CONTENTS

GENERAL INSTRUCTIONS FOR THE MASTER

THIS LOADING STABILITY INFORMATION SHOWS THAT THE SHIP COMPLIES WITH DEFINITE INTACT STABILITY AND STRENGTH REQUIREMENTS IN ALL DESIGNED CONDITIONS AND GIVES THE DATA DEEMED NECESSARY FOR THE CALCULATION AND EVALUATION OF STABILITY AND STRENGTH TO THE MASTER IN ORDER THAT HE CAN TAKE SUITABLE MEASURES FOR SECURING THE STABILITY AND STRENGTH IN ANY SERVICE CONDITION.

The master of the ship must accept and keep the following limits and recommendations at all time for safety operation with respect to stability and hull girder strength of the ship, and be well familiar with characteristic of the ship before placing it into service.

Notices on ship operation ;

1) In evaluation of stability, all hatches, doors, ventilation heads and air pipes are assumed to be closed and secured weather tight in proper way.
   Consequently, weathertightness of main hull and superstructure must be kept and maintained all times at sea.

2) The free surface effect of liquid in tank must be made as small as possible.
   Especially, in conditions where it is necessary to take on ballast in mid voyage, the number of slack tanks should be kept to a minimum and maximum possible GoM maintained.

3) Due to slamming view point, fore draft must take as deep as possible and more than 3.95 m.
   The master should pay attentions also on the ship's course and speed as well as ship's fore draft to avoid such load in rough sea.

4) The view of the sea surface from the conning position must not be obscured by more than 339.98 meters (= two ship length) under all conditions of draft and trim.
   With this, the trim of the ship must not exceed the limitations which are shown on sections 4-6 "NAVIGATION BRIDGE VISIBILITY" of "APPENDIX TO LOADING BOOKLET".

5) Even keel or slightly trim by the stern is recommended on Ocean going voyage.
   The aft draft is recommended not to be less than approximately 6.2 m in view of proper propeller immersion.

6) Intact stability;
Minimum intact stability requirement by IMO Res. A.749(18) 3.1 and A.749(18) 3.2 and Damage Stability of Cargo Ship must be applied for any loading conditions at sea.

The stability should be checked in term of transverse metacentric height (GoM).
A chart of minimum required GoM has been provided as shown on section Ⅰ-3-1 "MINIMUM REQUIRED GoM CURVE" complying with abovementioned applicable stability requirements.

When the ship's actual GoM is within zone "SUFFICIENT STABILITY" in this chart, the ship can satisfy all relevant stability requirements.

In any stage of sea going conditions including ballasting and de-ballasting operation, the calculated GoM after correction for free surface must be not less than the required.

The Master is to plot the actual transverse metacentric height (GoM) and the draft in the every actual navigating condition into this required GoM chart, and the Master will find out the proper extent of the GoM and the draft according to his experience in the operation of the ship.

Calculation methods for evaluation of stability are explained on section Ⅰ "STABLITY INFORMATION" and necessary data for calculation are given on section 4 "LOADING DATA AND INFORMATION" of "APPENDIX TO LOADING BOOKLET".

7) Classification & Notation;
LR+100A1 Bulk Carrier, CSR, BC-A, Holds 2 & 4 may be empty, GRAB [20], Timber Deck Cargo, ESP, LI, with the descriptive note "Ship Right BWMP (S+F)".

8) Hull strength;
To avoid the creation of any unacceptable stress in the ship's structure, bending moment and shear force must be less than their permissible values which approved by the classification society.
In any conditions, even at any stage of loading/unloading at pier, bending moment and shear force should be checked and ascertained to be less than their corresponding permissible values.

A simplified method to calculate bending moment and shear force has been provided together with their permissible values on section Ⅱ "HULL STRENGTH".

9) Design load;
a) Bulk cargo loading
Design load and condition to be based on CSR BC-A and BC-C.

Alternate loading of heavy cargo (3t/m2) to be loaded in No.1, No.3 and No.5 Cargo Hold.

b) Local load

Uniform load on tank top;	196.1 KN/m2 (20.0 t/m^2)
Uniform load on upper deck;	39.2 KN/m2 (4.0 t/m^2)

c) Steel coil loading;

Weight of steel coil;	147.0 KN/unit (15 t/unit)
Size (Diameter x length);	1.50 mϕ x 1.50 m
Tier;	Two (2) tiers
Dunnage;	Three (3) rows

d) Hatch cover
No.1 Hatch cover ; 34.3 kN/m2
Other Hatch cover ; 29.4 kN/m2

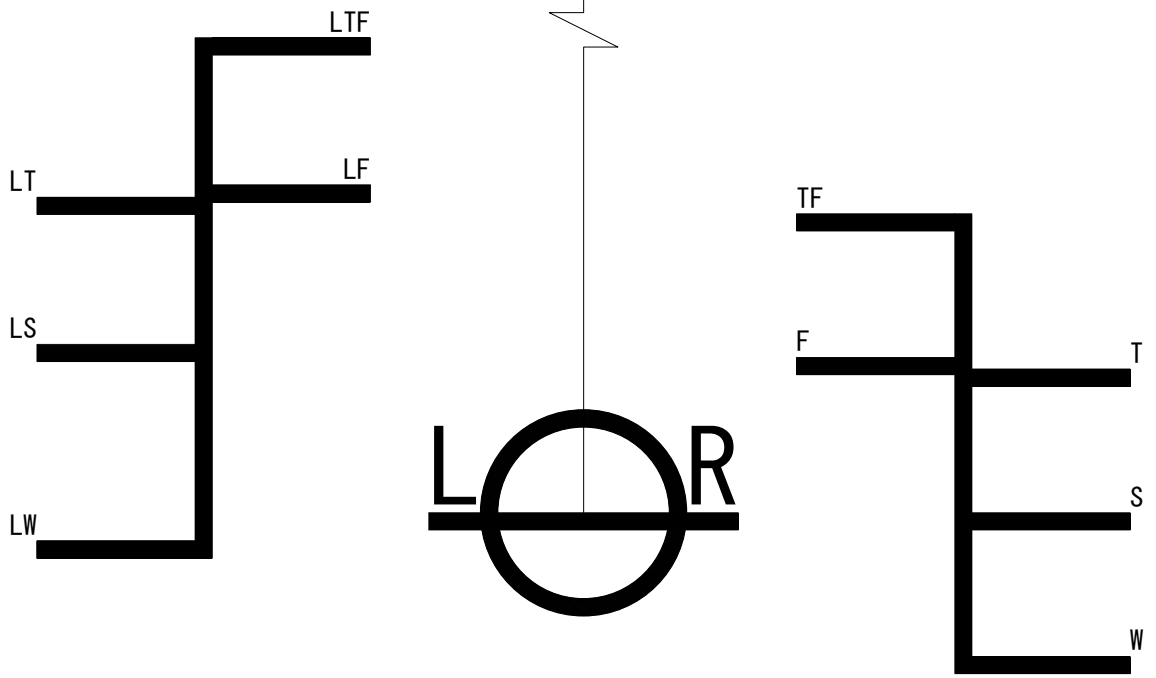
10) Cargo hold mass;
The weight of each cargo hold and adjacent two holds should be confirmed to plot on the Cargo mass chart as shown on section Ⅱ-4 "CARGO MASS CHART".
The maximum permissible mass in each cargo hold as shown below.

Cargo hold No.	1	2	3	4	5
Max.Mass(t)	6503	8689	12642	8968	10316

11) At arrival condition of lumber load, the weight of lumber on the deck should be added 10% of its weight as the absorption of the water, so the specific gravity of Lumber at arrival should be multiplied 1.10 at departure.

12) The cargo holds of the ships have been designed for loading/unloading by grabs having a maximum specific weight up to 20 tonnes.

FREEBOARD & DEADWEIGHT TABLE



ZONE	FREEBOARD (m)	DRAFT (m)	DISPLACEMENT (t)	DEADWEIGHT (t)
TROPICAL F.W.	3.758	10.490	37694	29909
FRESH WATER	3.967	10.281	36858	29073
TROPICAL	3.984	10.264	37710	29925
SUMMER	4.193	10.055	36855	29070
WINTER	4.402	9.846	36002	28217
WINTER N, ATLANTIC	-	-	-	-
L.TROPICAL F.W.	3.502	10.746	38723	30938
L.FRESH WATER	3.716	10.532	37863	30078
L.TROPICAL	3.734	10.514	38735	30950
L.SUMMER	3.948	10.300	37857	30072
L.WINTER	4.234	10.014	36688	28903
L.WINTER N, ATLANTIC	-	-	-	-

SYMBOLS

SYMBOL	DEFINITION	UNIT
t, kt, Mt	Weight unit 1000 kg	-
df	Draft at fore draft mark	m
da	Draft at aft draft mark	m
dF, DRAFT(F)	Draft at F.P.	m
dA, DRAFT(A)	Draft at A.P.	m
dMID.	Draft at midship, mean of P and S	m
dm, DRAFT(M)	Mean draft, (dF + dA)/2	m
T	Trim, dA - dF	m
δd	Deflection of hull, dMID. - dm	m
$\triangle$o	Displacement corresponding to dm (ρ = 1.025)	t
$\delta\triangle$	Displacement corrections by trim, deflection, etc.	t
$\triangle$	Actual displacement or total weight of ship	t
dCF, DRAFT(EQ)	Corresponding draft or draft at LCF	m
MID.G, LCG	Center of gravity from midship, (-) for forward	m
MID.B, LCB	Center of buoyancy from midship, (-) for forward	m
MID.F, LCF	Center of floatation from midship, (-) for forward	m
BG	Distance MID.G — MID.B	m
CR.G, CG, CRL.G	Center of gravity off center line of ship	m
KG, VCG	Center of gravity above base line	m
KM, TKM	Transverse metacenter above base line	m
GM	Metacentric height, KM - KG	m
GGo, GoG	Apparent rise of KG	m
GoM	Apparent metacentric height, GM - GGo	m
KGo	Apparent VCG, KG + GGo	m
ρ, RHO	Specific gravity of liquid	t/m^3
I, IT	Moment of inertia of free surface in tank	m^4
G'Z	Righting lever on assumed KG (0.000 m)	m
GoZ	Righting lever with KGo, GoZ = G'Z - KGo * sinθ	m
θ	Heel angle	m
θf	Downflooding angle	deg.
TPC	Tons per 1 cm immersion	deg.
MTC	Moment to change trim 1 cm	t
LPP	Length between perpendicular (163.6 m)	t-m
WPA	Water plane area	m
WSA	Wetted surface area	m^2
MID.A	Midship sectional area	m^2
Cb	Block coefficient	m^2
Cp	Prismatic coefficient	-
Cw	Water plane area coefficient	-
Cm	Midship Sectional area coefficient	-

Note:
"No sign" and "minus (-) sign" of LCG(MID.G), LCB(MID.B), and LCF(MID.F) show aft and fore from midship respectively.
All drafts in this booklet are measured from the bottom of keel.

Ⅰ. STABILITY INFORMATION

Ⅰ－1　GENERAL

This section is explained the calculation method deemed necessary for evaluation of stability and outline of applied stability criteria.

Applied stability criteria

The stability characteristic in any service condition should comply with the following criteria.　Refer to section Ⅰ-2-2 "STABILITY CRITERIA IN WIND AND WAVES".

1) IMO Resolution A.749(18) 3.1 & 3.2
2) IMO Resolution A.749(18) 4.1
3) IMO Resolution A.684(17) & MSC 194(80)

Procedure of stability judgment

1) In the stage of planning of a loading arrangement, assume the cargoes oil fuel, fresh water, etc. then make the trim and stability calculations.
   Adjust water ballast if necessary.

2) The trim and stability calculation gives drafts, trim, KG and GoM at the assumed loading condition.
   Calculation method are explained on section Ⅰ-3-3 "TRIM CALCULATION" and Ⅰ-3-4 "STABILITY CALCULATION".

3) Read off the minimum required GoM correspond to the draft from the chart on section Ⅰ-3-1 "MINIMUM REQUIRED GoM CURVE".

4) Get the judgment of the safety or not on the stability to compare the required GoM with the calculated GoM.
   The calculated GoM is to be greater than the minimum required GoM.

5) The stability characteristic can be given more accurately by direct calculation to make the stability curve.　Refer to section Ⅰ-3-4 "STABILITY CALCULATION.

6) If the assumed loading condition does not comply with the stability criteria, the adequate ballasting and/or the change of cargo distribution are necessary in order to improve the stability.

I-2 INTACT STABILITY REQUIREMENTS

This subsection describes detail of intact stability requirements of the rules which the ship must comply with.

1. GENERAL STABILITY REQUIREMENTS (IMO Res. A.749(18) 3.1)

For ships without timber deck cargoes, the stability curves are to comply with the following requirements in Fig.1.1.

1) Area A_1 is to be not less than 0.055 m·rad.
2) Area A_2 is to be not less than 0.03 m·rad.
3) Area $A_1 + A_2$ is to be not less than 0.09 m·rad.
4) GoZ is to be at least 0.20m at an angle of heel equal to or greater than 30°.
5) θmax is to be not less than 25°.
6) GoM is to be not less than 0.15 m.

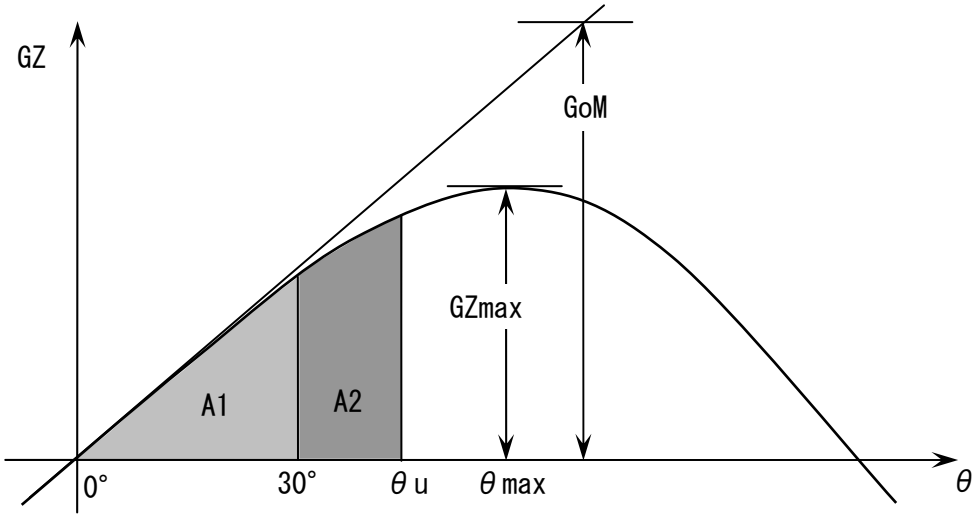


Fig.1.1 Stability Curve (General Stability Requirements)

Where ;

A1 = Area under stability curve between 0° and 30° (m·rad).
A2 = Area under stability curve between 30° and θu (m·rad).
θu = Heeling angle(degree) to be taken of whichever is less, downflood angle(θf) in relevant loading condition or 40°.
GZ max = Maximum righting lever (m)
θ max = Heeling angle at which righting arm reaches maximum(degree).
GoM = Initial metacentric height corrected by free surface effect (m).

2. STABILITY CRITERIA IN WIND AND WAVES (IMO Res. A.749(18) 3.2)

Stability curves and wind-heeling moment lever curves of ships are to comply with the following requirements in Fig.1.2.

(1) Heeling angle caused by steady wind is to be less than 16° or an angle corresponding to 80% of immersing angle of deck edge whichever is less.

(2) Area "b" is not to be less than area "a".

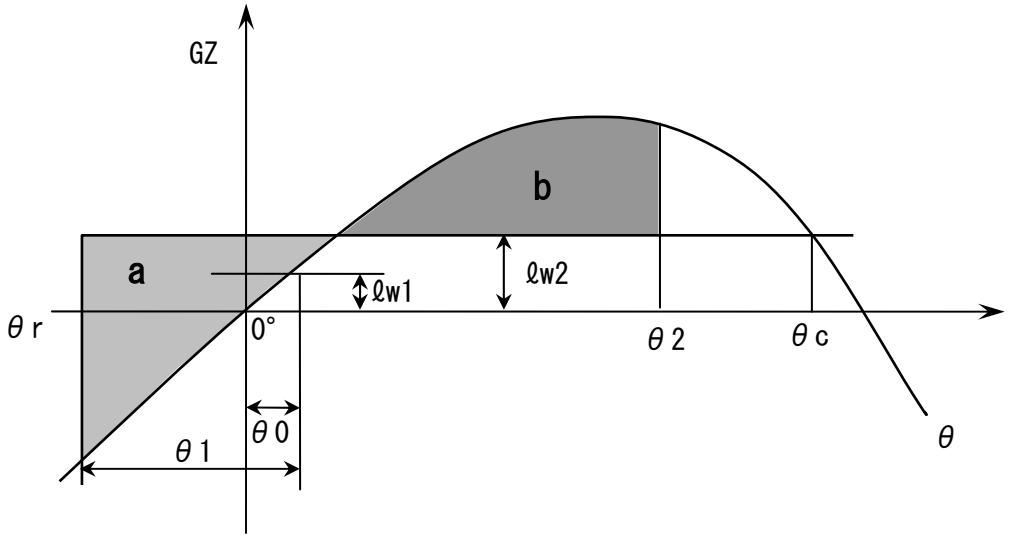
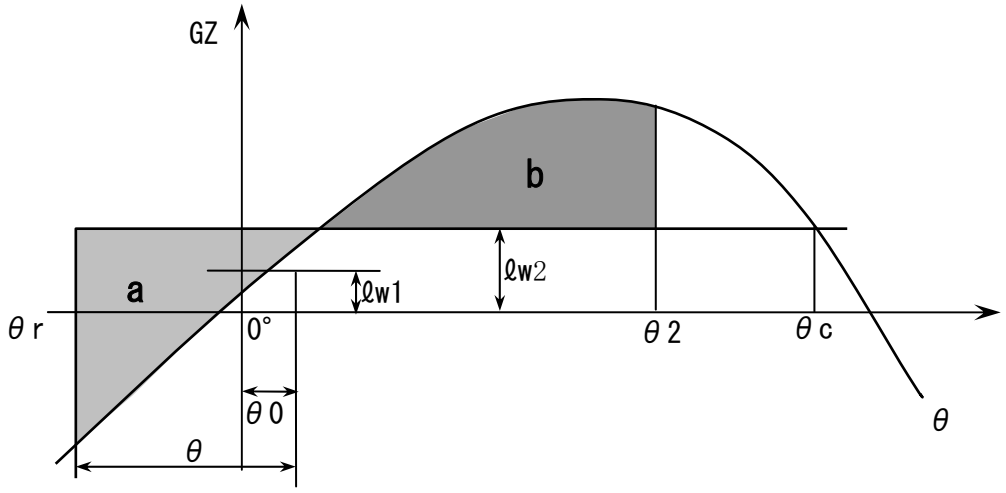


Fig.1.2 Stability and wind-heeling Moment Lever Curve
(Stability Requirements in Wind and Waves)

Where ;

$\theta 0$ = angle of heel under action of steady wind
$\theta 1$ = angle of roll to windward due to wave action
$\theta 2$ = angle of downflooding (θf) or 50° or θc whichever is less
θc = angle of second intercept between wind heeling lever ℓw2 and GoZ curves.
ℓw1 = Wind heeling lever caused by steady wind
ℓw2 = Wind heeling lever caused by gust

Wind heeling lever and angle of roll to windward due to wave action



1) The angle in the above figure are defined as follows;
   θ0 = angle of heel under action of steady wind
   θ1 = angle of roll to windward due to wave action
   θ2 = angle of downflooding (θf) or 50° or θc whichever is less
   θr = rolling angle
   where,
   θf = downflooding angle
   (from 4-4 "CROSS CURVE TABLE (INC. DOWNFLOODING ANGLE) of "APPENDIX TO LOADING BOOKLET")
   θc = angle of second intercept between wind heeling lever ℓw2 and GoZ curves

2) The wind heeling levers ℓW1 and ℓw2 should be calculated as follows;
   ℓw1 = P·A·Z / W ····· in m
   and
   ℓw2 = 1.5 ℓw1 ····· in m

   where;
   P = 0.0514 (t/m^2)
   A = projected lateral area of the portion of the ship and deck cargo above the water line (m^2)
   Z = vertical distance from the center of "A" to the center of the underwater lateral area or approximately to a point at one half the draft (m)
   W = displacement (t)

3) The angle of roll ($\theta 1$) should be calculated as follows.

$$\theta 1 = 109 \cdot K \cdot X_1 \cdot X_2 \cdot \sqrt{rs}$$

Where,

X_1 = factor as shown in Table 1

X_2 = factor as shown in Table 2

factor (K) as follows;

K = 1.0 for round-bilged ship having no bilge or bar keels;

K = 0.7 for a ship having sharp bilges ;

K = to be obtained from table 3 for a ship having bilge keels, a bar keel or both.

r = 0.73 + 0.6 OG / d

with

OG = distance between the center of gravity and the water line

(+) ... if center of gravity is above the waterline

(−) ... if it is below

s = factor as shown in Table 4.

Table 1
factor x_1

B/d	X_1
≦ 2.4	1.0
2.5	0.98
2.6	0.96
2.7	0.95
2.8	0.93
2.9	0.91
3.0	0.90
3.1	0.88
3.2	0.86
3.3	0.84
3.4	0.82
≧ 3.5	0.80

Table 2
factor x_2

cb	x_2
≦ 0.45	0.75
0.50	0.82
0.55	0.89
0.60	0.95
0.65	0.97
≧ 0.70	1.00

Table 3
factor k

$\frac{AK \cdot 100}{L \cdot B}$	K
0.0	1.0
1.0	0.98
1.5	0.95
2.0	0.88
2.5	0.79
3.0	0.74
3.5	0.72
≧ 4.0	0.70

Table 4
factor s

T	s
≦ 6	0.100
7	0.098
8	0.093
12	0.065
14	0.053
16	0.044
18	0.038
≧ 20	0.035

(Intermediate values in table 1～4 should be obtained by linear interpolation)

Rolling period $T = 2 \cdot C \cdot B / \sqrt{GoM}$ (sec.)

Where,

C = 0.373 + 0.023 (B/d) — 0.043(L/100)

The symbols as follows;

L = length of the ship (m) = 163.60 m

B = moulded breadth of the ship (m) = 27.00 m

d = mean moulded draft of the ship (m)

cb = block coefficient = W / 1.025·L·B·d

Ak = total overall area of bilge keels(m^2) = 31.35 m^2

GoM = metacentric height corrected for free surface effect (m)

3. STABILITY REQUIREMENTS FOR LUMBER LOADING (IMO Res.A.749(18) 4.1)

For ship's with Lumber on the deck, the stability curves are to comply with the following requirements in Fig.2.

(1) Area A1 is to be not less than 0.080 m-rad.
(2) GoM is to be not less than 0.10 at departure and keep to be positive throughout her voyage.
(3) The buoyancy as deck cargoes of its 75% occupied capacity are take into account.
(4) At the arrival condition, the weight of deck cargo should be added the absorption of its 10% weight.

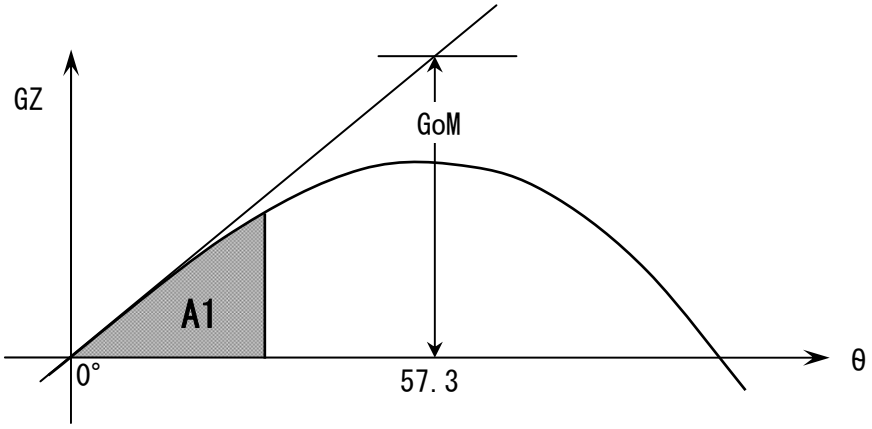


Fig.2

Where ;
A1 = Area under stability curve between 0° and θu (m-rad).
θu = Heeling angle (degree) to be taken of whichever is less, downflood angle (θf) in relevant loading condition or 40°
GoM = Initial metacentric height corrected by free surface effect (m)

Ⅰ-3 STABILITY REQUREMENTS

1. MINIMUM REQUIRED GoM CURVE

In order to avoid complicated calculation for checking stability according to the stability criteria, required GoM vs. draft has been computed and drawn in chart as shown on next page.

This chart indicates limiting GoM to comply with requirements of all relevant intact and damage stability criteria.

When the ship's actual GoM locates in sufficient stability area i.e. GoM is not less than the required minimum, the ship complies with the said criteria in this condition.

By using the required GoM chart, the ship operator can easily check the stability whether it complies with the criteria or not.
Procedure for checking stability with required GoM chart.

1) Calculate the displacement, draft and GoM in accordance with method described in section Ⅰ-3-3 "TRIM CALCULATION" and Ⅰ-3-4 "STABILITY CALCULATION".
GoM includes correction for free surface of liquid in tanks.
In operation of ballasting/deballasting, the maximum free surface of the subject tank(s) must be taken into consideration.

2) Read the required GoM at this draft in the chart.

3) If the calculated GoM is less than required GoM, the condition does not comply with stability requirement.
Then loading arrangement must be changed so as to achieve at least the minimum required GoM.

Note : All standard loading conditions shown in section Ⅲ "STANDARD LOADING CONDITIONS" comply with relevant stability requirement as plotted on this chart.

Permissible Trim Range

The permissible trim range is a result of damage stability requirement set by SOLAS 2009, Chapter Ⅱ-1, Part B-1, Reg. 5-1.

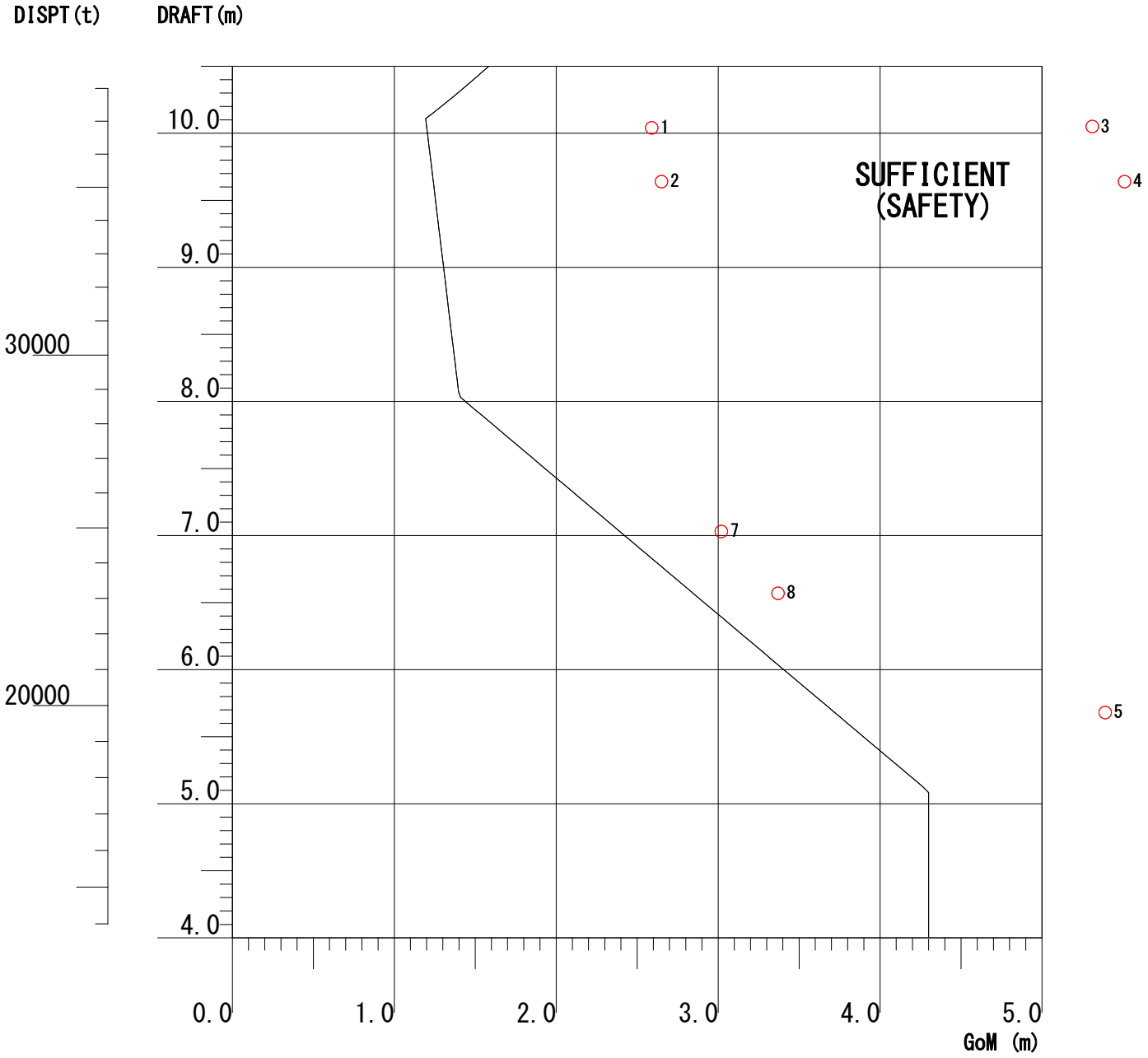
The vessel has a permissible operational trim range as below. These shall be used in conjunction with limit GM curves.

Permissible Trim (m)	Normal Freeboard			Timber Freeboard		
	Light Draft	Partial Draft	Summer Draft	Light Draft	Partial Draft	Summer Draft
	5.090	8.057	10.035	5.090	8.204	10.280
By bow	-	0.82	0.82	-	0.82	0.82
By stern	1.46 - 3.16	2.45	2.45	1.46 - 3.16	2.45	2.45

The permissible trim shall be linearly varied between the partial draught and light service draught. Please note the drafts in above table are moulded.

MINIMUM REQUIRED GoM CURVE

(ORDINARY TRIM 0 m)



* Area under curve up to 30 to be not less than 0.055 m-rad.
* Area under curve up to θf to be not less than 0.090 m-rad.
* Area between 30 and of to be not less than 0.030 m-rad.
* GZ to be at least 0.20 m in height at angle not less than 30
* Max. GZ to occur not less than 25
* Initial GoM to be not less than 0.15 m
* Area (b) to be not less than Area (a)
* Heeling angle due to wind not less than θ0

*Dry Cargo Damage
Where
θf : flooding Angle or 40. Whichever is less.
θ0 : 80% of the angle of deck edge immersion or 16.
whichever is less.

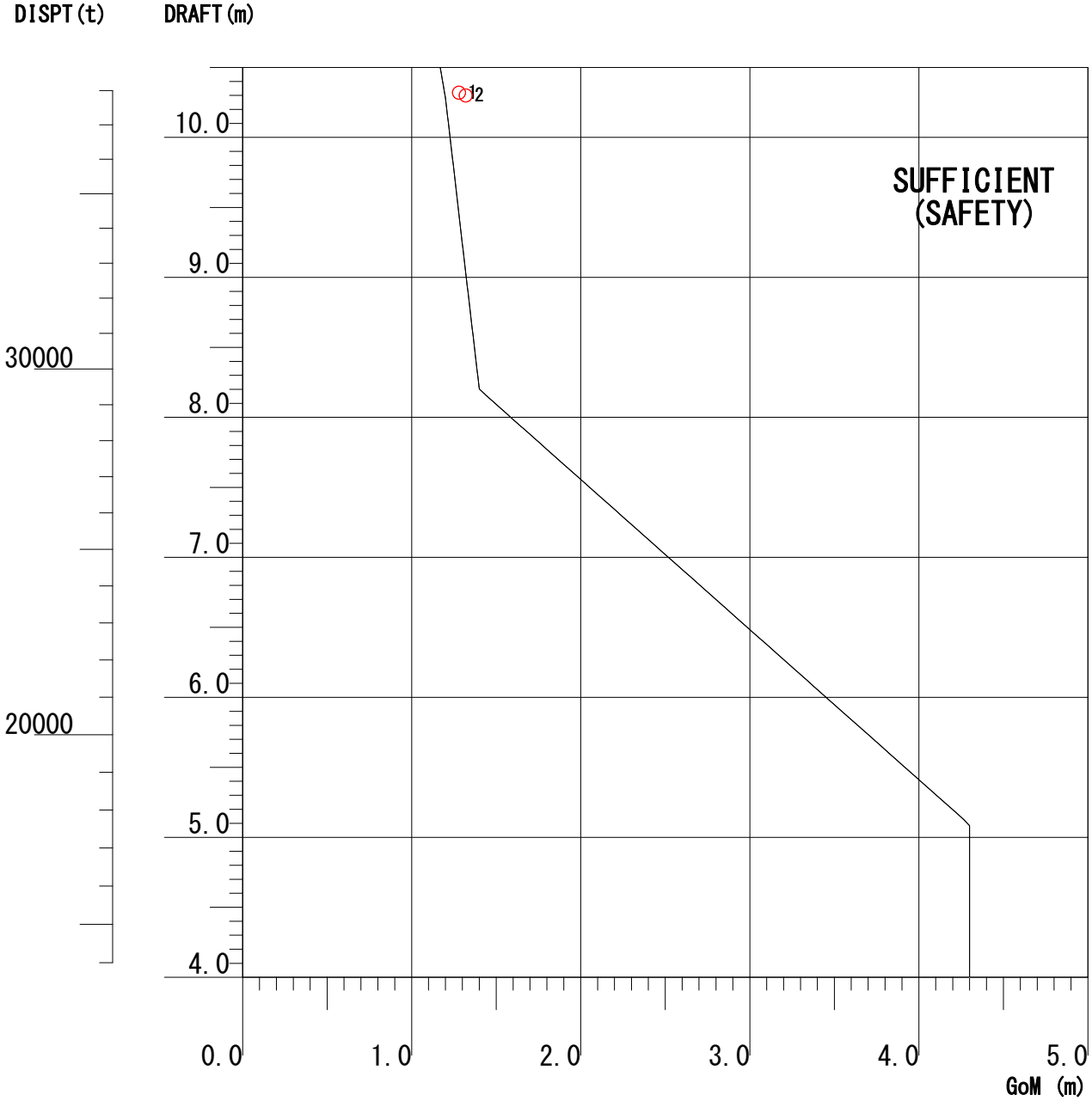
(1) 6-1 FULL LOAD.COND.(HOMO)DEP.
(2) 6-3 FULL LOAD.COND.(HOMO)ARR.
(3) 8-1 FULL LOAD. COND.(ALT)DEP.
(4) 8-3 FULL LOAD. COND.(ALT)ARR.
(5) 3-1 BALLAST CONDITION DEP.
(6) 3-3 BALLAST CONDITION ARR.
(7) 4-1 HEAVY BALLAST COND. DEP.
(8) 4-3 HEAVY BALLAST COND. ARR.

MINIMUM REQUIRED GoM TABLE

DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)
4.00	4.300	5.00	4.300	6.00	3.414	7.00	2.441	8.00	1.468
4.05	4.300	5.05	4.300	6.05	3.366	7.05	2.393	8.05	1.421
4.10	4.300	5.10	4.286	6.10	3.317	7.10	2.344	8.10	1.397
4.15	4.300	5.15	4.242	6.15	3.268	7.15	2.295	8.15	1.392
4.20	4.300	5.20	4.193	6.20	3.220	7.20	2.247	8.20	1.387
4.25	4.300	5.25	4.144	6.25	3.171	7.25	2.198	8.25	1.382
4.30	4.300	5.30	4.096	6.30	3.122	7.30	2.149	8.30	1.377
4.35	4.300	5.35	4.047	6.35	3.074	7.35	2.101	8.35	1.372
4.40	4.300	5.40	3.998	6.40	3.025	7.40	2.052	8.40	1.367
4.45	4.300	5.45	3.950	6.45	2.977	7.45	2.003	8.45	1.362
4.50	4.300	5.50	3.901	6.50	2.928	7.50	1.955	8.50	1.357
4.55	4.300	5.55	3.852	6.55	2.879	7.55	1.906	8.55	1.352
4.60	4.300	5.60	3.804	6.60	2.831	7.60	1.857	8.60	1.346
4.65	4.300	5.65	3.755	6.65	2.782	7.65	1.809	8.65	1.341
4.70	4.300	5.70	3.706	6.70	2.733	7.70	1.760	8.70	1.336
4.75	4.300	5.75	3.658	6.75	2.685	7.75	1.711	8.75	1.331
4.80	4.300	5.80	3.609	6.80	2.636	7.80	1.663	8.80	1.326
4.85	4.300	5.85	3.560	6.85	2.587	7.85	1.614	8.85	1.321
4.90	4.300	5.90	3.512	6.90	2.539	7.90	1.565	8.90	1.316
4.95	4.300	5.95	3.463	6.95	2.490	7.95	1.517	8.95	1.311
5.00	4.300	6.00	3.414	7.00	2.441	8.00	1.468	9.00	1.306
5.05	4.300	6.05	3.366	7.05	2.393	8.05	1.421	9.05	1.301
5.10	4.286	6.10	3.317	7.10	2.344	8.10	1.397	9.10	1.296
5.15	4.242	6.15	3.268	7.15	2.295	8.15	1.392	9.15	1.291
5.20	4.193	6.20	3.220	7.20	2.247	8.20	1.387	9.20	1.286
5.25	4.144	6.25	3.171	7.25	2.198	8.25	1.382	9.25	1.281
5.30	4.096	6.30	3.122	7.30	2.149	8.30	1.377	9.30	1.276
5.35	4.047	6.35	3.074	7.35	2.101	8.35	1.372	9.35	1.271
5.40	3.998	6.40	3.025	7.40	2.052	8.40	1.367	9.40	1.266
5.45	3.950	6.45	2.977	7.45	2.003	8.45	1.362	9.45	1.261
5.50	3.901	6.50	2.928	7.50	1.955	8.50	1.357	9.50	1.256
5.55	3.852	6.55	2.879	7.55	1.906	8.55	1.352	9.55	1.251
5.60	3.804	6.60	2.831	7.60	1.857	8.60	1.346	9.60	1.245
5.65	3.755	6.65	2.782	7.65	1.809	8.65	1.341	9.65	1.240
5.70	3.706	6.70	2.733	7.70	1.760	8.70	1.336	9.70	1.235
5.75	3.658	6.75	2.685	7.75	1.711	8.75	1.331	9.75	1.230
5.80	3.609	6.80	2.636	7.80	1.663	8.80	1.326	9.80	1.225
5.85	3.560	6.85	2.587	7.85	1.614	8.85	1.321	9.85	1.220
5.90	3.512	6.90	2.539	7.90	1.565	8.90	1.316	9.90	1.215
5.95	3.463	6.95	2.490	7.95	1.517	8.95	1.311	9.95	1.210
6.00	3.414	7.00	2.441	8.00	1.468	9.00	1.306	10.00	1.205
6.05	3.366	7.05	2.393	8.05	1.421	9.05	1.301	10.05	1.200
6.10	3.317	7.10	2.344	8.10	1.397	9.10	1.296	10.10	1.195
6.15	3.268	7.15	2.295	8.15	1.392	9.15	1.291	10.15	1.238
6.20	3.220	7.20	2.247	8.20	1.387	9.20	1.286	10.20	1.290
6.25	3.171	7.25	2.198	8.25	1.382	9.25	1.281	10.25	1.342
6.30	3.122	7.30	2.149	8.30	1.377	9.30	1.276	10.30	1.392
6.35	3.074	7.35	2.101	8.35	1.372	9.35	1.271	10.35	1.440
6.40	3.025	7.40	2.052	8.40	1.367	9.40	1.266	10.40	1.489
6.45	2.977	7.45	2.003	8.45	1.362	9.45	1.261	10.45	1.536
6.50	2.928	7.50	1.955	8.50	1.357	9.50	1.256	10.50	1.583

MINIMUM REQUIRED GoM CURVE

(LUMBER TRIM 0 m)



* Area under curve up to 30 to be not less than 0.055 m-rad.
* Area under curve up to θf to be not less than 0.090 m-rad.
* Area between 30 and of to be not less than 0.030 m-rad.
* GZ to be at least 0.20 m in height at angle not less than 30
* Max. GZ to occur not less than 25
* Initial GoM to be not less than 0.15 m
* Area (b) to be not less than Area (a)
* Heeling angle due to wind not less than θ0

*Dry Cargo Damage
Where
θf : flooding Angle or 40. Whichever is less.
θ0 : 80% of the angle of deck edge immersion or 16.
whichever is less.

(1) 10-1 LOG LOAD. COND. DEP.
(2) 10-2 LOG LOAD. COND. ARR.

MINIMUM REQUIRED GoM TABLE

DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)	DRAFT (m)	REQUIRED GoM (m)
4.00	4.300	5.00	4.300	6.00	3.454	7.00	2.525	8.00	1.595
4.05	4.300	5.05	4.300	6.05	3.408	7.05	2.478	8.05	1.549
4.10	4.300	5.10	4.287	6.10	3.361	7.10	2.432	8.10	1.502
4.15	4.300	5.15	4.244	6.15	3.315	7.15	2.385	8.15	1.456
4.20	4.300	5.20	4.198	6.20	3.268	7.20	2.339	8.20	1.409
4.25	4.300	5.25	4.151	6.25	3.222	7.25	2.292	8.25	1.396
4.30	4.300	5.30	4.105	6.30	3.175	7.30	2.246	8.30	1.391
4.35	4.300	5.35	4.058	6.35	3.129	7.35	2.199	8.35	1.386
4.40	4.300	5.40	4.012	6.40	3.082	7.40	2.153	8.40	1.382
4.45	4.300	5.45	3.965	6.45	3.036	7.45	2.106	8.45	1.377
4.50	4.300	5.50	3.919	6.50	2.989	7.50	2.060	8.50	1.372
4.55	4.300	5.55	3.872	6.55	2.943	7.55	2.013	8.55	1.367
4.60	4.300	5.60	3.826	6.60	2.896	7.60	1.967	8.60	1.362
4.65	4.300	5.65	3.779	6.65	2.850	7.65	1.921	8.65	1.357
4.70	4.300	5.70	3.733	6.70	2.804	7.70	1.874	8.70	1.353
4.75	4.300	5.75	3.687	6.75	2.757	7.75	1.828	8.75	1.348
4.80	4.300	5.80	3.640	6.80	2.711	7.80	1.781	8.80	1.343
4.85	4.300	5.85	3.594	6.85	2.664	7.85	1.735	8.85	1.338
4.90	4.300	5.90	3.547	6.90	2.618	7.90	1.688	8.90	1.333
4.95	4.300	5.95	3.501	6.95	2.571	7.95	1.642	8.95	1.329
5.00	4.300	6.00	3.454	7.00	2.525	8.00	1.595	9.00	1.324
5.05	4.300	6.05	3.408	7.05	2.478	8.05	1.549	9.05	1.319
5.10	4.287	6.10	3.361	7.10	2.432	8.10	1.502	9.10	1.314
5.15	4.244	6.15	3.315	7.15	2.385	8.15	1.456	9.15	1.309
5.20	4.198	6.20	3.268	7.20	2.339	8.20	1.409	9.20	1.304
5.25	4.151	6.25	3.222	7.25	2.292	8.25	1.396	9.25	1.300
5.30	4.105	6.30	3.175	7.30	2.246	8.30	1.391	9.30	1.295
5.35	4.058	6.35	3.129	7.35	2.199	8.35	1.386	9.35	1.290
5.40	4.012	6.40	3.082	7.40	2.153	8.40	1.382	9.40	1.285
5.45	3.965	6.45	3.036	7.45	2.106	8.45	1.377	9.45	1.280
5.50	3.919	6.50	2.989	7.50	2.060	8.50	1.372	9.50	1.275
5.55	3.872	6.55	2.943	7.55	2.013	8.55	1.367	9.55	1.271
5.60	3.826	6.60	2.896	7.60	1.967	8.60	1.362	9.60	1.266
5.65	3.779	6.65	2.850	7.65	1.921	8.65	1.357	9.65	1.261
5.70	3.733	6.70	2.804	7.70	1.874	8.70	1.353	9.70	1.256
5.75	3.687	6.75	2.757	7.75	1.828	8.75	1.348	9.75	1.251
5.80	3.640	6.80	2.711	7.80	1.781	8.80	1.343	9.80	1.246
5.85	3.594	6.85	2.664	7.85	1.735	8.85	1.338	9.85	1.242
5.90	3.547	6.90	2.618	7.90	1.688	8.90	1.333	9.90	1.237
5.95	3.501	6.95	2.571	7.95	1.642	8.95	1.329	9.95	1.232
6.00	3.454	7.00	2.525	8.00	1.595	9.00	1.324	10.00	1.227
6.05	3.408	7.05	2.478	8.05	1.549	9.05	1.319	10.05	1.222
6.10	3.361	7.10	2.432	8.10	1.502	9.10	1.314	10.10	1.217
6.15	3.315	7.15	2.385	8.15	1.456	9.15	1.309	10.15	1.213
6.20	3.268	7.20	2.339	8.20	1.409	9.20	1.304	10.20	1.208
6.25	3.222	7.25	2.292	8.25	1.396	9.25	1.300	10.25	1.203
6.30	3.175	7.30	2.246	8.30	1.391	9.30	1.295	10.30	1.198
6.35	3.129	7.35	2.199	8.35	1.386	9.35	1.290	10.35	1.193
6.40	3.082	7.40	2.153	8.40	1.382	9.40	1.285	10.40	1.188
6.45	3.036	7.45	2.106	8.45	1.377	9.45	1.280	10.45	1.183
6.50	2.989	7.50	2.060	8.50	1.372	9.50	1.275	10.50	1.179

2. DISPLACEMENT CALCULATION (FROM DRAFT READING)

Refer to "DISPLACEMENT CALCULATION SHEET" on next page.

1) Reads the drafts at fore, aft and midship draft marks.

2) Finds the drafts at F.P. (dF), A.P. (dA) and midship (dMID) using 4.2 "CORRECTION TABLE OF DRAFT BY TRIM".

3) Calculates trim (T), mean draft (dM, dMδ) and deflection (δ) as follows;

$T = dA - dF$ ..... in m

$dM = (dA + dF) / 2$ ..... in m

$\delta d = dMID - dM$ ..... in m

and corrected mean draft due to deflection (dMδ)

$dM\delta = dM + 3/4 \times \delta$ ..... in m

Where ;

dMID	: Draft at midship (mean of port & starboard)
$T > 0$	: Trim by the stern
$T < 0$	: Trim by the head
$\delta > 0$	: Sagging condition
$\delta < 0$	: Hogging condition

4) Reads displacement (WM), tons per 1 cm immersion (TPC) and center of floatation (MID.F) corresponding to "dMδ" from 4-1 "HYDROSTATIC TABLE".

5) Corrects displacement due to trim ($\delta WT = \delta WT1 + \delta WT2$).

$\delta WT1 = MID.F \times T/LPP \times TPC \times 100$ ..... in t

Make a secondary correction when the trim is larger than LPP/100.

$\delta WT2 = 500 \times \delta MTC \times T \times T / LPP$ ..... in t

Where,

δMTC : Difference of MTC per 10 cm draft change near to "dMδ" on 4-1 "HYDROSTATIC TABLE"

($\delta WT1 + \delta WT2$) can be given more easily by 4-3 "CORRECTION TABLE OF DISPLACEMENT BY TRIM" instead of above method.

6) When the specific gravity of sea water differs from standard of 1.025, displacement should also be corrected due to specific gravity.
Therefore, actual displacement is obtained by the following formula.

$W = (WM + \delta WT) \times$ Actual S.G./1.025 ..... in t

DISPLACEMENT CALCULATION (FROM DRAFT READING)

DRAFT MEASUREMENT		PORT	STARB'D	MEAN	
	FORE	6.207	6.207	df	6.207 m
	MID	6.907	7.142	dMID	7.025 m
	AFT	7.843	7.843	da	7.843 m
	APPARENT TRIM			T'	1.636 m
	SPECIFIC GRAVITY OF WATER			ρ	1.023 t/m3
DRAFT CORRECTION	FORE	from "CORRECTION TABLE of DRAFT BY TRIM"		⊿dF	-0.011 m
	MID			⊿dMID	0.000 m
	AFT			⊿dA	0.107 m
DRAFT AT PERPENDICULARS	F.P.	ds +⊿ dF		dF	6.196 m
	MID	dMID +⊿dMID		dMID	7.025 m
	A.P.	da +⊿dA		dA	7.950 m
MEAN DRAFT		(dF + dA)／ 2		dM	7.073 m
ACTUAL TRIM (+) : by STERN (-) : by STEM		dA − dF		T	1.754 m
DEFLECTION (+) : SAGGING (-) : HOGGING		dMID − dM		δ	-0.048 m
CORRECTION OF DRAFT BY DEFLECTION		3／ 4・δ		δ d	-0.036 m
MEAN DRAFT (Corrected by deflection)		dM + δ d		dMδ	7.037 m
DISPLACEMENT (equivalent to "dMδ")		from "HYDROSTATIC TABLE"		WM	24920 t
CORRECTION OF DISPLACEMENT BY TRIM		from "CORRECTION TABLE OF DISLACEMENT BY TRIM"			-106 t
DISPLACEMENT (at Specific Gravity 1.025)		WM + δ WT		WT	24814 t
ACTUAL DISPLACEMENT		ρ ・WT / 1.025		W	24765 t
CORRESPOND. DRAFT		equivalent to "WT" from "HYDROSTATIC TABLE"		d	7.009 m
MID.B				MID.B	-5.05 m
MTC				MTC	383.40 m
MID.G		MID.B + MTC・T・100/WT		MID.G	-2.34 m

DISPLACEMENT CALCULATION (FROM DRAFT READING)

DRAFT MEASUREMENT		PORT	STARB'D	MEAN	
	FORE			df	m
	MID			dMID	m
	AFT			da	m
	APPARENT TRIM			T'	m
	SPECIFIC GRAVITY OF WATER			ρ	t/m3
DRAFT CORRECTION	FORE	from "CORRECTION TABLE of DRAFT BY TRIM"		⊿dF	m
	MID			⊿dMID	m
	AFT			⊿dA	m
DRAFT AT PERPENDICULARS	F.P.	ds +⊿ dF		dF	m
	MID	dMID +⊿dMID		dMID	m
	A.P.	da +⊿dA		dA	m
MEAN DRAFT		(dF + dA)／ 2		dM	m
ACTUAL TRIM (+) : by STERN (−) : by STEM		dA − dF		T	m
DEFLECTION (+) : SAGGING (−) : HOGGING		dMID − dM		δ	m
CORRECTION OF DRAFT BY DEFLECTION		3／ 4・δ		δ d	m
MEAN DRAFT (Corrected by deflection)		dM + δ d		dMδ	m
DISPLACEMENT (equivalent to "dMδ")		from "HYDROSTATIC TABLE"		WM	t
CORRECTION OF DISPLACEMENT BY TRIM		from "CORRECTION TABLE OF DISLACEMENT BY TRIM"			t
DISPLACEMENT (at Specific Gravity 1.025)		WM + δ WT		WT	t
ACTUAL DISPLACEMENT		ρ ・WT / 1.025		W	t
CORRESPOND. DRAFT		equivalent to "WT" from "HYDROSTATIC TABLE"		d	m
MID.B				MID.B	m
MTC				MTC	m
MID.G		MID.B + MTC・T・100/WT		MID.G	m

3. TRIM CALCULATION

Refer to "TRIM CALCULATION SHEET" (page 26).

1) Put the weight and MID.G of cargo, fuel oil, fresh water or ballast water in each tank and provisions, etc. into the column of "WEIGHT" and "MID.G" respectively.
MID.G of tanks can be obtained from 4-10 "TANK CAPACITY TABLE" and 4-11 "TANK PROPERTIES" of "APPENDIX TO LOADING BOOKLET".

2) Sum up the above-mentioned weights to make the deadweight, then add the light weight. The total makes the displacement (W).

3) Multiply the "WEIGHT" by "MID.G" and put them into the column of "MOMENT".

4) Divide the total of "MOMENT" by the displacement.
Results show the MID.G of this loading condition.

5) Get trim (T) and drafts as below ;

$$\text{Trim} = \frac{\text{Trimming moment}}{\text{MTC} \times 100} = \frac{W \times (\text{MID.G} - \text{MID.B})}{\text{MTC} \times 100} \quad \cdots\cdots\cdots \text{in m}$$

$$dF = dCF - \text{Trim} \times \frac{\text{LPP}/2 + \text{MID.F}}{\text{LPP}} \quad \cdots\cdots\cdots\cdots\cdots\cdots \text{in m}$$

$$dA = dCF + \text{Trim} \times \frac{\text{LPP}/2 + \text{MID.F}}{\text{LPP}} \quad \cdots\cdots\cdots\cdots\cdots\cdots \text{in m}$$

$$dm = \frac{dF + dA}{2} \quad \cdots\cdots\cdots\cdots\cdots\cdots \text{in m}$$

MID.B, dCF, MID.F and MTC are to correspond to the displacement (W) on the 4-1 "HYDROSTATIC TABLE".

Reference ; Propeller immersion (I/D)

$$\frac{I}{D} = \frac{dA - \text{Shaft Cr.H}}{\text{Propeller Dia.}} = \frac{dA - 3.160}{6.000} \times 100 \quad \cdots\cdots\cdots \text{in \%}$$

4. STABILITY CALCULATION

Refer to "TRIM CALCULATION SHEET" (page 26) and "STABILITY CALCULATION SHEET" (page 27 - 29).
Metacentric Height (GoM, GGo, KG) is given in "TRIM CALCULATION SHEET".

1) Put the height of vertical center of gravity above base line of each loading weight into the column of "KG" in m.
"KG" of tanks can be obtained from 4-11 "TANK PROPERTIES" of "APPENDIX TO LOADING BOOKLET".

2) Multiply the "WEIGHT" by "KG" and put them into the column of "VERTICAL MOMENT".

3) Divide the total of "VERTICAL MOMENT" by the displacement.
Result shows the vertical center of gravity above base line (KG) of this loading condition.

4) Tanks where free surface effect is to be taken account ;
For tanks which are partly filled, the effect due to the free surface on the stability is to be given as the function of the volume or the depth of the liquid.

For tanks which may be consumed or discharged during navigation or may be transferred to and from other tanks, the expected maximum moment of free surface is to be considered.

5) Put the products of moment of inertia of free surface about longitudinal axis of each tank and specific gravity of liquid into the column of "$\rho * I$".
"I" can be obtained from 4.11 "TANK PROPERTIES".

6) Rise of apparent vertical center of gravity due to effect of free surface can be given as follows;

$$GGo = \frac{total(\rho * I)}{W} \quad \cdots\cdots\cdots\cdots\cdots \text{ in m}$$

7) Ship's metacentric height (GM) can be given as follows;

$$GM = KM - KG \quad \cdots\cdots\cdots\cdots\cdots \text{ in m}$$
and
$$GoM = GM - GGo \quad \cdots\cdots\cdots\cdots\cdots \text{ in m}$$

where, "KM" is that which corresponds to the displacement in 4-1 "HYDROSTATIC TABLE".

5. STATICAL STABILITY CURVES

Statical stability curves (righting arm vs. heeling angle) can be obtained by the following procedure ;

1) Calculate the "KGo".

$$KGo = KG + GGo \quad \cdots\cdots\cdots\cdots\cdots \text{ in m}$$

2) Read "G'Z" in meter from 4.4 "CROSS CURVE TABLE" of "APPENDIX TO LOADING BOOKLET" for each heeling angle (θ) at the displacement (W).

3) Calculate the actual righting arm (GoZ) for each heeling angle (θ).

$$GoZ = G'Z - KGo \times \sin\theta \quad \cdots\cdots\cdots\cdots\cdots \text{ in m}$$

θ	10°	12°	20°	30°	40°	50°	60°	75°	90°
$\sin\theta$	0.1736	0.2079	0.3420	0.5000	0.6427	0.7660	0.8660	0.9659	1.0000

4) Plot GoZ against θ and connect these points by a fair curve to make a statical stability curve.
At negative heeling angle, GoZ calculated above should be plotted in negative direction of ordinate.

Usually the curve at small angles will be straight line which, if extended, would pass through a point, the ordinate of which equals the initial GoM and abscissa of which is 57.3 degrees.

STABILITY CALCULATION SHEET (1/2)

CONDITION NAME	8-1 FULL LOAD. COND.(ALT)DEP.				
TRIM CALCULATION RESULTS	DISPLACEMENT (W)				36855 t
	K G				5.96 m
	K M				11.31 m
	G M (K M − K G)				5.35 m
	GoG (Σ(ρ × I)/W)				0.04 m
	GoM (G M − GGo)				5.31 m
	KGa (K G + GGo - ASKG)				6.00 m
	FLOODING ANGLE (θf)				66.55 deg
GoZ CALCULATION	θ (deg)	G'Z (m)	Sinθ (m)	KGa · sinθ (m)	GoZ = G'Z − KGa · sinθ (m)
	10	1.979	0.1736	1.042	0.937
	12	2.378	0.2079	1.247	1.131
	20	3.968	0.3420	2.052	1.916
	30	5.584	0.5000	3.000	2.584
	40	6.954	0.6427	3.856	3.098
	50	7.888	0.7660	4.596	3.292
	60	8.399	0.8660	5.196	3.203
	75	8.521	0.9659	5.795	2.726
	90	7.985	1.0000	6.000	1.985
	Draw the statical stability curve (GoZ curve) on page next.				

STABILITY CALCULATION FOR IMO RES. A.749(18) 3.1						
CALCULATION OF AREA OF UNDER THE GoZ CURVE	θ (deg)	GoZ (m)	S	GoZ·S	Σ(GoZ·S)	
	0	0.000	1	0.000	①	
	10	0.937	3	2.811		
	20	1.916	3	5.748		11.144
	30	2.585	1	2.585	②	
	15+θu/2	2.871	4	11.484		
	θu	3.098	1	3.098		17.167

JUDGEMENT OF STABILITY FOR IMO RES. A.749(18) 3.1	ITEM		RESULTS	REQUIRED
	AREA A1 (m-rad)	① × 30 / 8 × 57.3	0.729	≧ 0.055
	AREA A2 (m-rad)	② × (θu-30) / 6 × 57.3	0.499	≧ 0.030
	AREA (m-rad)	A1 + A2	1.228	≧ 0.090
	GoZ max (m)	find up from "GoZ CURVE"	3.29	≧ 0.20
	θ max (deg)	find up from "GoZ CURVE"	51.30	≧ 25
	GoM (m)		5.31	≧ 0.15

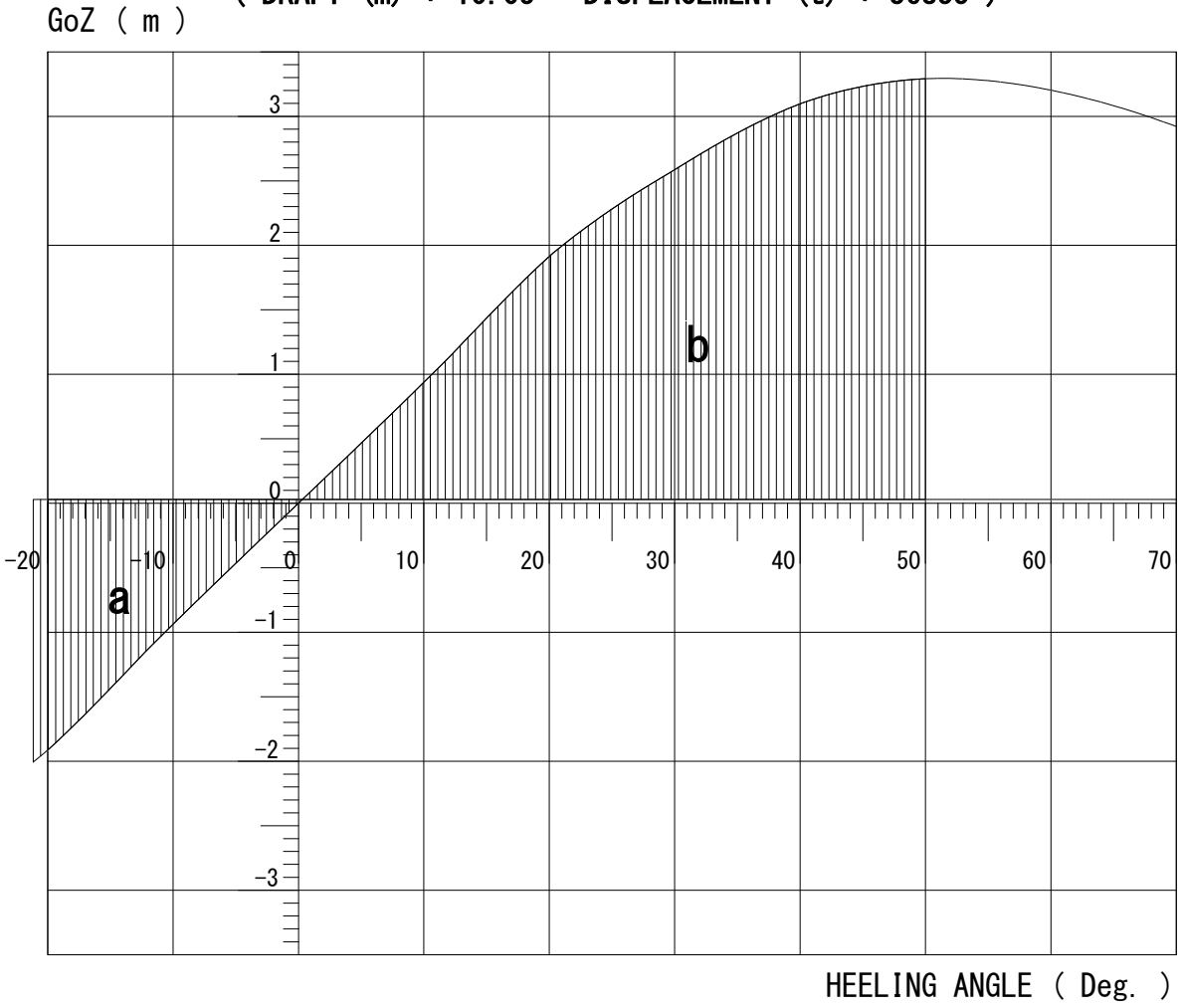
STABILITY CALCULATION SHEET (2/2)

STABILITY CALCULATION FOR IMO RES. A. 749(18) 3.2								
CALCULATION OF WIND HEELING LEVER	DISPLACEMENT (W)			36855 t				
	WIND. PROJ. AREA (A)			1245.33 m2				
	LEVER (Z)			11.03 m				
	w1	0.0514・A・Z / W						w1 0.019 m
	w2	1.5・w1						w2 0.029 m
CALCULATION OF ANGLE OF ROLL TO WINDWARD DUE TO WAVE ACTION								
	LENGTH (L)			163.600 m				
	BREADTH MLD. (B)			27.000 m				
	MEAN DRAFT MLD. (d')			10.030 m				
	AREA OF BILGE KEEL (Ak)			31.35 m2				
	GoM			5.31 m				
	KGo			6.00 m				
	O G (: K G− d')			-4.03 m				
	X1	B／ d'		2.692				X1 0.951
		FROM TABLE− 1						
	X2	Cb (:W/1.025 L B d')		0.800				X2 1.000
		FROM TABLE− 2						
	k	Ak・100／ L B		0.700				k 0.986
		FROM TABLE− 3						
	r	0.73 + 0.60・0G/d' (however, ≦ 1.0)						r 0.489
	s	C (:0.373+0.023・B/d' − 0.043・L/100)		0.364				s 0.089
		T (: 2・B・C/ √GoM)		8.52 sec				
		FROM TABLE− 4						
	θ1 109・X1・X2・k・√ r・s							θ1 21.36 deg
CALCULATION OF AREA "a" AND "b"	AREA "a"				AREA "b"			
	θ	y	S	y・s	θ	y	S	y・s
	-21.15	2.035	1	2.035	0.31	0.000	1	0.000
	-10.42	1.007	4	4.028	12.73	1.177	4	4.708
	0.31	0.000	1	0.000	25.15	2.263	2	4.526
					37.58	2.967	4	11.868
					50.00	3.263	1	3.263
	Σ (y・s) ①			6.063	Σ (y・s) ②			24.365
	AREA "a" ① × (21.463) / 6 × 57.3 = 0.379 m-rad				AREA "b" ② × (49.691) / 12 × 57.3 = 1.761 m-rad			
DECK EDGE IMMERSION	80% OF THE ANGLE OF DECK EDGE IMMERSION OR 16° ,Whichever is less							θd 13.73 deg
JUDGEMENT OF STABILITY FOR IMO RES. A749(18) 3.2	ITEM				RESULTS			REQUIRED
	θo	Find up from "GoZ CURVE"			0.21			≦θd
	b / a				4.652			≧1.0

STABILITY CURVE

COND.NAME : 8-1 FULL LOAD. COND.(ALT)DEP.
CARGO=3.000t/m3

(DRAFT (m) : 10.05 DISPLACEMENT (t) : 36855)



[A749(18) 3.2]		
WIND AREA	(m2)	1245.3
WIND LEVER	(m)	11.03
ROLLING ANGLE (θ1)	(deg.)	21.36
AREA "a"	(m-rad)	0.379
AREA "b"	(m-rad)	1.761
C (b/a)		4.652
ANGLE θo	(deg.)	0.21

[A749(18) 3.1]		
AREA 0° -30°	(m-rad)	0.729
AREA 30° -θu	(m-rad)	0.499
AREA 0° -θu	(m-rad)	1.228
MAX. GoZ	(m)	3.29
MAX. GoZ	(deg.)	51.30
GoM		5.31
FLOOD. ANGLE	(deg.)	66.55

NOTE : θu ... 40° or the angle of flooding whichever is less.

STABILITY CALCULATION SHEET (1/2)

CONDITION NAME					
TRIM CALCULATION RESULTS	DISPLACEMENT (W)				t
	K G				m
	K M				m
	G M (K M − K G)				m
	GoG (Σ(ρ × I)/W)				m
	GoM (G M − GGo)				m
	KGa (K G + GGo - ASKG)				m
	FLOODING ANGLE (θf)				deg
GoZ CALCULATION	θ (deg)	G'Z (m)	Sinθ (m)	KGa · sinθ (m)	GoZ = G'Z − KGa · sinθ (m)
	Draw the statical stability curve (GoZ curve) on page next.				

STABILITY CALCULATION FOR IMO RES. A.749(18) 3.1

CALCULATION OF AREA OF UNDER THE GoZ CURVE	θ (deg)	GoZ (m)	S	GoZ·S	Σ(GoZ·S)
	0		1		①
	10		3		
	20		3		
	30		1		
	15+θu/2		4		②
	θu		1		

JUDGEMENT OF STABILITY FOR IMO RES. A.749(18) 3.1	ITEM		RESULTS	REQUIRED
	AREA A1 (m-rad)	$\frac{① \times 30}{8 \times 57.3}$		≧ 0.055
	AREA A2 (m-rad)	$\frac{② \times (\theta u - 30)}{6 \times 57.3}$		≧ 0.030
	AREA (m-rad)	A1 + A2		≧ 0.090
	GoZ max (m)	find up from "GoZ CURVE"		≧ 0.20
	θ max (deg)	find up from "GoZ CURVE"		≧ 25
	GoM (m)			≧ 0.15

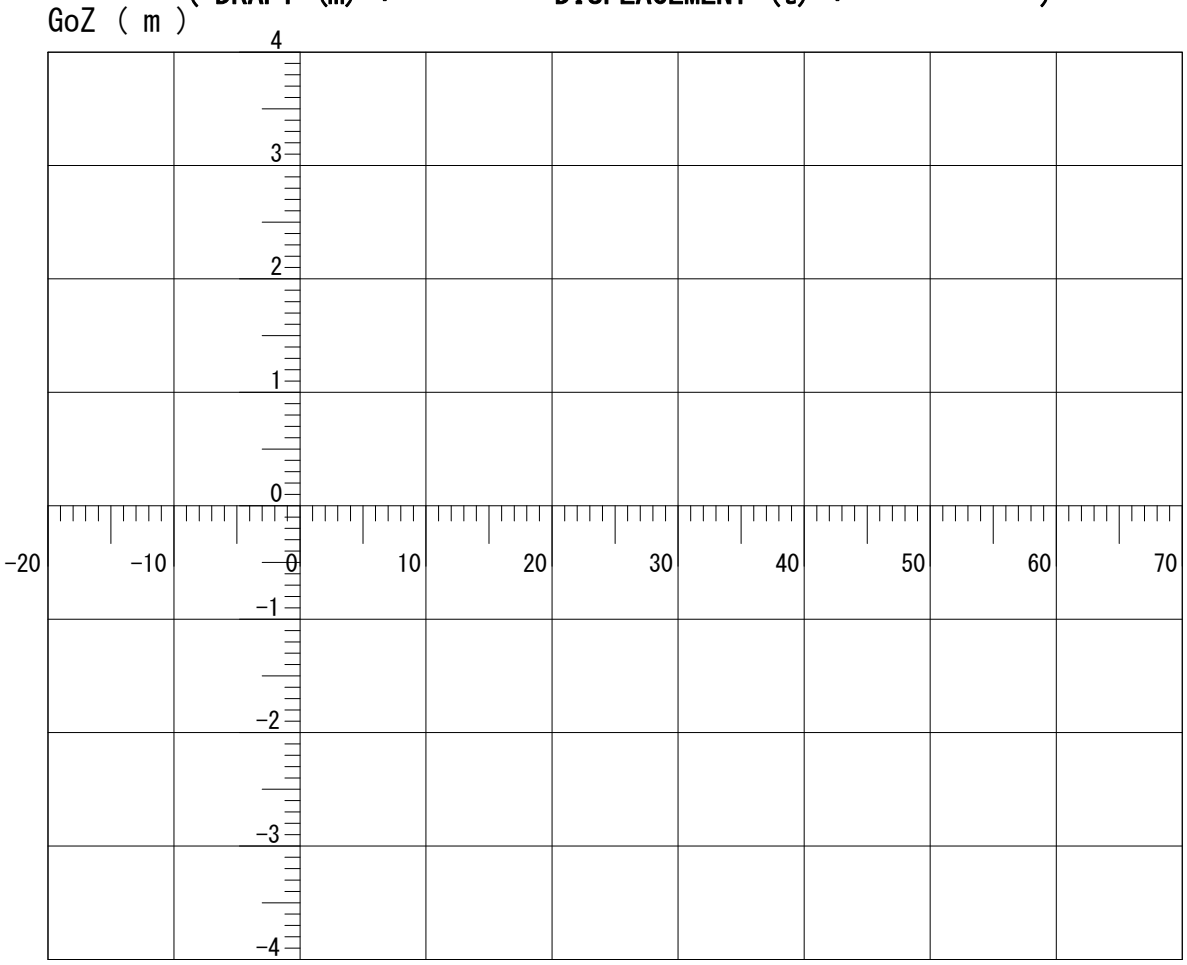
STABILITY CALCULATION SHEET (2/2)

STABILITY CALCULATION FOR IMO RES. A. 749(18) 3.2								
CALCULATION OF WIND HEELING LEVER	DISPLACEMENT (W)			t				
	WIND. PROJ. AREA (A)			m2				
	LEVER (Z)			m				
	w1	0.0514・A・Z / W			w1 m			
	w2	1.5・w1			w2 m			
CALCULATION OF ANGLE OF ROLL TO WINDWARD DUE TO WAVE ACTION								
	LENGTH (L)			m				
	BREADTH MLD. (B)			m				
	MEAN DRAFT MLD. (d')			m				
	AREA OF BILGE KEEL (Ak)			m2				
	GoM			m				
	KGo			m				
	O G (: K G− d')			m				
	X1	B／ d'			X1			
		FROM TABLE− 1						
	X2	Cb (:W/1.025 L B d')			X2			
		FROM TABLE− 2						
	k	Ak・100／ L B			k			
		FROM TABLE− 3						
	r	0.73 + 0.60・OG/d' (however, ≦ 1.0)			r			
	s	C (:0.373+0.023・B/d' − 0.043・L/100)			s			
		T (: 2・B・C/ √GoM)		sec				
		FROM TABLE− 4						
	θ1 109・X1・X2・k・√ r・s				θ1 deg			
CALCULATION OF AREA "a" AND "b"	AREA "a"				AREA "b"			
	θ	y	S	y・s	θ	y	S	y・s
			1				1	
			4				4	
			1				2	
							4	
							1	
	Σ (y・s) ①				Σ (y・s) ②			
	AREA "a" ① × ( ) / 6 × 57.3 = m-rad				AREA "b" ② × ( ) / 12 × 57.3 = m-rad			
DECK EDGE IMMERSION	80% OF THE ANGLE OF DECK EDGE IMMERSION OR 16° ,Whichever is less				θd deg			
JUDGEMENT OF STABILITY FOR IMO RES. A.749(18) 3.2	ITEM				RESULTS		REQUIRED	
	θo	Find up from "GoZ CURVE"					≦θd	
	b / a						≧1.0	

STABILITY CURVE

COND.NAME :

(DRAFT (m) : DISPLACEMENT (t) :)



[A749(18) 3.2]	
WIND AREA	(m2)
WIND LEVER	(m)
ROLLING ANGLE (θ1)	(deg.)
AREA "a"	(m-rad)
AREA "b"	(m-rad)
C (b/a)	
ANGLE θo	(deg.)

[A749(18) 3.1]	
AREA 0° -30°	(m-rad)
AREA 30° -θu	(m-rad)
AREA 0° -θu	(m-rad)
MAX. GoZ	(m)
MAX. GoZ	(deg.)
GoM	
FLOOD. ANGLE	(deg.)

NOTE : θu ... 40° or the angle of flooding whichever is less.

Ⅱ. HULL STRENGTH

Ⅱ-1 GENERAL

This information and instruction are prepared for the master of the ship in accordance with the Regulation 10, Chapter Ⅱ of the international convention on Load Lines 1966, to enable him to arrange for the loading and ballasting of the ship in such way as to avoid the creation of any unacceptable stress in the ship's structure.

In the stage of planning loading arrangement, it is necessary to calculate the bending moment and shearing force according to the method stated in section Ⅲ-3 "TRIM STABILITY AND STRENGTH CALCULATION FOR STANDARD LOADING CONDITIONS" and confirm that those are not exceed the limits respectively.

Ⅱ-2 ALLOWABLE BENDING MOMENT AND SHEARING FORCE

In any condition, the calculate B.M. and S.F. must not be more than following allowable values so that a creation of any unacceptable stress in hull structure can be avoidable.

Allowable bending moment in still water (KN-m)						
Calculating position	At sea		In harbour		Damaged	
	(Hog.)	(Sag.)	(Hog.)	(Sag.)	(Hog.)	(Sag.)
34	415,000	-325,000	640,000	-567,000	454,000	-509,000
75	823,000	-645,000	1,299,000	-1,156,000	910,000	-1,010,000
117	823,000	-645,000	1,420,000	-1,285,000	910,000	-1,010,000
159	823,000	-645,000	1,398,000	-1,262,000	910,000	-1,010,000
180	823,000	-645,000	1,398,000	-1,262,000	910,000	-1,010,000
201	471,000	-369,000	752,000	-671,000	516,000	-578,000
230	170,000	-133,000	253,000	-222,000	185,000	-208,000

Allowable shearing forces in still water (KN)						
Calculating position	At sea		In harbour		Damaged	
	(Hog.)	(Sag.)	(Hog.)	(Sag.)	(Hog.)	(Sag.)
34	22,000	-22,000	30,000	-30,000	28,000	-28,000
75	32,000	-32,000	50,000	-50,000	48,000	-48,000
117	31,000	-31,000	48,000	-48,000	43,000	-43,000
159	31,000	-31,000	48,000	-48,000	43,000	-43,000
180	31,000	-31,000	48,000	-48,000	43,000	-43,000
201	31,000	-31,000	48,000	-48,000	43,000	-43,000
230	22,000	-22,000	30,000	-30,000	28,000	-28,000

Allowable still water Bending Moment and Shearing Force indicated by NK independently for service modes at sea and at harbour which are defined as below.

At sea
1. Usual sea going conditions
2. At harbour in high waves
3. Moving out of port to get rid of storm

At harbour
1. Loading/unloading at pier
2. Shifting in port in low waves

Ⅱ－3 LONGITUDINAL STRENGTH CALCULATION

1) General explanation

Applying this method of calculation of longitudinal strength, the longitudinal still water bending moment and still water shearing force at various locations of the hull under the actual loading condition of the ship can be obtained.

The method of calculation and symbols for longitudinal strength are as follows;

ΣW : Integral value of deadweight from the fore end of L to each point of output [shearing force due to dead-weight] (unit : thousand tons)

SS : Integral value of (buoyancy-light weight) from the fore end of L to each point of output [shearing force due to (buoyancy-light weight)] (unit : thousand tons)

ΣM : Double integral value of deadweight from the fore end of L to each point of output [bending moment due to deadweight] (unit : thousand ton-m)

SB : Double integral value of buoyancy and the ship's weight from the fore end of L to each point of output [bending moment due to buoyancy and the ship's light weight]

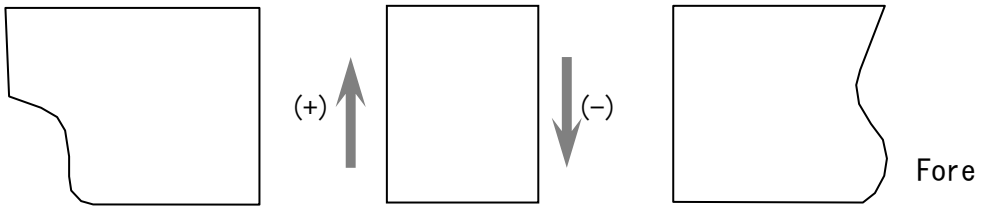
The longitudinal still water shearing force (Fs) and still water bending moment (Ms) at each point of output can be calculated by the following formula:

$$Fs = (SS - \Sigma W) \times 1000 \times 9.80665 \ (KN)$$

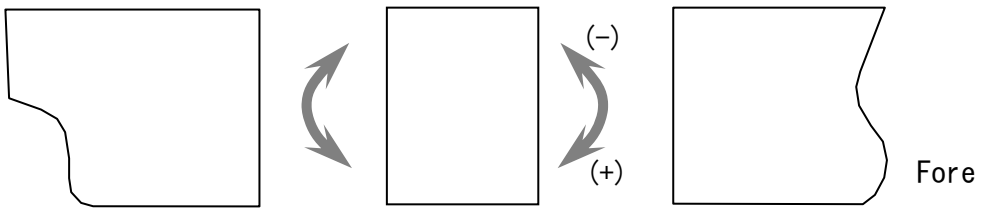
$$Ms = (\Sigma M - SB) \times 1000 \times 9.80665 \ (KN\text{-}m)$$

Where the sign convention of Fs and Ms is the same of each allowable value, as shown in the following figures;

Shearing force



Bending moment



In this method of calculation of longitudinal strength, the shearing force (SS) and the bending moments (SB) due to buoyancy and the ship's light weight are calculated for every meter of draft and the longitudinal strength data, a list of shearing forces and bending moments for respective set-up drafts are prepared.
In pages 40 - 43, an example of numerical table for one set for the specific draft is given for an example.

Accordingly, by calculating only the shearing force and bending moment due to deadweight, the longitudinal still water shearing force (Fs) and still water bending moment (Ms) for each point of output can easily be obtained on board the ship.

2) Procedure for calculation of longitudinal strength
The calculation of longitudinal strength may be proceeded by filling up the spaces given in pages 47 - 50. The procedure is given as follows;

(a) After draft (D_A) and trim
The after draft and trim in the conditions for which the calculation of longitudinal strength is to be made, are to be filled up in the blank spaces.
In this case, the trim by the bow is to be noted with negative sign (-).

(b) Base draft (D_B) and difference of draft ($\triangle D$)
A draft, closes to but is less than the after draft is to be selected from among the base drafts given in the longitudinal strength data and is to be filled up in the space for the base draft, and the difference between the after draft and the selected base draft is to be entered in the space for the difference ($\triangle D$).

(c) Column for weight
One-thousandth of the deadweight (ton) in the respective compartments is to be entered in this column.

(d) Column for WI
This column is for indicating the deadweight in the respective compartments exerted in points of longitudinal strength output, which is obtained by multiplying the deadweight by the ratio (ratio of compartment to be included in each point of output).

(e) Column for MI
This column is tor indicating the moment around the midship which is created by the deadweight in the respective compartments, and here the value of WI×MID.G is to be entered.

no sign in MID.G : Aft ward of midship
(-) sign in MID.G : Forward of midship

(f) ΣWI and ΣMI
The accumulations of WI and MI included between the fore end and each point of output are to be filled up here.

(g) SS and SB

SS and SB indicate the shearing force and the bending moment due to buoyancy and the ship's light weight respectively and they are to be calculated according to the following procedures;

(ⅰ) Correction factors (CD and CT) in accordance with base value, difference of draft and trim

The base value (column "1") and the respective correction factors (CD and CT) at each point of output is to be transferred from the longitudinal strength data for the draft adopted as the base draft to the corresponding space.

(ⅱ) Correction for difference of draft (△D) (column "2")

This is to correct the difference between the base draft and the actual draft. The correction is to be made by multiplying the correction factor (CD) by the difference of draft (△D).

(ⅲ) Correction for trim (column "3")

In case where the ship has any trim, the correction for trim is to be made by multiplying the correction factor (CT) by the value of trim (m).

(ⅳ) Summation

The base value "1", corrected value for the difference of draft "2" and the corrected value for trim "3" are to be summed up and the sums are to be filled up in the spaces for SS and SB.

(h) ΣW and ΣM

ΣW and ΣM indicate the shearing force and bending moment due to deadweight respectively which are obtained by the following procedure;

(ⅰ) Column for ΣW

ΣW is the accumulation (ΣWl) of deadweight at each point of output which is to be transferred in this column.

(ⅱ) Column for ΣM

ΣM is the bending moment at each point of output converted from the bending moment (ΣMl) around the midship due to deadweight at each point of output, and the values obtained from the following formula is to be entered;

$$\Sigma W \times (\text{corrected lever}) - \Sigma Ml$$

(i) Still water shearing force (Fs)

Fs indicates the actual still water shearing force under loading condition at each point of output and is obtained from by the following formula.

$$Fs = (SS - \Sigma W) \times 1000 \times 9.80665 \ (KN)$$

(j) Longitudinal still water bending moment (Ms)

Ms indicates the actual longitudinal still water bending moment under loading condition at each point of output, and is obtained from the following formula.

$$Ms = (\Sigma M - SB) \times 1000 \times 9.80665 \ (KN\text{-}m)$$

＊＊＊ WEIGHT CALCULATION FOR LONGITUDINAL STRENGTH ＊＊＊

CONDITION : 8-1 FULL LOAD. COND.(ALT)DEP.

AFT DRAFT (DA) 10.44 (M)
BASE DRAFT (DB) 10.00 (M)
DIFFERENCE (△D) 0.44 (M) (△D = DA - DB)
TRIM 0.79 (M)

NO.	DEADWEIGHT ITEM	WEIGHT 1/1000	RATIO	LOAD (WI)	MID.G	MOMENT (MI)
1	F. P. T.	0.000	1.000	0.000	-77.52	0.000
	FR. 230	ΣWI = (0.000)			ΣMI = (0.000)	
2	COLLAPS.STANCHON	0.064	0.099	0.006	-60.85	-0.386
3	SECURING FITTINGS	0.000	0.099	0.000	-60.85	0.000
4	NO.1 CARGO HOLD	6.439	0.978	6.297	-63.47	-399.692
5	NO.1 HATCH & DECK	0.000	0.944	0.000	-62.24	0.000
6	NO.1 UPP. W. T.(P)	0.000	1.000	0.000	-61.71	0.000
7	NO.1 UPP. W. T.(S)	0.000	1.000	0.000	-61.71	0.000
8	NO.1 W. B. T. (P)	0.000	1.000	0.000	-62.88	0.000
9	NO.1 W. B. T. (S)	0.000	1.000	0.000	-62.88	0.000
	FR. 201	ΣWI = (6.304)			ΣMI = (-400.078)	
10	COLLAPS.STANCHON	0.064	0.115	0.007	-47.79	-0.352
11	SECURING FITTINGS	0.000	0.115	0.000	-47.79	0.000
12	NO.1 CARGO HOLD	6.439	0.022	0.142	-54.65	-7.742
13	NO.2 CARGO HOLD	0.000	0.498	0.000	-47.61	0.000
14	NO.1 HATCH & DECK	0.000	0.056	0.000	-54.48	0.000
15	NO.2 HATCH & DECK	0.000	0.531	0.000	-47.62	0.000
16	NO.2 UPP. W. T.(P)	0.000	0.496	0.000	-47.77	0.000
17	NO.2 UPP. W. T.(S)	0.000	0.496	0.000	-47.77	0.000
18	NO.2 W. B. T. (P)	0.000	0.483	0.000	-47.70	0.000
19	NO.2 W. B. T. (S)	0.000	0.479	0.000	-47.68	0.000
	FR. 180	ΣWI = (6.453)			ΣMI = (-408.171)	
20	COLLAPS.STANCHON	0.064	0.115	0.007	-33.72	-0.248
21	SECURING FITTINGS	0.000	0.115	0.000	-33.72	0.000
22	NO.2 CARGO HOLD	0.000	0.502	0.000	-33.87	0.000
23	NO.3 CARGO HOLD	12.122	0.012	0.145	-26.85	-3.906
24	NO.2 HATCH & DECK	0.000	0.469	0.000	-33.94	0.000
25	NO.2 UPP. W. T.(P)	0.000	0.504	0.000	-33.70	0.000
26	NO.2 UPP. W. T.(S)	0.000	0.504	0.000	-33.70	0.000
27	NO.2 W. B. T. (P)	0.000	0.517	0.000	-33.64	0.000
28	NO.2 W. B. T. (S)	0.000	0.521	0.000	-33.62	0.000
29	NO.3 CARGO HOLD(W.B)	0.000	0.012	0.000	-26.85	0.000
	FR. 159	ΣWI = (6.606)			ΣMI = (-412.325)	
30	CONSTANTS	0.175	0.070	0.012	-7.56	-0.093
31	COLLAPS.STANCHON	0.064	0.229	0.015	-12.62	-0.185
32	SECURING FITTINGS	0.000	0.229	0.000	-12.62	0.000
33	NO.3 U.W.F.O.T.(P)	0.228	1.000	0.228	-12.61	-2.875
34	NO.3 U.W.F.O.T.(S)	0.228	1.000	0.228	-12.61	-2.875
35	NO.3 CARGO HOLD	12.122	0.977	11.843	-12.61	-149.343
36	NO.3 HATCH & DECK	0.000	0.978	0.000	-12.93	0.000
37	NO.3 UPP. W. T.(P)	0.000	1.000	0.000	-12.61	0.000
38	NO.3 UPP. W. T.(S)	0.000	1.000	0.000	-12.61	0.000
39	NO.3 W. B. T. (P)	0.000	1.000	0.000	-12.61	0.000
40	NO.3 W. B. T. (S)	0.000	1.000	0.000	-12.61	0.000
41	NO.3 CARGO HOLD(W.B)	0.000	0.966	0.000	-12.76	0.000
	FR. 117	ΣWI = (18.932)			ΣMI = (-567.695)	

* * * WEIGHT CALCULATION FOR LONGITUDINAL STRENGTH * * *

CONDITION : 8-1 FULL LOAD. COND.(ALT)DEP.

AFT DRAFT (DA) 10.44 (M)
BASE DRAFT (DB) 10.00 (M)
DIFFERENCE (△D) 0.44 (M) (△D = DA - DB)
TRIM 0.79 (M)

NO.	DEADWEIGHT ITEM	WEIGHT 1/1000	RATIO	LOAD (WI)	MID.G	MOMENT (MI)
42	CONSTANTS	0.175	0.199	0.035	16.99	0.592
43	COLLAPS.STANCHON	0.064	0.227	0.015	15.52	0.225
44	SECURING FITTINGS	0.000	0.227	0.000	15.52	0.000
45	NO.4 U.W.F.O.T.(P)	0.228	1.000	0.228	15.53	3.541
46	NO.4 U.W.F.O.T.(S)	0.228	1.000	0.228	15.53	3.541
47	NO.4 F.O.T. (C)	0.275	1.000	0.275	15.53	4.271
48	NO.3 CARGO HOLD	12.122	0.012	0.145	1.63	0.237
49	NO.4 CARGO HOLD	0.000	0.988	0.000	15.73	0.000
50	NO.3 HATCH & DECK	0.000	0.022	0.000	1.79	0.000
51	NO.4 HATCH & DECK	0.000	0.982	0.000	14.78	0.000
52	NO.4 UPP. W. T.(P)	0.000	1.000	0.000	15.53	0.000
53	NO.4 UPP. W. T.(S)	0.000	1.000	0.000	15.53	0.000
54	NO.4 W. B. T. (P)	0.000	1.000	0.000	15.45	0.000
55	NO.4 W. B. T. (S)	0.000	1.000	0.000	15.45	0.000
56	NO.3 CARGO HOLD(W.B)	0.000	0.022	0.000	1.79	0.000
FR. 75		ΣWI = (19.857)			ΣMI = (-555.289)	
57	CONSTANTS	0.175	0.314	0.055	44.20	2.429
58	COLLAPS.STANCHON	0.064	0.215	0.014	42.99	0.592
59	SECURING FITTINGS	0.000	0.215	0.000	42.99	0.000
60	F. W. T. (P)	0.119	1.000	0.119	49.69	5.913
61	F. W. T. (S)	0.119	1.000	0.119	49.69	5.913
62	DRINK W. T. (S)	0.049	1.000	0.049	55.39	2.714
63	DIST. W. T. (P)	0.049	1.000	0.049	55.39	2.714
64	NO.5 F.O.T. (C)	0.234	0.982	0.230	41.75	9.594
65	NO.4 CARGO HOLD	0.000	0.012	0.000	29.77	0.000
66	NO.5 CARGO HOLD	8.389	1.000	8.389	43.22	362.573
67	NO.4 HATCH & DECK	0.000	0.018	0.000	29.93	0.000
68	NO.5 HATCH & DECK	0.000	1.000	0.000	43.17	0.000
69	NO.5 UPP. W. T.(P)	0.000	1.000	0.000	37.88	0.000
70	NO.5 UPP. W. T.(S)	0.000	1.000	0.000	37.88	0.000
71	NO.5 W. B. T. (P)	0.000	0.979	0.000	42.16	0.000
72	NO.5 W. B. T. (S)	0.000	0.979	0.000	42.16	0.000
FR. 34		ΣWI = (28.881)			ΣMI = (-162.848)	

* * * SHEARING FORCE AND BENDING MOMENT CALCULATION IN STILL WATER * * *

CONDITION : 8-1 FULL LOAD. COND.(ALT)DEP.

AFT DRAFT (DA) : 10.44 (M)
BASE DRAFT (DB) : 10.00 (M)
DIFFERENCE (△D) : 0.44 (M) (△D = DA - DB)
TRIM : 0.79 (M)

I T E M	SHEARING FORCE (FS)			BENDING MOMENT (MS)		
BASE VALUE		1	0.271		1	0.458
DRAFT CORRECTION	CD (0.058) * △D	2	0.026	CD (0.171) * △D	2	0.075
TRIM CORRECTION	CT (-0.054) * TRIM	3	-0.042	CT (-0.148) * TRIM	3	-0.117
BUOYANCY AND L.W	1 + 2 + 3	SS	0.254	1 + 2 + 3	SB	0.416
DEADWEIGHT	ΣWI	ΣW	0.000	ΣW * -73.77 - ΣMI(0.000)	ΣM	0.000
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665		2494	(ΣM - SB) * 1000 * 9.80665		-4079
ALLOWABLE (FR.230)	ALLOWABLE SHEARING FORCE	HOG.	22000	ALLOWABLE BENDING MOMENT	HOG.	170000
		SAG.	-22000		SAG.	-133000
BASE VALUE		1	3.276		1	30.061
DRAFT CORRECTION	CD (0.475) * △D	2	0.209	CD (4.829) * △D	2	2.125
TRIM CORRECTION	CT (-0.417) * TRIM	3	-0.329	CT (-4.313) * TRIM	3	-3.407
BUOYANCY AND L.W	1 + 2 + 3	SS	3.156	1 + 2 + 3	SB	28.778
DEADWEIGHT	ΣWI	ΣW	6.304	ΣW * -54.82 - ΣMI(-400.078)	ΣM	54.510
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665		-30872	(ΣM - SB) * 1000 * 9.80665		252345
ALLOWABLE (FR.201)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	471000
		SAG.	-31000		SAG.	-369000
BASE VALUE		1	6.425		1	97.673
DRAFT CORRECTION	CD (0.864) * △D	2	0.380	CD (14.245) * △D	2	6.268
TRIM CORRECTION	CT (-0.722) * TRIM	3	-0.570	CT (-12.353) * TRIM	3	-9.759
BUOYANCY AND L.W	1 + 2 + 3	SS	6.235	1 + 2 + 3	SB	94.183
DEADWEIGHT	ΣWI	ΣW	6.453	ΣW * -40.75 - ΣMI(-408.171)	ΣM	145.224
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665		-2136	(ΣM - SB) * 1000 * 9.80665		500544
ALLOWABLE (FR.180)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-31000		SAG.	-645000
BASE VALUE		1	9.685		1	211.266
DRAFT CORRECTION	CD (1.254) * △D	2	0.552	CD (29.145) * △D	2	12.824
TRIM CORRECTION	CT (-0.996) * TRIM	3	-0.787	CT (-24.476) * TRIM	3	-19.336
BUOYANCY AND L.W	1 + 2 + 3	SS	9.450	1 + 2 + 3	SB	204.753
DEADWEIGHT	ΣWI	ΣW	6.606	ΣW * -26.68 - ΣMI(-412.325)	ΣM	236.090
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665		27898	(ΣM - SB) * 1000 * 9.80665		307307
ALLOWABLE (FR.159)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-31000		SAG.	-645000
BASE VALUE		1	16.228		1	575.851
DRAFT CORRECTION	CD (2.033) * △D	2	0.895	CD (75.397) * △D	2	33.174
TRIM CORRECTION	CT (-1.446) * TRIM	3	-1.142	CT (-59.139) * TRIM	3	-46.720
BUOYANCY AND L.W	1 + 2 + 3	SS	15.980	1 + 2 + 3	SB	562.306
DEADWEIGHT	ΣWI	ΣW	18.932	ΣW * 1.46 - ΣMI(-567.695)	ΣM	595.336
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665		-28945	(ΣM - SB) * 1000 * 9.80665		323912
ALLOWABLE (FR.117)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-31000		SAG.	-645000
BASE VALUE		1	22.732		1	1124.323
DRAFT CORRECTION	CD (2.813) * △D	2	1.238	CD (143.582) * △D	2	63.176
TRIM CORRECTION	CT (-1.765) * TRIM	3	-1.394	CT (-104.625) * TRIM	3	-82.654
BUOYANCY AND L.W	1 + 2 + 3	SS	22.576	1 + 2 + 3	SB	1104.845
DEADWEIGHT	ΣWI	ΣW	19.857	ΣW * 29.60 - ΣMI(-555.289)	ΣM	1143.069
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665		26655	(ΣM - SB) * 1000 * 9.80665		374844
ALLOWABLE (FR. 75)	ALLOWABLE SHEARING FORCE	HOG.	32000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-32000		SAG.	-645000
BASE VALUE		1	28.358		1	1830.338
DRAFT CORRECTION	CD (3.570) * △D	2	1.571	CD (231.285) * △D	2	101.765
TRIM CORRECTION	CT (-1.950) * TRIM	3	-1.540	CT (-155.942) * TRIM	3	-123.194
BUOYANCY AND L.W	1 + 2 + 3	SS	28.389	1 + 2 + 3	SB	1808.909
DEADWEIGHT	ΣWI	ΣW	28.881	ΣW * 57.07 - ΣMI(-162.848)	ΣM	1811.083
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665		-4822	(ΣM - SB) * 1000 * 9.80665		21314
ALLOWABLE (FR. 34)	ALLOWABLE SHEARING FORCE	HOG.	22000	ALLOWABLE BENDING MOMENT	HOG.	415000
		SAG.	-22000		SAG.	-325000

NOTE : TRIM ... BY THE STERN (+), BY THE HEAD (-) BENDING MOMENT ... HOGGING (+), SAGGING (-)

CORRECTION OF SHEARING FORCE IN ALTERNATE LOADING

CONDITION :

DRAFT FORE (MLD.) 0.92 m TRIM 3.07 m (θ = 1.0751°)
DRAFT AFT (MLD.) 3.99 m

No	BHD (FR.NO.)		FR. 34	FR. 75	FR.117	FR.159	FR.201
①	S.F. IN STILL WATER	(KN)	-4822	26655	-28945	27898	-30872
②	NO. OF HOLD		NO.5 CARGO HOLD	NO.4 CARGO HOLD	NO.3 CARGO HOLD	NO.2 CARGO HOLD	
③	HOLD LENGTH (LH)	(m)	27.14	28.14	28.81	27.47	
④	HOLD BREADTH (BH)	(m)	22.20	26.97	26.97	26.70	
⑤	CARGO WEIGHT (M)	(t)	0	0	0	0	
⑥	COEFFICIENT (α)		615.98	862.48	856.21	865.49	
⑦	DIST. FROM A.P.	(m)	38.47	66.27	94.41	122.55	
⑧	HEIGHT (DRAFT - B.L.)(TLc)	(m)	3.29	2.77	2.24	1.71	
⑨	CORRECTION	(KN)	2076	2446	1965	1518	
⑩	CORRECTED S.F. (AFT/FORE)	(KN)	-2746	24579	24209	-26499	-26980	25933	26380	-29354
⑪	CORRECTED S.F.	(KN)	-4822	26655	-28945	27898	-30872
⑫	ALLOWABLE S.F. (KN)	HOG.	22000	32000	31000	31000	31000
		SAG.	-22000	-32000	-31000	-31000	-31000

No	BHD (FR.NO.)		FR.201	FR.230
①	S.F. IN STILL WATER	(KN)	-30872	2494
②	NO. OF HOLD		NO.1 CARGO HOLD	
③	HOLD LENGTH (LH)	(m)	19.29	
④	HOLD BREADTH (BH)	(m)	17.82	
⑤	CARGO WEIGHT (M)	(t)	0	
⑥	COEFFICIENT (α)		397.07	
⑦	DIST. FROM A.P.	(m)	146.10	
⑧	HEIGHT (DRAFT - B.L.)(TLc)	(m)	1.27	
⑨	CORRECTION	(KN)	516	
⑩	CORRECTED S.F. (AFT/FORE)	(KN)	-30356	1978
⑪	CORRECTED S.F.	(KN)	-30872	2494
⑫	ALLOWABLE S.F. (KN)	HOG.	31000	31000
		SAG.	-31000	-31000

⑧ = (⑦ / L.P.P. x TRIM + DRAFT AFT(MLD)) / Cos θ , CORRECTION = ⑥ x {⑤ / (③ x ④) - ⑧ * 1.025}

* * *　LONGITUDINAL STRENGTH DATA　* * *

(EACH VALUE SHOWS ACTUAL VALUE/1000)

		SHEARING FORCE (T)			BENDING MOMENT (T - M)		
DRAFT (m)	BHD.NO. (FR.)	BASE VALUE (S.F.)	DRAFT CORRECT (CD)	TRIM CORRECT (CT)	BASE VALUE (B.M.)	DRAFT CORRECT (CD)	TRIM CORRECT (CT)
	230.00	-0.233	0.068	-0.056	-1.571	0.244	-0.159
	201.00	-0.012	0.440	-0.375	-5.038	4.631	-3.958
	180.00	0.440	0.820	-0.674	-2.547	13.459	-11.390
3.00	159.00	0.970	1.210	-0.951	7.619	27.740	-22.899
	117.00	2.053	1.990	-1.402	50.156	72.759	-56.347
	75.00	3.101	2.769	-1.718	122.963	139.730	-100.525
	34.00	3.705	3.427	-1.875	218.318	225.509	-150.190
	230.00	-0.199	0.074	-0.063	-1.449	0.279	-0.181
	201.00	0.207	0.454	-0.390	-2.723	4.861	-4.216
	180.00	0.849	0.835	-0.691	4.183	13.899	-11.890
3.50	159.00	1.575	1.225	-0.968	21.489	28.392	-23.644
	117.00	3.049	2.004	-1.419	86.535	73.824	-57.569
	75.00	4.485	2.784	-1.735	192.828	141.194	-102.215
	34.00	5.419	3.455	-1.895	331.072	227.513	-152.386
	230.00	-0.162	0.078	-0.069	-1.309	0.312	-0.246
	201.00	0.434	0.463	-0.403	-0.293	5.030	-4.409
	180.00	1.267	0.846	-0.705	11.133	14.219	-12.218
4.00	159.00	2.187	1.237	-0.981	35.685	28.874	-24.119
	117.00	4.051	2.017	-1.432	123.447	74.650	-58.378
	75.00	5.877	2.797	-1.749	263.424	142.377	-103.438
	34.00	7.146	3.478	-1.912	444.828	229.144	-154.116
	230.00	-0.123	0.082	-0.074	-1.154	0.329	-0.267
	201.00	0.666	0.472	-0.413	2.223	5.168	-4.579
	180.00	1.690	0.856	-0.716	18.242	14.485	-12.539
4.50	159.00	2.806	1.246	-0.992	50.122	29.269	-24.592
	117.00	5.059	2.026	-1.442	160.772	75.298	-59.152
	75.00	7.275	2.806	-1.760	334.613	143.280	-104.519
	34.00	8.885	3.500	-1.926	559.400	230.426	-155.537
	230.00	-0.082	0.083	-0.078	-0.989	0.361	-0.287
	201.00	0.902	0.478	-0.421	4.807	5.273	-4.715
	180.00	2.118	0.863	-0.725	25.485	14.685	-12.793
5.00	159.00	3.429	1.254	-1.000	64.757	29.575	-24.964
	117.00	6.072	2.034	-1.451	198.421	75.830	-59.757
	75.00	8.678	2.814	-1.768	406.253	144.040	-105.362
	34.00	10.635	3.515	-1.938	674.613	231.442	-156.651
	230.00	-0.041	0.084	-0.080	-0.808	0.351	-0.296
	201.00	1.141	0.480	-0.427	7.443	5.287	-4.805
	180.00	2.550	0.864	-0.731	32.827	14.720	-12.970
5.50	159.00	4.055	1.254	-1.006	79.544	29.616	-25.227
	117.00	7.089	2.033	-1.457	236.336	75.855	-60.196
	75.00	10.085	2.814	-1.775	478.273	144.048	-105.988
	34.00	12.393	3.527	-1.947	790.334	231.559	-157.493
	230.00	0.001	0.083	-0.081	-0.633	0.384	-0.299
	201.00	1.381	0.482	-0.430	10.087	5.341	-4.847
	180.00	2.982	0.868	-0.734	40.187	14.828	-13.051
6.00	159.00	4.682	1.258	-1.008	94.352	29.790	-25.341
	117.00	8.106	2.038	-1.459	274.263	76.169	-60.359
	75.00	11.492	2.817	-1.777	550.297	144.484	-106.198
	34.00	14.156	3.536	-1.952	906.114	232.102	-157.787

＊＊＊ LONGITUDINAL STRENGTH DATA ＊＊＊

(EACH VALUE SHOWS ACTUAL VALUE/1000)

		SHEARING FORCE (T)			BENDING MOMENT (T - M)		
DRAFT (m)	BHD.NO. (FR.)	BASE VALUE (S.F.)	DRAFT CORRECT (CD)	TRIM CORRECT (CT)	BASE VALUE (B.M.)	DRAFT CORRECT (CD)	TRIM CORRECT (CT)
	230.00	0.043	0.080	-0.081	-0.441	0.338	-0.300
	201.00	1.622	0.480	-0.432	12.757	5.239	-4.865
	180.00	3.416	0.866	-0.736	47.602	14.693	-13.099
6.50	159.00	5.311	1.256	-1.011	109.247	29.620	-25.420
	117.00	9.124	2.036	-1.461	312.348	75.935	-60.504
	75.00	12.901	2.818	-1.780	622.539	144.235	-106.423
	34.00	15.924	3.548	-1.958	1022.165	231.983	-158.124
	230.00	0.083	0.075	-0.079	-0.272	0.278	-0.290
	201.00	1.862	0.477	-0.431	15.377	5.094	-4.826
	180.00	3.849	0.863	-0.735	54.948	14.502	-13.052
7.00	159.00	5.939	1.253	-1.010	124.057	29.383	-25.362
	117.00	10.143	2.034	-1.460	350.315	75.620	-60.419
	75.00	14.310	2.817	-1.780	694.657	143.861	-106.319
	34.00	17.698	3.555	-1.960	1138.157	231.627	-158.032
	230.00	0.121	0.068	-0.075	-0.133	0.344	-0.248
	201.00	2.101	0.472	-0.428	17.924	5.058	-4.716
	180.00	4.280	0.858	-0.733	62.199	14.404	-12.902
7.50	159.00	6.566	1.248	-1.007	138.749	29.219	-25.171
	117.00	11.160	2.028	-1.457	388.125	75.298	-60.144
	75.00	15.718	2.810	-1.778	766.588	143.362	-105.969
	34.00	19.476	3.554	-1.960	1253.970	230.956	-157.643
	230.00	0.155	0.063	-0.069	0.039	0.277	-0.238
	201.00	2.337	0.472	-0.423	20.453	4.938	-4.602
	180.00	4.709	0.860	-0.727	69.401	14.300	-12.715
8.00	159.00	7.189	1.250	-1.001	153.358	29.150	-24.903
	117.00	12.173	2.030	-1.451	425.774	75.308	-59.702
	75.00	17.123	2.807	-1.772	838.269	143.369	-105.360
	34.00	21.253	3.548	-1.957	1369.448	230.809	-156.905
	230.00	0.186	0.057	-0.063	0.178	0.210	-0.211
	201.00	2.572	0.469	-0.420	22.922	4.790	-4.486
	180.00	5.139	0.857	-0.724	76.551	14.115	-12.555
8.50	159.00	7.815	1.248	-0.998	167.934	28.929	-24.701
	117.00	13.188	2.026	-1.447	463.428	74.993	-59.403
	75.00	18.526	2.800	-1.766	909.953	142.902	-104.923
	34.00	23.027	3.543	-1.949	1484.852	230.134	-156.267
	230.00	0.215	0.057	-0.057	0.283	0.183	-0.174
	201.00	2.807	0.470	-0.416	25.317	4.762	-4.364
	180.00	5.568	0.859	-0.721	83.608	14.101	-12.389
9.00	159.00	8.438	1.249	-0.995	182.398	28.933	-24.494
	117.00	14.201	2.029	-1.444	500.925	75.062	-59.110
	75.00	19.927	2.806	-1.762	981.404	143.101	-104.521
	34.00	24.798	3.556	-1.944	1599.919	230.570	-155.723
	230.00	0.243	0.056	-0.054	0.375	0.167	-0.153
	201.00	3.041	0.468	-0.416	27.698	4.725	-4.320
	180.00	5.997	0.855	-0.722	90.659	14.028	-12.362
9.50	159.00	9.063	1.245	-0.997	196.864	28.802	-24.497
	117.00	15.216	2.024	-1.447	538.456	74.791	-59.195
	75.00	21.330	2.805	-1.765	1052.954	142.737	-104.700
	34.00	26.576	3.564	-1.947	1715.204	230.268	-155.980

* * *　LONGITUDINAL STRENGTH DATA　* * *

(EACH VALUE SHOWS ACTUAL VALUE/1000)

		SHEARING FORCE (T)			BENDING MOMENT (T - M)		
DRAFT (m)	BHD.NO. (FR.)	BASE VALUE (S.F.)	DRAFT CORRECT (CD)	TRIM CORRECT (CT)	BASE VALUE (B.M.)	DRAFT CORRECT (CD)	TRIM CORRECT (CT)
	230.00	0.271	0.058	-0.054	0.458	0.171	-0.148
	201.00	3.276	0.475	-0.417	30.061	4.829	-4.313
	180.00	6.425	0.864	-0.722	97.673	14.245	-12.353
10.00	159.00	9.685	1.254	-0.996	211.266	29.145	-24.476
	117.00	16.228	2.033	-1.446	575.851	75.397	-59.139
	75.00	22.732	2.813	-1.765	1124.323	143.582	-104.625
	34.00	28.358	3.570	-1.950	1830.338	231.285	-155.942
	230.00	0.300	0.060	-0.055	0.543	0.172	-0.151
	201.00	3.513	0.480	-0.422	32.475	4.906	-4.383
	180.00	6.857	0.869	-0.729	104.796	14.395	-12.508
10.50	159.00	10.312	1.259	-1.003	225.838	29.364	-24.728
	117.00	17.244	2.038	-1.453	613.550	75.753	-59.597
	75.00	24.139	2.818	-1.771	1196.114	144.082	-105.266
	34.00	30.144	3.579	-1.953	1945.981	231.951	-156.702
	230.00	0.330	0.065	-0.057	0.630	0.193	-0.157
	201.00	3.753	0.490	-0.427	34.928	5.073	-4.464
	180.00	7.292	0.879	-0.734	111.993	14.697	-12.662
11.00	159.00	10.942	1.268	-1.008	240.520	29.803	-24.954
	117.00	18.263	2.048	-1.458	651.427	76.464	-59.965
	75.00	25.548	2.827	-1.776	1268.155	145.058	-105.779
	34.00	31.933	3.588	-1.958	2061.956	233.174	-157.361

＊＊＊ WEIGHT CALCULATION FOR LONGITUDINAL STRENGTH ＊＊＊

CONDITION :

AFT DRAFT (DA) (M)
BASE DRAFT (DB) (M)
DIFFERENCE (△D) (M) (△D = DA - DB)
TRIM (M)

NO.	DEADWEIGHT ITEM	WEIGHT 1/1000	RATIO	LOAD (WI)	MID.G	MOMENT (MI)
1	F. P. T.		1.000		-77.52	
	FR. 230		ΣWI = ( )		ΣMI = ( )	
2	COLLAPS.STANCHON		0.099		-60.85	
3	SECURING FITTINGS		0.099		-60.85	
4	NO.1 CARGO HOLD		0.978		-63.47	
5	NO.1 HATCH & DECK		0.944		-62.24	
6	NO.1 UPP. W. T.(P)		1.000		-61.71	
7	NO.1 UPP. W. T.(S)		1.000		-61.71	
8	NO.1 W. B. T. (P)		1.000		-62.88	
9	NO.1 W. B. T. (S)		1.000		-62.88	
	FR. 201		ΣWI = ( )		ΣMI = ( )	
10	COLLAPS.STANCHON		0.115		-47.79	
11	SECURING FITTINGS		0.115		-47.79	
12	NO.1 CARGO HOLD		0.022		-54.65	
13	NO.2 CARGO HOLD		0.498		-47.61	
14	NO.1 HATCH & DECK		0.056		-54.48	
15	NO.2 HATCH & DECK		0.531		-47.62	
16	NO.2 UPP. W. T.(P)		0.496		-47.77	
17	NO.2 UPP. W. T.(S)		0.496		-47.77	
18	NO.2 W. B. T. (P)		0.483		-47.70	
19	NO.2 W. B. T. (S)		0.479		-47.68	
	FR. 180		ΣWI = ( )		ΣMI = ( )	
20	COLLAPS.STANCHON		0.115		-33.72	
21	SECURING FITTINGS		0.115		-33.72	
22	NO.2 CARGO HOLD		0.502		-33.87	
23	NO.3 CARGO HOLD		0.012		-26.85	
24	NO.2 HATCH & DECK		0.469		-33.94	
25	NO.2 UPP. W. T.(P)		0.504		-33.70	
26	NO.2 UPP. W. T.(S)		0.504		-33.70	
27	NO.2 W. B. T. (P)		0.517		-33.64	
28	NO.2 W. B. T. (S)		0.521		-33.62	
29	NO.3 CARGO HOLD(W.B)		0.012		-26.85	
	FR. 159		ΣWI = ( )		ΣMI = ( )	
30	CONSTANTS		0.070		-7.56	
31	COLLAPS.STANCHON		0.229		-12.62	
32	SECURING FITTINGS		0.229		-12.62	
33	NO.3 U.W.F.O.T.(P)		1.000		-12.61	
34	NO.3 U.W.F.O.T.(S)		1.000		-12.61	
35	NO.3 CARGO HOLD		0.977		-12.61	
36	NO.3 HATCH & DECK		0.978		-12.93	
37	NO.3 UPP. W. T.(P)		1.000		-12.61	
38	NO.3 UPP. W. T.(S)		1.000		-12.61	
39	NO.3 W. B. T. (P)		1.000		-12.61	
40	NO.3 W. B. T. (S)		1.000		-12.61	
41	NO.3 CARGO HOLD(W.B)		0.966		-12.76	
	FR. 117		ΣWI = ( )		ΣMI = ( )	

＊＊＊ WEIGHT CALCULATION FOR LONGITUDINAL STRENGTH ＊＊＊

CONDITION :

AFT DRAFT (DA) (M)
BASE DRAFT (DB) (M)
DIFFERENCE (△D) (M) (△D = DA - DB)
TRIM (M)

NO.	DEADWEIGHT ITEM	WEIGHT 1/1000	RATIO	LOAD (WI)	MID.G	MOMENT (MI)
42	CONSTANTS		0.199		16.99	
43	COLLAPS.STANCHON		0.227		15.52	
44	SECURING FITTINGS		0.227		15.52	
45	NO.4 U.W.F.O.T.(P)		1.000		15.53	
46	NO.4 U.W.F.O.T.(S)		1.000		15.53	
47	NO.4 F.O.T. (C)		1.000		15.53	
48	NO.3 CARGO HOLD		0.012		1.63	
49	NO.4 CARGO HOLD		0.988		15.73	
50	NO.3 HATCH & DECK		0.022		1.79	
51	NO.4 HATCH & DECK		0.982		14.78	
52	NO.4 UPP. W. T.(P)		1.000		15.53	
53	NO.4 UPP. W. T.(S)		1.000		15.53	
54	NO.4 W. B. T. (P)		1.000		15.45	
55	NO.4 W. B. T. (S)		1.000		15.45	
56	NO.3 CARGO HOLD(W.B)		0.022		1.79	
FR. 75		ΣWI = ( )			ΣMI = ( )	
57	CONSTANTS		0.314		44.20	
58	COLLAPS.STANCHON		0.215		42.99	
59	SECURING FITTINGS		0.215		42.99	
60	F. W. T. (P)		1.000		49.69	
61	F. W. T. (S)		1.000		49.69	
62	DRINK W. T. (S)		1.000		55.39	
63	DIST. W. T. (P)		1.000		55.39	
64	NO.5 F.O.T. (C)		0.982		41.75	
65	NO.4 CARGO HOLD		0.012		29.77	
66	NO.5 CARGO HOLD		1.000		43.22	
67	NO.4 HATCH & DECK		0.018		29.93	
68	NO.5 HATCH & DECK		1.000		43.17	
69	NO.5 UPP. W. T.(P)		1.000		37.88	
70	NO.5 UPP. W. T.(S)		1.000		37.88	
71	NO.5 W. B. T. (P)		0.979		42.16	
72	NO.5 W. B. T. (S)		0.979		42.16	
FR. 34		ΣWI = ( )			ΣMI = ( )	

* * * SHEARING FORCE AND BENDING MOMENT CALCULATION IN STILL WATER * * *

CONDITION :

AFT DRAFT (DA) : (M)
BASE DRAFT (DB) : (M)
DIFFERENCE (△D) : (M) (△D = DA - DB)
TRIM : (M)

I T E M	SHEARING FORCE (FS)			BENDING MOMENT (MS)		
BASE VALUE		1			1	
DRAFT CORRECTION	CD ( ) * △D	2		CD ( ) * △D	2	
TRIM CORRECTION	CT ( ) * TRIM	3		CT ( ) * TRIM	3	
BUOYANCY AND L.W	1 + 2 + 3	SS		1 + 2 + 3	SB	
DEADWEIGHT	ΣWI	ΣW		ΣW * -73.77 - ΣMI( )	ΣM	
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665			(ΣM - SB) * 1000 * 9.80665		
ALLOWABLE (FR.230)	ALLOWABLE SHEARING FORCE	HOG.	22000	ALLOWABLE BENDING MOMENT	HOG.	170000
		SAG.	-22000		SAG.	-133000
BASE VALUE		1			1	
DRAFT CORRECTION	CD ( ) * △D	2		CD ( ) * △D	2	
TRIM CORRECTION	CT ( ) * TRIM	3		CT ( ) * TRIM	3	
BUOYANCY AND L.W	1 + 2 + 3	SS		1 + 2 + 3	SB	
DEADWEIGHT	ΣWI	ΣW		ΣW * -54.82 - ΣMI( )	ΣM	
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665			(ΣM - SB) * 1000 * 9.80665		
ALLOWABLE (FR.201)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	471000
		SAG.	-31000		SAG.	-369000
BASE VALUE		1			1	
DRAFT CORRECTION	CD ( ) * △D	2		CD ( ) * △D	2	
TRIM CORRECTION	CT ( ) * TRIM	3		CT ( ) * TRIM	3	
BUOYANCY AND L.W	1 + 2 + 3	SS		1 + 2 + 3	SB	
DEADWEIGHT	ΣWI	ΣW		ΣW * -40.75 - ΣMI( )	ΣM	
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665			(ΣM - SB) * 1000 * 9.80665		
ALLOWABLE (FR.180)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-31000		SAG.	-645000
BASE VALUE		1			1	
DRAFT CORRECTION	CD ( ) * △D	2		CD ( ) * △D	2	
TRIM CORRECTION	CT ( ) * TRIM	3		CT ( ) * TRIM	3	
BUOYANCY AND L.W	1 + 2 + 3	SS		1 + 2 + 3	SB	
DEADWEIGHT	ΣWI	ΣW		ΣW * -26.68 - ΣMI( )	ΣM	
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665			(ΣM - SB) * 1000 * 9.80665		
ALLOWABLE (FR.159)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-31000		SAG.	-645000
BASE VALUE		1			1	
DRAFT CORRECTION	CD ( ) * △D	2		CD ( ) * △D	2	
TRIM CORRECTION	CT ( ) * TRIM	3		CT ( ) * TRIM	3	
BUOYANCY AND L.W	1 + 2 + 3	SS		1 + 2 + 3	SB	
DEADWEIGHT	ΣWI	ΣW		ΣW * 1.46 - ΣMI( )	ΣM	
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665			(ΣM - SB) * 1000 * 9.80665		
ALLOWABLE (FR.117)	ALLOWABLE SHEARING FORCE	HOG.	31000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-31000		SAG.	-645000
BASE VALUE		1			1	
DRAFT CORRECTION	CD ( ) * △D	2		CD ( ) * △D	2	
TRIM CORRECTION	CT ( ) * TRIM	3		CT ( ) * TRIM	3	
BUOYANCY AND L.W	1 + 2 + 3	SS		1 + 2 + 3	SB	
DEADWEIGHT	ΣWI	ΣW		ΣW * 29.60 - ΣMI( )	ΣM	
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665			(ΣM - SB) * 1000 * 9.80665		
ALLOWABLE (FR. 75)	ALLOWABLE SHEARING FORCE	HOG.	32000	ALLOWABLE BENDING MOMENT	HOG.	823000
		SAG.	-32000		SAG.	-645000
BASE VALUE		1			1	
DRAFT CORRECTION	CD ( ) * △D	2		CD ( ) * △D	2	
TRIM CORRECTION	CT ( ) * TRIM	3		CT ( ) * TRIM	3	
BUOYANCY AND L.W	1 + 2 + 3	SS		1 + 2 + 3	SB	
DEADWEIGHT	ΣWI	ΣW		ΣW * 57.07 - ΣMI( )	ΣM	
CALCULATED VALUE	(SS - ΣW) * 1000 * 9.80665			(ΣM - SB) * 1000 * 9.80665		
ALLOWABLE (FR. 34)	ALLOWABLE SHEARING FORCE	HOG.	22000	ALLOWABLE BENDING MOMENT	HOG.	415000
		SAG.	-22000		SAG.	-325000

NOTE : TRIM ... BY THE STERN (+), BY THE HEAD (-) BENDING MOMENT ... HOGGING (+), SAGGING (-)

CORRECTION OF SHEARING FORCE IN ALTERNATE LOADING

CONDITION :

DRAFT FORE (MLD.) m TRIM m (θ = °)
DRAFT AFT (MLD.) m

No	BHD (FR.NO.)		FR. 34	FR. 75	FR. 117	FR. 159	FR. 201
①	S.F. IN STILL WATER	(KN)					
②	NO. OF HOLD		NO.5 CARGO HOLD	NO.4 CARGO HOLD	NO.3 CARGO HOLD	NO.2 CARGO HOLD	
③	HOLD LENGTH (LH)	(m)	27.14	28.14	28.81	27.47	
④	HOLD BREADTH (BH)	(m)	22.20	26.97	26.97	26.70	
⑤	CARGO WEIGHT (M)	(t)					
⑥	COEFFICIENT (α)		615.98	862.48	856.21	865.49	
⑦	DIST. FROM A.P.	(m)					
⑧	HEIGHT (DRAFT - B.L.)(TLc)	(m)					
⑨	CORRECTION	(KN)					
⑩	CORRECTED S.F. (AFT/FORE)	(KN)					
⑪	CORRECTED S.F.	(KN)					
⑫	ALLOWABLE S.F. (KN)	HOG.	22000	32000	31000	31000	31000
		SAG.	-22000	-32000	-31000	-31000	-31000

No	BHD (FR.NO.)		FR. 201	FR. 230
①	S.F. IN STILL WATER	(KN)		
②	NO. OF HOLD		NO.1 CARGO HOLD	
③	HOLD LENGTH (LH)	(m)	19.29	
④	HOLD BREADTH (BH)	(m)	17.82	
⑤	CARGO WEIGHT (M)	(t)		
⑥	COEFFICIENT (α)		397.07	
⑦	DIST. FROM A.P.	(m)		
⑧	HEIGHT (DRAFT - B.L.)(TLc)	(m)		
⑨	CORRECTION	(KN)		
⑩	CORRECTED S.F. (AFT/FORE)	(KN)		
⑪	CORRECTED S.F.	(KN)		
⑫	ALLOWABLE S.F. (KN)	HOG.	31000	31000
		SAG.	-31000	-31000

⑧ = (⑦ / L.P.P. x TRIM + DRAFT AFT(MLD)) / Cos θ , CORRECTION = ⑥ x {⑤ / (③ x ④) - ⑧ * 1.025}

Ⅱ－4 CARGO MASS CHART

The weights of each hold and adjacent two hold should be kept between then maximum allowable and minimum required mass as named "MASS CHART".

The judges of the mass of each holds are shown below.

1. Get the aft draft (dA) and the trim (Trim).

2. The mean draft (Draft) may be calculated the following formula.

   Draft = dA + Trim × Dst / Length P.P.
   where;
   Dst : Distance from A.P. to center of holds (shown as "Table1")
   Length P.P. = 163.60 m

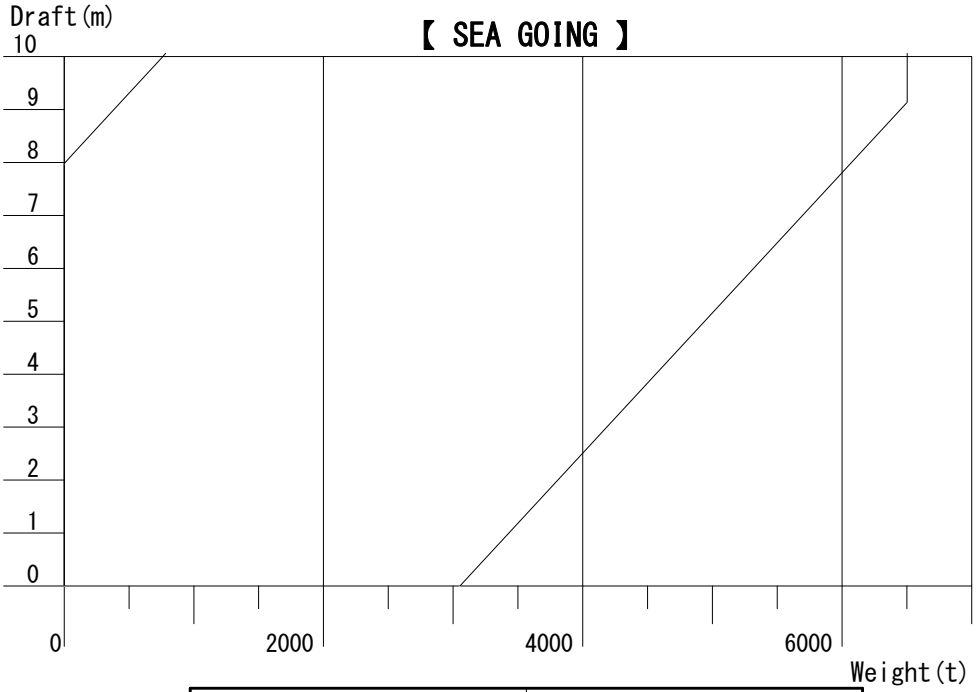
3. Put into Draft and Weight in the each mass chart, so the plotting point should be more than the minimum and less than the maximum for all the chart.

Table 1

HOLD	Dst (m)
NO.1 CARGO HOLD	145.93
NO.2 CARGO HOLD	122.72
NO.3 CARGO HOLD	94.43
NO.4 CARGO HOLD	65.77
NO.5 CARGO HOLD	38.30
NO.1 & NO.2 CARGO HOLD	132.36
NO.2 & NO.3 CARGO HOLD	108.18
NO.3 & NO.4 CARGO HOLD	80.28
NO.4 & NO.5 CARGO HOLD	52.25

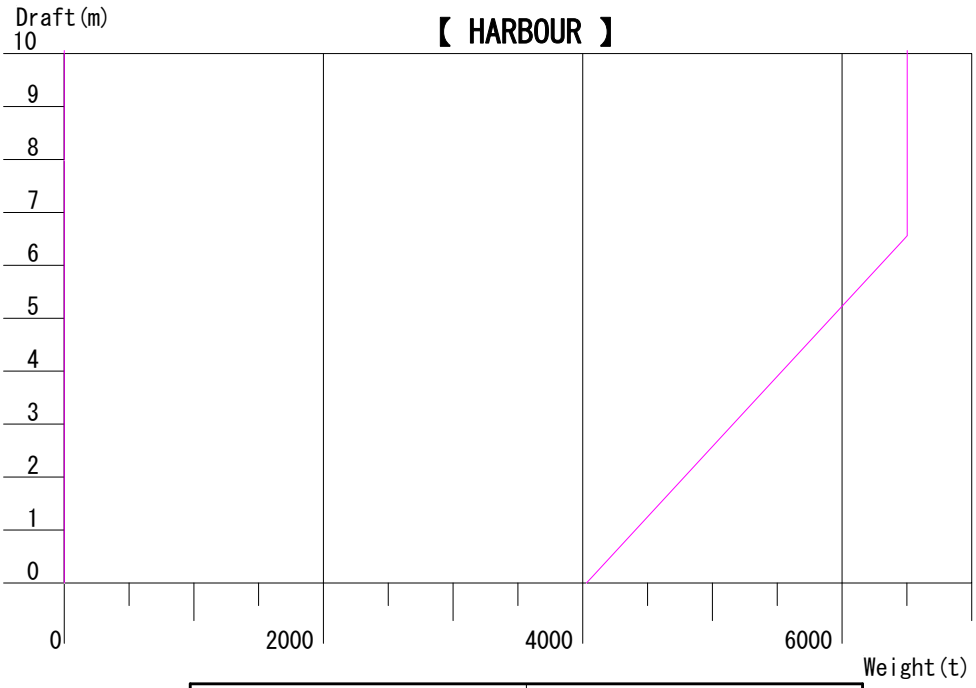
MASS CHART
No.1 HOLD

【 SEA GOING 】



	MINIMUM		MAXIMUM	
NO	DRAFT (m)	WEIGHT (t)	DRAFT (m)	WEIGHT (t)
1	0.00	0	0.00	3053
2	7.98	0	9.14	6503
3	10.06	783	10.06	6503

【 HARBOUR 】



	MINIMUM		MAXIMUM	
NO	DRAFT (m)	WEIGHT (t)	DRAFT (m)	WEIGHT (t)
1	0.00	0	0.00	4029
2	7.98	0	6.56	6503
3	10.06	0	10.06	6503

Ⅲ. STANDARD LOADING CONDITIONS

Ⅲ-2 SUMMARY, TRIM, STABILITY, STRENGTH AND HOLDMASS FOR STANDARD LOADING CONDITIONS

2.1 BALLAST CONDITION

＊＊＊　SUMMARY　TABLE　＊＊＊

CONDITION NO.		1	2	3-1	3-2	3-3	
CONDITION		LIGHT CONDITION	DOCKING CONDITION	BALLAST CONDITION			
ITEM				DEP.	50% BUNK.	ARR.	
LIGHT WEIGHT (t)		7785	7785	7785	7785	7785	
CONSTANTS (t)		0	239	239	239	239	
PROVISIONS (t)		0	6	6	6	6	
FRESH WATER TOTAL (t)		0	34	336	168	34	
FUEL OIL TOTAL (t)		0	129	1421	703	129	
DIESEL OIL (t)		0	6	118	56	6	
CARGO TOTAL (t)		0	0	0	0	0	
LUMBER TOTAL (t)		0	0	0	0	0	
WATER BALLAST TOTAL (t)		0	1242	9613	9613	9198	
DEADWEIGHT (t)		0	1656	11733	10785	9612	
DISPLACEMENT (t)		7785	9441	19518	18570	17397	
DRAFT (m)	EQUIVALENT	2.37	2.84	5.60	5.35	5.03	
	FORE	0.94	2.39	4.38	4.34	3.95	
	AFT	4.01	3.35	6.97	6.50	6.26	
	MEAN	2.48	2.87	5.68	5.42	5.11	
TRIM (m)		3.07	0.96	2.59	2.16	2.31	
MID.F (m)		-5.36	-5.42	-4.94	-5.11	-5.27	
MID.B (m)		-5.27	-5.28	-5.32	-5.33	-5.34	
MID.G (m)		7.22	-2.00	-0.60	-1.22	-0.70	
M.T.C. (t-m)		316.4	324.2	356.2	352.7	348.8	
T.P.C. (t)		35.0	35.4	37.0	36.9	36.7	
I/D (%)		14.17	3.17	63.50	55.67	51.67	
T.KM (m)		24.46	21.02	13.07	13.39	13.87	
K G (m)		9.73	9.59	7.52	7.26	7.22	
G M (m)		14.73	11.43	5.55	6.13	6.65	
GGo (m)		0.00	0.07	0.16	0.16	0.12	
GoM (m)		14.73	11.36	5.39	5.97	6.53	
GoM (REQUIRED) (m)		13.65	10.92	3.69	3.94	4.24	
JUDGEMENT		Good	Good	Good	Good	Good	
STABILITY	AREA 0-30 (m-rad)	1.404	1.204	0.794	0.865	0.926	
	AREA 30-θu (m-rad)	0.556	0.528	0.586	0.624	0.647	
	AREA 0-θu (m-rad)	1.960	1.732	1.380	1.489	1.573	
	MAX GoZ (m)	3.62	3.27	3.57	3.81	3.94	
	MAX GoZ ANGLE (deg)	23.1	25.3	41.8	42.6	43.1	
	FLOOD. ANGLE (deg)	90.0	90.0	90.0	90.0	90.0	
	θo (deg)	0.6	0.7	0.6	0.5	0.5	
	AREA a (m-rad)	1.252	1.020	0.506	0.579	0.668	
	AREA b (m-rad)	2.183	2.003	1.926	2.074	2.175	
	C = b / a -	1.744	1.964	3.807	3.580	3.258	
SHEARING FORCE (KN)	MAX	13406	14967	16202	16559	16595	
	ALLOW.	22000	22340	22000	22000	22000	
BENDING MOMENT (KN-m)	MAX	496310	714701	697106	734770	692156	
	ALLOW.	823000	823000	823000	823000	823000	

(-)MARK is FORE, (+)MARK is AFT.　　< > shows S.F. after BHD Correction.

(-)MARK is SAGGING, (+)MARK is HOGGING.

＊＊＊　SUMMARY　TABLE　＊＊＊

CONDITION NO.		4-1	4-2	4-3	5-1	5-2	
CONDITION		HEAVY BALLAST COND.			HEAVY BALLAST COND. (FULL BALLAST)		
ITEM		DEP.	50% BUNK.	ARR.	DEP.	ARR.	
LIGHT WEIGHT (t)		7785	7785	7785	7785	7785	
CONSTANTS (t)		239	239	239	239	239	
PROVISIONS (t)		6	6	6	6	6	
FRESH WATER TOTAL (t)		336	168	34	336	34	
FUEL OIL TOTAL (t)		1421	703	129	1421	129	
DIESEL OIL (t)		118	56	6	118	6	
CARGO TOTAL (t)		0	0	0	0	0	
LUMBER TOTAL (t)		0	0	0	0	0	
WATER BALLAST TOTAL (t)		14888	14888	14888	19059	19059	
DEADWEIGHT (t)		17008	16060	15302	21179	19473	
DISPLACEMENT (t)		24793	23845	23087	28964	27258	
DRAFT (m)	EQUIVALENT	7.00	6.75	6.56	8.08	7.64	
	FORE	6.33	6.24	6.36	8.04	8.04	
	AFT	7.73	7.30	6.77	8.12	7.23	
	MEAN	7.03	6.77	6.57	8.08	7.64	
TRIM (m)		1.40	1.06	0.41	0.08	-0.81	
MID.F (m)		-3.12	-3.56	-3.88	-1.07	-1.94	
MID.B (m)		-5.05	-5.12	-5.17	-4.62	-4.82	
MID.G (m)		-2.88	-3.45	-4.51	-4.51	-6.00	
M.T.C. (t-m)		383.3	377.4	373.0	407.8	397.8	
T.P.C. (t)		38.1	37.8	37.7	39.0	38.6	
I/D (%)		76.17	69.00	60.17	82.67	67.83	
T.KM (m)		11.93	12.06	12.19	11.52	11.65	
K G (m)		8.84	8.70	8.79	7.75	7.63	
G M (m)		3.09	3.36	3.40	3.77	4.02	
GGo (m)		0.07	0.06	0.03	0.06	0.02	
GoM (m)		3.02	3.30	3.37	3.71	4.00	
GoM (REQUIRED) (m)		2.38	2.63	2.83	1.40	1.79	
JUDGEMENT		Good	Good	Good	Good	Good	
S T A B I L I T Y	AREA 0-30 (m-rad)	0.488	0.528	0.537	0.566	0.613	
	AREA 30-θu (m-rad)	0.392	0.421	0.425	0.438	0.481	
	AREA 0-θu (m-rad)	0.880	0.948	0.961	1.005	1.094	
	MAX GoZ (m)	2.33	2.52	2.54	2.66	2.92	
	MAX GoZ ANGLE (deg)	39.7	40.0	40.0	43.1	43.0	
	FLOOD. ANGLE (deg)	87.0	88.8	89.9	79.7	82.7	
	θo (deg)	0.7	0.7	0.7	0.5	0.5	
	AREA a (m-rad)	0.215	0.250	0.265	0.255	0.269	
	AREA b (m-rad)	1.219	1.316	1.330	1.427	1.557	
	C = b / a -	5.678	5.269	5.019	5.589	5.780	
SHEARING FORCE (KN)	MAX	< -27253>	< -26110>	< -27447>	< -30673>	< -30955>	
	ALLOW.	-31040	-31040	-31040	-31040	-31040	
BENDING MOMENT (KN-m)	MAX	441833	456137	477649	-595172	-536029	
	ALLOW.	769768	782395	823000	-645000	-645000	

(-)MARK is FORE, (+)MARK is AFT.　　< > shows S.F. after BHD Correction.

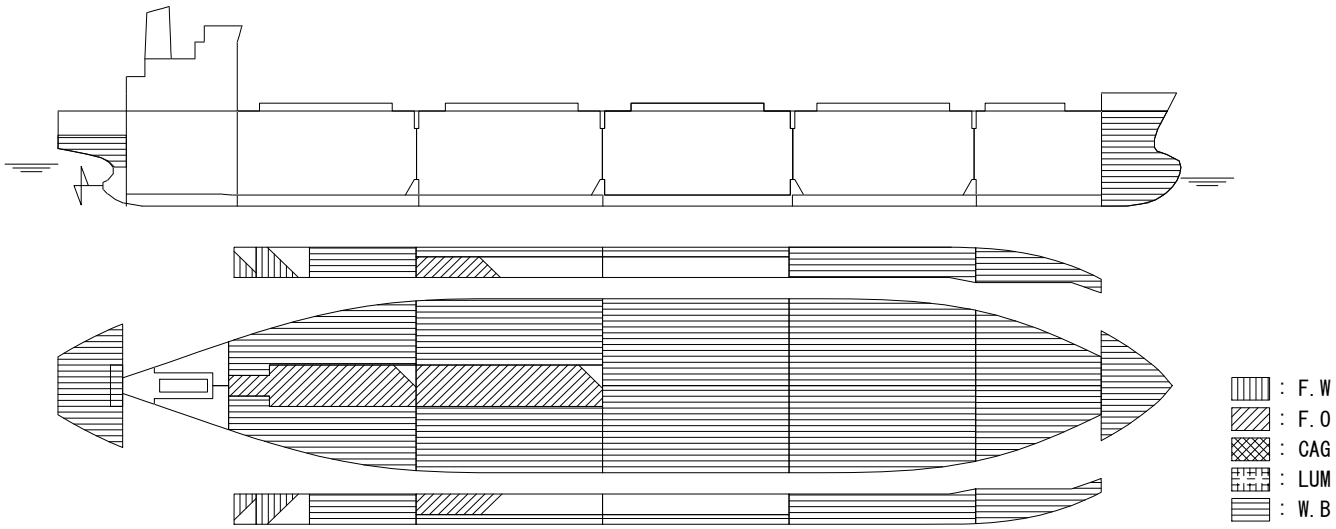
(-)MARK is SAGGING, (+)MARK is HOGGING.

CONDITION NAME : 3-2 BALLAST CONDITION 50% B.

I T E M	(%)	WEIGHT (t)	MID.G (m)	MOMENT (t-m)	K G (m)	MOMENT (t-m)	ρ*I (t-m)
LIGHT WEIGHT		7785	7.22	56208	9.73	75748	0
CONSTANTS		175	46.31	8104	10.06	1761	
COLLAPS.STANCHON		64	-5.50	-352	14.80	947	
SECURING FITTINGS		0	0.00	0	0.00	0	
CONSTANTS	0	239	32.44	7752	11.33	2708	0
PROVISIONS		6	71.80	431	15.70	94	0
F. W. T. (P)	50	60	49.69	2981	11.72	703	69
F. W. T. (S)	50	60	49.69	2981	11.72	703	69
DRINK W. T. (S)	50	24	55.39	1329	11.79	283	29
DIST. W. T. (P)	50	24	55.39	1329	11.79	283	29
FRESH WATER TOTAL		168	51.31	8620	11.74	1972	196
NO.3 U.W.F.O.T.(P)		0	0.00	0	0.00	0	0
NO.3 U.W.F.O.T.(S)		0	0.00	0	0.00	0	0
NO.4 U.W.F.O.T.(P)	40	97	15.53	1506	11.97	1161	75
NO.4 U.W.F.O.T.(S)	40	97	15.53	1506	11.97	1161	75
NO.4 F.O.T. (C)	96	275	15.53	4271	0.81	223	584
NO.5 F.O.T. (C)	96	234	42.04	9837	0.82	192	438
FUEL OIL TOTAL		703	24.35	17120	3.89	2737	1172
NO.1 D.O.T. (P)	43	21	61.64	1294	0.59	12	43
NO.1 D.O.T. (S)	48	22	61.69	1357	0.65	14	44
NO.2 D.O.T. (C)	48	13	74.79	972	11.66	152	35
DIESEL OIL		56	64.70	3623	3.18	178	122
NO.1 CARGO HOLD		0	0.00	0	0.00	0	
NO.2 CARGO HOLD		0	0.00	0	0.00	0	
NO.3 CARGO HOLD		0	0.00	0	0.00	0	
NO.4 CARGO HOLD		0	0.00	0	0.00	0	
NO.5 CARGO HOLD		0	0.00	0	0.00	0	
CARGO TOTAL		0	0.00	0	0.00	0	
NO.1 HATCH & DECK		0	0.00	0	0.00	0	0
NO.2 HATCH & DECK		0	0.00	0	0.00	0	0
NO.3 HATCH & DECK		0	0.00	0	0.00	0	0
NO.4 HATCH & DECK		0	0.00	0	0.00	0	0
NO.5 HATCH & DECK		0	0.00	0	0.00	0	0
LUMBER TOTAL		0	0.00	0	0.00	0	0
F. P. T.	100	898	-77.52	-69613	7.93	7121	1445
NO.1 UPP. W. T.(P)	100	172	-61.71	-10614	13.03	2241	0
NO.1 UPP. W. T.(S)	100	172	-61.71	-10614	13.03	2241	0
NO.2 UPP. W. T.(P)	100	428	-40.68	-17411	12.60	5393	0
NO.2 UPP. W. T.(S)	100	428	-40.68	-17411	12.60	5393	0
NO.3 UPP. W. T.(P)	100	176	-12.61	-2219	12.18	2144	0
NO.3 UPP. W. T.(S)	100	176	-12.61	-2219	12.18	2144	0
NO.4 UPP. W. T.(P)	100	176	15.53	2733	12.18	2144	0
NO.4 UPP. W. T.(S)	100	176	15.53	2733	12.18	2144	0
NO.5 UPP. W. T.(P)	100	239	37.88	9053	12.61	3014	0
NO.5 UPP. W. T.(S)	100	239	37.88	9053	12.61	3014	0
NO.1 W. B. T. (P)	100	307	-62.88	-19304	1.37	421	0
NO.1 W. B. T. (S)	100	307	-62.88	-19304	1.37	421	0
NO.2 W. B. T. (P)	100	727	-40.44	-29400	1.21	880	0
NO.2 W. B. T. (S)	100	724	-40.35	-29213	1.21	876	0
NO.3 W. B. T. (P)	100	761	-12.61	-9596	1.19	906	0
NO.3 W. B. T. (S)	100	761	-12.61	-9596	1.19	906	0
NO.4 W. B. T. (P)	100	599	15.45	9255	1.28	767	0
NO.4 W. B. T. (S)	100	599	15.45	9255	1.28	767	0
NO.5 W. B. T. (P)	100	455	42.48	19328	1.45	660	0
NO.5 W. B. T. (S)	100	455	42.48	19328	1.45	660	0
A. P. T.	100	638	77.47	49426	11.29	7203	0
NO.3 CARGO HOLD(W.B)		0	0.00	0	0.00	0	0
WATER BALLAST TOTAL		9613	-12.10	-116350	5.35	51460	1445
T O T A L		18570	-1.22	-22596	7.26	134897	2935

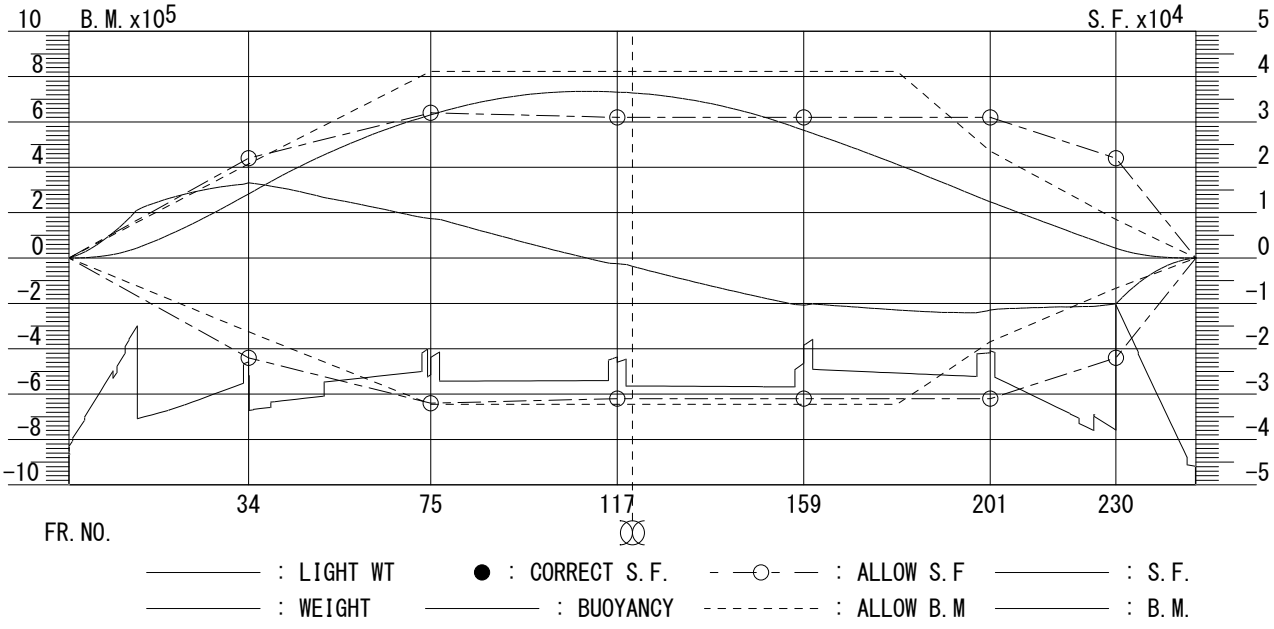
* * * * * S U M M A R Y * * * * *							
DISPT (t)	18570	MID.G (m)	-1.22	T.KM (m)	13.39		
DRAFT (EQ) (m)	5.35	MID.B (m)	-5.33	K G (m)	7.26		
DRAFT (F) (m)	4.34	B G (m)	4.11	G M (m)	6.13		
DRAFT (A) (m)	6.50	MID.F (m)	-5.11	GoG (m)	0.16		
DRAFT (M) (m)	5.42	M.T.C. (t-m)	352.73	GoM (m)	5.97		
TRIM (m)	2.16	T.P.C. (t)	36.88	I/D (%)	55.67		

COND.NAME : 3-2 BALLAST CONDITION 50% B.

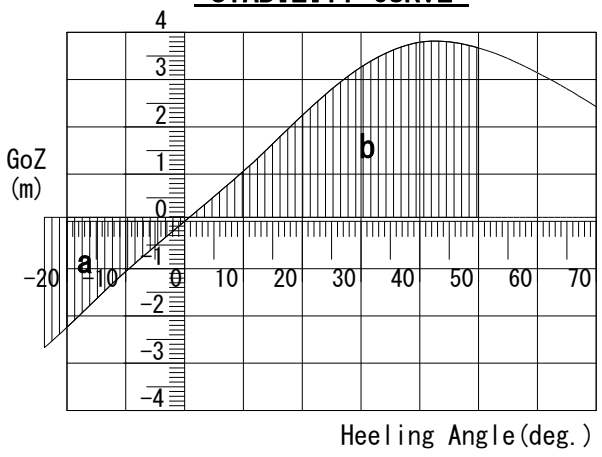


LONGITUDINAL STRENGTH CURVE

<< In Still Water (Sea Going) >>



STABILITY CURVE

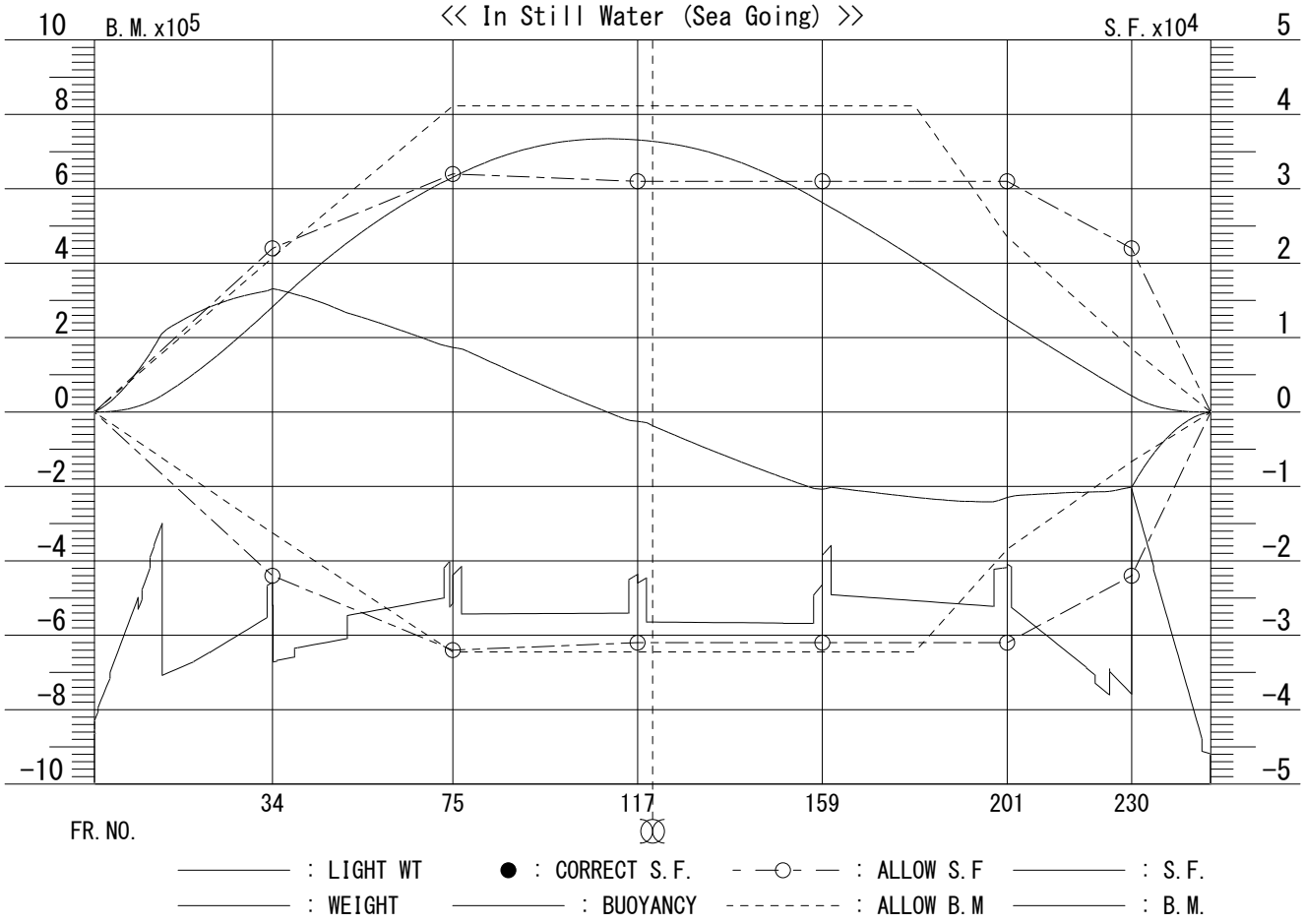


SUMMARY

DISPLACEMENT	(t)	18570
DRAFT (MEAN)	(m)	5.42
STRENGTH		
MAX. BEND. MT.	(KN-m)	734770 (FR. 110.3)
〃 RATE	(%)	89 (FR. 110.3)
〃 SHEAR. FORCE	(KN)	16559 (FR. 34.0)
〃 RATE	(%)	75 (FR. 34.0)
STABILITY		
ACTUAL GoM	(m)	5.97
REQUIRED GoM	(m)	3.94
JUDGEMENT		GOOD

SHEARING FORCE and BENDING MOMENT

COND.NAME : 3-2 BALLAST CONDITION 50% B.



No.	FR No.	S.F.(KN) Actual	S.F.(KN) Allow.	S.F.(KN) Ratio	B.M.(KN-M) Actual	B.M.(KN-M) Allow.	B.M.(KN-M) Ratio
1	34	16559	22000	75 %	282756	415000	68 %
2	75	8678	32000	27 %	631020	823000	77 %
3	117	-1258	-31000	4 %	731431	823000	89 %
4	159	-10379	-31000	33 %	563091	823000	68 %
5	180	-11450	-31000	37 %	413022	823000	50 %
6	201	-11488	-31000	37 %	247713	471000	53 %
7	230	-10095	-22000	46 %	43450	170000	26 %
	Maximum	16559	(Fr 34.0)		734770	(Fr 110.3)	
	Max.Rate	75	(Fr 34.0)		89	(Fr 117.0)	

* : After BHD Correction

Shearing Force and Bending Moment in Damage

Condition Name : 3-2 BALLAST CONDITION 50% B.

Hold No.	Fr.No.	Shearing Force (KN)			Bending Moment (KN-m)		
		Actual	Allow	Ratio	Actual	Allow	Ratio
	Add. WT 1295 t		Draft Fore		5.68 m	Draft Aft	5.72 m
	34.0	17651	28000	63%	291461	454000	64%
	75.0	11580	48000	24%	701853	910000	77%
	117.0	941	43000	2%	881147	910000	97%
1	159.0	-11638	-43000	27%	730458	910000	80%
	180.0	-15473	-43000	36%	542076	910000	60%
	201.0	* -17848	-43000	42%	294450	516000	57%
	230.0	-9057	-28000	32%	39505	185000	21%
	Maximum	-17848 (Fr.199.1)			882300 (Fr.119.1)		
	Max.Rate	63 (Fr. 34.0)			97 (Fr.119.1)		
	Add. WT 2923 t		Draft Fore		6.50 m	Draft Aft	5.73 m
	34.0	17461	28000	62%	290213	454000	64%
	75.0	9999	48000	21%	678394	910000	75%
	117.0	-3202	-43000	7%	778959	910000	86%
2	159.0	* -17297	-43000	40%	462602	910000	51%
	180.0	-10984	-43000	26%	249186	910000	27%
	201.0	* -593	-43000	1%	149914	516000	29%
	230.0	-8398	-28000	30%	36682	185000	20%
	Maximum	-17296 (Fr.159.0)			790865 (Fr.106.4)		
	Max.Rate	62 (Fr. 34.0)			87 (Fr.106.4)		
	Add. WT 3017 t		Draft Fore		5.49 m	Draft Aft	6.92 m
	34.0	15366	28000	55%	274659	454000	60%
	75.0	3255	48000	7%	535379	910000	59%
	117.0	* -9818	-43000	23%	408116	910000	45%
3	159.0	* -3616	-43000	8%	261464	910000	29%
	180.0	-2737	-43000	6%	259566	910000	29%
	201.0	-6511	-43000	15%	191116	516000	37%
	230.0	-9191	-28000	33%	39466	185000	21%
	Maximum	15366 (Fr. 34.0)			546232 (Fr. 83.6)		
	Max.Rate	55 (Fr. 34.0)			66 (Fr. 49.3)		
	Add. WT 3384 t		Draft Fore		4.38 m	Draft Aft	8.32 m
	34.0	12222	28000	44%	248771	454000	55%
	75.0	* -2773	-48000	6%	344871	910000	38%
	117.0	* 7720	43000	18%	415457	910000	46%
4	159.0	-5349	-43000	12%	469095	910000	52%
	180.0	-8627	-43000	20%	374121	910000	41%
	201.0	-10307	-43000	24%	236781	516000	46%
	230.0	-9991	-28000	36%	43008	185000	23%
	Maximum	12748 (Fr. 25.6)			499721 (Fr.143.2)		
	Max.Rate	44 (Fr. 34.0)			56 (Fr. 41.7)		
	Add. WT 4094 t		Draft Fore		3.01 m	Draft Aft	10.24 m
	34.0	6789	28000	24%	191012	454000	42%
	75.0	* 21634	48000	45%	575276	910000	63%
	117.0	1337	43000	3%	896917	910000	99%
5	159.0	-13519	-43000	31%	706195	910000	78%
	180.0	-15276	-43000	36%	504700	910000	55%
	201.0	-14558	-43000	34%	288406	516000	56%
	230.0	-10835	-28000	39%	46766	185000	25%
	Maximum	21633 (Fr. 75.0)			898398 (Fr.119.1)		
	Max.Rate	45 (Fr. 75.0)			99 (Fr.119.1)		

* : After BHD Correction

Shearing Force and Bending Moment in Damage

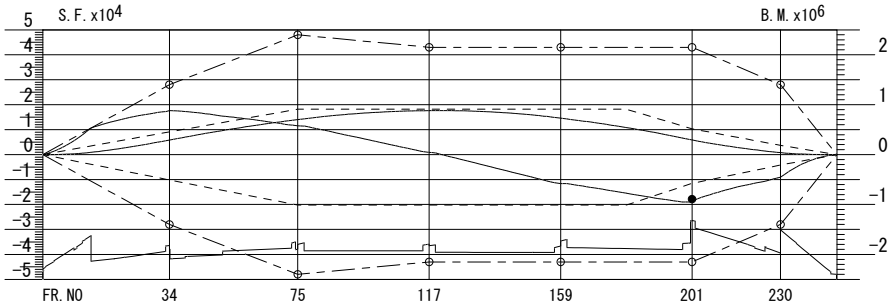
Condition Name : 3-2 BALLAST CONDITION 50% B.

NO.1 CARGO HOLD

Additional Weight 1295(t)

Shearing Force (KN)
- Maximum -17848 (Fr.199.1)
- Max.Rate 63 (Fr. 34.0)

Bending Moment (KN-m)
- Maximum 882300 (Fr.119.1)
- Max.Rate 97 (Fr.119.1)

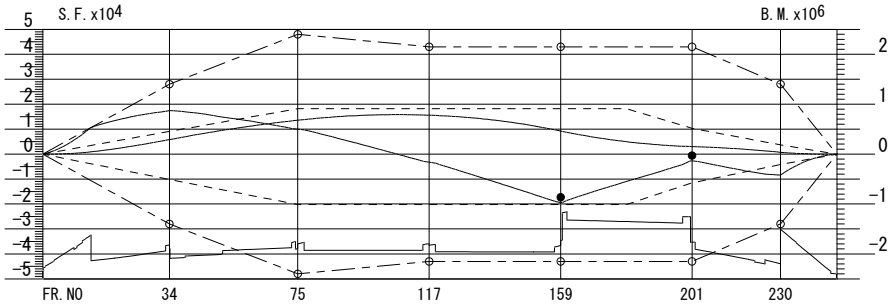


NO.2 CARGO HOLD

Additional Weight 2923(t)

Shearing Force (KN)
- Maximum -17296 (Fr.159.0)
- Max.Rate 62 (Fr. 34.0)

Bending Moment (KN-m)
- Maximum 790865 (Fr.106.4)
- Max.Rate 87 (Fr.106.4)

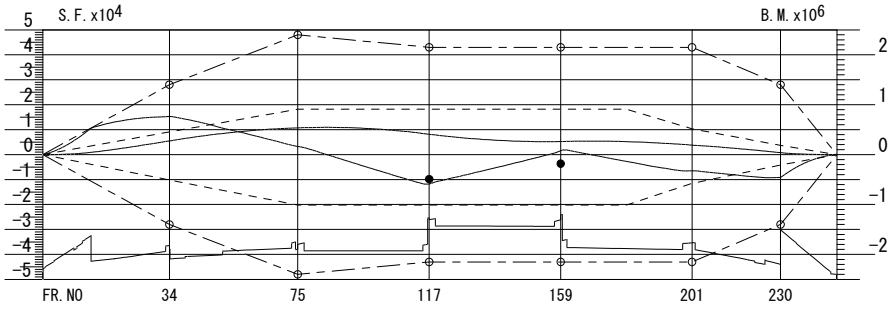


NO.3 CARGO HOLD

Additional Weight 3017(t)

Shearing Force (KN)
- Maximum 15366 (Fr. 34.0)
- Max.Rate 55 (Fr. 34.0)

Bending Moment (KN-m)
- Maximum 546232 (Fr. 83.6)
- Max.Rate 66 (Fr. 49.3)

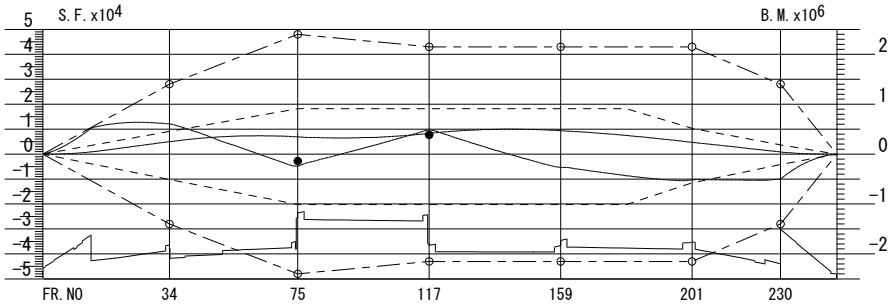


NO.4 CARGO HOLD

Additional Weight 3384(t)

Shearing Force (KN)
- Maximum 12748 (Fr. 25.6)
- Max.Rate 44 (Fr. 34.0)

Bending Moment (KN-m)
- Maximum 499721 (Fr.143.2)
- Max.Rate 56 (Fr. 41.7)

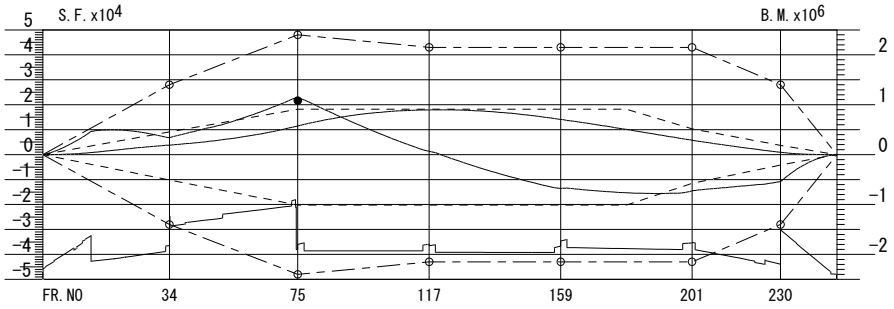


NO.5 CARGO HOLD

Additional Weight 4094(t)

Shearing Force (KN)
- Maximum 21633 (Fr. 75.0)
- Max.Rate 45 (Fr. 75.0)

Bending Moment (KN-m)
- Maximum 898398 (Fr.119.1)
- Max.Rate 99 (Fr.119.1)

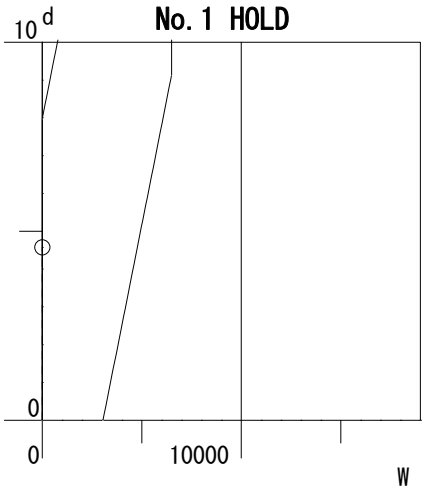


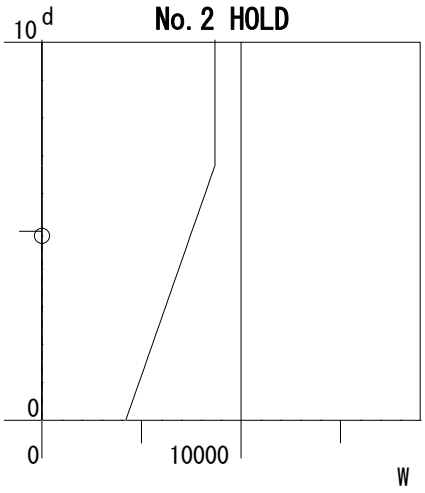
——— : S.F. — – : ALLOW S.F ——— : WEIGHT

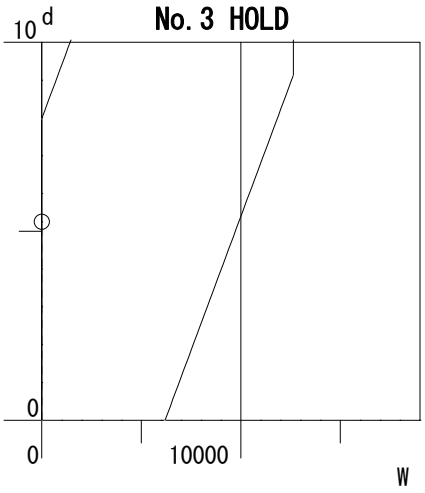
——— : B.M. – – – – : ALLOW B.M ○ : CORRECT S.F.

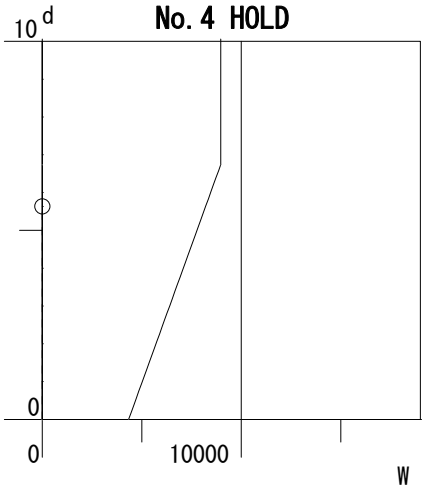
HOLD MASS CHECK

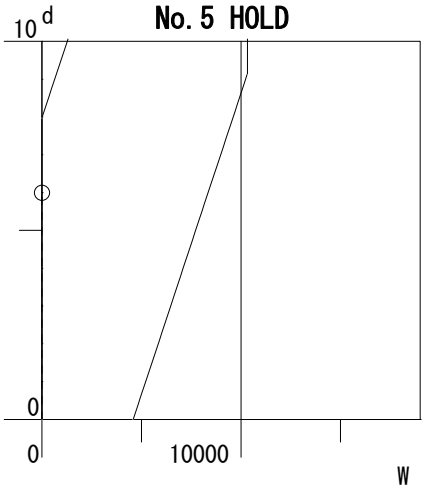
Cond.Name : 3-2 BALLAST CONDITION 50% B.
Cond.Comment :
<< Sea Going (JUDGE ... OK) >>

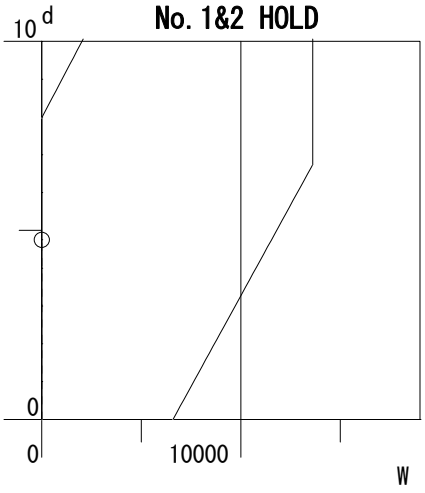


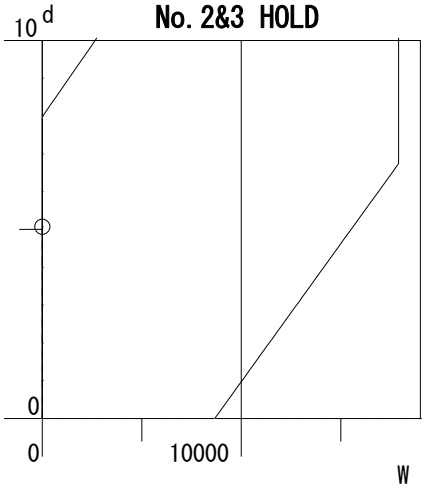


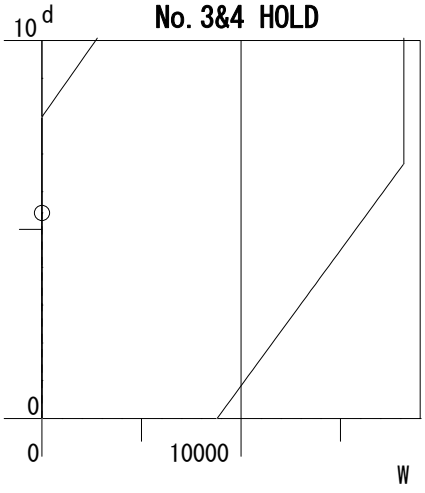


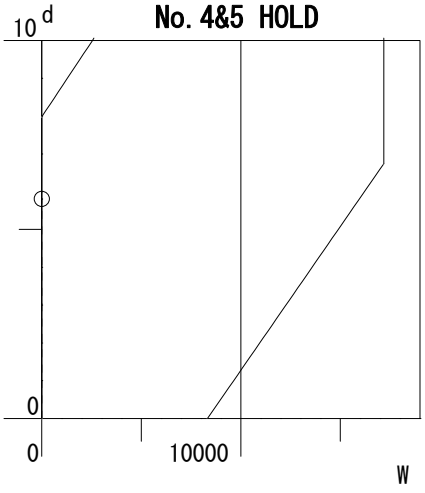












Ⅳ. ATTACHMENT

1 GENERAL ARRANGEMENT

2 CAPACITY PLAN

3 INCLING TEST RESULT