LoadmatePlus

On-board loading software

Tutorial 4 – Grain

Ship Design
solutions

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Introduction

LoadmatePlus is intended as an on-board stability, strength and load planning program. The program complies with the IMO rules, and the primary purpose is to ensure that the vessel is safe to sail with respect to stability and longitudinal strength.

This is the forth in the series of tutorials to demonstrate **LoadmatePlus** and its various features. This one demonstrates the special features for handling grain in bulk. Other tutorials will explore the other advanced or specialised features.

In these tutorials, use will be made of a series of demonstration vessels that are included with the special demonstration installation, which can be obtained by filling out a contact form on our website: http://shipdesign.co.uk/contact/ .

The demo ships may borrow features from similar ships, but are not direct copies of any actual ship. No proprietary information has been used and the hull forms, in particular, have been specially designed in house.

To follow this tutorial, it is assumed that the user has downloaded and run the demonstration setup program.

Grain regulations

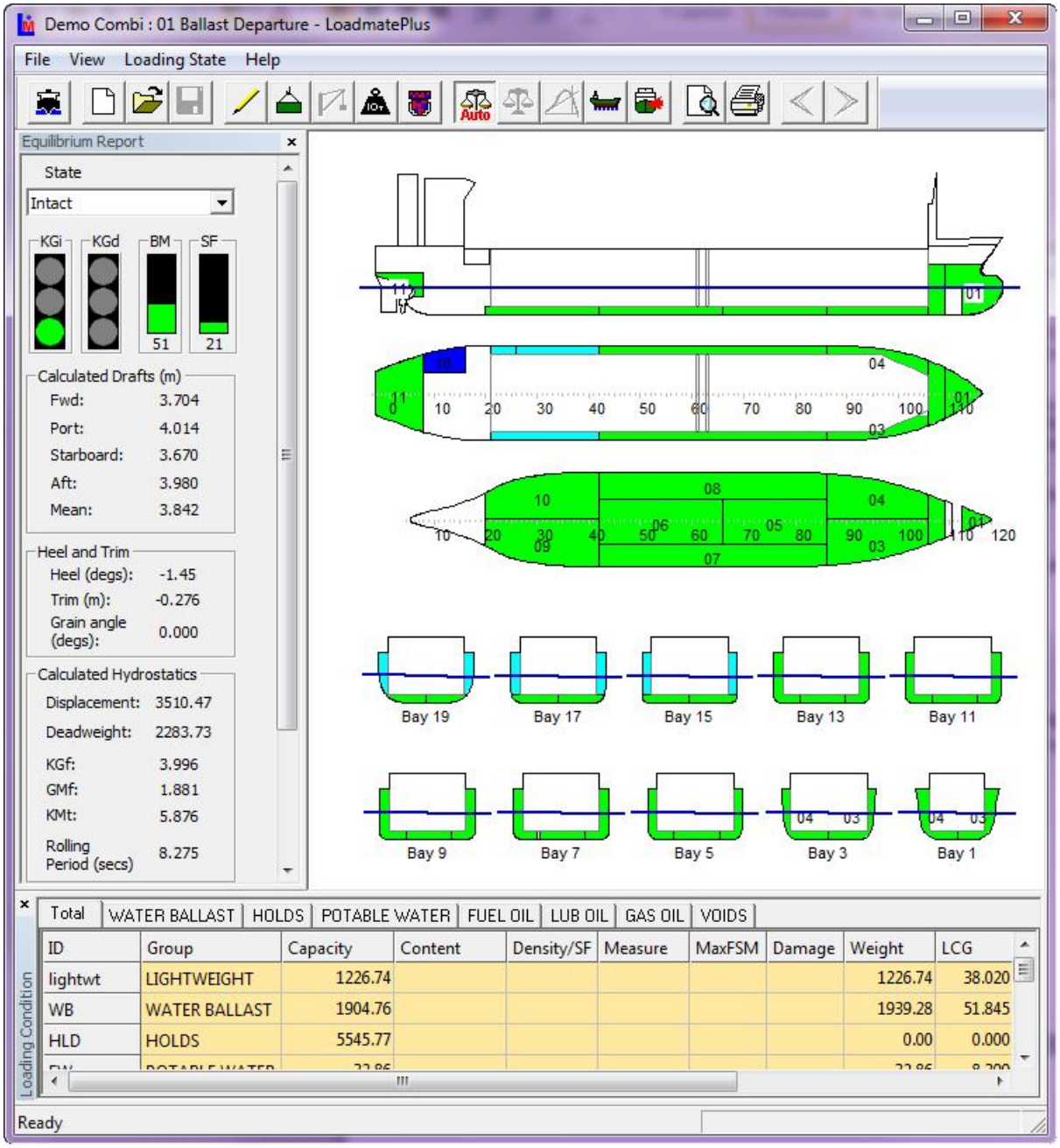
When grain is carried in the holds, the program will check the stability of the vessel according to the *International Code for the Safe Carriage of Grain in Bulk.* Specifically, after taking account of the heeling moments due to grain shift:

1. the angle of heel due to the shift of grain shall not be greater than 12° or in the case of ships constructed on or after 1 January 1994 the angle at which the deck edge is immersed, whichever is the lesser;
2. in the statical stability diagram, the net or residual area between the heeling arm curve and the righting arm curve up to the angle of heel of maximum difference between the ordinates of the two curves, or 40° or the angle of flooding (θ_1), whichever is the least, shall in all conditions of loading be not less than 0.075 metre-radians; and
3. the initial metacentric height, after correction for the free surface effects of liquids in tanks, shall be not less than 0.30 m.

It is important to note that the Grain regulations will only be invoked, if the cargo type is set to GRAIN.

Setting up a Grain Loading Condition

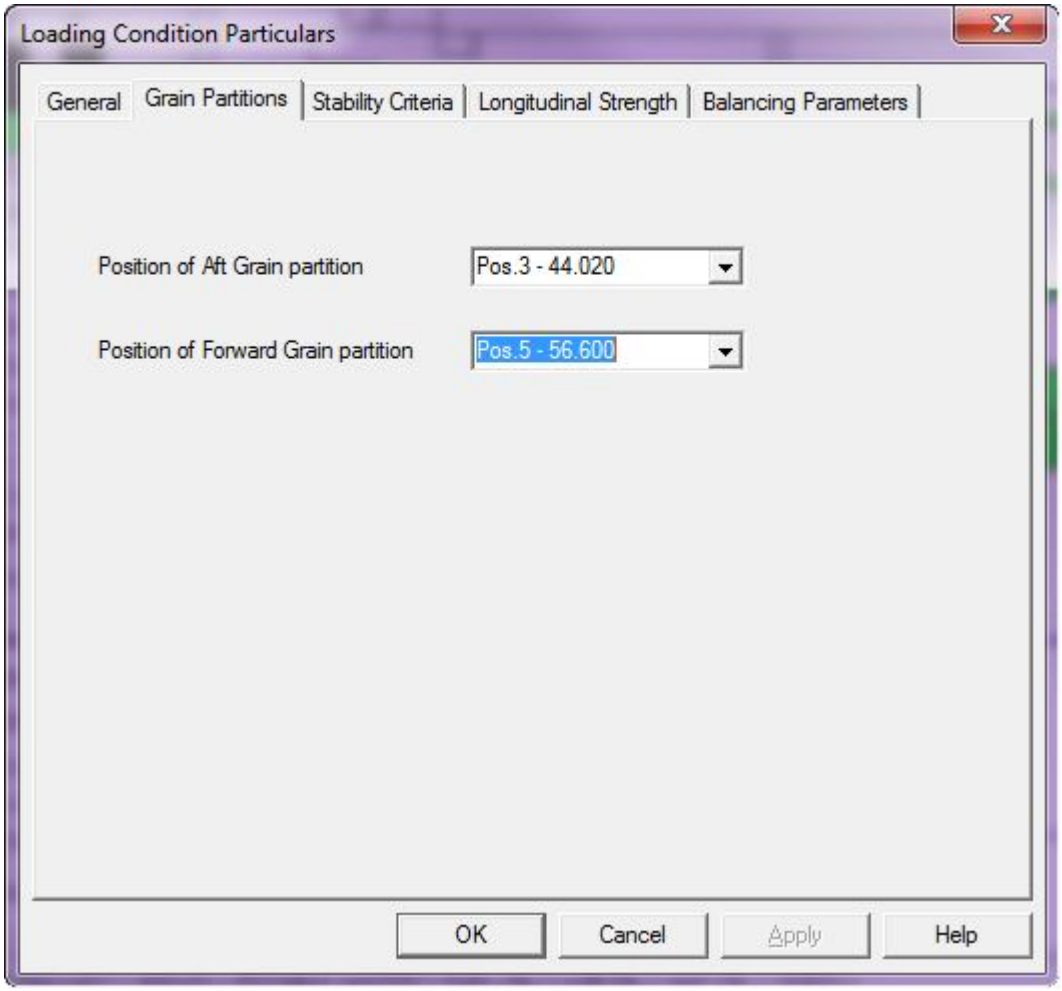
We will use the Demo Combi example to illustrate how to set up a grain loading condition. Loading the Demo Combi and selecting the Ballast Departure condition as a basis, results in the following screen shot:



Partition bulkheads

A feature of this vessel and other similar types of small multi-purpose cargo ships, is that it is fitted with two portable partition bulkheads, which can be located at a number of pre-designated positions in the hold, thus sub-dividing the main hold into three parts. The partition bulkheads are currently in their stowed positions, so the first task is to move them to form suitably sized sub-divisions of the main hull, as follows:

Open the Loading Condition particulars dialog and select the Grain Partitions page.

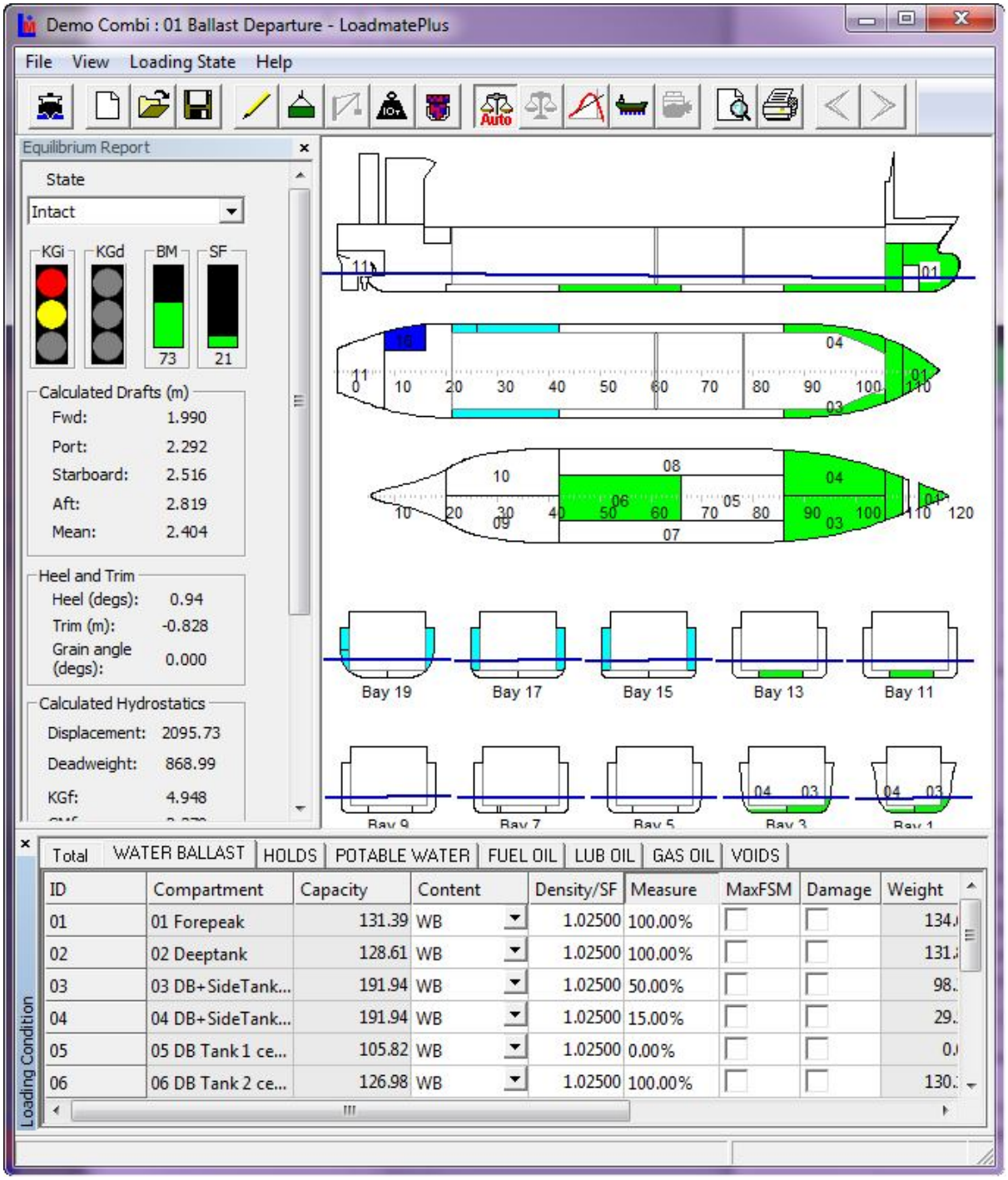


The aft bulkhead is ok, but we will move the forward bulkhead from position 4 to 5, by selecting it in the drop-down list.

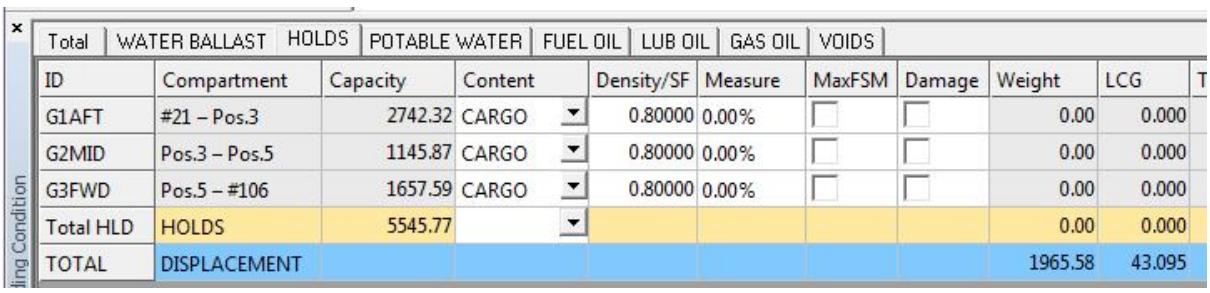
Note that the partition bulkheads may be removed from the ship by selecting "NO partition onboard" from the list of positions, in which case, the first hold will extend the full length and the others will be set to a capacity of zero.

Whilst in this dialog, it is usually a good idea to set the name of the loading condition to, for example, "Grain departure".

We will also empty some of the ballast tanks, which results in the following arrangement:

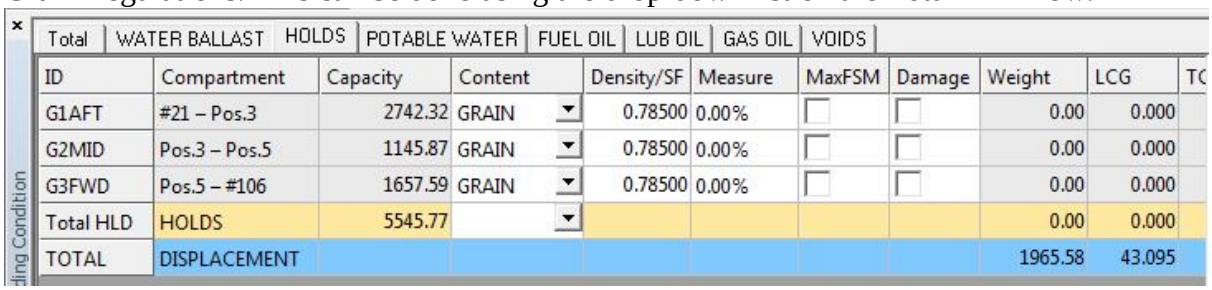


Note the new positions of the partition bulkheads. Repositioning the bulkheads causes the program to recalculate the volumes and centres of the three holds, as shown.



Setting the GRAIN cargo type

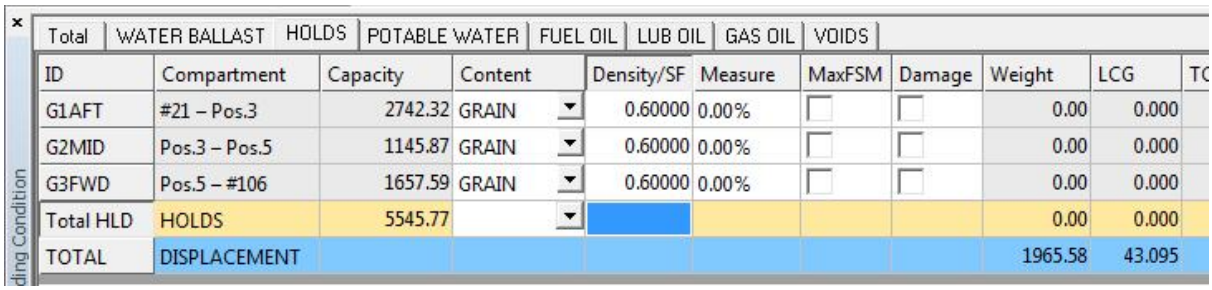
As noted above, the cargo type must be changes to GRAIN to trigger checking against the Grain Regulations. This can be done using the drop-down list on the Total HLD row.



Total	WATER BALLAST	HOLDS	POTABLE WATER	FUEL OIL	LUB OIL	GAS OIL	VOIDS

ID	Compartment	Capacity	Content	Density/SF	Measure	MaxFSM	Damage	Weight	LCG	TC
G1AFT	#21 – Pos.3	2742.32	GRAIN	0.78500	0.00%	☐	☐	0.00	0.000	
G2MID	Pos.3 – Pos.5	1145.87	GRAIN	0.78500	0.00%	☐	☐	0.00	0.000	
G3FWD	Pos.5 – #106	1657.59	GRAIN	0.78500	0.00%	☐	☐	0.00	0.000	
Total HLD	HOLDS	5545.77						0.00	0.000	
TOTAL	DISPLACEMENT							1965.58	43.095	

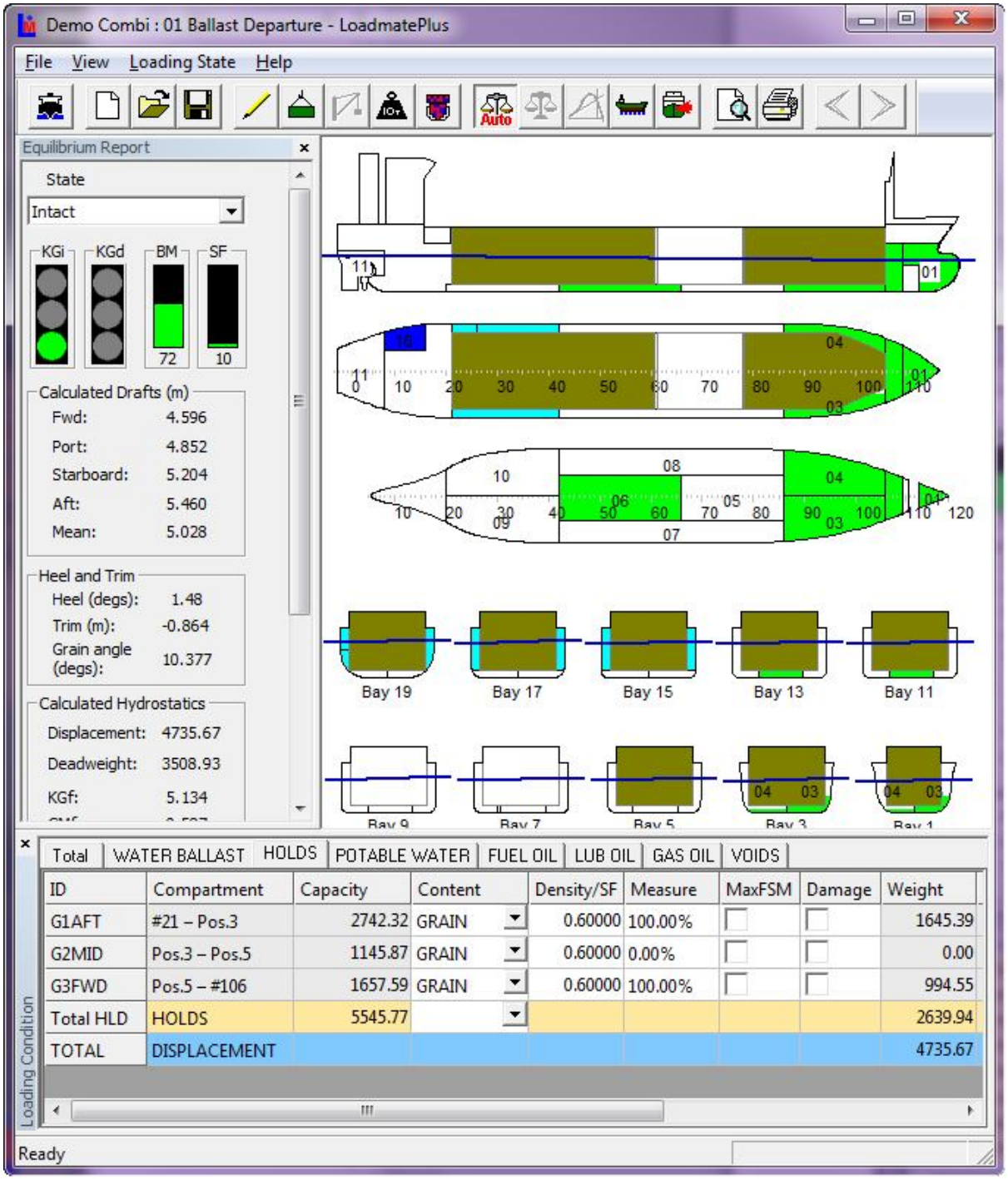
The cargo density is set to the default of 0.785 tonnes/cu.m, This needs to be changed for our loading condition to 0.6 tonnes/cu.m and this can be done by typing the value in the Density column of the grid.



Total	WATER BALLAST	HOLDS	POTABLE WATER	FUEL OIL	LUB OIL	GAS OIL	VOIDS

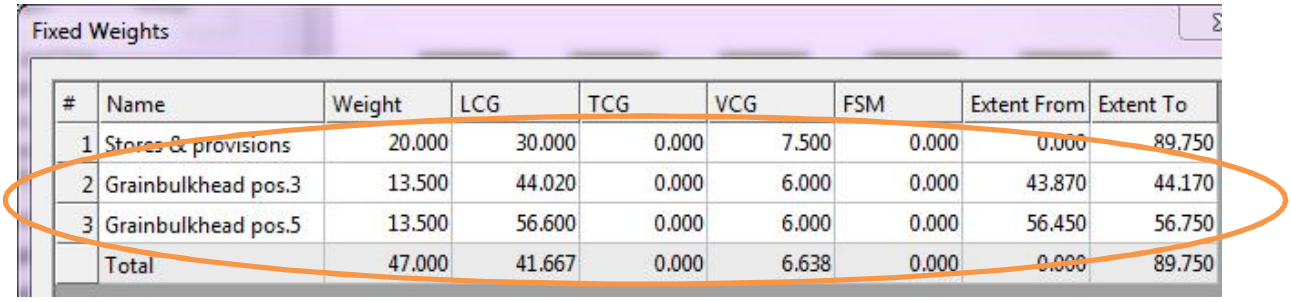
ID	Compartment	Capacity	Content	Density/SF	Measure	MaxFSM	Damage	Weight	LCG	TC
G1AFT	#21 – Pos.3	2742.32	GRAIN	0.60000	0.00%	☐	☐	0.00	0.000	
G2MID	Pos.3 – Pos.5	1145.87	GRAIN	0.60000	0.00%	☐	☐	0.00	0.000	
G3FWD	Pos.5 – #106	1657.59	GRAIN	0.60000	0.00%	☐	☐	0.00	0.000	
Total HLD	HOLDS	5545.77						0.00	0.000	
TOTAL	DISPLACEMENT							1965.58	43.095	

Finally we specify how much grain is in each hold. G1AFT and G3FWD, are filled, but G2MID is left empty. Here is the final grain condition:



Weight and position of the partition bulkheads

The weight and centre of gravity of the partition bulkheads, are automatically added the FIXED weights, as shown.



Fixed Weights

#	Name	Weight	LCG	TCG	VCG	FSM	Extent From	Extent To
1	Stores & provisions	20.000	30.000	0.000	7.500	0.000	0.000	89.750
2	Grainbulkhead pos.3	13.500	44.020	0.000	6.000	0.000	43.870	44.170
3	Grainbulkhead pos.5	13.500	56.600	0.000	6.000	0.000	56.450	56.750
	Total	47.000	41.667	0.000	6.638	0.000	0.000	89.750

Grain Heeling moments

Grain heeling moments for each hold are interpolated from the grain calibration tables. These values are displayed in the Loading Condition report as follows:

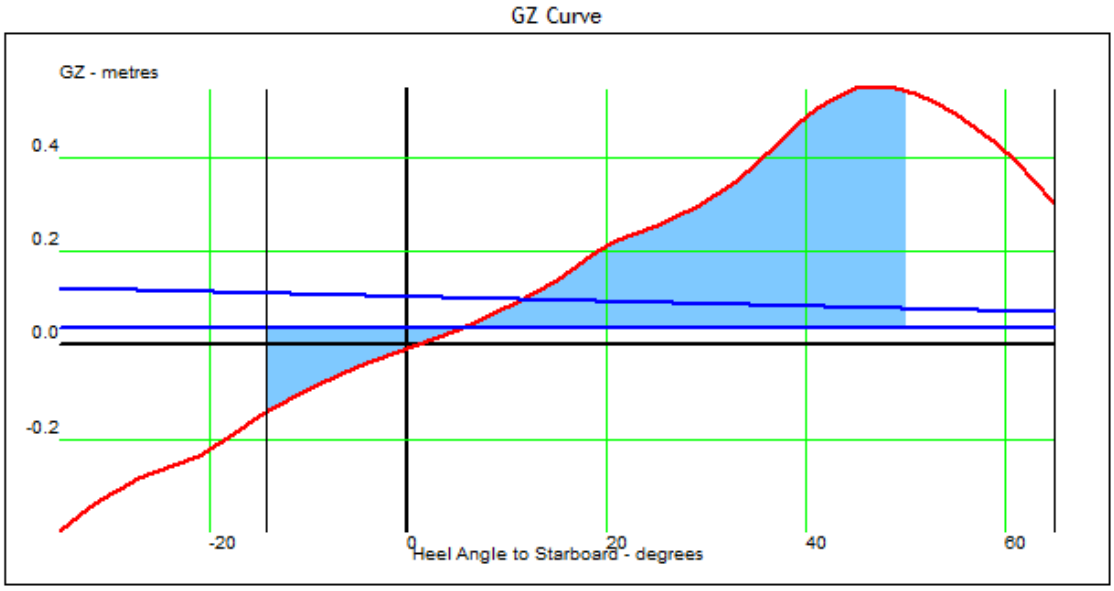
Demo Combi *Grain departure*

Intact

Name	*Content*	*% Full*	*Volume* (m3)	*Density* (t/m3)	*Weight* (tonnes)	*LCG* (metres)	*TCG* (metres)	*VCG* (metres)	*FSM* (t*m)	*GRM* (t*m)
WATER BALLAST										
01 Forepeak	WB	100.0	131.4	1.025	134.7	82.70	-0.00	4.35	0.0	0.0
02 Deeptank	WB	100.0	128.6	1.025	131.8	78.31	0.00	3.88	0.0	0.0
03 DB+SideTank 1 SB	WB	50.0	96.0	1.025	98.4	69.20	3.01	0.74	15.4	0.0
04 DB+SideTank 1 PS	WB	15.0	28.8	1.025	29.5	68.92	-2.45	0.22	188.5	0.0
Total WATER BALLAST					394.4	76.84	0.57	2.98	203.9	0.0
HOLDS										
#21 - Pos.3	GRAIN	100.0	2742.3	0.600	1645.4	29.17	0.00	5.28	0.0	307.6
Pos.5 - #106	GRAIN	100.0	1657.6	0.600	994.6	66.00	0.00	5.28	0.0	167.7
Total HOLDS					2639.9	43.05	0.00	5.28	0.0	475.3
POTABLE WATER										
16 Potable water	FW	100.0	32.9	1.000	32.9	8.40	-4.30	4.93	0.0	0.0
Total POTABLE WATER					32.9	8.40	-4.30	4.93	0.0	0.0
FUEL OIL										
12 Sidetank 3 PS	FO	98.0	90.0	0.990	89.1	24.14	-6.14	4.15	2.1	0.0
13 Sidetank 3 SB	FO	98.0	112.3	0.990	111.2	22.60	6.13	4.26	2.8	0.0
14 Sidetank 4 low (Dtk 1)	FO	98.0	7.4	0.990	7.3	16.53	-5.97	2.97	0.5	0.0
14 Sidetank 4 upper (Dtk 2)	FO	98.0	14.9	0.990	14.7	16.28	-6.14	5.58	0.7	0.0
34 HFO Daytank	FO	98.0	11.9	0.990	11.8	13.55	-6.14	5.89	1.5	0.0
36 HFO Settlingtank	FO	98.0	18.0	0.990	17.9	10.82	-6.06	5.96	2.5	0.0
Total FUEL OIL					252.0	21.34	-0.72	4.46	10.1	0.0
35 Lub.oil storage M.E.	LO	98.0	7.3	0.920	6.7	12.17	6.49	5.94	0.3	0.0
40 Dirty oil tank II	LO	98.0	3.4	0.920	3.1	14.26	-4.13	1.85	1.8	0.0
Total					9.8	12.83	3.12	4.64	2.2	0.0
33 Gasoil Daytank 1	GO	98.0	5.1	0.860	4.4	13.90	6.52	5.90	0.2	0.0
41 Gasoil Daytank 2	GO	98.0	8.2	0.860	7.1	8.02	5.92	6.16	0.8	0.0
Total					11.5	10.27	6.15	6.06	1.0	0.0
Total					0.0	0.00	0.00	0.00	0.0	0.0
FIXED WEIGHTS										
Stores & provisions					20.0	30.00	0.00	7.50	0.0	0.0
Grainbulkhead pos.3					13.5	44.02	0.00	6.00	0.0	0.0
Grainbulkhead pos.5					13.5	56.60	0.00	6.00	0.0	0.0
Total FIXED WEIGHTS					47.0	41.67	0.00	6.64	0.0	0.0
DEADWEIGHT					3387.5	44.81	0.00	4.97	217.2	475.3
Lightweight					1226.7	38.02	0.00	5.91	0.0	0.0
DISPLACEMENT					4614.3	43.01	0.00	5.22	217.2	475.3

Grain Stability results

Demo Combi *Grain departure*



The righting lever (GZ) diagram show both the wind heeling moment and the heeling moment due to grain shift.

IMO Intact Stability Rules + Grain

ID	*Name*	*Value*	*Units*	*Limit*	*OK?*
1	Area to 30 degs	0.0760	m-rads	> 0.0550	Yes
2	Area 30 to 40 degs	0.0682	m-rads	> 0.0300	Yes
3	Area to 40 degs	0.1442	m-rads	> 0.0900	Yes
4	Initial GM	0.454	m	> 0.150	Yes
5	Max GZ at angle > 30degs	0.555	m	> 0.200	Yes
6	Position of Max GZ	48.62	degs	> 25.00	Yes
7	GZ at 30degs	0.306	m	> 0.200	Yes
8	0.8 x deck immersion angle	52.00	degs		
9	Wind steady state angle	5.16	degs	< 16.00	Yes
10	Wind gust angle	7.12	degs		
11	Rollback angle	19.39	degs		
12	Heeling moment arm	0.035	m		
13	Area A	0.0339	m-rads		
14	Area B	0.1953	m-rads		
15	AreaB / AreaA	5.7629		> 1.0000	Yes
16	Initial GM	0.455	m	> 0.300	Yes
17	Grain angle	11.56	degs	< 12.00	Yes
18	Grain area	0.0912	m-rads	> 0.0750	Yes

This table in the report shows the three additional grain criteria.

Conclusion

This tutorial has explored the grain loading feature of **LoadmatePlus**.

Please contact us if you have comments or queries, preferably using the contact form on our website: http://shipdesign.co.uk/contact which can also be used to request a demonstration version of **LoadmatePlus** including a selection of demo vessels.