

1 Condition at the Inclining Test

Date	29 April 2011
Time	8:00 – 9:00
Location	Beauty Point, Tasmania, Australia
Wind	2 knot light breeze
Wind direction	135°
Weather	Fine
Sea State	Calm
Air temperature	11°
Specific gravity of water	1.0175
Vessel heading	110°

1.1 Mooring Arrangement

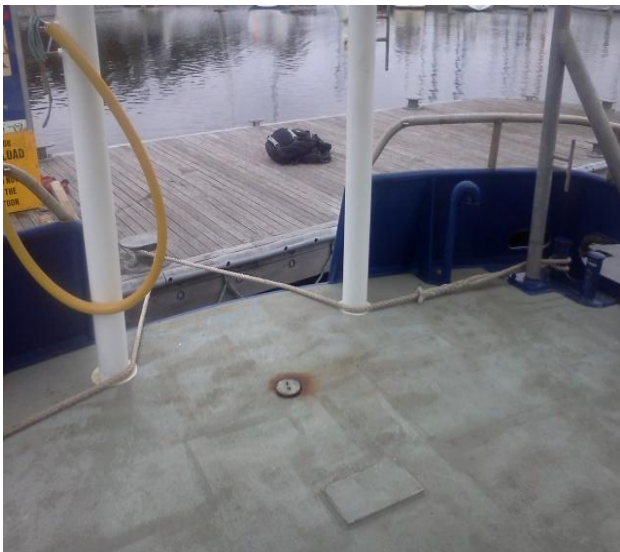


Figure 1 Stern mooring arrangement



Figure 2 Bow mooring arrangement

1.2 Attendance

Supervision	Paul Furness
Lower pendulum	Steve Grogan Harold Floyd
Upper Pendulum	Maniu Dawanincura Lauchlan Clarke
Total no. of persons aboard	9

1.3 Data Provided

FTV *Reviresco* – INCLINING EXPERIMENT (2011) HYDROSTATIC & TANK DATA

Note: Fwd of MS (+ve), Stbd of C.L (+ve)

Tank Summary

TANK	% FILLING (%)	VOLUME (M ³)	MASS (TONNES)	VCG (ABL) (METRES)	LCG (MS) (METRES)	TCG (CL) (METRES)	FSM (T-M)
F.O PORT	36%	0.775	0.650	1.806	- 3.194	- 1.910	0.079 × 0.84
F.O. STBD	32%	0.700	0.590	1.779	- 3.189	+ 1.905	0.077 × 0.84
F.W. PORT	100%	1.313	1.313	2.597	- 6.207	- 1.754	-
F.W. STBD	100%	1.313	1.313	2.597	- 6.207	+ 1.754	-

Hydrostatic Data

$$d_{FMKS} = 1.095 \text{ m}$$

$$d_{AMKS} = 2.260 \text{ m} \quad (\text{mean of P \& S})$$

$$T_{BP} = 0.298 \text{ m} \quad (\text{corrected for ROK})$$

$$d_{MS(USK)} = 1.659 \text{ m}$$

$$\rho_{WATER} = 1.0175 \text{ t/m}^3 \quad (\text{at inclining})$$

$$\text{For } T_{BP} = 0.298 \text{ m} \quad \text{for } d_{MS(USK)} = 1.659 \text{ m}$$

$$\Delta = 42.534 \text{ tonnes} \quad \text{for density} = 1.025 \text{ t/m}^3$$

$$KM = 3.497 \text{ m} \quad (\text{above BL})$$

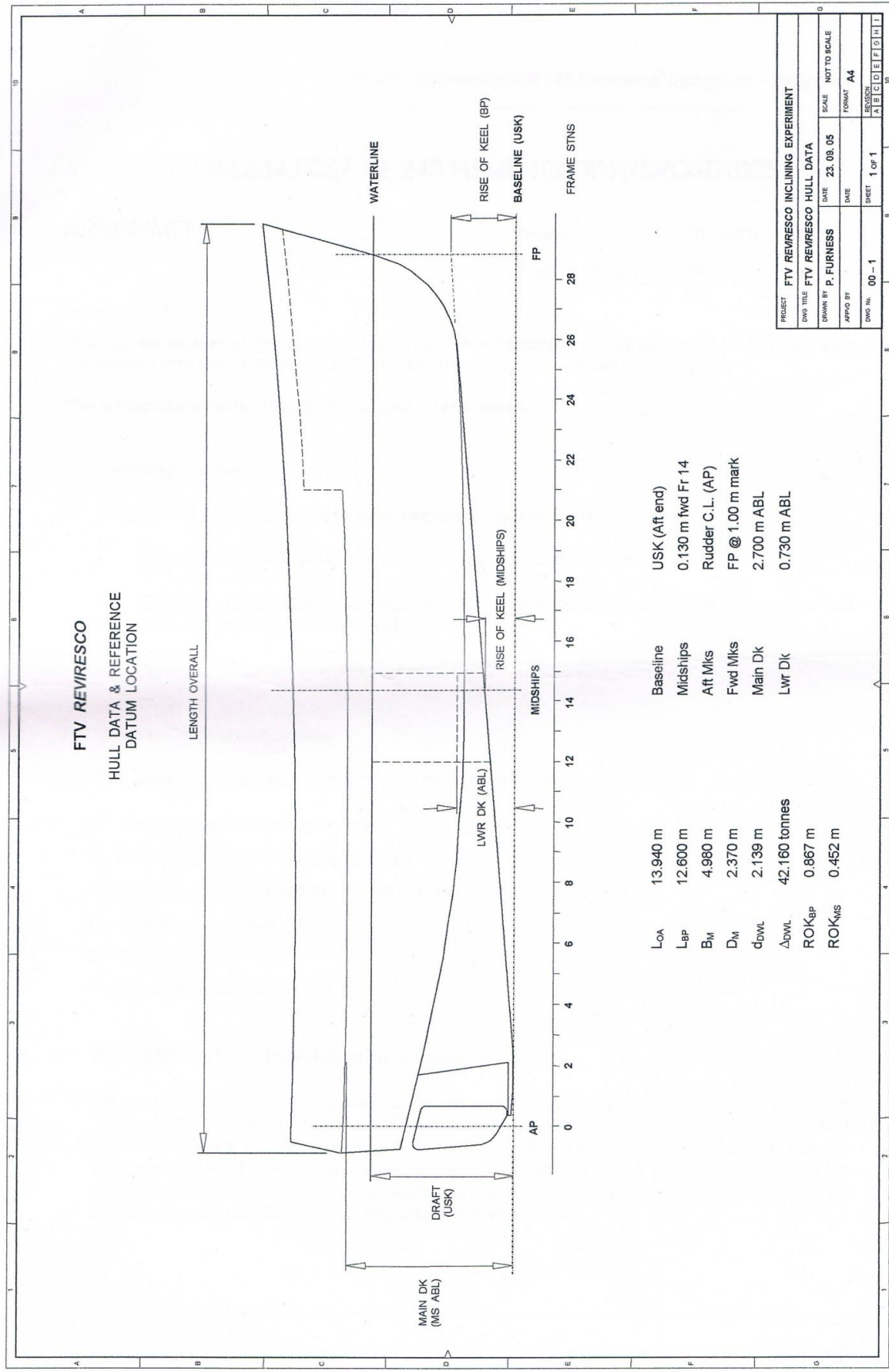
$$LCB = -1.249 \text{ m} \quad (\text{aft of MS})$$

$$VCB = 1.644 \text{ m} \quad (\text{above BL})$$

For the Calculation of G_FM @ Inclining

$$\text{Upper pendulum length} = 1878 \text{ mm}$$

$$\text{Lower pendulum length} = 1644 \text{ mm (except Group 9)}$$



PROJECT: FTV REVIRESCO INCLINING EXPERIMENT			
DRAWN TITLE: FTV REVIRESCO HULL DATA			
DRAWN BY: P. FURNESS	DATE: 23.08.05	SCALE: NOT TO SCALE	FORMAT: A4
APPROV BY:	DATE:	REVISION:	SHEET: 1 OF 1
DWG NO: 00-1			

FTV *Reviresco* – INCLINING EXPERIMENT

GENERAL DATA

Inclining weights	4 × 200 litre drums 100% filling with FW 230 kg gross weight each [200 kg fresh water + 30 kg dry weight (2011)]
VCG of weights	0.270 m above main deck 2.970 m ABL
Probable GM	0.95 – 1.05 m
Main deck	2.700 m ABL
Lower deck	0.730 m ABL (fish hold) 1.970 m below main deck
L_{OA}	13.94 m
L_{BP}	12.60 m
B_M	4.980 m
D_M	2.370 m
d_{DWL}	2.139 m
Δ_{DESIGN}	42.16 tonnes
Midships	0.130 m fwd of frame 14
Aft marks	Rudder centreline (AP)
Fwd marks	1.00 m draft/stem (FP)
Baseline	USK aft
ROK	0.867 m over L_{BP}
ROK to midships	0.452 m
Shell plating	6 mm (throughout)
Personnel VCG	1.00 m above deck – standing 0.30 m above seat – seated 0.40 m above deck – if kneeling

2. Lightweight Survey

2.1 Total Items Off

Date: 29/4/11		Vessel: FTV Riveresco		Vert. Datum: Baseline (USK)		Horiz. Datum: Midships FWD of Midships (-ve) AFT of Midships (+ve)	
Items to Remove		Mass (Tonnes)	VCG Rel. B.L. (Metres)	Vert. Mom. About B.L. (Tonne-Metres)	LCG Rel. Midships (Metres)	Long. Mom. About MS (Tonne-Metres)	
Inclining Weights (Incl. Wood Chocks)		0.9210	2.9700	2.7354	4.3740	4.0285	
Personnel		0.7370	3.2937	2.4275	2.1540	1.5875	
Water Filled Containers (Upper)		0.0300	2.8000	0.0840	1.7000	0.0510	
(Lower)		0.0100	0.7330	0.0073	0.0000	0.0000	
Liquids Off		3.8660	2.3392	9.0432	5.2398	20.2572	
Miscellaneous		0.2815	0.4377	0.1232	-0.9222	-0.2596	
Total		5.8455		14.4206		25.6645	

2.1.1 Personnel

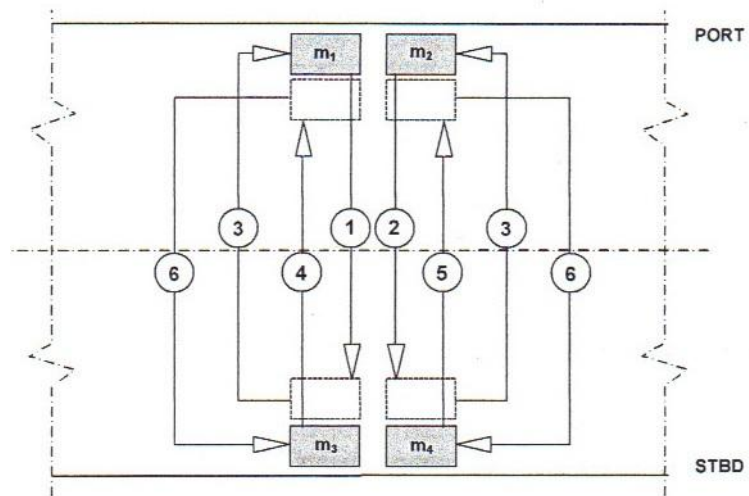
Date: 29/4/11			Vessel: FTV Riveresco		Vert. Datum: Baseline (USK)		Horiz. Datum: Midships FWD of Midships (-ve) AFT of Midships (+ve)	
Personnel			Mass (Tonnes)	VCG Rel B.L. (Metres)	Vert. Mom About B.L. (Tonne-Metres)	LCG Rel. Midships (Metres)	Long. Mom. About MS (Tonne-Metres)	
Supervisor		Paul	0.082	3.70	0.3034	0	0.0000	
Students	1	Mark	0.084	3.70	0.3108	2	0.1680	
	2	Maniu	0.095	3.70	0.3515	1.7	0.1615	
	3	Steven	0.086	1.73	0.1488	0	0.0000	
	4	Lachlan	0.103	3.70	0.3811	1.7	0.1751	
	5	Harold	0.066	1.73	0.1142	0	0.0000	
	6	James	0.075	3.70	0.2775	4.9	0.3675	
	7	Moose	0.070	3.70	0.2590	4.9	0.3430	
	8	Sam	0.076	3.70	0.2812	4.9	0.3724	
Total			0.737	-	2.4275	-	1.5875	

2.1.2 Liquid Items Off

Date: 29/4/11 Vessel: FTV Riveresco				Vert. Datum: Baseline (USK)		Horiz. Datum: Midships FWD of Midships (-ve) AFT of Midships (+ve)		
Tank	Volume (m ³)	% Filling (%)	Mass (Tonnes)	VCG Rel B.L (Metres)	Vert. Mom About B.L. (Tonne-Metres)	LCG Rel. Midships (Metres)	Long. Mom. About MS (Tonne-Metres)	FSM (Tonne-metres)
Port F.O.	0.775	36	0.650	1.806	1.1739	3.194	2.0761	0.0664
Stbd F.O.	0.700	32	0.590	1.779	1.0496	3.189	1.8815	0.0647
Port F.W.	1.313	100	1.313	2.597	3.4099	6.207	8.1498	0.0000
Stbd F.W.	1.313	100	1.313	2.597	3.4099	6.207	8.1498	0.0000
Liquids Off	4.101	-	3.866	-	9.0432	-	20.2572	0.1310

3. Inclining Weights

3.1 Arrangement/Movement of Inclining Weights



3.2 Moments of Inclining Weights

Weight Group	Weight Moved (m) Tonnes	Distance Moved (gg ₁) Metres	Moment (m gg ₁) Tonne-Metres	Total Moment $\Sigma(m gg_1)$ Tonne-Metres
1	0.23	3.52	0.8096	0.8096
2	0.23	3.39	0.7797	0.7797
3	0.23	3.50	0.8050	0.8050
4	0.23	3.40	0.7820	0.7820

5. Calculations

5.1 Draft Readings

Draft Marks		Reading (metres)	Correction For ROK (metres)	Mean (metres)
Fwd		1.095	0.867	1.962
MidShips		1.659	0.000	1.659
Aft	Port:	2.310	0.000	2.260
	Stbd:	2.205	0.000	

5.2 Calculation of Displacement @ Inclining and correction for density

$\Delta = 42.534$ tonnes at density (ρ) of 1.025 t/m^3

$$\Delta = \nabla \rho$$

where ∇ is the volumetric displacement

$$42.534 = \nabla \times 1.025$$

$$\nabla = 41.497$$

at a density (ρ) of 1.0175 t/m^3 the mass displacement is:

$$\Delta_{1.0175} = 41.497 \times 1.0175$$

$$\Delta_{1.0175} = 42.22 \text{ tonnes}$$

5.3 Calculation of GM @ Inclining

$$G_F M = \frac{m g g_1 l}{\Delta a}$$

Upper Pendulum: $\frac{m g g_1}{a \text{ mean}} = 0.0220$ and $l_U = 1878 \text{ mm}$

$$G_F M = \frac{0.0220 \times 1878}{42.22}$$

$$= 0.9786$$

Lower Pendulum: $\frac{m g g_1}{a \text{ mean}} = 0.0259$ and $l_L = 1644 \text{ mm}$

$$G_F M = \frac{0.0259 \times 1644}{42.22}$$

$$= 1.009$$

Therefore: Mean $G_F M = \frac{0.9786+1.009}{2} = 0.9938$ metres

5.3.1 Correction for Free Surface Effect

$$FSC = \frac{\sum FSM}{\Delta}$$

$$= \frac{0.1310}{42.22}$$

$$= 0.003 \text{ metres}$$

GM @ inclining: GM = mean $G_F M$ + FSC
 = 1.009 + 0.003
 = 1.012 metres

5.4 Calculation of KG @ Inclining

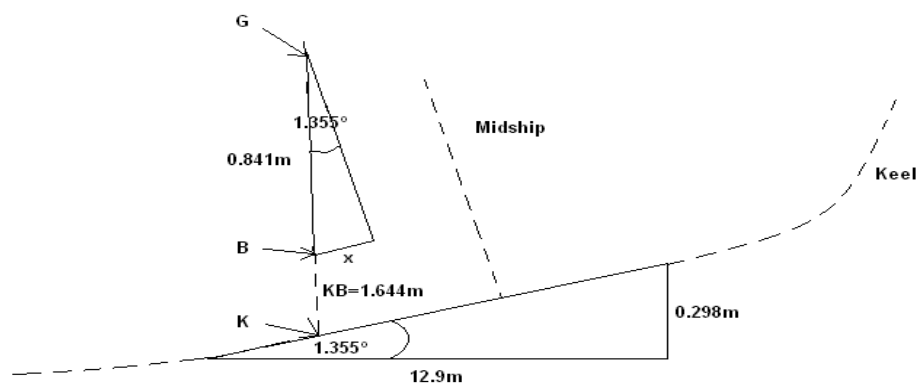
$$KG = KM - GM$$

where KM = 3.497 metres above baseline

$$= 3.497 - 1.012$$

$$= 2.485 \text{ metres above the baseline}$$

5.5 LCG for lightship



$$LCG = LCB - x$$

where LCB = 1.249 metres aft of midships

x = horizontal distance between LCB and LCG

$$LCG = 1.2208 \text{ metres aft of M. S.}$$

6. Lightship Summary Table

Item	Weight (tonnes)	VCG Rel. BL (metres)	V. Mom. About BL (Tonne-metres)	LCG Rel. MS (metres)	L. Mom. About MS (Tonne-metres)
Vessel as Inclined	42.2200	2.485	104.9167	1.2208	51.542
Items to Remove	-5.8455		-14.4206		-25.665
Items to Add	0.0000		0.0000		0.000
Lightship	36.3745	2.4879	90.4961	0.7114	25.877

Lightship Weight = 36.3745 tonnes

LCG at Inclining = 0.7114 metres aft of midships

Discussion/Recommendations

The inclining experiment was conducted as accurately as possible, and as a result the data that was obtained from the calculations seemed to be fairly accurate.

Values that calculated came out to that of expected. From the probable GM of 0.95 to 1.05 m that our calculated average GM_F of 1.012 metres was in the specified region.

The results although seemingly accurate may have been negatively affected by small amounts of error on inclining day. There were many small factors which could have altered these results. The most obvious in which could have been due to the recording of the measurements of the pendulum. This would have been most likely been due to human error as the deflection of the pendulum could not always be accurately measured by line of sight. This was due to the fact that the pendulum was exposed to the conditions such as light winds and also the wake of a passing vessel.

The recording of the draft from the draft marks would have also not have been perfectly accurate as a result of large increments between the draft values. This would have again affected any calculations that included the aft and forward draft values. Such as calculating the LCG values and change in trim.

The mooring arrangements were meant to be as straight off the centre of the vessel so that the vessel was able to heel/incline during the test. The stern ropes were not completely centered which would have again affected the results. But what would have really made a large difference is that the ropes were tight which would have again had a negative effect on the results. This would have minimized the amount of heeling and trimming that the vessel could undertake and as a result restricted the inclination of the pendulum.

The masses had to be in the exact same position each time. Using markers they were kept quite accurate but due to pipes on the sides of the vessel it made it hard to get the drums constantly aligned.

The weights of everyone were taken before boarding the vessel. These were kept accurate as a scale was brought along on the day. But when the inclining measurements were taken the weights of the persons on board were not accurately measured to be the correct distance from the vessels mid-ship. This would have affected the calculation of the LCG vales of the personnel. As an average was taken the value could well be accurate however some error may have occurred.

Many objects needed to be removed so the lightship weight could be determined and any unnecessary weights had to be removed. These weights were taken by eyesight and as a result they were not accurate. This would have affected the calculation of the lightship displacement and ultimately made the final value slightly inaccurate. Even more so, various smaller items on the vessel were not removed including that of books and tools, which again may have made a slight difference to the inclination values (almost negligible).

We agree that equal contribution to the report was undertaken by all.

Name

Signature

Sam Davey

James Fisher

Maniu Dawanincura