PLAN HISTORY

REV. NO	DATE	DESCRIPTION	REMARK
0	2023.05.31	Prepared by basic design team	

(10) SHEETS WITH COVER

본 도면은 대한민국 정부의 “친환경중소형선박 기술역량 강화사업”의 일환으로 작성된 문서입니다.

MANAGER	K.D. OK	**DATE : 2023. 05. 31**	**SCALE**
APPROVED	S.S. JEONG	메탄올 연료추진 13K급 Product/Chemical Tanker	NONE
CHECKED	D. HUH	**Freeboard Calculation**	**TEAM**
DRAWN	J.W. KIM		BASIC DESIGN
TEL.	051-260-7826		**REV.** 0
KRISO		친환경선박설계기술사업단	

C O N T E N T S

	FREEBOARD CALCULATION	PAGE	1
		PROJECT NO	
		DWG. NO	

A. GENERAL INFORMATION

LOA	:	129.9 m
LBP	:	122.0 m
B(mld.)	:	21.0 m
D(mld.)	:	11.8 m
Freeboard Deck Level(mld.)	:	11.8 m
Design Draft(mld.)	:	8.55 m
Scantling Draft(mld.)	:	8.55 m

Type of Ship	:	Product/Chemical Tanker
Freeboard Type	:	A type
Freeboard Deck	:	Upper deck
0.85 Depth(df)	:	10.03 m

B. PRINCIPAL DIMENSIONS

1 Freeboard Length (Lf) : 122.53 m

a) LWL (Extreme length at 85% D) x 0.96 : 121.001 m

F.P. - Stem	:	0.517 m
A.P. - F.P.	:	122.000 m
Stern - A.P.	:	3.500 m
Stem Plate Thickness	:	0.013 m
Stern plate Thickness	:	0.013 m

LWL(Extreme length at 85%D) 126.043 m

b) From Stem to A.P. (Rudder stock center) : 122.530 m

F.P. - Stem	:	0.517 m
A.P. - F.P.	:	122.000 m
Stem Plate Thickness	:	0.013 m

122.53 m

Where, b > a

2 Breadth (Bmld) : 21.000 m

3 Depth for freeboard (Df) : 11.813 m

Depth (mld)	:	11.800 m
Deck stringer plate	:	0.013 m

11.813 m

C. FREEBOARD CALCULATIONS

1 Tabular Freeboard (Ft) — 1,503 mm

Type "A"

Length of Ship (m)	Freeboard (mm)
122	1494.0
123	1511.0
122.530	1503.0

2 Correction for Block coefficient (Cbc) — 130 mm

a) Cb at 85% Dmld :

$$Cb = \frac{\text{Volume(mld) at df}}{Lf * Bmld * df}$$

$$= \frac{20586.3}{122.53x21x10.03} = 0.7977$$

b) Correction for Cb

$$Fc = Ft \times \frac{Cb + 0.68}{1.36}$$

$$= 1503 \times \frac{0.7977 + 0.68}{1.36} = 1,633 \text{ mm}$$

Cbc = Fc - Ft = 130 mm

3 Correction for Depth (Dc) — 911 mm

* Df = 11.813 mm
* Lf/15 = 8.169 mm

D>Lf/15 and Lf>=120

Dc = (Df - Lf / 15) x 250 = 911 mm

4 Correction for Recess in freeboard deck (Rc) — 0 mm

(l X b x dr)/(WP Area at 0.85D) = 0 mm

5 Correction for Superstructure and Trunks

214 mm
(Deduction)

a) Effective length

Fore. Superstructure

Mean Length	:	10.137 m
Actual height (Haf)	:	2.600 m
Standard height (Hs)	:	2.275 m
Height correction	:	0.000 m
Effective length (Lef)	:	10.137 m

Aft. Superstructure

Mean Length	:	24.800 m
Actual height (Haa)	:	2.900 m
Standard height (Hs)	:	2.275 m
Height correction	:	0.000 m
Effective length (Lea)	:	24.800 m

Total effective length (Le) : 34.937 m

b) Deduction (ratio of Le/Lf) : 0.2851

0.2000 L	14.00 %
0.3000 L	21.00 %
0.2851 L	19.96 %

Standard value of deduction = 1070.000 mm

*Height of deduction

$$= \text{Standard value of deduction} \times \frac{\text{Deductive percentage}}{100}$$

$$= \frac{1070 \times 19.959}{100} = 214 \text{ mm}$$

6 Correction for Sheer

337 mm

a) Excess or Deficiency of Sheer

Stati.	Standard				Actual		
	Height	Ordinate	S.M	Product	Ordinate	S.M	Product
A.P	25.0*(L/3+10)	1271	1	1271	0	1	0
L/6	11.1*(L/3+10)	564	3	1692	0	3	0
L/3	2.8*(L/3+10)	142	3	426	0	3	0
Amidship	0	0	1	0	0	1	0
	Sum	As :		3389	Aa :		0
Amidship	0	0	1	0	0	1	0
L/3	5.6*(L/3+10)	285	3	855	0	3	0
L/6	22.2*(L/3+10)	1129	3	3387	30	3	90
F.P	50.0*(L/3+10)	2542	1	2542	384	1	384
Sum		Fs :		6784	Fa :		474

* Deficiency of AFT Sheer : (As - Aa) / 8 = 423.6 --ⓐ

* Deficiency of FWD Sheer : (Fs - Fa) / 8 = 788.8 --ⓑ

* Total deficiency of Sheer (St) : (ⓐ + ⓑ) / 2 = 606.2 mm

b) Sheer Credit for Superstructure (mm)

Fore super. : Yf = Haf - Hs = 325 mm

Sf = Yf/3 * Lef/Lf

= 325/3 *10137/122530 = 9 mm

Aft super. : Ya = Haa - Hs = 625 mm

Sa = Ya/3 * Lea/Lf

= 625/3 *24800/122530 = 42 mm

Total Sheer Credi(Sc) : 51 mm

c) Correction for sheer

Sum of superstructure length (Le) : 34.937 m

Sheer Correction = (St - Sc) * (0.75-0.5*Le/Lf) = 337 mm

7 Summary

a) Tabular Freeboard : **1503** mm --ⓐ

* Correction for Block Coefficient : **130** mm --ⓑ

* Correction for Depth **911** mm --ⓒ

* Correction for recess in freeboard : **0** mm --ⓓ

* Correction for Superstructure : **-214** mm --ⓔ

* Correction for Sheer : **337** mm --ⓕ

b) Calculated Summer Freeboard (fs) : **2667.8** mm

* Summer Draft (ds = Df - fs) : **9145.2** mm
(calculated moulded draft)

c) Final draft

* Freeboard (summer) : **2.668** m
* Freeboard Depth : **11.813** m
* Max. moulded summer draft : **9.145** m

Required Moulded Summer Draft	:	**8.550** m

d) Allowance of Seasonal Load Line

* Winter Allowance (WA) **178** mm
WA = {Required Summer Draft(mld) / 48 } x 1000 (addition)
= **178.125** mm

* Winter North Atlantic Allowance (WNAA) **178** mm
WNAA = Winter Allowance (addition)
= **178.125** mm

* Fresh Water Allowance (FWA) **187** mm
FWA = {disp.(at summer. Draft) / (40*TPC)} x 10 (deduction)
= **187.279** mm

* Tropical Allowance (TA) **178** mm
TA = {Required summer. Draft) / 48} x 1000 (deduction)
= **178.125** mm

* Tropical Fresh Water Allowance (TFA) **365** mm
TFA = FWA + TA (deduction)
= **365.404** mm

D. MINIMUM BOW HEIGHT & RESERVE BUOYANCE

1 Minimum Bow Height

a) Required minimum bow height (Hr) : **5.410** m

$Fb=(6075(L/100)-1875(L/100)^2+200(L/100)^3)x(2.08+0.609Cb-1.603Cwf-0.0129(L/d1))$

= **5410.003**

WHERE, (L/100) = **1.225**

Cb = **0.798**

Cwf = Awf /((Lf/2) x Bmld)

= **1063.816 /((122.53 /2) x 21)**

= **0.827**

b) Actual bow height (Ha) : **6.247** m

1) The length of F'cle deck > 0.07LF

HA = D(mld) + Fore Superstructure H + sheer + Plate Th. - Assign.summer draft(mld)

= **11.8+2.6+0.384+0.013-8.55**

= **6.247**

2) The length of F'cle deck < 0.07LF and Fore Superstructure H ≥ 0.07LF

HA = D(mld) + Fore Superstructure H + sheer + Plate Th. - Assign.summer draft(mld)

=

= **Not adopted**

3) The length of F'cle deck < 0.07LF and Fore Superstructure H < 0.07LF

HA = D(mld) + sheer + Plate thick. - Assign. Summer draft (Mld)

=

= **Not adopted**

4) If there is no F'cle Deck and Fore Superstructure H < 0.07LF

HA = D(mld) + sheer + Plate thick. - Assign. Summer draft (Mld)

=

= **Not adopted**

5) If there is no F'cle Deck and Fore Superstructure H ≥ 0.07LF

HA = D(mld) + Fore Superstructure H + Sheer

=

= **Not adopted**

Therefore, **Actual Height (HA) > Required Height (HR) is OK**

* Hydrostatic Table

1. Scantling draft (8.55 m)

DRAFT m	VOL m3	DISP t	VCB m	LCB m	KMT m	TPC t/cm	MTC tm/cm	WSA m2
8.300	16564.2	17018.3	4.365	62.41	8.867	23.4	196.1	3909.2
8.350	16678.0	17135.2	4.392	62.37	8.872	23.4	196.7	3923.5
8.400	16792.1	17252.2	4.419	62.33	8.878	23.4	197.4	3937.6
8.450	16906.2	17369.4	4.446	62.29	8.884	23.4	198.1	3951.7
8.500	17020.6	17486.7	4.473	62.25	8.890	23.5	198.7	3965.7
8.550	17135.0	17604.2	4.500	62.21	8.896	23.5	199.4	3979.7
8.600	17249.6	17721.8	4.527	62.17	8.903	23.5	200.1	3993.6
8.650	17364.4	17839.6	4.554	62.13	8.910	23.6	200.7	4007.5
8.700	17479.3	17957.5	4.581	62.09	8.917	23.6	201.4	4021.3
8.750	17594.3	18075.5	4.608	62.05	8.924	23.6	202.1	4035.1

2. 85% D_{min} (10.03m)

DRAFT m	VOL m3	DISP t	VCB m	LCB m	KMT m	TPC t/cm	MTC tm/cm	WSA m2
9.780	19994.9	20539.0	5.167	61.29	9.116	24.2	215.6	4314.1
9.830	20112.9	20660.1	5.194	61.26	9.127	24.2	216.3	4327.6
9.880	20231.1	20781.3	5.221	61.22	9.138	24.3	216.9	4341.1
9.930	20349.3	20902.7	5.248	61.19	9.149	24.3	217.6	4354.5
9.980	20467.7	21024.2	5.276	61.16	9.161	24.3	218.3	4368.0
10.030	20586.3	21145.8	5.303	61.13	9.173	24.3	219.0	4381.4
10.080	20704.9	21267.6	5.330	61.09	9.184	24.4	219.7	4394.9
10.130	20823.6	21389.3	5.357	61.06	9.196	24.4	220.4	4408.3
10.180	20942.5	21511.4	5.384	61.03	9.208	24.4	221.1	4421.8
10.230	21061.5	21633.5	5.412	61.00	9.221	24.4	221.8	4435.3

S H E E R

(UNIT:mm , EXCEPT MARKED)