0.000	0.130
Lightship	11.920	-2.094	-24.96	1.519	18.11	0.000	0.000
Displacement	14.326	-2.199	-31.51	1.507	21.59	0.000	0.130

Draught Aft 0.620 metres

Mid 0.500 metres

Fwd 0.375 metres

Trim Between Marks 0.254 metres by the stern

GM Solid 1.580 metres

GM Fluid 1.571 metres

Effective VCG 1.516 metres

Moulded Displacement 14.326 tonnes

Waterline at LCF referred to hull definition datum 0.534 metres

LCF referred to hull definition datum -1.356 metres

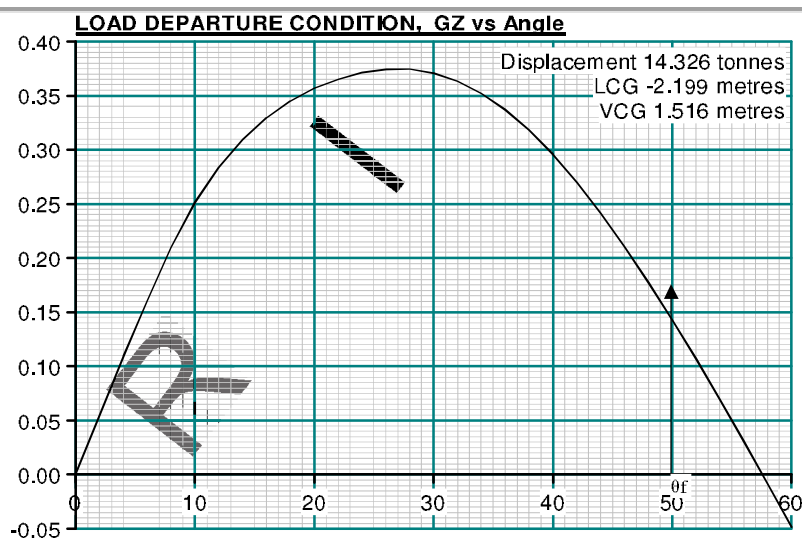
Heel Angle 0.00 degrees to starboard

Free Trimming Stability Data

LOAD DEPARTURE CONDITION

Displacement	14.326 tonnes
Longitudinal Centre of Gravity	-2.199 metres
Vertical Centre of Gravity	1.516 metres
Transverse Centre of Gravity	0.000 metres
Equilibrium GM	1.571 metres
Equilibrium Heel Angle	0.000 degrees to stbd
Equilibrium Draught	0.508 metres
Equilibrium Trim Between Marks	0.254 metres by the stern
Angle of Vanishing Stability	57.6 degrees
Maximum GZ	0.375 metres
Maximum GZ Angle	27.3 degrees

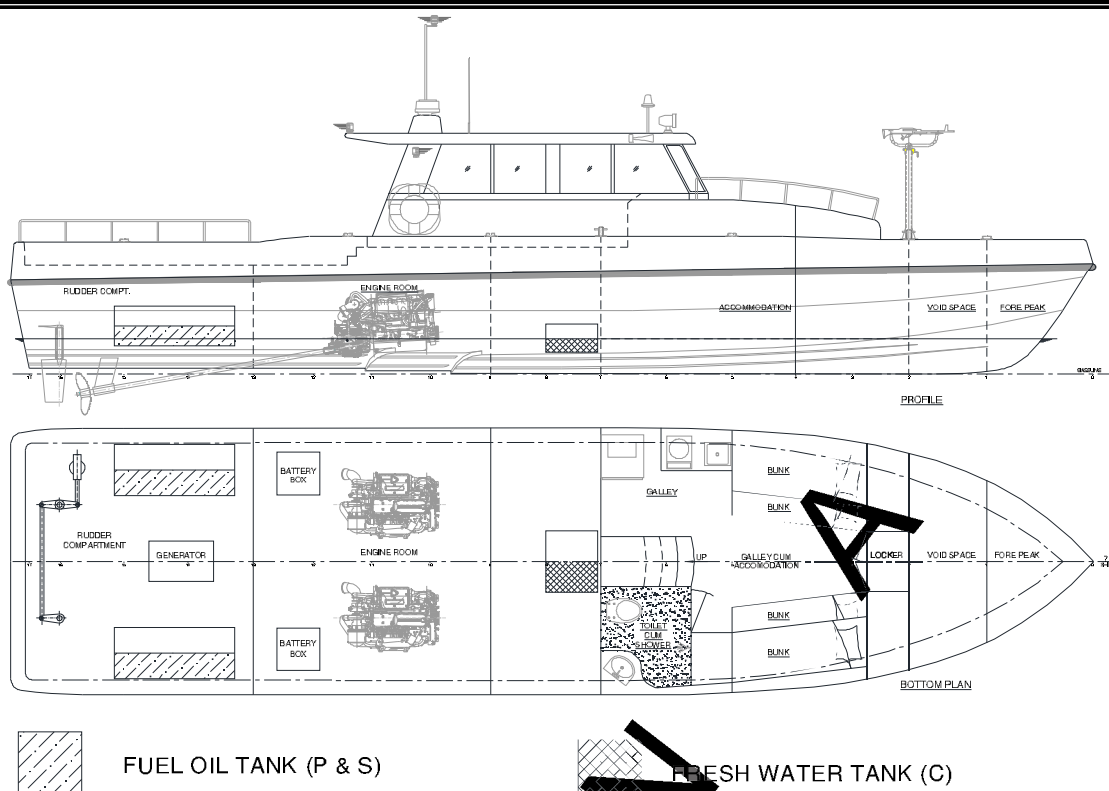
Heel Angle degrees	Righting GZ metres	Lever KN metres	Waterline metres	Trim metres	VCB metres	GZ Curve Area metres.rad
0.0	0.000	0.000	0.508	0.254	0.359	0.000
10.0	0.252	0.515	0.499	0.282	0.398	0.023
20.0	0.357	0.875	0.449	0.311	0.478	0.078
30.0	0.371	1.129	0.378	0.320	0.576	0.143
40.0	0.296	1.270	0.302	0.373	0.665	0.209
50.0	0.143	1.304	0.233	0.472	0.727	0.241
60.0	-0.049	1.264	0.180	0.579	0.771	--



DOWN ANGLE FLOODING, 0f

50.04 Degrees

No.	Criterion	Reqd. for monohull	Actual
1	When GZ Max. at 30° or above Area under GZ curve at 30 Deg	> 0.055 m.rad	0.143
2	GZ area 30° to 40° on down flooding > 40°	> 0.03 m.rad	0.059
3	Minimum GZ at 30° or more	> 0.2 m	0.371
4	Min angle of max GZ	15°	27.3
5	Minimum GM.	0.35 m	1.571

**Condition 3: LOAD ARRIVAL CONDITION**

Item	Weight	LCG	LMom	VCG	VMom	TCG	FSM
FUEL OIL TANK (P&S)	0.116	-5.473	-0.63	0.678	0.08	0.000	0.090
FRESH WATER TANK	0.025	0.135	0.00	0.512	0.01	0.000	0.040
8 NOS. PASSENGERS	0.600	-0.920	-0.55	2.790	1.67	0.000	0.000
4 NOS. CREW	0.300	0.487	0.15	2.790	0.84	0.000	0.000
STORE	0.010	1.500	0.01	0.560	0.01	0.000	0.000
Deadweight	1.051	-0.971	-1.02	2.482	2.61	0.000	0.130
Lightship	11.920	-2.094	-24.96	1.519	18.11	0.000	0.000
Displacement	12.971	-2.003	-25.98	1.597	20.71	0.000	0.130

Draught Aft 0.565 metres

Mid 0.485 metres

Fwd 0.398 metres

Trim Between Marks 0.167 metres by the stern

GM Solid 1.729 metres

GM Fluid 1.719 metres

Effective VCG 1.607 metres

Moulded Displacement 12.971 tonnes

Waterline at LCF referred to hull definition datum 0.503 metres

LCF referred to hull definition datum -1.324 metres

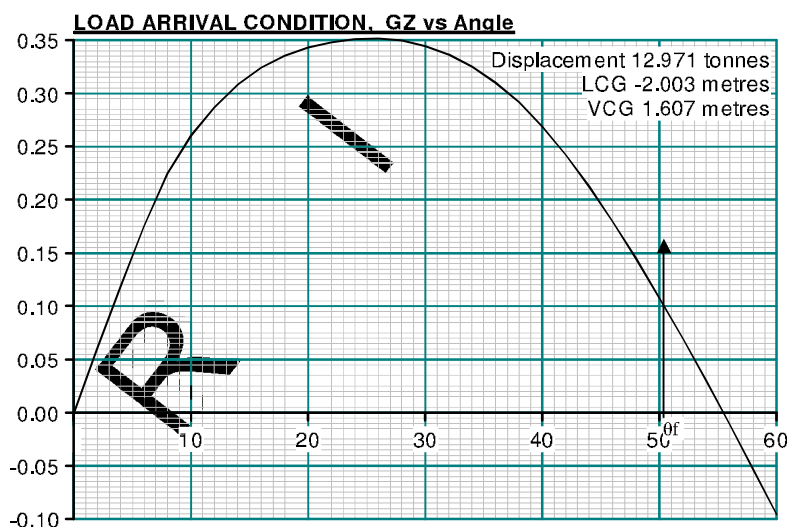
Heel Angle 0.00 degrees to starboard

Free Trimming Stability Data

LOAD ARRIVAL CONDITION

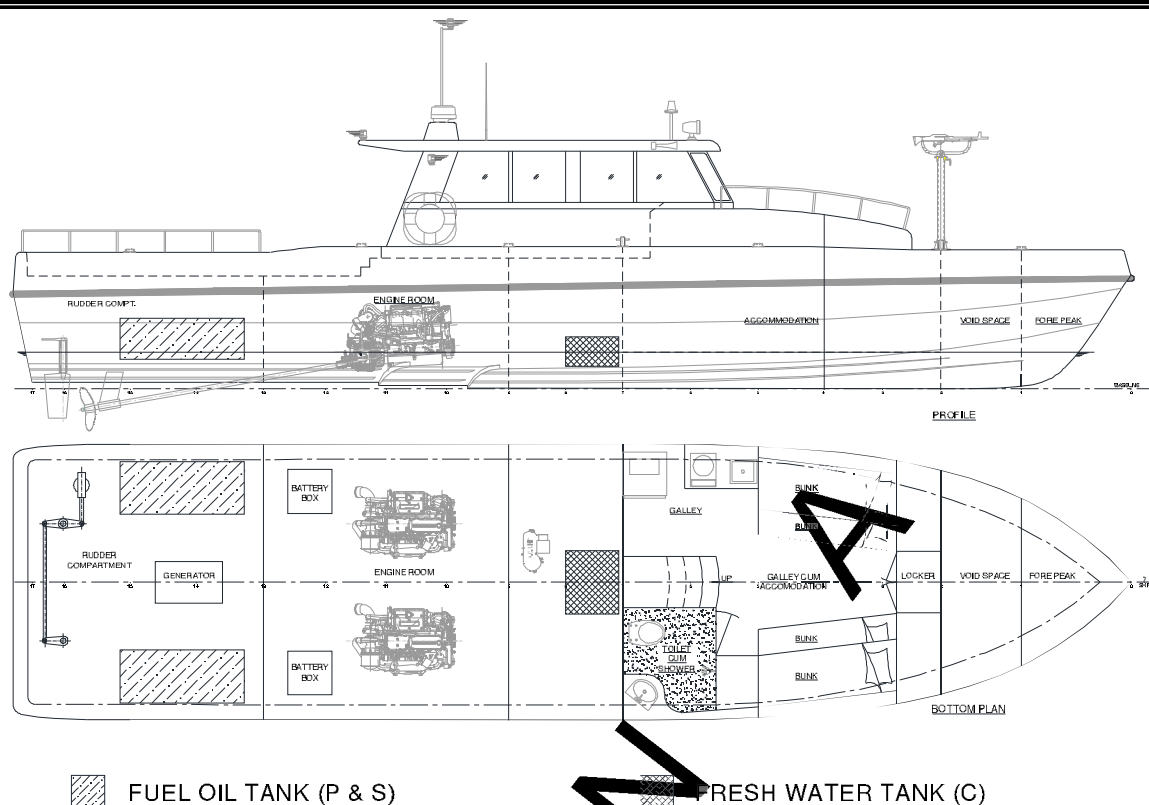
Displacement	12.971 tonnes
Longitudinal Centre of Gravity	-2.003 metres
Vertical Centre of Gravity	1.607 metres
Transverse Centre of Gravity	0.000 metres
Equilibrium GM	1.719 metres
Equilibrium Heel Angle	0.000 degrees to stbd
Equilibrium Draught	0.485 metres
Equilibrium Trim Between Marks	0.167 metres by the stern
Angle of Vanishing Stability	55.4 degrees to stbd 55.4 degrees to port
Maximum GZ	0.352 metres to stbd 0.352 metres to port
Maximum GZ Angle	25.7 degrees to stbd 25.7 degrees to port

Heel Angle degrees	Righting GZ metres	Lever KN metres	Waterline metres	Trim metres	VCB metres	GZ Curve Area metres.rad
0.0	0.000	0.000	0.485	0.167	0.338	0.000
10.0	0.261	0.540	0.474	0.194	0.378	0.025
20.0	0.343	0.893	0.422	0.209	0.458	0.079
30.0	0.345	1.148	0.347	0.200	0.559	0.140
40.0	0.269	1.302	0.265	0.216	0.658	0.195
50.0	0.108	1.339	0.189	0.287	0.727	0.229
60.0	-0.096	1.296	0.129	0.368	0.775	--

DOWN ANGLE FLOODING, θ_f

50.47 Degrees

No.	Criterion	Reqd. for monohull	Actual
1	When GZ Max. at 30° or above Area under GZ curve at 30° Deg	20.05 m.rad	0.140
2	GZ area 30° to 180° of down flooding 11.40°	10.03 m.rad	0.055
3	Minimum GZ at 30° or more	0.2 m	0.345
4	Min. angle of max GZ	15°	25.7
5	Minimum GM.	0.35 m	1.719

**Condition 4: LIGHT DEPARTURE CONDITION**

Item	Weight	LCG	LMom	VCG	VMom	TCG	FSM
FUEL OIL TANK (P&S)	1.156	-5.473	-6.33	0.678	0.78	0.000	0.090
FRESH WATER TANK	0.250	0.135	0.03	0.512	0.13	0.000	0.040
8 NOS. PASSENGERS	0.000	--	--	--	--	--	0.000
4 NOS. CREW	0.300	0.487	0.15	2.790	0.84	0.000	0.000
STORE	0.100	1.500	0.15	0.560	0.06	0.000	0.000
Deadweight	1.806	-3.321	-6.00	0.999	1.80	0.000	0.130
Lightship	11.920	-2.094	-24.96	1.519	18.11	0.000	0.000
Displacement	13.726	-2.255	-30.96	1.451	19.91	0.000	0.130

Draught Aft **0.617** metres

Mid **0.493** metres

Fwd 0.357 metres

Trim Between Marks 0.260 metres by the stern

GM Solid 1.721 metres

GM Fluid 1.711 metres

Effective VCG 1.460 metres

Moulded Displacement 13.726 tonnes

Waterline at LCF referred to hull definition datum 0.521 metres

LCF referred to hull definition datum -1.393 metres

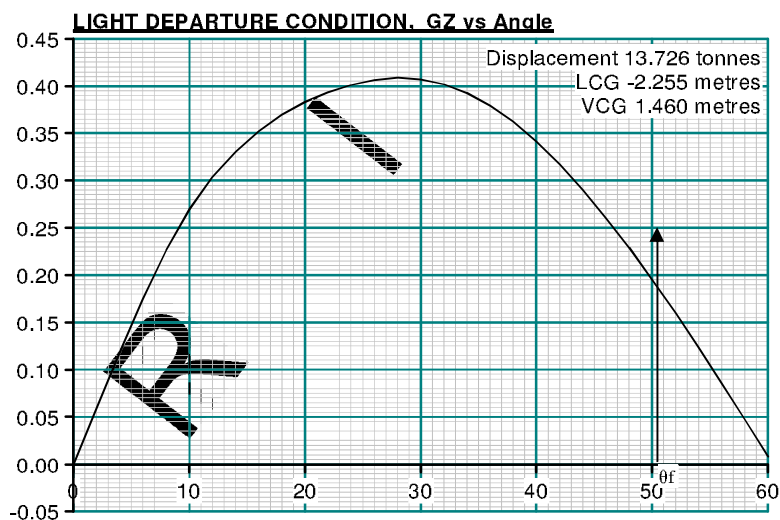
Heel Angle 0.00 degrees to starboard

Free Trimming Stability Data

LIGHT DEPARTURE CONDITION

Displacement	13.726 tonnes
Longitudinal Centre of Gravity	-2.255 metres
Vertical Centre of Gravity	1.460 metres
Transverse Centre of Gravity	0.000 metres
Equilibrium GM	1.711 metres
Equilibrium Heel Angle	0.000 degrees to stbd
Equilibrium Draught	0.493 metres
Equilibrium Trim Between Marks	0.260 metres by the stern
Angle of Vanishing Stability	60.4 degrees to stbd 60.4 degrees to port
Maximum GZ	0.409 metres to stbd 0.409 metres to port
Maximum GZ Angle	28.1 degrees to stbd 28.1 degrees to port

Heel Angle degrees	Righting GZ metres	Lever KN metres	Waterline metres	Trim metres	VCB metres	GZ Curve Area metres.rad
0.0	0.000	0.000	0.493	0.260	0.352	0.000
10.0	0.270	0.523	0.483	0.291	0.392	0.025
20.0	0.383	0.882	0.432	0.319	0.472	0.084
30.0	0.407	1.137	0.359	0.326	0.571	0.154
40.0	0.341	1.280	0.279	0.377	0.662	0.220
50.0	0.195	1.314	0.205	0.478	0.725	0.268
60.0	0.008	1.272	0.149	0.585	0.770	0.286

DOWN ANGLE FLOODING, θ_f

50.33 Degrees

No.	Criterion	Reqd. for monohull	Actual
1	When GZ Max. at 30 or above Area under GZ curve at 90 Deg	0.053 m.rad	0.154
2	GZ area 30 to 40 of down flooding	0.03 m.rad	0.068
3	Minimum GZ at 30 or more	0.2 m	0.407
4	Min angle of max GZ	15°	28.1
5	Minimum GM.	0.35 m	1.711

SHM - XX

YARD NO. 155

INCLINING EXPERIMENT REPORT

DRG NO: SHM/MPT/27

DRG NO: REV. AOWNERSHM SHIPCARE.
DARUKHANA, MAZGAON,
MUMBAIBUILDERSHM SHIP CARE
GHODBUNDER,
Mumbai

* See remarks in red on page 2, 4 and 5

PROGRAM USED

HYDROSTATICS & STABILITY PROGRAM
VERSION 06.07.05 FV 16.6

DEVELOPED BY

WOLFSON UNIT M.T.I.A
SOUTHAMPTON UNIVERSITY
ENGLAND**RI 94469**

RINA	Korea Engineering Centre
SUITE Approvato Approved In conformità ai vigenti Regolamenti del RINA (In compliance with RINA Rules in force) Con Nota With Remarks	
N. PUCD0000006418	
28 JUL 2016	
	RINA SERVICES

See Letter: PUCD0000006418

TOTAL 05 SHEETS

INCLINING EXPERIMENT REPORT

Vessel : SHM - XX
 Yard No : 155
 Place : SHM Shipcare Shipyard,
 Ghodbunder – Mumbai.
 Date : 27th Apr. '16
 Time : 1200 HRS TO 1300 HRS
 Total no. of persons on board : 05 nos.
 Weather : Settled, Clear Visibility.
 Wind : Calm
 Restraining Line : Slack
 State of the Vessel : All bilges dry.
 Specific gravity : 1.020
 Temperature : 30 deg C
 Test witnessed by : 1) Mr. Haneydict. A
 RINA Surveyor.
 2) Mr. Rajesh Belgaonkar
 Main dimension : 15.37 m x 3.77 m x 1.94 m

SOUNDINGS OF TANKS

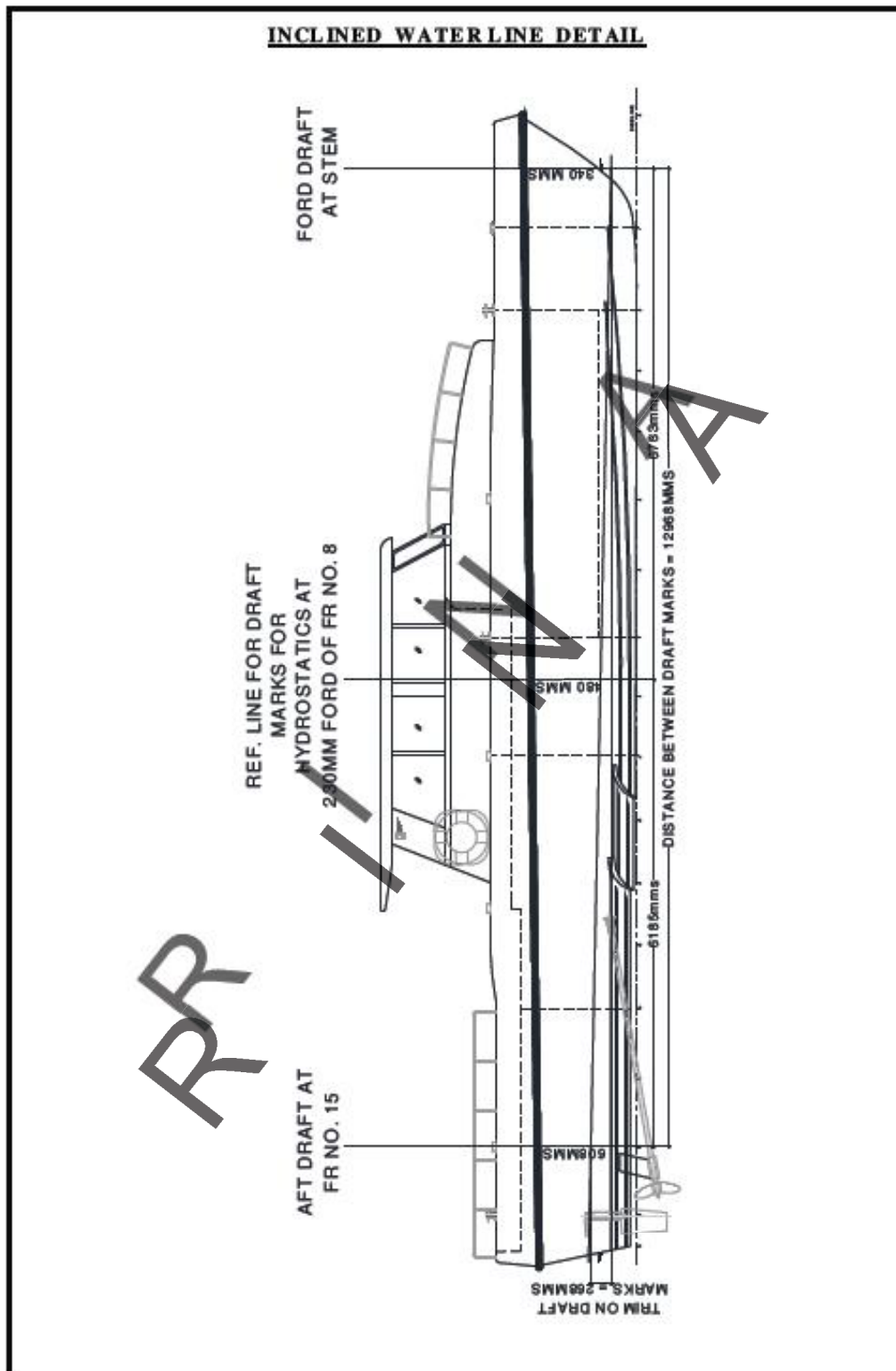
No.	Description	Side	Location (Fr.Nos)	Sounding (m)	Weight (t)	F.S.M mt (t-m)
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ALL TANKS EMPTY

DRAFT AT TIME OF INCLINING

	P	S	Mean
Draft Aft (Fr.No. 15)	0.520 m	0.520 m	0.520 m
Draft Aft (Fr.No. 15) WRT Baseline	0.608 m	0.608 m	0.608 m
Draft Ford (Stem)	0.340 m	0.340 m	0.340 m
Draft Midship (Fr.No 12)			0.474 m
Trim by aft on Draft Mark			0.268 m

Sign Convection : Longitudinal Position (LCG, LCB, LCF etc) are measured from Midship (230mm ford of Fr No. 8). Aft of Midship is considered -ve and forward +ve All vertical measurement (VGG, VCB etc) are measured from baseline. Trim Aft + ve Trim Ford - ve. TCG are measured wrt Centerline Port -ve Stbd +ve.



Inclining Experiment Results**SHM - XX**

Mean Shell Thickness 0.0000 metres

Longitudinal Datum 230mm FORD OF FR NO.8 (7.523MTRS FROM TRANSOM)

Vertical Datum BASELINE

Trim Length 12.968 metres

Draught Marks Name X metres Z metres

Aft Marks FR. NO. 15 -6.185 0.000

Mid Marks Midships 0.000 0.000

Fwd Marks STEM 6.783 0.000

Weight Shifts

No.	Direction	Weight tonnes	Distance metres	Deflection P1, mm	Rate P1, Deflection/Moment
1	Starboard	0.1400	2.7000	57.0	150.794
2	Starboard	0.1400	2.6000	55.0	151.099
3	Port	0.1400	2.7000	57.0	150.794
4	Port	0.1400	2.6000	56.0	153.846
5	Port	0.1400	2.7000	56.0	148.148
6	Port	0.1400	2.6000	55.0	151.099
7	Starboard	0.1400	2.7000	56.0	148.148
8	Starboard	0.1400	2.6000	55.0	151.099

Pendulum Data

No.	Position	Length metres	GM metres
1	FR NO. 11	3.425	1.724

Draught readings

No.	Position	X Value metres	Draught metres
1	FR NO. 15	-6.185	0.608
2	STEM	6.783	0.340

As Inclined ConditionDisplacement ~~12.88~~ 13.140 tonnesLCG ~~-2.331~~ -2.314 metresVCG ~~1.354~~ 1.328 metresKMT ~~3.228~~ 3.152 metres

GMT 1.724 metres

LCB ~~-2.35~~ -2.338 metres

VCB 0.347 metres

Specific Gravity at Inclining 1.0200

Mid Marks Draught 0.480 metres

Trim Between Marks 0.268 metres by the stern

Items to be added to calculate lightship

None to be added

Items to be removed to calculate lightship

Item	Weight tonnes	LCG metres	VCG metres	TCG metres	FSM tonnes.m
INCL. WT 1	0.140	-6.086	1.840	1.350	0.000
INCL. WT 2	0.140	-7.086	1.840	-1.350	0.000
INCL. WT 3	0.140	-4.086	1.840	1.300	0.000
INCL. WT 4	0.140	-5.086	1.840	-1.300	0.000
2 PERSONS AT AFT	0.150	-7.085	2.540	0.000	0.000
3 PERSONS AT AFT CABIN	0.225	-3.550	2.581	0.000	0.000
PENDULUM	0.030	-2.685	1.712	0.000	0.000
Total	0.965	-5.254	2.118	0.000	0.000

Lightship Condition

Specific Gravity 1.0250

11.92Displacement ~~12.175~~ tonnesLCG ~~-2.094~~ **-2.681** metres

VCG (uncorrected for fluids) 1.481 metres

VCG **1.519** ~~1.481~~ metresGM ~~1.283~~ metres

Draught Aft 0.550 metres

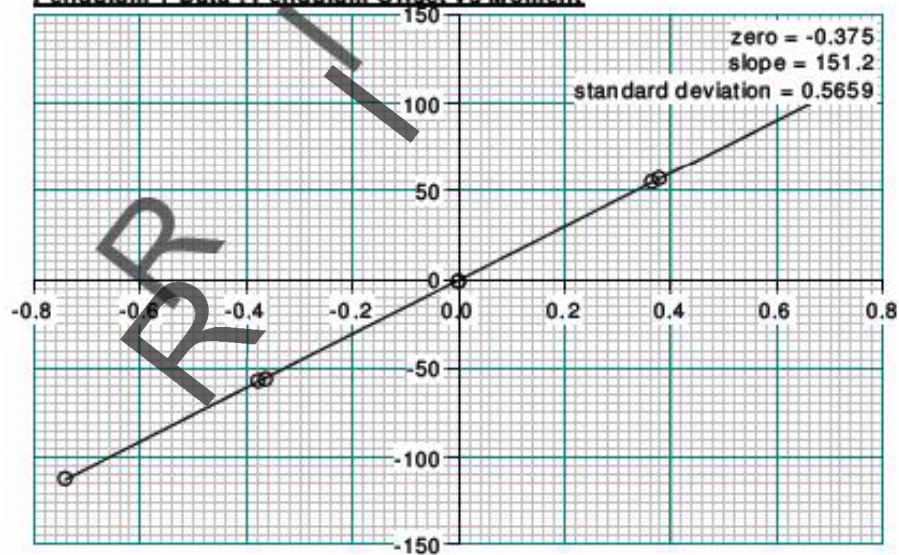
Mid 0.466 metres

Fwd 0.374 metres

Trim Between Marks 0.176 metres by the stern

Moulded Displacement ~~12.175~~ tonnes

Waterline at LCF referred to hull definition datum 0.466 metres

LCF referred to hull definition datum ~~-1.378~~ metres**Pendulum 1 Data . Pendulum Offset vs Moment**

Hydrostatics Report

SHM - XXShip Particulars

Waterline Length	14.390 metres
Waterline Beam	3.434 metres
Top of Keel	0.000 metres
CP and CM referred to Section SHM - XX, FR NO. 15: X=0 metres	
Specific Gravity of Water	1.0200
Mean Shell Thickness	0.0000 metres
Longitudinal Datum	230mm FORD OF FR NO.8 (7.523MTRS FROM TRANSOM)
Vertical Datum	BASELINE
Trim Length	12.968 metres
Draught Marks	Name X metres Z metres
Aft Marks	FR. NO. 15 -6.185 0.000
Mid Marks	Midships 0.000 0.000
Fwd Marks	STEM 6.783 0.000

Trim Between Marks 0.268 metres by the stern

Draught at Mid Marks	Moulded Draught	Moulded Displacement	Full Displacement	LCB	LCF	Moulded Immersion VCB	WSA
metres	metres	tonnes	tonnes	metres	metres	metres	tonnes/cm metres³
0.450	0.450	11.876	11.876	-2.430	-1.518	0.331	0.415 46.08
0.460	0.460	12.292	12.292	-2.399	-1.491	0.336	0.417 46.50
0.470	0.470	12.711	12.711	-2.368	-1.462	0.341	0.420 46.95
0.480	0.480	13.140	13.140	-2.338	-1.430	0.347	0.423 47.44
0.490	0.490	13.556	13.556	-2.310	-1.408	0.352	0.425 47.83
0.500	0.500	13.982	13.982	-2.282	-1.386	0.357	0.427 48.22

Trim Between Marks 0.268 metres by the stern

Draught at Mid Marks	Moulded KMT	Moulded KML	MCT tonnes-metres/cm	CB	CP	CM	CW
metres	metres	metres	metres/cm				
0.450	3.465	44.069	0.404	0.524	0.841	0.623	0.824
0.460	3.385	43.169	0.409	0.530	0.840	0.631	0.828
0.470	3.312	42.378	0.415	0.537	0.840	0.639	0.833
0.480	3.252	41.654	0.422	0.543	0.840	0.646	0.839
0.490	3.185	40.849	0.427	0.549	0.840	0.653	0.843
0.500	3.121	40.070	0.432	0.555	0.840	0.660	0.847