

Report on the capsizing of fv O.13 - MORGENSTER on November 7th, 2018

Part II - Stability calculations



Picture : Van Elverdinghe - VLIZ photo gallery

STABILITY CALCULATIONS FV O.13 - MORGENSTER

Before fv O.13-MORGENSTER capsized, it was reported that there was a difference in the position of portside and starboard side derrick and that a huge amount of water came on deck when the vessel was in moderate seas with a 7bft wind.

Could these conditions make this fishing vessel, where no major shortcomings were detected, sink?

The engineering bureau that calculated the latest stability conditions of the vessel was consulted and it was determined that more detailed calculations regarding the amount of water on deck were necessary to make any conclusions.

SARC Maritime Software and Services made the necessary calculations related to the possible amount of water on deck and to the stability of the vessel in the given conditions.

The full study including all stability calculations can be found on the next pages.

The study showed that the vessel was very likely to capsize and that the effects of water on deck and the influence of waves to the stability of fishing vessels need further investigation.



O-13 “MORGENSTER”

STABILITY DURING THE CAPSIZING OF THE VESSEL



Specification: Report on the stability of the Fishing Vessel O-13 “Morgenster”

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REVISION INFORMATION

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GENERAL INTRODUCTION

This booklet is prepared to investigate the stability of the fishing vessel O-13 “Morgenster” during the accident November 7th 2018, where the vessel capsized. This report is based on the following documents:

Synopsis O.13 Morgenster (see end of this document)

Schets Morgenster (see end of this document)

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1. ABBREVIATIONS AND UNITS

1.1. COORDINATE SYSTEM

Longitudinal distances are related to the aft perpendicular

Vertical distances are related to the baseline

Transverse distances are related to the centerline

Starboard is positive

Portside is negative

A negative trim is a trim to the stern

A positive trim is to the bow

1.2. STABILITY / HYDROSTATIC PARTICULARS

Loa	Length overall	[m]
Lpp	Length between perpendiculars	[m]
APP	Aft perpendicular	[m]
FPP	Forward perpendicular	[m]
Draft	Draft from base at 1/2 Lpp	[m]
Mean draft	Mean draft from base at 1/2 Lpp, from baseline	[m]
Draft aft	Draft from base at aft perpendicular App	[m]
Draft fore	Draft from base at fore perpendicular Fpp	[m]
Draft above B.o.K.	Mean draft from bottom of keel(plate)	[m]
T Draft mark	Draft at draft mark, measured from bottom of keel	[m]
Displacement	Displacement of the vessel	[ton]
FSM	Free surface moment	[tonm]
VCG	Vertical centre of gravity from baseline	[m]
VCG'	VCG corrected for free surface effects	[m]
LCG	Longitudinal centre of gravity from App	[m]
TCG	Transverse centre of gravity from centreline	[m]
LCF	Longitudinal centre of floatation of the waterline	[m]
LCB	Longitudinal centre of buoyancy	[m]
Volume	Moulded volume displacement without appendages	[m ³]
Volume & appendages	Moulded volume displacement including appendages	[m ³]
Mom change trim	Moment to change trim 1 cm	[tonm]
Ton/cm immersion	Immersion of the vessel per cm	[ton/cm]
KM transverse	Vertical distance between the transverse metacentre and the baseline	[m]
GM solid	Metacentre height, not corrected for free surface effects	[m]
GG' correction	Free surface correction	[m]
G'M	Metacentre height, corrected for free surface effects	[m]
KG	See VCG	[m]
KG'	See VCG'	[m]
Trim	Total trim on perpendiculars, a negative trim is a trim by the stern	[m]
G'N sin	Righting lever at angle of inclination	[m]
KN sin	Horizontal distance between CoB and CL	[m]

1.3. TANK CAPACITIES

Volume	Volume of liquid in tank	[m ³]
Weight	Weight of liquid in tank	[ton]
S.W.	Specific weight of liquid in tank	[ton/m ³]
VCG	Vertical centre of gravity of liquid in tank	[m]
LCG	Longitudinal centre of gravity of liquid in tank	[m]
TCG	Transverse centre of gravity from of liquid in tank	[m]
FSM	Free surface moment of liquid in tank	[Tonm]
Mom. In. T	Transverse moment of inertia of tank cross section	[m ⁴]

1.4. FLOODABILITY AND DAMAGE STABILITY

Intact displacement	Displacement in intact condition	[ton]
Intact VCG	VCG from baseline in intact condition, corrected for FSM	[m]
Intact LCG	LCG for intact condition from App	[m]
Intact TCG	TCG for intact condition from centreline	[m]
Wintact	Weight in compartment in intact condition	[ton]
SWintact	Specific weight in compartment in intact condition	[ton/m ³]
Gdamag	Weight in compartment in damaged condition	[ton]
SWdam	Specific weight in compartment in damaged condition	[ton/m ³]
NG sin	Righting lever in damaged condition	[m]
Area	Area under the righting lever curve	[mrad]

1.5. METRIC CONVERSIONS

1.5.1. METRIC EQUIVALENTS

The use of SI (Systeme Internationale) units is strongly recommended.

<i>MULTIPLY BY</i>	<i>TO CONVERT FROM</i>	<i>TO OBTAIN</i>	<i>-</i>
0.03937	MILLIMETRES	INCHES	25.4
0.3937	CENTIMETRES	INCHES	2.54
3.2808	METRES	FEET	0.3048
2.2046	KILOGRAMMES	POUNDS	0.45359
0.000984	KILOGRAMMES	TONS (2240 lbs.)	1016.047
0.9842	TONNES(1000 KG)	TONS (2240 lbs.)	1.016
2.4998	TONNES PER CENTIMETRE (OF IMMERSION)	TONNES PER INCH (OF IMMERSION)	0.4
8.2014	MOMENT TO CHANGE TRIM ONE CENTIMETRE (TONNES METRE UNITS)	MOMENT TO CHANGE TRIM ONE INCH (FOOT TON UNITS)	0.122
187.9767	METRE RADIANS	FEET DEGREES	0.0053
-	<i>TO OBTAIN</i>	<i>TO CONVERT FROM</i>	<i>MULTIPLY BY ABOVE</i>

1.5.2. RELATION BETWEEN WEIGHT AND VOLUME

10 m.m. cubed	=	1 cubic centimetre
1 cubic centimetre of freshwater (S.G. 1.0)	=	1 gramme
1000 cubic centimetre of freshwater (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
1 cubic metre	=	35.316 cubic feet

2. GENERAL

2.1. SHIP DATA

Name vessel	O-13 "Morgenster"	-
Type vessel	Fishing Vessel Beam trawler	-
Length o.a.	23.94	m
Breadth mld.	6.00	m
Depth moulded	3.00	m
Call Sign	OPAM	-
Vessel-ID	1922	-

2.2. STABILITY CALCULATIONS

2.2.1. STABILITY CRITERIA “DIENSTNORM 15”

Calculations are made checking with the applicable criteria and fashion as used in the latest stability booklet dated from 1995 which was approved by the “Zeevaartinspectie Oostende Belgium”. This means static stability without taking into account dynamic effects as wind, waves etc. Wind has been taken into account in the original calculations (see end of this report) but as separate criteria. The other criteria are calculated without the influence of wind.

The calculations in this report are made in the same fashion but with the effect of:

- Water on deck
- Wind from the side
- Stability in waves

Taken into account too, to show their influence on the stability. Please note that the static approach of the intact stability is commonly used and prescribed according to the rules. The values of the criteria are taken so, that these dynamical effects can be withstand in normal conditions.

Stability criteria, as used in the 1995 stability booklet, that are checked against in this report (with a simplified explanation on the meaning):

Minimum metacentric height [G'M] [0.50m]

- The metacentric height is amount of initial static stability. A high G'M means a short roll period and high stability at small angles of heel.

Maximum GZ at 30 degrees or more [0.24m]

- The GZ is the righting arm, in this case the maximum righting which occurs at an angle of 30 degrees or more.

Top of the GZ curve at least at 25 degrees

- The top of the GZ curve indicates where the maximum righting lever occurs.

Area under the GZ curve up to 30 degrees [0.66 mrad]

- The “amount” of stability up to 30 degrees of heel.

Area under the GZ curve up to 40 degrees [0.108 mrad]

- The “amount” of stability up to 40 degrees of heel.

Area under the GZ curve between 30 to 40 degrees [0.036 mrad]

- The “amount” of stability between 30 and 40 degrees of heel.

Maximum statical angle of inclination under the influence of wind [40degrees]

- The statical angle under the influence of a steady wind pressure of 75kg/m² up to a height of 5m above the waterline and a steady wind pressure of 125kg/m² above 5m above the waterline with an inclination of 10 degrees leeward.

So, there is a measure for initial stability and stability at larger angles of heel. At some point the GZ-curve will intersect the base line. At this point of “vanishing stability, the stability is zero and becomes negative after that point. Hence, the ship capsizes. The range of positive stability is the range in degrees between the static angle and the point of vanishing stability.

2.2.2. WATER ON DECK

In the original stability calculations there is no criteria to take into account water on deck. Since water on deck is reported, the calculations in this report were made with water on deck. Therefore we modelled the deck including the bulwark and water can pour in and out via the top of the bulwark. Also it is possible to start with an amount of water on deck. In these calculations we add water as described in the synopsis.

2.2.3. LIGHT SHIP WEIGHT.

In 1995 an inclining test was performed to obtain the light ship weight and centres of gravity. This Light ship weight is used in this report. However this inclining test was performed over 20 years ago. If the vessel did not had a rebuild or modifications this light ship weight can be used. If the vessel had some modifications than it is questionable if this weight is still accurate. Since there is no information on modifications we assume the light ship weight is still the same as in 1995.

2.3. SUMMARY OF STABILITY CALCULATIONS

2.3.1. INITIAL CONDITION OF THE VESSEL:

"The derricks were topped. PS derrick between 20-35 degrees with fishing gear in the water. SB fishing gear attached to the ship's side."

For the stability calculations, PS derrick is calculated both 20 degrees as 35 degrees.

Initial condition, derrick at 20 degrees:

Vessel does not comply with the stability criteria and has a static angle of heel of almost 3 degrees but still a positive range of stability of 45 degrees. No real danger.

Initial condition, derrick at 35 degrees:

Vessel does not completely comply with the stability criteria and has a static angle of heel of 6 degrees but still a positive range of stability of 42 degrees. No real danger.

2.3.2. FASE 2:

"The vessel came into a wave trough (possibly caused by a passing ship) and a "huge" amount of water came on board on PS."

Assumed amount of water on deck: 5m³

PS derrick at 20 degrees:

Stability values are about 50% of the required values. The static angle of inclination with 5m³ water on deck is 10 degrees and the positive range of stability of almost 42 degrees. The vessel still should not capsize, but the stability decreased significantly.

PS derrick at 35 degrees:

Stability values are about the 1/3rd of the required values. The static angle of inclination with 5m³ water on deck is 13 degrees and a positive range of stability of 35 degrees. The vessel still should not capsize, but the stability decreased significantly.

2.3.3. FASE 3:

"A second wave of water came on board and reportedly the PS side disappeared under water."

Assumed amount of water on deck: 10m³

PS derrick at 20 degrees:

Stability values have decreased about 1/2 to 2/3 of the required values. The static angle of inclination with 10m³ water on deck is 16 degrees and the positive range of stability of 32 degrees. The vessel still, should not capsize, but the stability decreased significantly

PS derrick at 35 degrees:

Stability values are about 1/4th to 1/2nd of the required values. The static angle of inclination with 10m³ water on deck is almost 19 degrees and a positive range of stability of almost 28.5 degrees. The vessel still should not capsize, but the stability decreased significantly. The static angle of 19 degrees is in accordance with the reportedly portside side of the deck disappearing under water. The top of the bulwark is then at the water level.

2.3.4. FASE 4:

“The vessel rolled to SB and back to PS, further than the last time. Water entered the wheelhouse and the SB derrick went over to PS and the vessel capsized.”

PS derrick at 20 degrees:

Stability values have decreased about 1/4th to 1/3rd of the required values. The static angle of inclination with 15m³ water on deck is 19 degrees and the positive range of stability of 29 degrees. The difference between 10 or 15m³ water on deck is not a major difference. This is because the water will pour out/in at a certain angle and from that moment the situation of water on deck is the same

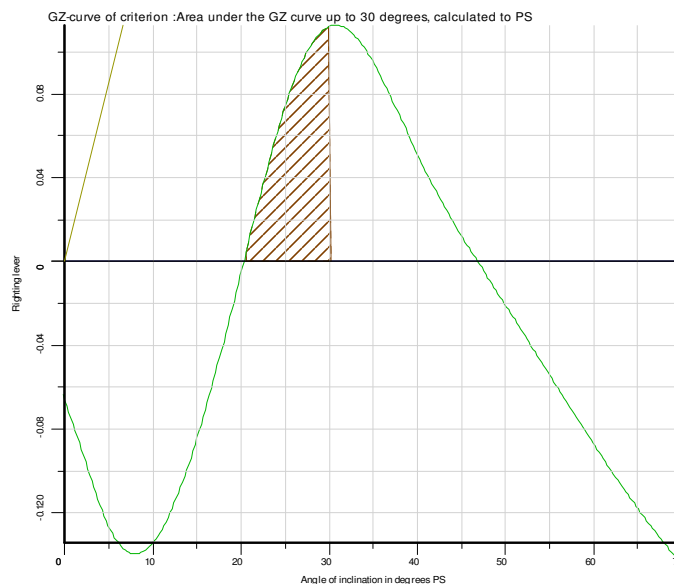
The vessel still, should not capsize, but the stability decreased significantly

PS derrick at 35 degrees:

Stability values are about 1/4th of the required values. The static angle of inclination with 15m³ water on deck is more than 20 degrees and a positive range of stability of only 26.5 degrees. Within this small positive range, the “amount” of stability is also much reduced which means that the vessel has less energy left to get upright (to its equilibrium at 19 degrees)

It is reported that water entered the wheelhouse. In Calm water, water can enter the wheelhouse at an angle of heel of approximately 58 degrees. If we look at the GZ Curve we see that the angle of vanishing stability is 49 degrees. In theory the vessel the vessel would already have capsized when water enters the wheelhouse. Obviously the water was not calm and the steepness of the waves will probably helped water entering the wheelhouse at a smaller angle.

The vessel was rolling due to the waves and the effect of water on deck which also moves from side to side which means it has a momentum rolling from SB to PS. When we look at the GZ curve in this situation:



You can see that the (negative) area from 0 degrees to the static angle of equilibrium (20 degrees) is about the size of the positive (hatched) area from the static angle to the angle of vanishing stability. The area represents the “energy” of the vessel to get back to its equilibrium. This energy also causes the vessel to roll further than the static angle of equilibrium. Therefore the vessel does not calmly laying at its static angle of 20 degrees, but will roll further. Apparently until the wheelhouse gets flooded and the vessels capsizes.

2.4. OTHER CONSIDERATIONS

What not has been taken into account since there is no information about it, but not unlikely, is the influence of:

- Dynamical forces due to rolling of the vessel
- Shifting of loose weights such as fish and ice in the hold
- Water entering the vessel
- wind
- Stability in waves

2.4.1. DYNAMICAL FORCES

As it seems the vessel got an angle of inclination when it got into a wave trough which caused water to get on deck. By this water on deck and following waves the vessel started rolling and got an even larger angle of heel and more water on deck etc. Normally these forces can be withstand by having a sufficient positive range of stability. Due to the water on deck the vessel got a large angle of heel which reduces the range of positive stability

2.4.2. SHIFTING OF LOOSE WEIGHTS

Though the report does not state anything about shifting of loose weights, it is not unlikely that weights started to shift with these (unexpected?) motions of the vessel. The effect of this can be huge. For instance, if 2 tons of the fish in the hold (of the 13 tons in total) shift 1.5 meter, it will cause an extra degree of heel. If all the boxes would shift for half a meter it would cause 1,5 degree of heel.

2.4.3. WATER ENTERING THE VESSEL

The report does not state about water entering/flooding the vessel or whether the hatch cover of the fish hold was open or closed. To give an idea on the effect of water entering the vessel, If 500 litres of sea water could have entered the fish hold it would give the vessel an extra 2 degrees of heel.

2.4.4. EFFECT OF WIND

As mentioned earlier, the stability values do not include external forces. In the synopsis it is mentioned that there was a strong south south westerly wind, 7 beaufort. When we apply this steady windpressure (7 beaufort is a wind pressure of 20kg/m²) we get the following results:

Condition : Step 4, PS derrick at 35 degrees, 15 m³ water on deck

Verification against the stability criteria "Dienstnorm 15 with the effect of wind"

Calculated to PS	Criterion	Value
----- Vessel in still water without wind		
Minimum metacentric height G'M	0.500	1.087 meter
Maximum GZ at 30 degrees or more	0.240	0.115 meter
Top of the GZ curve at least at	25.000	28.722 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.015 mrad
Area under the GZ curve up to 40 degrees	0.108	0.031 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.016 mrad
----- in wind (20kg/m ²)		
Maximum GZ at 30 degrees or more	0.240	0.087 meter
Top of the GZ curve at least at	25.000	28.722 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.010 mrad
Area under the GZ curve up to 40 degrees	0.108	0.021 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.011 mrad

Compared with the stability results without wind there is a reduction of about 1/3rd.

2.4.5. STABILITY IN WAVES

Many articles are written about stability in waves. Unfortunately the most of them are not considering beam waves. Also for our software, we can place the vessel on a wave top, trough or in between. These waves are longitudinal waves so they are not representing the waves nor the stability values during the accident. They do however show the differences in stability that can occur between still water and being in a wave trough, top or in between. In this example a wave amplitude of 1 m has been used and the wave length is twice the vessels length. Vessel at wave top means that de wave top is half the length of the vessel, vessel in wave trough means that the trough is at half the length of the vessel.

This wave data is not representing the actual waves during the accident. This calculation is only to show the effect of waves on the stability.

Loading condition Fase 4, PS derrick at 35 degrees, 15 m³ water on deck, cargo liquid

Calculated to PS	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.977 meter
Maximum GZ at 30 degrees or more	0.200	0.113 meter
Top of the GZ curve at least at	25.000	30.701 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.012 mrad
Area under the GZ curve up to 40 degrees	0.090	0.027 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.016 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.027 meter
Top of the GZ curve at least at	25.000	26.513 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.005 mrad
Area under the GZ curve up to 40 degrees	0.090	0.005 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.001 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.102 meter
Top of the GZ curve at least at	25.000	27.898 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.015 mrad
Area under the GZ curve up to 40 degrees	0.090	0.027 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.012 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.176 meter
Top of the GZ curve at least at	25.000	29.125 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.026 mrad
Area under the GZ curve up to 40 degrees	0.090	0.052 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.026 mrad

It is clearly shown that the stability of the vessel is strongly reduced when it is at a wave top. In this example with longitudinal waves there is almost no positive stability anymore. And that is static stability without any external forces such as wind. In this situation only a small external forces (such as wind, waves etc) would have been enough do let the vessel capsize.

When we combine the water on deck, wind and waves we can see that stability is almost zero.

2.4.6. CONCLUSION

So, starting with an initial static angle of heel, combined with the situation of water on deck, wind and waves and thus motions, the vessel is very likely to capsize. Though it has to be said that there are some parameters of which we don't exactly know their exact influence such as the amount of water and the exact wave data and its influence on the ship.

2.4.7. RECOMMENDATION

Further study on the effects on water on deck and behavior in waves is recommended

3. STABILITY CALCULATIONS [FULL OUTPUT]

3.1. CONDITION : INITIAL CONDITION DURING ACCIDENT, PS DERRICK AT 20 DEGREES

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	0.0	1.0250	0.000	-	-	-	-
SUBTOTAL	-	-	0.000	4.000	8.817	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
TOTAL	-	-	170.287	2.561	9.723	-0.034	1.971

Hydrostatics

Volume	165.142 m ³
LCF	9.060 m
Mom. change trim	1.745 tonm/cm
Ton/cm immersion	1.159 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.293 m
Draft aft (App)	2.428 m
Draft fore (Fpp)	2.159 m
Trim	-0.268 m

Transverse stability

KM transverse	3.171 m		
VCG	2.561 m		
GM solid	0.610 m		
GG' correction	0.012 m		
G'M liquid	0.598 m	VCG'	2.573 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:09

Condition : Condition during accident, PS derrick at 20 degrees

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.377	10.501
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.048
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.147	-0.083	-0.011	0.067	0.135
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	0.000	0.000	0.000	0.000	0.000
Level of water on deck	0.000	0.000	0.000	0.000	0.000
Draft ship	2.222	2.252	2.272	2.285	2.291
Trim ship	-0.166	-0.205	-0.235	-0.256	-0.266
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	1.347	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	0.229	0.176	0.123	0.070	0.018
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:09

Condition : Condition during accident, PS derrick at 20 degrees

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	0.000	0.000	0.000	0.000	0.000
Level of water on deck	0.000	0.000	0.000	0.000	0.000
Draft ship	2.293	2.293	2.293	2.291	2.285
Trim ship	-0.268	-0.268	-0.268	-0.266	-0.256
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	0.111	0.000	0.111	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	-0.013	0.034	0.055	0.086	0.137
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	0.000	0.000	0.000	10.501	21.377
Level of water on deck	0.000	0.000	0.000	2.279	2.323
Draft ship	2.272	2.252	2.222	2.279	2.323
Trim ship	-0.235	-0.205	-0.166	-0.247	-0.270
Displacement	170.287	170.287	170.287	181.048	192.196
NKsin(ϕ) closed ship	0.822	1.088	1.347	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	3.854	4.026
NKsin(ϕ) water & cargo	0.000	0.000	0.000	3.854	4.026
Righting lever (GZ)	0.188	0.240	0.290	0.191	0.114
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.026	-0.055	-0.128
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:09

Condition : Condition during accident, PS derrick at 20 degrees

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.127	0.147	0.081
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.180	0.083	0.081
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.216	0.011	0.081
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.220	-0.067	0.076
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.155	-0.135	0.060
25.00	PS	2.222	-0.166	-1.347	-1.087	-0.031	-0.229	0.044
20.00	PS	2.252	-0.205	-1.088	-0.880	-0.032	-0.176	0.025
15.00	PS	2.272	-0.235	-0.822	-0.666	-0.033	-0.123	0.013
10.00	PS	2.285	-0.256	-0.550	-0.447	-0.033	-0.070	0.004
5.00	PS	2.291	-0.266	-0.276	-0.224	-0.034	-0.018	0.000
2.00	PS	2.293	-0.268	-0.111	-0.090	-0.034	0.013	0.000
0.00		2.293	-0.268	0.000	0.000	-0.034	0.034	0.001
2.00	SB	2.293	-0.268	0.111	0.090	-0.034	0.055	0.003
5.00	SB	2.291	-0.266	0.276	0.224	-0.034	0.086	0.006
10.00	SB	2.285	-0.256	0.550	0.447	-0.033	0.137	0.016
15.00	SB	2.272	-0.235	0.822	0.666	-0.033	0.188	0.030
20.00	SB	2.252	-0.205	1.088	0.880	-0.032	0.240	0.049
25.00	SB	2.222	-0.166	1.347	1.087	-0.031	0.290	0.072
30.00	SB	2.279	-0.247	1.602	1.312	0.099	0.191	0.094
40.00	SB	2.323	-0.270	2.014	1.727	0.174	0.114	0.118
50.00	SB	2.379	-0.232	2.298	2.093	0.179	0.026	0.131
60.00	SB	2.442	-0.010	2.497	2.400	0.153	-0.055	0.132
70.00	SB	2.535	0.492	2.618	2.637	0.108	-0.128	0.132

Statical angle of inclination is 3.25 degrees to portside

Contour :

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:09

Condition : Condition during accident, PS derrick at 20 degrees

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.293 m
Trim	-0.268 m
Statical angle of inclination	3.25 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.135 meter
Top of the GZ curve at least at	25.000	24.522 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.060 mrad
Area under the GZ curve up to 40 degrees	0.108	0.076 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.015 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	18.561 degrees PS
----- Additional information		
Range of positive stability	0.000	45.528 degrees
Angle of vanishing stability	0.000	48.782 degrees PS
Roll Period acc Irish authorities	0.000	5.430 sec
Roll Period acc IS 2008	1.000	6.580 sec

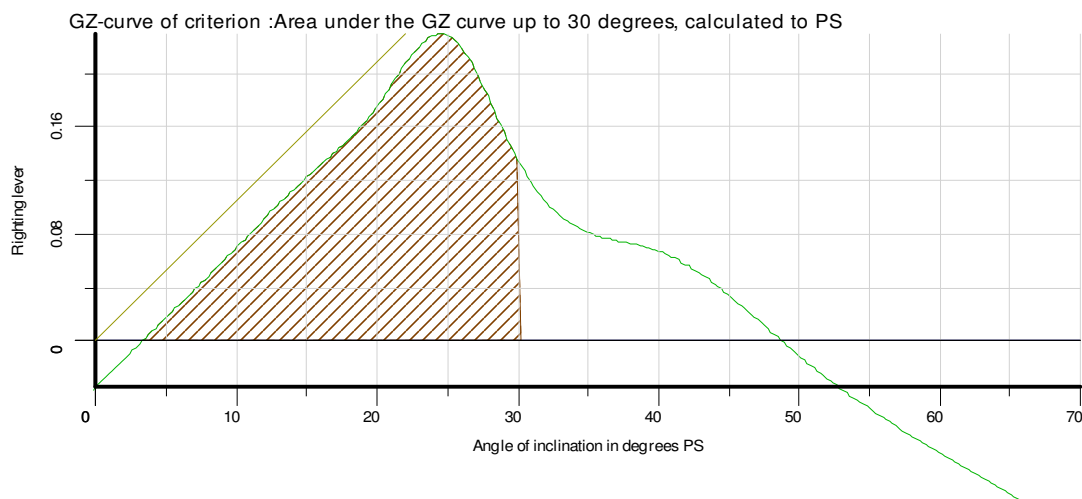
Calculated to SB

	Criterion	Value
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.191 meter
Top of the GZ curve at least at	25.000	24.442 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.093 mrad
Area under the GZ curve up to 40 degrees	0.108	0.117 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.024 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	11.942 degrees SB
----- Additional information		
Range of positive stability	0.000	56.106 degrees
Angle of vanishing stability	0.000	52.852 degrees SB
Roll Period acc Irish authorities	0.000	5.430 sec
Roll Period acc IS 2008	1.000	6.580 sec

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

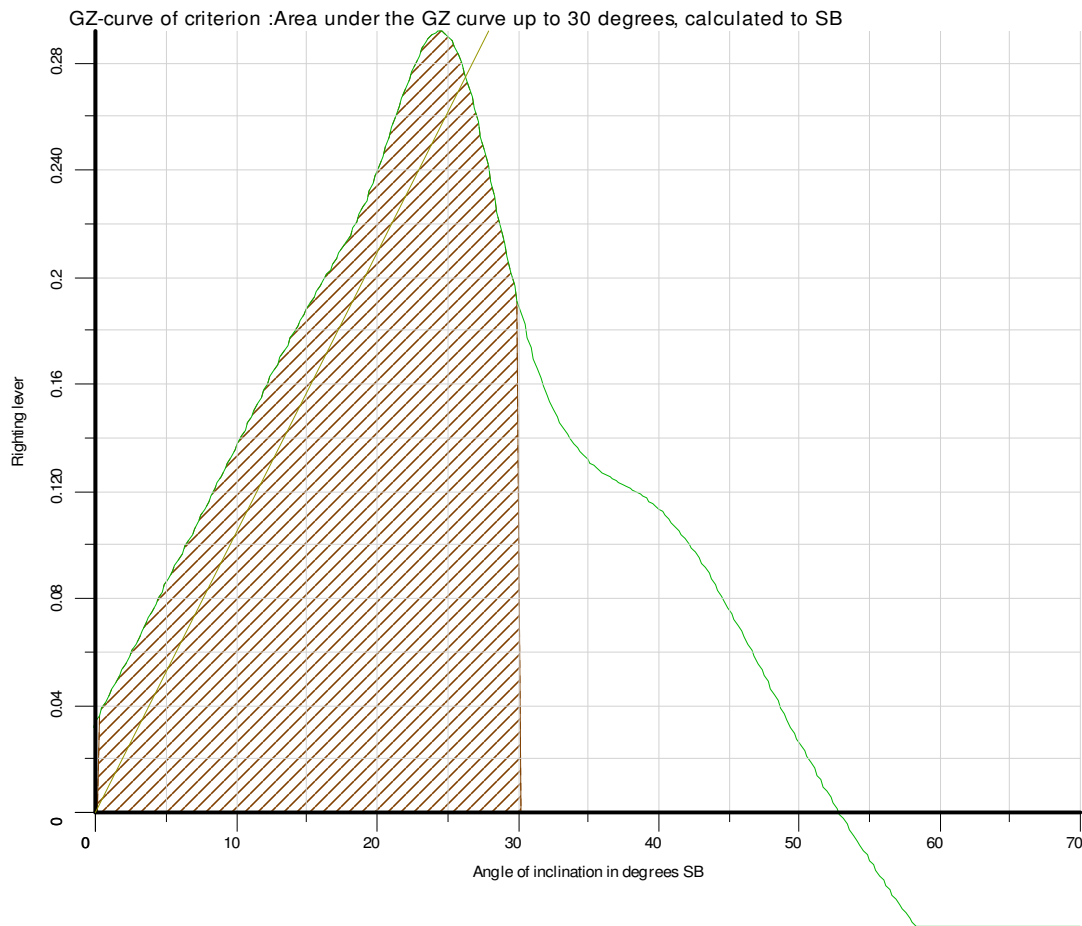
Loading condition DOES NOT comply with the stated criteria.



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:09

Condition : Condition during accident, PS derrick at 20 degrees



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:09

Condition : Condition during accident, PS derrick at 20 degrees

Water on deck, Cross section at 7.000 m

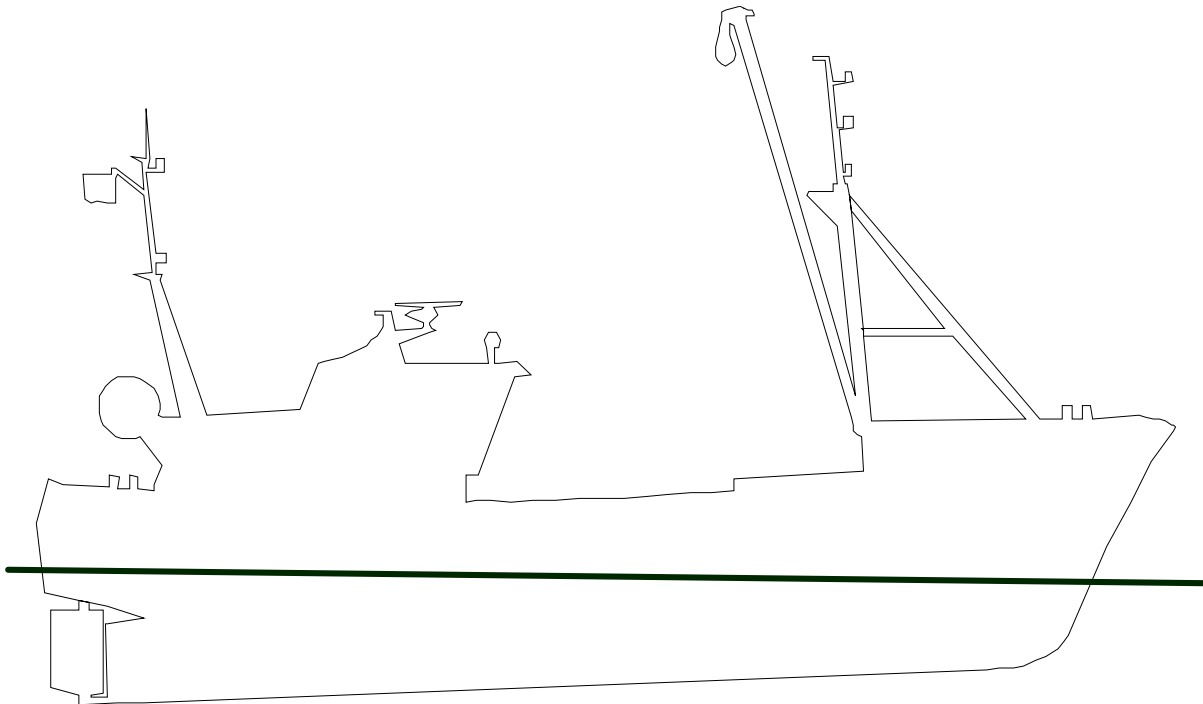
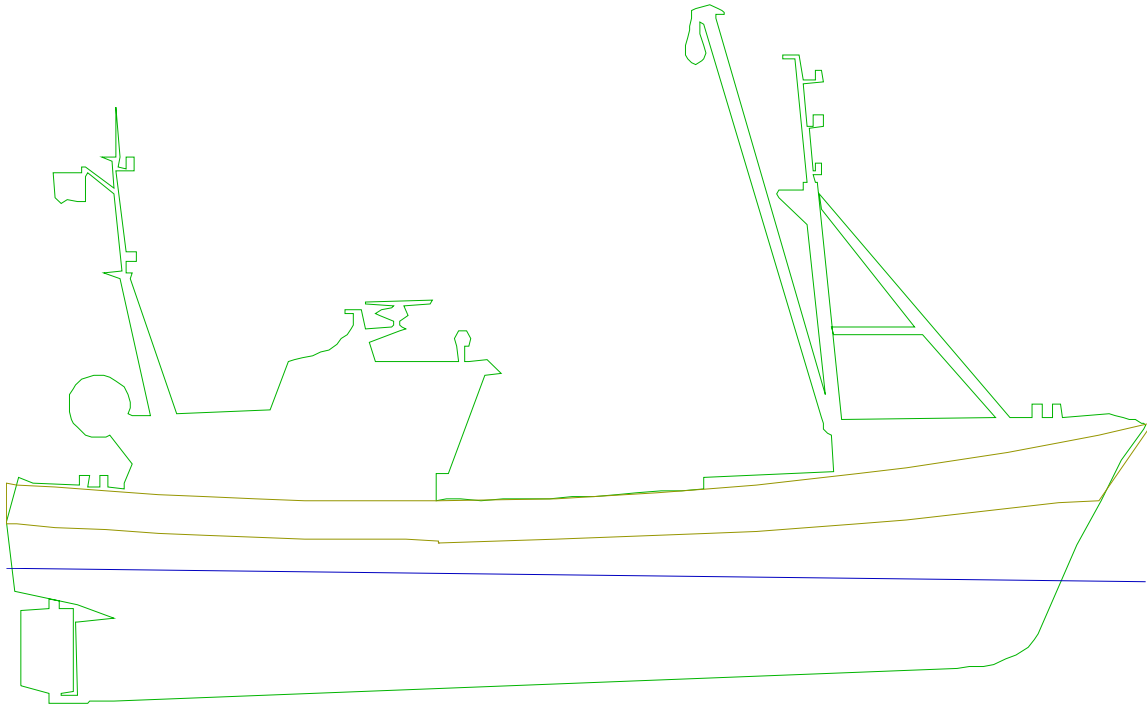


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:09

Condition : Condition during accident, PS derrick at 20 degrees

Longitudinal view, no heel, cargo liquid



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

3.2. CONDITION : INITIAL CONDITION DURING ACCIDENT, PS DERRICK AT 35 DEGREES

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	0.0	1.0250	0.000	-	-	-	-
SUBTOTAL	-	-	0.000	4.000	8.817	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
TOTAL	-	-	170.287	2.544	9.723	-0.066	1.971

Hydrostatics

Volume	165.142 m ³
LCF	9.060 m
Mom. change trim	1.745 tonm/cm
Ton/cm immersion	1.159 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.293 m
Draft aft (App)	2.428 m
Draft fore (Fpp)	2.159 m
Trim	-0.268 m

Transverse stability

KM transverse	3.166 m	
VCG	2.544 m	
GM solid	0.622 m	
GG' correction	0.012 m	
G'M liquid	0.610 m	VCG' 2.556 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:10

Condition : Condition during accident, PS derrick at 35 degrees

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.377	10.501
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.048
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.143	-0.085	-0.018	0.055	0.117
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	0.000	0.000	0.000	0.000	0.000
Level of water on deck	0.000	0.000	0.000	0.000	0.000
Draft ship	2.222	2.252	2.272	2.285	2.291
Trim ship	-0.166	-0.205	-0.235	-0.256	-0.266
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	1.347	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	0.207	0.151	0.096	0.041	-0.013
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:10

Condition : Condition during accident, PS derrick at 35 degrees

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	0.000	0.000	0.000	0.000	0.000
Level of water on deck	0.000	0.000	0.000	0.000	0.000
Draft ship	2.293	2.293	2.293	2.291	2.285
Trim ship	-0.268	-0.268	-0.268	-0.266	-0.256
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	0.111	0.000	0.111	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	-0.045	0.066	0.088	0.119	0.172
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	0.000	0.000	0.000	10.501	21.377
Level of water on deck	0.000	0.000	0.000	2.279	2.323
Draft ship	2.272	2.252	2.222	2.279	2.323
Trim ship	-0.235	-0.205	-0.166	-0.247	-0.270
Displacement	170.287	170.287	170.287	181.048	192.196
NKsin(ϕ) closed ship	0.822	1.088	1.347	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	3.854	4.026
NKsin(ϕ) water & cargo	0.000	0.000	0.000	3.854	4.026
Righting lever (GZ)	0.224	0.276	0.327	0.225	0.145
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.055	-0.030	-0.106
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:10

Condition : Condition during accident, PS derrick at 35 degrees

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.136	0.143	0.066
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.194	0.085	0.066
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.234	0.018	0.066
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.242	-0.055	0.062
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.181	-0.117	0.049
25.00	PS	2.222	-0.166	-1.347	-1.080	-0.060	-0.207	0.034
20.00	PS	2.252	-0.205	-1.088	-0.874	-0.062	-0.151	0.018
15.00	PS	2.272	-0.235	-0.822	-0.661	-0.064	-0.096	0.007
10.00	PS	2.285	-0.256	-0.550	-0.444	-0.065	-0.041	0.001
5.00	PS	2.291	-0.266	-0.276	-0.223	-0.066	0.013	0.000
2.00	PS	2.293	-0.268	-0.111	-0.089	-0.066	0.045	0.002
0.00		2.293	-0.268	0.000	0.000	-0.066	0.066	0.004
2.00	SB	2.293	-0.268	0.111	0.089	-0.066	0.088	0.006
5.00	SB	2.291	-0.266	0.276	0.223	-0.066	0.119	0.012
10.00	SB	2.285	-0.256	0.550	0.444	-0.065	0.172	0.024
15.00	SB	2.272	-0.235	0.822	0.661	-0.064	0.224	0.042
20.00	SB	2.252	-0.205	1.088	0.874	-0.062	0.276	0.063
25.00	SB	2.222	-0.166	1.347	1.080	-0.060	0.327	0.090
30.00	SB	2.279	-0.247	1.602	1.304	0.073	0.225	0.115
40.00	SB	2.323	-0.270	2.014	1.717	0.152	0.145	0.145
50.00	SB	2.379	-0.232	2.298	2.082	0.162	0.055	0.163
60.00	SB	2.442	-0.010	2.497	2.388	0.139	-0.030	0.166
70.00	SB	2.535	0.492	2.618	2.625	0.099	-0.106	0.166

Statical angle of inclination is 6.18 degrees to portside

Contour :

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:10

Condition : Condition during accident, PS derrick at 35 degrees

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.293 m
Trim	-0.268 m
Statical angle of inclination	6.18 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.610 meter
Maximum GZ at 30 degrees or more	0.240	0.117 meter
Top of the GZ curve at least at	25.000	24.585 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.049 mrad
Area under the GZ curve up to 40 degrees	0.108	0.062 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.013 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	20.660 degrees PS
----- Additional information		
Range of positive stability	0.000	41.759 degrees
Angle of vanishing stability	0.000	47.935 degrees PS
Roll Period acc Irish authorities	0.000	5.377 sec
Roll Period acc IS 2008	1.000	6.516 sec

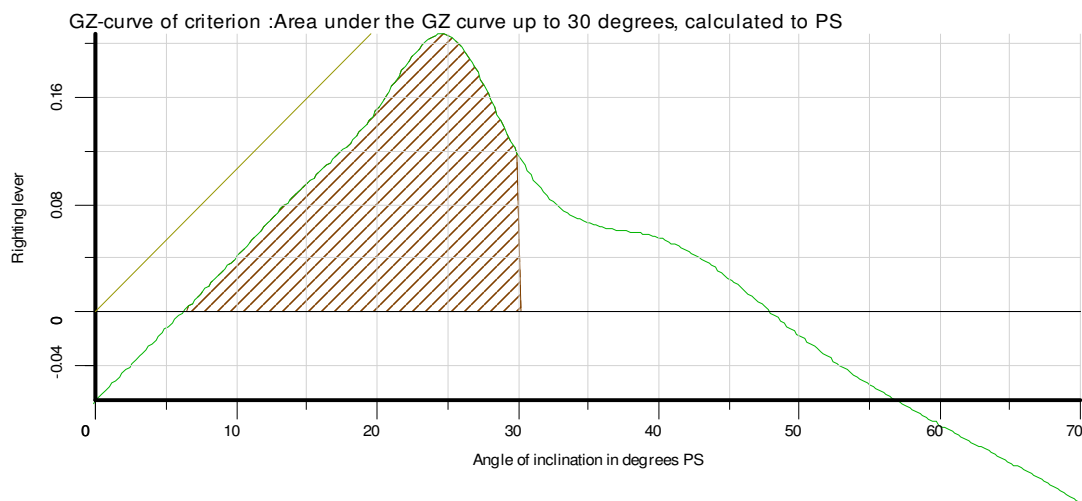
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.610 meter
Maximum GZ at 30 degrees or more	0.240	0.225 meter
Top of the GZ curve at least at	25.000	24.429 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.111 mrad
Area under the GZ curve up to 40 degrees	0.108	0.141 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.030 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	8.656 degrees SB
----- Additional information		
Range of positive stability	0.000	62.297 degrees
Angle of vanishing stability	0.000	56.120 degrees SB
Roll Period acc Irish authorities	0.000	5.377 sec
Roll Period acc IS 2008	1.000	6.516 sec

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

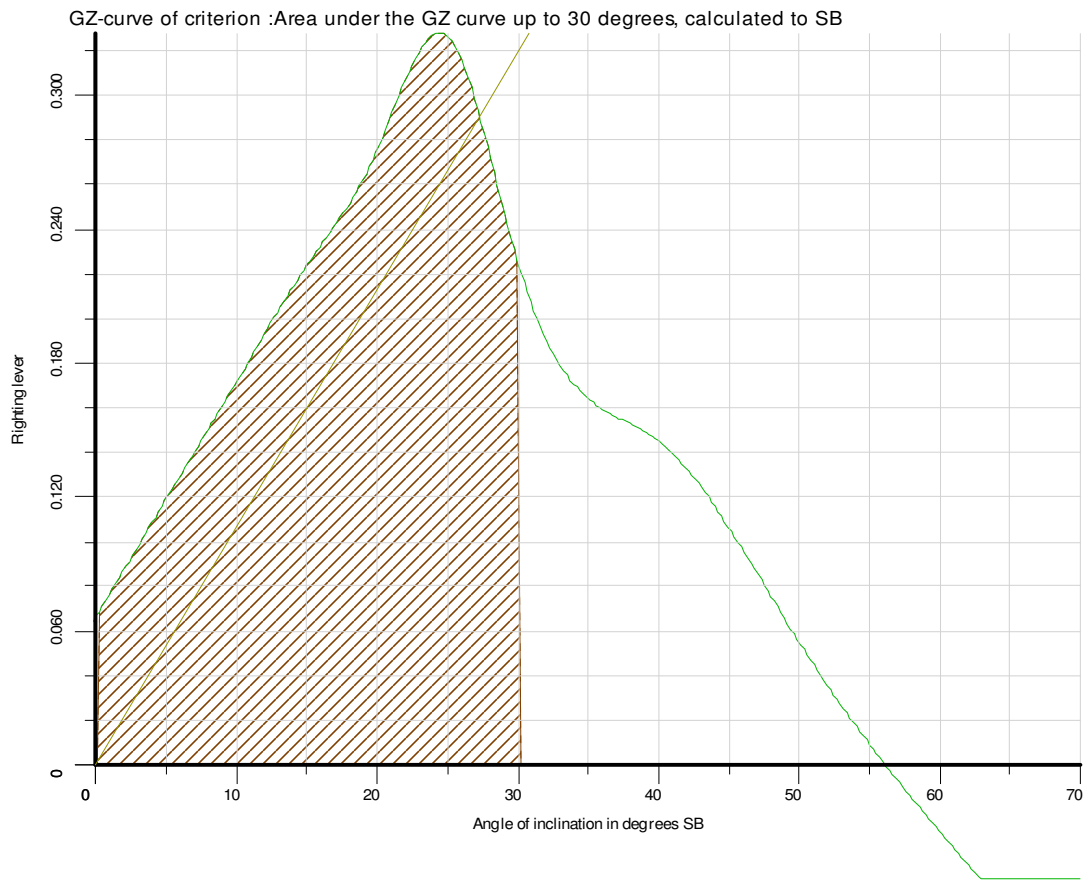
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:10

Condition : Condition during accident, PS derrick at 35 degrees



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:10

Condition : Condition during accident, PS derrick at 35 degrees

Water on deck, Cross section at 7.000 m

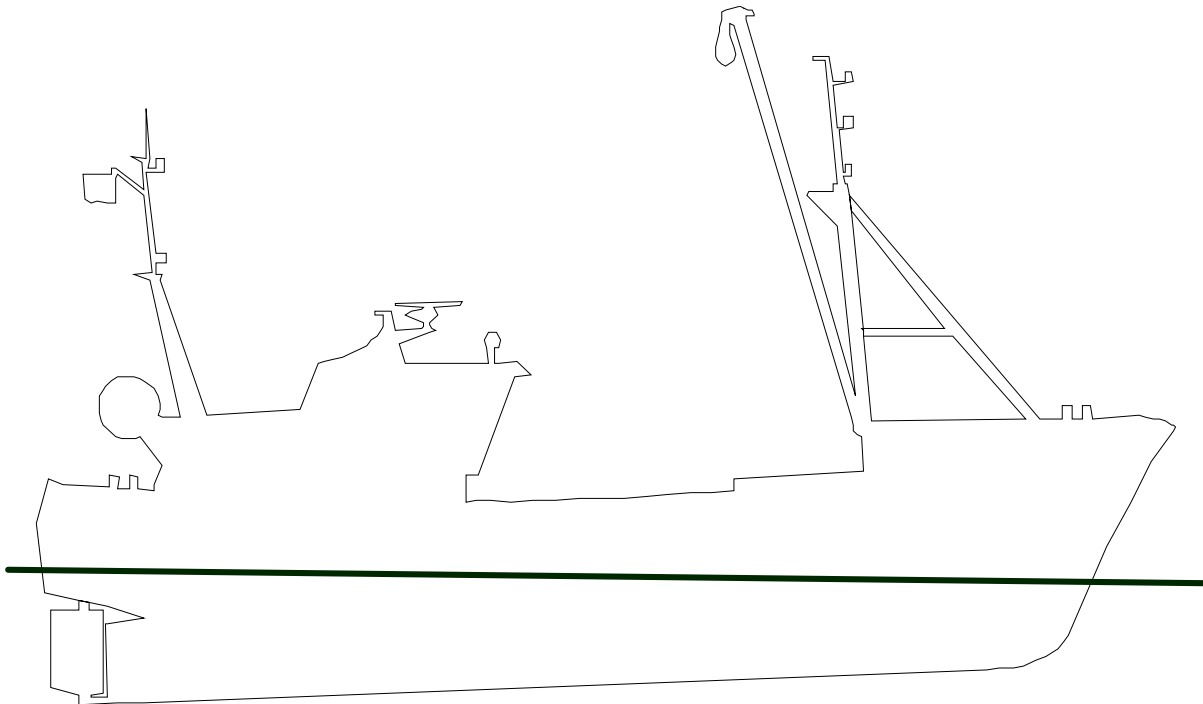
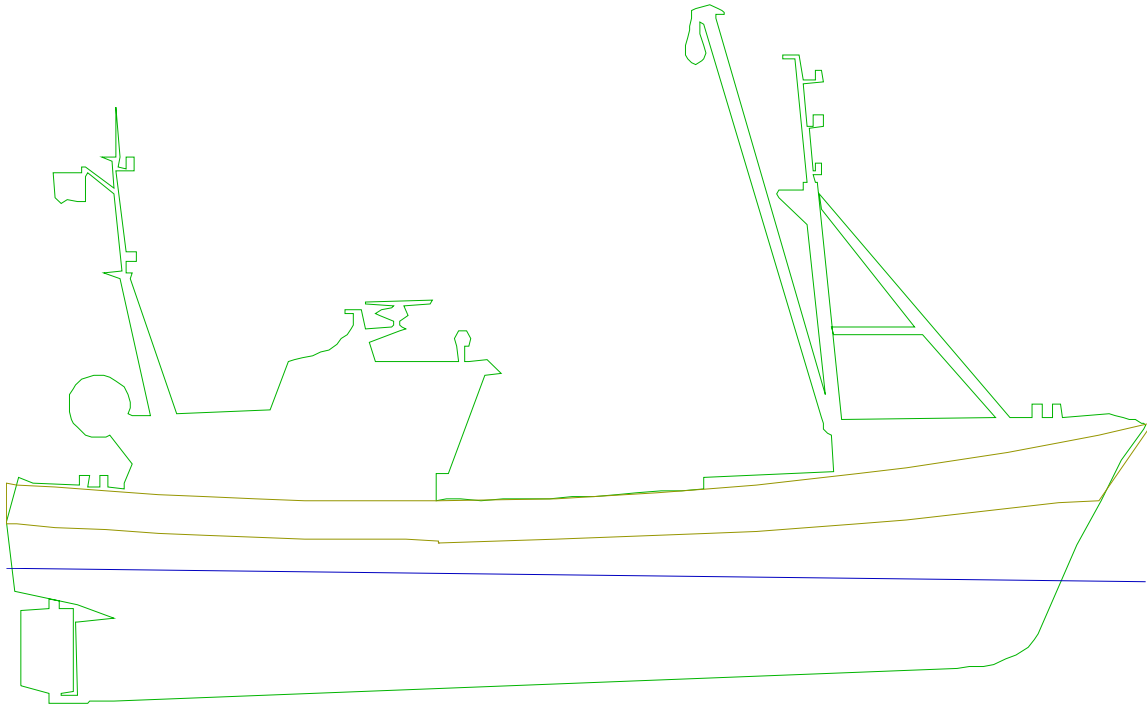


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:10

Condition : Condition during accident, PS derrick at 35 degrees

Longitudinal view, no heel, cargo liquid



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

3.3. CONDITION : FASE 2, PS DERRICK AT 20 DEGREES, 5 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	5.1	1.0250	5.125	-	-	-	-
SUBTOTAL	-	-	5.125	3.137	6.927	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
TOTAL	-	-	175.412	2.578	9.641	-0.033	1.971

Hydrostatics

Volume	170.113 m ³
LCF	9.046 m
Mom. change trim	1.759 tonm/cm
Ton/cm immersion	1.163 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.333 m
Draft aft (App)	2.498 m
Draft fore (Fpp)	2.168 m
Trim	-0.330 m

Transverse stability

KM transverse	3.178 m	
VCG	2.578 m	
GM solid	0.599 m	
GG' correction	0.011 m	
G'M liquid	0.588 m	VCG' 2.589 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.376	10.503
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.191	181.058
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.147	-0.083	-0.011	0.067	0.135
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	5.000	5.001	5.000	5.000	5.000
Level of water on deck	2.274	2.509	2.726	2.925	3.101
Draft ship	2.268	2.296	2.314	2.325	2.331
Trim ship	-0.230	-0.272	-0.304	-0.325	-0.332
Displacement	175.412	175.412	175.412	175.412	175.413
NKsin(ϕ) closed ship	1.348	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.731	3.492	3.216	2.886	2.393
NKsin(ϕ) water & cargo	3.731	3.492	3.216	2.886	2.393
Righting lever (GZ)	0.154	0.101	0.050	-0.001	-0.045
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION

O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Hopper : Water on deck

Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	5.000	5.000	5.000	5.001	5.000
Level of water on deck	3.164	3.171	3.164	3.101	2.925
Draft ship	2.333	2.333	2.333	2.331	2.325
Trim ship	-0.331	-0.330	-0.331	-0.332	-0.325
Displacement	175.412	175.412	175.413	175.412	175.412
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	1.348	0.000	1.349	2.393	2.886
NKsin(ϕ) water & cargo	1.348	0.000	1.349	2.393	2.886
Righting lever (GZ)	-0.049	0.033	0.017	0.021	0.064
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	5.000	5.000	5.000	10.503	21.376
Level of water on deck	2.726	2.509	2.274	2.279	2.323
Draft ship	2.314	2.296	2.268	2.279	2.323
Trim ship	-0.304	-0.272	-0.230	-0.247	-0.270
Displacement	175.413	175.412	175.412	181.057	192.191
NKsin(ϕ) closed ship	0.822	1.088	1.348	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.216	3.492	3.731	3.854	4.026
NKsin(ϕ) water & cargo	3.216	3.492	3.731	3.854	4.026
Righting lever (GZ)	0.113	0.163	0.213	0.191	0.114
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.026	-0.055	-0.128
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.127	0.147	0.056
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.180	0.083	0.056
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.216	0.011	0.056
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.220	-0.067	0.051
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.155	-0.135	0.033
25.00	PS	2.268	-0.230	-1.348	-1.096	-0.098	-0.154	0.020
20.00	PS	2.296	-0.272	-1.088	-0.887	-0.100	-0.101	0.009
15.00	PS	2.314	-0.304	-0.822	-0.671	-0.101	-0.050	0.002
10.00	PS	2.325	-0.325	-0.550	-0.450	-0.100	0.001	0.000
5.00	PS	2.331	-0.332	-0.276	-0.226	-0.095	0.045	0.002
2.00	PS	2.333	-0.331	-0.110	-0.090	-0.069	0.049	0.005
0.00		2.333	-0.330	0.000	0.000	-0.033	0.033	0.006
2.00	SB	2.333	-0.331	0.110	0.090	0.003	0.017	0.007
5.00	SB	2.331	-0.332	0.276	0.226	0.029	0.021	0.008
10.00	SB	2.325	-0.325	0.550	0.450	0.035	0.064	0.011
15.00	SB	2.314	-0.304	0.822	0.671	0.037	0.113	0.019
20.00	SB	2.296	-0.272	1.088	0.887	0.038	0.163	0.031
25.00	SB	2.268	-0.230	1.348	1.096	0.038	0.213	0.048
30.00	SB	2.279	-0.247	1.602	1.312	0.099	0.191	0.066
40.00	SB	2.323	-0.270	2.014	1.727	0.174	0.114	0.092
50.00	SB	2.379	-0.232	2.298	2.093	0.179	0.026	0.105
60.00	SB	2.442	-0.010	2.497	2.400	0.153	-0.055	0.105
70.00	SB	2.535	0.492	2.618	2.637	0.108	-0.128	0.105

Statical angle of inclination is 10.05 degrees to portside

Contour :

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.333 m
Trim	-0.330 m
Statical angle of inclination	10.05 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
Minimum metacentric height G'M	0.500	0.588 meter
Maximum GZ at 30 degrees or more	0.240	0.135 meter
Top of the GZ curve at least at	25.000	25.924 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.033 mrad
Area under the GZ curve up to 40 degrees	0.108	0.051 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.018 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	24.405 degrees PS
----- Additional information		
Range of positive stability	0.000	38.560 degrees
Angle of vanishing stability	0.000	48.612 degrees PS
Roll Period acc Irish authorities	0.000	5.476 sec
Roll Period acc IS 2008	1.000	6.620 sec

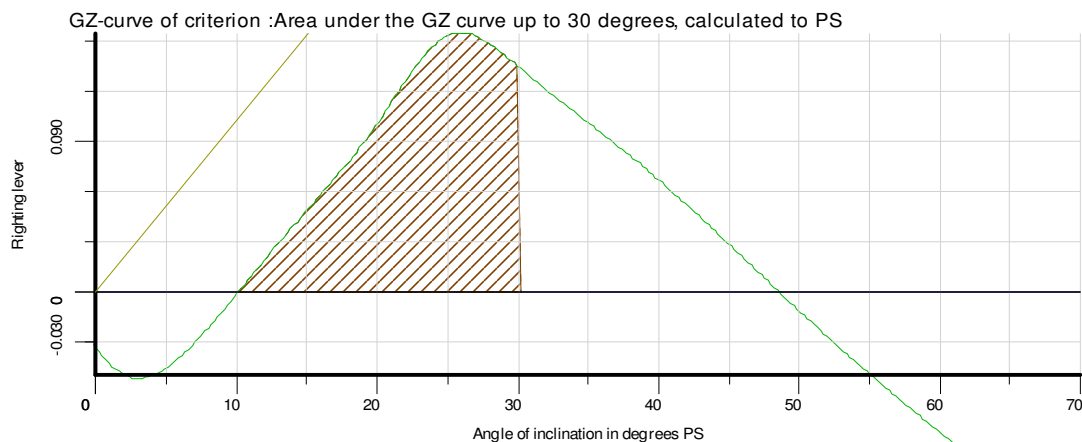
Calculated to SB

	Criterion	Value
Minimum metacentric height G'M	0.500	0.588 meter
Maximum GZ at 30 degrees or more	0.240	0.191 meter
Top of the GZ curve at least at	25.000	25.726 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.060 mrad
Area under the GZ curve up to 40 degrees	0.108	0.086 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.027 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	18.994 degrees SB
----- Additional information		
Range of positive stability	0.000	63.112 degrees
Angle of vanishing stability	0.000	53.060 degrees SB
Roll Period acc Irish authorities	0.000	5.476 sec
Roll Period acc IS 2008	1.000	6.620 sec

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

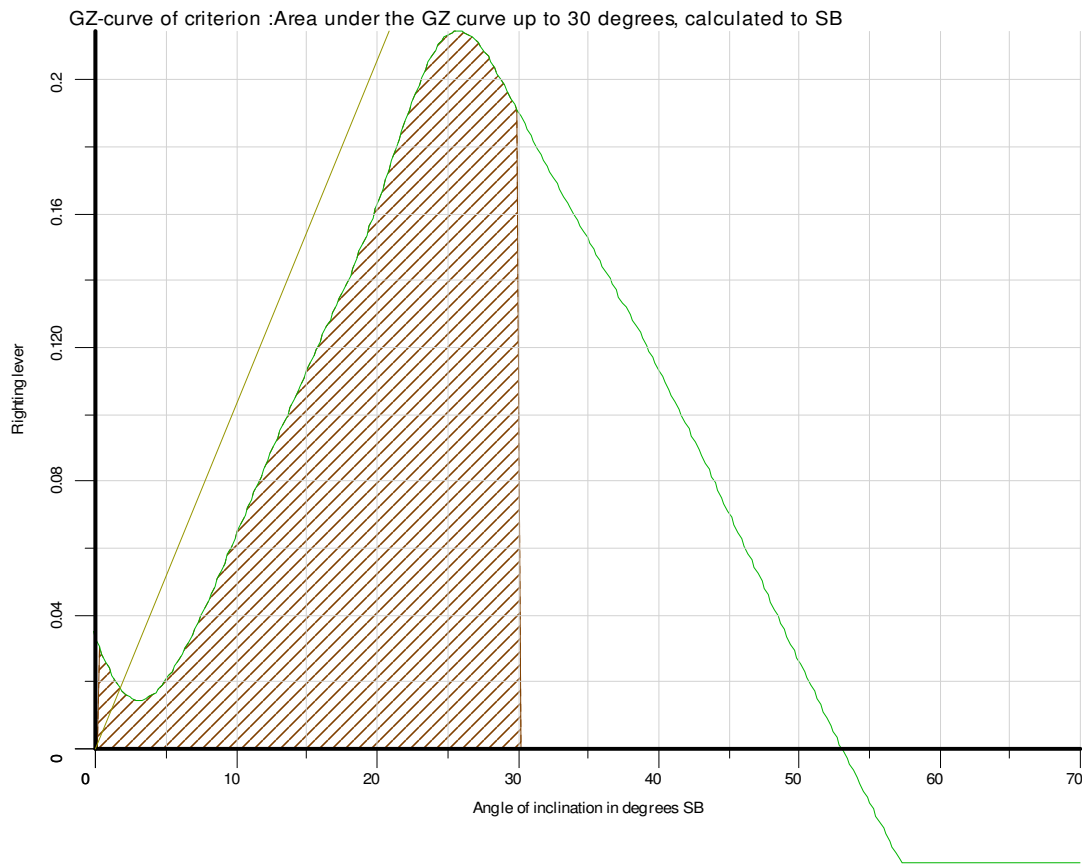
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Water on deck, Cross section at 7.000 m

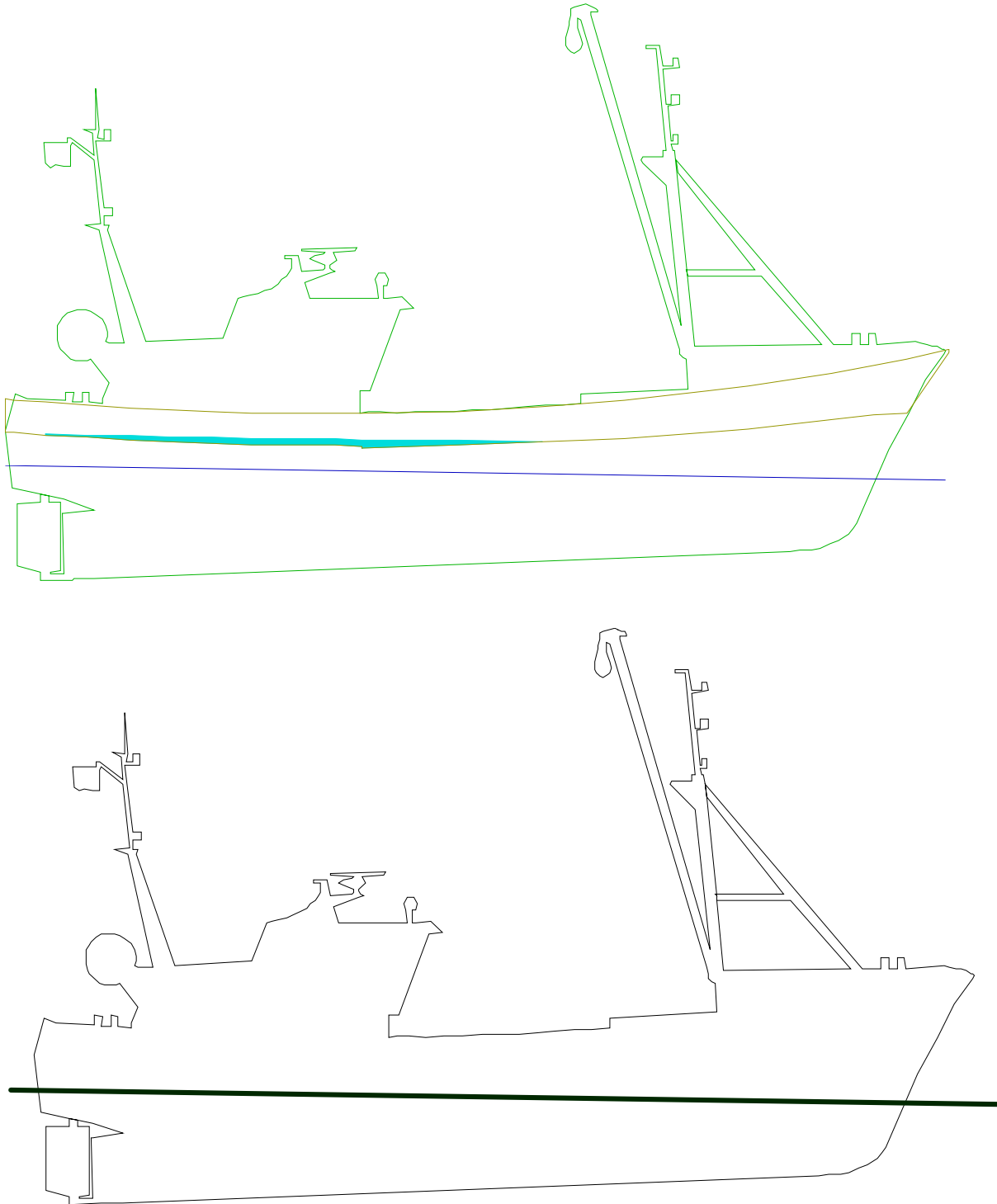


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Longitudinal view, no heel, cargo liquid



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

3.4. CONDITION : FASE 2, PS DERRICK AT 35 DEGREES, 5 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	5.1	1.0250	5.125	-	-	-	-
SUBTOTAL	-	-	5.125	3.137	6.927	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
TOTAL	-	-	175.412	2.562	9.641	-0.064	1.971

Hydrostatics

Volume	170.113 m ³
LCF	9.046 m
Mom. change trim	1.759 tonm/cm
Ton/cm immersion	1.163 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.333 m
Draft aft (App)	2.498 m
Draft fore (Fpp)	2.168 m
Trim	-0.330 m

Transverse stability

KM transverse	3.171 m	
VCG	2.562 m	
GM solid	0.609 m	
GG' correction	0.011 m	
G'M liquid	0.598 m	VCG' 2.573 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.376	10.503
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.191	181.058
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.143	-0.085	-0.018	0.055	0.117
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	5.000	5.001	5.000	5.000	5.000
Level of water on deck	2.274	2.509	2.726	2.925	3.101
Draft ship	2.268	2.296	2.314	2.325	2.331
Trim ship	-0.230	-0.272	-0.304	-0.325	-0.332
Displacement	175.412	175.412	175.412	175.412	175.413
NKsin(ϕ) closed ship	1.348	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.731	3.492	3.216	2.886	2.393
NKsin(ϕ) water & cargo	3.731	3.492	3.216	2.886	2.393
Righting lever (GZ)	0.132	0.077	0.023	-0.029	-0.074
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION

O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Hopper : Water on deck

Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	5.000	5.000	5.000	5.001	5.000
Level of water on deck	3.164	3.171	3.164	3.101	2.925
Draft ship	2.333	2.333	2.333	2.331	2.325
Trim ship	-0.331	-0.330	-0.331	-0.332	-0.325
Displacement	175.412	175.412	175.413	175.412	175.412
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	1.348	0.000	1.349	2.393	2.886
NKsin(ϕ) water & cargo	1.348	0.000	1.349	2.393	2.886
Righting lever (GZ)	-0.080	0.064	0.049	0.054	0.098
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	5.000	5.000	5.000	10.503	21.376
Level of water on deck	2.726	2.509	2.274	2.279	2.323
Draft ship	2.314	2.296	2.268	2.279	2.323
Trim ship	-0.304	-0.272	-0.230	-0.247	-0.270
Displacement	175.413	175.412	175.412	181.057	192.191
NKsin(ϕ) closed ship	0.822	1.088	1.348	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.216	3.492	3.731	3.854	4.026
NKsin(ϕ) water & cargo	3.216	3.492	3.731	3.854	4.026
Righting lever (GZ)	0.148	0.198	0.249	0.225	0.145
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.055	-0.030	-0.106
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.136	0.143	0.044
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.194	0.085	0.044
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.234	0.018	0.044
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.242	-0.055	0.041
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.181	-0.117	0.025
25.00	PS	2.268	-0.230	-1.348	-1.089	-0.126	-0.132	0.014
20.00	PS	2.296	-0.272	-1.088	-0.881	-0.130	-0.077	0.005
15.00	PS	2.314	-0.304	-0.822	-0.667	-0.131	-0.023	0.000
10.00	PS	2.325	-0.325	-0.550	-0.447	-0.131	0.029	0.001
5.00	PS	2.331	-0.332	-0.276	-0.224	-0.126	0.074	0.005
2.00	PS	2.333	-0.331	-0.110	-0.090	-0.100	0.080	0.010
0.00		2.333	-0.330	0.000	0.000	-0.064	0.064	0.012
2.00	SB	2.333	-0.331	0.110	0.090	-0.028	0.049	0.014
5.00	SB	2.331	-0.332	0.276	0.224	-0.002	0.054	0.017
10.00	SB	2.325	-0.325	0.550	0.447	0.005	0.098	0.023
15.00	SB	2.314	-0.304	0.822	0.667	0.007	0.148	0.034
20.00	SB	2.296	-0.272	1.088	0.881	0.009	0.198	0.049
25.00	SB	2.268	-0.230	1.348	1.089	0.010	0.249	0.069
30.00	SB	2.279	-0.247	1.602	1.304	0.073	0.225	0.090
40.00	SB	2.323	-0.270	2.014	1.717	0.152	0.145	0.122
50.00	SB	2.379	-0.232	2.298	2.082	0.162	0.055	0.139
60.00	SB	2.442	-0.010	2.497	2.388	0.139	-0.030	0.142
70.00	SB	2.535	0.492	2.618	2.625	0.099	-0.106	0.142

Statical angle of inclination is 12.70 degrees to portside

Contour :

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.333 m
Trim	-0.330 m
Statical angle of inclination	12.70 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.117 meter
Top of the GZ curve at least at	25.000	26.087 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.025 mrad
Area under the GZ curve up to 40 degrees	0.108	0.041 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.015 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	70.000 degrees PS
----- Additional information		
Range of positive stability	0.000	34.916 degrees
Angle of vanishing stability	0.000	47.614 degrees PS
Roll Period acc Irish authorities	0.000	5.433 sec
Roll Period acc IS 2008	1.000	6.567 sec

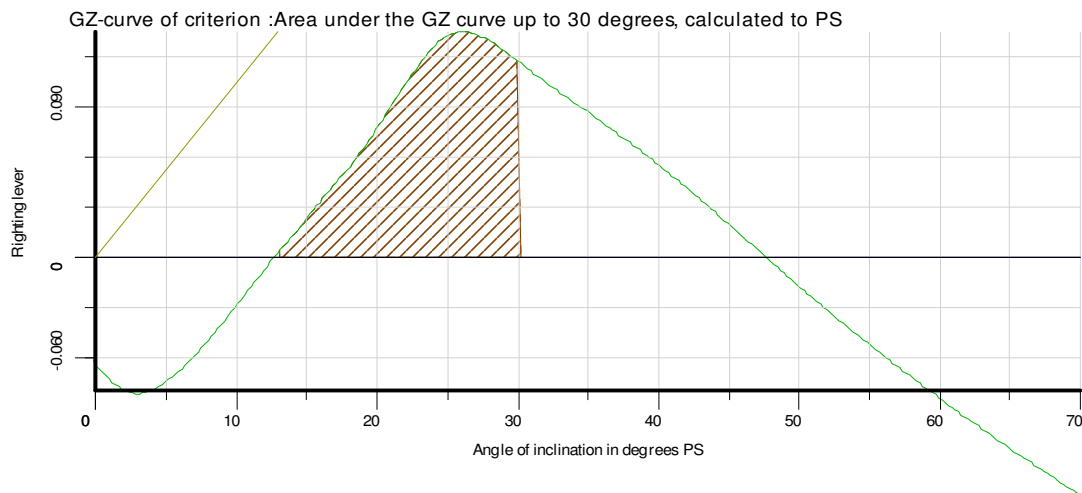
Calculated to SB

	Criterion	Value
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.225 meter
Top of the GZ curve at least at	25.000	25.694 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.078 mrad
Area under the GZ curve up to 40 degrees	0.108	0.110 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.032 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	15.348 degrees SB
----- Additional information		
Range of positive stability	0.000	69.018 degrees
Angle of vanishing stability	0.000	56.319 degrees SB
Roll Period acc Irish authorities	0.000	5.433 sec
Roll Period acc IS 2008	1.000	6.567 sec

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

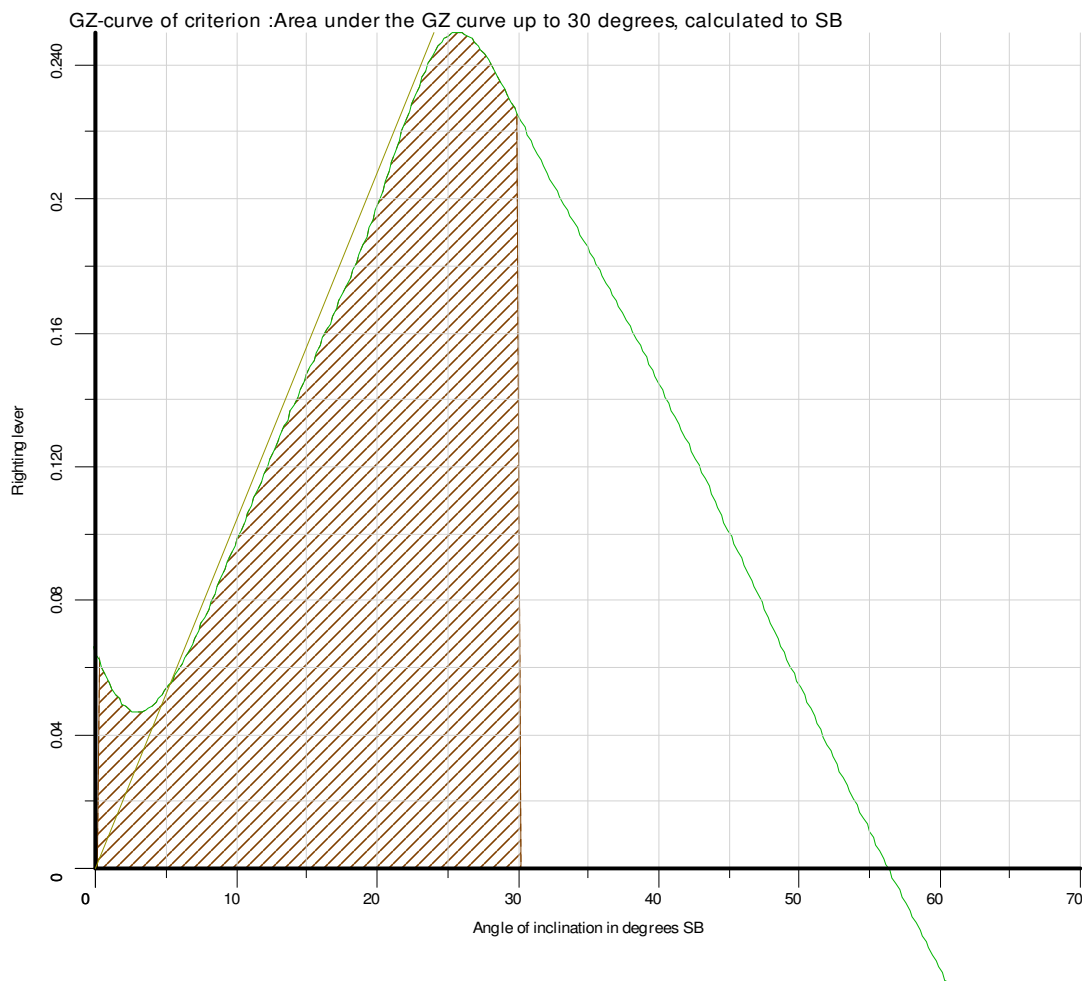
Loading condition DOES NOT comply with the stated criteria.



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Water on deck, Cross section at 7.000 m

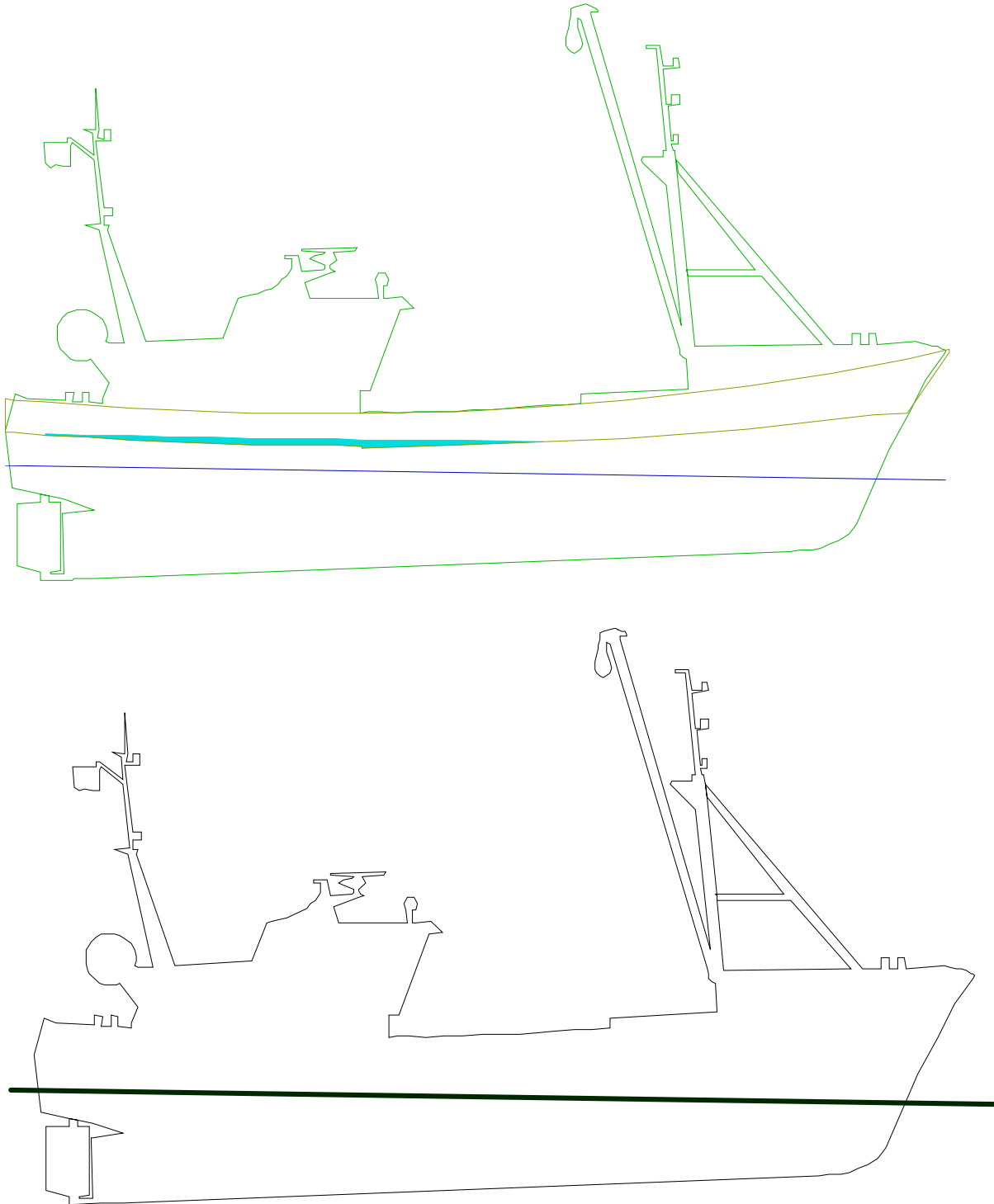


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:11

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Longitudinal view, no heel, cargo liquid



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

3.5. CONDITION : FASE 3, PS DERRICK AT 20 DEGREES, 10 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek. water	10.2	1.0250	10.252	-	-	-	-
SUBTOTAL	-	-	10.252	3.227	6.113	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
TOTAL	-	-	180.539	2.599	9.518	-0.032	1.971

Hydrostatics

Volume	175.085 m ³
LCF	9.023 m
Mom. change trim	1.768 tonm/cm
Ton/cm immersion	1.167 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.370 m
Draft aft (App)	2.589 m
Draft fore (Fpp)	2.151 m
Trim	-0.438 m

Transverse stability

KM transverse	3.121 m	
VCG	2.598 m	
GM solid	0.523 m	
GG' correction	0.011 m	
G'M liquid	0.512 m	VCG' 2.609 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:12

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.377	10.503
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.057
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.147	-0.083	-0.011	0.067	0.135
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	9.033	10.000	10.000	10.000	10.001
Level of water on deck	2.460	2.719	2.917	3.092	3.222
Draft ship	2.304	2.339	2.356	2.366	2.371
Trim ship	-0.280	-0.333	-0.364	-0.385	-0.400
Displacement	179.545	180.537	180.537	180.537	180.537
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.549	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.394	3.092	2.707	2.002
NKsin(ϕ) water & cargo	3.660	3.394	3.092	2.707	2.002
Righting lever (GZ)	0.100	0.036	-0.013	-0.057	-0.082
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:12

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	10.001	10.002	10.001	10.001	10.001
Level of water on deck	3.239	3.240	3.239	3.222	3.092
Draft ship	2.370	2.370	2.370	2.371	2.366
Trim ship	-0.428	-0.438	-0.428	-0.400	-0.385
Displacement	180.537	180.539	180.538	180.538	180.537
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.549
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.862	0.000	0.862	2.002	2.707
NKsin(ϕ) water & cargo	0.862	0.000	0.862	2.002	2.707
Righting lever (GZ)	-0.055	0.032	0.008	-0.018	0.006
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	10.000	10.001	9.033	10.503	21.377
Level of water on deck	2.917	2.719	2.460	2.279	2.323
Draft ship	2.356	2.339	2.304	2.279	2.323
Trim ship	-0.364	-0.333	-0.280	-0.247	-0.270
Displacement	180.537	180.537	179.545	181.057	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.092	3.394	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.092	3.394	3.660	3.854	4.026
Righting lever (GZ)	0.049	0.096	0.158	0.191	0.114
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.583	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.026	-0.055	-0.128
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:12

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.127	0.147	0.042
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.180	0.083	0.042
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.216	0.011	0.042
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.220	-0.067	0.037
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.155	-0.135	0.018
25.00	PS	2.304	-0.280	-1.349	-1.105	-0.144	-0.100	0.007
20.00	PS	2.339	-0.333	-1.088	-0.895	-0.157	-0.036	0.001
15.00	PS	2.356	-0.364	-0.821	-0.677	-0.157	0.013	0.000
10.00	PS	2.366	-0.385	-0.549	-0.454	-0.152	0.057	0.003
5.00	PS	2.371	-0.400	-0.275	-0.228	-0.129	0.082	0.010
2.00	PS	2.370	-0.428	-0.110	-0.091	-0.074	0.055	0.013
0.00		2.370	-0.438	0.000	0.000	-0.032	0.032	0.015
2.00	SB	2.370	-0.428	0.110	0.091	0.011	0.008	0.016
5.00	SB	2.371	-0.400	0.275	0.228	0.066	-0.018	0.016
10.00	SB	2.366	-0.385	0.549	0.454	0.089	0.006	0.016
15.00	SB	2.356	-0.364	0.821	0.677	0.095	0.049	0.018
20.00	SB	2.339	-0.333	1.088	0.895	0.097	0.096	0.024
25.00	SB	2.304	-0.280	1.349	1.105	0.086	0.158	0.035
30.00	SB	2.279	-0.247	1.602	1.312	0.099	0.191	0.051
40.00	SB	2.323	-0.270	2.014	1.727	0.174	0.114	0.079
50.00	SB	2.379	-0.232	2.298	2.093	0.179	0.026	0.091
60.00	SB	2.442	-0.010	2.497	2.400	0.153	-0.055	0.092
70.00	SB	2.535	0.492	2.618	2.637	0.108	-0.128	0.092

Statical angle of inclination is 16.48 degrees to portside

Statical angle of inclination is 9.36 degrees to starboard

Contour :

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:12

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.370 m
Trim	-0.438 m
Statical angle of inclination	16.48 degrees PS
Statical angle of inclination	9.36 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.512 meter
Maximum GZ at 30 degrees or more	0.240	0.136 meter
Top of the GZ curve at least at	25.000	30.524 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.018 mrad
Area under the GZ curve up to 40 degrees	0.108	0.037 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.019 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	70.000 degrees PS
----- Additional information		
Range of positive stability	0.000	31.987 degrees
Angle of vanishing stability	0.000	48.463 degrees PS
Roll Period acc Irish authorities	0.000	5.867 sec
Roll Period acc IS 2008	1.000	7.078 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.512 meter
Maximum GZ at 30 degrees or more	0.240	0.191 meter
Top of the GZ curve at least at	25.000	30.225 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.036 mrad
Area under the GZ curve up to 40 degrees	0.108	0.064 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.028 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	24.198 degrees SB
----- Additional information		
Range of positive stability	0.000	43.847 degrees
Angle of vanishing stability	0.000	53.208 degrees SB
Roll Period acc Irish authorities	0.000	5.867 sec
Roll Period acc IS 2008	1.000	7.078 sec

VCG'

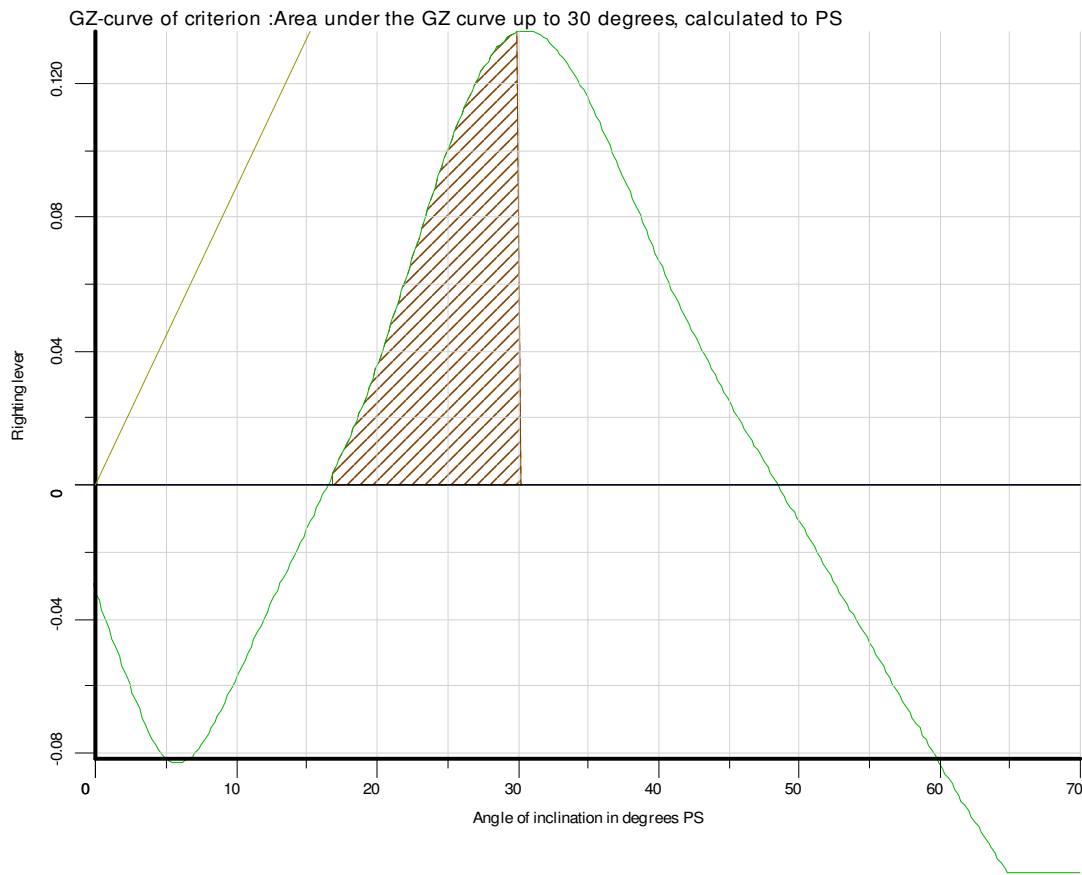
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

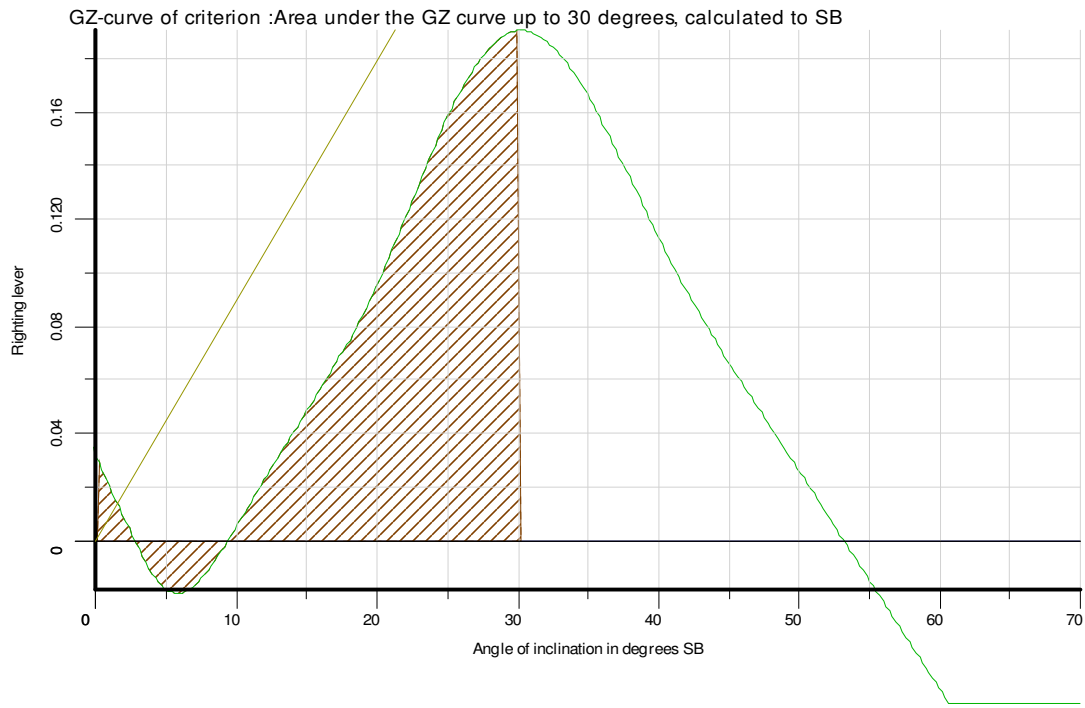
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:12

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:12

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Water on deck, Cross section at 7.000 m

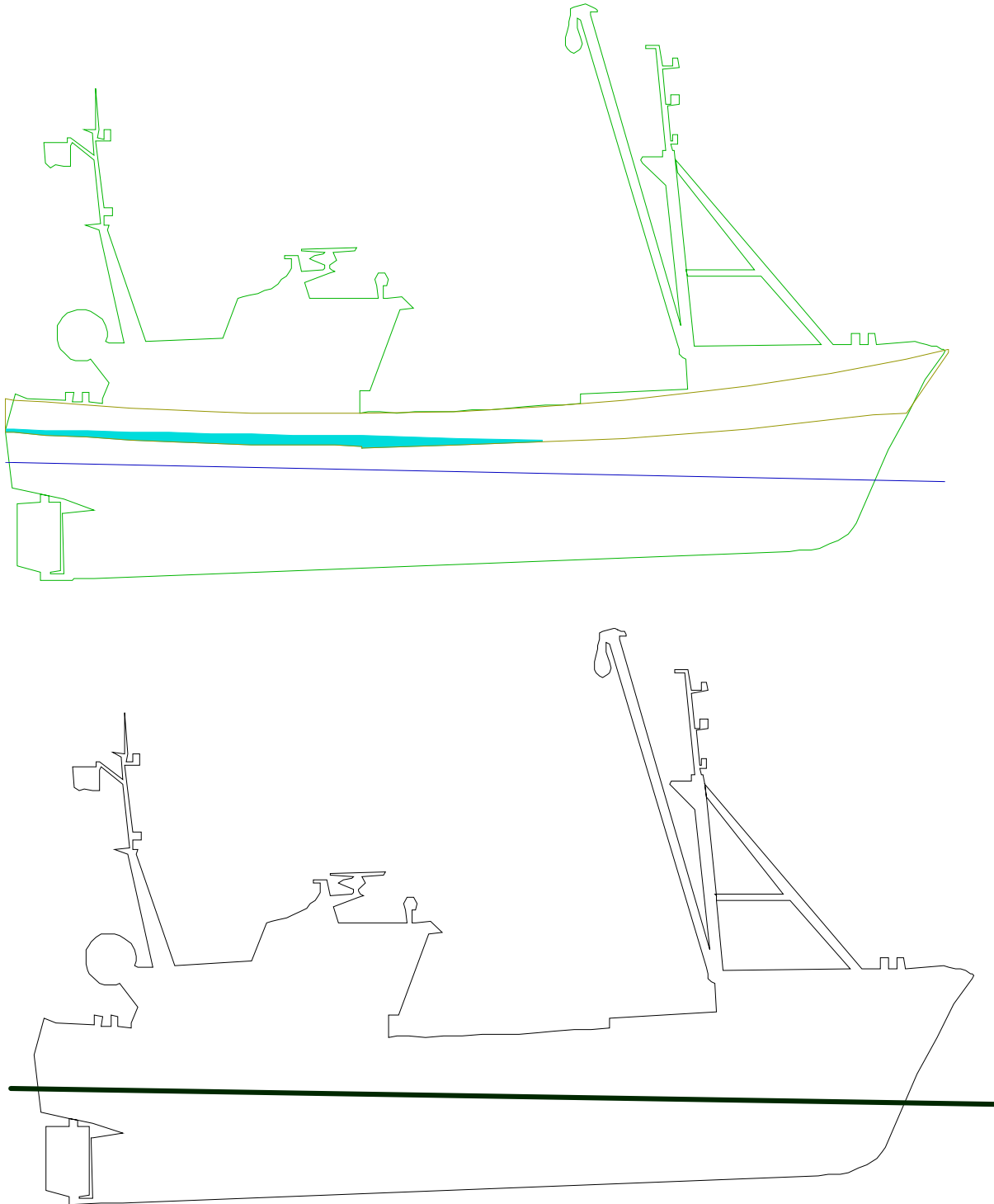


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:12

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Longitudinal view, no heel, cargo liquid



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

3.6. CONDITION : FASE 3, PS DERRICK AT 35 DEGREES, 10 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	10.2	1.0250	10.252	-	-	-	-
SUBTOTAL	-	-	10.252	3.227	6.113	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
TOTAL	-	-	180.539	2.583	9.518	-0.062	1.971

Hydrostatics

Volume	175.085 m ³
LCF	9.023 m
Mom. change trim	1.768 tonm/cm
Ton/cm immersion	1.167 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.370 m
Draft aft (App)	2.589 m
Draft fore (Fpp)	2.151 m
Trim	-0.438 m

Transverse stability

KM transverse	3.225 m	
VCG	2.582 m	
GM solid	0.643 m	
GG' correction	0.011 m	
G'M liquid	0.632 m	VCG' 2.593 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:13

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.377	10.503
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.057
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.143	-0.085	-0.018	0.055	0.117
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	9.033	10.000	10.000	10.000	10.001
Level of water on deck	2.460	2.719	2.917	3.092	3.222
Draft ship	2.304	2.339	2.356	2.366	2.371
Trim ship	-0.280	-0.333	-0.364	-0.385	-0.400
Displacement	179.545	180.537	180.537	180.537	180.537
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.549	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.394	3.092	2.707	2.002
NKsin(ϕ) water & cargo	3.660	3.394	3.092	2.707	2.002
Righting lever (GZ)	0.079	0.012	-0.038	-0.085	-0.111
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:13

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	10.001	10.002	10.001	10.001	10.001
Level of water on deck	3.239	3.240	3.239	3.222	3.092
Draft ship	2.370	2.370	2.370	2.371	2.366
Trim ship	-0.428	-0.438	-0.428	-0.400	-0.385
Displacement	180.537	180.539	180.538	180.538	180.537
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.549
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.862	0.000	0.862	2.002	2.707
NKsin(ϕ) water & cargo	0.862	0.000	0.862	2.002	2.707
Righting lever (GZ)	-0.085	0.062	0.039	0.014	0.038
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	10.000	10.001	9.033	10.503	21.377
Level of water on deck	2.917	2.719	2.460	2.279	2.323
Draft ship	2.356	2.339	2.304	2.279	2.323
Trim ship	-0.364	-0.333	-0.280	-0.247	-0.270
Displacement	180.537	180.537	179.545	181.057	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.092	3.394	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.092	3.394	3.660	3.854	4.026
Righting lever (GZ)	0.082	0.130	0.193	0.225	0.145
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.583	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.055	-0.030	-0.106
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:13

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.136	0.143	0.033
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.194	0.085	0.033
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.234	0.018	0.033
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.242	-0.055	0.030
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.181	-0.117	0.013
25.00	PS	2.304	-0.280	-1.349	-1.098	-0.172	-0.079	0.004
20.00	PS	2.339	-0.333	-1.088	-0.890	-0.186	-0.012	0.000
15.00	PS	2.356	-0.364	-0.821	-0.673	-0.186	0.038	0.001
10.00	PS	2.366	-0.385	-0.549	-0.451	-0.182	0.085	0.007
5.00	PS	2.371	-0.400	-0.275	-0.226	-0.160	0.111	0.016
2.00	PS	2.370	-0.428	-0.110	-0.091	-0.105	0.085	0.021
0.00		2.370	-0.438	0.000	0.000	-0.062	0.062	0.024
2.00	SB	2.370	-0.428	0.110	0.091	-0.020	0.039	0.025
5.00	SB	2.371	-0.400	0.275	0.226	0.035	0.014	0.027
10.00	SB	2.366	-0.385	0.549	0.451	0.059	0.038	0.028
15.00	SB	2.356	-0.364	0.821	0.673	0.066	0.082	0.034
20.00	SB	2.339	-0.333	1.088	0.890	0.068	0.130	0.043
25.00	SB	2.304	-0.280	1.349	1.098	0.058	0.193	0.057
30.00	SB	2.279	-0.247	1.602	1.304	0.073	0.225	0.076
40.00	SB	2.323	-0.270	2.014	1.717	0.152	0.145	0.109
50.00	SB	2.379	-0.232	2.298	2.082	0.162	0.055	0.127
60.00	SB	2.442	-0.010	2.497	2.388	0.139	-0.030	0.130
70.00	SB	2.535	0.492	2.618	2.625	0.099	-0.106	0.130

Statical angle of inclination is 18.93 degrees to portside

Contour :

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:13

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.370 m
Trim	-0.438 m
Statical angle of inclination	18.93 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.632 meter
Maximum GZ at 30 degrees or more	0.240	0.118 meter
Top of the GZ curve at least at	25.000	30.757 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.013 mrad
Area under the GZ curve up to 40 degrees	0.108	0.030 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.017 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	70.000 degrees PS
----- Additional information		
Range of positive stability	0.000	28.400 degrees
Angle of vanishing stability	0.000	47.330 degrees PS
Roll Period acc Irish authorities	0.000	5.281 sec
Roll Period acc IS 2008	1.000	6.371 sec

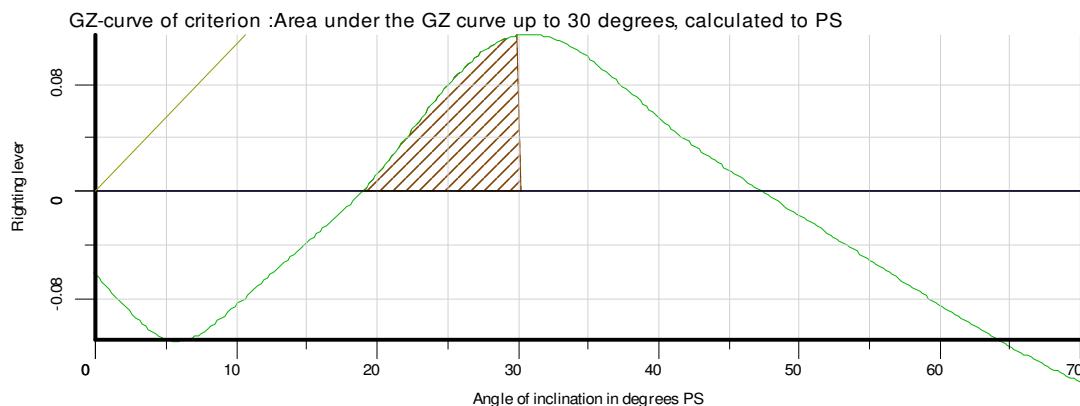
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.632 meter
Maximum GZ at 30 degrees or more	0.240	0.225 meter
Top of the GZ curve at least at	25.000	30.166 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.052 mrad
Area under the GZ curve up to 40 degrees	0.108	0.086 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.034 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	21.502 degrees SB
----- Additional information		
Range of positive stability	0.000	75.376 degrees
Angle of vanishing stability	0.000	56.447 degrees SB
Roll Period acc Irish authorities	0.000	5.281 sec
Roll Period acc IS 2008	1.000	6.371 sec

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

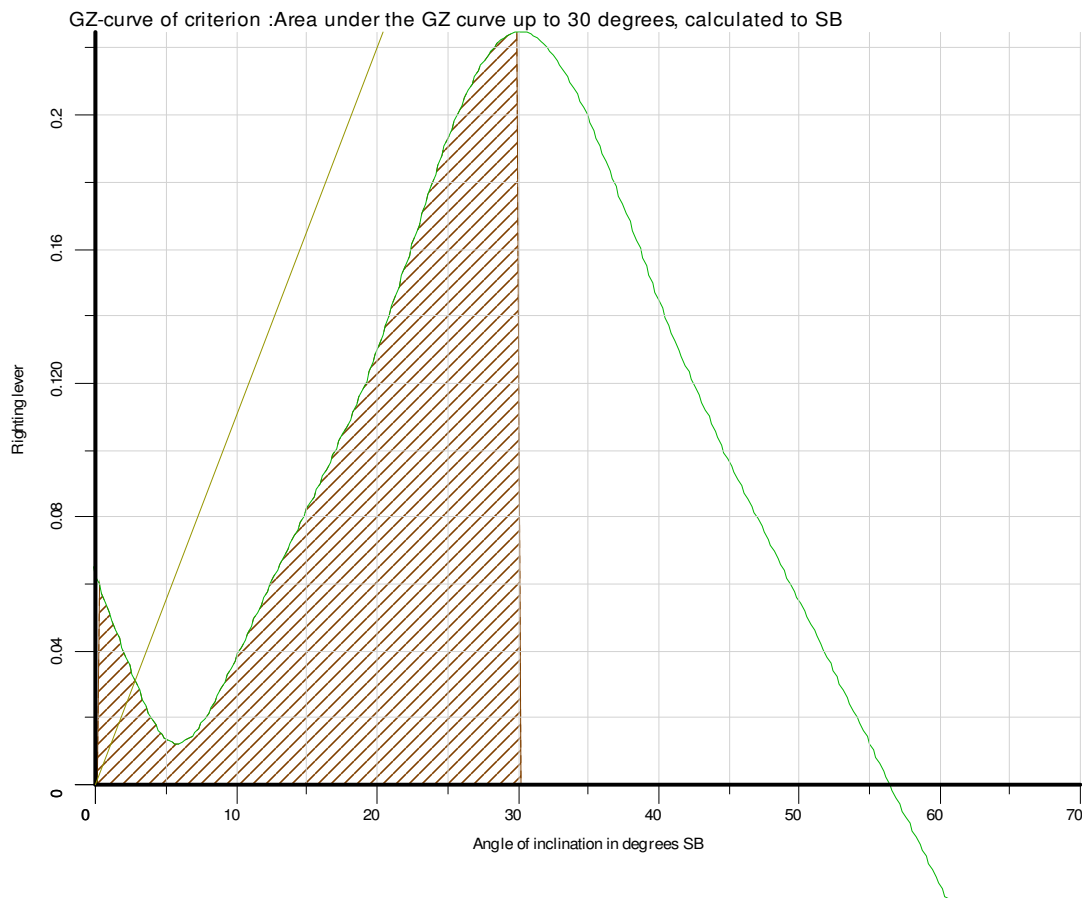
Loading condition DOES NOT comply with the stated criteria.



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

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Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

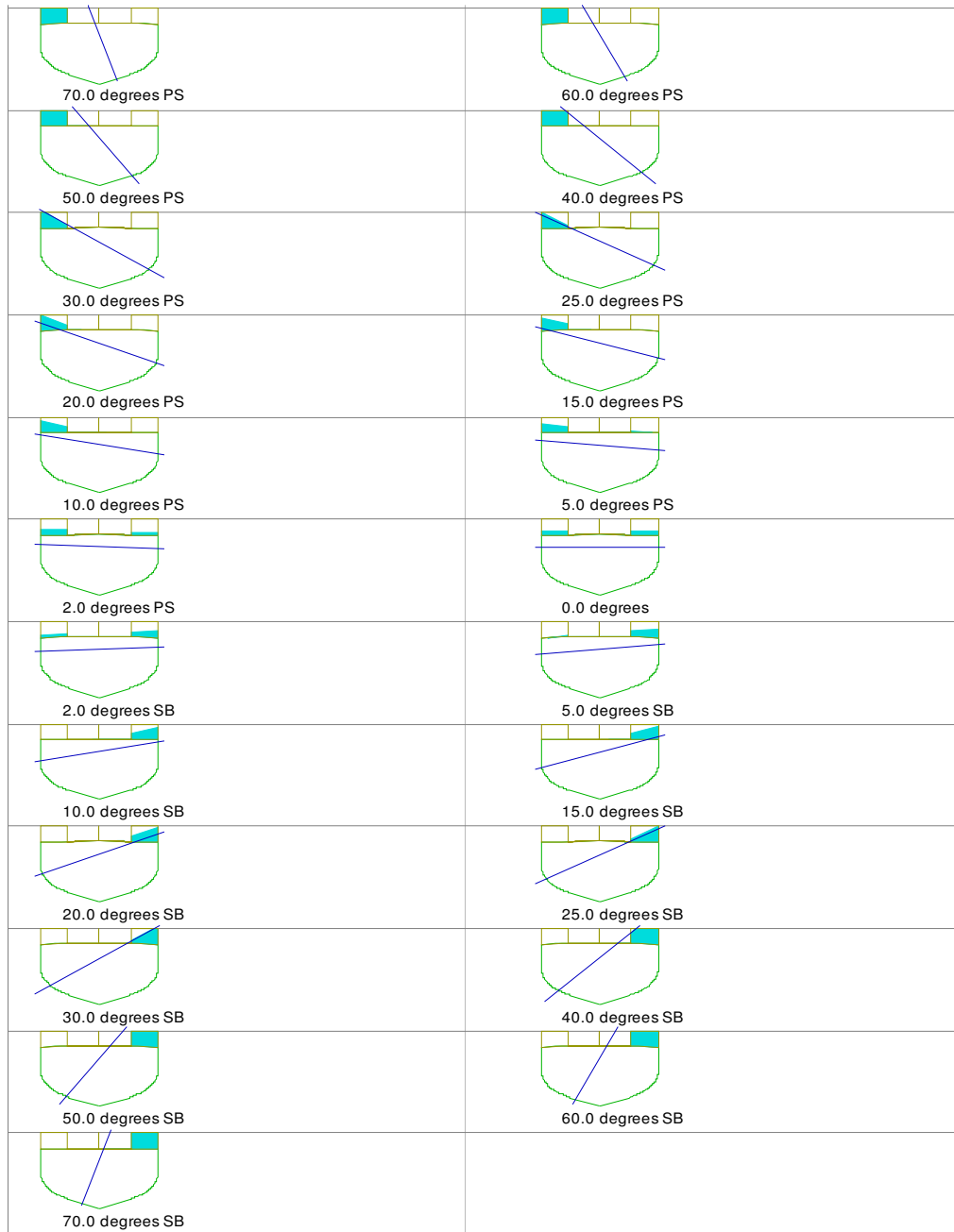


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:13

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Water on deck, Cross section at 7.000 m

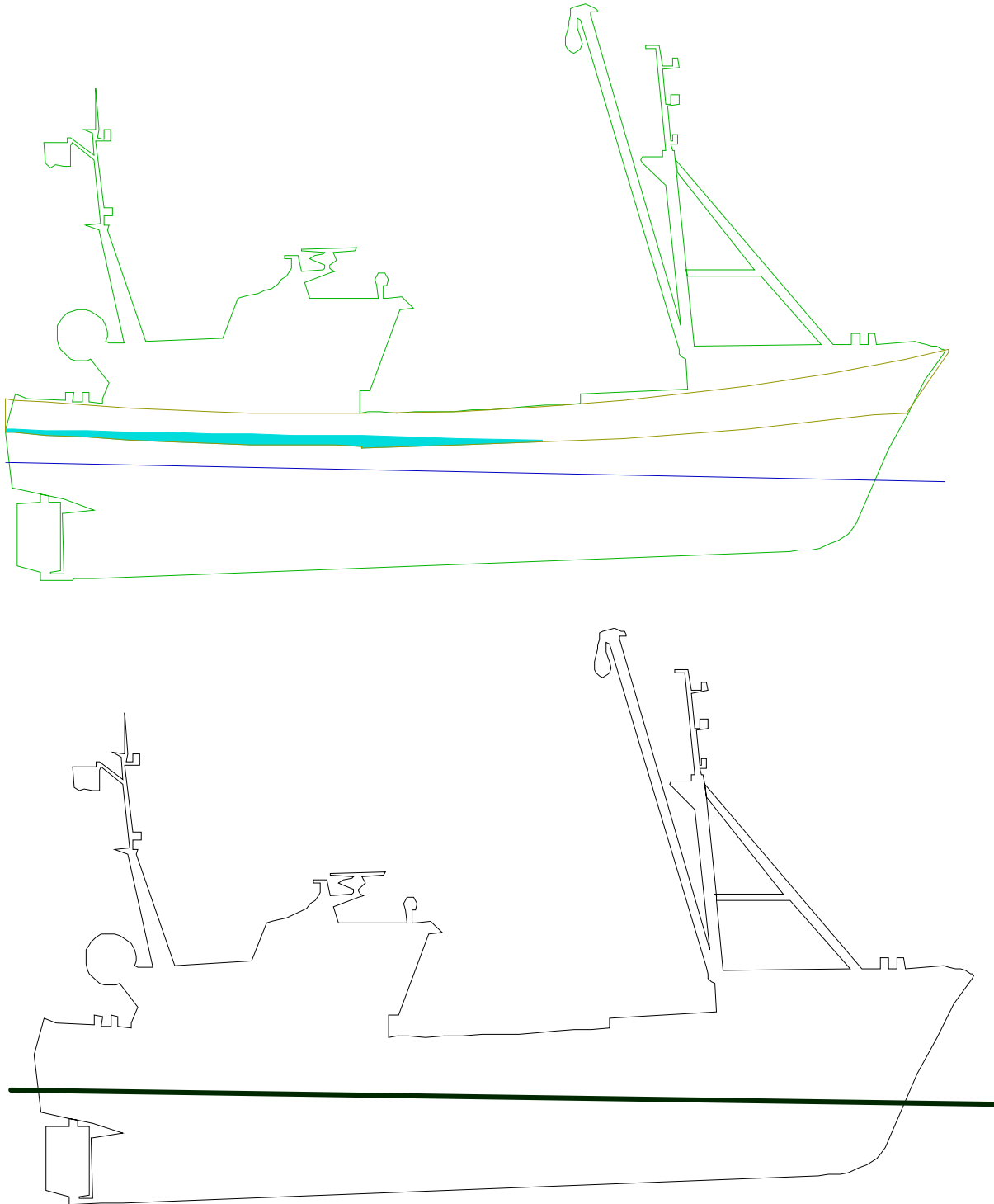


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:13

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Longitudinal view, no heel, cargo liquid



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

3.7. CONDITION : FASE 4, PS DERRICK AT 20 DEGREES, 15 M3 WATER ON DECK,

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek. water	15.2	1.0250	15.375	-	-	-	-
SUBTOTAL	-	-	15.375	3.285	5.883	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
SB derrick to PS (-)	-	-	-0.600	10.000	17.000	1.700	-
SB derrick to PS (+)	-	-	0.600	10.000	17.000	0.000	-
TOTAL	-	-	185.662	2.621	9.405	-0.037	1.971

Hydrostatics

Volume	180.053 m ³
LCF	9.004 m
Mom. change trim	1.776 tonm/cm
Ton/cm immersion	1.170 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.406 m
Draft aft (App)	2.677 m
Draft fore (Fpp)	2.135 m
Trim	-0.541 m

Transverse stability

KM transverse	3.561 m		
VCG	2.618 m		
GM solid	0.943 m		
GG' correction	0.011 m		
G'M liquid	0.933 m	VCG'	2.629 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.377	10.502
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.052
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.148	-0.086	-0.014	0.063	0.130
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	9.033	11.040	13.709	15.000	15.000
Level of water on deck	2.460	2.757	3.029	3.215	3.295
Draft ship	2.304	2.348	2.387	2.407	2.408
Trim ship	-0.280	-0.344	-0.401	-0.438	-0.490
Displacement	179.545	181.602	184.337	185.662	185.662
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.548	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.378	3.013	2.541	1.584
NKsin(ϕ) water & cargo	3.660	3.378	3.013	2.541	1.584
Righting lever (GZ)	0.095	0.018	-0.059	-0.108	-0.099
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	15.002	15.000	14.999	15.000	15.000
Level of water on deck	3.299	3.300	3.299	3.295	3.215
Draft ship	2.406	2.406	2.406	2.408	2.407
Trim ship	-0.535	-0.541	-0.535	-0.490	-0.438
Displacement	185.660	185.662	185.660	185.662	185.663
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.548
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.643	0.000	0.643	1.584	2.541
NKsin(ϕ) water & cargo	0.643	0.000	0.643	1.584	2.541
Righting lever (GZ)	-0.062	0.037	0.011	-0.026	-0.036
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	13.709	11.040	9.033	10.502	21.377
Level of water on deck	3.029	2.757	2.460	2.279	2.323
Draft ship	2.387	2.348	2.304	2.279	2.323
Trim ship	-0.401	-0.344	-0.280	-0.247	-0.270
Displacement	184.337	181.602	179.545	181.052	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.013	3.378	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.013	3.378	3.660	3.854	4.026
Righting lever (GZ)	0.012	0.088	0.163	0.195	0.118
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.029	-0.053	-0.126
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.128	0.148	0.038
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.183	0.086	0.038
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.220	0.014	0.038
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.224	-0.063	0.034
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.160	-0.130	0.015
25.00	PS	2.304	-0.280	-1.349	-1.105	-0.149	-0.095	0.005
20.00	PS	2.348	-0.344	-1.088	-0.897	-0.173	-0.018	0.000
15.00	PS	2.387	-0.401	-0.821	-0.682	-0.198	0.059	0.002
10.00	PS	2.407	-0.438	-0.548	-0.458	-0.198	0.108	0.010
5.00	PS	2.408	-0.490	-0.275	-0.230	-0.144	0.099	0.019
2.00	PS	2.406	-0.535	-0.110	-0.092	-0.080	0.062	0.023
0.00		2.406	-0.541	0.000	0.000	-0.037	0.037	0.025
2.00	SB	2.406	-0.535	0.110	0.092	0.007	0.011	0.026
5.00	SB	2.408	-0.490	0.275	0.230	0.071	-0.026	0.026
10.00	SB	2.407	-0.438	0.548	0.458	0.126	-0.036	0.026
15.00	SB	2.387	-0.401	0.821	0.682	0.127	0.012	0.026
20.00	SB	2.348	-0.344	1.088	0.897	0.103	0.088	0.030
25.00	SB	2.304	-0.280	1.349	1.105	0.081	0.163	0.042
30.00	SB	2.279	-0.247	1.602	1.312	0.095	0.195	0.058
40.00	SB	2.323	-0.270	2.014	1.727	0.170	0.118	0.087
50.00	SB	2.379	-0.232	2.298	2.093	0.176	0.029	0.099
60.00	SB	2.442	-0.010	2.497	2.400	0.150	-0.053	0.100
70.00	SB	2.535	0.492	2.618	2.637	0.107	-0.126	0.100

Statical angle of inclination is 18.93 degrees to portside

Statical angle of inclination is 14.06 degrees to starboard

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.406 m
Trim	-0.541 m
Statical angle of inclination	18.93 degrees PS
Statical angle of inclination	14.06 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.933 meter
Maximum GZ at 30 degrees or more	0.240	0.131 meter
Top of the GZ curve at least at	25.000	30.460 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.015 mrad
Area under the GZ curve up to 40 degrees	0.108	0.034 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.018 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	70.000 degrees PS
----- Additional information		
Range of positive stability	0.000	29.060 degrees
Angle of vanishing stability	0.000	47.990 degrees PS
Roll Period acc Irish authorities	0.000	4.349 sec
Roll Period acc IS 2008	1.000	5.235 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.933 meter
Maximum GZ at 30 degrees or more	0.240	0.196 meter
Top of the GZ curve at least at	25.000	30.101 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.032 mrad
Area under the GZ curve up to 40 degrees	0.108	0.061 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.029 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	23.699 degrees SB
----- Additional information		
Range of positive stability	0.000	39.508 degrees
Angle of vanishing stability	0.000	53.567 degrees SB
Roll Period acc Irish authorities	0.000	4.349 sec
Roll Period acc IS 2008	1.000	5.235 sec

VCG'

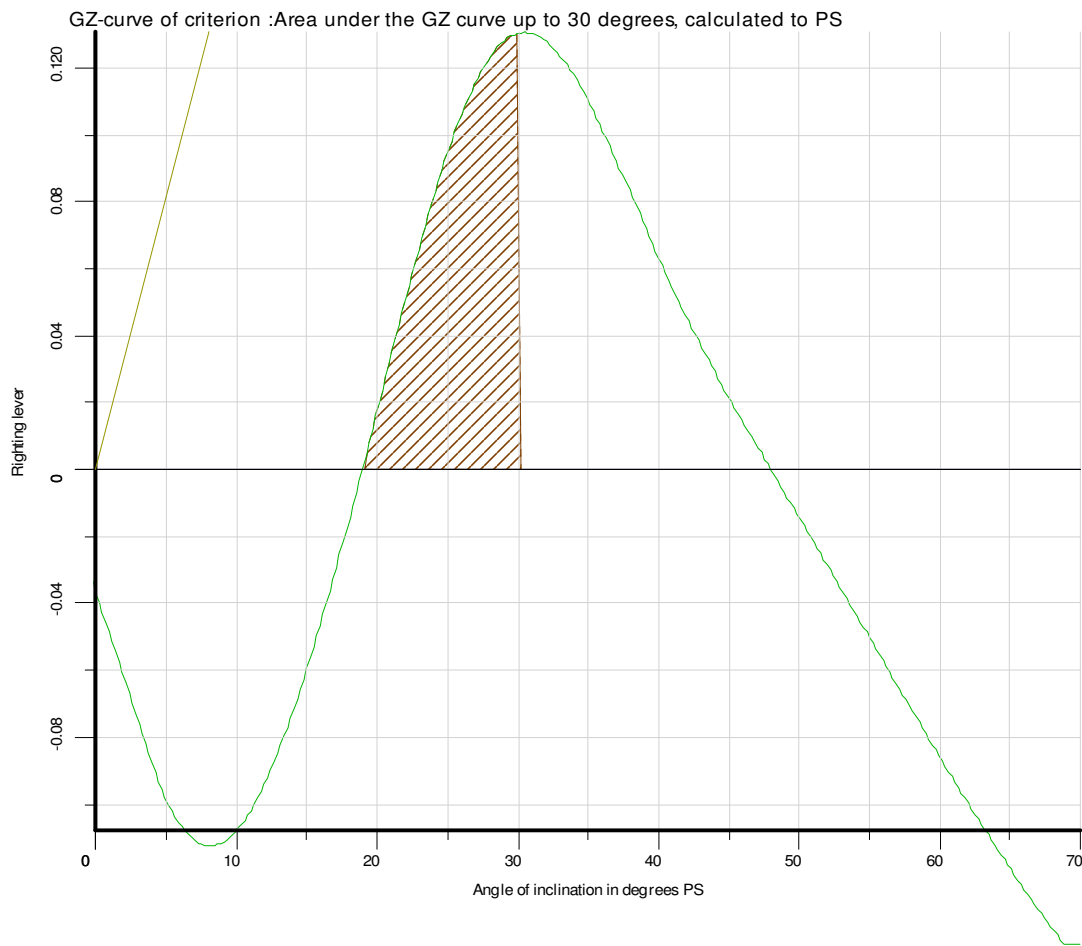
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

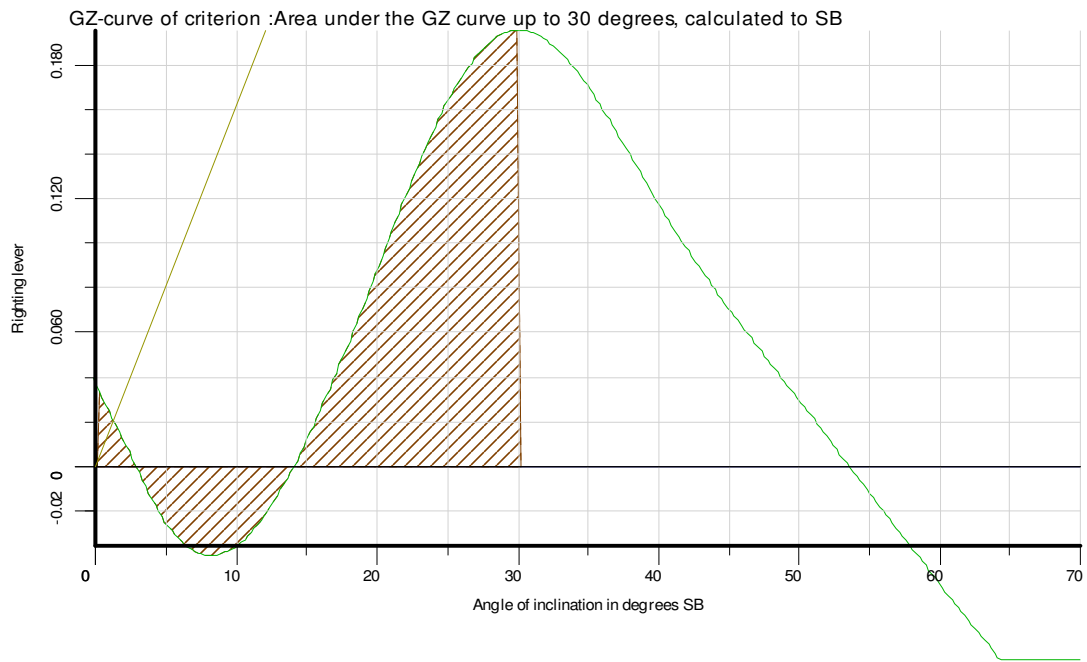
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Water on deck, Cross section at 7.000 m

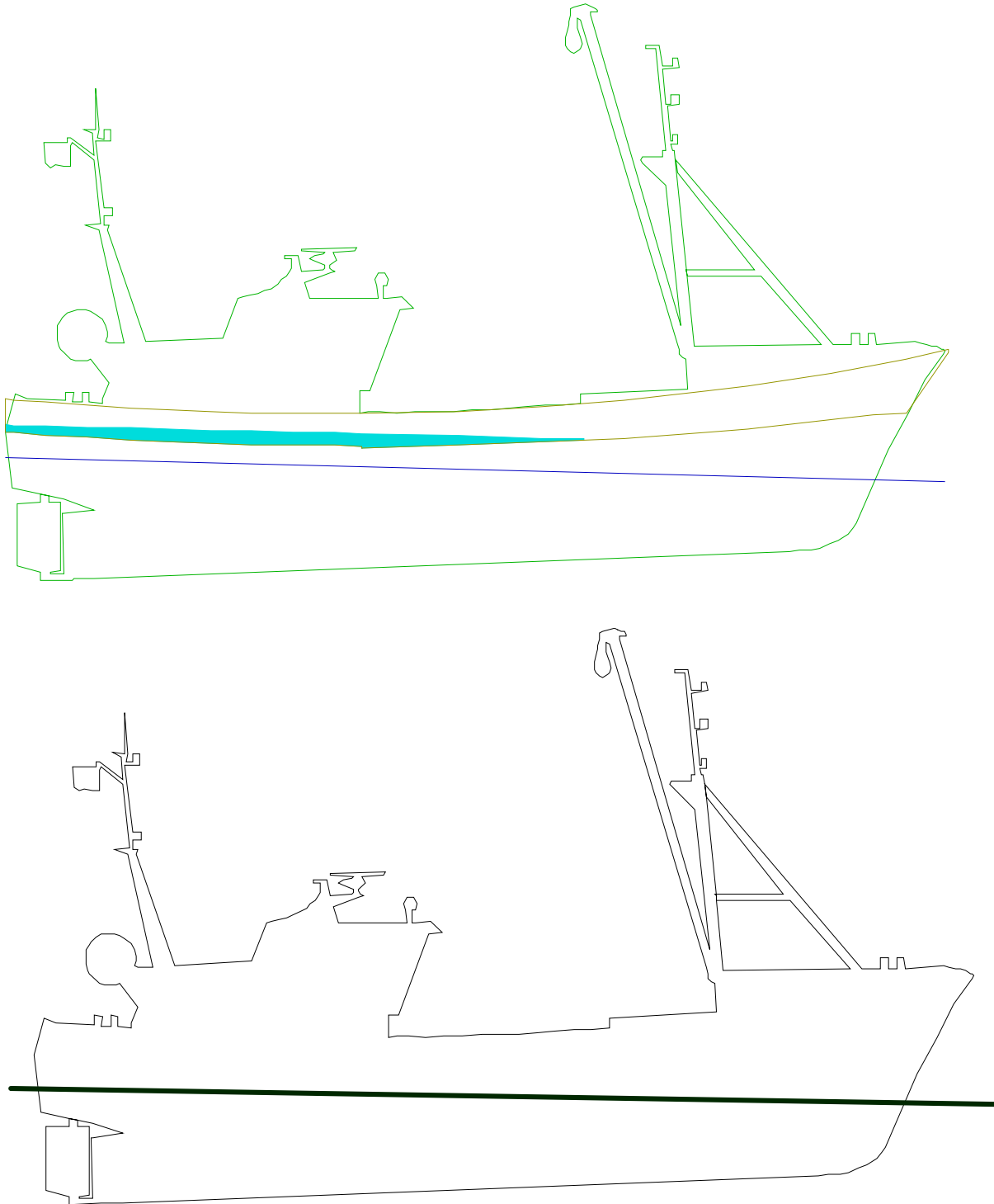


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Longitudinal view, no heel, cargo liquid



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

3.8. CONDITION : FASE 4, PS DERRICK AT 35 DEGREES, 15 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCg m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek. water	15.2	1.0250	15.375	-	-	-	-
SUBTOTAL	-	-	15.375	3.285	5.883	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
SB derrick to PS (-)	-	-	-0.600	10.000	17.000	1.700	-
SB derrick to PS (+)	-	-	0.600	10.000	17.000	0.000	-
TOTAL	-	-	185.662	2.606	9.405	-0.066	1.971

Hydrostatics

Volume	180.053 m ³
LCF	9.004 m
Mom. change trim	1.776 tonm/cm
Ton/cm immersion	1.170 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.406 m
Draft aft (App)	2.677 m
Draft fore (Fpp)	2.135 m
Trim	-0.541 m

Transverse stability

KM transverse	3.590 m		
VCg	2.603 m		
GM solid	0.988 m		
GG' correction	0.011 m		
G'M liquid	0.977 m	VCg'	2.613 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on deck	41.164	35.412	29.056	21.377	10.502
Level of water on deck	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.052
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.144	-0.087	-0.021	0.051	0.112
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on deck	9.033	11.040	13.709	15.000	15.000
Level of water on deck	2.460	2.757	3.029	3.215	3.295
Draft ship	2.304	2.348	2.387	2.407	2.408
Trim ship	-0.280	-0.344	-0.401	-0.438	-0.490
Displacement	179.545	181.602	184.337	185.662	185.662
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.548	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.378	3.013	2.541	1.584
NKsin(ϕ) water & cargo	3.660	3.378	3.013	2.541	1.584
Righting lever (GZ)	0.074	-0.005	-0.084	-0.134	-0.127
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION

O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Hopper : Water on deck

Density water on deck : 1.025 ton/m3

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on deck	15.002	15.000	14.999	15.000	15.000
Level of water on deck	3.299	3.300	3.299	3.295	3.215
Draft ship	2.406	2.406	2.406	2.408	2.407
Trim ship	-0.535	-0.541	-0.535	-0.490	-0.438
Displacement	185.660	185.662	185.660	185.662	185.663
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.548
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.643	0.000	0.643	1.584	2.541
NKsin(ϕ) water & cargo	0.643	0.000	0.643	1.584	2.541
Righting lever (GZ)	-0.091	0.066	0.041	0.005	-0.004
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on deck	13.709	11.040	9.033	10.502	21.377
Level of water on deck	3.029	2.757	2.460	2.279	2.323
Draft ship	2.387	2.348	2.304	2.279	2.323
Trim ship	-0.401	-0.344	-0.280	-0.247	-0.270
Displacement	184.337	181.602	179.545	181.052	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.013	3.378	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.013	3.378	3.660	3.854	4.026
Righting lever (GZ)	0.045	0.122	0.198	0.230	0.149
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on deck	29.056	35.412	41.164
Level of water on deck	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.058	-0.028	-0.105
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.137	0.144	0.030
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.196	0.087	0.030
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.237	0.021	0.030
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.246	-0.051	0.027
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.186	-0.112	0.012
25.00	PS	2.304	-0.280	-1.349	-1.098	-0.177	-0.074	0.003
20.00	PS	2.348	-0.344	-1.088	-0.892	-0.202	0.005	0.000
15.00	PS	2.387	-0.401	-0.821	-0.678	-0.227	0.084	0.004
10.00	PS	2.407	-0.438	-0.548	-0.456	-0.227	0.134	0.014
5.00	PS	2.408	-0.490	-0.275	-0.228	-0.173	0.127	0.026
2.00	PS	2.406	-0.535	-0.110	-0.091	-0.110	0.091	0.032
0.00		2.406	-0.541	0.000	0.000	-0.066	0.066	0.034
2.00	SB	2.406	-0.535	0.110	0.091	-0.022	0.041	0.036
5.00	SB	2.408	-0.490	0.275	0.228	0.041	0.005	0.037
10.00	SB	2.407	-0.438	0.548	0.456	0.096	-0.004	0.037
15.00	SB	2.387	-0.401	0.821	0.678	0.098	0.045	0.039
20.00	SB	2.348	-0.344	1.088	0.892	0.074	0.122	0.046
25.00	SB	2.304	-0.280	1.349	1.098	0.053	0.198	0.060
30.00	SB	2.279	-0.247	1.602	1.304	0.068	0.230	0.079
40.00	SB	2.323	-0.270	2.014	1.717	0.148	0.149	0.114
50.00	SB	2.379	-0.232	2.298	2.082	0.158	0.058	0.132
60.00	SB	2.442	-0.010	2.497	2.388	0.137	-0.028	0.135
70.00	SB	2.535	0.492	2.618	2.625	0.098	-0.105	0.135

Statical angle of inclination is 20.32 degrees to portside

Statical angle of inclination is 10.68 degrees to starboard

Contour :

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.406 m
Trim	-0.541 m
Statical angle of inclination	20.32 degrees PS
Statical angle of inclination	10.68 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.977 meter
Maximum GZ at 30 degrees or more	0.240	0.113 meter
Top of the GZ curve at least at	25.000	30.700 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.012 mrad
Area under the GZ curve up to 40 degrees	0.108	0.027 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.016 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	70.000 degrees PS
----- Additional information		
Range of positive stability	0.000	26.495 degrees
Angle of vanishing stability	0.000	46.814 degrees PS
Roll Period acc Irish authorities	0.000	4.249 sec
Roll Period acc IS 2008	1.000	5.115 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.977 meter
Maximum GZ at 30 degrees or more	0.240	0.230 meter
Top of the GZ curve at least at	25.000	30.041 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.045 mrad
Area under the GZ curve up to 40 degrees	0.108	0.080 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.035 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	21.567 degrees SB
----- Additional information		
Range of positive stability	0.000	46.083 degrees
Angle of vanishing stability	0.000	56.764 degrees SB
Roll Period acc Irish authorities	0.000	4.249 sec
Roll Period acc IS 2008	1.000	5.115 sec

VCG'

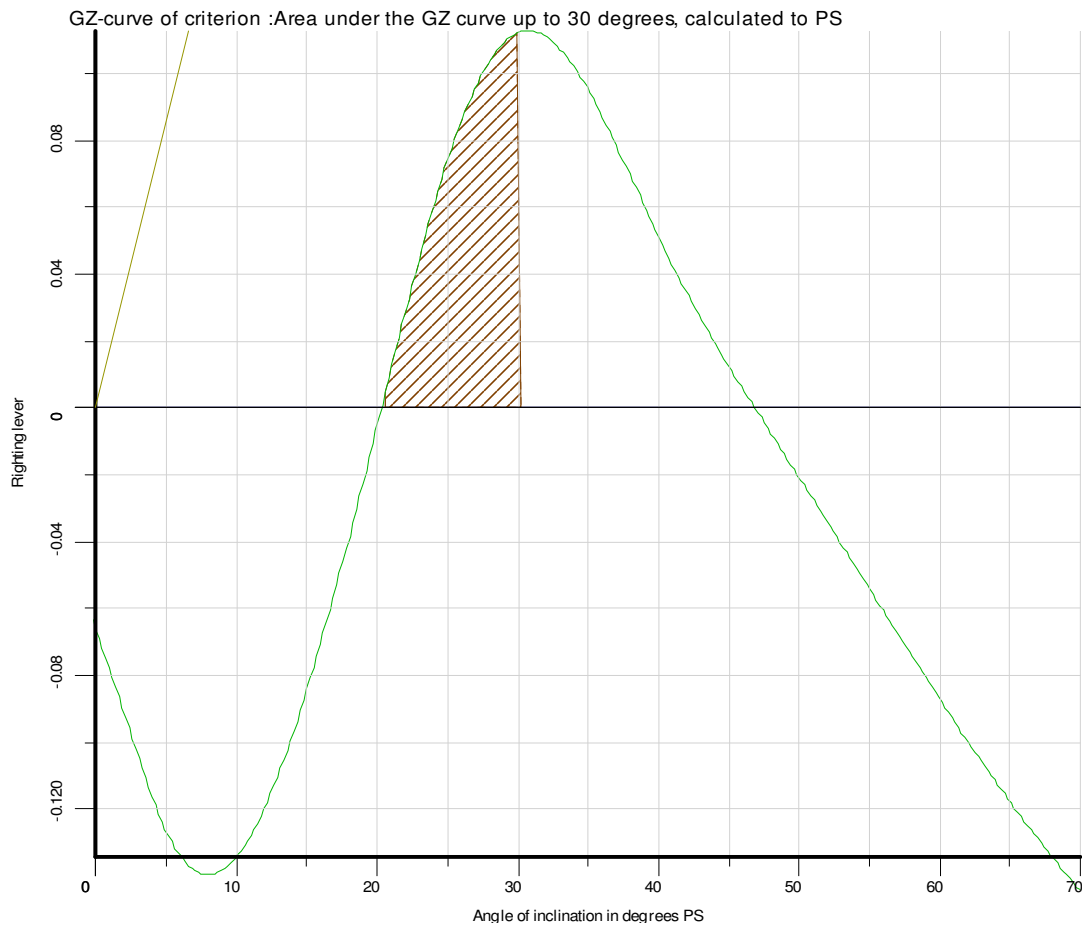
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

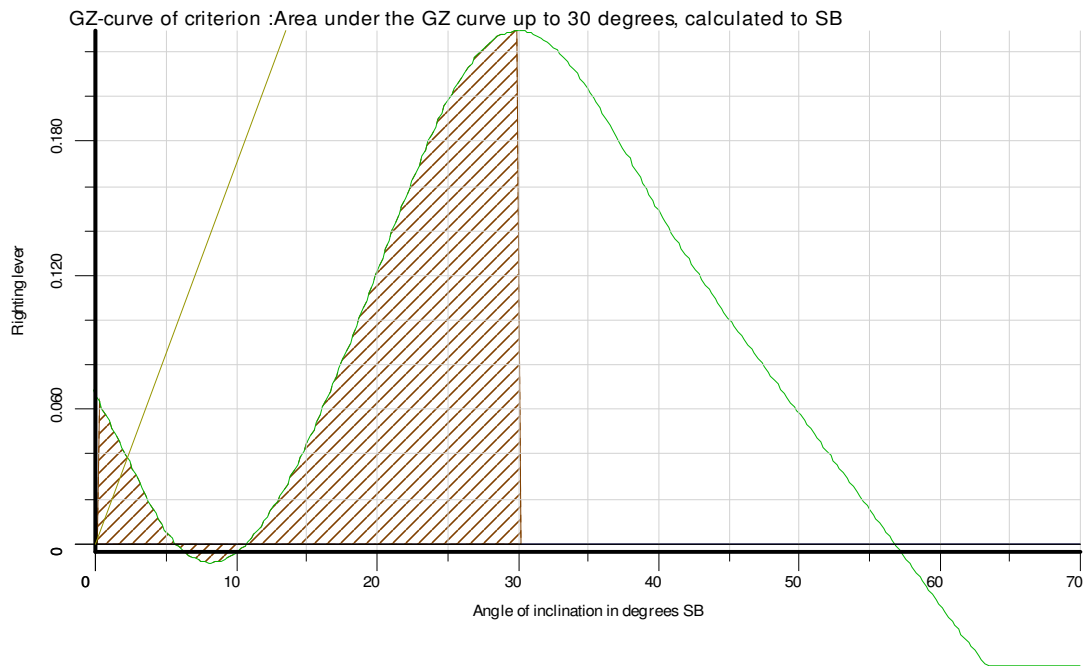
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Water on deck, Cross section at 7.000 m

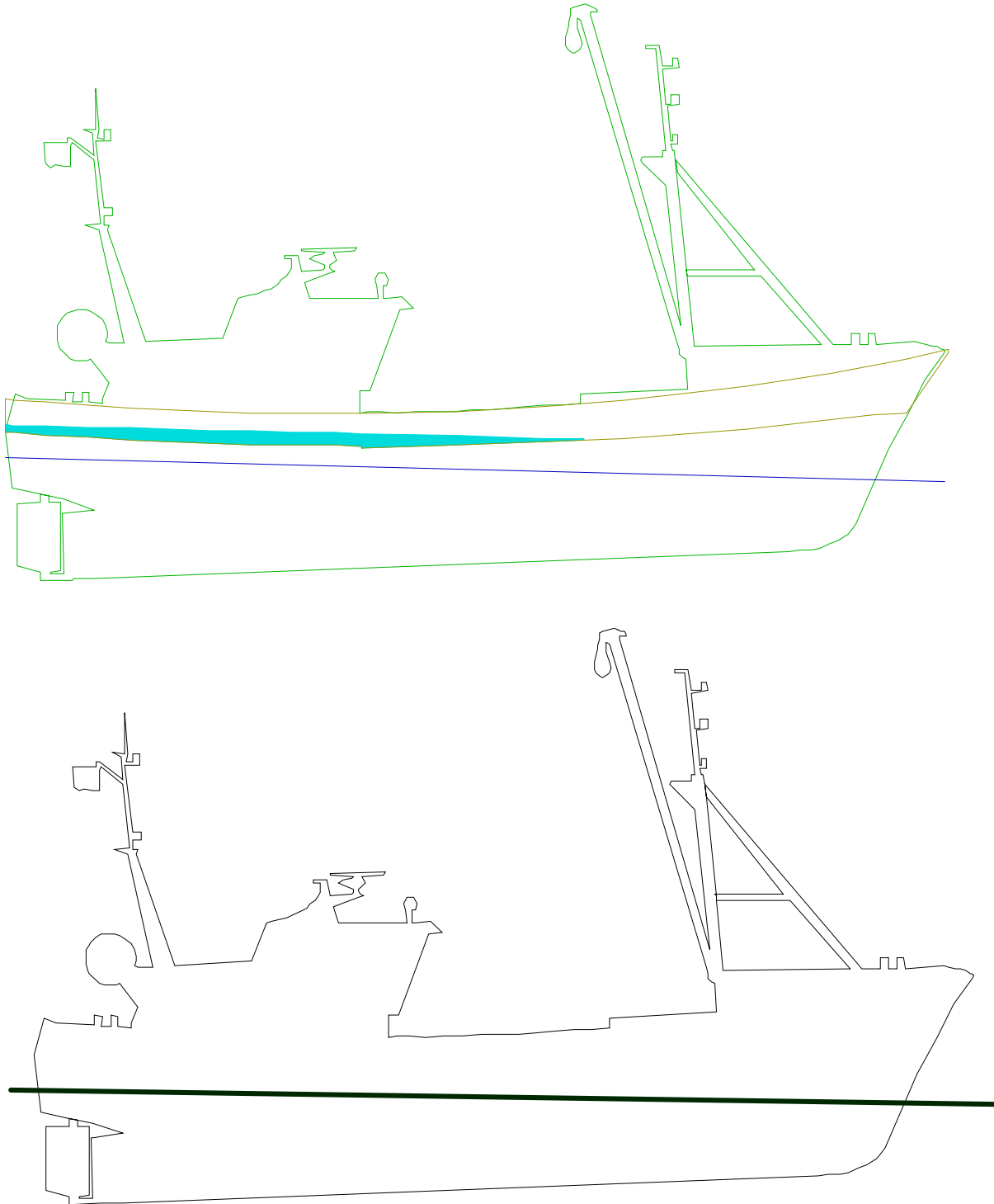


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 13:38:14

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Longitudinal view, no heel, cargo liquid



4. STABILITY CALCULATIONS WITH WIND (7BFT) [FULL OUTPUT]

4.1. CONDITION : INITIAL CONDITION DURING ACCIDENT, PS DERRICK AT 20 DEGREES

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	0.0	1.0250	0.000	-	-	-	-
SUBTOTAL	-	-	0.000	4.000	8.817	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
TOTAL	-	-	170.287	2.561	9.723	-0.034	1.971

Hydrostatics

Volume	165.142 m ³
LCF	9.060 m
Mom. change trim	1.745 tonm/cm
Ton/cm immersion	1.159 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.293 m
Draft aft (App)	2.428 m
Draft fore (Fpp)	2.159 m
Trim	-0.268 m

Transverse stability

KM transverse	3.171 m		
VCG	2.561 m		
GM solid	0.610 m		
GG' correction	0.012 m		
G'M liquid	0.598 m	VCG'	2.573 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:00

Condition : Condition during accident, PS derrick at 20 degrees

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.377	10.501
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.048
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.147	-0.083	-0.011	0.067	0.135
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	0.000	0.000	0.000	0.000	0.000
Level of water on cargo	0.000	0.000	0.000	0.000	0.000
Draft ship	2.222	2.252	2.272	2.285	2.291
Trim ship	-0.166	-0.205	-0.235	-0.256	-0.266
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	1.347	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	0.229	0.176	0.123	0.070	0.018
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:00

Condition : Condition during accident, PS derrick at 20 degrees

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	0.000	0.000	0.000	0.000	0.000
Level of water on cargo	0.000	0.000	0.000	0.000	0.000
Draft ship	2.293	2.293	2.293	2.291	2.285
Trim ship	-0.268	-0.268	-0.268	-0.266	-0.256
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	0.111	0.000	0.111	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	-0.013	0.034	0.055	0.086	0.137
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	0.000	0.000	0.000	10.501	21.377
Level of water on cargo	0.000	0.000	0.000	2.279	2.323
Draft ship	2.272	2.252	2.222	2.279	2.323
Trim ship	-0.235	-0.205	-0.166	-0.247	-0.270
Displacement	170.287	170.287	170.287	181.048	192.196
NKsin(ϕ) closed ship	0.822	1.088	1.347	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	3.854	4.026
NKsin(ϕ) water & cargo	0.000	0.000	0.000	3.854	4.026
Righting lever (GZ)	0.188	0.240	0.290	0.191	0.114
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.026	-0.055	-0.128
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:00

Condition : Condition during accident, PS derrick at 20 degrees

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.127	0.147	0.081
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.180	0.083	0.081
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.216	0.011	0.081
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.220	-0.067	0.076
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.155	-0.135	0.060
25.00	PS	2.222	-0.166	-1.347	-1.087	-0.031	-0.229	0.044
20.00	PS	2.252	-0.205	-1.088	-0.880	-0.032	-0.176	0.025
15.00	PS	2.272	-0.235	-0.822	-0.666	-0.033	-0.123	0.013
10.00	PS	2.285	-0.256	-0.550	-0.447	-0.033	-0.070	0.004
5.00	PS	2.291	-0.266	-0.276	-0.224	-0.034	-0.018	0.000
2.00	PS	2.293	-0.268	-0.111	-0.090	-0.034	0.013	0.000
0.00		2.293	-0.268	0.000	0.000	-0.034	0.034	0.001
2.00	SB	2.293	-0.268	0.111	0.090	-0.034	0.055	0.003
5.00	SB	2.291	-0.266	0.276	0.224	-0.034	0.086	0.006
10.00	SB	2.285	-0.256	0.550	0.447	-0.033	0.137	0.016
15.00	SB	2.272	-0.235	0.822	0.666	-0.033	0.188	0.030
20.00	SB	2.252	-0.205	1.088	0.880	-0.032	0.240	0.049
25.00	SB	2.222	-0.166	1.347	1.087	-0.031	0.290	0.072
30.00	SB	2.279	-0.247	1.602	1.312	0.099	0.191	0.094
40.00	SB	2.323	-0.270	2.014	1.727	0.174	0.114	0.118
50.00	SB	2.379	-0.232	2.298	2.093	0.179	0.026	0.131
60.00	SB	2.442	-0.010	2.497	2.400	0.153	-0.055	0.132
70.00	SB	2.535	0.492	2.618	2.637	0.108	-0.128	0.132

Statical angle of inclination is 3.25 degrees to portside

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:00

Condition : Condition during accident, PS derrick at 20 degrees

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.293 m
Trim	-0.268 m
Statical angle of inclination	3.25 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.135 meter
Top of the GZ curve at least at	25.000	24.522 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.060 mrad
Area under the GZ curve up to 40 degrees	0.108	0.076 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.015 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.102 meter
Top of the GZ curve at least at	25.000	24.522 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.045 mrad
Area under the GZ curve up to 40 degrees	0.108	0.055 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.009 mrad
----- Additional information		
Range of positive stability	0.000	38.558 degrees
Angle of vanishing stability	0.000	45.077 degrees PS
Roll Period acc Irish authorities	0.000	5.430 sec
Roll Period acc IS 2008	1.000	6.580 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.191 meter
Top of the GZ curve at least at	25.000	24.442 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.093 mrad
Area under the GZ curve up to 40 degrees	0.108	0.117 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.024 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.157 meter
Top of the GZ curve at least at	25.000	24.442 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.075 mrad
Area under the GZ curve up to 40 degrees	0.108	0.094 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.018 mrad
----- Additional information		
Range of positive stability	0.000	57.062 degrees
Angle of vanishing stability	0.000	57.052 degrees SB
Roll Period acc Irish authorities	0.000	5.430 sec
Roll Period acc IS 2008	1.000	6.580 sec

VCG'

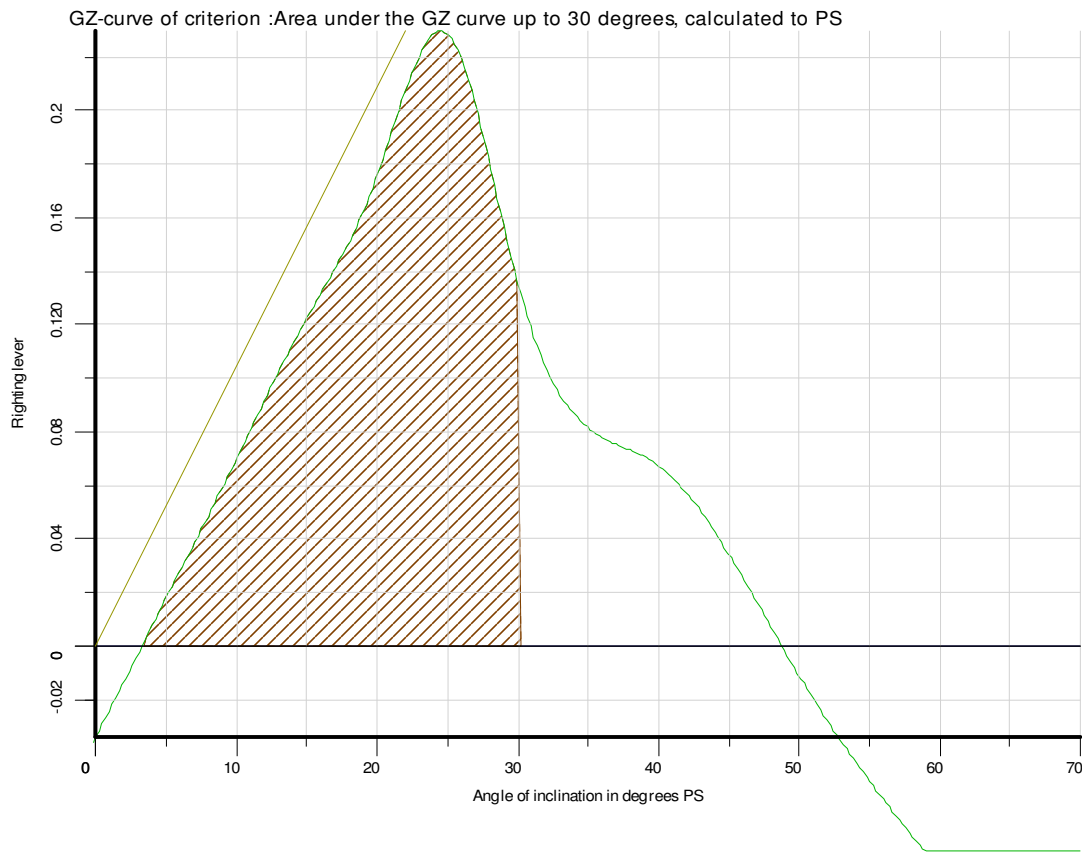
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

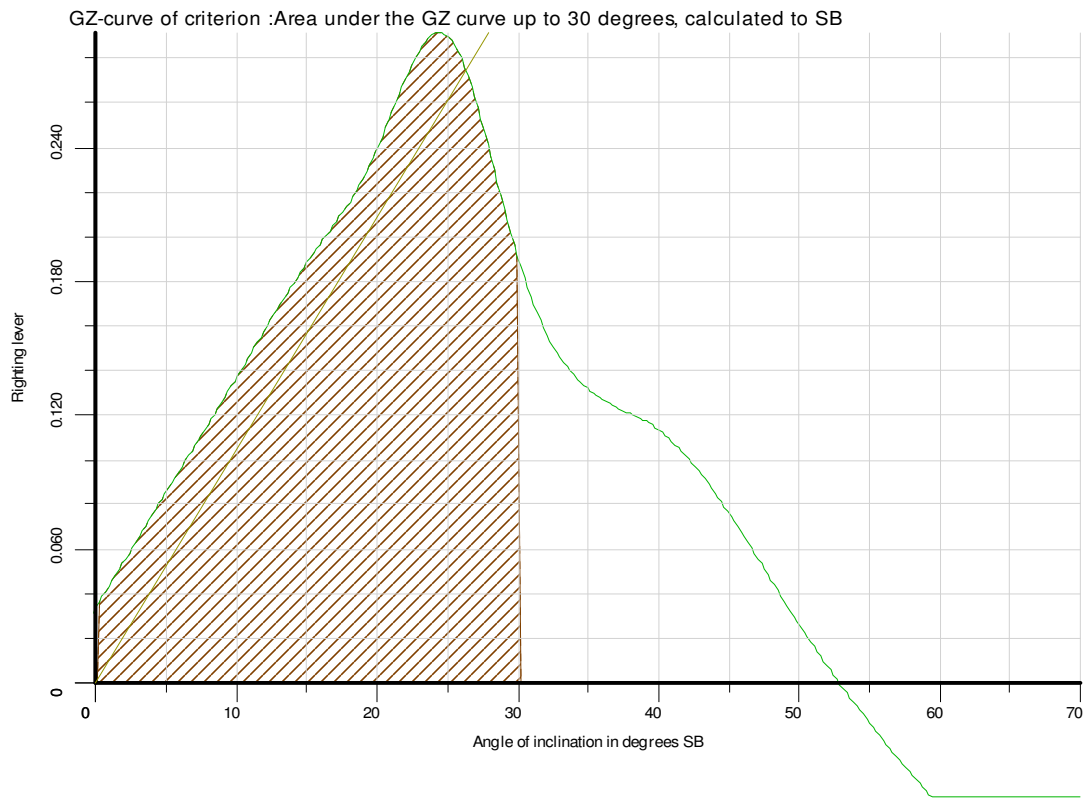
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:00

Condition : Condition during accident, PS derrick at 20 degrees





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:00

Condition : Condition during accident, PS derrick at 20 degrees

Water on deck, Cross section at 7.000 m

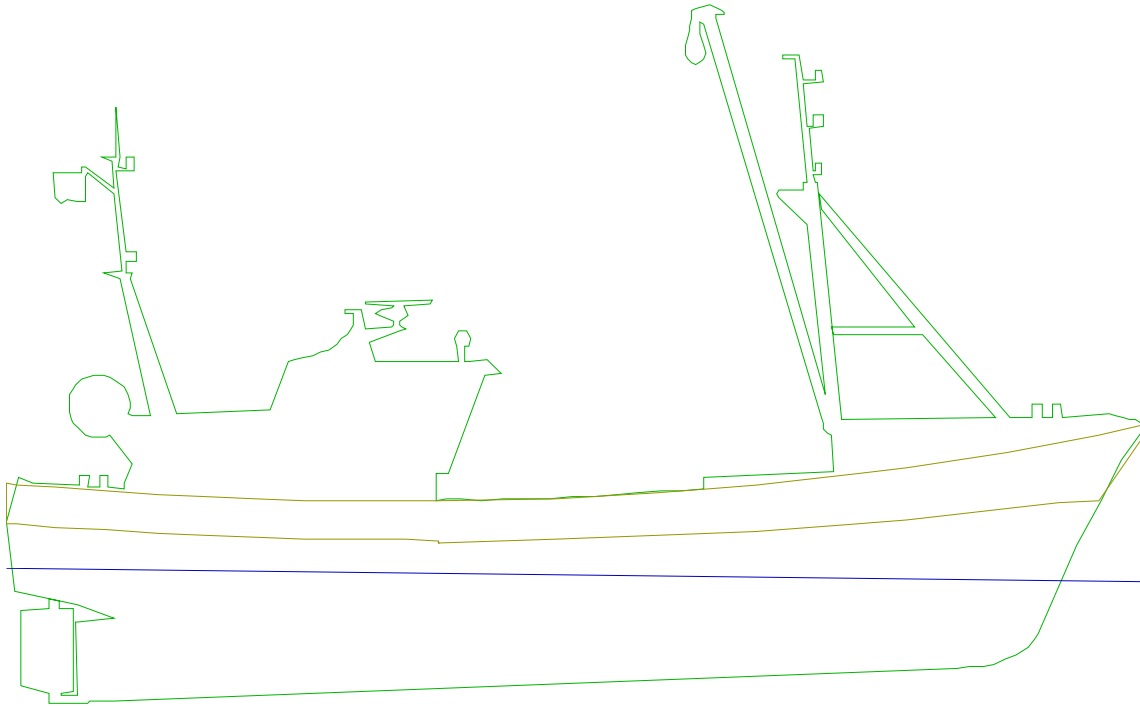


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

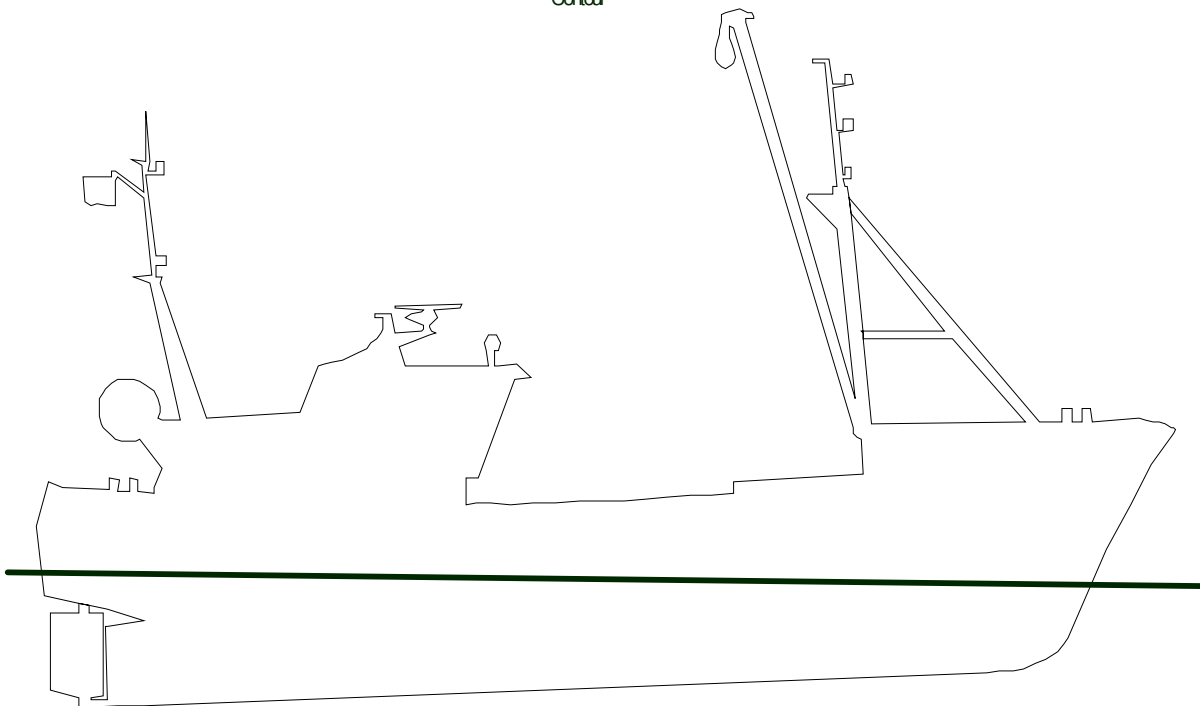
18 Oct 2019 14:22:00

Condition : Condition during accident, PS derrick at 20 degrees

Longitudinal view, no heel, cargo liquid



Contour



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

4.2. CONDITION : INITIAL CONDITION DURING ACCIDENT, PS DERRICK AT 35 DEGREES

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	0.0	1.0250	0.000	-	-	-	-
SUBTOTAL	-	-	0.000	4.000	8.817	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
TOTAL	-	-	170.287	2.544	9.723	-0.066	1.971

Hydrostatics

Volume	165.142 m ³
LCF	9.060 m
Mom. change trim	1.745 tonm/cm
Ton/cm immersion	1.159 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.293 m
Draft aft (App)	2.428 m
Draft fore (Fpp)	2.159 m
Trim	-0.268 m

Transverse stability

KM transverse	3.166 m	
VCG	2.544 m	
GM solid	0.622 m	
GG' correction	0.012 m	
G'M liquid	0.610 m	VCG' 2.556 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:01

Condition : Condition during accident, PS derrick at 35 degrees

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.377	10.501
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.048
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.143	-0.085	-0.018	0.055	0.117
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	0.000	0.000	0.000	0.000	0.000
Level of water on cargo	0.000	0.000	0.000	0.000	0.000
Draft ship	2.222	2.252	2.272	2.285	2.291
Trim ship	-0.166	-0.205	-0.235	-0.256	-0.266
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	1.347	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	0.207	0.151	0.096	0.041	-0.013
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:01

Condition : Condition during accident, PS derrick at 35 degrees

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	0.000	0.000	0.000	0.000	0.000
Level of water on cargo	0.000	0.000	0.000	0.000	0.000
Draft ship	2.293	2.293	2.293	2.291	2.285
Trim ship	-0.268	-0.268	-0.268	-0.266	-0.256
Displacement	170.287	170.287	170.287	170.287	170.287
NKsin(ϕ) closed ship	0.111	0.000	0.111	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water & cargo	0.000	0.000	0.000	0.000	0.000
Righting lever (GZ)	-0.045	0.066	0.088	0.119	0.172
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	0.000	0.000	0.000	10.501	21.377
Level of water on cargo	0.000	0.000	0.000	2.279	2.323
Draft ship	2.272	2.252	2.222	2.279	2.323
Trim ship	-0.235	-0.205	-0.166	-0.247	-0.270
Displacement	170.287	170.287	170.287	181.048	192.196
NKsin(ϕ) closed ship	0.822	1.088	1.347	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.000	0.000	0.000	3.854	4.026
NKsin(ϕ) water & cargo	0.000	0.000	0.000	3.854	4.026
Righting lever (GZ)	0.224	0.276	0.327	0.225	0.145
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.055	-0.030	-0.106
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:01

Condition : Condition during accident, PS derrick at 35 degrees

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.136	0.143	0.066
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.194	0.085	0.066
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.234	0.018	0.066
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.242	-0.055	0.062
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.181	-0.117	0.049
25.00	PS	2.222	-0.166	-1.347	-1.080	-0.060	-0.207	0.034
20.00	PS	2.252	-0.205	-1.088	-0.874	-0.062	-0.151	0.018
15.00	PS	2.272	-0.235	-0.822	-0.661	-0.064	-0.096	0.007
10.00	PS	2.285	-0.256	-0.550	-0.444	-0.065	-0.041	0.001
5.00	PS	2.291	-0.266	-0.276	-0.223	-0.066	0.013	0.000
2.00	PS	2.293	-0.268	-0.111	-0.089	-0.066	0.045	0.002
0.00		2.293	-0.268	0.000	0.000	-0.066	0.066	0.004
2.00	SB	2.293	-0.268	0.111	0.089	-0.066	0.088	0.006
5.00	SB	2.291	-0.266	0.276	0.223	-0.066	0.119	0.012
10.00	SB	2.285	-0.256	0.550	0.444	-0.065	0.172	0.024
15.00	SB	2.272	-0.235	0.822	0.661	-0.064	0.224	0.042
20.00	SB	2.252	-0.205	1.088	0.874	-0.062	0.276	0.063
25.00	SB	2.222	-0.166	1.347	1.080	-0.060	0.327	0.090
30.00	SB	2.279	-0.247	1.602	1.304	0.073	0.225	0.115
40.00	SB	2.323	-0.270	2.014	1.717	0.152	0.145	0.145
50.00	SB	2.379	-0.232	2.298	2.082	0.162	0.055	0.163
60.00	SB	2.442	-0.010	2.497	2.388	0.139	-0.030	0.166
70.00	SB	2.535	0.492	2.618	2.625	0.099	-0.106	0.166

Statical angle of inclination is 6.18 degrees to portside

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:01

Condition : Condition during accident, PS derrick at 35 degrees

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.293 m
Trim	-0.268 m
Statical angle of inclination	6.18 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.610 meter
Maximum GZ at 30 degrees or more	0.240	0.117 meter
Top of the GZ curve at least at	25.000	24.585 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.049 mrad
Area under the GZ curve up to 40 degrees	0.108	0.062 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.013 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.083 meter
Top of the GZ curve at least at	25.000	24.585 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.036 mrad
Area under the GZ curve up to 40 degrees	0.108	0.043 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.007 mrad
----- Additional information		
Range of positive stability	0.000	34.537 degrees
Angle of vanishing stability	0.000	43.856 degrees PS
Roll Period acc Irish authorities	0.000	5.377 sec
Roll Period acc IS 2008	1.000	6.516 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.610 meter
Maximum GZ at 30 degrees or more	0.240	0.225 meter
Top of the GZ curve at least at	25.000	24.429 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.111 mrad
Area under the GZ curve up to 40 degrees	0.108	0.141 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.030 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.191 meter
Top of the GZ curve at least at	25.000	24.429 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.094 mrad
Area under the GZ curve up to 40 degrees	0.108	0.118 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.024 mrad
----- Additional information		
Range of positive stability	0.000	63.524 degrees
Angle of vanishing stability	0.000	60.505 degrees SB
Roll Period acc Irish authorities	0.000	5.377 sec
Roll Period acc IS 2008	1.000	6.516 sec

VCG'

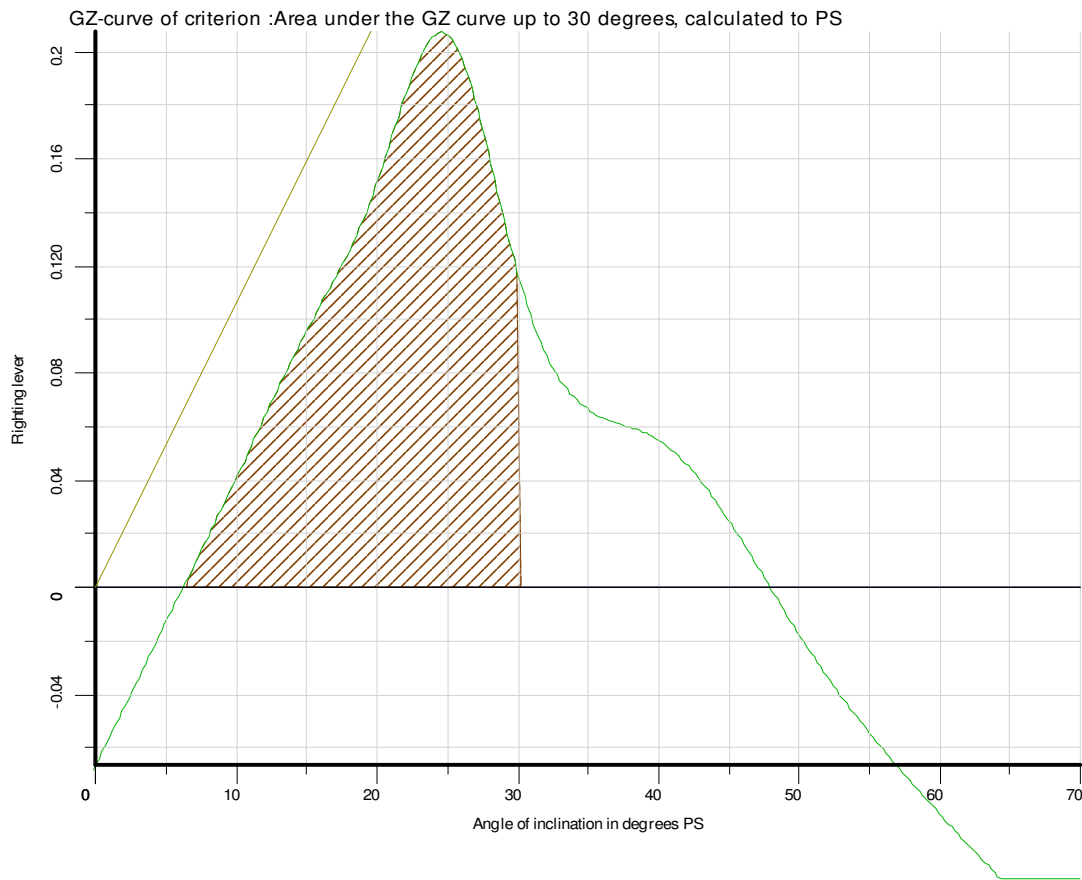
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

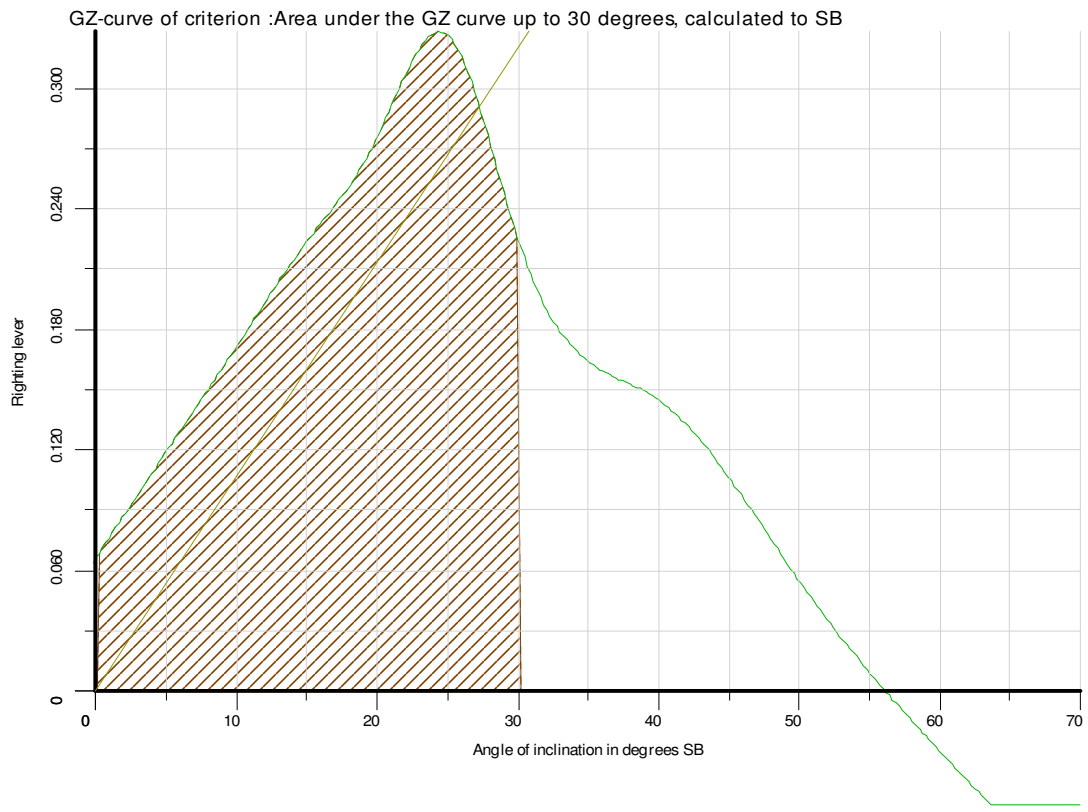
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:01

Condition : Condition during accident, PS derrick at 35 degrees





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:01

Condition : Condition during accident, PS derrick at 35 degrees

Water on deck, Cross section at 7.000 m

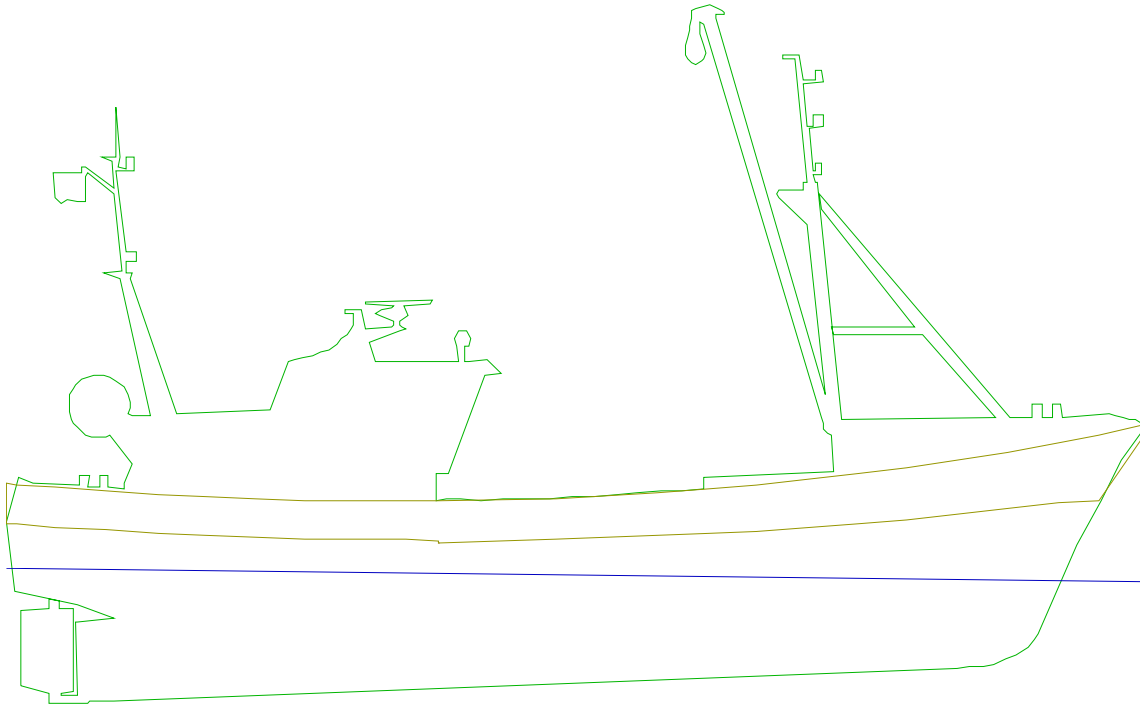


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

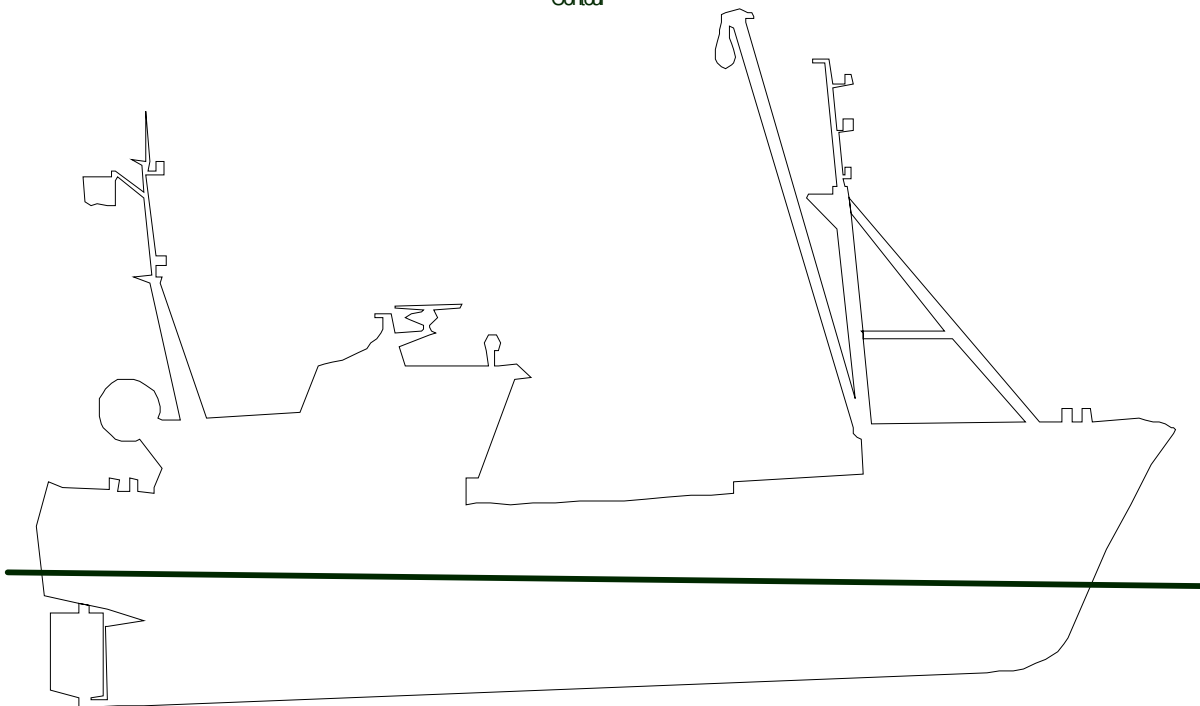
18 Oct 2019 14:22:01

Condition : Condition during accident, PS derrick at 35 degrees

Longitudinal view, no heel, cargo liquid



Contour



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

4.3. CONDITION : FASE 2, PS DERRICK AT 20 DEGREES, 5 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	5.1	1.0250	5.125	-	-	-	-
SUBTOTAL	-	-	5.125	3.137	6.927	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
TOTAL	-	-	175.412	2.578	9.641	-0.033	1.971

Hydrostatics

Volume	170.113 m ³
LCF	9.046 m
Mom. change trim	1.759 tonm/cm
Ton/cm immersion	1.163 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.333 m
Draft aft (App)	2.498 m
Draft fore (Fpp)	2.168 m
Trim	-0.330 m

Transverse stability

KM transverse	3.178 m	
VCG	2.578 m	
GM solid	0.599 m	
GG' correction	0.011 m	
G'M liquid	0.588 m	VCG' 2.589 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.376	10.503
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.191	181.058
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.147	-0.083	-0.011	0.067	0.135
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	5.000	5.001	5.000	5.000	5.000
Level of water on cargo	2.274	2.509	2.726	2.925	3.101
Draft ship	2.268	2.296	2.314	2.325	2.331
Trim ship	-0.230	-0.272	-0.304	-0.325	-0.332
Displacement	175.412	175.412	175.412	175.412	175.413
NKsin(ϕ) closed ship	1.348	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.731	3.492	3.216	2.886	2.393
NKsin(ϕ) water & cargo	3.731	3.492	3.216	2.886	2.393
Righting lever (GZ)	0.154	0.101	0.050	-0.001	-0.045
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION

O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Hopper : Water on deck

Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	5.000	5.000	5.000	5.001	5.000
Level of water on cargo	3.164	3.171	3.164	3.101	2.925
Draft ship	2.333	2.333	2.333	2.331	2.325
Trim ship	-0.331	-0.330	-0.331	-0.332	-0.325
Displacement	175.412	175.412	175.413	175.412	175.412
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	1.348	0.000	1.349	2.393	2.886
NKsin(ϕ) water & cargo	1.348	0.000	1.349	2.393	2.886
Righting lever (GZ)	-0.049	0.033	0.017	0.021	0.064
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	5.000	5.000	5.000	10.503	21.376
Level of water on cargo	2.726	2.509	2.274	2.279	2.323
Draft ship	2.314	2.296	2.268	2.279	2.323
Trim ship	-0.304	-0.272	-0.230	-0.247	-0.270
Displacement	175.413	175.412	175.412	181.057	192.191
NKsin(ϕ) closed ship	0.822	1.088	1.348	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.216	3.492	3.731	3.854	4.026
NKsin(ϕ) water & cargo	3.216	3.492	3.731	3.854	4.026
Righting lever (GZ)	0.113	0.163	0.213	0.191	0.114
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.026	-0.055	-0.128
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.127	0.147	0.056
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.180	0.083	0.056
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.216	0.011	0.056
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.220	-0.067	0.051
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.155	-0.135	0.033
25.00	PS	2.268	-0.230	-1.348	-1.096	-0.098	-0.154	0.020
20.00	PS	2.296	-0.272	-1.088	-0.887	-0.100	-0.101	0.009
15.00	PS	2.314	-0.304	-0.822	-0.671	-0.101	-0.050	0.002
10.00	PS	2.325	-0.325	-0.550	-0.450	-0.100	0.001	0.000
5.00	PS	2.331	-0.332	-0.276	-0.226	-0.095	0.045	0.002
2.00	PS	2.333	-0.331	-0.110	-0.090	-0.069	0.049	0.005
0.00		2.333	-0.330	0.000	0.000	-0.033	0.033	0.006
2.00	SB	2.333	-0.331	0.110	0.090	0.003	0.017	0.007
5.00	SB	2.331	-0.332	0.276	0.226	0.029	0.021	0.008
10.00	SB	2.325	-0.325	0.550	0.450	0.035	0.064	0.011
15.00	SB	2.314	-0.304	0.822	0.671	0.037	0.113	0.019
20.00	SB	2.296	-0.272	1.088	0.887	0.038	0.163	0.031
25.00	SB	2.268	-0.230	1.348	1.096	0.038	0.213	0.048
30.00	SB	2.279	-0.247	1.602	1.312	0.099	0.191	0.066
40.00	SB	2.323	-0.270	2.014	1.727	0.174	0.114	0.092
50.00	SB	2.379	-0.232	2.298	2.093	0.179	0.026	0.105
60.00	SB	2.442	-0.010	2.497	2.400	0.153	-0.055	0.105
70.00	SB	2.535	0.492	2.618	2.637	0.108	-0.128	0.105

Statical angle of inclination is 10.05 degrees to portside

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.333 m
Trim	-0.330 m
Statical angle of inclination	10.05 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.588 meter
Maximum GZ at 30 degrees or more	0.240	0.135 meter
Top of the GZ curve at least at	25.000	25.924 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.033 mrad
Area under the GZ curve up to 40 degrees	0.108	0.051 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.018 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.103 meter
Top of the GZ curve at least at	25.000	25.924 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.023 mrad
Area under the GZ curve up to 40 degrees	0.108	0.035 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.012 mrad
----- Additional information		
Range of positive stability	0.000	31.308 degrees
Angle of vanishing stability	0.000	44.561 degrees PS
Roll Period acc Irish authorities	0.000	5.476 sec
Roll Period acc IS 2008	1.000	6.620 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.588 meter
Maximum GZ at 30 degrees or more	0.240	0.191 meter
Top of the GZ curve at least at	25.000	25.726 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.060 mrad
Area under the GZ curve up to 40 degrees	0.108	0.086 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.027 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.158 meter
Top of the GZ curve at least at	25.000	25.726 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.044 mrad
Area under the GZ curve up to 40 degrees	0.108	0.065 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.021 mrad
----- Additional information		
Range of positive stability	0.000	42.594 degrees
Angle of vanishing stability	0.000	49.272 degrees SB
Roll Period acc Irish authorities	0.000	5.476 sec
Roll Period acc IS 2008	1.000	6.620 sec

VCG'

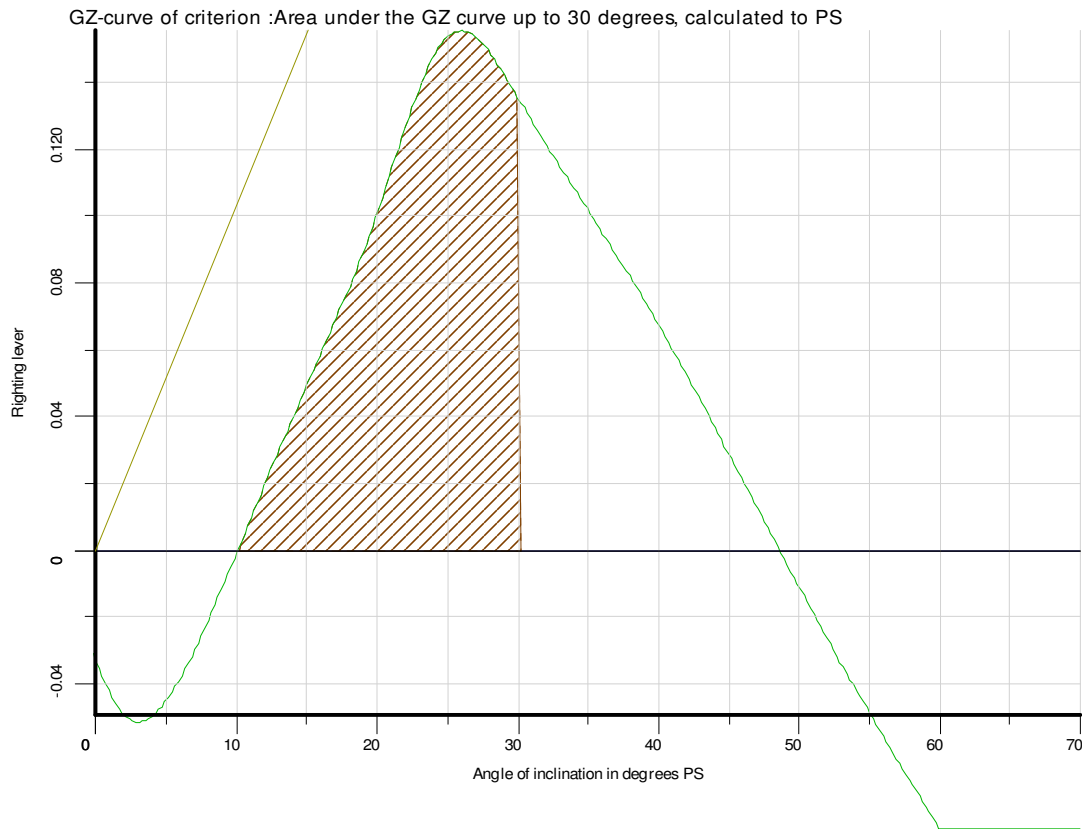
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

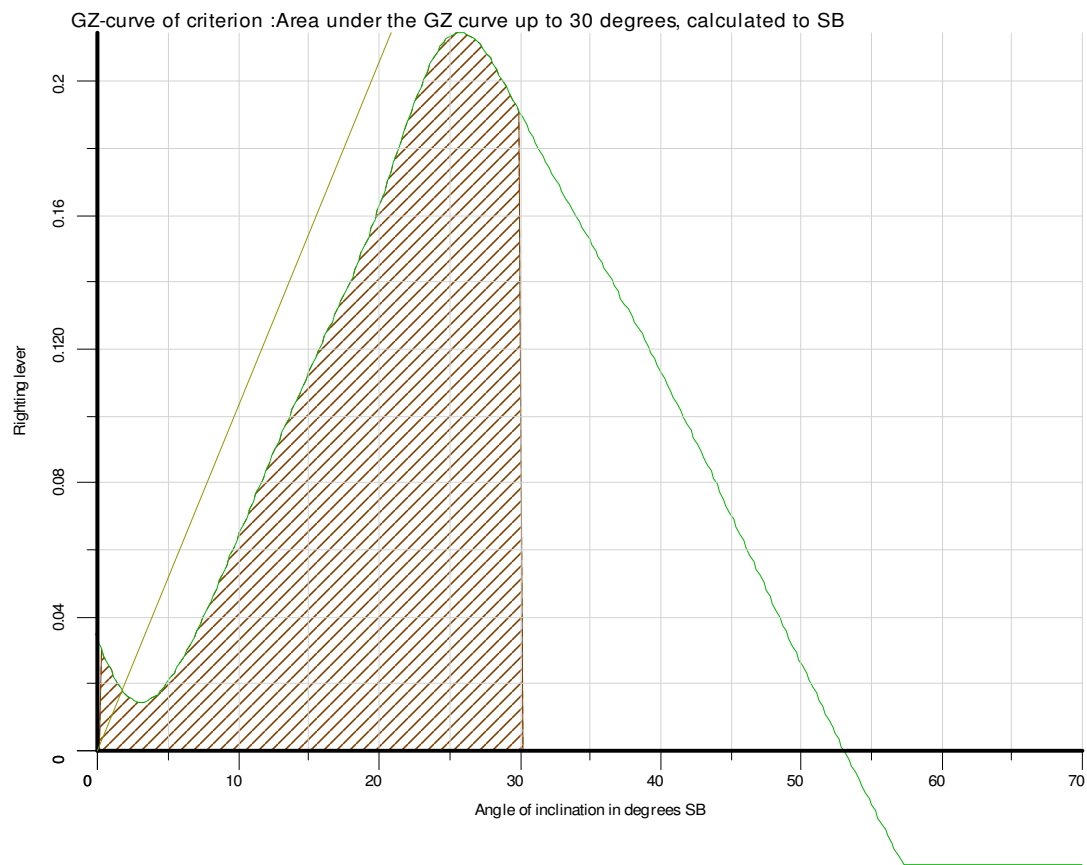
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Water on deck, Cross section at 7.000 m

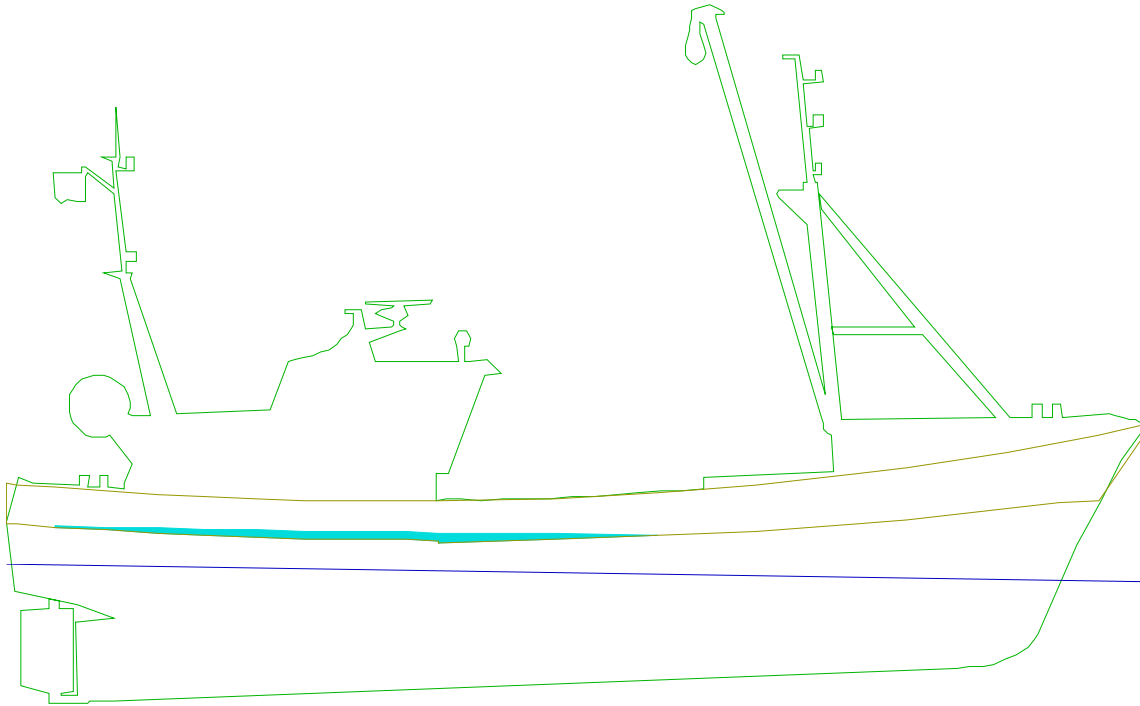


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

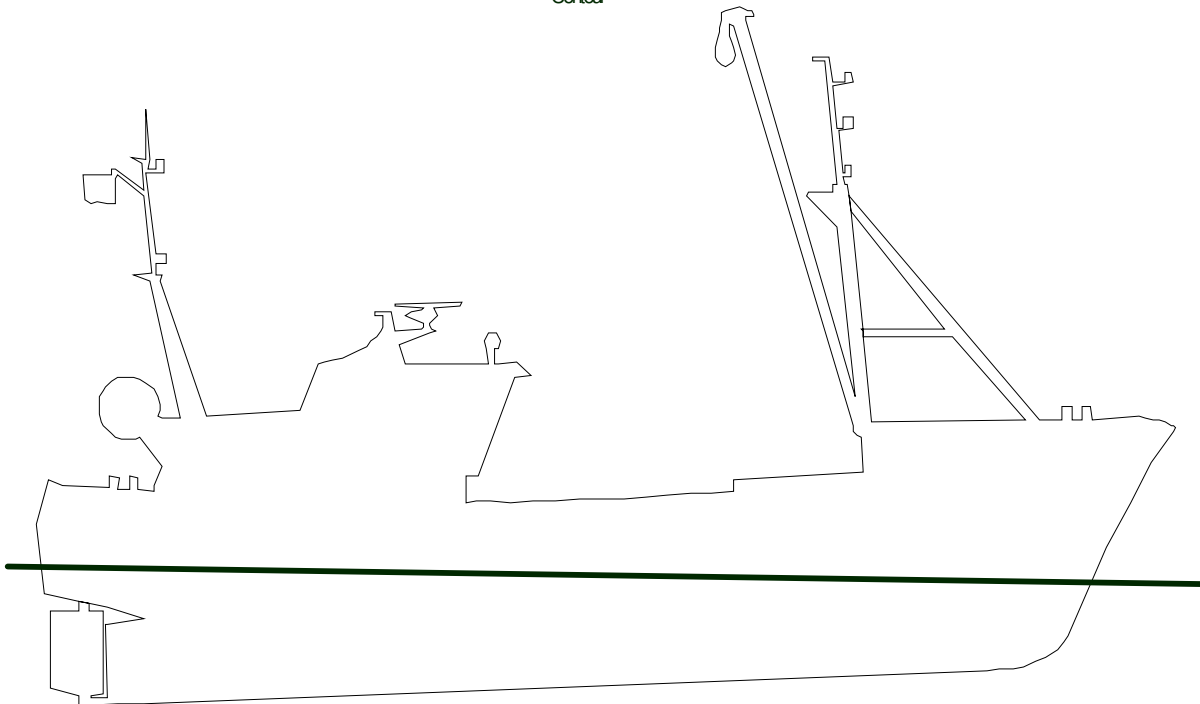
18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 20 degrees, 5 m3 water on deck

Longitudinal view, no heel, cargo liquid



Contour



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

4.4. CONDITION : FASE 2, PS DERRICK AT 35 DEGREES, 5 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek, water	5.1	1.0250	5.125	-	-	-	-
SUBTOTAL	-	-	5.125	3.137	6.927	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
TOTAL	-	-	175.412	2.562	9.641	-0.064	1.971

Hydrostatics

Volume	170.113 m ³
LCF	9.046 m
Mom. change trim	1.759 tonm/cm
Ton/cm immersion	1.163 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.333 m
Draft aft (App)	2.498 m
Draft fore (Fpp)	2.168 m
Trim	-0.330 m

Transverse stability

KM transverse	3.171 m	
VCG	2.562 m	
GM solid	0.609 m	
GG' correction	0.011 m	
G'M liquid	0.598 m	VCG' 2.573 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.376	10.503
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.191	181.058
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.143	-0.085	-0.018	0.055	0.117
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	5.000	5.001	5.000	5.000	5.000
Level of water on cargo	2.274	2.509	2.726	2.925	3.101
Draft ship	2.268	2.296	2.314	2.325	2.331
Trim ship	-0.230	-0.272	-0.304	-0.325	-0.332
Displacement	175.412	175.412	175.412	175.412	175.413
NKsin(ϕ) closed ship	1.348	1.088	0.822	0.550	0.276
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.731	3.492	3.216	2.886	2.393
NKsin(ϕ) water & cargo	3.731	3.492	3.216	2.886	2.393
Righting lever (GZ)	0.132	0.077	0.023	-0.029	-0.074
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	5.000	5.000	5.000	5.001	5.000
Level of water on cargo	3.164	3.171	3.164	3.101	2.925
Draft ship	2.333	2.333	2.333	2.331	2.325
Trim ship	-0.331	-0.330	-0.331	-0.332	-0.325
Displacement	175.412	175.412	175.413	175.412	175.412
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.276	0.550
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	1.348	0.000	1.349	2.393	2.886
NKsin(ϕ) water & cargo	1.348	0.000	1.349	2.393	2.886
Righting lever (GZ)	-0.080	0.064	0.049	0.054	0.098
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	5.000	5.000	5.000	10.503	21.376
Level of water on cargo	2.726	2.509	2.274	2.279	2.323
Draft ship	2.314	2.296	2.268	2.279	2.323
Trim ship	-0.304	-0.272	-0.230	-0.247	-0.270
Displacement	175.413	175.412	175.412	181.057	192.191
NKsin(ϕ) closed ship	0.822	1.088	1.348	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.216	3.492	3.731	3.854	4.026
NKsin(ϕ) water & cargo	3.216	3.492	3.731	3.854	4.026
Righting lever (GZ)	0.148	0.198	0.249	0.225	0.145
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.055	-0.030	-0.106
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.136	0.143	0.044
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.194	0.085	0.044
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.234	0.018	0.044
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.242	-0.055	0.041
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.181	-0.117	0.025
25.00	PS	2.268	-0.230	-1.348	-1.089	-0.126	-0.132	0.014
20.00	PS	2.296	-0.272	-1.088	-0.881	-0.130	-0.077	0.005
15.00	PS	2.314	-0.304	-0.822	-0.667	-0.131	-0.023	0.000
10.00	PS	2.325	-0.325	-0.550	-0.447	-0.131	0.029	0.001
5.00	PS	2.331	-0.332	-0.276	-0.224	-0.126	0.074	0.005
2.00	PS	2.333	-0.331	-0.110	-0.090	-0.100	0.080	0.010
0.00		2.333	-0.330	0.000	0.000	-0.064	0.064	0.012
2.00	SB	2.333	-0.331	0.110	0.090	-0.028	0.049	0.014
5.00	SB	2.331	-0.332	0.276	0.224	-0.002	0.054	0.017
10.00	SB	2.325	-0.325	0.550	0.447	0.005	0.098	0.023
15.00	SB	2.314	-0.304	0.822	0.667	0.007	0.148	0.034
20.00	SB	2.296	-0.272	1.088	0.881	0.009	0.198	0.049
25.00	SB	2.268	-0.230	1.348	1.089	0.010	0.249	0.069
30.00	SB	2.279	-0.247	1.602	1.304	0.073	0.225	0.090
40.00	SB	2.323	-0.270	2.014	1.717	0.152	0.145	0.122
50.00	SB	2.379	-0.232	2.298	2.082	0.162	0.055	0.139
60.00	SB	2.442	-0.010	2.497	2.388	0.139	-0.030	0.142
70.00	SB	2.535	0.492	2.618	2.625	0.099	-0.106	0.142

Statical angle of inclination is 12.70 degrees to portside

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.333 m
Trim	-0.330 m
Statical angle of inclination	12.70 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.117 meter
Top of the GZ curve at least at	25.000	26.087 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.025 mrad
Area under the GZ curve up to 40 degrees	0.108	0.041 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.015 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.084 meter
Top of the GZ curve at least at	25.000	26.087 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.017 mrad
Area under the GZ curve up to 40 degrees	0.108	0.026 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.009 mrad
----- Additional information		
Range of positive stability	0.000	27.332 degrees
Angle of vanishing stability	0.000	43.241 degrees PS
Roll Period acc Irish authorities	0.000	5.433 sec
Roll Period acc IS 2008	1.000	6.567 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.598 meter
Maximum GZ at 30 degrees or more	0.240	0.225 meter
Top of the GZ curve at least at	25.000	25.694 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.078 mrad
Area under the GZ curve up to 40 degrees	0.108	0.110 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.032 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.192 meter
Top of the GZ curve at least at	25.000	25.693 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.061 mrad
Area under the GZ curve up to 40 degrees	0.108	0.087 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.027 mrad
----- Additional information		
Range of positive stability	0.000	69.943 degrees
Angle of vanishing stability	0.000	60.310 degrees SB
Roll Period acc Irish authorities	0.000	5.433 sec
Roll Period acc IS 2008	1.000	6.567 sec

VCG'

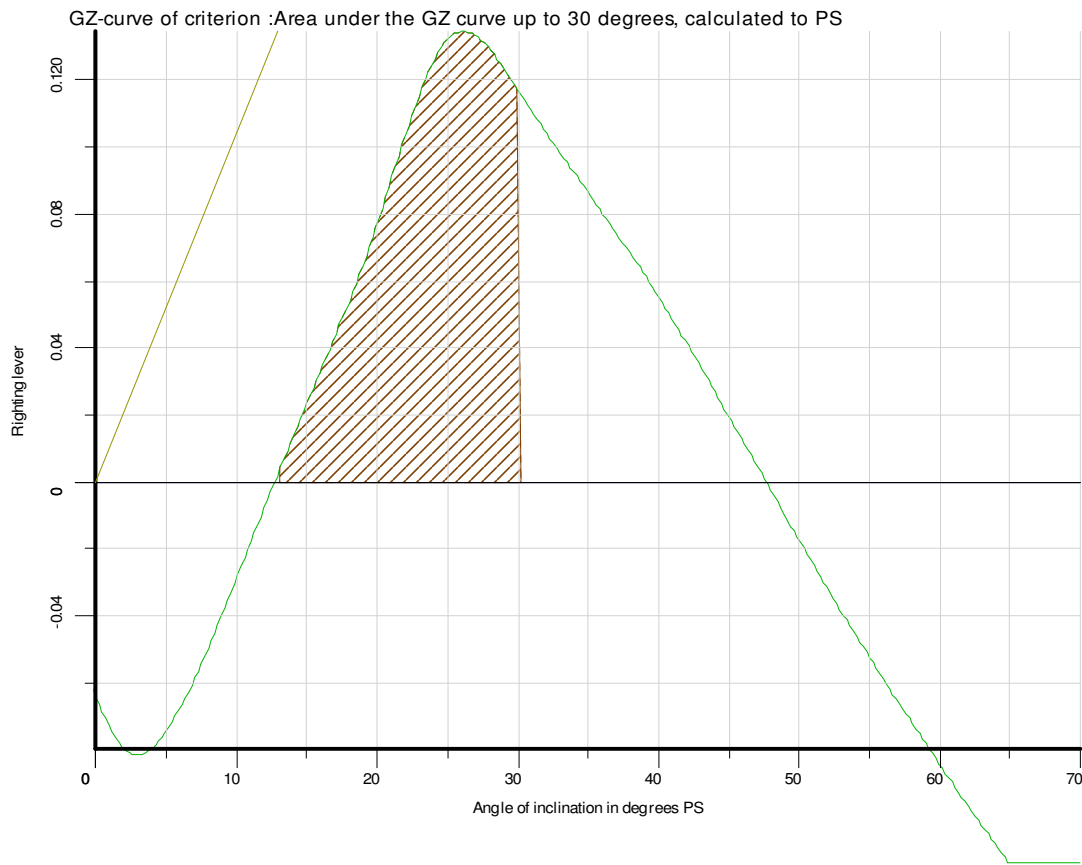
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

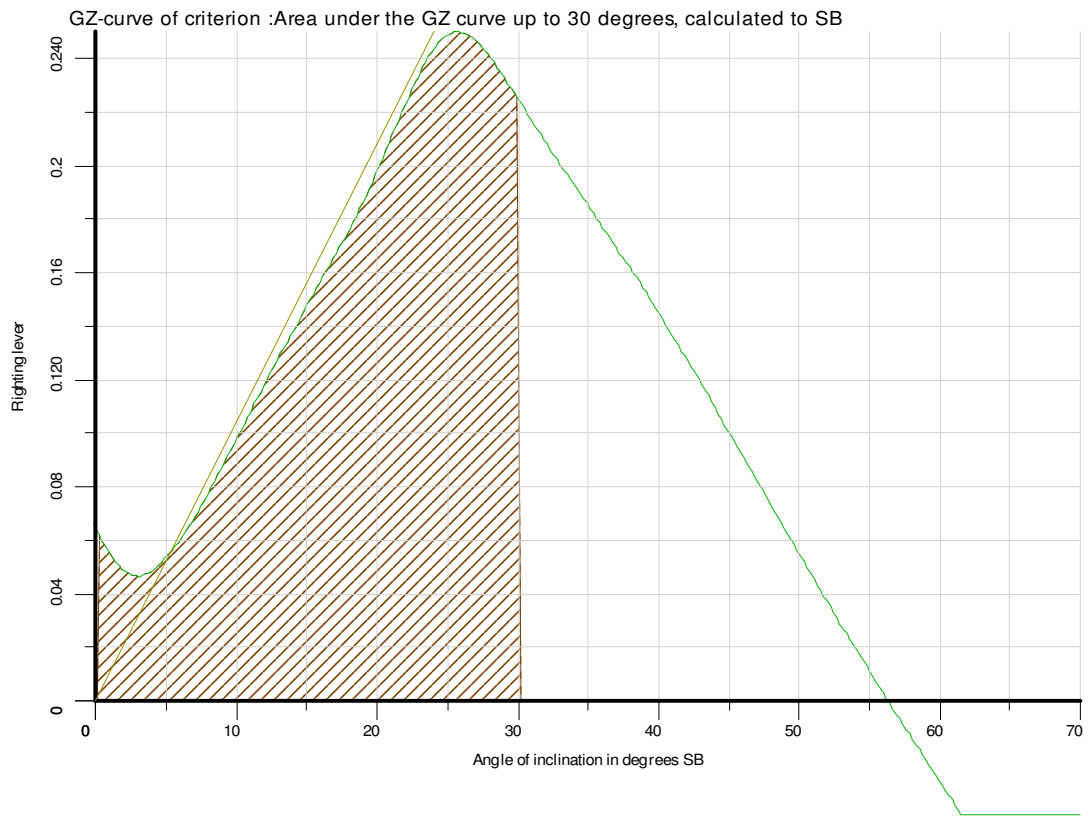
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck



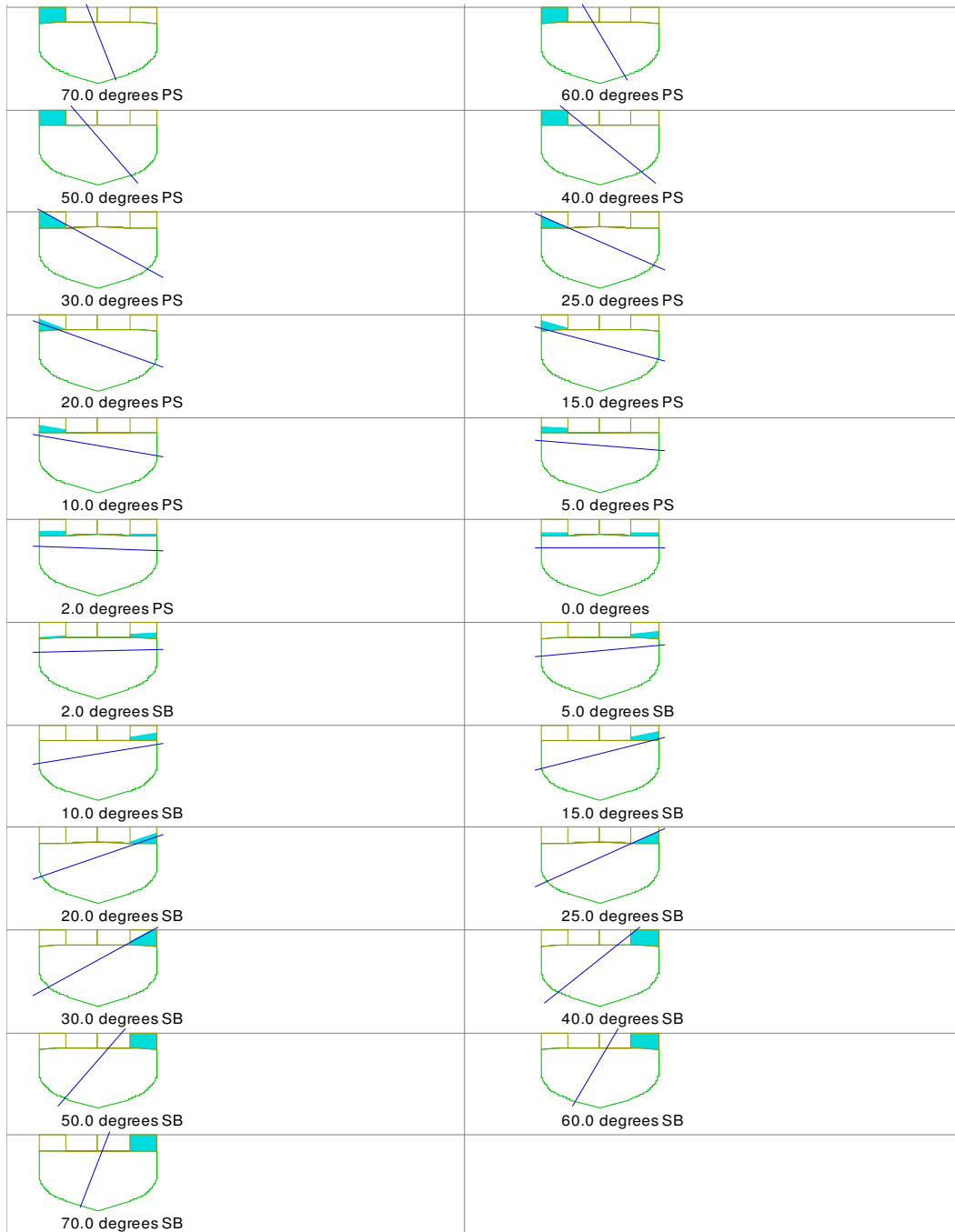


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Water on deck, Cross section at 7.000 m

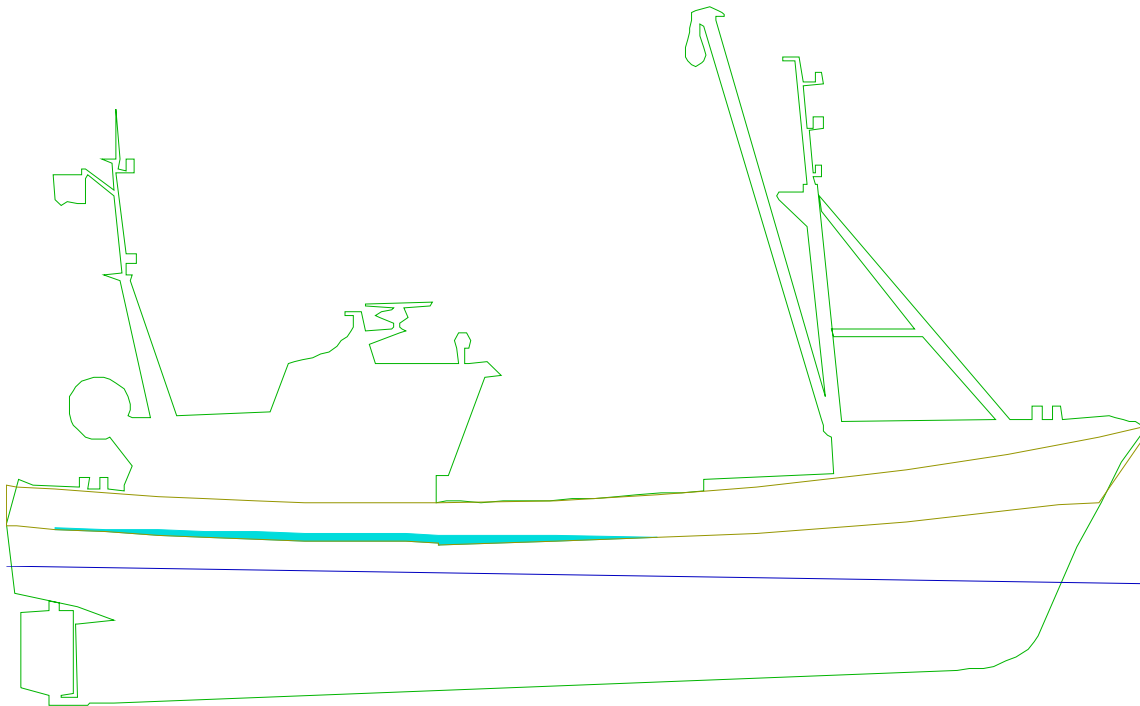


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

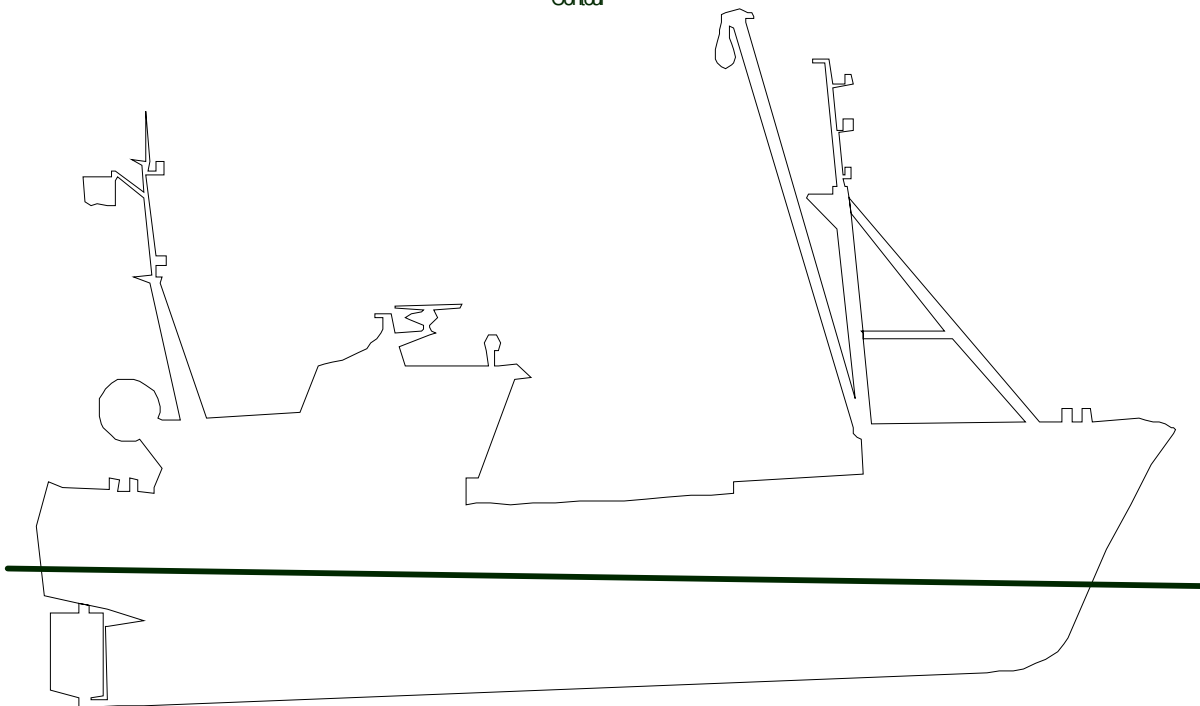
18 Oct 2019 14:22:02

Condition : Fase 2, PS derrick at 35 degrees, 5 m3 water on deck

Longitudinal view, no heel, cargo liquid



Contour



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

4.5. CONDITION : FASE 3, PS DERRICK AT 20 DEGREES, 10 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek. water	10.2	1.0250	10.252	-	-	-	-
SUBTOTAL	-	-	10.252	3.227	6.113	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
TOTAL	-	-	180.539	2.599	9.518	-0.032	1.971

Hydrostatics

Volume	175.085 m ³
LCF	9.023 m
Mom. change trim	1.768 tonm/cm
Ton/cm immersion	1.167 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.370 m
Draft aft (App)	2.589 m
Draft fore (Fpp)	2.151 m
Trim	-0.438 m

Transverse stability

KM transverse	3.121 m	
VCG	2.598 m	
GM solid	0.523 m	
GG' correction	0.011 m	
G'M liquid	0.512 m	VCG' 2.609 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:03

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.377	10.503
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.057
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.147	-0.083	-0.011	0.067	0.135
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	9.033	10.000	10.000	10.000	10.001
Level of water on cargo	2.460	2.719	2.917	3.092	3.222
Draft ship	2.304	2.339	2.356	2.366	2.371
Trim ship	-0.280	-0.333	-0.364	-0.385	-0.400
Displacement	179.545	180.537	180.537	180.537	180.537
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.549	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.394	3.092	2.707	2.002
NKsin(ϕ) water & cargo	3.660	3.394	3.092	2.707	2.002
Righting lever (GZ)	0.100	0.036	-0.013	-0.057	-0.082
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:03

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	10.001	10.002	10.001	10.001	10.001
Level of water on cargo	3.239	3.240	3.239	3.222	3.092
Draft ship	2.370	2.370	2.370	2.371	2.366
Trim ship	-0.428	-0.438	-0.428	-0.400	-0.385
Displacement	180.537	180.539	180.538	180.538	180.537
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.549
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.862	0.000	0.862	2.002	2.707
NKsin(ϕ) water & cargo	0.862	0.000	0.862	2.002	2.707
Righting lever (GZ)	-0.055	0.032	0.008	-0.018	0.006
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	10.000	10.001	9.033	10.503	21.377
Level of water on cargo	2.917	2.719	2.460	2.279	2.323
Draft ship	2.356	2.339	2.304	2.279	2.323
Trim ship	-0.364	-0.333	-0.280	-0.247	-0.270
Displacement	180.537	180.537	179.545	181.057	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.092	3.394	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.092	3.394	3.660	3.854	4.026
Righting lever (GZ)	0.049	0.096	0.158	0.191	0.114
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.583	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.026	-0.055	-0.128
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:03

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.127	0.147	0.042
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.180	0.083	0.042
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.216	0.011	0.042
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.220	-0.067	0.037
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.155	-0.135	0.018
25.00	PS	2.304	-0.280	-1.349	-1.105	-0.144	-0.100	0.007
20.00	PS	2.339	-0.333	-1.088	-0.895	-0.157	-0.036	0.001
15.00	PS	2.356	-0.364	-0.821	-0.677	-0.157	0.013	0.000
10.00	PS	2.366	-0.385	-0.549	-0.454	-0.152	0.057	0.003
5.00	PS	2.371	-0.400	-0.275	-0.228	-0.129	0.082	0.010
2.00	PS	2.370	-0.428	-0.110	-0.091	-0.074	0.055	0.013
0.00		2.370	-0.438	0.000	0.000	-0.032	0.032	0.015
2.00	SB	2.370	-0.428	0.110	0.091	0.011	0.008	0.016
5.00	SB	2.371	-0.400	0.275	0.228	0.066	-0.018	0.016
10.00	SB	2.366	-0.385	0.549	0.454	0.089	0.006	0.016
15.00	SB	2.356	-0.364	0.821	0.677	0.095	0.049	0.018
20.00	SB	2.339	-0.333	1.088	0.895	0.097	0.096	0.024
25.00	SB	2.304	-0.280	1.349	1.105	0.086	0.158	0.035
30.00	SB	2.279	-0.247	1.602	1.312	0.099	0.191	0.051
40.00	SB	2.323	-0.270	2.014	1.727	0.174	0.114	0.079
50.00	SB	2.379	-0.232	2.298	2.093	0.179	0.026	0.091
60.00	SB	2.442	-0.010	2.497	2.400	0.153	-0.055	0.092
70.00	SB	2.535	0.492	2.618	2.637	0.108	-0.128	0.092

Statical angle of inclination is 16.48 degrees to portside

Statical angle of inclination is 9.36 degrees to starboard

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:03

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.370 m
Trim	-0.438 m
Statical angle of inclination	16.48 degrees PS
Statical angle of inclination	9.36 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.512 meter
Maximum GZ at 30 degrees or more	0.240	0.136 meter
Top of the GZ curve at least at	25.000	30.524 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.018 mrad
Area under the GZ curve up to 40 degrees	0.108	0.037 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.019 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.104 meter
Top of the GZ curve at least at	25.000	30.524 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.011 mrad
Area under the GZ curve up to 40 degrees	0.108	0.025 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.014 mrad
----- Additional information		
Range of positive stability	0.000	24.589 degrees
Angle of vanishing stability	0.000	44.218 degrees PS
Roll Period acc Irish authorities	0.000	5.867 sec
Roll Period acc IS 2008	1.000	7.078 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.512 meter
Maximum GZ at 30 degrees or more	0.240	0.191 meter
Top of the GZ curve at least at	25.000	30.225 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.036 mrad
Area under the GZ curve up to 40 degrees	0.108	0.064 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.028 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.159 meter
Top of the GZ curve at least at	25.000	30.225 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.025 mrad
Area under the GZ curve up to 40 degrees	0.108	0.048 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.023 mrad
----- Additional information		
Range of positive stability	0.000	36.406 degrees
Angle of vanishing stability	0.000	49.354 degrees SB
Roll Period acc Irish authorities	0.000	5.867 sec
Roll Period acc IS 2008	1.000	7.078 sec

VCG'

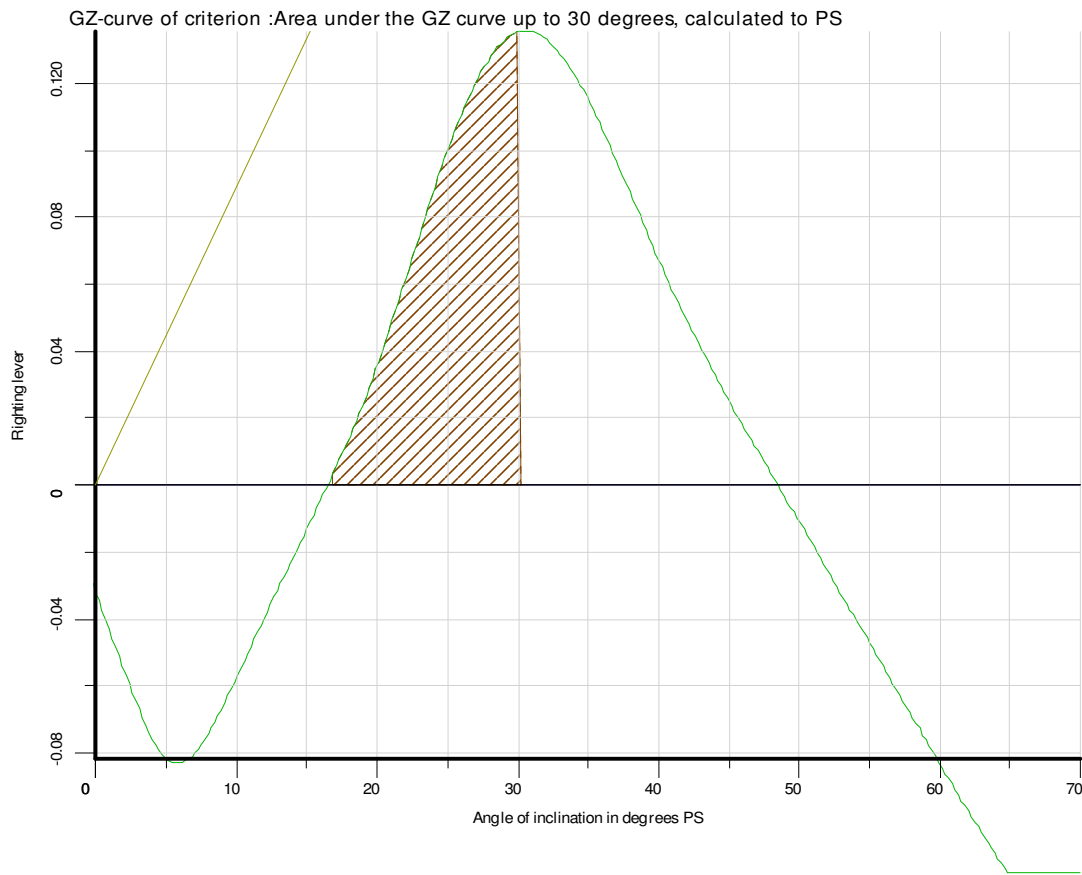
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

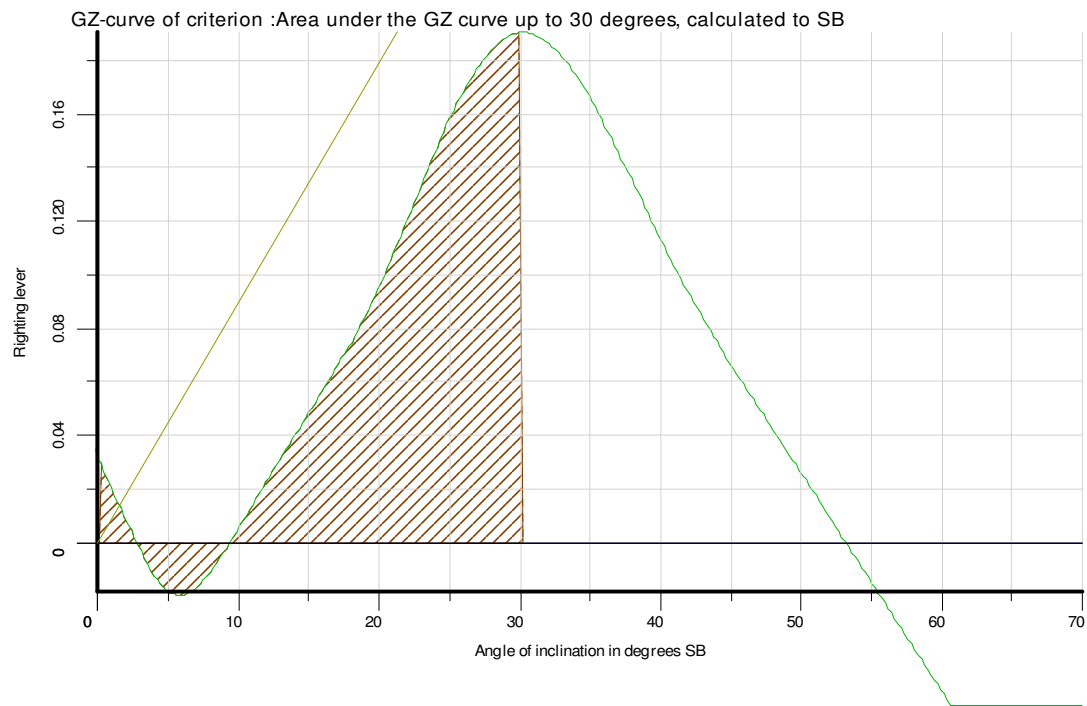
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:03

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:03

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Water on deck, Cross section at 7.000 m

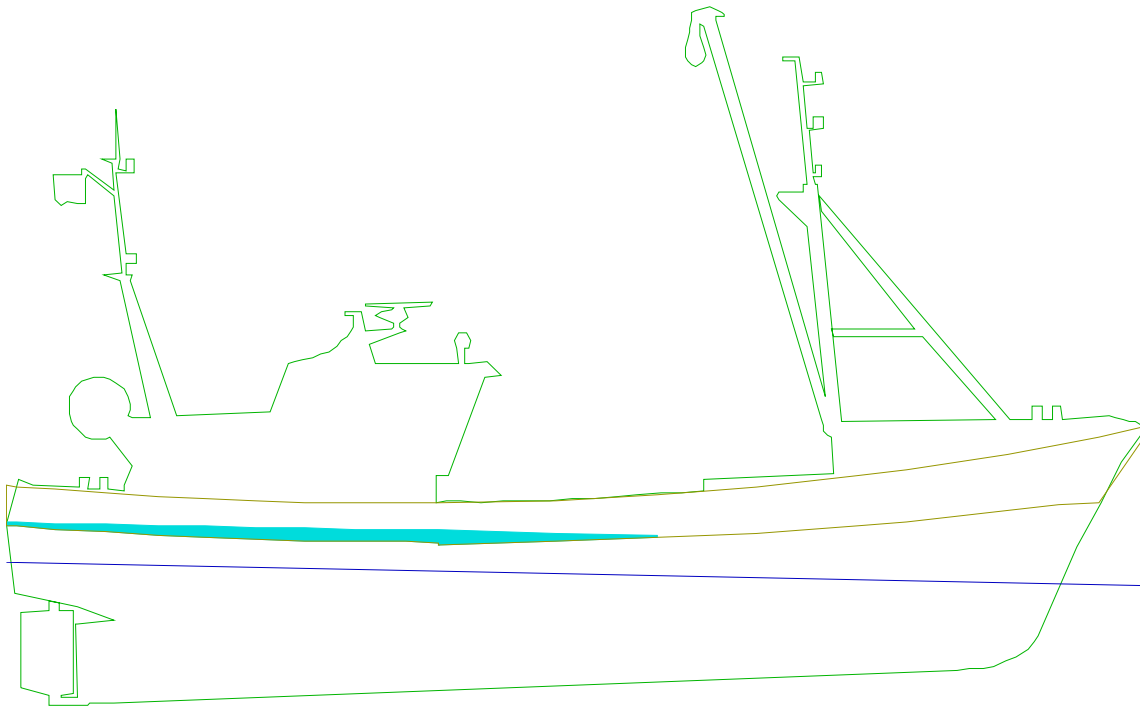


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

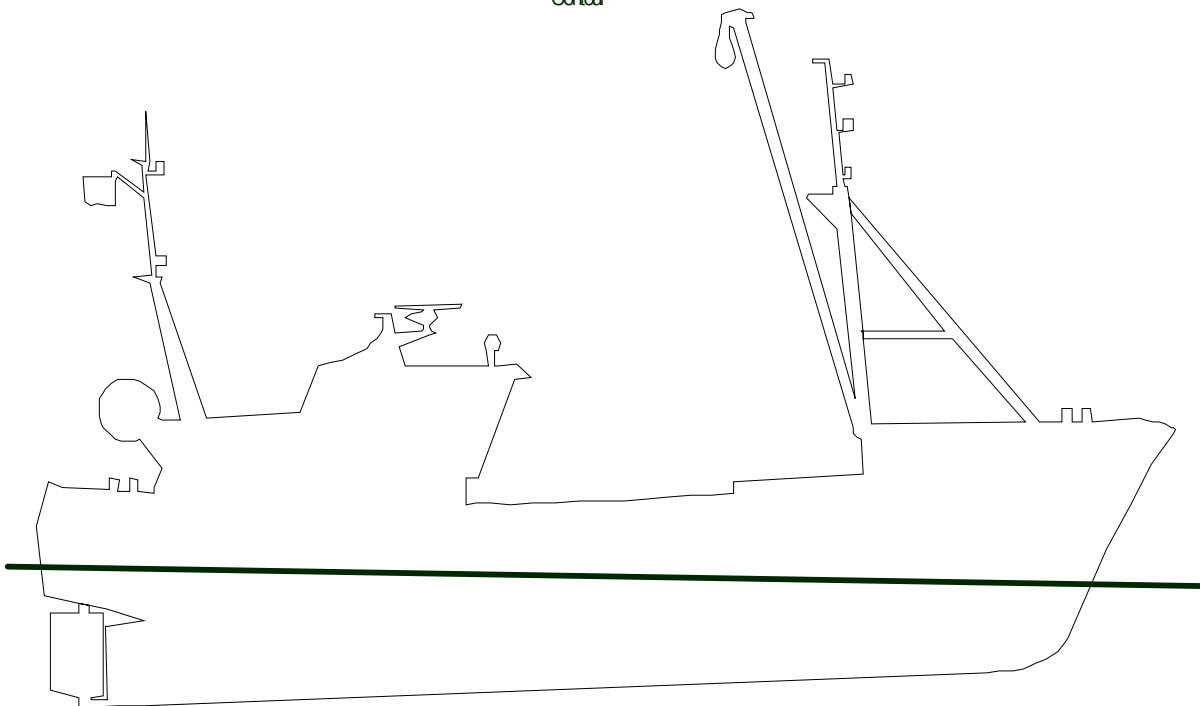
18 Oct 2019 14:22:03

Condition : Fase 3, PS derrick at 20 degrees, 10 m3 water on deck

Longitudinal view, no heel, cargo liquid



Contour



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

4.6. CONDITION : FASE 3, PS DERRICK AT 35 DEGREES, 10 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek. water	10.2	1.0250	10.252	-	-	-	-
SUBTOTAL	-	-	10.252	3.227	6.113	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
TOTAL	-	-	180.539	2.583	9.518	-0.062	1.971

Hydrostatics

Volume	175.085 m ³
LCF	9.023 m
Mom. change trim	1.768 tonm/cm
Ton/cm immersion	1.167 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.370 m
Draft aft (App)	2.589 m
Draft fore (Fpp)	2.151 m
Trim	-0.438 m

Transverse stability

KM transverse	3.225 m	
VCG	2.582 m	
GM solid	0.643 m	
GG' correction	0.011 m	
G'M liquid	0.632 m	VCG' 2.593 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.377	10.503
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.057
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.143	-0.085	-0.018	0.055	0.117
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	9.033	10.000	10.000	10.000	10.001
Level of water on cargo	2.460	2.719	2.917	3.092	3.222
Draft ship	2.304	2.339	2.356	2.366	2.371
Trim ship	-0.280	-0.333	-0.364	-0.385	-0.400
Displacement	179.545	180.537	180.537	180.537	180.537
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.549	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.394	3.092	2.707	2.002
NKsin(ϕ) water & cargo	3.660	3.394	3.092	2.707	2.002
Righting lever (GZ)	0.079	0.012	-0.038	-0.085	-0.111
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	10.001	10.002	10.001	10.001	10.001
Level of water on cargo	3.239	3.240	3.239	3.222	3.092
Draft ship	2.370	2.370	2.370	2.371	2.366
Trim ship	-0.428	-0.438	-0.428	-0.400	-0.385
Displacement	180.537	180.539	180.538	180.538	180.537
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.549
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.862	0.000	0.862	2.002	2.707
NKsin(ϕ) water & cargo	0.862	0.000	0.862	2.002	2.707
Righting lever (GZ)	-0.085	0.062	0.039	0.014	0.038
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	10.000	10.001	9.033	10.503	21.377
Level of water on cargo	2.917	2.719	2.460	2.279	2.323
Draft ship	2.356	2.339	2.304	2.279	2.323
Trim ship	-0.364	-0.333	-0.280	-0.247	-0.270
Displacement	180.537	180.537	179.545	181.057	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.092	3.394	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.092	3.394	3.660	3.854	4.026
Righting lever (GZ)	0.082	0.130	0.193	0.225	0.145
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.583	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.055	-0.030	-0.106
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.136	0.143	0.033
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.194	0.085	0.033
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.234	0.018	0.033
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.242	-0.055	0.030
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.181	-0.117	0.013
25.00	PS	2.304	-0.280	-1.349	-1.098	-0.172	-0.079	0.004
20.00	PS	2.339	-0.333	-1.088	-0.890	-0.186	-0.012	0.000
15.00	PS	2.356	-0.364	-0.821	-0.673	-0.186	0.038	0.001
10.00	PS	2.366	-0.385	-0.549	-0.451	-0.182	0.085	0.007
5.00	PS	2.371	-0.400	-0.275	-0.226	-0.160	0.111	0.016
2.00	PS	2.370	-0.428	-0.110	-0.091	-0.105	0.085	0.021
0.00		2.370	-0.438	0.000	0.000	-0.062	0.062	0.024
2.00	SB	2.370	-0.428	0.110	0.091	-0.020	0.039	0.025
5.00	SB	2.371	-0.400	0.275	0.226	0.035	0.014	0.027
10.00	SB	2.366	-0.385	0.549	0.451	0.059	0.038	0.028
15.00	SB	2.356	-0.364	0.821	0.673	0.066	0.082	0.034
20.00	SB	2.339	-0.333	1.088	0.890	0.068	0.130	0.043
25.00	SB	2.304	-0.280	1.349	1.098	0.058	0.193	0.057
30.00	SB	2.279	-0.247	1.602	1.304	0.073	0.225	0.076
40.00	SB	2.323	-0.270	2.014	1.717	0.152	0.145	0.109
50.00	SB	2.379	-0.232	2.298	2.082	0.162	0.055	0.127
60.00	SB	2.442	-0.010	2.497	2.388	0.139	-0.030	0.130
70.00	SB	2.535	0.492	2.618	2.625	0.099	-0.106	0.130

Statical angle of inclination is 18.93 degrees to portside

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.370 m
Trim	-0.438 m
Statical angle of inclination	18.93 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.632 meter
Maximum GZ at 30 degrees or more	0.240	0.118 meter
Top of the GZ curve at least at	25.000	30.757 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.013 mrad
Area under the GZ curve up to 40 degrees	0.108	0.030 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.017 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.086 meter
Top of the GZ curve at least at	25.000	30.757 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.008 mrad
Area under the GZ curve up to 40 degrees	0.108	0.019 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.011 mrad
----- Additional information		
Range of positive stability	0.000	21.443 degrees
Angle of vanishing stability	0.000	42.891 degrees PS
Roll Period acc Irish authorities	0.000	5.281 sec
Roll Period acc IS 2008	1.000	6.371 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.632 meter
Maximum GZ at 30 degrees or more	0.240	0.225 meter
Top of the GZ curve at least at	25.000	30.166 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.052 mrad
Area under the GZ curve up to 40 degrees	0.108	0.086 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.034 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.194 meter
Top of the GZ curve at least at	25.000	30.166 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.037 mrad
Area under the GZ curve up to 40 degrees	0.108	0.065 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.028 mrad
----- Additional information		
Range of positive stability	0.000	43.572 degrees
Angle of vanishing stability	0.000	52.782 degrees SB
Roll Period acc Irish authorities	0.000	5.281 sec
Roll Period acc IS 2008	1.000	6.371 sec

VCG'

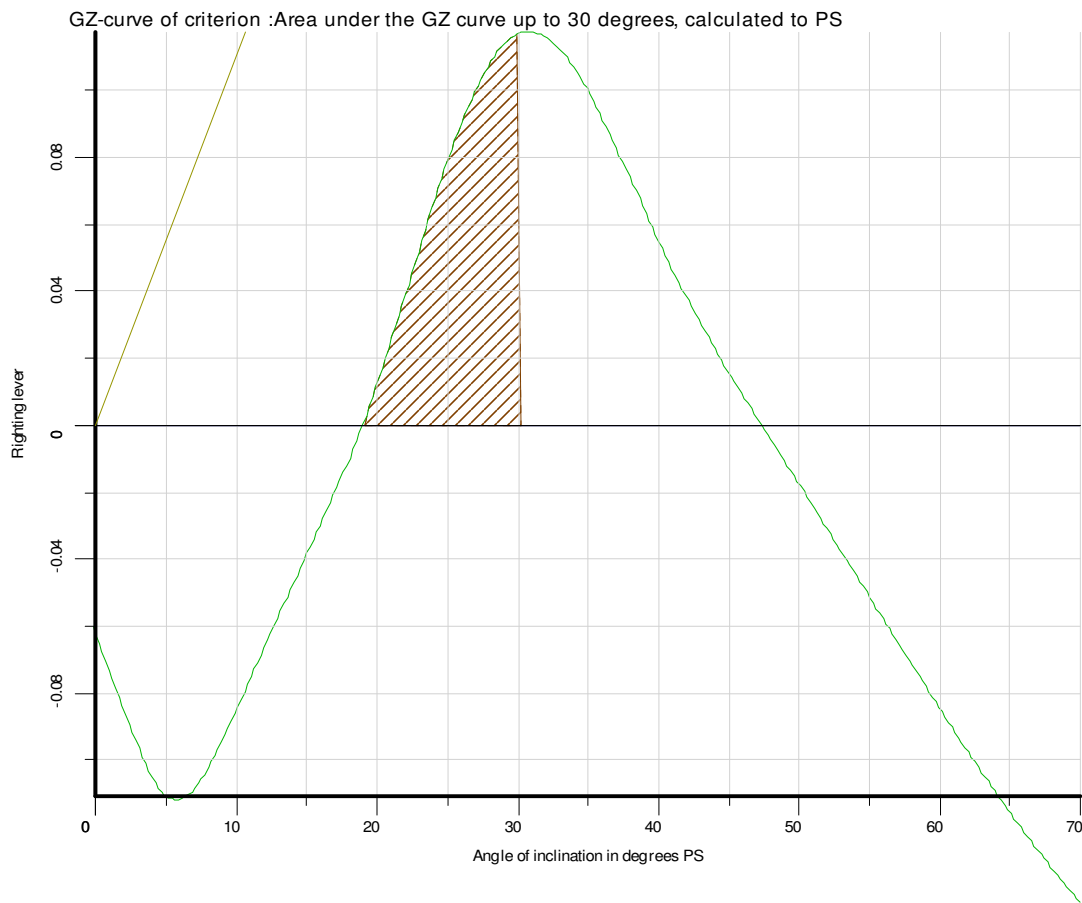
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

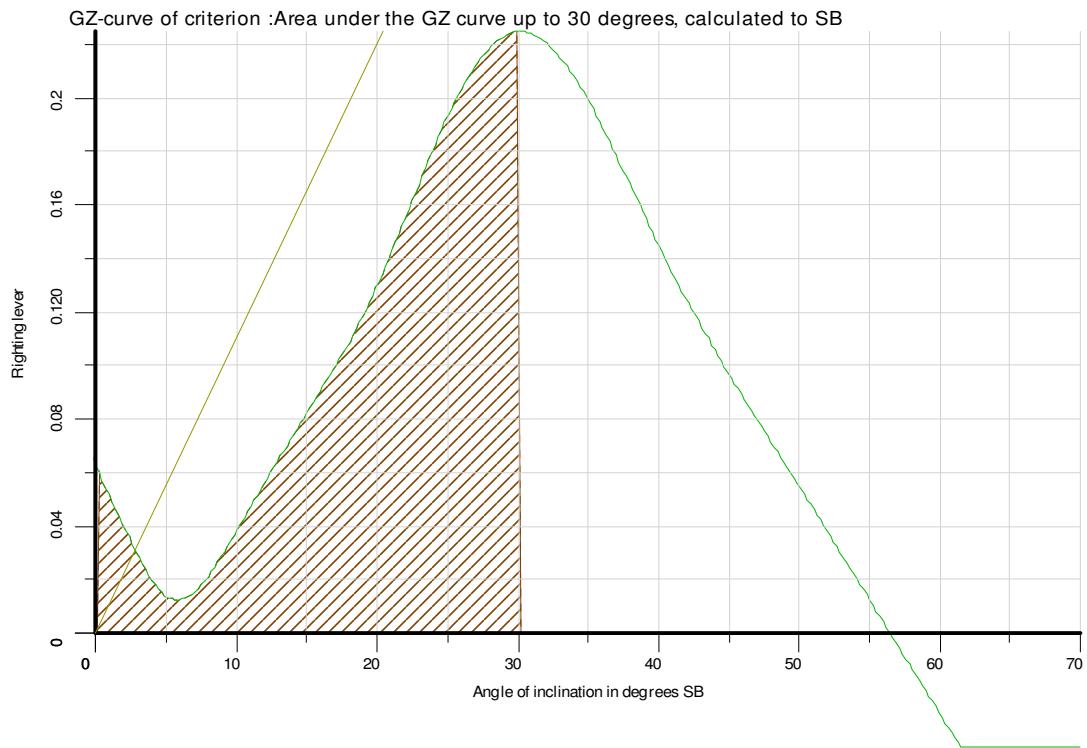
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Water on deck, Cross section at 7.000 m

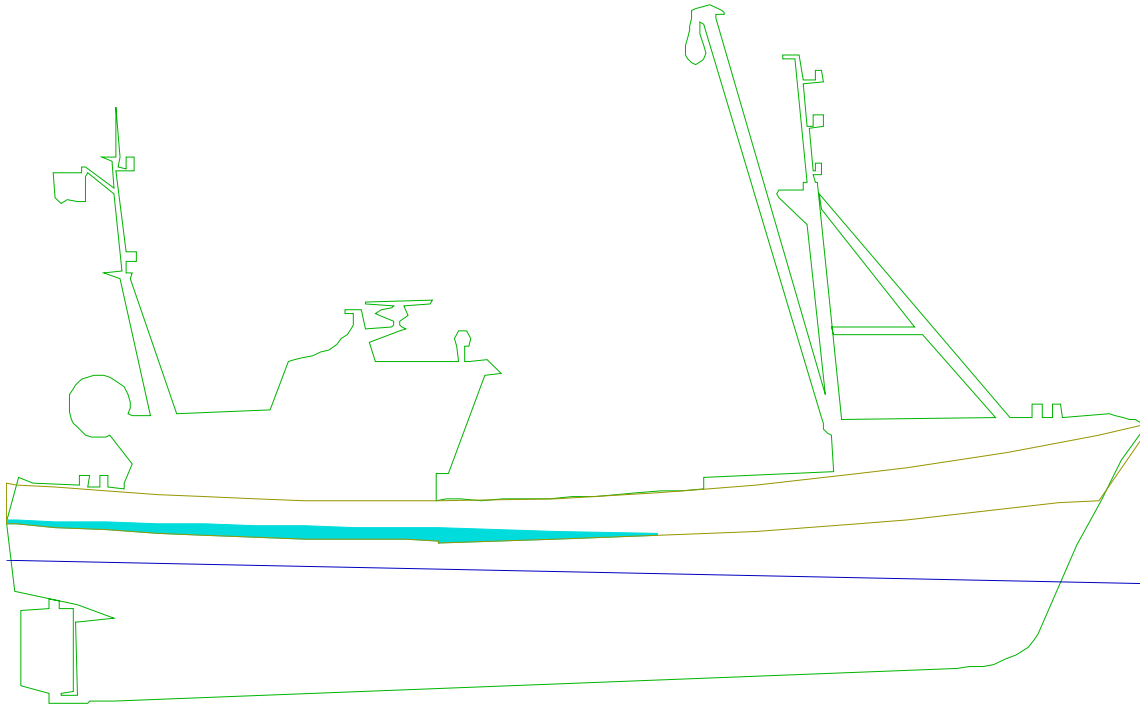


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

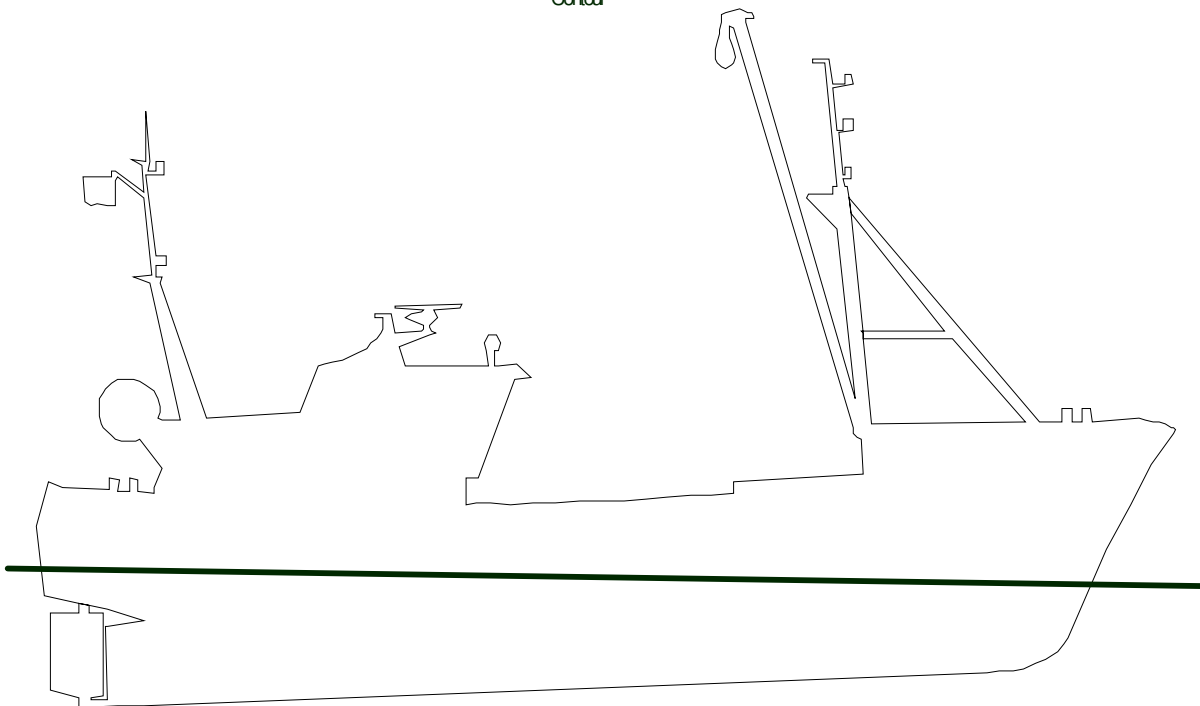
18 Oct 2019 14:22:04

Condition : Fase 3, PS derrick at 35 degrees, 10 m3 water on deck

Longitudinal view, no heel, cargo liquid



Contour



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

4.7. CONDITION : FASE 4, PS DERRICK AT 20 DEGREES, 15 M3 WATER ON DECK,

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek. water	15.2	1.0250	15.375	-	-	-	-
SUBTOTAL	-	-	15.375	3.285	5.883	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 20deg	-	-	2.500	14.280	12.950	-4.550	-
SB derrick to PS (-)	-	-	-0.600	10.000	17.000	1.700	-
SB derrick to PS (+)	-	-	0.600	10.000	17.000	0.000	-
TOTAL	-	-	185.662	2.621	9.405	-0.037	1.971

Hydrostatics

Volume	180.053 m ³
LCF	9.004 m
Mom. change trim	1.776 tonm/cm
Ton/cm immersion	1.170 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.406 m
Draft aft (App)	2.677 m
Draft fore (Fpp)	2.135 m
Trim	-0.541 m

Transverse stability

KM transverse	3.561 m	
VCG	2.618 m	
GM solid	0.943 m	
GG' correction	0.011 m	
G'M liquid	0.933 m	VCG' 2.629 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.377	10.502
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.052
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.148	-0.086	-0.014	0.063	0.130
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	9.033	11.040	13.709	15.000	15.000
Level of water on cargo	2.460	2.757	3.029	3.215	3.295
Draft ship	2.304	2.348	2.387	2.407	2.408
Trim ship	-0.280	-0.344	-0.401	-0.438	-0.490
Displacement	179.545	181.602	184.337	185.662	185.662
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.548	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.378	3.013	2.541	1.584
NKsin(ϕ) water & cargo	3.660	3.378	3.013	2.541	1.584
Righting lever (GZ)	0.095	0.018	-0.059	-0.108	-0.099
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION

O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Hopper : Water on deck

Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	15.002	15.000	14.999	15.000	15.000
Level of water on cargo	3.299	3.300	3.299	3.295	3.215
Draft ship	2.406	2.406	2.406	2.408	2.407
Trim ship	-0.535	-0.541	-0.535	-0.490	-0.438
Displacement	185.660	185.662	185.660	185.662	185.663
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.548
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.643	0.000	0.643	1.584	2.541
NKsin(ϕ) water & cargo	0.643	0.000	0.643	1.584	2.541
Righting lever (GZ)	-0.062	0.037	0.011	-0.026	-0.036
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	13.709	11.040	9.033	10.502	21.377
Level of water on cargo	3.029	2.757	2.460	2.279	2.323
Draft ship	2.387	2.348	2.304	2.279	2.323
Trim ship	-0.401	-0.344	-0.280	-0.247	-0.270
Displacement	184.337	181.602	179.545	181.052	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.013	3.378	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.013	3.378	3.660	3.854	4.026
Righting lever (GZ)	0.012	0.088	0.163	0.195	0.118
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.029	-0.053	-0.126
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.637	-0.128	0.148	0.038
60.00	PS	2.442	-0.010	-2.497	-2.400	-0.183	0.086	0.038
50.00	PS	2.379	-0.232	-2.298	-2.093	-0.220	0.014	0.038
40.00	PS	2.323	-0.270	-2.014	-1.727	-0.224	-0.063	0.034
30.00	PS	2.279	-0.247	-1.602	-1.312	-0.160	-0.130	0.015
25.00	PS	2.304	-0.280	-1.349	-1.105	-0.149	-0.095	0.005
20.00	PS	2.348	-0.344	-1.088	-0.897	-0.173	-0.018	0.000
15.00	PS	2.387	-0.401	-0.821	-0.682	-0.198	0.059	0.002
10.00	PS	2.407	-0.438	-0.548	-0.458	-0.198	0.108	0.010
5.00	PS	2.408	-0.490	-0.275	-0.230	-0.144	0.099	0.019
2.00	PS	2.406	-0.535	-0.110	-0.092	-0.080	0.062	0.023
0.00		2.406	-0.541	0.000	0.000	-0.037	0.037	0.025
2.00	SB	2.406	-0.535	0.110	0.092	0.007	0.011	0.026
5.00	SB	2.408	-0.490	0.275	0.230	0.071	-0.026	0.026
10.00	SB	2.407	-0.438	0.548	0.458	0.126	-0.036	0.026
15.00	SB	2.387	-0.401	0.821	0.682	0.127	0.012	0.026
20.00	SB	2.348	-0.344	1.088	0.897	0.103	0.088	0.030
25.00	SB	2.304	-0.280	1.349	1.105	0.081	0.163	0.042
30.00	SB	2.279	-0.247	1.602	1.312	0.095	0.195	0.058
40.00	SB	2.323	-0.270	2.014	1.727	0.170	0.118	0.087
50.00	SB	2.379	-0.232	2.298	2.093	0.176	0.029	0.099
60.00	SB	2.442	-0.010	2.497	2.400	0.150	-0.053	0.100
70.00	SB	2.535	0.492	2.618	2.637	0.107	-0.126	0.100

Statical angle of inclination is 18.93 degrees to portside

Statical angle of inclination is 14.06 degrees to starboard

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.406 m
Trim	-0.541 m
Statical angle of inclination	18.93 degrees PS
Statical angle of inclination	14.06 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.933 meter
Maximum GZ at 30 degrees or more	0.240	0.131 meter
Top of the GZ curve at least at	25.000	30.460 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.015 mrad
Area under the GZ curve up to 40 degrees	0.108	0.034 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.018 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.101 meter
Top of the GZ curve at least at	25.000	30.460 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.010 mrad
Area under the GZ curve up to 40 degrees	0.108	0.023 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.013 mrad
----- Additional information		
Range of positive stability	0.000	23.146 degrees
Angle of vanishing stability	0.000	43.900 degrees PS
Roll Period acc Irish authorities	0.000	4.349 sec
Roll Period acc IS 2008	1.000	5.235 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.933 meter
Maximum GZ at 30 degrees or more	0.240	0.196 meter
Top of the GZ curve at least at	25.000	30.101 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.032 mrad
Area under the GZ curve up to 40 degrees	0.108	0.061 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.029 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.165 meter
Top of the GZ curve at least at	25.000	30.101 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.024 mrad
Area under the GZ curve up to 40 degrees	0.108	0.047 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.024 mrad
----- Additional information		
Range of positive stability	0.000	33.598 degrees
Angle of vanishing stability	0.000	49.904 degrees SB
Roll Period acc Irish authorities	0.000	4.349 sec
Roll Period acc IS 2008	1.000	5.235 sec

VCG'

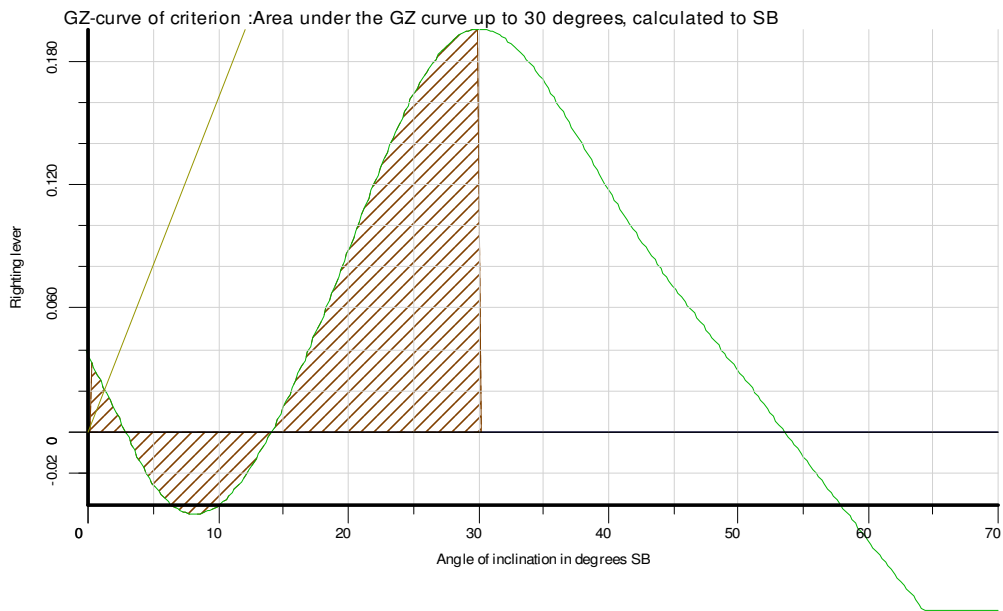
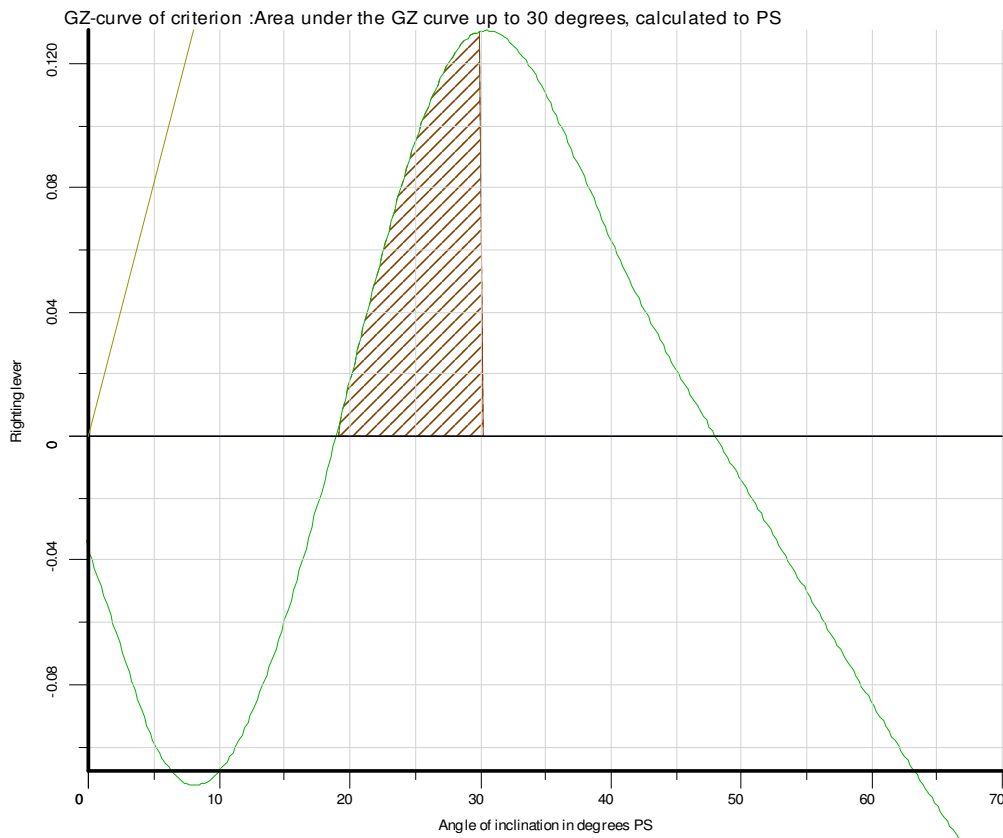
A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:04

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Water on deck, Cross section at 7.000 m

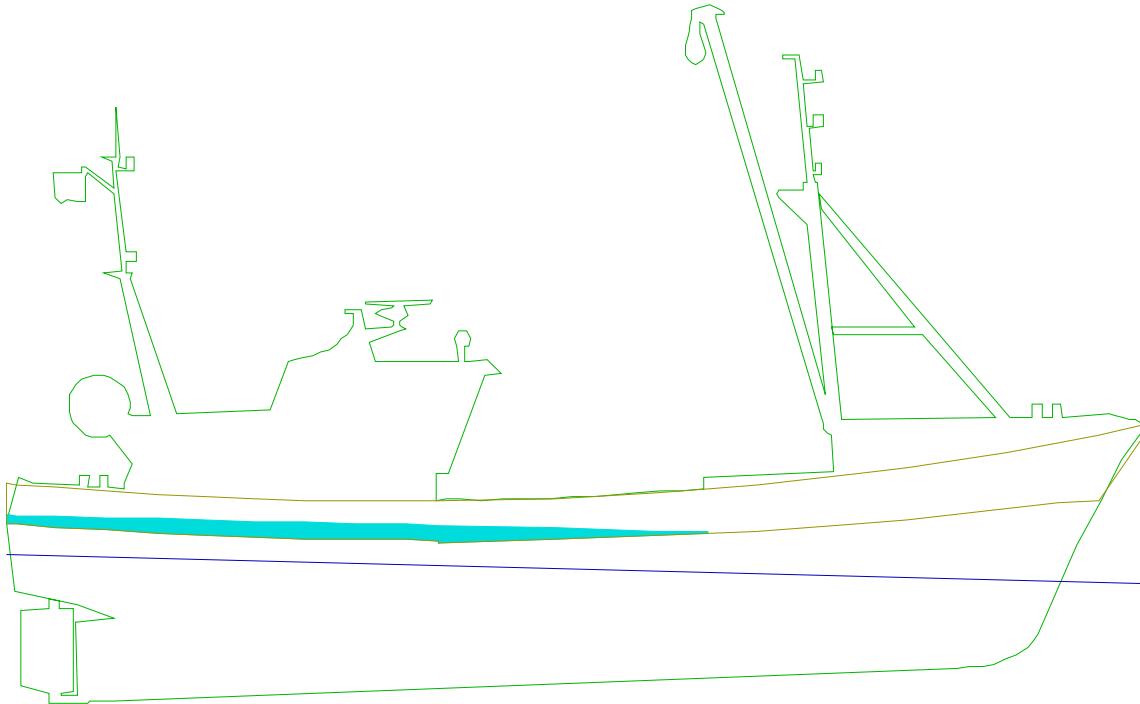


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

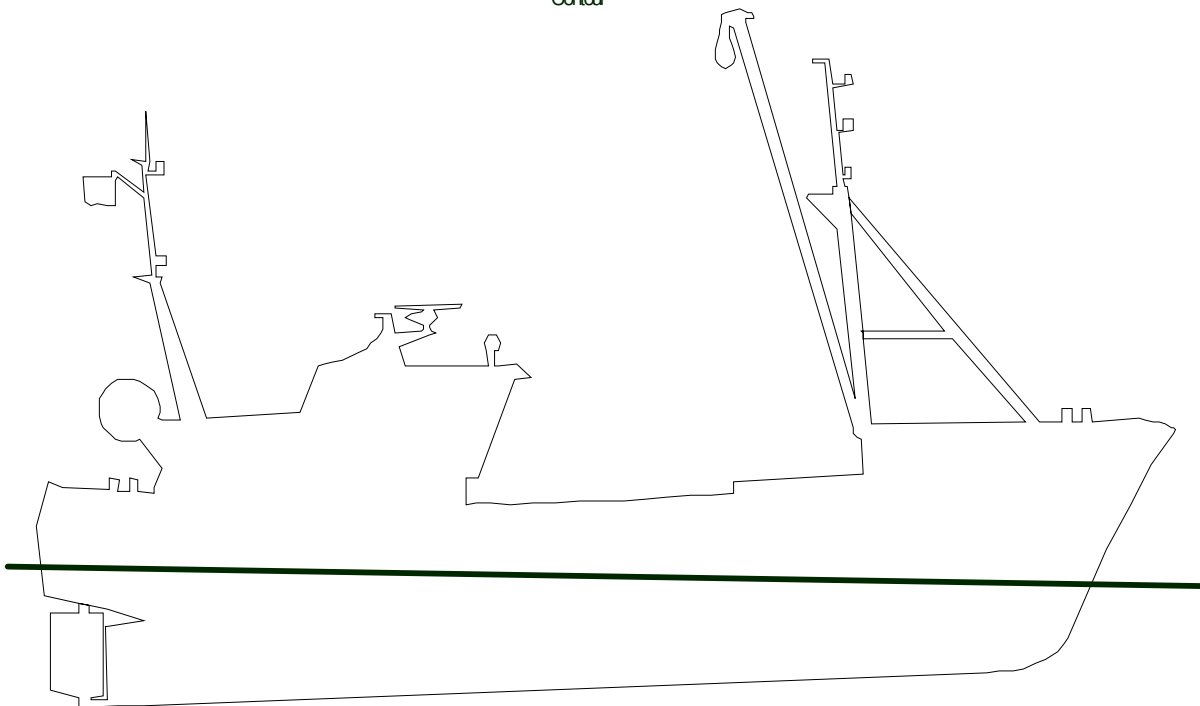
18 Oct 2019 14:22:04

Condition : Fase 4, PS derrick at 20 degrees, 15 m3 water on deck,

Longitudinal view, no heel, cargo liquid



Contour



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

4.8. CONDITION : FASE 4, PS DERRICK AT 35 DEGREES, 15 M3 WATER ON DECK

Description	Filling %	Density ton/m ³	Weight ton	VCg m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	45.4	0.8750	1.724	1.525	15.969	1.538	0.372
FO. Fr.38 PS	45.4	0.8750	1.724	1.525	15.969	-1.538	0.372
FO. Fr.38 CL	33.5	0.8750	1.732	0.836	15.993	0.000	0.454
SUBTOTAL	40.6	0.8750	5.180	1.294	15.977	0.000	1.199
Subtotals for group : Water							
FW Fore	10.0	1.0000	0.379	0.510	18.245	0.000	0.286
FW Aft	98.0	1.0000	2.322	2.303	-0.296	0.000	0.335
SUBTOTAL	43.9	1.0000	2.701	2.052	2.304	0.000	0.621
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	98.0	1.0000	2.478	0.896	8.505	2.045	0.076
IceW. Fr.18/24 PS	98.0	1.0000	2.478	0.896	8.505	-2.045	0.076
SUBTOTAL	98.0	1.0000	4.956	0.896	8.505	0.000	0.152
Subtotals for group : Fish & Ice							
Fish & Ice	-	-	3.500	1.500	12.750	0.000	-
SUBTOTAL	-	-	3.500	1.500	12.750	0.000	-
Subtotals for group : Water on deck							
Water op dek. water	15.2	1.0250	15.375	-	-	-	-
SUBTOTAL	-	-	15.375	3.285	5.883	0.000	-
Fish boxes at aft deck	-	-	0.350	3.900	0.450	0.000	-
Fishing gear SB	-	-	2.500	4.450	12.950	2.240	-
Fishing gear PS Beam @ 35deg	-	-	2.500	13.130	12.950	-6.750	-
SB derrick to PS (-)	-	-	-0.600	10.000	17.000	1.700	-
SB derrick to PS (+)	-	-	0.600	10.000	17.000	0.000	-
TOTAL	-	-	185.662	2.606	9.405	-0.066	1.971

Hydrostatics

Volume	180.053 m ³
LCF	9.004 m
Mom. change trim	1.776 tonm/cm
Ton/cm immersion	1.170 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.406 m
Draft aft (App)	2.677 m
Draft fore (Fpp)	2.135 m
Trim	-0.541 m

Transverse stability

KM transverse	3.590 m		
VCg	2.603 m		
GM solid	0.988 m		
GG' correction	0.011 m		
G'M liquid	0.977 m	VCg'	2.613 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:05

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Calculation for : Intact stability, including possible in/outflow effects
Calculation method : International agreement reduced freeboard (dr-67 and dr-68)

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-70.000	-60.000	-50.000	-40.000	-30.000
Volume water on cargo	41.164	35.412	29.056	21.377	10.502
Level of water on cargo	2.535	2.442	2.379	2.323	2.279
Draft ship	2.535	2.442	2.379	2.323	2.279
Trim ship	0.492	-0.010	-0.232	-0.270	-0.247
Displacement	212.478	206.583	200.069	192.196	181.052
NKsin(ϕ) closed ship	2.618	2.497	2.298	2.014	1.602
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.124	4.161	4.128	4.026	3.854
NKsin(ϕ) water & cargo	4.124	4.161	4.128	4.026	3.854
Righting lever (GZ)	-0.144	-0.087	-0.021	0.051	0.112
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	Yes	Yes	Yes	Yes	Yes

Angle of ship	-25.000	-20.000	-15.000	-10.000	-5.000
Volume water on cargo	9.033	11.040	13.709	15.000	15.000
Level of water on cargo	2.460	2.757	3.029	3.215	3.295
Draft ship	2.304	2.348	2.387	2.407	2.408
Trim ship	-0.280	-0.344	-0.401	-0.438	-0.490
Displacement	179.545	181.602	184.337	185.662	185.662
NKsin(ϕ) closed ship	1.349	1.088	0.821	0.548	0.275
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.660	3.378	3.013	2.541	1.584
NKsin(ϕ) water & cargo	3.660	3.378	3.013	2.541	1.584
Righting lever (GZ)	0.074	-0.005	-0.084	-0.134	-0.127
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:05

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Hopper : Water on deck
Density hopper cargo : 1.025 ton/m³

Intermediate results for LIQUID cargo calculations

Angle of ship	-2.000	0.000	2.000	5.000	10.000
Volume water on cargo	15.002	15.000	14.999	15.000	15.000
Level of water on cargo	3.299	3.300	3.299	3.295	3.215
Draft ship	2.406	2.406	2.406	2.408	2.407
Trim ship	-0.535	-0.541	-0.535	-0.490	-0.438
Displacement	185.660	185.662	185.660	185.662	185.663
NKsin(ϕ) closed ship	0.110	0.000	0.110	0.275	0.548
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	0.643	0.000	0.643	1.584	2.541
NKsin(ϕ) water & cargo	0.643	0.000	0.643	1.584	2.541
Righting lever (GZ)	-0.091	0.066	0.041	0.005	-0.004
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	No	No

Angle of ship	15.000	20.000	25.000	30.000	40.000
Volume water on cargo	13.709	11.040	9.033	10.502	21.377
Level of water on cargo	3.029	2.757	2.460	2.279	2.323
Draft ship	2.387	2.348	2.304	2.279	2.323
Trim ship	-0.401	-0.344	-0.280	-0.247	-0.270
Displacement	184.337	181.602	179.545	181.052	192.196
NKsin(ϕ) closed ship	0.821	1.088	1.349	1.602	2.014
NKsin(ϕ) cargo	0.000	0.000	0.000	0.000	0.000
NKsin(ϕ) water on cargo	3.013	3.378	3.660	3.854	4.026
NKsin(ϕ) water & cargo	3.013	3.378	3.660	3.854	4.026
Righting lever (GZ)	0.045	0.122	0.198	0.230	0.149
Cargo pouring out hopper	No	No	No	No	No
Seawater entering hopper	No	No	No	Yes	Yes

Angle of ship	50.000	60.000	70.000
Volume water on cargo	29.056	35.412	41.164
Level of water on cargo	2.379	2.442	2.535
Draft ship	2.379	2.442	2.535
Trim ship	-0.232	-0.010	0.492
Displacement	200.069	206.584	212.478
NKsin(ϕ) closed ship	2.298	2.497	2.618
NKsin(ϕ) cargo	0.000	0.000	0.000
NKsin(ϕ) water on cargo	4.128	4.161	4.124
NKsin(ϕ) water & cargo	4.128	4.161	4.124
Righting lever (GZ)	0.058	-0.028	-0.105
Cargo pouring out hopper	No	No	No
Seawater entering hopper	Yes	Yes	Yes

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:05

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	2.535	0.492	-2.618	-2.625	-0.137	0.144	0.030
60.00	PS	2.442	-0.010	-2.497	-2.388	-0.196	0.087	0.030
50.00	PS	2.379	-0.232	-2.298	-2.082	-0.237	0.021	0.030
40.00	PS	2.323	-0.270	-2.014	-1.717	-0.246	-0.051	0.027
30.00	PS	2.279	-0.247	-1.602	-1.304	-0.186	-0.112	0.012
25.00	PS	2.304	-0.280	-1.349	-1.098	-0.177	-0.074	0.003
20.00	PS	2.348	-0.344	-1.088	-0.892	-0.202	0.005	0.000
15.00	PS	2.387	-0.401	-0.821	-0.678	-0.227	0.084	0.004
10.00	PS	2.407	-0.438	-0.548	-0.456	-0.227	0.134	0.014
5.00	PS	2.408	-0.490	-0.275	-0.228	-0.173	0.127	0.026
2.00	PS	2.406	-0.535	-0.110	-0.091	-0.110	0.091	0.032
0.00		2.406	-0.541	0.000	0.000	-0.066	0.066	0.034
2.00	SB	2.406	-0.535	0.110	0.091	-0.022	0.041	0.036
5.00	SB	2.408	-0.490	0.275	0.228	0.041	0.005	0.037
10.00	SB	2.407	-0.438	0.548	0.456	0.096	-0.004	0.037
15.00	SB	2.387	-0.401	0.821	0.678	0.098	0.045	0.039
20.00	SB	2.348	-0.344	1.088	0.892	0.074	0.122	0.046
25.00	SB	2.304	-0.280	1.349	1.098	0.053	0.198	0.060
30.00	SB	2.279	-0.247	1.602	1.304	0.068	0.230	0.079
40.00	SB	2.323	-0.270	2.014	1.717	0.148	0.149	0.114
50.00	SB	2.379	-0.232	2.298	2.082	0.158	0.058	0.132
60.00	SB	2.442	-0.010	2.497	2.388	0.137	-0.028	0.135
70.00	SB	2.535	0.492	2.618	2.625	0.098	-0.105	0.135

Statical angle of inclination is 20.32 degrees to portside

Statical angle of inclination is 10.68 degrees to starboard

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:05

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Verification against the stability criteria "Dienstnorm 15 including steady wind [7Bft]"

Hydrostatics

Draft mld.	2.406 m
Trim	-0.541 m
Statical angle of inclination	20.32 degrees PS
Statical angle of inclination	10.68 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.977 meter
Maximum GZ at 30 degrees or more	0.240	0.113 meter
Top of the GZ curve at least at	25.000	30.700 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.012 mrad
Area under the GZ curve up to 40 degrees	0.108	0.027 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.016 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.083 meter
Top of the GZ curve at least at	25.000	30.700 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.007 mrad
Area under the GZ curve up to 40 degrees	0.108	0.018 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.011 mrad
----- Additional information		
Range of positive stability	0.000	20.450 degrees
Angle of vanishing stability	0.000	42.553 degrees PS
Roll Period acc Irish authorities	0.000	4.249 sec
Roll Period acc IS 2008	1.000	5.115 sec

Calculated to SB

	<u>Criterion</u>	<u>Value</u>
-----Without wind		
Minimum metacentric height G'M	0.500	0.977 meter
Maximum GZ at 30 degrees or more	0.240	0.230 meter
Top of the GZ curve at least at	25.000	30.041 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.045 mrad
Area under the GZ curve up to 40 degrees	0.108	0.080 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.035 mrad
-----With wind [7Bft]		
Maximum GZ at 30 degrees or more	0.240	0.200 meter
Top of the GZ curve at least at	25.000	30.041 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.034 mrad
Area under the GZ curve up to 40 degrees	0.108	0.063 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.029 mrad
----- Additional information		
Range of positive stability	0.000	39.407 degrees
Angle of vanishing stability	0.000	53.264 degrees SB
Roll Period acc Irish authorities	0.000	4.249 sec
Roll Period acc IS 2008	1.000	5.115 sec

VCG'

A non-zero statical angle of equilibrium occurs,

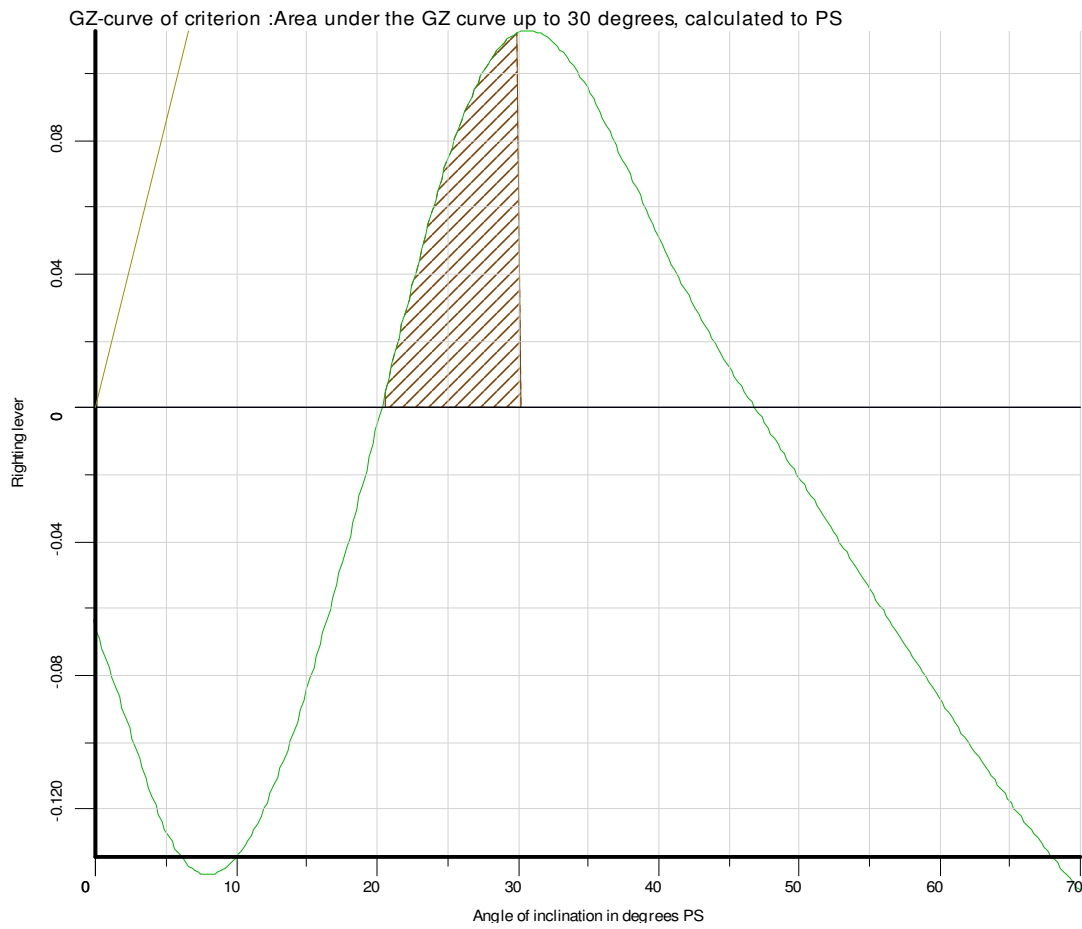
No maximum allowable VCG' is calculated.

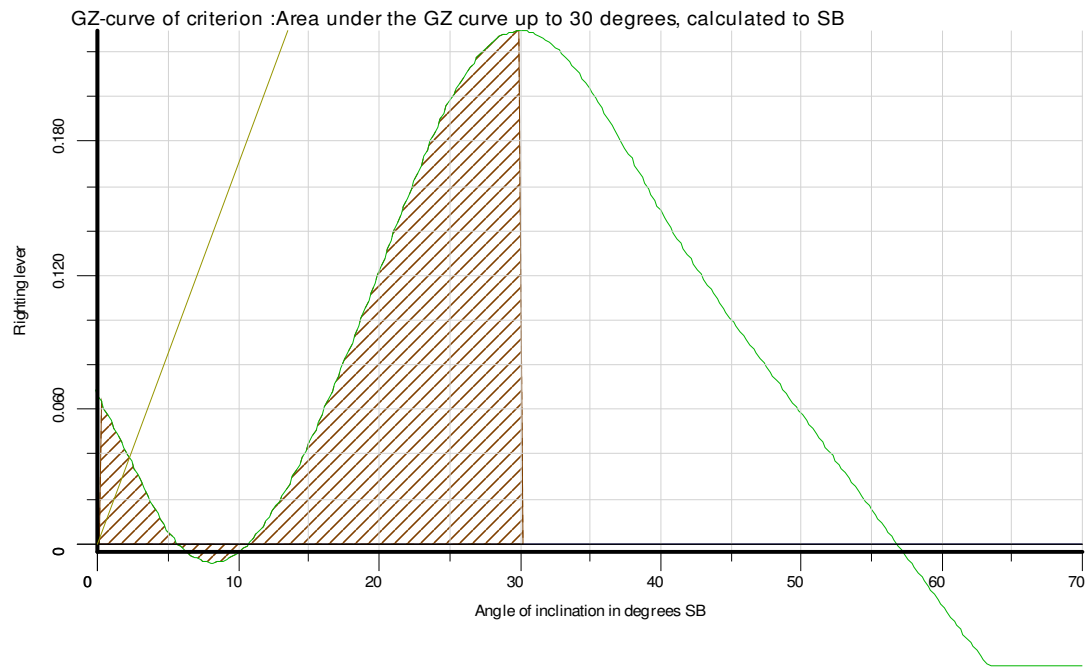
Loading condition DOES NOT comply with the stated criteria.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:05

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck





TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 14:22:05

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Water on deck, Cross section at 7.000 m

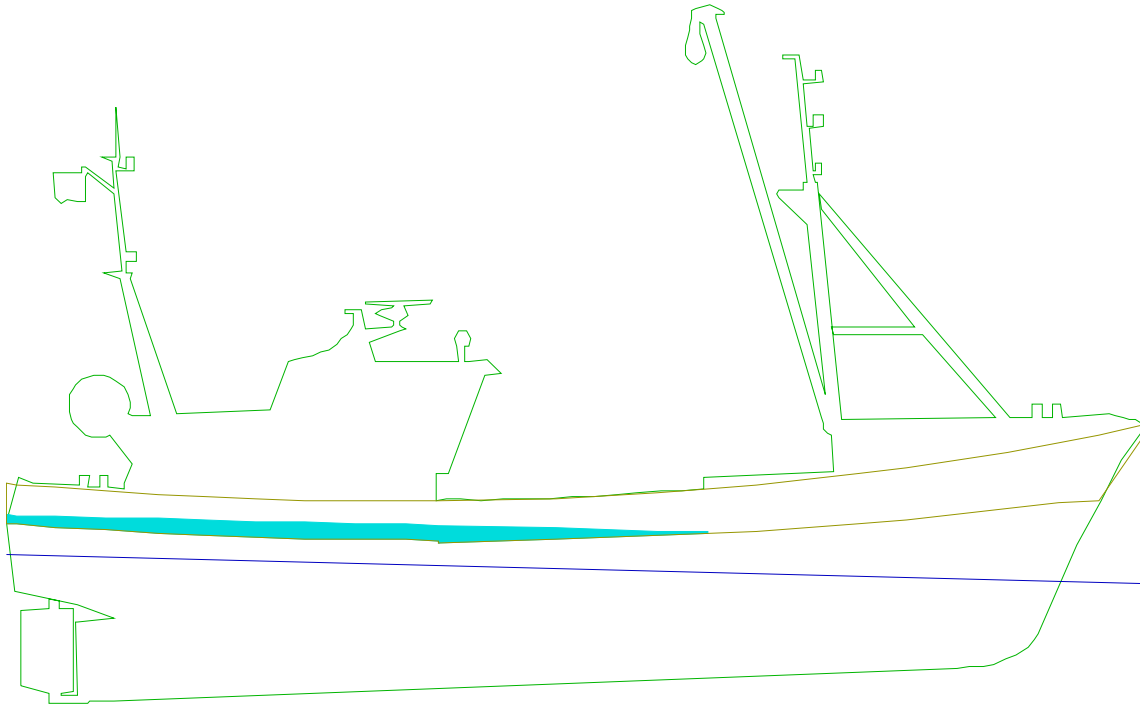


TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

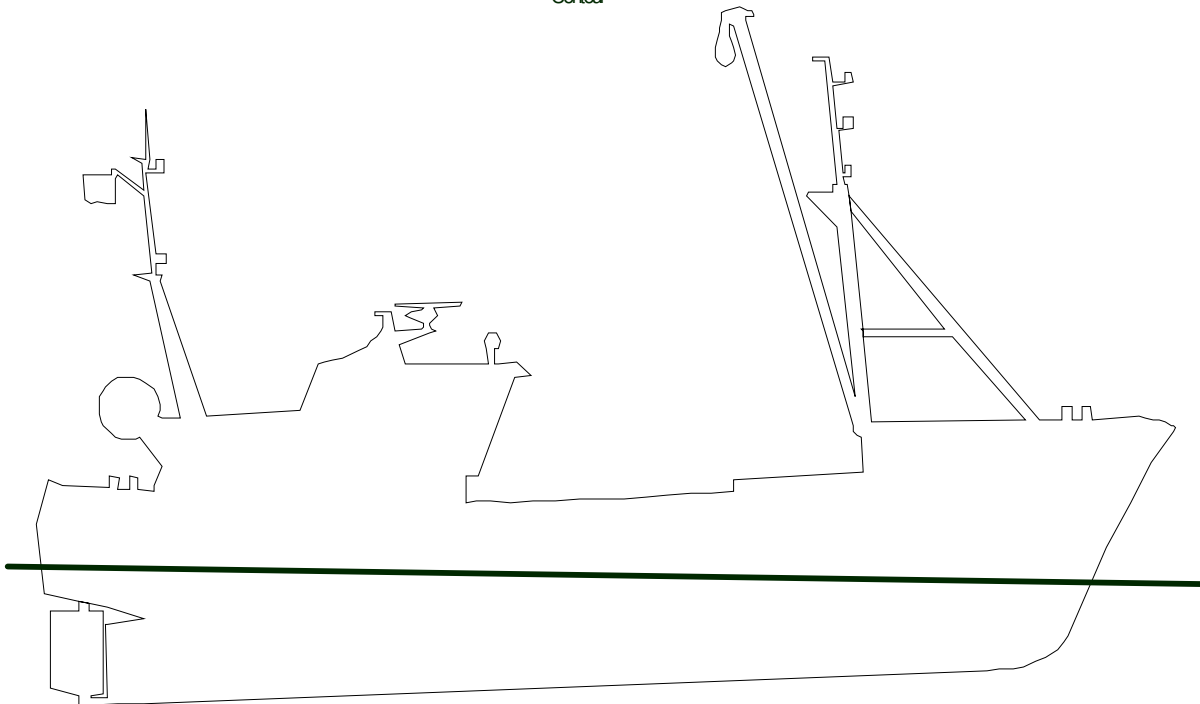
18 Oct 2019 14:22:05

Condition : Fase 4, PS derrick at 35 degrees, 15 m3 water on deck

Longitudinal view, no heel, cargo liquid



Contour



5. STABILITY CALCULATIONS IN WAVES [SUMMARY]

(Only output, since the loading conditions are the same)

Loading condition Condition during accident, PS derrick at 20 degrees, cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.293 m
Trim	-0.268 m
Statical angle of inclination	3.25 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.598 meter
Maximum GZ at 30 degrees or more	0.200	0.135 meter
Top of the GZ curve at least at	25.000	24.522 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.060 mrad
Area under the GZ curve up to 40 degrees	0.090	0.076 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.015 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.050 meter
Top of the GZ curve at least at	25.000	24.126 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.037 mrad
Area under the GZ curve up to 40 degrees	0.090	0.038 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.001 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.125 meter
Top of the GZ curve at least at	25.000	24.288 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.064 mrad
Area under the GZ curve up to 40 degrees	0.090	0.076 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.012 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.199 meter
Top of the GZ curve at least at	25.000	24.400 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.091 mrad
Area under the GZ curve up to 40 degrees	0.090	0.116 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.025 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.598 meter
Maximum GZ at 30 degrees or more	0.200	0.191 meter
Top of the GZ curve at least at	25.000	24.442 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.093 mrad
Area under the GZ curve up to 40 degrees	0.090	0.117 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.024 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.106 meter
Top of the GZ curve at least at	25.000	24.047 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.070 mrad
Area under the GZ curve up to 40 degrees	0.090	0.077 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.007 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.180 meter
Top of the GZ curve at least at	25.000	24.218 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.097 mrad
Area under the GZ curve up to 40 degrees	0.090	0.117 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.020 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.254 meter
Top of the GZ curve at least at	25.000	24.337 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.125 mrad
Area under the GZ curve up to 40 degrees	0.090	0.158 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.033 mrad

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

SUMMARY STABILITY CALCULATIONS

O-13 "Morgenster"

18 Oct 2019 14:46:08

Loading condition Condition during accident, PS derrick at 35 degrees, cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.293 m
Trim	-0.268 m
Statical angle of inclination	6.18 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.610 meter
Maximum GZ at 30 degrees or more	0.200	0.117 meter
Top of the GZ curve at least at	25.000	24.585 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.049 mrad
Area under the GZ curve up to 40 degrees	0.090	0.062 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.013 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.032 meter
Top of the GZ curve at least at	25.000	24.195 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.027 mrad
Area under the GZ curve up to 40 degrees	0.090	0.028 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.000 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.106 meter
Top of the GZ curve at least at	25.000	24.346 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.053 mrad
Area under the GZ curve up to 40 degrees	0.090	0.062 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.009 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.181 meter
Top of the GZ curve at least at	25.000	24.450 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.079 mrad
Area under the GZ curve up to 40 degrees	0.090	0.102 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.022 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.610 meter
Maximum GZ at 30 degrees or more	0.200	0.225 meter
Top of the GZ curve at least at	25.000	24.430 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.111 mrad
Area under the GZ curve up to 40 degrees	0.090	0.141 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.030 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.140 meter
Top of the GZ curve at least at	25.000	24.040 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.088 mrad
Area under the GZ curve up to 40 degrees	0.090	0.101 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.013 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.214 meter
Top of the GZ curve at least at	25.000	24.210 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.115 mrad
Area under the GZ curve up to 40 degrees	0.090	0.141 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.026 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.288 meter
Top of the GZ curve at least at	25.000	24.327 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.143 mrad
Area under the GZ curve up to 40 degrees	0.090	0.182 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.039 mrad

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

SUMMARY STABILITY CALCULATIONS

O-13 "Morgenster"

18 Oct 2019 14:46:09

Loading condition Fase 2, PS derrick at 20 degrees, 5 m3 water on deck, cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.333 m
Trim	-0.330 m
Statical angle of inclination	10.05 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.588 meter
Maximum GZ at 30 degrees or more	0.200	0.135 meter
Top of the GZ curve at least at	25.000	25.924 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.033 mrad
Area under the GZ curve up to 40 degrees	0.090	0.051 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.018 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.050 meter
Top of the GZ curve at least at	25.000	24.954 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.016 mrad
Area under the GZ curve up to 40 degrees	0.090	0.018 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.002 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.125 meter
Top of the GZ curve at least at	25.000	25.097 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.037 mrad
Area under the GZ curve up to 40 degrees	0.090	0.051 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.014 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.199 meter
Top of the GZ curve at least at	25.000	25.179 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.061 mrad
Area under the GZ curve up to 40 degrees	0.090	0.088 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.027 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.588 meter
Maximum GZ at 30 degrees or more	0.200	0.191 meter
Top of the GZ curve at least at	25.000	25.728 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.060 mrad
Area under the GZ curve up to 40 degrees	0.090	0.086 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.027 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.106 meter
Top of the GZ curve at least at	25.000	24.803 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.041 mrad
Area under the GZ curve up to 40 degrees	0.090	0.051 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.010 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.180 meter
Top of the GZ curve at least at	25.000	24.981 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.066 mrad
Area under the GZ curve up to 40 degrees	0.090	0.089 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.023 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.254 meter
Top of the GZ curve at least at	25.000	25.076 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.090 mrad
Area under the GZ curve up to 40 degrees	0.090	0.126 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.036 mrad

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

SUMMARY STABILITY CALCULATIONS

O-13 "Morgenster"

18 Oct 2019 14:46:09

Loading condition Fase 2, PS derrick at 35 degrees, 5 m3 water on deck, cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.333 m
Trim	-0.330 m
Statical angle of inclination	12.70 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.598 meter
Maximum GZ at 30 degrees or more	0.200	0.117 meter
Top of the GZ curve at least at	25.000	26.089 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.025 mrad
Area under the GZ curve up to 40 degrees	0.090	0.041 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.015 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.032 meter
Top of the GZ curve at least at	25.000	25.088 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.010 mrad
Area under the GZ curve up to 40 degrees	0.090	0.011 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.001 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.106 meter
Top of the GZ curve at least at	25.000	25.198 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.029 mrad
Area under the GZ curve up to 40 degrees	0.090	0.041 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.011 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.181 meter
Top of the GZ curve at least at	25.000	25.262 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.051 mrad
Area under the GZ curve up to 40 degrees	0.090	0.076 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.025 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.598 meter
Maximum GZ at 30 degrees or more	0.200	0.225 meter
Top of the GZ curve at least at	25.000	25.694 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.078 mrad
Area under the GZ curve up to 40 degrees	0.090	0.110 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.032 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.140 meter
Top of the GZ curve at least at	25.000	24.794 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.059 mrad
Area under the GZ curve up to 40 degrees	0.090	0.074 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.015 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.214 meter
Top of the GZ curve at least at	25.000	24.966 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.084 mrad
Area under the GZ curve up to 40 degrees	0.090	0.112 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.029 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.288 meter
Top of the GZ curve at least at	25.000	25.060 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.108 mrad
Area under the GZ curve up to 40 degrees	0.090	0.150 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.042 mrad

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

SUMMARY STABILITY CALCULATIONS

O-13 "Morgenster"

18 Oct 2019 14:46:10

Loading condition Fase 3, PS derrick at 20 degrees, 10 m3 water on deck, cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.370	m
Trim	-0.438	m
Statcal angle of inclination	16.48	degrees PS
Statcal angle of inclination	9.36	degrees SB
Flooding angle PS	>70.00	degrees
Flooding angle SB	>70.00	degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.512 meter
Maximum GZ at 30 degrees or more	0.200	0.136 meter
Top of the GZ curve at least at	25.000	30.524 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.018 mrad
Area under the GZ curve up to 40 degrees	0.090	0.037 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.019 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.050 meter
Top of the GZ curve at least at	25.000	26.268 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.009 mrad
Area under the GZ curve up to 40 degrees	0.090	0.012 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.003 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.125 meter
Top of the GZ curve at least at	25.000	27.782 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.023 mrad
Area under the GZ curve up to 40 degrees	0.090	0.038 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.015 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.199 meter
Top of the GZ curve at least at	25.000	29.359 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.039 mrad
Area under the GZ curve up to 40 degrees	0.090	0.069 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.029 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.512 meter
Maximum GZ at 30 degrees or more	0.200	0.191 meter
Top of the GZ curve at least at	25.000	30.226 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.036 mrad
Area under the GZ curve up to 40 degrees	0.090	0.064 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.028 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.106 meter
Top of the GZ curve at least at	25.000	26.038 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.027 mrad
Area under the GZ curve up to 40 degrees	0.090	0.037 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.010 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.180 meter
Top of the GZ curve at least at	25.000	27.450 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.045 mrad
Area under the GZ curve up to 40 degrees	0.090	0.070 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.024 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.254 meter
Top of the GZ curve at least at	25.000	29.023 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.064 mrad
Area under the GZ curve up to 40 degrees	0.090	0.102 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.038 mrad

VCG'

A non-zero statcal angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

SUMMARY STABILITY CALCULATIONS

O-13 "Morgenster"

18 Oct 2019 14:46:11

Loading condition Fase 3, PS derrick at 35 degrees, 10 m3 water on deck, cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.370 m
Trim	-0.438 m
Statical angle of inclination	18.93 degrees PS
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.633 meter
Maximum GZ at 30 degrees or more	0.200	0.118 meter
Top of the GZ curve at least at	25.000	30.756 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.013 mrad
Area under the GZ curve up to 40 degrees	0.090	0.030 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.017 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.032 meter
Top of the GZ curve at least at	25.000	26.483 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.005 mrad
Area under the GZ curve up to 40 degrees	0.090	0.007 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.001 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.106 meter
Top of the GZ curve at least at	25.000	28.065 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.017 mrad
Area under the GZ curve up to 40 degrees	0.090	0.030 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.013 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.181 meter
Top of the GZ curve at least at	25.000	29.617 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.032 mrad
Area under the GZ curve up to 40 degrees	0.090	0.059 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.027 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.633 meter
Maximum GZ at 30 degrees or more	0.200	0.225 meter
Top of the GZ curve at least at	25.000	30.168 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.052 mrad
Area under the GZ curve up to 40 degrees	0.090	0.086 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.034 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.140 meter
Top of the GZ curve at least at	25.000	26.022 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.045 mrad
Area under the GZ curve up to 40 degrees	0.090	0.061 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.016 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.214 meter
Top of the GZ curve at least at	25.000	27.405 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.063 mrad
Area under the GZ curve up to 40 degrees	0.090	0.093 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.030 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.288 meter
Top of the GZ curve at least at	25.000	28.960 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.081 mrad
Area under the GZ curve up to 40 degrees	0.090	0.125 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.044 mrad

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

SUMMARY STABILITY CALCULATIONS

O-13 "Morgenster"

18 Oct 2019 14:46:12

Loading condition Fase 4, PS derrick at 20 degrees, 15 m3 water on deck, , cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.406 m
Trim	-0.541 m
Statcal angle of inclination	18.93 degrees PS
Statcal angle of inclination	14.06 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.933 meter
Maximum GZ at 30 degrees or more	0.200	0.131 meter
Top of the GZ curve at least at	25.000	30.460 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.015 mrad
Area under the GZ curve up to 40 degrees	0.090	0.034 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.018 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.045 meter
Top of the GZ curve at least at	25.000	26.301 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.008 mrad
Area under the GZ curve up to 40 degrees	0.090	0.011 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.002 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.120 meter
Top of the GZ curve at least at	25.000	27.658 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.020 mrad
Area under the GZ curve up to 40 degrees	0.090	0.034 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.014 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.195 meter
Top of the GZ curve at least at	25.000	28.870 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.031 mrad
Area under the GZ curve up to 40 degrees	0.090	0.060 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.028 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.933 meter
Maximum GZ at 30 degrees or more	0.200	0.196 meter
Top of the GZ curve at least at	25.000	30.101 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.032 mrad
Area under the GZ curve up to 40 degrees	0.090	0.061 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.029 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.111 meter
Top of the GZ curve at least at	25.000	26.034 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.029 mrad
Area under the GZ curve up to 40 degrees	0.090	0.040 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.011 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.185 meter
Top of the GZ curve at least at	25.000	27.337 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.041 mrad
Area under the GZ curve up to 40 degrees	0.090	0.066 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.025 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.259 meter
Top of the GZ curve at least at	25.000	28.510 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.054 mrad
Area under the GZ curve up to 40 degrees	0.090	0.093 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.039 mrad

VCG'

A non-zero statcal angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

SUMMARY STABILITY CALCULATIONS

O-13 "Morgenster"

18 Oct 2019 14:46:13

Loading condition Fase 4, PS derrick at 35 degrees, 15 m3 water on deck, cargo liquid

Verification against the stability criteria "Stability in waves"

Hydrostatics

Draft mld.	2.406 m
Trim	-0.541 m
Statical angle of inclination	20.32 degrees PS
Statical angle of inclination	10.68 degrees SB
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.977 meter
Maximum GZ at 30 degrees or more	0.200	0.113 meter
Top of the GZ curve at least at	25.000	30.701 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.012 mrad
Area under the GZ curve up to 40 degrees	0.090	0.027 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.016 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.027 meter
Top of the GZ curve at least at	25.000	26.513 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.005 mrad
Area under the GZ curve up to 40 degrees	0.090	0.005 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.001 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.102 meter
Top of the GZ curve at least at	25.000	27.898 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.015 mrad
Area under the GZ curve up to 40 degrees	0.090	0.027 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.012 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.176 meter
Top of the GZ curve at least at	25.000	29.125 degrees PS
Area under the GZ curve up to 30 degrees	0.055	0.026 mrad
Area under the GZ curve up to 40 degrees	0.090	0.052 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.026 mrad

Calculated to SB

	Criterion	Value
----- Vessel in still water		
Minimum metacentric height G'M	0.150	0.977 meter
Maximum GZ at 30 degrees or more	0.200	0.230 meter
Top of the GZ curve at least at	25.000	30.041 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.045 mrad
Area under the GZ curve up to 40 degrees	0.090	0.080 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.035 mrad
----- Vessel at wave top (1 m)		
Maximum GZ at 30 degrees or more	0.200	0.145 meter
Top of the GZ curve at least at	25.000	26.018 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.046 mrad
Area under the GZ curve up to 40 degrees	0.090	0.063 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.017 mrad
----- Vessel in between wave top and trough		
Maximum GZ at 30 degrees or more	0.200	0.219 meter
Top of the GZ curve at least at	25.000	27.302 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.058 mrad
Area under the GZ curve up to 40 degrees	0.090	0.089 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.031 mrad
----- Vessel in wave trough		
Maximum GZ at 30 degrees or more	0.200	0.293 meter
Top of the GZ curve at least at	25.000	28.459 degrees SB
Area under the GZ curve up to 30 degrees	0.055	0.070 mrad
Area under the GZ curve up to 40 degrees	0.090	0.115 mrad
Area under the GZ curve between 30 and 40 degrees	0.030	0.044 mrad

VCG'

A non-zero statical angle of equilibrium occurs,
No maximum allowable VCG' is calculated.

Loading condition DOES NOT comply with the stated criteria.

The vessel DOES NOT comply with 1 or more criteria

6. INPUT DATA

6.1. MAIN DIMENSIONS

General particulars and main dimensions

Project name : O-13 "Morgenster"

Length between perpendiculars	:	21.020	m
Waterline length	:	21.020	m
Moulded breadth	:	6.000	m
Design draft	:	3.000	m
Moulded depth	:	5.000	m
Appendage coefficient	:	1.0060	
Mean shell plate thickness	:	0.0000	m

Frame spacing definition

Frame spacing for the entire ship is 0.4500 m

Frame zero lies on -1.000 m

The vessel is symmetrical.

Furthermore the vessel has 3 added hullform(s):

Name	L-dis	V-dis	T-dis	Perm.	Side
Accommodation	0.000	0.000	0.000	1.000	PS&SB
accommodation top	0.000	0.000	0.000	1.000	PS&SB
Deck	0.000	0.000	0.000	1.000	PS&SB

The abbreviations above mean :

Name Identification of the part to add. This part has been defined by hullgeneration, digitizer or hulltransformation

etc. as if it were a separate hullform.

L-dis Longitudinal distance between APP of basic vessel and APP of part to add.

V-dis Vertical distance between baseline of basic vessel and baseline of part to add.

T-dis Transverse distance between centreline of basic vessel and centreline of part to add.

Perm. Permeability (between -1 and 1) of part to add.

Side Side (SB, PS of SB&PS) of part to add.

Upper appendages

Hullform :Symmetrical main hullform

Appendage nr. 1

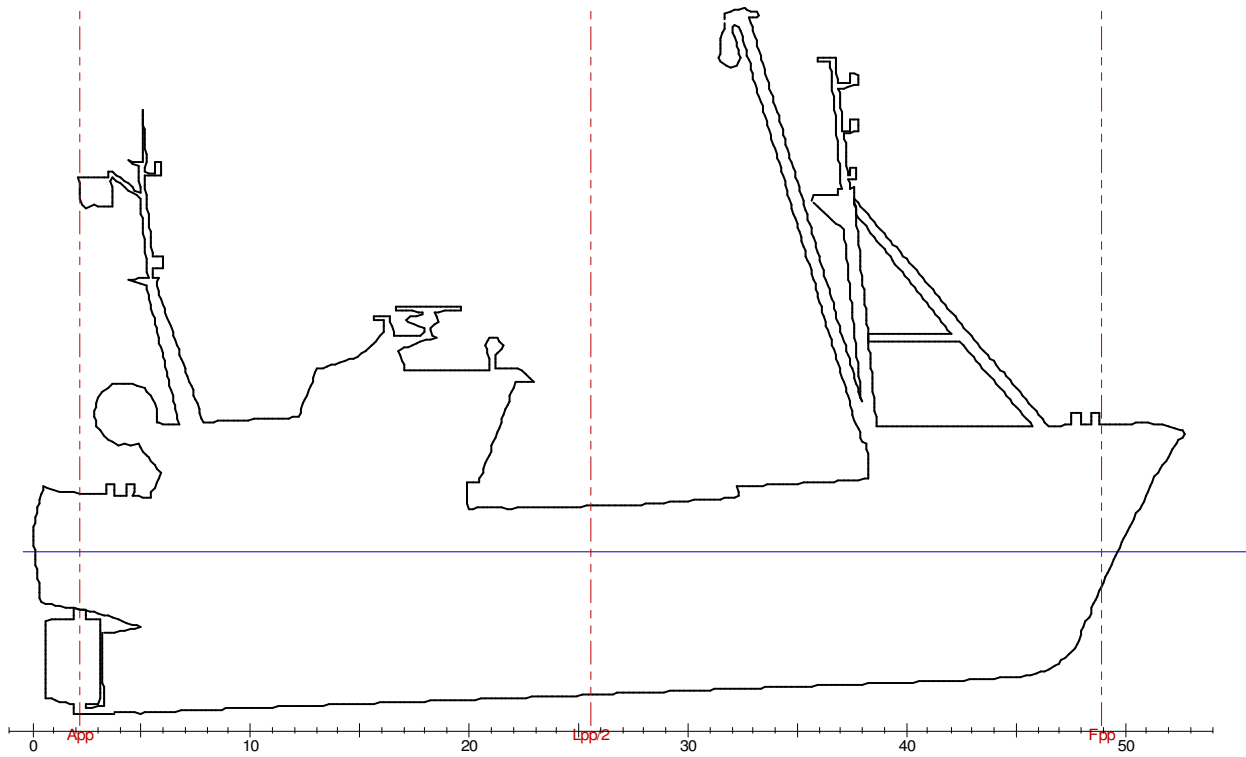
Deck camber is 1/108.0TH of the breadth, measured from the side

Aftside is -1.000 m

Frontside is 20.900 m

MAIN DIMENSIONS
O-13 "Morgenster"

03 Sep 2019 17:42:12



Legend

- Perpendiculars
- Water line
- Mark lines

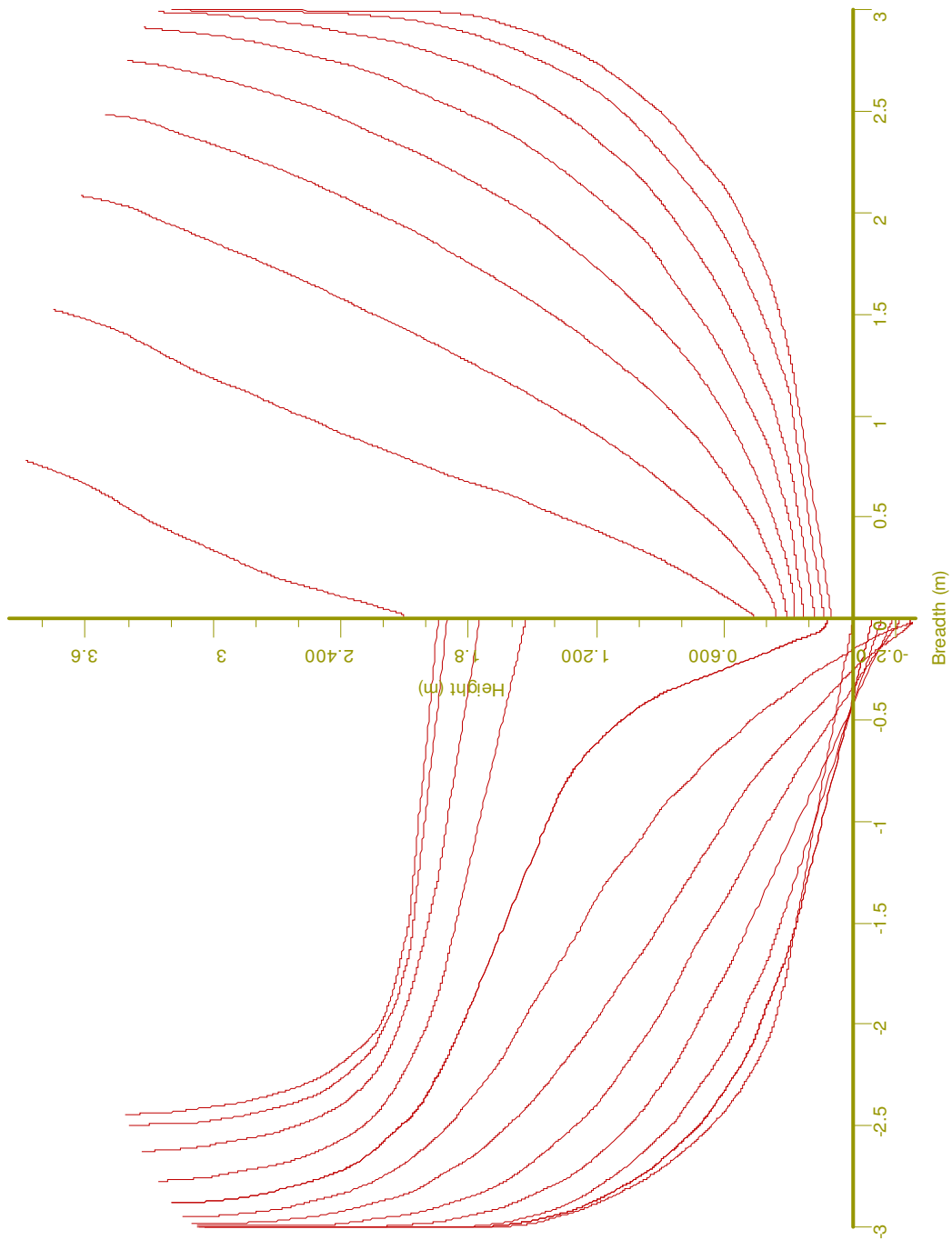
Main dimensions

Length perpendiculars	21.020m
Hull length	23.850m
Moulded breadth	6.000m
Moulded depth	5.000m
Design draft	3.000m

BODYPLAN
O-13 "Morgenster"

Symmetrical main hullform

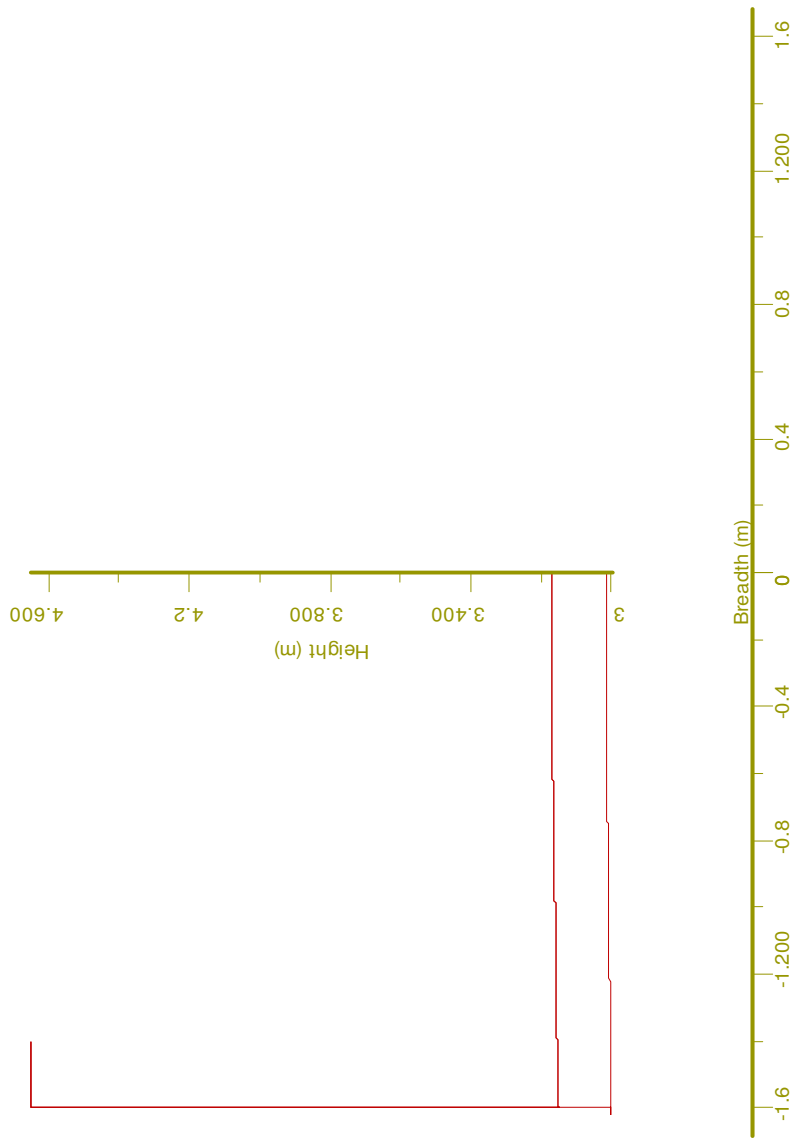
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BODYPLAN
O-13 "Morgenster"

Accommodation

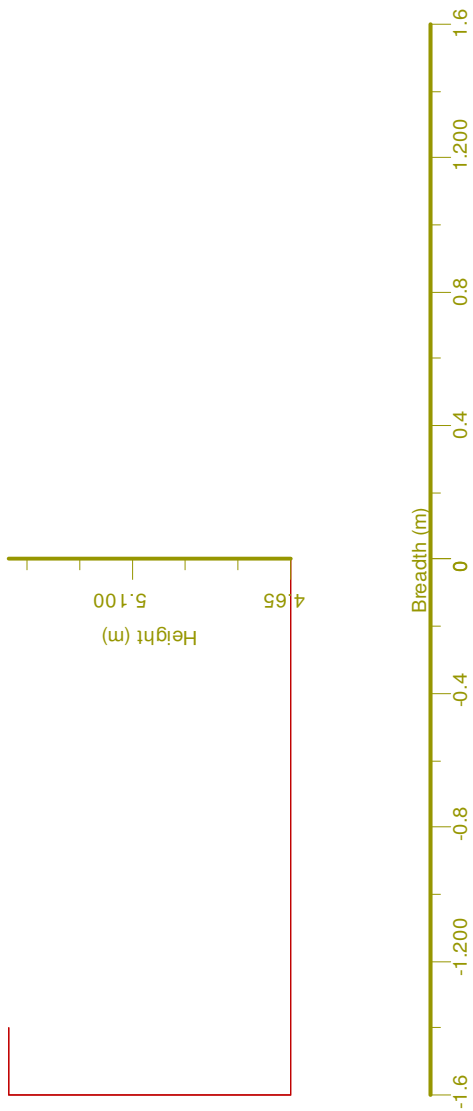
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BODYPLAN
O-13 "Morgenster"

accomodation top

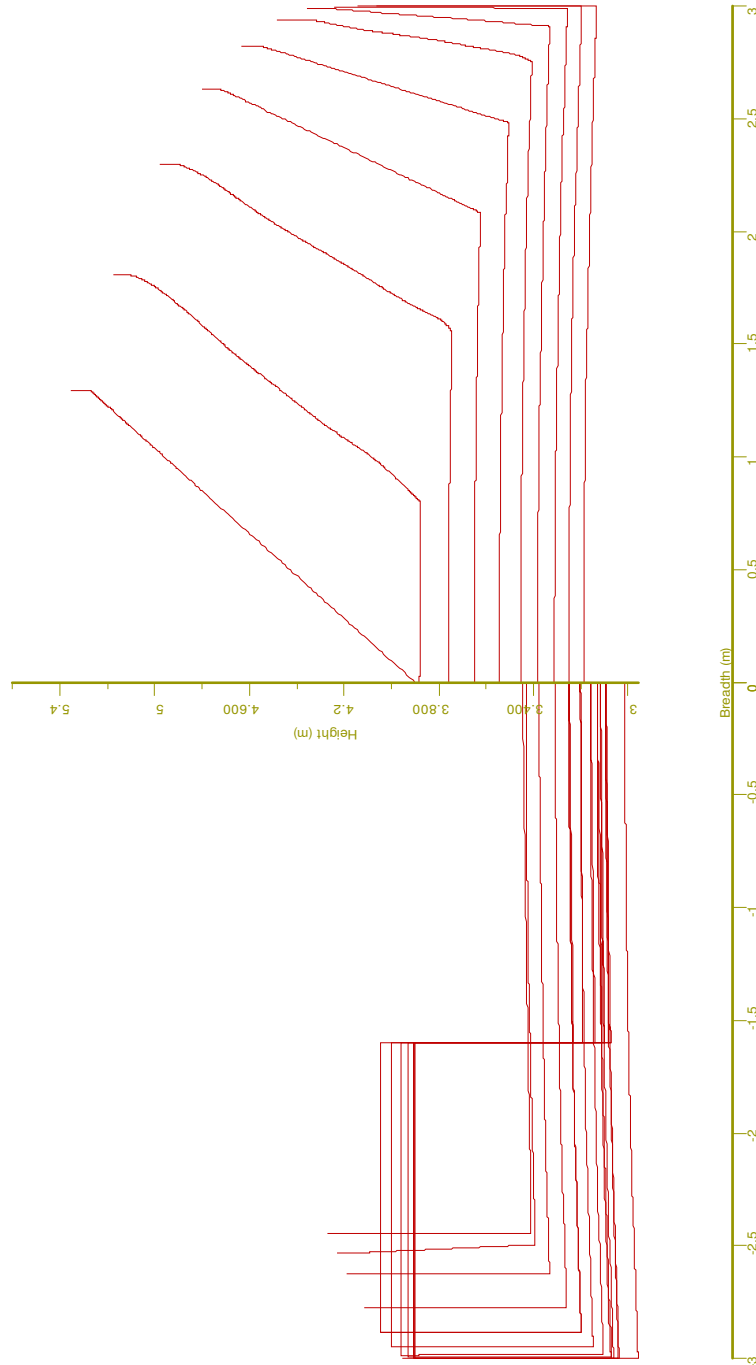
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BODYPLAN
O-13 "Morgenster"

Deck

03 Sep 2019 17:42:51



6.2. HYDROSTATIC PARTICULARS

O-13 "Morgenster"

Trim = 0.000 m

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Draft from base m	Displ. [density 1.0000] ton	Displ. [density 1.0250] ton	Immer- sion ton/cm	Moment change trim tonm/cm	LCB from APP m	TCB from CL m	LCF from APP m	KM transv. m
1.000	43.89	44.99	0.74	0.65	10.199	0.000	10.512	3.609
1.050	47.55	48.74	0.76	0.67	10.223	0.000	10.504	3.565
1.100	51.29	52.57	0.78	0.70	10.243	0.000	10.495	3.526
1.150	55.12	56.49	0.79	0.72	10.260	0.000	10.482	3.495
1.200	59.02	60.50	0.81	0.75	10.275	0.000	10.469	3.464
1.250	63.01	64.59	0.83	0.78	10.287	0.000	10.452	3.434
1.300	67.08	68.75	0.84	0.80	10.296	0.000	10.435	3.401
1.350	71.22	73.00	0.86	0.83	10.304	0.000	10.417	3.369
1.400	75.42	77.31	0.87	0.85	10.310	0.000	10.395	3.340
1.450	79.70	81.69	0.89	0.88	10.314	0.000	10.372	3.315
1.500	84.05	86.15	0.90	0.91	10.316	0.000	10.349	3.292
1.550	88.46	90.67	0.91	0.94	10.317	0.000	10.302	3.270
1.600	92.96	95.28	0.93	0.98	10.315	0.000	10.231	3.249
1.650	97.54	99.98	0.95	1.03	10.310	0.000	10.161	3.230
1.700	102.20	104.75	0.96	1.07	10.302	0.000	10.098	3.211
1.750	106.93	109.60	0.98	1.11	10.292	0.000	10.030	3.194
1.800	111.75	114.54	1.00	1.17	10.278	0.000	9.911	3.179
1.850	116.66	119.58	1.02	1.23	10.262	0.000	9.848	3.168
1.900	121.65	124.69	1.04	1.28	10.243	0.000	9.728	3.160
1.950	126.75	129.92	1.06	1.37	10.220	0.000	9.580	3.159
2.000	131.96	135.26	1.08	1.45	10.192	0.000	9.455	3.161
2.050	137.27	140.70	1.10	1.52	10.162	0.000	9.351	3.164
2.100	142.67	146.24	1.12	1.59	10.130	0.000	9.274	3.163
2.150	148.14	151.84	1.13	1.64	10.098	0.000	9.230	3.164
2.200	153.67	157.51	1.14	1.68	10.066	0.000	9.197	3.164
2.250	159.25	163.23	1.15	1.71	10.035	0.000	9.177	3.160
2.300	164.86	168.99	1.16	1.74	10.006	0.000	9.168	3.155
2.350	170.52	174.78	1.16	1.76	9.978	0.000	9.157	3.148
2.400	176.21	180.61	1.17	1.79	9.952	0.000	9.158	3.143
2.450	181.93	186.48	1.18	1.81	9.927	0.000	9.163	3.137
2.500	187.67	192.37	1.18	1.83	9.903	0.000	9.169	3.131
2.550	193.44	198.28	1.19	1.84	9.882	0.000	9.176	3.126
2.600	199.24	204.22	1.19	1.86	9.861	0.000	9.184	3.121
2.650	205.05	210.18	1.19	1.87	9.842	0.000	9.193	3.117
2.700	210.88	216.16	1.20	1.89	9.824	0.000	9.204	3.114
2.750	216.73	222.15	1.20	1.90	9.808	0.000	9.216	3.112
2.800	222.60	228.17	1.21	1.92	9.792	0.000	9.229	3.111
2.850	228.48	234.20	1.21	1.93	9.778	0.000	9.253	3.110
2.900	234.38	240.24	1.21	1.94	9.765	0.000	9.265	3.111
2.950	240.29	246.30	1.21	1.95	9.753	0.000	9.276	3.113
3.000	246.29	252.45	1.28	1.97	9.741	0.000	9.248	3.196

6.3. CROSS CURVES

O-13 "Morgenster"

Initial trim = 0.000 m

03 Sep 2019 17:47:14

Draft is from underside keel. (0.0 mm)

The trim is modified to meet constant LCB.

Calculation for inclination to PS

In the table below the KN sin(ϕ) values are printed (m).

Displ. ton	T[$\phi=0$] m	Angle of inclination in degrees											
		0.00	2.00	5.00	10.00	15.00	20.00	25.00	30.00	40.00	50.00	60.00	70.00
25.00	0.705	0.000	0.135	0.337	0.661	0.959	1.229	1.477	1.707	2.116	2.414	2.596	2.760
30.00	0.785	0.000	0.132	0.329	0.648	0.943	1.210	1.452	1.676	2.083	2.411	2.623	2.798
35.00	0.860	0.000	0.130	0.323	0.637	0.928	1.193	1.433	1.654	2.060	2.409	2.647	2.824
40.00	0.931	0.000	0.128	0.318	0.626	0.915	1.178	1.417	1.637	2.039	2.406	2.669	2.840
45.00	1.000	0.000	0.126	0.313	0.617	0.903	1.166	1.404	1.623	2.026	2.402	2.689	2.849
50.00	1.067	0.000	0.124	0.309	0.608	0.892	1.154	1.392	1.611	2.015	2.396	2.703	2.854
55.00	1.131	0.000	0.122	0.305	0.601	0.882	1.143	1.382	1.603	2.008	2.392	2.712	2.856
60.00	1.194	0.000	0.121	0.301	0.594	0.873	1.133	1.373	1.596	2.004	2.389	2.717	2.856
65.00	1.255	0.000	0.120	0.298	0.588	0.864	1.124	1.366	1.591	2.001	2.388	2.718	2.852
70.00	1.315	0.000	0.118	0.295	0.582	0.857	1.117	1.360	1.586	2.000	2.389	2.716	2.848
75.00	1.373	0.000	0.117	0.292	0.577	0.851	1.111	1.355	1.583	1.999	2.391	2.712	2.842
80.00	1.431	0.000	0.116	0.289	0.572	0.845	1.105	1.351	1.580	2.000	2.392	2.707	2.836
85.00	1.487	0.000	0.115	0.287	0.568	0.840	1.100	1.347	1.579	2.001	2.394	2.701	2.827
90.00	1.543	0.000	0.114	0.285	0.564	0.836	1.096	1.344	1.577	2.003	2.395	2.692	2.818
95.00	1.597	0.000	0.113	0.283	0.561	0.832	1.093	1.342	1.577	2.005	2.395	2.682	2.809
100.0	1.650	0.000	0.113	0.281	0.558	0.829	1.091	1.340	1.576	2.008	2.395	2.671	2.799
105.0	1.703	0.000	0.112	0.279	0.556	0.826	1.089	1.339	1.576	2.012	2.394	2.660	2.788
110.0	1.754	0.000	0.111	0.278	0.554	0.825	1.087	1.338	1.576	2.016	2.393	2.649	2.776
115.0	1.805	0.000	0.111	0.277	0.552	0.823	1.085	1.337	1.577	2.020	2.392	2.640	2.764
120.0	1.854	0.000	0.111	0.276	0.551	0.822	1.084	1.337	1.578	2.024	2.389	2.631	2.751
125.0	1.903	0.000	0.110	0.276	0.551	0.821	1.083	1.336	1.578	2.028	2.387	2.621	2.738
130.0	1.951	0.000	0.110	0.276	0.550	0.820	1.083	1.336	1.579	2.031	2.384	2.611	2.725
135.0	1.998	0.000	0.110	0.276	0.550	0.819	1.082	1.337	1.581	2.034	2.381	2.602	2.713
140.0	2.044	0.000	0.110	0.276	0.549	0.819	1.082	1.337	1.582	2.036	2.377	2.592	2.702
145.0	2.089	0.000	0.110	0.276	0.549	0.818	1.082	1.337	1.583	2.037	2.373	2.583	2.691
150.0	2.134	0.000	0.110	0.276	0.549	0.818	1.082	1.338	1.585	2.038	2.368	2.573	2.682
155.0	2.178	0.000	0.110	0.276	0.549	0.818	1.082	1.338	1.586	2.038	2.363	2.564	2.674
160.0	2.222	0.000	0.110	0.275	0.548	0.817	1.082	1.339	1.588	2.037	2.357	2.555	2.667
165.0	2.265	0.000	0.110	0.275	0.548	0.817	1.081	1.339	1.590	2.035	2.351	2.546	2.660
170.0	2.309	0.000	0.110	0.275	0.547	0.817	1.082	1.340	1.591	2.033	2.344	2.539	2.655
175.0	2.352	0.000	0.110	0.274	0.547	0.816	1.082	1.341	1.593	2.030	2.337	2.532	2.650
180.0	2.395	0.000	0.110	0.274	0.546	0.816	1.082	1.341	1.594	2.026	2.330	2.525	2.646
185.0	2.437	0.000	0.110	0.274	0.546	0.816	1.081	1.342	1.595	2.022	2.322	2.519	2.641
190.0	2.480	0.000	0.109	0.273	0.545	0.815	1.081	1.343	1.595	2.017	2.314	2.514	2.637
195.0	2.522	0.000	0.109	0.273	0.545	0.815	1.082	1.344	1.595	2.011	2.307	2.508	2.633
200.0	2.564	0.000	0.109	0.272	0.545	0.815	1.082	1.344	1.594	2.005	2.300	2.503	2.628
205.0	2.607	0.000	0.109	0.272	0.544	0.815	1.082	1.345	1.593	1.999	2.293	2.498	2.624
210.0	2.649	0.000	0.109	0.272	0.544	0.814	1.082	1.346	1.591	1.992	2.286	2.494	2.620
215.0	2.690	0.000	0.109	0.272	0.544	0.814	1.082	1.346	1.588	1.985	2.279	2.489	2.616
220.0	2.732	0.000	0.109	0.272	0.544	0.814	1.083	1.345	1.585	1.977	2.272	2.485	2.612
225.0	2.774	0.000	0.109	0.272	0.544	0.814	1.083	1.344	1.581	1.969	2.265	2.481	2.607
230.0	2.815	0.000	0.109	0.272	0.544	0.814	1.083	1.343	1.576	1.961	2.259	2.476	2.603
235.0	2.857	0.000	0.109	0.273	0.544	0.815	1.084	1.341	1.572	1.954	2.252	2.471	2.599
240.0	2.898	0.000	0.109	0.273	0.544	0.815	1.084	1.339	1.566	1.946	2.245	2.466	2.595
245.0	2.939	0.000	0.109	0.273	0.545	0.815	1.084	1.336	1.560	1.938	2.239	2.461	2.591
250.0	2.980	0.000	0.110	0.273	0.545	0.816	1.084	1.332	1.554	1.931	2.233	2.456	2.587

TRIM AND STABILITY CALCULATION

O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.1 100% Consumables

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 CL	97.6	0.8750	5.049	1.824	15.998	0.000	0.357
FO. Fr.38 SB	97.2	0.8750	3.694	2.186	15.979	1.692	0.466
FO. Fr.38 PS	97.2	0.8750	3.694	2.186	15.979	-1.692	0.466
SUBTOTAL	97.4	0.8750	12.436	2.039	15.986	0.000	1.289
Subtotals for group : Water							
FW Fore	95.0	1.0000	3.600	1.033	18.368	0.000	0.946
FW Aft	88.6	1.0000	2.100	2.262	-0.293	0.000	0.964
SUBTOTAL	92.6	1.0000	5.700	1.486	11.493	0.000	1.909
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	100.0	1.0000	2.529	0.904	8.504	2.048	0.000
IceW. Fr.18/24 PS	100.0	1.0000	2.529	0.904	8.504	-2.048	0.000
SUBTOTAL	100.0	1.0000	5.057	0.904	8.504	0.000	0.000
REST.IIS	-	-	0.500	1.250	14.700	0.000	-
TOTAL	-	-	172.293	2.351	10.039	0.000	3.198

Hydrostatics

Volume	167.089 m ³
LCF	9.184 m
Mom. change trim	1.753 tonm/cm
Ton/cm immersion	1.160 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.332 m
Draft aft (App)	2.308 m
Draft fore (Fpp)	2.356 m
Trim	0.048 m

Transverse stability

KM transverse	3.148 m		
VCG	2.351 m		
GM solid	0.797 m		
GG' correction	0.019 m		
G'M liquid	0.779 m	VCG'	2.369 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.1 100% Consumables

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	1.328	0.852	-2.652	-2.226	0.000	-0.426	0.446
60.00	PS	1.742	0.561	-2.535	-2.052	0.000	-0.483	0.367
50.00	PS	1.949	0.462	-2.341	-1.815	0.000	-0.526	0.278
40.00	PS	2.096	0.367	-2.031	-1.523	0.000	-0.508	0.187
30.00	PS	2.214	0.247	-1.591	-1.185	0.000	-0.406	0.106
25.00	PS	2.258	0.192	-1.339	-1.001	0.000	-0.338	0.074
20.00	PS	2.288	0.141	-1.080	-0.810	0.000	-0.270	0.047
15.00	PS	2.309	0.100	-0.816	-0.613	0.000	-0.202	0.027
10.00	PS	2.322	0.070	-0.546	-0.411	0.000	-0.135	0.012
5.00	PS	2.329	0.053	-0.274	-0.207	0.000	-0.068	0.003
2.00	PS	2.331	0.049	-0.110	-0.083	0.000	-0.027	0.000
0.00		2.332	0.048	0.000	0.000	0.000	-0.000	-0.000
2.00	SB	2.331	0.049	0.110	0.083	0.000	0.027	0.000
5.00	SB	2.329	0.053	0.274	0.207	0.000	0.068	0.003
10.00	SB	2.322	0.070	0.546	0.411	0.000	0.135	0.012
15.00	SB	2.309	0.100	0.816	0.613	0.000	0.202	0.027
20.00	SB	2.288	0.141	1.080	0.810	0.000	0.270	0.047
25.00	SB	2.258	0.192	1.339	1.001	0.000	0.338	0.074
30.00	SB	2.214	0.247	1.591	1.185	0.000	0.406	0.106
40.00	SB	2.096	0.367	2.031	1.523	0.000	0.508	0.187
50.00	SB	1.949	0.462	2.341	1.815	0.000	0.526	0.278
60.00	SB	1.742	0.561	2.535	2.052	0.000	0.483	0.367
70.00	SB	1.328	0.852	2.652	2.226	0.000	0.426	0.446

Statical angle of inclination is 0.00 degrees

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.1 100% Consumables

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.332 m
Trim	0.048 m
Statical angle of inclination	0.00 degrees
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.779 meter
Maximum GZ at 30 degrees or more	0.240	0.529 meter
Top of the GZ curve at least at	25.000	47.123 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.106 mrad
Area under the GZ curve up to 40 degrees	0.108	0.187 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.081 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	11.677 degrees PS

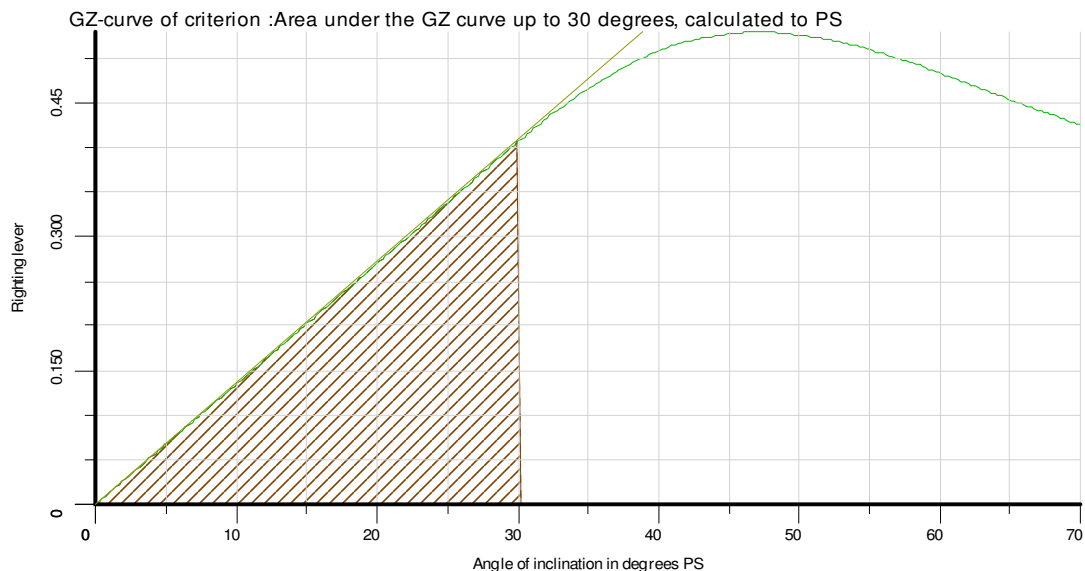
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.779 meter
Maximum GZ at 30 degrees or more	0.240	0.529 meter
Top of the GZ curve at least at	25.000	47.125 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.106 mrad
Area under the GZ curve up to 40 degrees	0.108	0.187 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.081 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	11.677 degrees SB

VCG'

Maximum allowable PS	2.648 m
Maximum allowable SB	2.648 m
Maximum allowable	2.648 m
Actual	2.369 m

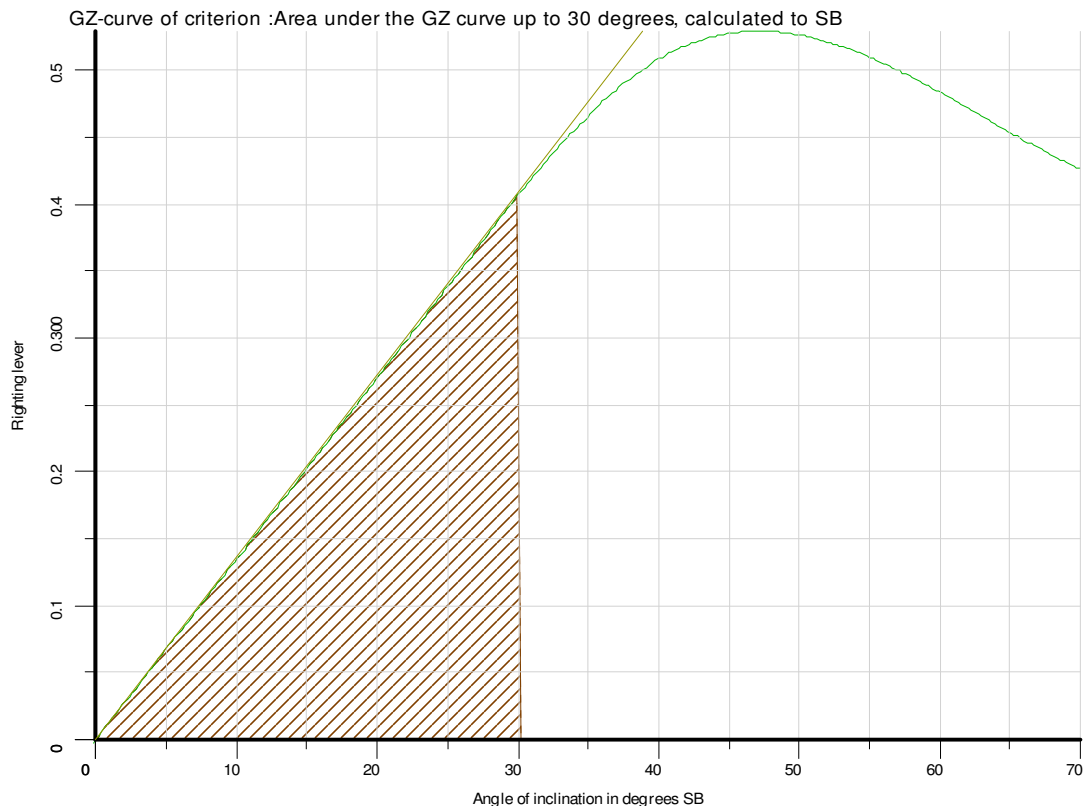
Loading condition complies with the stated criteria.



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

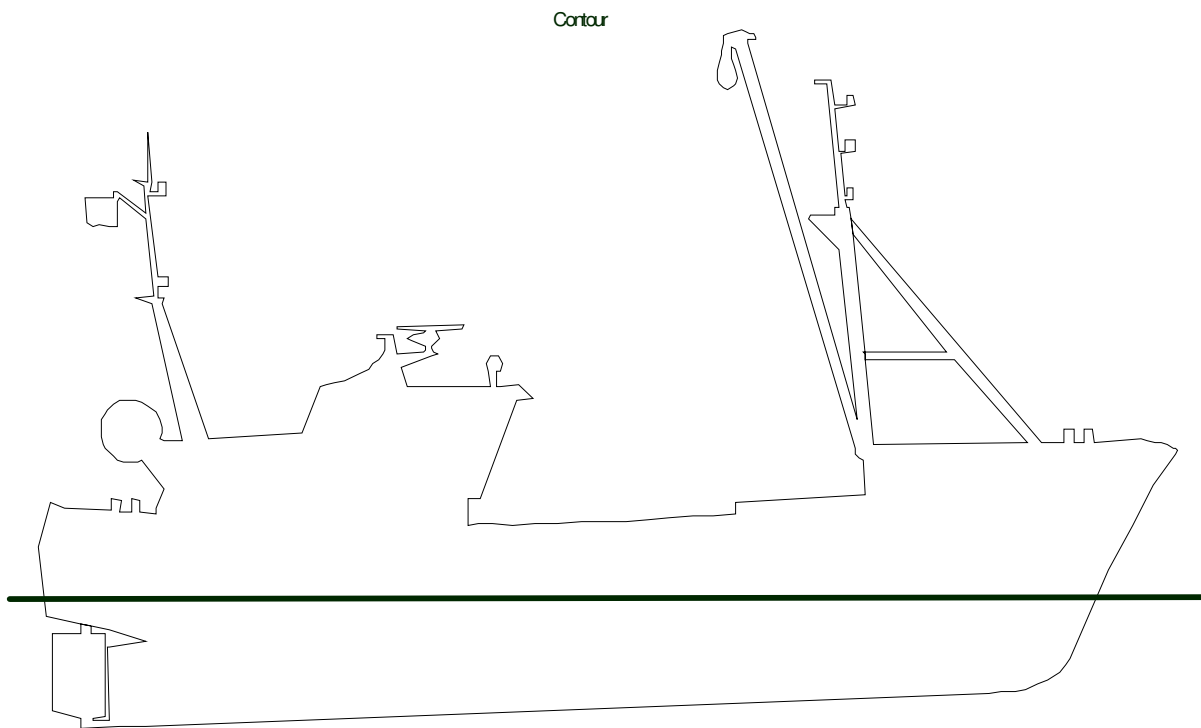
Condition : cond.1 100% Consumables



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.1 100% Consumables



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.2 50% Consumables 100% Fish

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	42.8	0.8750	1.625	1.487	15.969	1.526	0.354
FO. Fr.38 PS	42.8	0.8750	1.625	1.487	15.969	-1.526	0.354
FO. Fr.38 CL	58.9	0.8750	3.048	1.228	15.996	0.000	0.454
SUBTOTAL	49.3	0.8750	6.299	1.362	15.982	-0.000	1.161
Subtotals for group : Water							
FW Fore	18.5	1.0000	0.700	0.590	18.287	0.000	0.539
FW Aft	88.6	1.0000	2.100	2.262	-0.293	0.000	0.964
SUBTOTAL	45.5	1.0000	2.800	1.844	4.352	0.000	1.503
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	5.9	1.0000	0.148	0.394	8.716	1.702	0.046
IceW. Fr.18/24 PS	5.9	1.0000	0.148	0.394	8.716	-1.702	0.046
SUBTOTAL	5.9	1.0000	0.296	0.394	8.716	-0.000	0.091
VIS EN IJS	-	-	13.000	1.500	12.750	0.000	-
TOTAL	-	-	170.995	2.336	9.919	-0.000	2.756

Hydrostatics

Volume	165.830 m ³
LCF	9.130 m
Mom. change trim	1.748 tonm/cm
Ton/cm immersion	1.160 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.313 m
Draft aft (App)	2.350 m
Draft fore (Fpp)	2.275 m
Trim	-0.075 m

Transverse stability

KM transverse	3.157 m	
VCG	2.336 m	
GM solid	0.821 m	
GG' correction	0.016 m	
G'M liquid	0.805 m	VCG' 2.352 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.2 50% Consumables 100% Fish

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	1.282	0.501	-2.655	-2.210	-0.000	-0.445	0.460
60.00	PS	1.711	0.310	-2.537	-2.037	-0.000	-0.501	0.378
50.00	PS	1.927	0.274	-2.342	-1.801	-0.000	-0.541	0.287
40.00	PS	2.076	0.212	-2.033	-1.512	-0.000	-0.522	0.193
30.00	PS	2.196	0.106	-1.594	-1.176	-0.000	-0.418	0.110
25.00	PS	2.239	0.055	-1.342	-0.994	-0.000	-0.348	0.076
20.00	PS	2.270	0.008	-1.083	-0.804	-0.000	-0.279	0.049
15.00	PS	2.291	-0.029	-0.818	-0.609	-0.000	-0.209	0.027
10.00	PS	2.304	-0.056	-0.548	-0.408	-0.000	-0.140	0.012
5.00	PS	2.310	-0.070	-0.275	-0.205	-0.000	-0.070	0.003
2.00	PS	2.312	-0.074	-0.110	-0.082	-0.000	-0.028	0.000
0.00		2.313	-0.075	0.000	0.000	-0.000	0.000	0.000
2.00	SB	2.312	-0.074	0.110	0.082	-0.000	0.028	0.000
5.00	SB	2.310	-0.070	0.275	0.205	-0.000	0.070	0.003
10.00	SB	2.304	-0.056	0.548	0.408	-0.000	0.140	0.012
15.00	SB	2.291	-0.029	0.818	0.609	-0.000	0.209	0.027
20.00	SB	2.270	0.008	1.083	0.804	-0.000	0.279	0.049
25.00	SB	2.239	0.055	1.342	0.994	-0.000	0.348	0.076
30.00	SB	2.196	0.106	1.594	1.176	-0.000	0.418	0.110
40.00	SB	2.076	0.212	2.033	1.512	-0.000	0.522	0.193
50.00	SB	1.927	0.274	2.342	1.801	-0.000	0.541	0.287
60.00	SB	1.711	0.310	2.537	2.037	-0.000	0.501	0.378
70.00	SB	1.282	0.501	2.655	2.210	-0.000	0.445	0.460

Statical angle of inclination is 0.00 degrees

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.2 50% Consumables 100% Fish

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.313 m
Trim	-0.075 m
Statical angle of inclination	0.00 degrees
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.805 meter
Maximum GZ at 30 degrees or more	0.240	0.543 meter
Top of the GZ curve at least at	25.000	47.251 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.110 mrad
Area under the GZ curve up to 40 degrees	0.108	0.193 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.083 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	11.439 degrees PS

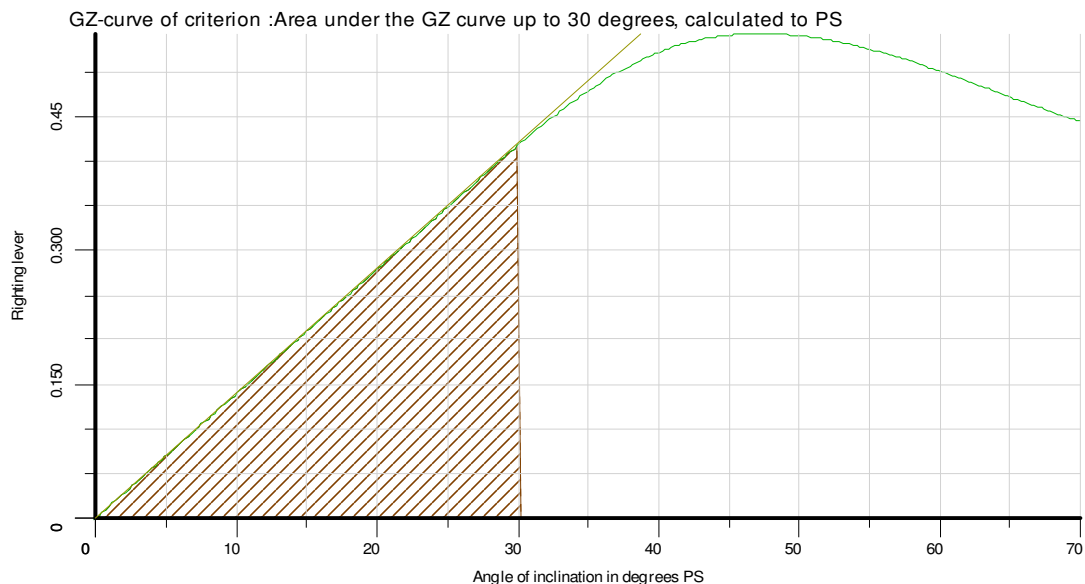
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.805 meter
Maximum GZ at 30 degrees or more	0.240	0.543 meter
Top of the GZ curve at least at	25.000	47.254 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.110 mrad
Area under the GZ curve up to 40 degrees	0.108	0.193 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.083 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	11.439 degrees SB

VCG'

Maximum allowable PS	2.656 m
Maximum allowable SB	2.656 m
Maximum allowable	2.656 m
Actual	2.352 m

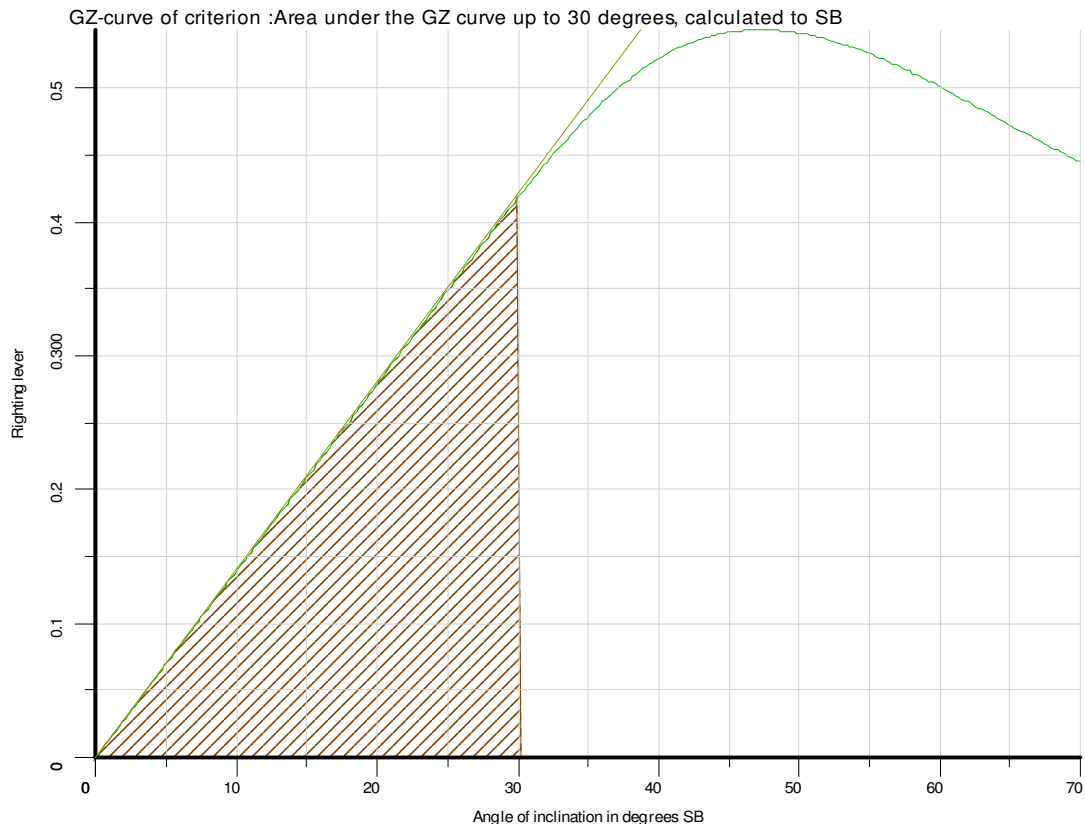
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

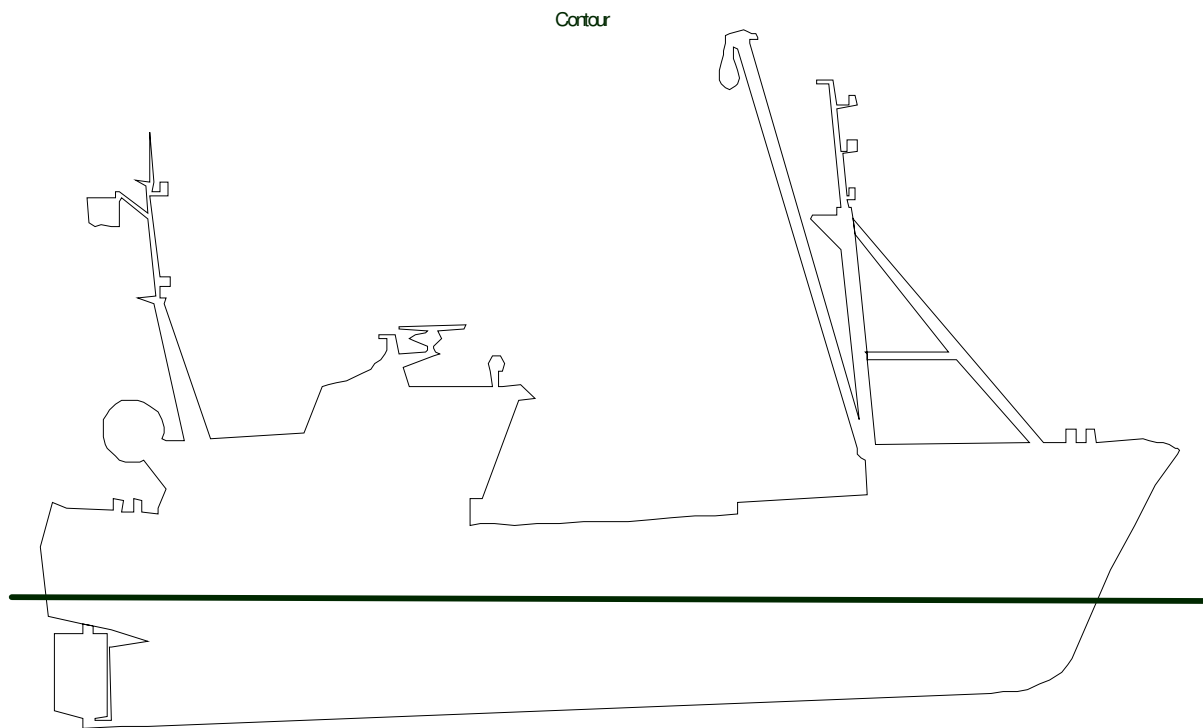
Condition : cond.2 50% Consumables 100% Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.2 50% Consumables 100% Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.3 10% Consumables, 100% Fish

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 CL	25.5	0.8750	1.321	0.713	15.991	0.000	0.454
SUBTOTAL	25.5	0.8750	1.321	0.713	15.991	0.000	0.454
Subtotals for group : Water							
FW Fore	15.8	1.0000	0.600	0.568	18.278	0.000	0.461
SUBTOTAL	15.8	1.0000	0.600	0.568	18.278	0.000	0.461
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	5.9	1.0000	0.148	0.394	8.716	1.702	0.046
IceW. Fr.18/24 PS	5.9	1.0000	0.148	0.394	8.716	-1.702	0.046
SUBTOTAL	5.9	1.0000	0.296	0.394	8.716	-0.000	0.091
VIS EN IJS	-	-	13.000	1.500	12.750	0.000	-
TOTAL	-	-	163.817	2.362	9.861	-0.000	1.006

Hydrostatics

Volume	158.870 m ³
LCF	9.106 m
Mom. change trim	1.719 tonm/cm
Ton/cm immersion	1.151 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.245 m
Draft aft (App)	2.326 m
Draft fore (Fpp)	2.163 m
Trim	-0.162 m

Transverse stability

KM transverse	3.173 m		
VCG	2.362 m		
GM solid	0.811 m		
GG' correction	0.006 m		
G'M liquid	0.805 m	VCG'	2.368 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.3 10% Consumables, 100% Fish

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	1.063	0.352	-2.663	-2.225	-0.000	-0.438	0.456
60.00	PS	1.560	0.221	-2.548	-2.051	-0.000	-0.497	0.374
50.00	PS	1.814	0.206	-2.352	-1.814	-0.000	-0.538	0.283
40.00	PS	1.988	0.140	-2.038	-1.522	-0.000	-0.516	0.190
30.00	PS	2.121	0.030	-1.594	-1.184	-0.000	-0.410	0.108
25.00	PS	2.167	-0.025	-1.344	-1.001	-0.000	-0.343	0.075
20.00	PS	2.199	-0.073	-1.086	-0.810	-0.000	-0.276	0.048
15.00	PS	2.221	-0.113	-0.820	-0.613	-0.000	-0.208	0.027
10.00	PS	2.235	-0.141	-0.550	-0.411	-0.000	-0.139	0.012
5.00	PS	2.242	-0.157	-0.276	-0.206	-0.000	-0.070	0.003
2.00	PS	2.244	-0.162	-0.111	-0.083	-0.000	-0.028	0.000
0.00		2.245	-0.162	0.000	0.000	-0.000	0.000	0.000
2.00	SB	2.244	-0.162	0.111	0.083	-0.000	0.028	0.000
5.00	SB	2.242	-0.157	0.276	0.206	-0.000	0.070	0.003
10.00	SB	2.235	-0.141	0.550	0.411	-0.000	0.139	0.012
15.00	SB	2.221	-0.113	0.820	0.613	-0.000	0.208	0.027
20.00	SB	2.199	-0.073	1.086	0.810	-0.000	0.276	0.048
25.00	SB	2.167	-0.025	1.344	1.001	-0.000	0.343	0.075
30.00	SB	2.121	0.030	1.594	1.184	-0.000	0.410	0.108
40.00	SB	1.988	0.140	2.038	1.522	-0.000	0.516	0.190
50.00	SB	1.814	0.206	2.352	1.814	-0.000	0.538	0.283
60.00	SB	1.560	0.221	2.548	2.051	-0.000	0.497	0.374
70.00	SB	1.063	0.352	2.663	2.225	-0.000	0.438	0.456

Statical angle of inclination is 0.00 degrees

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.3 10% Consumables, 100% Fish

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.245 m
Trim	-0.162 m
Statical angle of inclination	0.00 degrees
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.805 meter
Maximum GZ at 30 degrees or more	0.240	0.541 meter
Top of the GZ curve at least at	25.000	47.531 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.108 mrad
Area under the GZ curve up to 40 degrees	0.108	0.190 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.082 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	12.136 degrees PS

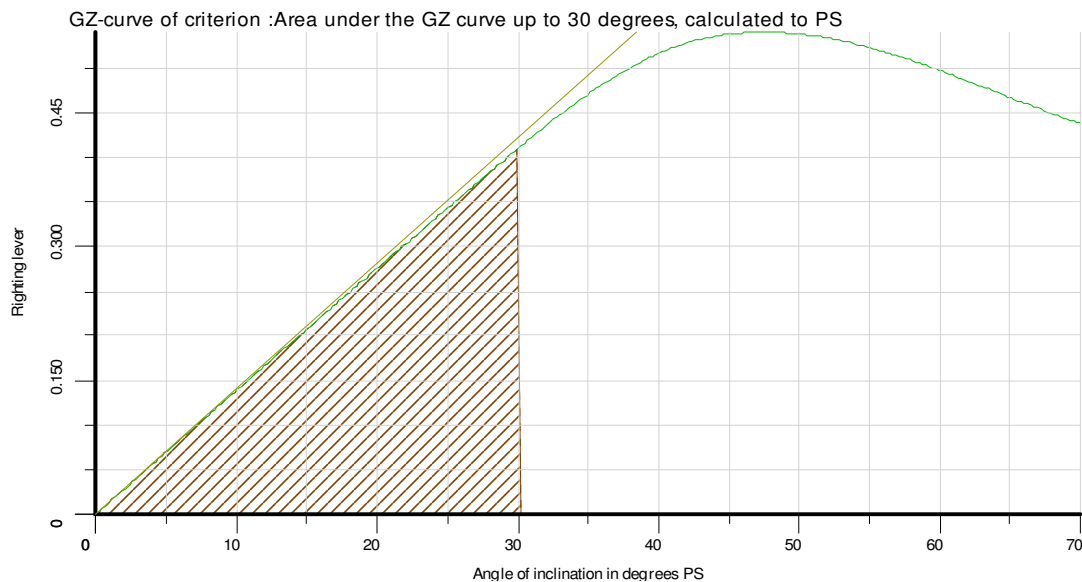
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.805 meter
Maximum GZ at 30 degrees or more	0.240	0.541 meter
Top of the GZ curve at least at	25.000	47.530 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.108 mrad
Area under the GZ curve up to 40 degrees	0.108	0.190 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.082 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	12.136 degrees SB

VCG'

Maximum allowable PS	2.672 m
Maximum allowable SB	2.672 m
Maximum allowable	2.672 m
Actual	2.368 m

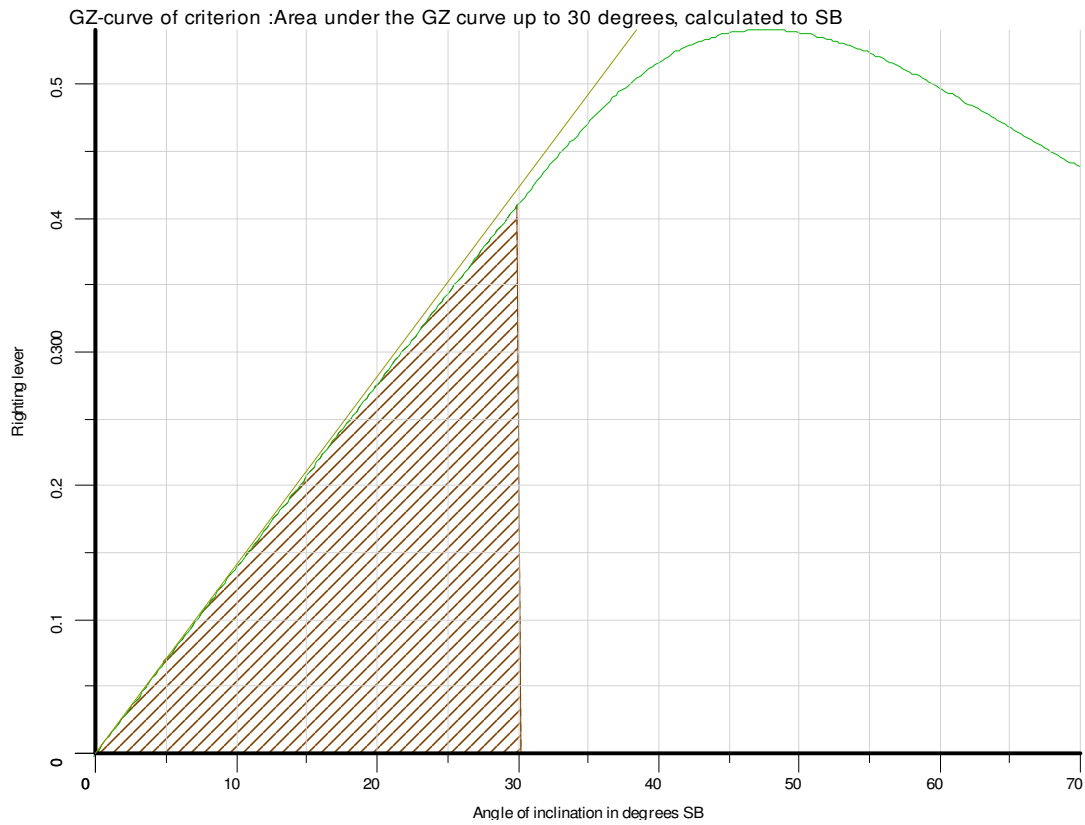
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

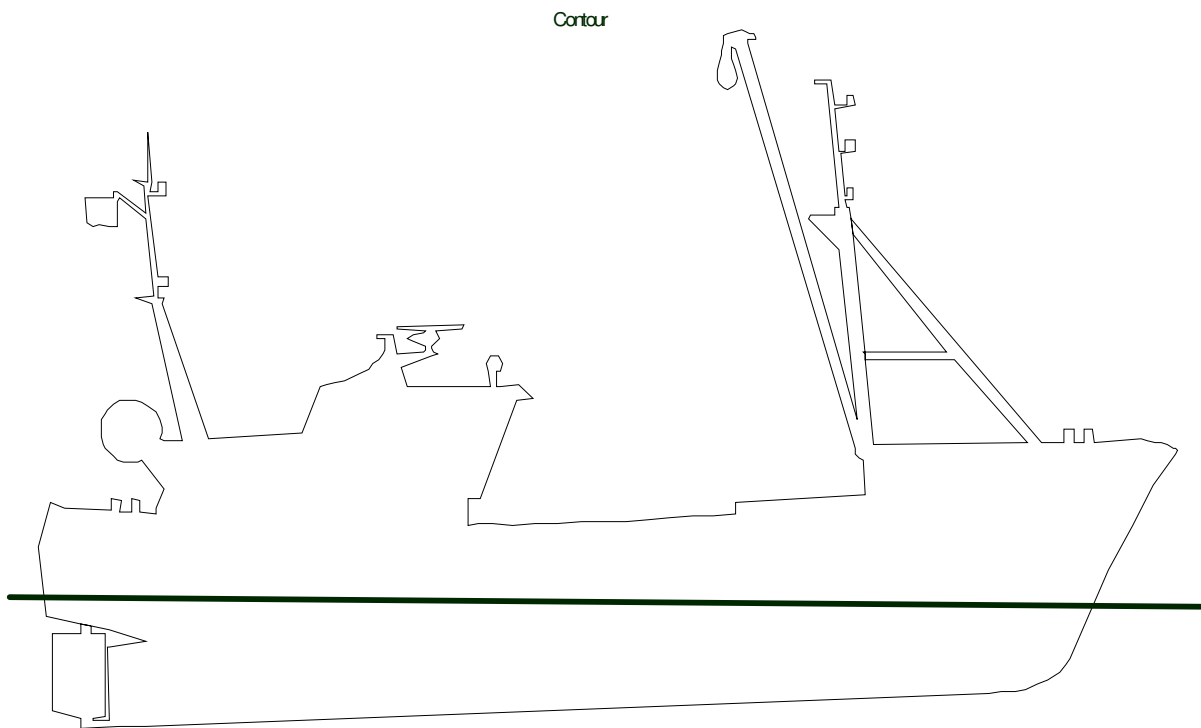
Condition : cond.3 10% Consumables, 100% Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.3 10% Consumables, 100% Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.4 10% Consumables, 20% Fish

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 CL	25.5	0.8750	1.321	0.713	15.991	0.000	0.454
SUBTOTAL	25.5	0.8750	1.321	0.713	15.991	0.000	0.454
Subtotals for group : Water							
FW Fore	15.8	1.0000	0.600	0.568	18.278	0.000	0.461
SUBTOTAL	15.8	1.0000	0.600	0.568	18.278	0.000	0.461
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	5.9	1.0000	0.148	0.394	8.716	1.702	0.046
IceW. Fr.18/24 PS	5.9	1.0000	0.148	0.394	8.716	-1.702	0.046
SUBTOTAL	5.9	1.0000	0.296	0.394	8.716	-0.000	0.091
VIS EN IJS	-	-	6.500	1.350	12.850	0.000	-
TOTAL	-	-	157.317	2.391	9.746	-0.000	1.006

Hydrostatics

Volume	152.567 m ³
LCF	9.055 m
Mom. change trim	1.691 tonm/cm
Ton/cm immersion	1.143 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.179 m
Draft aft (App)	2.327 m
Draft fore (Fpp)	2.030 m
Trim	-0.298 m

Transverse stability

KM transverse	3.194 m	
VCG	2.391 m	
GM solid	0.803 m	
GG' correction	0.006 m	
G'M liquid	0.797 m	VCG' 2.398 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.4 10% Consumables, 20% Fish

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	0.861	0.063	-2.672	-2.253	-0.000	-0.419	0.443
60.00	PS	1.422	0.034	-2.558	-2.076	-0.000	-0.482	0.365
50.00	PS	1.710	0.053	-2.362	-1.837	-0.000	-0.525	0.276
40.00	PS	1.906	0.000	-2.043	-1.541	-0.000	-0.502	0.185
30.00	PS	2.050	-0.107	-1.596	-1.199	-0.000	-0.397	0.106
25.00	PS	2.097	-0.161	-1.347	-1.013	-0.000	-0.334	0.074
20.00	PS	2.131	-0.209	-1.090	-0.820	-0.000	-0.270	0.048
15.00	PS	2.154	-0.248	-0.824	-0.621	-0.000	-0.204	0.027
10.00	PS	2.169	-0.276	-0.554	-0.416	-0.000	-0.137	0.012
5.00	PS	2.176	-0.293	-0.278	-0.209	-0.000	-0.069	0.003
2.00	PS	2.178	-0.297	-0.111	-0.084	-0.000	-0.028	0.000
0.00		2.179	-0.298	0.000	0.000	-0.000	0.000	0.000
2.00	SB	2.178	-0.297	0.111	0.084	-0.000	0.028	0.000
5.00	SB	2.176	-0.293	0.278	0.209	-0.000	0.069	0.003
10.00	SB	2.169	-0.276	0.554	0.416	-0.000	0.137	0.012
15.00	SB	2.154	-0.248	0.824	0.621	-0.000	0.204	0.027
20.00	SB	2.131	-0.209	1.090	0.820	-0.000	0.270	0.048
25.00	SB	2.097	-0.161	1.347	1.013	-0.000	0.334	0.074
30.00	SB	2.050	-0.107	1.596	1.199	-0.000	0.397	0.106
40.00	SB	1.906	0.000	2.043	1.541	-0.000	0.502	0.185
50.00	SB	1.710	0.053	2.362	1.837	-0.000	0.525	0.276
60.00	SB	1.422	0.034	2.558	2.076	-0.000	0.482	0.365
70.00	SB	0.861	0.063	2.672	2.253	-0.000	0.419	0.443

Statical angle of inclination is 0.00 degrees

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.4 10% Consumables, 20% Fish

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.179 m
Trim	-0.298 m
Statical angle of inclination	0.00 degrees
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.797 meter
Maximum GZ at 30 degrees or more	0.240	0.527 meter
Top of the GZ curve at least at	25.000	47.583 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.106 mrad
Area under the GZ curve up to 40 degrees	0.108	0.185 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.079 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	12.969 degrees PS

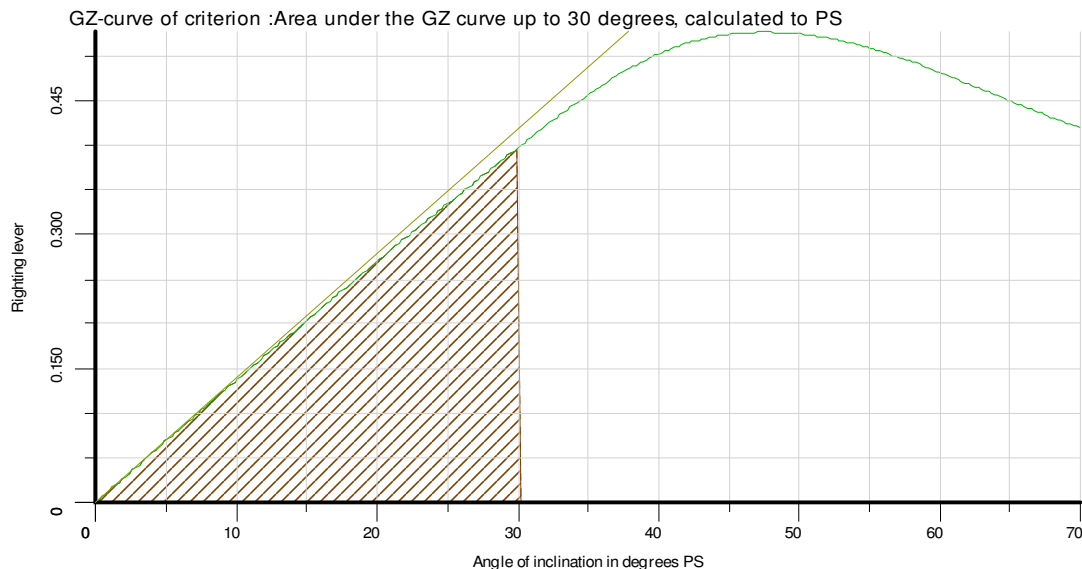
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.797 meter
Maximum GZ at 30 degrees or more	0.240	0.527 meter
Top of the GZ curve at least at	25.000	47.581 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.106 mrad
Area under the GZ curve up to 40 degrees	0.108	0.185 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.079 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	12.969 degrees SB

VCG'

Maximum allowable PS	2.694 m
Maximum allowable SB	2.694 m
Maximum allowable	2.694 m
Actual	2.398 m

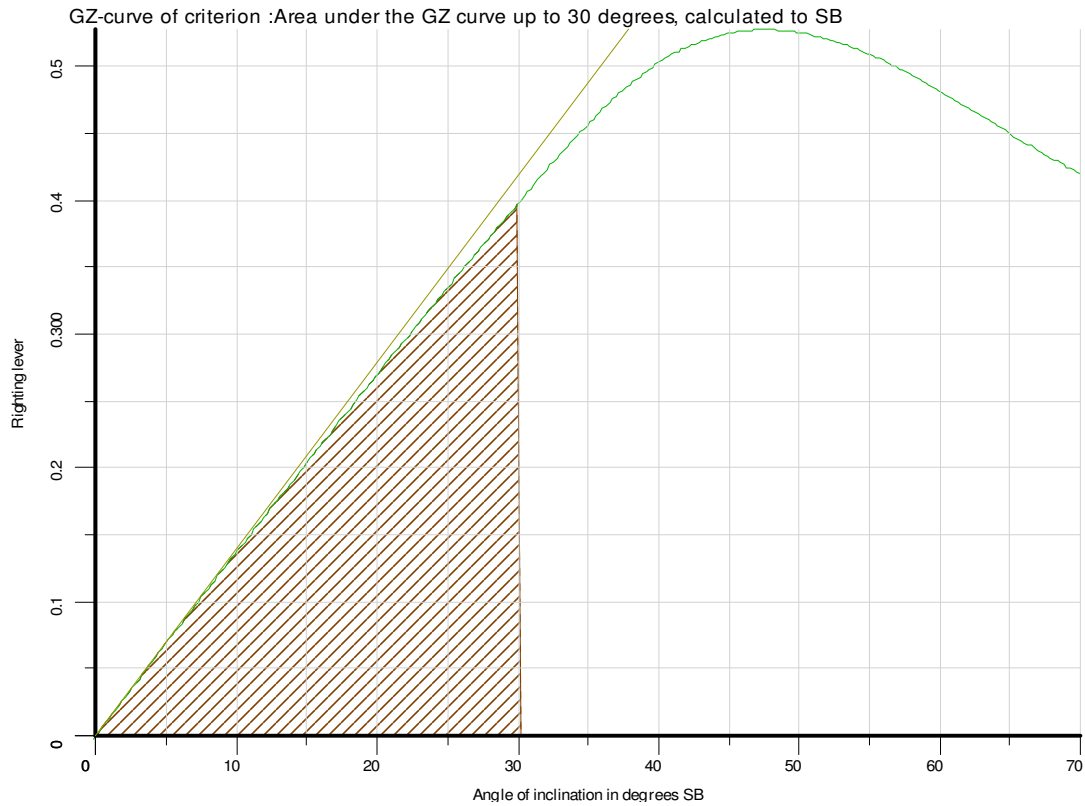
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

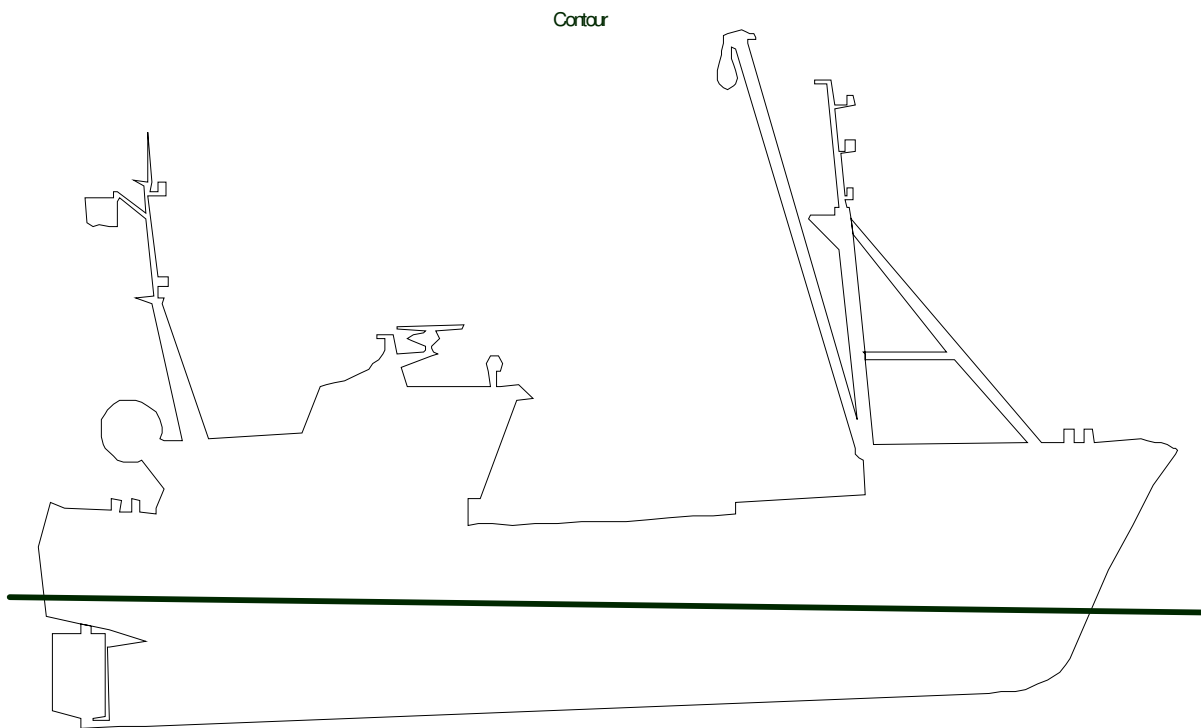
Condition : cond.4 10% Consumables, 20% Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:42

Condition : cond.4 10% Consumables, 20% Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.5 50% Consumables, 100% Round Fish

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 SB	42.8	0.8750	1.625	1.487	15.969	1.526	0.354
FO. Fr.38 PS	42.8	0.8750	1.625	1.487	15.969	-1.526	0.354
FO. Fr.38 CL	58.9	0.8750	3.048	1.228	15.996	0.000	0.454
SUBTOTAL	49.3	0.8750	6.299	1.362	15.982	-0.000	1.161
Subtotals for group : Water							
FW Fore	18.5	1.0000	0.700	0.590	18.287	0.000	0.539
FW Aft	88.6	1.0000	2.100	2.262	-0.293	0.000	0.964
SUBTOTAL	45.5	1.0000	2.800	1.844	4.352	0.000	1.503
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	5.9	1.0000	0.148	0.394	8.716	1.702	0.046
IceW. Fr.18/24 PS	5.9	1.0000	0.148	0.394	8.716	-1.702	0.046
SUBTOTAL	5.9	1.0000	0.296	0.394	8.716	-0.000	0.091
BOOMKOR MATERIAAL	-	-	-2.000	4.000	14.450	0.000	-
RONDVIS MATERIAAL	-	-	1.000	4.500	1.250	0.000	-
VIS EN IJS	-	-	25.000	1.900	12.200	0.000	-
TOTAL	-	-	181.995	2.329	9.933	-0.000	2.756

Hydrostatics

Volume	176.497 m ³
LCF	9.154 m
Mom. change trim	1.793 tonm/cm
Ton/cm immersion	1.172 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.411 m
Draft aft (App)	2.417 m
Draft fore (Fpp)	2.405 m
Trim	-0.013 m

Transverse stability

KM transverse	3.142 m		
VCG	2.329 m		
GM solid	0.813 m		
GG' correction	0.015 m		
G'M liquid	0.798 m	VCG'	2.344 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.5 50% Consumables, 100% Round Fish

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	1.613	0.509	-2.644	-2.203	-0.000	-0.441	0.457
60.00	PS	1.940	0.303	-2.523	-2.030	-0.000	-0.493	0.376
50.00	PS	2.100	0.255	-2.327	-1.796	-0.000	-0.531	0.286
40.00	PS	2.209	0.225	-2.025	-1.507	-0.000	-0.518	0.193
30.00	PS	2.305	0.142	-1.595	-1.172	-0.000	-0.423	0.110
25.00	PS	2.345	0.094	-1.342	-0.991	-0.000	-0.351	0.076
20.00	PS	2.373	0.053	-1.082	-0.802	-0.000	-0.280	0.049
15.00	PS	2.391	0.022	-0.816	-0.607	-0.000	-0.209	0.027
10.00	PS	2.403	0.000	-0.546	-0.407	-0.000	-0.139	0.012
5.00	PS	2.409	-0.010	-0.274	-0.204	-0.000	-0.070	0.003
2.00	PS	2.411	-0.012	-0.110	-0.082	-0.000	-0.028	0.000
0.00		2.411	-0.013	0.000	0.000	-0.000	0.000	0.000
2.00	SB	2.411	-0.012	0.110	0.082	-0.000	0.028	0.000
5.00	SB	2.409	-0.010	0.274	0.204	-0.000	0.070	0.003
10.00	SB	2.403	0.000	0.546	0.407	-0.000	0.139	0.012
15.00	SB	2.391	0.022	0.816	0.607	-0.000	0.209	0.027
20.00	SB	2.373	0.053	1.082	0.802	-0.000	0.280	0.049
25.00	SB	2.345	0.094	1.342	0.991	-0.000	0.351	0.076
30.00	SB	2.305	0.142	1.595	1.172	-0.000	0.423	0.110
40.00	SB	2.209	0.225	2.025	1.507	-0.000	0.518	0.193
50.00	SB	2.100	0.254	2.327	1.796	-0.000	0.531	0.286
60.00	SB	1.940	0.303	2.523	2.030	-0.000	0.493	0.376
70.00	SB	1.613	0.509	2.644	2.203	-0.000	0.441	0.457

Statical angle of inclination is 0.00 degrees

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.5 50% Consumables, 100% Round Fish

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.411 m
Trim	-0.013 m
Statical angle of inclination	0.00 degrees
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.798 meter
Maximum GZ at 30 degrees or more	0.240	0.534 meter
Top of the GZ curve at least at	25.000	46.596 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.110 mrad
Area under the GZ curve up to 40 degrees	0.108	0.193 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.083 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	10.621 degrees PS

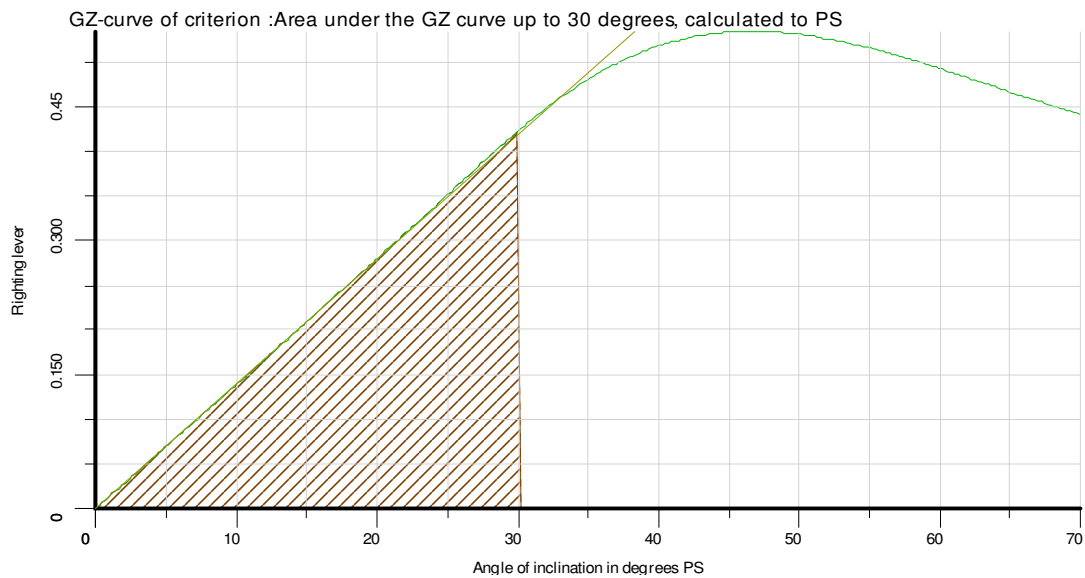
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.798 meter
Maximum GZ at 30 degrees or more	0.240	0.534 meter
Top of the GZ curve at least at	25.000	46.593 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.110 mrad
Area under the GZ curve up to 40 degrees	0.108	0.193 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.083 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	10.621 degrees SB

VCG'

Maximum allowable PS	2.641 m
Maximum allowable SB	2.641 m
Maximum allowable	2.641 m
Actual	2.344 m

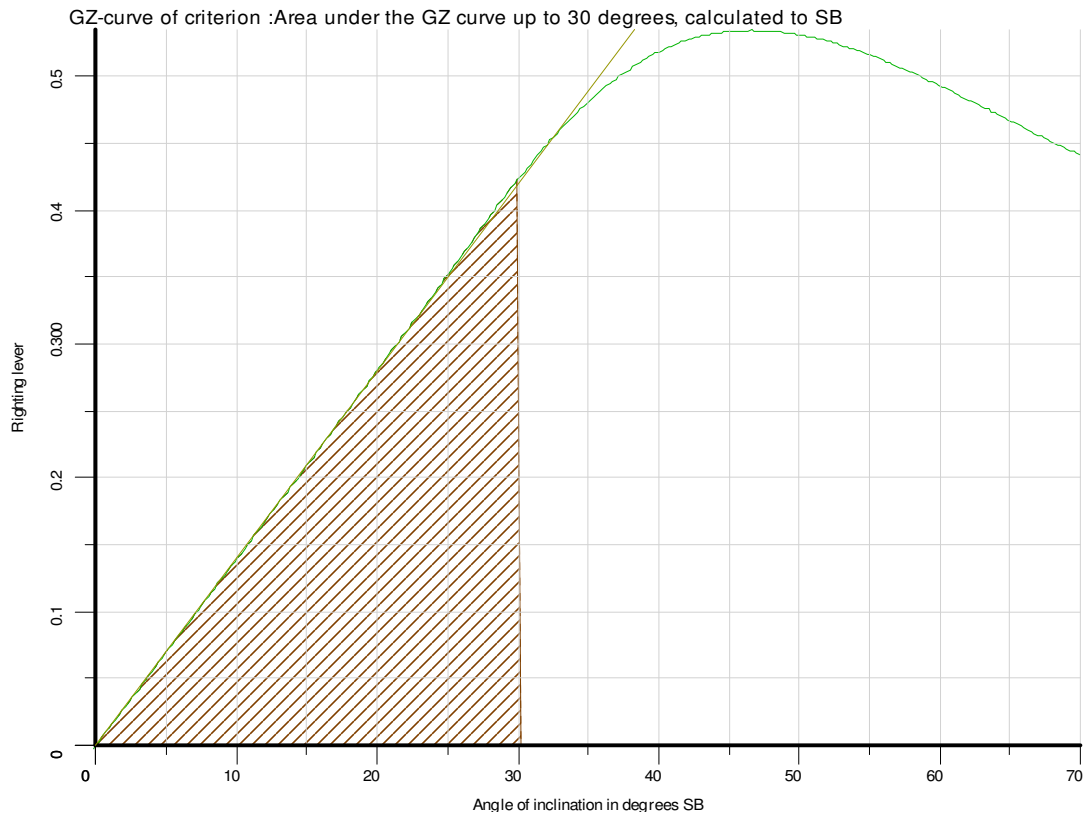
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

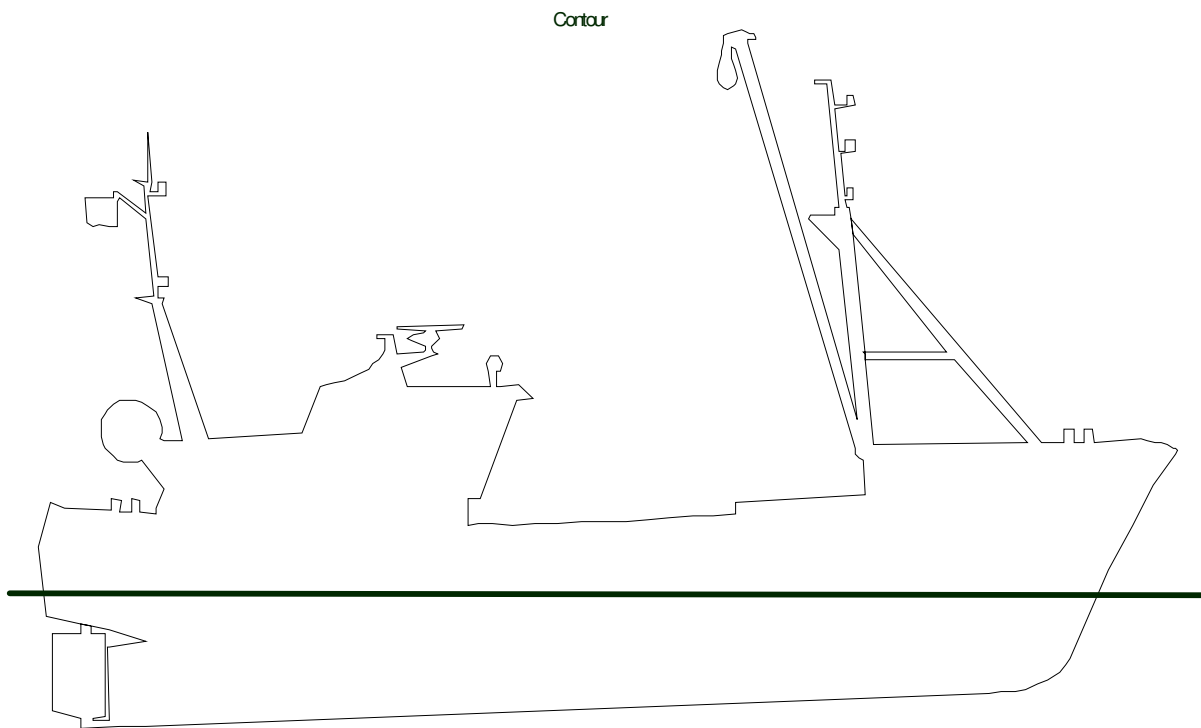
Condition : cond.5 50% Consumables, 100% Round Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.5 50% Consumables, 100% Round Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.6 10% Consumables, 100% Round Fish

Description	Filling %	Density ton/m ³	Weight ton	VCG m	LCG m	TCG m	FSM tonm
Empty ship	-	-	148.600	2.463	9.522	0.000	-
Subtotals for group : Fuel Oil							
FO. Fr.38 CL	25.5	0.8750	1.321	0.713	15.991	0.000	0.454
SUBTOTAL	25.5	0.8750	1.321	0.713	15.991	0.000	0.454
Subtotals for group : Water							
FW Fore	15.8	1.0000	0.600	0.568	18.278	0.000	0.461
SUBTOTAL	15.8	1.0000	0.600	0.568	18.278	0.000	0.461
Subtotals for group : Misc. Tanks							
IceW. Fr.18/24 SB	5.9	1.0000	0.148	0.394	8.716	1.702	0.046
IceW. Fr.18/24 PS	5.9	1.0000	0.148	0.394	8.716	-1.702	0.046
SUBTOTAL	5.9	1.0000	0.296	0.394	8.716	-0.000	0.091
BOOMKOR MATERIAAL	-	-	-2.000	4.000	14.450	0.000	-
RONDVIS MATERIAAL	-	-	1.000	4.500	1.250	0.000	-
VIS EN IJS	-	-	25.000	1.900	12.200	0.000	-
TOTAL	-	-	174.817	2.353	9.879	-0.000	1.006

Hydrostatics

Volume	169.537 m ³
LCF	9.121 m
Mom. change trim	1.765 tonm/cm
Ton/cm immersion	1.164 ton/cm
Density	1.0250 ton/m ³

Drafts and trim

Drafts above base :	
Draft mean (Lpp/2)	2.344 m
Draft aft (App)	2.393 m
Draft fore (Fpp)	2.295 m
Trim	-0.098 m

Transverse stability

KM transverse	3.154 m
VCG	2.353 m
GM solid	0.800 m
GG' correction	0.006 m
G'M liquid	0.794 m

VCG' 2.359 m

The stability values are calculated for the actual trim.

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.6 10% Consumables, 100% Round Fish

Statical stability, calculated with constant LCB :

Angle degrees		Draft mld. m	Trim m	KNsinφ m	VCG'sinφ m	TCGcosφ m	G'Nsinφ m	Area mrad
70.00	PS	1.394	0.368	-2.651	-2.217	-0.000	-0.434	0.453
60.00	PS	1.789	0.208	-2.532	-2.043	-0.000	-0.489	0.373
50.00	PS	1.986	0.194	-2.337	-1.807	-0.000	-0.530	0.283
40.00	PS	2.121	0.157	-2.031	-1.516	-0.000	-0.515	0.191
30.00	PS	2.232	0.066	-1.595	-1.180	-0.000	-0.416	0.109
25.00	PS	2.274	0.017	-1.343	-0.997	-0.000	-0.346	0.075
20.00	PS	2.303	-0.026	-1.084	-0.807	-0.000	-0.277	0.048
15.00	PS	2.323	-0.059	-0.818	-0.611	-0.000	-0.207	0.027
10.00	PS	2.335	-0.082	-0.548	-0.410	-0.000	-0.138	0.012
5.00	PS	2.342	-0.094	-0.275	-0.206	-0.000	-0.069	0.003
2.00	PS	2.344	-0.097	-0.110	-0.082	-0.000	-0.028	0.000
0.00		2.344	-0.098	0.000	0.000	-0.000	0.000	0.000
2.00	SB	2.344	-0.097	0.110	0.082	-0.000	0.028	0.000
5.00	SB	2.342	-0.094	0.275	0.206	-0.000	0.069	0.003
10.00	SB	2.335	-0.082	0.548	0.410	-0.000	0.138	0.012
15.00	SB	2.323	-0.059	0.818	0.611	-0.000	0.207	0.027
20.00	SB	2.303	-0.026	1.084	0.807	-0.000	0.277	0.048
25.00	SB	2.274	0.017	1.343	0.997	-0.000	0.346	0.075
30.00	SB	2.232	0.066	1.595	1.180	-0.000	0.416	0.109
40.00	SB	2.121	0.157	2.031	1.516	-0.000	0.515	0.191
50.00	SB	1.986	0.194	2.337	1.807	-0.000	0.530	0.283
60.00	SB	1.789	0.208	2.532	2.043	-0.000	0.489	0.373
70.00	SB	1.394	0.369	2.651	2.217	-0.000	0.434	0.453

Statical angle of inclination is 0.00 degrees

Contour : Contour

TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.6 10% Consumables, 100% Round Fish

Verification against the stability criteria "Dienstnorm 15"

Hydrostatics

Draft mld.	2.344 m
Trim	-0.098 m
Statical angle of inclination	0.00 degrees
Flooding angle PS	>70.00 degrees
Flooding angle SB	>70.00 degrees

Calculated to PS

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.794 meter
Maximum GZ at 30 degrees or more	0.240	0.533 meter
Top of the GZ curve at least at	25.000	46.741 degrees PS
Area under the GZ curve up to 30 degrees	0.066	0.109 mrad
Area under the GZ curve up to 40 degrees	0.108	0.191 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.082 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	11.246 degrees PS

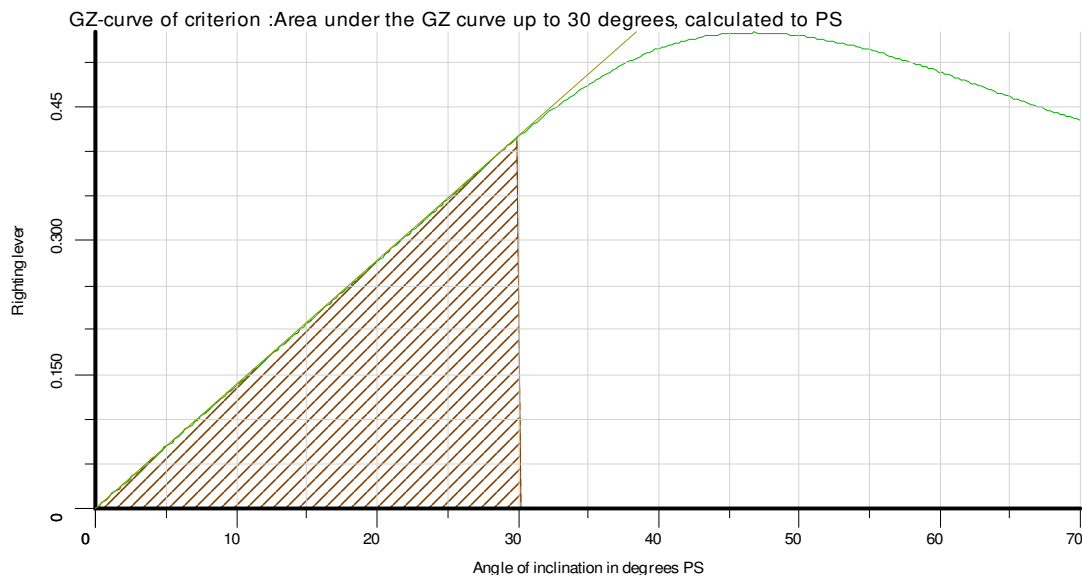
Calculated to SB

	<u>Criterion</u>	<u>Value</u>
Minimum metacentric height G'M	0.500	0.794 meter
Maximum GZ at 30 degrees or more	0.240	0.533 meter
Top of the GZ curve at least at	25.000	46.738 degrees SB
Area under the GZ curve up to 30 degrees	0.066	0.109 mrad
Area under the GZ curve up to 40 degrees	0.108	0.191 mrad
Area under the GZ curve between 30 and 40 degrees	0.036	0.082 mrad
Maximum angle of inclination acc Dienstnorm 15	40.000	11.246 degrees SB

VCG'

Maximum allowable PS	2.653 m
Maximum allowable SB	2.653 m
Maximum allowable	2.653 m
Actual	2.359 m

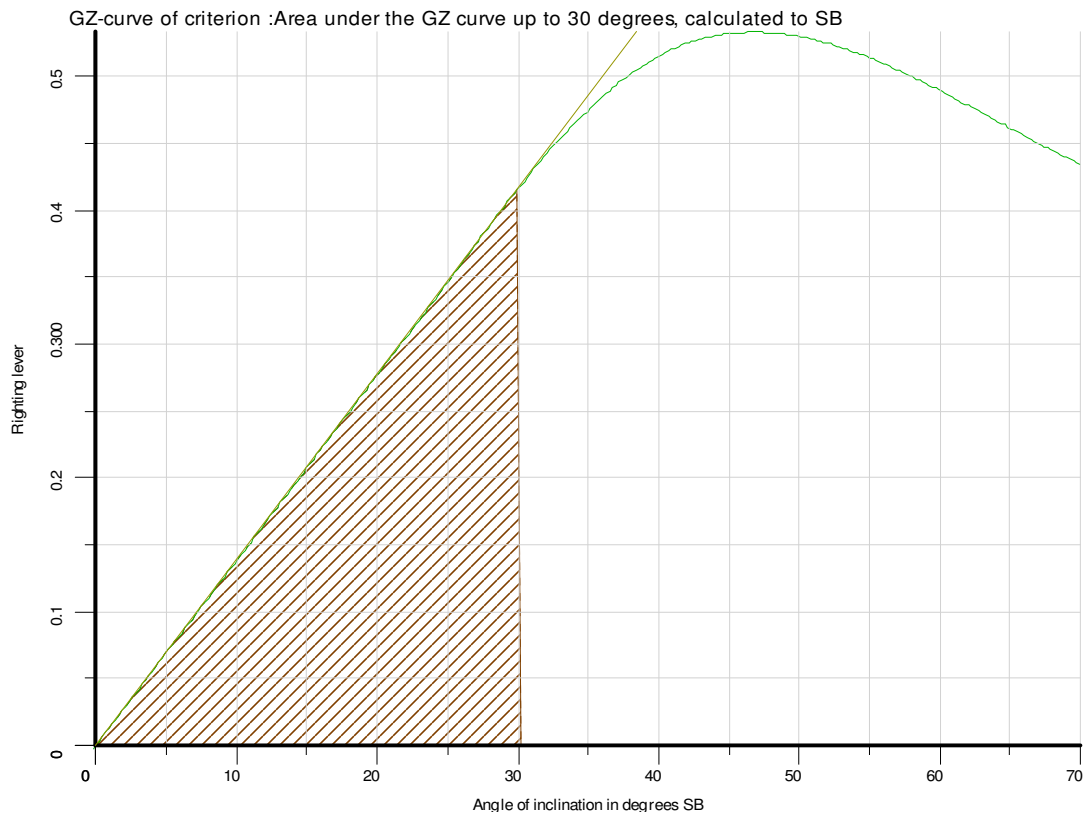
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TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

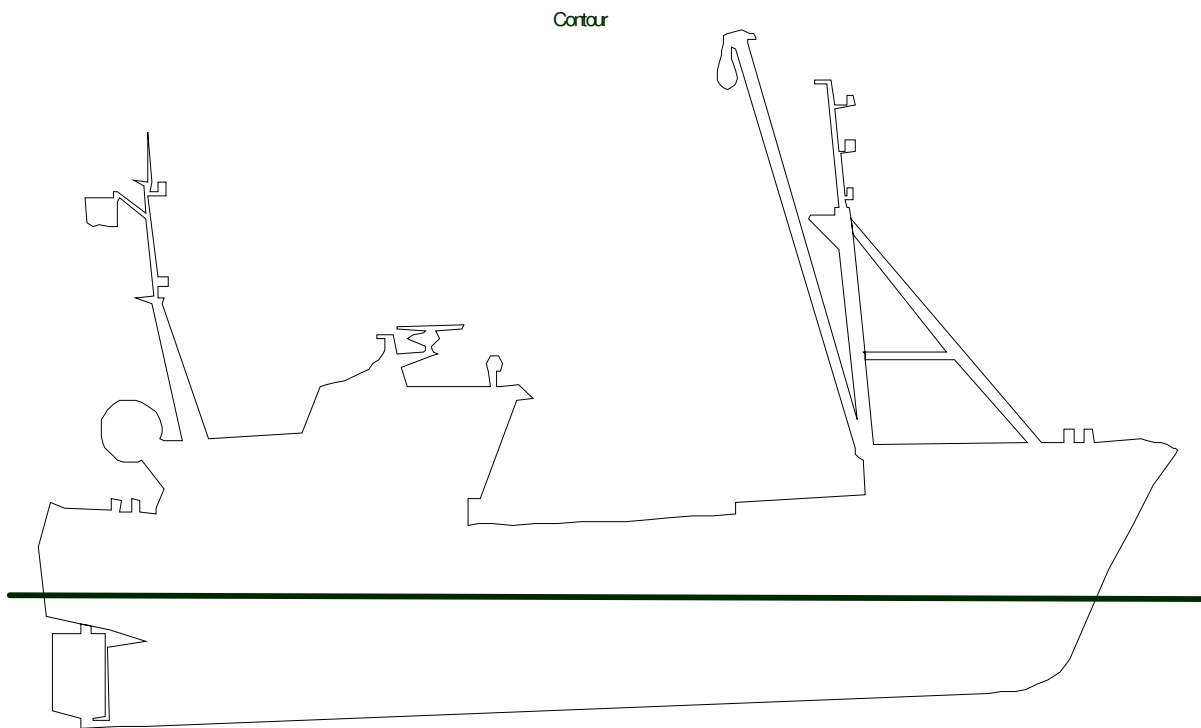
Condition : cond.6 10% Consumables, 100% Round Fish



TRIM AND STABILITY CALCULATION
O-13 "Morgenster"

18 Oct 2019 15:21:43

Condition : cond.6 10% Consumables, 100% Round Fish



7. INFORMATION REGARDING THE ACCIDENT

7.1. 1 SYNOPSIS O.13 MORGENSTER

Narrative (UTC, unless specified)

Fishing vessel O.13 – Morgenster left Oostende on Sunday, November 4th, 2018, bound to the fishing area south of Eastbourne. Fishing started November 5th and the vessel capsized November 7th, 22 km south-east of Eastbourne.



Figure 1 – Fishing divisions
O.13-Morgenster was fishing in division VIId- Eastern English Channel.

O.13-Morgenster was manned according to the regulations as stipulated in the minimum safe manning certificate.

The vessel had been approved to sail at sea. Latest inspections and applicable certificates showed no major shortcomings. Corrective action was taken and approved for most of the remarks made during flagstate inspection in March 2018.

There were two new crewmembers on board with experience on similar vessels. Skipper and engineer were well familiarized with the vessel and the fishing division. Both were owners of the vessel.

November 7th, around 15:00h, a fishing track had been finished and the nets were emptied. As there were some damages to both nets (ports and starboard), it had been decided to do the necessary repairs before dusk.

The vessel had been stopped, heading 120°, with beam waves on starboard.

There was a strong south south westerly wind, 7 beaufort, causing waves of 2 meters and over.

Sunset was predicted at 16:24h, the next low tide at 17:25h. The interval between high and low tide was 6.4m.

Station 62305 - Greenwich Lightship

Owned	and	maintained	by	UK	Met	Office
Lightship	50.400 N 0.000 E (50°24'0" N 0°0'0" E)	- 46 km South west of the place of the incident				

Month	Date	TIME (BST)	Wind direction	Wind Speed kts	Wave height ft
11	07	6:00 pm	SW	28.9	7.5
11	07	5:00 pm	SSW	29.9	6.9
11	07	4:00 pm	SSW	31.1	6.9
11	07	3:00 pm	SSW	33.0	7.2
11	07	2:00 pm	SSW	35.9	6.9
11	07	1:00 pm	S	36.9	6.9

FIGURE 2 – METEO GREENWICH

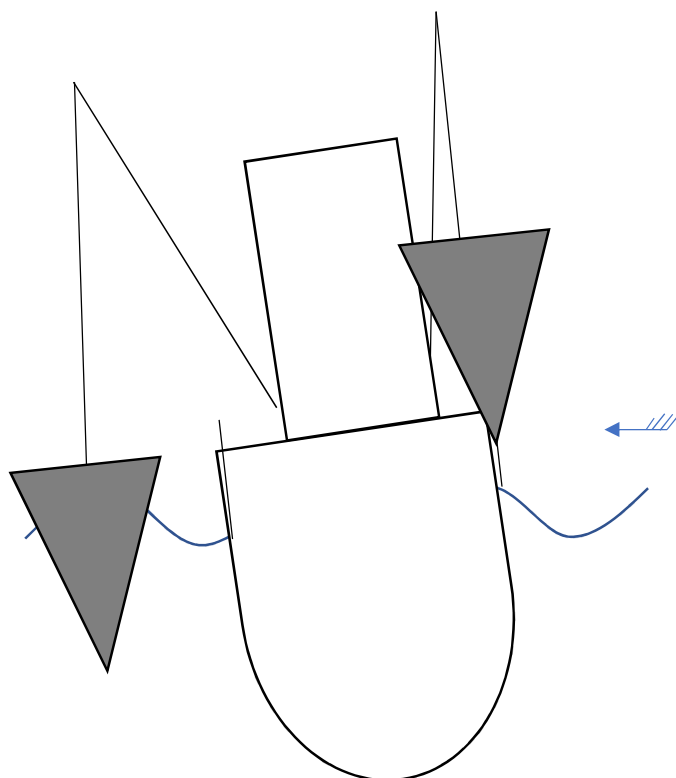
source: www.metoffice.gov.uk

Reportedly, the reparations on portside took around 10 minutes. Reportedly, portside derrick was topped 20-30° and the net was lowered to the water. Reportedly, the distance between net and ship's side was around 3m.

Reparations on starboard started after portside reparations were finished. Starboard net (damaged on the chain mat and cod-end) was attached to the clamps at the ship's side to bring the chain mat under tension to repair it. The rest of the net was lying on deck.

Both nets were empty, but due to the different positions of the derricks, there was a slight list over portside.

No manipulation of winches was ongoing.



7.1.1.1. FIGURE 3 – SCHEMATIC DRAWING

Indication of the vessel at the moment of capsizing. PS net in the water, SB net attached to the ship's side and a slight list over PS.

Arklow Breeze, heading 260°, sailing 9 knots, passed the O.13 Morgenster (AIS heading 110°, stopped) on portside at 15:35h. CPA between both vessels was 1.5nm.

Reportedly, radio contact between both vessels had taken place when Arklow Breeze was at a distance of 0.75 nm with an initial CPA of 0.1nm.



Figure 4 – CPA Arklow Breeze

CPA between Arklow Breeze (Dark Blue color) and O13. Morgenster is 0.15 nm or 278m, at 15:35:37 UTC.

(Source AIS data UK Coastguard)

Reportedly, shortly after the Arklow Breeze had passed, the vessel came into a wave trough and a huge amount of water came on board on portside.

Immediately, the starboard derrick had been veered by the man in the wheelhouse, but due to the list and the position of the derrick, it did not respond.

Meanwhile a second wave of water came on board and reportedly the portside side disappeared under water.

Portside wire was put in free running, so the portside net was lowered to the bottom. This action had no fishual effect to the stability of the vessel. The same time, the vessel rolled from portside a little bit back to starboard. Due to this movement, the starboard derrick came down, but the vessel did not regain its stability.

Very shortly afterwards, the vessel rolled back to portside. The vessel rolled further than before and water entered the wheelhouse. That moment, the man at the wheel left the wheelhouse and jumped overboard. He was not wearing a lifejacket.

The starboard derrick went over to portside, the vessel capsized and turned further into upright down position.



Figure 5 – Latest position

Latest available position received by UK Coastguard is N 50°38' 29" E 000° 32' 7" at 15:37:06 UTC.

(Source AIS data UK Coastguard)

Two of the three men working on deck managed to climb onto the hull when the vessel was rolling back from starboard to portside. Both of them were wearing a lifejacket.

The other man on deck hold the ship's side when the vessel capsized and fell into the water. He did not wear a lifejacket as his lifejacket got inflated during the fishing track before the incident.

The two persons in the water could grab a lifebuoy and a lifejacket that was thrown by one of the men that climbed onto the hull.

Figure 6 - picture by UK Coastguard - Two crewmembers on the hull of the turned vessel, impression of sea state



The liferaft that had been placed on top of the wheelhouse, did not come afloat.

The Arklow Breeze witnessed the incident and turned around to pick up the two men overboard.

Arklow Breeze also alerted the UK Coastguard. Shortly after the alert of Arklow Breeze, an EPIRB signal had been broadcasted.

Figure 7 - Arklow Breeze -Extract from video by UK Coastguard upon arrival.

An helicopter of UK coastguard picked up the two men sitting on the hull and the two crewmembers on



board Arklow Breeze.

At Dover Coastguard, a medical check-up was executed. Later that evening all crew was repatriated to Belgium by Ferry (via Calais).

Factual information

Vessel's details

Figure 8 – O.13- Morgenster - Picture: shipspotting.com, picture taken by Jack Sparrow



Name: O.13 – Morgenster

LOA: 23.94m

Type: Fishing vessel (Beam trawler)

LBPP: 21.14m

Flag: Belgian

Beam (moulded): 6.00m

Port of registry: Oostende

Depth (moulded): 3.00m

Vessel-ID: 1922

Gross tonnage: 94

Call Sign : OPAM

Net tonnage: 28

Shipyard : Holland Launch B.V

Engine power: 218 kW

Year of built : 1989

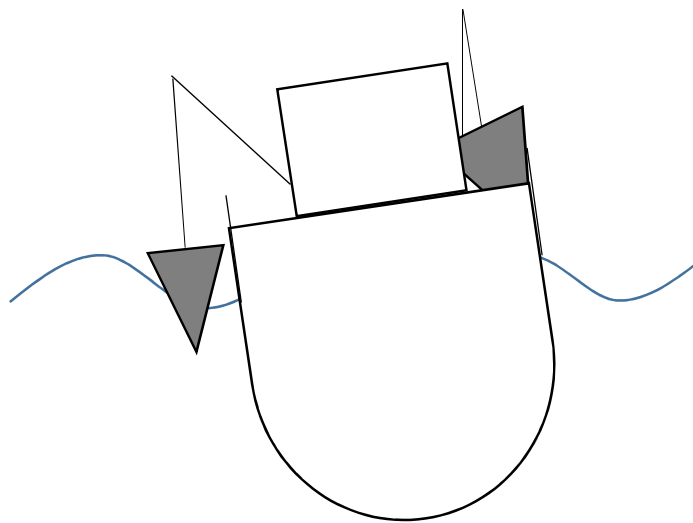
Engine type: Caterpillar 3408C (1997)

Current owner since 2011: BVBA Rederij

Hollebeke

Technical drawing of a ship's hull cross-section. The drawing includes the following dimensions and features:

- BB** (Baseline): Indicated on the left side.
- SB** (Side Body): Indicated on the right side.
- Dimensions:**
 - Vertical distance from BB to the top of the hull: 3,2 m.
 - Horizontal distance from the centerline to the left side of the hull: +3m.
 - Horizontal distance from the centerline to the right side of the hull: 0,94m.
 - Horizontal distance between the two vertical lines: 2,6m.
 - Vertical distance from the top of the hull to the top of the structure: 1,25m.
 - Vertical distance from the top of the hull to the top of the structure: 2,15m.
 - Horizontal distance from the centerline to the top of the structure: 9,5m.
 - Angle of the structure: 20-35°.
- Structural Details:**
 - A blue rectangular block is shown on the left side of the hull.
 - A blue rectangular block is shown on the right side of the hull.
 - A white rectangular block is shown on the right side of the hull.
 - A cross symbol (X) is located at the top center of the structure.



De morgenster lag stil in de golven die ongeveer 2m hoog waren en dwars inkomen van SB zijde.

Schip rolde allicht en heeft op een bepaald moment water geschept aan BB zijde.

Hierdoor is de slagzij die er al was toegenomen, kwam meer Water on deck en kapseisde het schip volledig. Men heeft nog getracht netten en gieken te vieren, maar heeft niet meer geholpen (dit terzijde).

Elk net was leeg met een gewicht van 2.5T.

Aanwezige gewichten aan boord, volgens verklaring bemanning :

Hydrauliek: 300L (zelfde hoeveelheid als bij slingerproef en mee in leeggewicht)

Gasolie: 6000 L in 3 tanks , ongeveer gelijk verdeeld

FW: 8000 L verdeeld over de 3 tanks achteraan. Fwdpiek was leeg

350kg kisten op achterdek

4 bemanningsleden (zelfde aantal als slingerproef en mee in leeggewicht)

Schip lag ongeveer even keel

- Kan de stabiliteit van deze beladingstoestand uitgerekend worden?
- Hoeveel water zou bijkomend aan dek moeten komen om schip te laten kapseizen?

Federal Bureau for the Investigation of Maritime Accidents

Vooruitgangstraat 56 – B1210 Brussels – Belgium

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