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OUTFIT ESTIMATING COEFFICIENTS FOR SHIPS

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TABLE OF CONTENTS

	page
ACKNOWLEDGEMENT	ii
VESSEL IDENTIFICATION	iv
LIST OF FIGURES	vi
LIST OF TABLES	vii
SUMMARY	viii
INTRODUCTION	1
DISCUSSION OF RESULTS	2
FIGURE 1 - CURVES OF OUTFITTING WEIGHT COEFFICIENTS VS CUBIC NUMBERS	4
TABLE 1 - SUMMARY OF SHIP CHARACTERISTICS (Vessels 1 through 21)	5
TABLE 2 - SUMMARY OF WEIGHTS AND CENTERS	8
TABLE 3 - OUTFITTING WEIGHT COEFFICIENTS	9
TABLE 3a - OUTFITTING WEIGHT COEFFICIENTS FOR ORE CARRIERS	11
TABLE 4 - V.C.G. COEFFICIENTS	12
TABLE 5 - L.C.G. COEFFICIENTS	13
BIBLIOGRAPHY	14
APPENDIX A - WEIGHT AND CENTER DATA, VESSELS 1 THROUGH 21	15
APPENDIX B - WEIGHT AND CENTER DATA, VESSELS I, II, and III (Vessels not used in study)	95

VESSEL IDENTIFICATION

Ship weight and center data received from the shipyards listed in the Acknowledgement and used in this study are assigned arabic numerals 1 through 21. The numbers for these vessels in Appendix A are listed as H-1, H-2, etc., the "H" standing for "Hull". The H is not used with the numbers identifying the points of the curves (Figure 1).

Ship weight and center data received from shipyards, but not complete enough to use in this study are assigned Roman numerals I, II, etc. and presented in Appendix B.

Vessels B, C, E, and G are taken from Reference 3 and are the identification symbols used in that reference. Vessels A, D, and F in Reference 3 are the same vessels as H-15, H-18, and H-14, respectively, and are identified in this paper with the latter symbols.

Lower case letters a through m are assigned by the author to vessels presented in Reference 2 and letters n through t assigned to vessels presented in Reference 5.

The following index of ship data presented in this paper will further clarify the numbers used for the ships:

Vessel or Hull Number	Name or Class	Type	Location of Data
1	Manhattan	Pass.-Cargo	Appendix A
2	Excalibur	Pass.-Cargo	" "
3	-	Gr.Lakes Bulk Carrier	" "
4	John F. Cushing	Tug	" "
5	Charles C. West	Self-Unloader	" "
6	Traverse City Socony	Tanker	" "
7	Edward W. Renwick	River Towboat	" "
8	Exporter	Gen. Cargo	" "
9	Mariposa	Cargo-Pass.	" "
10	Esso Baton Rouge	Tanker	" "
11	Parismina	Reefer Cargo	" "
12	Pres. Hoover	Pass.-Cargo	" "
13	Yorktown	Bay Steamer	" "
14	Esso Suez	Tanker	" (also F of Ref. 3)
15	Nightingale	Cargo	" (also A of Ref. 3)
16	John D. Archibald	Tanker	"
17	Esso Delivery No. 11	Tanker	"
18	America	Pass.-Cargo	" (also D of Ref. 3)
19	Columbia	Pass.-Cargo	"
20	Talamanca	Pass.-Cargo	"
21	Florida	Pass.-Cargo	"
I	Cherokee	River Towboat	Appendix B
II	Guntersville	River Towboat	" "
III	Delaware	Diesel Trawler	" "
B	Mariner	Cargo	Reference 3
C	Pres. Jackson	Pass.-Cargo	" "
E	North Dakota	Tanker	" "
G	Grand Bassa	Tanker	" "
a	Venore	Ocean Ore Carrier	Reference 2
b	Baltone	" " "	" "
c	Bomi Hills	" " "	" "
d	Californian	" " "	" "

Vessel or Hull Number	Name or Class	Type	Location of Data
e	Ore Chief	Ocean Ore Carrier	Reference 2
f	Hanna Class	" " "	" "
g	Cerro-Bolivar	" " "	" "
h	Carl Schmedeman	" " "	" "
i	Pathfinder	" " "	" "
j	Sugar Line Class	" " "	" "
k	Geo. M. Humphrey	Gr. Lakes Ore Carrier	" "
l	E. L. Wier	" " " "	" "
m	Philip R. Clark	" " " "	" "
n	(Proposed) 495'	Ocean Ore Carrier	Reference 5
p	" 580'	" " "	" "
q	" 645'	" " "	" "
r	" 720'	" " "	" "
s	" 800'	" " "	" "
t	Orinoco Type	" " "	" "

LIST OF FIGURES

Figure		Page
1	Curves of Outfitting Weight Coefficients vs Cubic Numbers	4
2	Profile of Passenger-Cargo Vessel 1	19
3	" " " " 2	19
4	" " Great Lakes Bulk Carrier 3	25
5	" " Tug 4	25
6	" " Self-Unloading Ore Carrier 5	31
7	" " Tanker 6	31
8	" " River Towboat 7	34
9	" " General Cargo Vessel 8	34
10	" " Cargo-Passenger Vessel 9	39
11	" " Tanker 10	39
12	" " Refrigerated-Cargo Vessel 11	46
13	" " Passenger-Cargo Vessel 12	46
14	" " Bay Steamer 13	54
15	" " Tanker 14 (F in Reference 5)	54
16	" " Cargo Vessel 15 (A in Reference 5)	64
17	" " Passenger-Cargo Vessel 18 (D in Reference 5)	77
18	" " " " " 19	77
19	" " " " " 20	86
20	" " " " " 21	86
21	" " Cargo Vessel B	93
22	" " Cargo-Passenger Vessel C	93
23	" " Tanker E	94
24	" " " G	94
25	" " River Towboat I	98
26	" " " " II	100

LIST OF TABLES

Table		Page
1	Summary of Ship Characteristics (Vessels 1 through 21)	5
2	Summary of Weights and Centers	8
3	Outfitting Weight Coefficients	9
3a	Outfitting Weight Coefficients for Ore Carriers	11
4	V.C.G. Coefficients	12
5	L.C.G. Coefficients	13

SUMMARY

This thesis was prepared to help fill a gap in the fund of knowledge required to carry out the preliminary design of merchant ships. Published information on outfitting weights and centers is almost non-existent.

The author has edited and correlated data furnished by numerous shipyards and has supplemented this with such published information as was already available. This compilation of data is, in itself, a unique addition to our technical literature.

In addition to compiling the tabular data, profile drawings of the ships have been prepared. These show the exact centers of gravity of the various light ship components and should prove most useful in estimating centers on similar ships.

To add to the usefulness of the thesis, non-dimensional analyses were made for weights, longitudinal centers, and vertical centers. Calculated values were plotted in the case of weights and put into readily usable tabular form in the other instances.

INTRODUCTION

This paper has been prepared as a thesis for a Master's Degree in Naval Architecture and Marine Engineering with the purpose of presenting outfitting weight and center data and coefficients developed from that data for a large variety of ships.

Naval architects and estimators frequently need to estimate weights and centers on proposed ships before plans are well developed and must rely on data compiled from previous similar ships, usually data from their own confidential files. Since most offices are rather restricted in types of ships built in the past, they lack data on other types and there is very little published on outfitting weights and centers. Students have even less data to use in their design studies; therefore, this paper attempts to present another readily available source of useful information.

Since starting this work, a new book (Reference 3) has published data on seven ships, three of which were already included in the information on hand. The remaining vessels, designated B, C, E, and G were also used in this report. Estimated weights from References 2 and 5 are utilized in Figure 1 and are identified with lower case letters. The bulk of the analysis is based on the furnished data for twenty-one ships designated with H numbers throughout the thesis. A complete explanation of the vessel identification system used and an index of vessels is presented ahead of this Introduction.

Where the term "Wood and outfit" is used, it is meant to include all such nominally non-mechanical hull appurtanences as: hull fittings, boats and davits, anchors and chains, rigging and canvas, insulation, sheathing, and sparring, deck covering, paint, and cement, hotel equipment, hatch covers, rudder, and joiner work.

Where the term "hull engineering" is used it is meant to include all non-propulsive machinery as well as the concomitant systems of piping, wiring, and duct work. This would include, for example: deck machinery, ventilation, refrigeration, heating, and air conditioning systems, electrical generation and distribution, mechanically operated doors, plumbing and piping, fire detection and fire extinguishing systems.

Where the term "total outfit is used, it is meant to be the summation of "wood and outfit" and "hull engineering".

Data and methods of estimating steel hull and machinery weights are fairly easy to obtain and are not analyzed in this paper. However, detailed weights and centers for steel and in some cases, machinery weights are presented along with the outfitting weights to present complete data for a ship wherever possible. Table 1 summarizes the weights and characteristics of the ships.

In compiling data from many sources, many different breakdowns were received and in some cases, there was not enough detail to rearrange the breakdowns to a common basis; therefore, very little rearranging has been done and no attempt made to establish coefficients for individual parts of outfitting. In some cases where hull engineering was not presented as a separate sub totoal, an attempt was made to segregate hull engineering items following as nearly as possible the breakdown used by Newport News Shipbuilding and Dry Dock Company. The detail weights are marked in Appendix A whenever they were rearranged in sub totals of hull engineering, steel, and/or outfitting for Table 1 and not given as a separate group in the weight details.

Attempts at analysis of the individual subdivisions proved fruitless and the conclusion was reached that for preliminary design purposes, the most accurate estimates were based on the two big subdivisions of "wood and outfit" and "hull engineering".

DISCUSSION OF RESULTS

A. Presentation:

The results of the study are presented in accordance with the following outline:

1. Figure 1 - Curves of outfitting weight coefficients for various types of ships.
2. Table 1 - Summary of ship characteristics for vessels 1 through 21 of various types.
3. Table 2 - Summary of outfitting, hull engineering, and total of outfit and hull engineering weights and centers (L.C.G. and V.C.G.) grouped according to types of ships. This table summarizes the data needed to calculate coefficients in Tables 3, 3A, 4, and 5.
4. Table 3 - Outfitting, hull engineering, and total of outfit and hull engineering weight coefficients for tankers, passenger cargo, cargo, and miscellaneous vessels. This table and Table 3A were used to plot Figure 1.
5. Table 3A (same as Table 3) for ore carriers from References 2 and 5.
6. Table 4 - Vertical center of gravity coefficients for outfit, hull engineering, and the total of the two groups expressed as a percent of depth of the vessel.
7. Table 5 - Longitudinal center of gravity coefficients for outfit, hull engineering, and total of the two groups expressed as a percent of LBP.
8. Appendices A and B contain the detailed weight and center data together with profiles of the ships showing the various centers of gravity.

B. Weight Coefficients:

A plot of outfitting weight coefficients versus cubic numbers for various types of ships is presented in Figure 1.

The outfitting coefficient used is the outfitting weight in long tons divided by the cubic number (length between perpendiculars x beam x depth). The outfitting weights used in Figure 1 for the most part included hull engineering since the definition of hull engineering varied with the source of data and was not in many cases separable from outfit weights. The data for Figure 1 is presented in Tables 3 and 3A.

Tanker data gave the best results in establishing a curve since a wider range of ship sizes was available and there are so few variables in this type of vessel. Quite a few of the ocean ore carriers from Reference 2 fitted the tanker curve, hence it was also labeled for ocean ore carriers.

Admittedly other curves could be drawn through the few points that are available. Figure 1 is presented as a suggested family of curves with the curves for cargo and passenger vessels based on the tanker curve with only the few points available for each type used to locate the ordinate of the curves. The curves for passenger vessels have passenger capacity indicated which should affect the outfitting weight but does not always seem to follow this rule.

The Great Lakes ore carriers seem to fall under the tanker curve, as is to be expected, but the proposed ocean ore carriers from Reference 5 seems to be low and somewhat displaced from the other curves.

C. Centers:

The centers of outfitting, hull engineering, and a total of both are presented in Tables 4 and 5 where they are available.

The following conclusions may be reached from the V.C.G. and L.C.G. study presented in Tables 4 and 5. The V.C.G. coefficient is expressed as a percent of the depth of the ship and L.C.G. as a percent of LBP.

1. The coefficients are not reliable with passenger-cargo ships because of the multiplicity of decks and varying degrees of relative division between passengers and cargo.

2. In cargo vessels the V.C.G. tendency is upward in newer ships owing to increased emphasis on cargo handling gear.

3. In large modern tankers, the V.C.G. of outfitting is found to be quite consistently 6 1/2 to 7 feet above the main deck. The V.C.G. of hull engineering is found consistently at just under 70 percent of the depth to the strength deck.

4. While very little CG data is available for modern ore carriers, it is to be expected that centers of both outfitting and hull engineering closely resemble those of tankers. This is found to be true in the case of the "Venore" where the CG outfitting is known.

5. In tankers, the L.C.G. (outfitting plus HE) of all but the smaller types is found to be consistently at 56 percent of the LBP from the fore perpendicular.

The centers where available are plotted on profiles of the vessels and are presented in the appendices with the detailed data for the vessels which should prove most useful in estimating centers on similar ships.

Figure 1

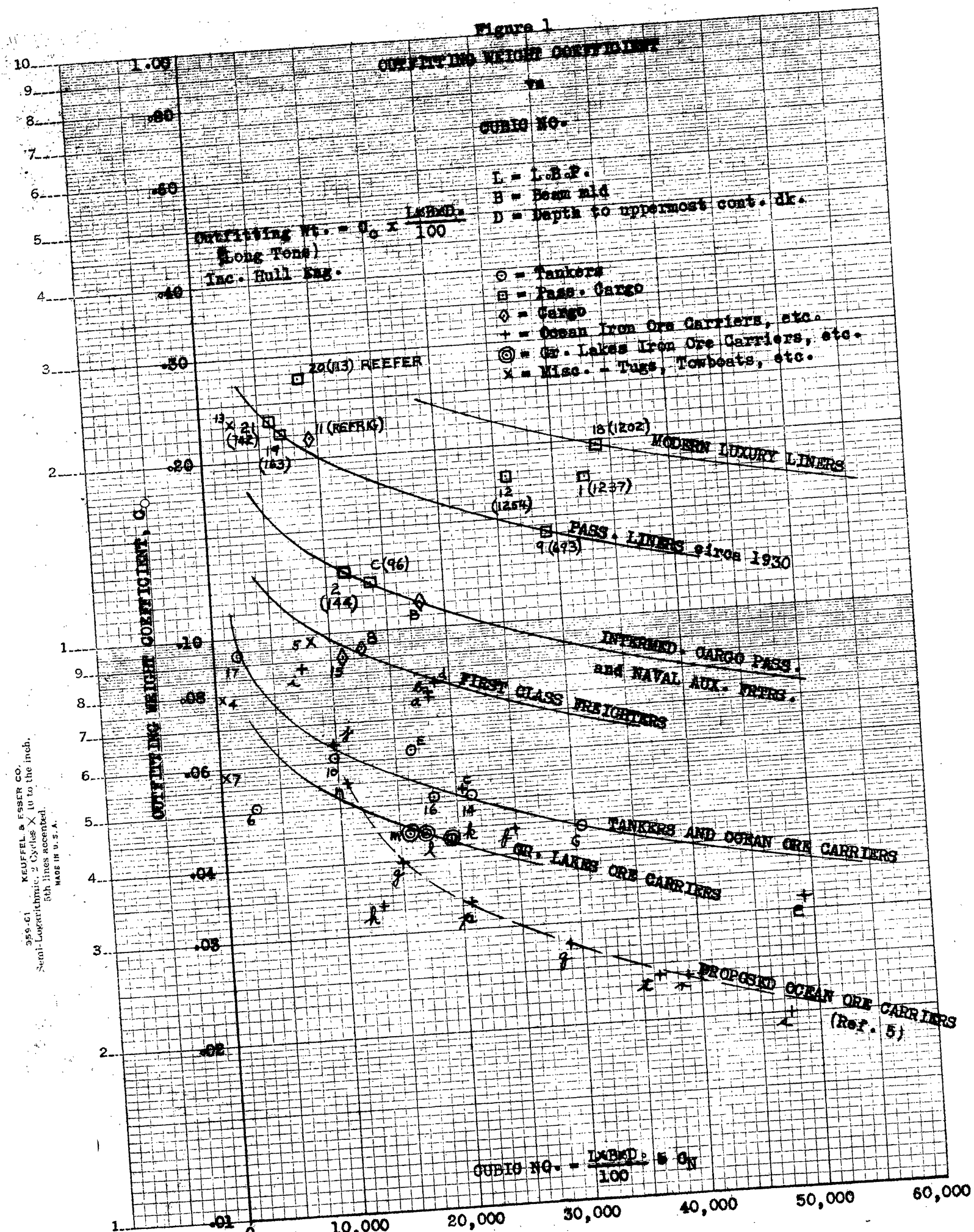

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TABLE 1 - SUMMARY OF SHIP CHARACTERISTICS

Hull No. Type	1 Pass. and Cargo	2 Pass. and Cargo	3 Gr. Lakes Bulk Carrier	4 Tug	5 Self-Unloader	6 Tanker	7 River Towboat
Name	Manhattan	Excalibur	-	John F. Cushing	Charles C. West	Traverse City Socony	Edward W. Renwick
Date Built	1932	1931	1942	1928	1925	1938	1939
Machinery	Turbine	Turbine	Recip.	Diesel	Recip.	Diesel - 2	Diesel
Position of Mach.	Midship	Midship	Aft	Midship	Aft	Aft	Midship
No. of Screws	2	1	1	1	2	1	2
SHP	30,000 Nor. 34,500 Max.	7,200 Nor. 8,000 Max.	2,500 IHP	1,000 BHP	2,000 IHP	1,500 BHP	600 BHP
Sea Speed in Knots	20.5	16.0	10.8			10.8	
LBP	666'-0"	450'	595'	113'-3"	452'	280'-4"	100'
Beam	86'	61'-6"	60'	27'-0"	60'	49'-6"	25'
Depth	57' "B" dk.	Sh.Dk.42'-3"	35'	16'-2"	31'	20'-6"	8'
Draft	30'-9"	27'-11"	23'-11 1/2"	12'-9" FW	21'-0"	17'-3 1/8"	5'-6"
No. Crew	484	99	35			23	10
No. Passengers	1,237	144	4	-		-	-
No. Full Decks	5	3	1	1	1	1	1
No. Trans. Bhds.	11	11	9	4	13	11	4
No. Longl. Bhds.	0	0	2	0	2	1	0
Per Cent Welding	0	0	75	0	0	100	100
Total Steel Wt.	12,050	3,871	4,601.0	286.9	2,823	885.0	96.2
Wood and Outfit Wt.	3,593.4	835.3	65.7	21.1	176	89.0	5.3
Hull Eng. Wt.	2,106.6	642.3	69.1	18.2	646.5	56.6	6.3
Mach. Wt. (Wet)	2,590	858	403.0	216.8	371.5	153.4	50.0
Misc Wt and Margin							
Light Ship (Wet)	20,340	6,207	5,139	543.0	4,017	1,184	157.8
Fuel	4,775	1,969		96.5			
Stores	400	40		1.8			4.4
Ballast (S.W.)	-			49.5			37.6
Fresh Water	3,827	974		8.5			10.1
Misc. Wt.							2.2
Cargo Deadwt.	4,875	6,265					
Crew and Pass. Wt.	340	45		2.7			0.9
Total Deadwt.	13,217	9,293	15,876	159.0	9,529	3,920	55.2
Displace. L.T. S.W.	33,557	15,498	21,015	702	13,546	5,104	213
D.W. Coeff.	0.395	0.600	0.727	0.206		0.767	0.260
l			0.888				
b	0.647	0.699	0.877		0.858	0.775	
m	0.973		0.990				

TABLE 1 - SUMMARY OF SHIP CHARACTERISTICS - Contd.

Hull No.	8	9	10	11	12	13	14
Type	Gen. Cargo	Cargo-Pass.	Tanker	Ref. Cargo	Pass-Cargo	Bay Steamer	Tanker
Name	Exporter	Mariposa	Esso Baton Rouge	Parismina	Pres. Hoover	Yorktown	Esso-Suez
Date Built	1939	1932	1937	1947	1931	1928	1949
Machinery	Steam Turb.	Steam Turb.	Turbine	Turbine	Turb. Elec.	Rec.Trip.Ex.	Turbine
Position of Mach.	Midship	Midship	Aft	Midship	Midship	Midship	Aft
No. of Screws	1	2	1	2	2		1
SHP	8,000 SHP	22,000 SHP	4,000 Max. 3,600 Nor.	12,000 Nor.	26,500 Max. 22,000 Nor.	2,700 SHP	12,500 SHP
Sea Speed in Knots	16.5	20.5	13	18.5	20	15.5	16
LBP	450'	605'	442'	431'	615'	268'-10"	600'
Beam	66'	79'	64'	61'	81'	53'	82'-6"
Depth	42'-6"Sh.Dk.	61' "B"	34'-10"	35'-6"	52' (SH)	18'	42'-6"
Draft	27'	28'-3"	28'-4"	26'-6"	34'-0"	13'-0"	31'-11 1/4"
No. Crew		358	-	62	325	53	58
No. Passengers	-	693		12	1,254	330	4
No. Full Decks	3.5	6.5	1	4.5	5	1	1
No. Trans. Bhds.	9	11	13	7	10	5	17
No. Longl. Bhds.	0	0	2	0	0	0	2
Per Cent Welding	5	0	100	75	0	0	95
Total Steel Wt.	3,500	8,544	2,897	2,885	9,025	595	5,933
Wood and Outfit Wt.	787	2,928	349	1,370	3,460	500	505
Hull Eng. Wt.	404	1,175	257	658	1,115	95	573
Mach. Wt. (Wet)	698	2,390	517	997	2,340	500	870
Misc Wt and Margin	-				160	83Fixed Ball.	
Light Ship (Wet)	5,389	15,037	4,020	5,910	16,100	1,773	7,881
Fuel		6,611		1,413	5,020	90 Coal	900
Stores				40	450	15	45
Ballast (S.W.)				101			
Fresh Water		2,869		309	2,320	113	475
Misc. Wt.					148		
Cargo Deadwt.			13,000	3,878	9,151	250	25,329
Crew and Pass. Wt.				10	160	9	10
Total Deadwt.	8,775	11,104	12,950	6,600	17,249	477	26,759
Displace. L.T. S.W.	14,164	26,141	16,970	12,500	33,350	2,250	34,640
D.W. Coeff.	0.763				0.517	0.212	0.771
l				0.628	0.677	0.532	0.769
b				0.600	0.669	0.502	0.763
m				0.955	0.987	0.945	0.994

TABLE 1 - SUMMARY OF SHIP CHARACTERISTICS - Concld.

Hull No. / Type	15 Cargo	16 Tanker	17 Tanker	18 Pass.-Cargo	19 Pass.-Cargo	20 Pass.-Cargo	21 Pass.-Cargo
Name	Nightingale	John D. Archbold	Esso Delivery No. 11	America	Columbia	Talamanca	Florida
Date Built	1939	1921	1938	1940	1932	1931	1931
Machinery	Turbine	Rec.Trip.Ex.	Diesel Elec.	Turbine	Turbine	Turbo Elec.	Gear Turb.
Position of Mach.	Midship	Aft	Aft	Midship	Midship	Midship	Midship
No. of Screws	1	2	1	2	1	2	2
SHP	6,000 SHP	3,800 IHP	1,000 SHP	34,000 SHP	7,500 Max. 6,500 Nor.	10,500 SHP	9,350 Max. 8,900 Nor.
Sea Speed in Knots	15.5	10.75	10.5	22	16	17.5	19.5
LBP	435'	555'	250'	660'-6"	385'	415'	365'
Beam	63'	75'	43'-6"	93'-3"	57'-6"	60'	56'-6"
Depth	40'-6" SH.Dk.	43.3'	18'-3 7/8"	55' Mn.Dk.	31'-6"	34'-9"	28'-6" U.Dk.
Draft	25'-9"	30'-4 1/4"	15'-9 1/2"	32'-6"	23'-7.9"	24'-0"	20'-1.6"
No. Crew	43			643	93		111
No. Passengers				1,202	163	113	742
No. Full Decks	3	2	1	7	3	4	3
No. Trans. Bhds.	7	15	10	14	9	8	7
No. Longl. Bhds.	0	1	1	0	0	0	0
Per Cent Welding	30	0	100	10	0	0	0
Total Steel Wt.	2,858	6,025	605	11,971	2,512	3,221	2,060
Wood and Outfit Wt.	811	586	110	4,693	1,144	1,643	1,140
Hull Eng. Wt.	205	332	76	1,950	400	725	245
Mach. Wt. (Wet)	590	920	150	2,495	767	1,211	926
Misc. Wt and Margin	100				87		
Light Ship (Wet)	4,564	7,863	941	21,109	4,910	6,800	4,371
Fuel	1,663	1,235	49	4,938	865	600	650
Stores	20	43	3	2,000	40	20	25
Ballast (S.W.)							70
Fresh Water	73	315	13	4,733	250	455	524
Misc. Wt.			4	110			
Cargo Deadwt.	7,532	19,700	2,593	2,250	3,455	2,985	1,015
Crew and Pass. Wt.	8	7	2	300	50	30	80
Total Deadwt.	9,296	21,300	2,664	14,181	4,600	4,090	2,364
Displace. L.T. S.W.	13,860	29,163	3,605	35,440	9,570	10,890	6,735
D.W. Coeff.	0.671	0.730	0.740		0.487	0.376	0.351
l	0.697		0.753	0.600	0.665	0.622	0.567
b	0.683	0.805	0.741	0.587	0.648	0.609	0.529
m	0.980		0.984	0.978	0.975	0.979	0.932

TABLE 2

Summary of Weights and Centers

Hull No.	Outfitting Wt L.tons	Outfitting V.C.G.	Outfitting L.C.G.	Hull Engineering Wt L.tons	Hull Engineering V.C.G.	Hull Engineering L.C.G.	Total Outfit. and H.E. Wt.L.tons	Total Outfit. and H.E. V.C.G.	Total Outfit. and H.E. L.C.G.
TANKERS									
6	89.0	*	-	56.6	-	-	145.6	-	-
14	505	49.1	320.2	573	29.6	351.9	1078	38.7	336
16	586	35.3	-	332	23.5	-	918	31.0	-
17	110	-	131.3	76	-	172.5	186	-	148
E	540	47.5	291.1	477	28.2	310.8	1017	38.4	300
G	620	55.5	343.6	730	33.8	410.8	1350	43.8	380
PASS. CARGO									
1	3593.4	-	-	2106.6	-	-	5700	49.8	-
2	835.3	-	-	642.3	-	-	1477.6	37.8	-
12	3460	54.3	330.4	1115	42.1	356.1	4575	51.4	336
18	4693	54.4	352.2	1950	48.8	352	6643	52.8	352.1
19	1144	32.2	-	400	27.5	204.9	1544	31.1	-
C	1168	38.9	227.8	500	40.6	241.2	1668	39.4	231.7
21	1140	34.5	197	245	28.1	210.9	1385	33.4	199.6
20	1643	33.8	214.5	725	26.5	226	2368	31.5	218
CARGO									
15	811	32	215	205	36.3	230.1	1016	32.9	218
B	1298	44.9	264.7	682	38.9	280.6	1980	42.8	270.1
11	1370	29.9	208.6	658	-	-	-	-	-
MISC.									
4	21.1			18.2			39.3		
7	5.3			6.3			11.6		
13	500			95	25.5	172.7	595		
5	176	22.1	205.8	646.5	18.85		822.5	20.9	314.2
3	65.7			69.1			134.8		

TABLE 3

OUTFITTING WEIGHT COEFFICIENTS

Hull No.	C_N Cubic No.	Outfitting Wt L.tons	Outfitting C	Hull Eng. Wt L.tons	Hull Eng. C	Total Wt L.tons	Total C_o
TANKER							
6	2,845	89	0.031	56.6	0.020	145.6	0.051
10	9,850	349	.035	257	.026	606	.061
14	21,030	505	.024	573	.027	1078	.051
16	18,030	586	.032	332	.018	918	.051
17	1,990	110	.055	76	.038	186	.093
E	16,260	540	.033	477	.029	1017	.062
G	30,540	620	.020	730	.024	1350	.044
PASS. CARGO							
1	32,650	3593.4	0.110	2106.6	0.064	5700	0.174
2	11,690	835.3	.071	642.3	.055	1477.6	.126
9	29,150	2928	.100	1175	.040	4103	.141
12	25,920	3460	.134	1115	.043	4575	.177
18	33,880	4693	.138	1950	.058	6643	.196
19	6,975	1144	.164	400	.057	1544	.221
C	13,740	1168	.085	500	.036	1668	.121
21	5,880	1140	.194	245	.042	1385	.236
20	8,655	1643	.190	725	.084	2368	.274
CARGO							
8	12,620	787	0.062	404	0.032	1191	0.094
15	11,100	811	.073	205	.018	1016	.091
B	17,860	1298	.073	682	.038	1980	.111
11	9,330	1370	.147	658	.071	2028	.218
MISC.							
4	495	21.1	0.043	18.2	0.037	39.3	0.079
7	200	5.3	.026	6.3	.032	11.6	.058
13	2,565	500	.195	95	.037	595	.232
5	8,410	176	.021	646.5	.077	822.5	.098
3*	12,500	65.7	-	69.1	-	134.8	-

*Not used due to incomplete outfitting weight.
All weights are in long tons.

$Wt = C \times \frac{L \times B \times D.}{100}$ See Appendix A for details of weight breakdown for each

ship 1 thru 21 and Reference 3 for ships A thru G.

Ships A, B, C, E, and G are described as follows:

A	Single	screw	dry	cargo freighter,	9,493 deadweight
B	"	"	"	"	13,409 "
C	"	"	passenger	cargo	9,937 "
E	"	"	tanker		19,183 "
G	"	"	"		38,911 "

Misc. ships are described as follows:

4 Tug
7 River Towboat
13 Bay Steamer
5 Great Lakes Ore Carrier - Self Unloading
3 Great Lakes Ore Carrier

TABLE 3A

OUTFITTING WEIGHT COEFFICIENTS FOR ORE CARRIERS

Name	Curve Identification	Outfit Wt. L.tons	Cubic No.	Outfitting Coeff.	Outfit + Bal. pumps
OCEAN ORE CARRIERS (Ref. 2)*					
Venore	a	1448	19,110	0.0758	
Baltore	b	1489	19,180	.0776	
Bomi Hills	c	1085	20,630	.0526	0.0647
Californian	d	1515	18,850	.0804	.0870
Ore Chief	e	1534	49,110	.0313	.0421
Hanna Class	f	1100	24,920	.0442	.0554
Cerro Bolivar	g	600	15,040	.0399	.0464
Carl Schmedeman	h	445	13,200	.0337	
Pathfinder	i	658	7,525	.0874	
Sugar Line Class	j	623	9,765	.0648	
GREAT LAKES ORE CARRIERS (Ref. 2)					
Geo. M. Humphrey	k	836	19,400	0.0431	
E. L. Wier	l	773	17,360	.0445	
Philip R. Clark	m	705	15,850	.0445	
PROPOSED OCEAN ORE CARRIERS (Ref. 5)					
L.B.P.					
465'	n	600	10,890	0.0551	
580'	p	700	20,870	.0335	
645'	q	800	29,000	.0276	
720'	r	925	38,900	.0238	
800'	s	950	47,530	.0200	
698' Orinoco Type	t	870	36,560	.0238	

*Outfitting weights do not include ballast pumps and piping as far as can be determined from reference 2.

All weights are in long tons.

TABLE 4

V.C.G. COEFFICIENTS

Hull No.	D*	Outfitting V.C.G.	Outfitting V.C.G./D	Hull Engineering V.C.G.	Hull Engineering V.C.G./D	Total V.C.G.	Total V.C.G./D
TANKERS							
6	20.5						
10	34.83						
14	42.5	49.1	1.155	29.6	0.697	38.7	0.910
16	43.3	35.3	.815	23.5	.543	31.0	.716
17	18.33						
E	40.5	47.5	1.172	28.2	.695	38.4	.948
G	48.5	55.5	1.145	33.8	.696	43.8	.904
PASS. CARGO							
1	57					49.8	0.874
2	42.25					37.8	.895
9	61						
12	52	54.3	1.044	42.1	0.810	51.4	.989
18	55	54.4	.989	48.8	.887	52.8	.960
19	31.5	32.25	1.023	27.5	.873	31.1	.986
C	44.5	38.9	.874	40.6	.911	39.4	.886
21	28.5	34.5	1.210	28.1	.986	33.4	1.172
20	34.75	33.8	.973	26.5	.763	31.5	.906
CARGO							
8	42.5						
15	40.5	32	0.790	36.3	0.897	32.9	0.812
B	40.5	44.9	1.109	38.9	.960	42.8	1.056
11	35.5	29.9	.842				
MISC.							
4	16.17						
7	8						
13	18			25.5	1.416		
5	31	22.1	0.713	18.85	.608	20.9	0.674
3	35						
Venore	43.75	50.5	1.155				

*D = Depth in feet from keel to uppermost continuous deck in most cases. See Table 1 for notes regarding deck to which D is measured.

TABLE 5

L.C.G. COEFFICIENTS

Hull No.	L.B.P.	Outfitting		Hull Engineering		Total	
		L.C.G.	L.C.G./L.B.P.	L.C.G.	L.C.G./L.B.P.	L.C.G.	L.C.G./L.B.P.
TANKERS							
6	280.33						
10	442						
14	600	330.2	0.534	351.9	0.586	336	0.560
16	555						
17	250	131.3	.525	172.5	.690	148	.592
E	535	291.1	.544	310.8	.581	300	.561
G	677	343.6	.508	410.8	.607	380	.561
PASS. CARGO							
1	666						
2	450						
9	605						
12	615	330.4	0.537	356.1	0.579	336	0.546
18	660.5	352.2	.533	352	.533	352.1	.533
19	385			204.9	.532		
C	465	277.8	.490	241.2	.518	231.7	.498
21	365	197	.540	210.9	.578	199.6	.547
20	415	214.5	.517	226	.545	218	.525
CARGO							
8	450						
15	435	215	0.494	230.1	0.529	218	0.501
B	528	264.7	.501	280.6	.531	270.1	.512
11	431	208.6	.484				
MISC.							
4	113.25						
7	100						
13	268.83			138.8	0.516		
5	452	205.8	0.455	230	.509	214.2	0.474
3	595						
Venore	560	291	.520				

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7.	2	" " Sept. 1930 and Jan. 1931
8.	3	" " Sept. 1943
9.	4	" " June 1928
10.	6	" " Sept. 1938
11.	8	" " Dec. 1939
12.	9	" " Feb. 1932
13.	9	Trans. S.N.A.M.E. 1949, pp. 33
14.	10	" " 1948, pp. 433
15.	11	Marine Eng. Aug. 1947
16.	12	" " Aug. 1931
17.	13	" " July 1928
18.	14	" " May 1949 (and Ref. 2)
19.	15	" " Oct. 1939 (and Ref. 2)
20.	18	" " Aug. 1940 (and Ref. 2)
21.	19	" " Jan. 1933
22.	20	" " Jan. 1932
23.	21	" " June 1930

APPENDIX A

WEIGHT AND CENTER DATA, VESSELS 1 THROUGH 21

Pass.-Cargo

STEEL WEIGHTS

Item	Wt. in L.tons	L.C.G. aft FP	V.C.G. abv. B.L.
Shell	2,358.7	334.56	27.25
Bilge, docking keels, fenders	11.7	332,99	4.84
Inner bottom plating	409.0	313.45	5.12
Deck plating	2,595.2	365.97	53.30
Transverse bhds.	877.8	325.83	25.06
Longitudinal bhds.	388.5	340.41	15.51
E & B casing below prom. dk.	212.8	342.05	46.26
Steel stairways	19.8	405.32	58.62
Shaft tunnels	46.3	559.33	10.17
Keel	66.0	335.75	.15
Center keelson	64.8	298.06	2.64
Side keelsons	158.8	303.39	2.79
Floors and brackets out of IB	229.6	362.50	20.82
Frs. revs. frs. & webs out of IB	426.1	352.32	30.02
Mast support main	4.4	468.80	61.36
Floors & frms. in IB	453.4	321.14	2.86
Decks beams or long'ls.	690.7	376.79	48.98
Stanchions & pillars	151.0	342.69	33.41
Girders	206.6	360.75	45.58
Transoms, cants, etc.	12.9	683.96	50.10
Side stringers and breast hooks	80.5	275.17	17.91
Platforms	35.0	318.15	29.45
Hatch coamings	95.1	278.01	46.02
Chain lockers (2)	9.2	33.17	29.76
Chain pipes	5.2	32.45	58.13
Founds. for deck machinery & steer. g.	18.5	512.25	48.46
Founds. for main eng.	92.2	433.40	8.23
Found. for aux. machinery Mach. spaces	78.4	403.08	20.57
Boiler saddles	52.0	329.43	8.32
Shaft & thrust bear. founds.	30.5	521.98	8.43
Misc. steel bhds.	709.0	336.75	51.89
Rudder plate	10.1	677.08	9.78
Cargo trunks	140.9	386.18	49.35
Equalizing trunks	14.5	402.51	5.94
Deck houses	50.0	625.33	62.90
Curtain pls. & supports	9.9	611.30	66.50
D.W. & El. trunks	29.4	301.55	60.11
Found. for bitts & chocks	4.5	533.83	56.73
TOTAL	10,919.0	349.48	34.39
-0.4/0 per cent for milling	-32.2	349.48	34.39
Rivet heads 2%	217.7	349.48	34.39
TOTAL HULL	11,104.5	349.48	34.39
Houses			
Deck houses	592.2	330.09	86.04
Pilot house	13.2	211.87	97.60
Bridges-Nav. & docking	8.5	467.05	83.24
Companions	11.5	332.70	90.17
TOTAL	625.4	329.50	86.32
Rivet heads 2%	12.5	329.50	86.32
TOTAL HOUSES	637.9	329.50	86.32

STEEL WEIGHTS - cont.

Item	Wt. in L. tons	L.C.G. aft FP	V.C.G. abv. B.L.
Steel masts (2)	36.9	316.75	98.05
Steel booms (21)	25.6	316.32	92.38
Steel king-posts (4)	29.4	347.14	82.96
TOTAL	91.9	326.91	91.64
-1.17/0 per cent for milling	-.7	326.91	91.64
Rivet heads 2%	1.8	326.91	91.64
TOTAL MASTS	93.0	326.91	91.64
Hull forgings & castings			
Stem	6.2	4.05	23.26
Stern frame	42.9	668.60	18.99
Rudder frame	27.7	663.30	11.80
Rudder stock	24.1	667.50	30.23
Misc. metals	3.1	662 .90	14.52
Spectacle frame	73.2	642.00	12.50
	177.2	633.28	16.79
TOTAL	12,012.6	352.43	37.34
Hull	11,129.0	349.5	34.3
Forgings & castings	177.2	633.3	16.8
Houses	650.8	329.5	86.3
Masts & booms	93.0	326.9	91.6
TOTAL STEEL	12,050.0	352.4	37.3

WOOD & OUTFIT

Item	Wt. in L.tons	L.C.G. aft FP	V.C.G. abv. BL
Wooden masts & spars	0.2		123.0
Carpenter work	419.6		60.0
J oiner work	995.0		60.0
Deck coverings	620.0		50.0
Lights, doors, & hatches	188.3		50.0
Deck castings	60.8		60.3
Misc. metal fittings	240.6		60.0
Side ladders (2)	4.2		68.0
Mast & spar fittings	16.8		87.0
C.G. & P. outfit	36.8		49.5
Portable furniture	125.0		60.0
Laundry mach., furn. by owner	56.5		55.0
Anchors, chains, etc.	156. 7		42.0
Deck outfit	116.2		82.0
Rigging	25.0		66.0
Canvas work	2.2		81.0
HE Heating system	62.0		53.0
Ventilating system	263.0		58.7
Reefer insulation, etc.	275.0		28.4
Mach. liquids - 10.26 T	157,0		17.5
Sanitary & FW system	530.0		50.0

cont.

H-1 - cont.

WOOD & OUTFIT - cont.

	Item	Wt. in L. tons	L.C.G. aft FP	V.C.G. abv. B.L.
HE ↓	Fire system	109.0		42.0
	Bilge & ballast system	123.0		14.0
	Deck scuppers	24.4		42.0
	Communicating system	46.0		57.0
	Cement & paint	325.0		26.9
	Insulation (Fire & heat)	195.5		51.0
HE ↓	Steering gear	62.0		40.0
	Deck machinery	125.4		66.0
	Elevators & D.W.'s	32.8		57.0
	Elect. gen'rs & wiring	242.0		41.0
	Elect. plant by engrs.	55.0		22.0
	Rat proofing	9.0		28.0
	TOTAL WOOD & OUT.	5700.0		49.8
	Propelling machinery			
	Prop. mach. incl. 154 T liquids	2500.0	401.6	19.4
	Spare gear	90.0		
	TOTAL PROP. MACH.	2590.0	401.6	19.4
	Light ship (wet)	20340.0	362.0	38.5
	Light ship from inclin'g exp't.	20330.0	362.4	38.1

DIMENSIONS:

LOA = 705'-3"
LBP = 666'-0"
L on 30'-0" WL = 685'-0"
B_{MLD} = 86'-0"
D_{MLD} to "B" dk. = 57'-0"
Depth of double bottom = 62"
$\frac{L \times B \times D^*}{100}$ = 26,900
Net tonnage = 13,924

*D to "C" dk. = 47' - 0"
(Bhd. dk.)

HULL DATA:

Load draft = 30'-8 27/32"
b (on 685') = 0.647
m = 0.973
Dead weight = 13,224 tons
Speed at sea = 20.5 knots
Light ship KG = 38.07
Twin screw
3 complete steel dks.
Steel orlop dk. at ends
14 WT & OT bhds:
4 to "B" dk.
7 to "C" dk.
3 to "E" dk.

Displ = 33,557 L.T. SW
T/in. = 105
Wet surf = 76,731 sq ft
Gross tons = 24,239
EHP = 17,250 at 29' H
GM = 1.49' light
3 elect. capstans
1 elect. windlass
20 elect. dk. winches
2 masts, 4 derrick posts
20 - 3 ton & 1 - 20 T pipe booms

CAPACITIES:

Cargo & holds, bales = 306,370 cu ft
Cargo trunks, bales = 67,870 cu ft
Cargo refrig. "A" = 47,090 cu ft; B-38,300
Cargo refrig "B" = 38,300 cu ft
Cold storage "A" = 16,040 cu ft
97% bunker oil at 38 cu ft = 4775 tons
Ships FW = 2899 tons
Water ballast - peaks = 570 tons
Deep tks. = 2660 tons
IB = 2519 tons
Res. feed = 680 tons

Distilled water = 248 tons

	"A"	"B"
Cabin cl. pass.	580	576
Tourist cl. pass.	461	366
3rd cl. pass.	196	141
TOTALS	1237	1083
Off. & crew	484	525

NOTE: "A" AND "B" ARE SISTER SHIPS.

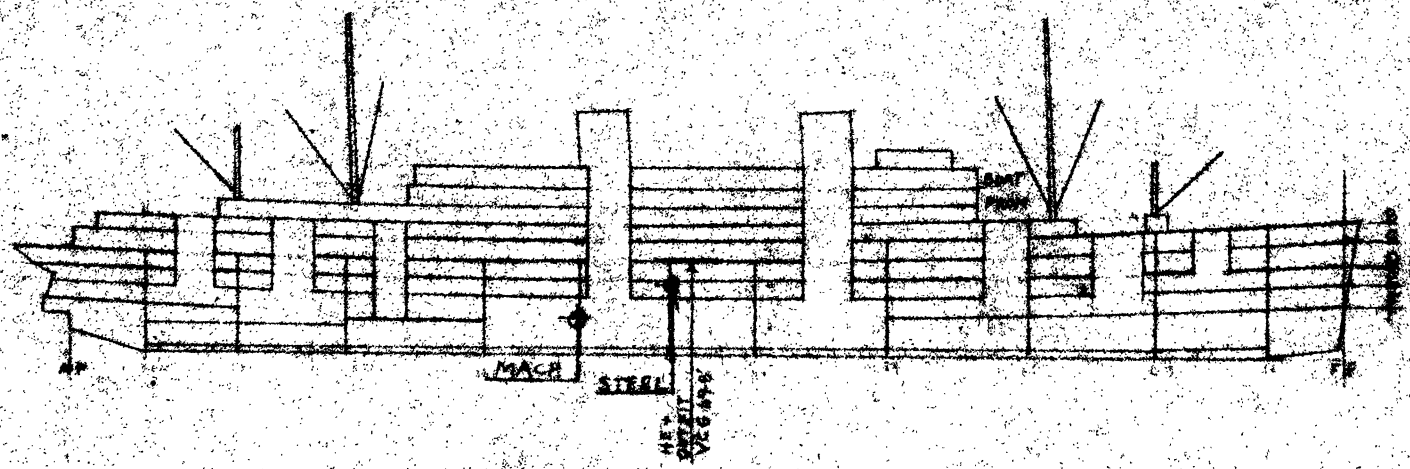


Figure 2 - Passenger and Cargo Vessel 1 (LBP = 660'-0")

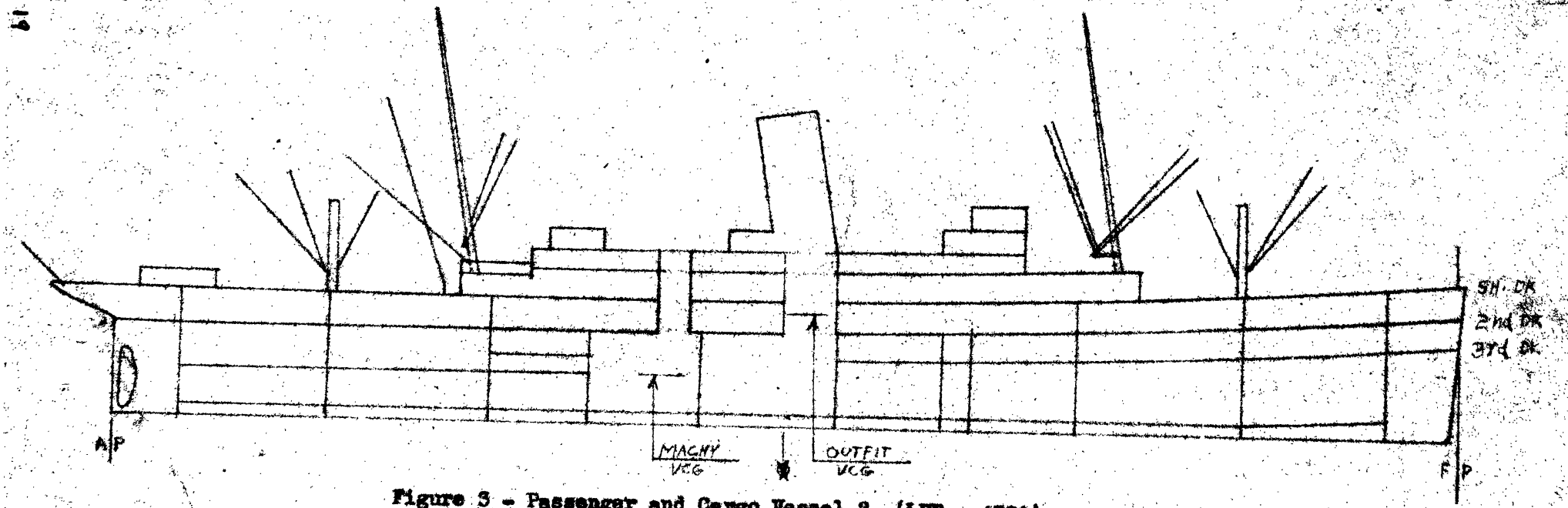


Figure 3 - Passenger and Cargo Vessel 2 (LBP = 450')

Pass.--Cargo

STEEL

Item	Wt. in L. tons	
Shell	811.0	
Bilge	8.7	
Inner bottom plating	160.5	
Deck plating, incl. S.A. flat	604.4	
Transverse bhds.	299.1	
Longitudinal bhds.	70.0	
E. & B. casing, screen bhds. etc.	215.3	
Shaft tunnels	31.1	
Keel, flat plate	26.5	
Center keelson	22.4	
Side keelsons	44.8	
Floors and brackets out of I.B.	85.0	
Frs. revs. frs. & webs out of I.B.	201.3	
Floors & frs. in I.B.	250.5	
Decks beams	208.3	
Stanchions and pillars,	90.1	
Deck girders	70.5	
Transoms, cants, etc.	8.7	
Side stringers and breast hooks	21.3	
Hatch coamings	66.6	
Chain lockers	6.2	
Founds. for deck mach. & steer. gear	22.9	
Founds. for main engine	44.4	
Found. for aux. machinery, Machy. space	21.4	
Boiler saddles	10.4	
Shaft & thrust bear. founds.	7.0	
Sheet steel bhds.	11.4	
Rudder plate	3.7	
Vent & pipe trunks	10.9	
Cargo trunks	22.1	
Gun foundations	0.8	
Bilge ceiling	16.9	
Steel stairs	3.6	
TOTAL	3477.8	
Percent for milling	24.5	
Rivet heads 1.9%	66.4	
TOTAL HULL	3568.7	
Houses		
Deck houses	181.7	
Bridges	6.6	
Skylights & companions	1.7	
TOTAL	190.0	← % FOR MILLING = 1.2
TOTAL HOUSES	194.8	RIVET HEADS 1.7%=3.0
Masts & spars		
Steel masts	18.3	
Steel booms	15.5	
King posts	25.0	
TOTAL	58.8	
Percent for milling	0.3	
Rivet heads 2.0%	1.3	
TOTAL MASTS	60.4	

cont'd. next page

STEEL - contd.

Item	Wt. in L. tons	
Hull forgings and castings		
Stem	3.5	
Stern frame	28.1	
Rudder frame	11.8	
Rudder stock	4.3	
TOTAL H.F.	47.7	
TOTAL STEEL	3871.6	

WOOD & OUTFIT

	Item	Wt. in L.tons	L.C.G. aft FP	V.C.G. abv. BL
	Wooden masts & spars	0.5		90.0
	Carpenter work	114.1		32.0
	Joiner work	152.7		50.0
	Deck coverings	99.7		46.0
	Lights, doors, etc.	60.8		38.0
	Deck castings	32.8		45.0
	Misc. metal fittings	27.9		54.0
	Mast & spar fittings	8.7		80.0
	C.G. & P. outfit	16.3		37.0
	" " " " (by owner)	26.8		45.0
	Anchors, chains, etc.	72.2		37.0
	Masters outfit	39.3		63.0
	Rigging	20.6		85.0
	Canvas work	1.9		54.0
HE	Heating system	12.5		45.0
	Ventilating system	42.2		42.0
	Reefer insulation, etc.	176.4		21.0
	Reefer machy.	67.1		28.0
	Sanitary & FW system	78.0		44.0
	Fire system	20.4		40.0
	Bilge & ballast system	64.9		9.0
	Deck scuppers	12.1		40.0
↓	Communicating system	4.6		45.0
	Cement & paint	118.3		27.0
HE	Deck steam & exhaust sys.	14.5		35.0
	Steering gear	16.3		40.0
	Deck machy.	73.3		52.0
	Electric plant, wiring etc.	16.7		40.0
↓	Electric plant-engrs.	25.3		28.0
	Insulation	42.7		40.0
HE	Cargo elevators & enclos.	18.0		25.0
	TOTAL WOOD & OUTFIT.	1477.6		37.80
	Propelling machinery			
	Prop. mach. incl. 43.4 T liquids	824.6		15.0
	Spare gear	33.2		12.0
	TOTAL PROP. MACH.	857.8		14.88
	Light ship (wet)	6207.0		27.46
	Light ship from incling. exp't	6205.0	228.35	27.44

DIMENSIONS:

LOA = 475'-4 1/4"
LBP = 450'-0"
B_{MLD} = 61'-6"
D_{MDD} to shelter dk = 42'-3"
Depth of double bottom = 57"
$\frac{LxBxD}{100}$ = 11,690
Gross Tonnage = 9360
Net tonnage = 5627

CAPACITIES:

Bale cargo incl. deep tks = 376,046 cu ft
Refrig. cargo = 29,938 cu ft
Ships stores = 18,302 cu ft
Ships cold storage = 4,528 cu ft
98% bunkers fuel oil at 38 cu ft = 1969 tons
FW 594 tons + peaks 159 tons
Water ballast - deep tks. = 2,076 tons SW
Reserve feed = 221 tons

1st class pass.	144 per. in 54 SR
Crew	99
TOTAL	243

HULL DATA:

Load draft = 27'-10 15/16"
Displacement = 15,498 L.T. SW
b = 0.699
T/in = 51.0
Deadweight = 9,293 tons
Wetted surface = 42,830 sq. ft.
Speed at sea = 16 knots
EHP = 5,300 at 26'-6"
Light ship KM = 29.69'
GM = 2.25' light
Single screw
2 complete steel dks & long bridge
Steel 3rd dk. from bow to aft end of eng. rm.
10 trans. WT bhds.; 9 to shelter dk. & 1 to 2nd dk.
16 - 5 ton pipe booms; 1 - 30 tons boom
16 steam deck winches
1 windlass

H-3
GREAT LAKES BULK CARRIER

Item	Location	Dimensions	S.Tons	L.C.G. abt ℄
Hull- Aft 3A to 8F	23'6" abaft AP to 172	$\frac{3+8}{2}$ x 129.5	712.25	246.43A
Aft 2-1/2A to 1F	209 to 172	$\frac{2.5+1}{2}$ x 106	185.5	262.07A
℄	172 to 27	8 x 435	3480.0	26.0F
For'd 10A to 5.7F	27 to 1' Fwd of #0	$\frac{10+5.7}{2}$ x 55	431.75	268.5F
Houses - Aft	209 to 174	1.53 x 100	153.0	247.5A
For'd	11 to 25	2.1 x 30.5	64.05	264.75F
Stern frame & Poop	7' aft to 3' fwd #209	2.15 x 10	21.5	299.5A
Rudder & stock	16'aft to 6'aft #209	1.60 x 10	16.0	308.5A
Shaft	5'aft to 24'fwd #209	0.3 x 29	8.7	288.0A
Steer gear & found'n	2'aft to 6'fwd #209	1.7 x 8	13.6	295.5A
After windlass	2'aft to 6'fwd #209	1.25 x 8	10.0	295.5A
After chain	1'aft to 4'fwd #209	1. 6 x 5	8.0	296.0A
After dk winch & found	9' to 4' abaft #209	0.8 x 5	4.0	304.0A
After anchor(3-1/2T) & pocket (4T)	17' to 7' abaft #209	0.75 x 10	7.5	309.5A
Machinery	178 to 204	1.7 x 78	132.6	248.5A
Boiler rm. - wet	178 to 189	5.3 x 33	174.9	226.0A
Stack & Breeching	1' abaft 187 to 182	1 x 16	16.0	229.5A
Eng & found'n	192 to 202	4.5 x 30	135.0	266.5A
Coal bunker	172 to 180	2.8 x 24	67.2	205.5A
Oil & water tks	200 to 208	0.3 x 20	6.0	285.5A
Boats & davits	189 to 180	0.15 x 27	4.05	229.0A
Dk winches aft (2)	174 to 170	0.65 x 12	7.8	191.5A
Dk winches fwd (2)	30 to 27	0.9 x 9	8.1	239.0F
Fwd windlass & found'n	7 x 13	2.2 x 9	19.8	281.5F
Fwd winch	9 to 13	0.7 x 6	4.2	280.0F
Fwd chain (27.8) & locker	7 to 11	6.0 x 6	36.0	283.0F
Fwd anchors (8.5) & pock't	2 to 6	3 x 6	18.0	290.5F
Hatch crane	#36 + 5'	1 x 10	10.0	216.5F
TOTAL (Light Ship)			5755.50	29.38A

LBP = 595'-0"
$Beam_{MLD}$ = 60'-0"

$Depth_{MLD}$ = 35'-0"

H_{FWD} = 3'-4"
H_{AFT} = 9'-7" } at 5855 S. tons FW

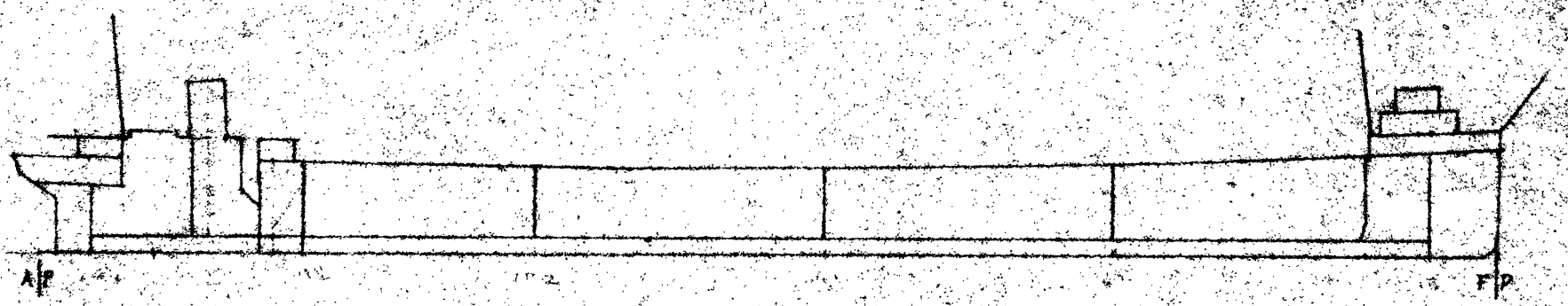


Figure 4 - Great Lakes Bulk Carrier S (LBP = 595')

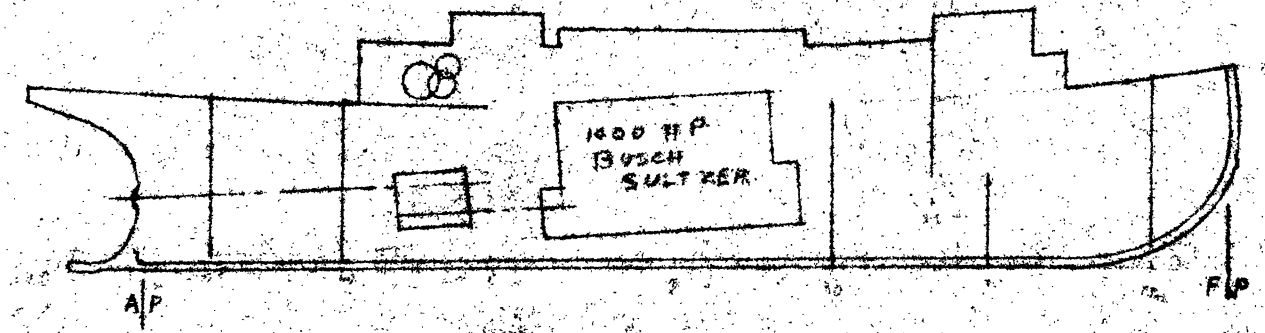


Figure 5 - Tug A (LBP = 115'-3")

H-4
Tug

	Item	Wt. short tons	L.C.G. (aft FP)	V.C.G.
S	Plate, shape & rivet	279.9	62.5	9.9
S	Stem	1.5	1.7	10.0
S	Stern frame	3.3	115.0	4.0
S	Rudder castings	.6	121.0	16.0
S	Rudder complete	3.0	122.0	7.0
HE	Quadrant	.6	119.0	17.7
HE	Air ports	.5	70.0	21.0
S	Towposts aft	1.2	93.7	18.5
S	Cleats	2.0	64.0	18.0
S	Bulwark chocks	.1	65.0	21.0
S	Deck scuttles	.6	57.0	17.0
S	Fender	15.0	60.0	15.0
S	Monkey rail fwd.	.5	7.0	20.5
S	Pilot house	2.0	23.0	22,0
S	Quarters fwd.	3.0	20.0	13.5
S	Galley	3.0	98.0	12.0
O	Grating over quadrant	.8	120.0	18.5
M	Engine room hoist	.7	59.0	21.5
HE	Plumbing	.5	80.0	11.0
S	Life boat davits	.6	61.0	25.0
S	Flag pole spar	.1	90.0	30.0
S	Anchor davit	.2	2.5	24.0
O	Heating plant	2.0	82.0	8.0
O	Ventilators	.3	80.0	25.0
O	Water tanks	.4	94.0	24.0
O	Rails, etc.	.2	55.0	20.0
O	Floor covering	.2	48.0	12.0
M	Water bilge & fire pipe	2.1	50.0	2.5
O	Signals	.1	30.0	20.0
HE	Seacocks	.6	55.0	4.0
S	Skylight	.5	56.0	24.0
O	Fire ext. equipment	.5	60.0	15.0
O	Pilot house equipment	.2	23.0	22.0
O	Wire, rope, dock equipment	.5	85.0	18.0
O	Life boat equipment	1.0	52.0	22.6
M	Stern tube	2.5	110.5	6.2
O	Anchor, chains, etc.	2.2	6.0	14.0
O	Berths, crews quarters	.9	20.0	13.0
O	Bedding etc.	.3	20.0	13.0
O	Galley outfit	.5	98.0	12.0
O	Range	.4	94.0	10.5
O	Mess room outfit	.2	96.0	12.0
O	Lamp room outfit	.1	85.0	20.0
O	Cement	3.2	60.0	3.0
O	Paint	2.2	61.0	11.0
M	Oil centrifuge piping	.3	60.0	6.0
M	Water circ. piping	.5	55.0	10.0
S	Misc. hull	5.0	60.0	10.0
O	Derrick	2.0	86.0	22.0
O	Refrigerator	.4	90.0	12.0

	Item	Wt. short tons	L.C.G. (aft FP)	V.C.G.
M	Air suction muffler- For. engine	1.5	38.0	20.0
	Exhaust muffler " "	2.0	63.5	24.0
	3 air tanks muffler " "	5.0	44.0	12.3
	Main engine 1000 HP Busch Sulzer	100.0	59.0	11.5
	Reduction gear & C.	29.0	80.0	6.0
	2-60 K.W. generator sets	16.6	62.0	7.7
	Daily fuel oil tank	1.0	76.0	14.0
	Lub. oil tank	.5	75.0	12.5
	Low pressure air tank	10.3	55.0	13.5
	Low pressure air compressor	5.2	48.5	7.5
	Electric storage battery	1.9	31.0	23.5
	Lub. oil pump & motor - 2	.6	59.6	5.8
	Lub. oil centrifuge	.4	62.0	7.7
	1 bilge pump - Fairbanks Morse	.3	56.7	7.5
	1 fire pump	1.3	63.0	8.0
	2 jacket water pumps	1.4	51.5	8.0
	1- 20KW generator set, Fairb. Morse	8.0	82.0	8.5
	2 Sump pumps - yeoman's	1.5	65.3	7.5
	Jacket water recooler	2.2	41.5	9.5
	Oil cooler	.4	64.0	8.3
HE	Steering gear	4.0	32.0	18.0
M	Transfer pump	.3	43.0	8.0
	Exhaust muffler gen. sets	1.5	78.0	25.0
	Heater stack	.8	76.0	24.5
HE	Towing winch	10.0	85.0	19.0
	FW tank	2.5	105.0	12.8
	Windlass	1.1	7.5	21.5
M	Line & tail shaft	6.5	107.0	8.5
	Steady bearing	.6	98.0	7.7
	Propeller	4.3	117.0	8.0
	Lux system	2.5	80.0	5.0
	Whistle	.2	35.0	25.0
	Switch board	1.0	69.0	18.3
	Wiring & fixtures	2.5	60.0	16.0
O	Towing cable 1800' of 1-5/8"	3.8	86.0	19.0
M	Fuel oil pumping & manifold	3.0	50.0	7.0
	Eng. room floor	6.0	65.0	5.0
	Thrust bearing & shaft	2.3	89.0	7.0
O	1 derrick hoist with 7-1/2 HP motor	.6	90.0	6.0
O	1 boom swinger 5 HP motor	.6	91.0	15.0
M	Engine room piping	2.0	60.0	14.0
M	Gratings etc.	2.5	60.0	15.0
		596.7	64.3	10.7
	A	9.0	56.0	11.6
	Light with A	605.7	64.2	10.7
	B	125.0	42.1	9.1
	Loaded with A & B	730.7	60.4	10.4
	B consists of the following:			
	Fresh water 2800 gal.	9.5	105.0	12.8
	Lub. oil 400 gal	1.5	75.0	12.5
	Daily service oil 700 gal	2.6	76.0	14.0
	Kerosene 100 gal	.4	78.0	12.0

Item	Wt. short tons	L.C.G. (aft FP)	V.C.G.
B - continued			
Fuel oil 28000 gal	105.0	34.0	9.0
Jacket water 500 gal	2.2	38.0	23.5
Flush tank 600 gal	2.5	75.0	24.5
Drain tank 350 gal.	1.3	65.5	1.5
	125.0	42.1	9.1
A consists of the following:			
Galley stores	2.0	97.0	12.5
Crew equipment	3.0	20.0	13.0
Water in pipes	4.0	60.0	10.0
	9.0	56.0	11.6
Ballast forward	29.0	17.0	
" aft	26.5	110.0	

Draft at launching
forward 5'-7"
aft 9'-5"
mean 7'-6"

Displacement at 7'6" draft = 293 tons

LOA = 125'-10-1/2"
LBP = 113'-3"
B_{MLD} = 27'-0"

$H_{MLD\ FW}$ at 730.7 short tons Δ = 12'-9"

Depth MLD = 16'-2"

Gr. Lakes Ore Carrier (Self-Unloading)

SUMMARY OF WEIGHTS AND CENTERS

Referred to ℄ of LBP

Item	Wt L.tons	V.C.G.	L.C.G.
Shell incl. bulwarks + anchor pockets	736	10.35	2.48 a
Framing incl. dbl. bottom struct. and arches	661.5	10.97	15.2 a
Decks inc. beams, pillars, hatches, beam brkts.	605	32.05	5.64 a
Hoppers incl. beams, pillars, saddle backs, and longl. bhds.	368	11.14	23.7 f
Tank top plating	112.5	3.30	43.8 a
Bulkheads incl. bunkers, deck houses, chain locker	211.5	26.25	55.2 a
Misc. structures incl. fdns., rudder, skylights, and masts	47	12.65	172.5 a
Castings and forgings	28	12.18	195 a
Rivet heads	53.5	12.0	0
TOTAL Steel Hull	2823	16.26	13.03 a
Conveyor boom	26	42	62 f
A frame	35	59.7	154.5 f
Misc. conveyor structure incl. fdns. and trunks	171.5	13.49	77.3 f
Conveyor drive machinery	85	17.45	173.2 f
Misc. conveyor items incl. belts, gears, gates, controls	253.5	22.22	71.3 f
TOTAL Conveyor System	545	21.17	94.5 f
Deck machinery	28.5	37.3	88.1 f
Steering engine incl. quadrant and controls	11.5	24.7	201.5 a
Misc. hull engineering incl. hull piping, and liquids	61.5	9.2	9.45a
TOTAL Hull Engineering	101.5	18.85	3.95a
LCG = 226 + 3.95 = 229.95'			
Joiner work incl. div. bhds., furniture	52.5	38.45	31.0 a
Ventilation incl. ducts, blowers, cowls	2.5	32.0	112 a
Electrical incl. wiring, and motors	4.5	31.0	0
Carpenter work incl. anchors, ladders, boats	68.5	17.03	68.6 a
Paint and cement	43.5	7.57	37.9 f
Steward's outfit	4.5	36.0	196 a
TOTAL Outfit	176.0	22.12	20.15f
LCG = 226 - 20.15 = 205.85'			
Main engines incl. prop., shafting, and bearings	116	13.15	185.9 a
Auxiliaries incl. air pumps, and generators	25	9.92	170.4 a
Heat exchangers incl. condensers	8	17.65	186.5 a
Piping in engine room incl. manifolds, and liquids	19	8.48	173.8 a
Misc. items in engine room incl. tanks, spare gear etc.	8	16.78	189.2 a
TOTAL Engine Room	176	12.55	182.3 a
Boilers incl. 58 L.T. water	169.5	20.97	162.8 a
Uptakes, stack fans, air heater	18	33.75	162.4 a
Boiler room piping, valves, and fittings	4.5	21.2	154.8 a
Misc. blr. rm. items incl. ash ejector, ladders, and tools	3.5	26.0	162.7 a
TOTAL Boiler Room	195.5	22.22	162.6

H-5

SUMMARY OF WEIGHTS AND CENTERS - Cont.

Referred to ♦ of LBP

Item	Wt L.tons	V.C.G.	L.C.G.
TOTAL Machinery Spaces	371.5	17.64	171.8a
Light ship	4017.0	17.38	11.45a
Deadweight at 21' draft	9529.0		
Displacement, L.T., F.W.	13546.0		
LCG = 226 + 11.45 = 237.45'			

Brief Description: Self-unloading Great Lakes bulk cargo vessel built in 1925. Twin screw; all riveted construction.

Characteristics:

LBP = 452'
B = 60'
D = 31'
H = 21'
IHP = 2 x 1000 = 2000

Deadweight = 9529 L.tons at 21' draft
Displacement = 13,546 L.tons SW at 21' draft
Gross tonnage = 6645
b = 0.858
L/D = 14.58
LBD/100 = 8140

Boilers: Three Scotch marine - 13' x 11' - 6" x 190 psi

Engines: Two - $17\frac{1}{2}$" x $28\frac{1}{2}$" x 48" x 35" steam reciprocating

Conveyor drive: 12 $\frac{3}{4}$" x 21 $\frac{1}{2}$" x 35" x 24" steam reciprocating, geared

Unloading rate: 1800 L.tons per hour (stone 90 lb/ft^3)

Boom length : 204'

Conveyors: Hold - 40" belts (two)
Elevator - 96" bucket type
Boom - 48" belt

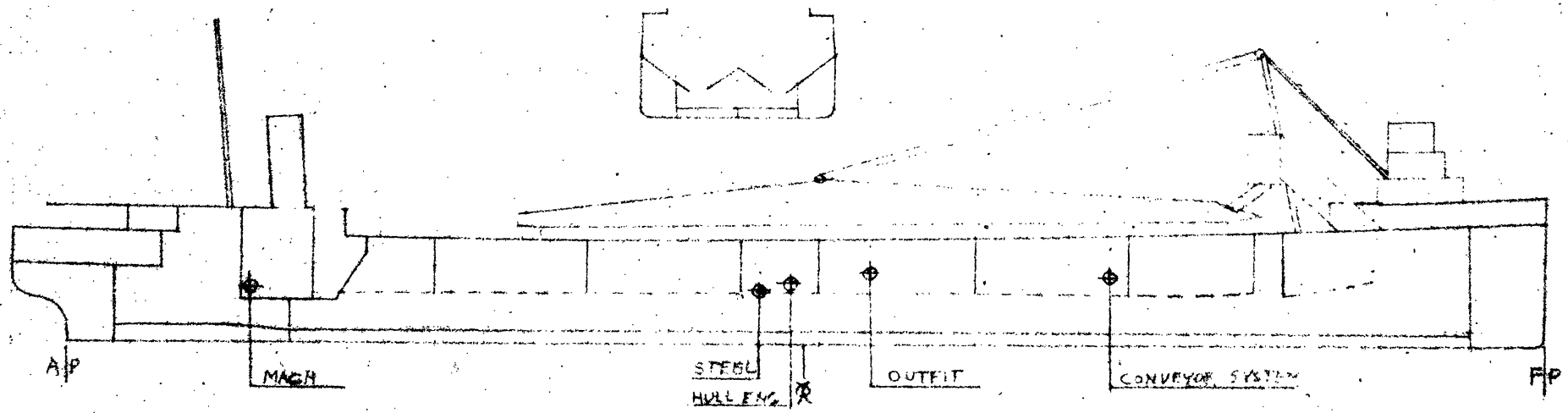


Figure 6 - Self-Unloading Ore Carrier 5 (LBP = 452')

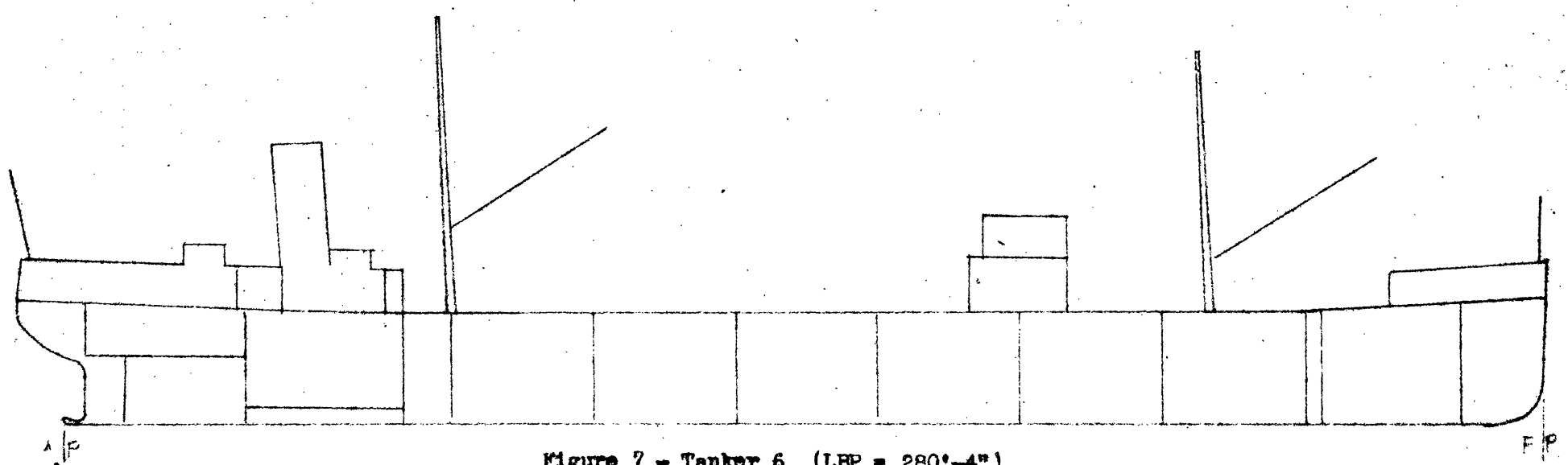


Figure 7 - Tanker 6 (LBP = 280'-4")

H-6
Tanker

	Item	Wt. S. tons	L.C.G. aft FP	V.C.G.
S	Plates and shapes	964.08	141.7	10.75
	Hull forgings and castings	11.80	141.2	12.50
	Masts	3.00	130.2	44.00
↓	Deck castings and fittings	10.39	153.6	21.20
HE	Deck machinery	10.00	40.2	23.20
	Heating system	3.00	245.2	20.00
	Sanitary and F.W. system	2.00	240.2	20.00
	Fire system (incl. Lux system)	7.00	250.2	21.00
	Bilge and ballast system	5.00	250.2	4.00
	Refrigeration system	3.00	245.2	20.00
↓	Cargo pumping equipment inc. piping	25.00	151.0	12.00
O	Booms and fittings	7.50	130.2	29.25
	Rigging	3.00	130.2	44.00
↓	Anchors and chain - Hawsers	20.00	9.2	19.00
HE	Ventilation	3.00	250.2	30.00
O	Paint & cement tile & floor covering	9.00	171.5	12.50
	Boats and davits	4.00	226.2	31.75
	Carpenter work	1.50		25.00
	Joiner work including furniture	25.00	245.2	24.00
	J oiner work insulation	1.50		26.00
	Cabin and mess outfit	17.00	250.2	24.00
	Plumbing and heating fixtures	5.00	240.2	23.00
↓	Navigating outfit	1.50		.29
HE	Water in deck piping	.50		.20
O	Miscellaneous	4.50	200.2	.10
M	Propelling engines	87.75	224.7	7.00
	Shafting & propellers (includes 2 sp.	9.60	215.9	6.00
	Heating boiler	4.00	249.2	14.50
	Stack	2.50	231.2	41.50
	Electric plant	4.00	235.2	13.00
	Auxiliaries	42.25	231.9	8.00
	Piping for propulsion machy.	5.00	220.2	8.00
	Ladders, gratings & floors	8.00	232.2	5.00
	Liquids in systems	2.63	228.4	10.00
↓	Miscellaneous	6.00	258.2	14.00
HE	Steering engine	4.00	278.2	20.00
HE	Capstan and motor aft.	1.00	271.2	26.00
	Total	1324.00 S.tons	156.1	11.80

LOA = 290'-0"
LBP = 280'-4"
$Beam_{MLD}$ = 49'-6"
$Depth_{MLD}$ = 20'-6"

H-7
River Towboat

	Item	Wt. L.tons	L.C.G. aft FP
	Hull from wt. estimate (orginal)	96.21	48
M	Engines 2-6 cyl.	30.36	40
	Cooling water pumps - 4	.40	33
	Silencers - 4	.79	26
	Heat exchanger - 4	.89	40
	Generators - 2	3.38	28
	Vertical boiler	.67	44
↓	F.O. transfer pump - 1	.09	47
HE	Refrigerator unit	.09	57
	Steering gear pumps - 2	.72	60
	Steering gear rams - 2	1.29	75
↓	Steering gear shafts, tillers etc.	1.28	90
M	Fire and bilge pump - 1	.18	51
	Air tanks - 8	.64	52
	Water tank & motor	.40	47
↓	Air compressor - 1	.18	52
HE	Pilot ho. hoist	.49	21
	Capstan - 3	1.92	12
↓	Power capstan motor & equipment	.45	12
O	Searchlights - 2	.27	16.5
M	Steady bearings - 2	.18	56.5
	Used lub. oil tank - 1	.36	43
	Lub. oil tank - 1	.89	33.5
	Piping	3.79	35
	Propellers - 2	.85	90
	Shafting	3.35	71
↓	Stern tubes with couplings	1.32	71
O	Boat & deck equipment	.13	97
FO	Fuel in fwd. tank 7400 gal.	25.05	18.5
FO	Fuel in aft tanks 3700 gal.	12.54	58.5
FW	Fresh water 2700 gal.	10.09	58.5
C	Crew 10 men at 200	.89	65
O	Furniture & room fittings	2.90	65
	Navigating equipment	.53	20
	Galley equipment	.98	51
↓	Cement & paint	.45	50
M	Switchboard	.53	26
M	Surge tanks - 2	.37	37
	Stores	4.46	68
	Misc.	2.23	50
	total	213.10	45.07

LOA = 100'-0"
Beam = 25'-0"
Draft$_{FW}$ = 5'-6" (even keel) at 213.1 L. Tons

Draft = 8'-0"
Twin Screw 600 BHP Diesel
LCB = 4.85' fwd of ℄

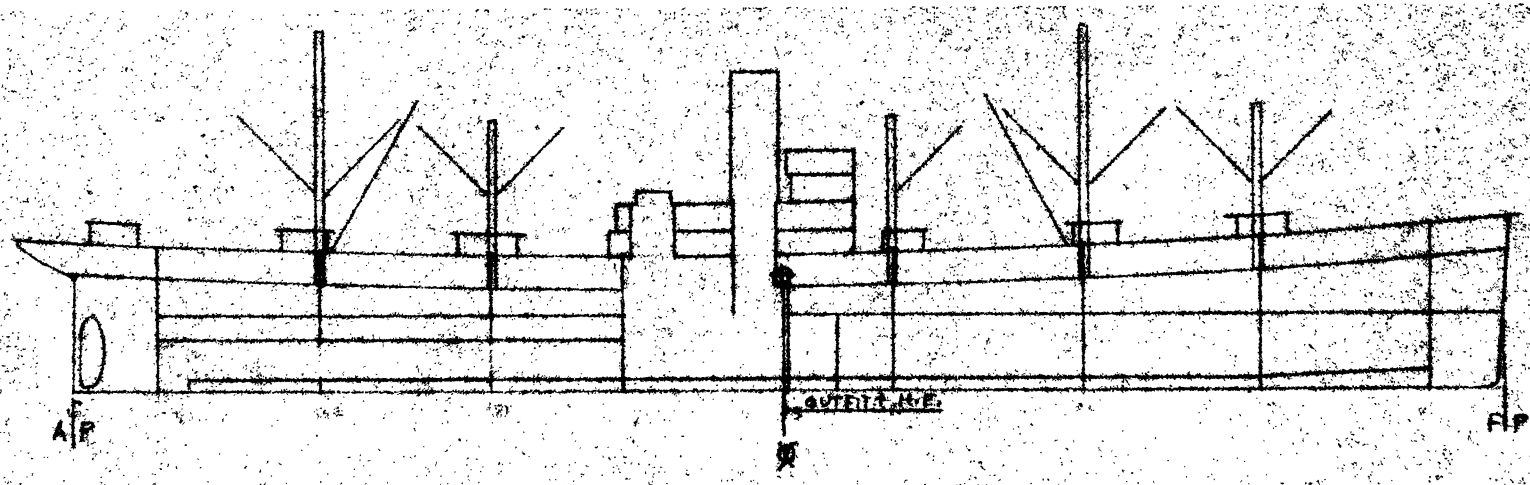


Figure 9 - General Cargo Vessel 8 (LBP = 450')

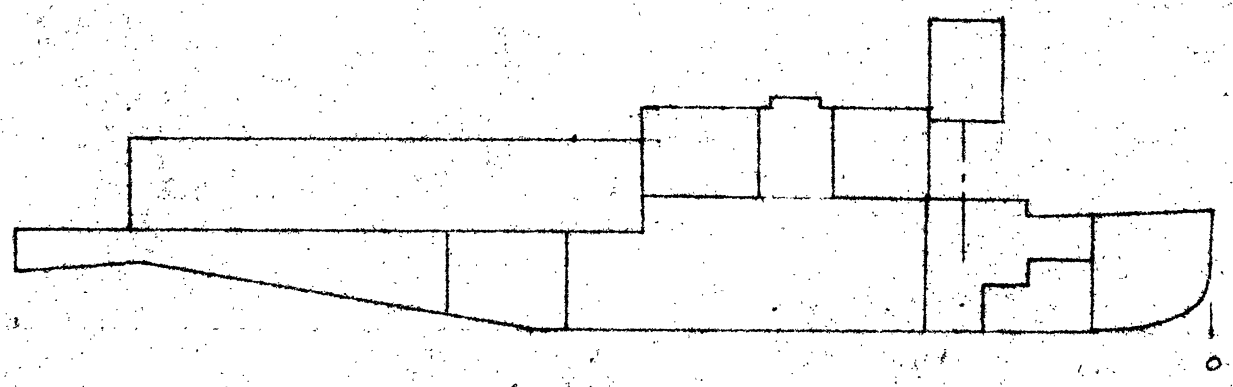


Figure 8 - River Towboat 7 (LBP = 100')

H-8

General Cargo

SUMMARY - ESTIMATED	Weight	V.C.G. (ft)	Referred to ⌀ of L.B.P. L.C.G. (aft) ⌀	L.C.G. (fwd) ⌀
Hull Steel	3500.0 L.tons	23.2	5.68 ft.	
Wood & Outfit + H.Eng.	1191.0 "	37.0		0.93 ft.
Machinery - Wet	698.0 "			
Margin				
Light Ship (Wet)	5389.0 "			
HULL STEEL	lbs/1000			
Framing	1531.4	10.8		17.3
Shell	1770.6	18.4		3.8
Decks	2637.0	29.8	9.9	
Bulkheads	915.0	20.7	13.6	
Foundations	190.0	10.0	40.0	
Superstructure	575.0	49.7	20.6	
Total Plates & Shapes	7619.0	23.2	3.3	
Milling	48.0			
Rivet Heads	151.0			
Welding	70.0			
Castings & Forgings	114.0	15.9	171.5	
Total Steel	7842.0	23.2	5.68	
	3500 L.tons			
WOOD & OUTFIT	lbs/1000			
Metal Doors	19.1	39.3	22.0	
Metal Hatches	272.8	46.7		16.0
Manholes & Skylights	19.1	27.4	11.9	
Airports	11.2	52.2	20.5	
Caulked Wood Decks	66.5	54.9	17.4	
Misc. Carp. Work	147.3	18.0	-	-
Joiner Work	124.0	50.0	20.0	
HE Refrig. Spaces)	214.5	18.0	60.0	
Insulation)				
Sheet Metal Bhds.	59.6	45.0	30.0	
Paint & Cement	230.0	20.0	-	-
HE Bilge & Ballast Sys.	190.8	12.7	4.4	
Firemain	24.3	32.0	20.0	
F.W. & Plumb. Sys.)	40.7	40.8	22.3	
Scuppers & Drains)				
Liquid Cargo Sys.	21.5	12.0		1.33
Ventilation	105.6	44.8	21.0	
Electrical	81.0	40.0	10.0	
Mast & Spares	199.5	62.5		14.8
Rigging	56.5	62.5		14.8
HE Steering Gear	37.0	43.5	219.0	

H-8 - continued

Referred to ♦ of L.B.P.

Item	Weight	V.C.G.(ft.)	L.C.G.(aft) ♦	L.C.G.(fwd) ♦
WOOD AND OUTFIT*cont.	lbs/1000			
HE Winches	181.7	51.2	7.18	
Warping Gear	62.0	43.0	-	-
Anchor Gear	165.3	41.1		191.7
Rail and Awning Stan.	23.2	48.0	16.0	
Ladders + Misc. Fittings	133.0	14.0		3.4
Boats and Boat Gear	18.5	53.5	38.0	
Deck Covering	101.0	42.4	27.3	
Deck Outfit	32.1	45.0		25.0
Hotel Outfit	22.0	44.1	34.4	
Total Wood and Outfit	2668.8	37.0		0.93
	1191 Tons			
MACHINERY	lbs/1000			
Main Engine)	236.7		LOA = 473' - 1"	
Red. Gears)			LBP = 450'	
Install. Mn. Engine	4.1		B = 56'	
Main Prop. Wiring	-		D to shelter dk. 42' - 3"	
Aux. Power Gen.	43.0		H = 27'	
Main Condenser	56.1			
Pumps	70.0			
Boilers and Fittings	296.5			
Stacks and Uptakes	62.0			
Forced Draft	13.0			
Fuel Burning	12.8			
Steam Exh. + Air Piping)	65.2			
Water Piping)	95.0			
Lub. Oil Piping)	18.2			
Misc. Mach. Piping	1.2			
Oil Heating Piping	19.0			
Heating System	15.0			
Lagging	28.0			
Shafting	198.4			
Bearings	42.3			
Propellers	36.0			
Floors and Gratings	61.3			
Aux. Machinery	34.0			
Refrig. and Fire Ext.	46.0			
Tanks	20.0			
Tools and Instruments	42.0			
Spares				
Total Machinery - Dry	1515.8			
Water-Boilers	23.5			
Misc.	22.9			
Total Machinery - Wet	1562.2			
	698 Tons			

Cargo-Pass.

Referred to ℄ of 605'

	Item	Weight	V.C.G.(ft.)	L.C.G.(aft) ℄	L.C.G. (fwd) ℄
	SUMMARY - ESTIMATED				
	Hull Steel	8544.0 L. tons	33.91	20.9	
	Wood and Outfit	4103.0 "	52.65	30.7	
	Machinery (Wet)	2390.0 "	20.35	76.2	
	Margin				
	Light Ship (Wet)	15037.0 "			
	HULL STEEL	lbs/1000			
	Framing	2400.0	12.35		1.83
	Shell	4035.3	23.53	4.0	
	Decks	6343.8	39.71	27.22	
	Bulkheads	2478.2	23.75	13.21	
	Foundations	430.0	24.8	66.3	
	Superstructure	2600.8	68.7	32.15	
	Total Plates Shapes	18288.2	34.16	18.0	
	Milling	214.2			
	Rivet Heads	411.3			
	Welding	-			
	Castings and Forgins	224.3	13.5	261.5	
	Total Steel	19138.0	33.91	20.9	
		8544 Tons			
	WOOD AND OUTFIT	lbs/1000			
	Metal Doors	84.7	36.6	38.3	
	Metal Hatches	147.5	44.3	1.35	
	Manholes Skylights	43.7	29.2	29.9	
	Airports	156.7	63.05	16.3	
	Caulked Wood Decks	724.1	71.0	67.7	
	Misc. Carp. Work	265.2	20.3		60.7
	Joiner Work	1363.0	58.6	40.25	
HE	Refrig. Spaces	576.3	29.45	192.0	
HE	Insulation	109.8	44.7	48.8	
	Sheet Metal Bhds.	451.0	51.8	63.5	
	Paint and Cement	334.8	28.25	53.25	
HE	Bilge Ballast Systems	341.4	13.05		4.3
	Firemain	65.0	43.0	6.0	
	F.W. Plumbing Systems	208.3)	50.0	24.2	
	Scuppers and Drains	250.6)			
	Liquid Cargo System	-	-	-	
	Ventilation	515.8	62.2	64.2	
	Electrical	325.0	46.9	28.4	
	Masts and Spares	103.4	88.9	41.8	
	Rigging	45.7	89.4	70.6	
HE	Steering Gear	71.0	24.5	274.0	

H-9 - continued

Referred to ℄ of 605'

	Weight	V.C.G.(ft)	L.C.G.(aft) ℄	L.C.G.(fwd) ℄
WOOD & OUTFIT - cont.	lbs/1000			
HE Winches	171.3	62.3	12.3	
Warping Gear	154.4	59.8		4.4
Anchor Gear	352.5	47.3		289.4
Rail & Awning Stan.	75.0	70.4	81.7	
Ladders & Misc. Figs.	96.9	38.9	60.0	
Boats & Boat Gear	320.1	86.4	9.0	
Deck Covering	853.2	50.0		1.1
Deck Outfit	53.4	55.0	20.0	
Hotel Outfit	930.0	60.0	25.0	
Total Wood & Outfit	9190.9	52.65	30.7	
	4103 Tons			
MACHINERY	lbs/1000			
Main Engine)	640.0	14.26	146.5	
Red. Gears)				
Install Mn. Engine				
Main Prop. Wiring				
Aux. Power Gen.	117.0	24.65	110.7	
Main Condenser	153.0	18.0	139.5	
Pumps	159.3	12.2	100.8	
Boilers & Fittings	1907.0	16.6	12.0	
Stacks & Uptakes	273.0	78.0	12.0	
Forced Draft	50.0	14.4	12.0	
Fuel Burning	63.8	13.96	14.23	
Steam Exh. & Air Piping)				
Water Piping)	366.2	19.1	88.9	
Lub. Oil Piping				
Misc. Mach. Piping	12.0	20.5	139.5	
Oil Heating Piping	9.0	5.0		6.0
Heating System	63.0	80.0		66.0
Lagging	45.0	20.3	76.2	
Shafting	318.5	11.1	230.0	
Bearings	103.0	10.7	246.0	
Propellers	66.0	9.5	291.0	
Floors & Gratings	170.0	9.0	30.0	
Aux. Machinery)	357.0	21.4	127.0	
Refrig. & Fire Ext.)				
Tanks	35.7	28.3	132.0	
Tool & Instruments	55.5	24.05	106.0	
Spares	(119.6 Not in Dry W.T.)			
Total Machinery - Dry	4964.0	20.45	77.0	
Water-Boilers)	269.0	18.5	55.7	
Misc.)				
Total Machinery - Wet	5352.6	20.35	76.2	
	2390.0 Tons			

LOA = 631'-6"
LBP = 605'-0"
B = 79'
H = 27'
D to D dk. = 44'-6"
D to C dk. = 52'-9"

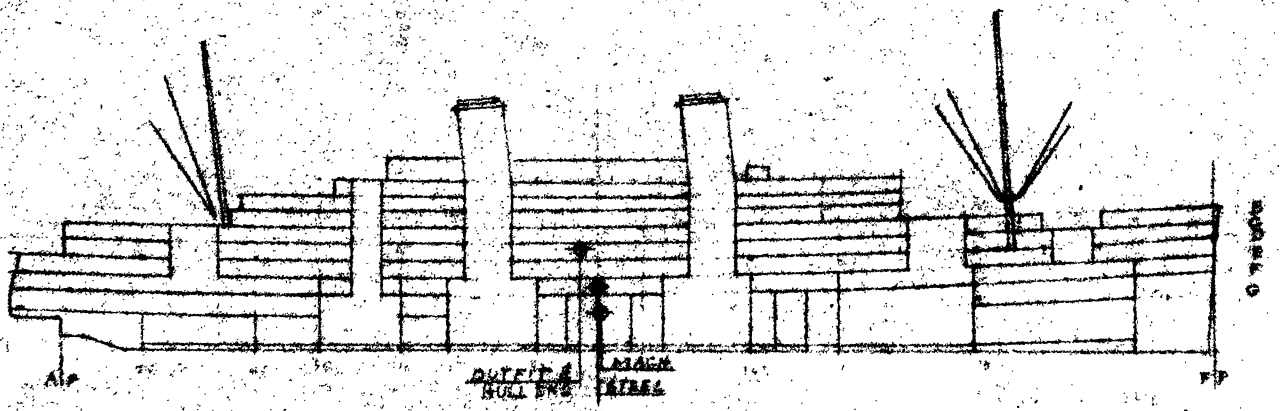


Figure 10 - Cargo-Passenger Vessel 9 (LBP = 605')

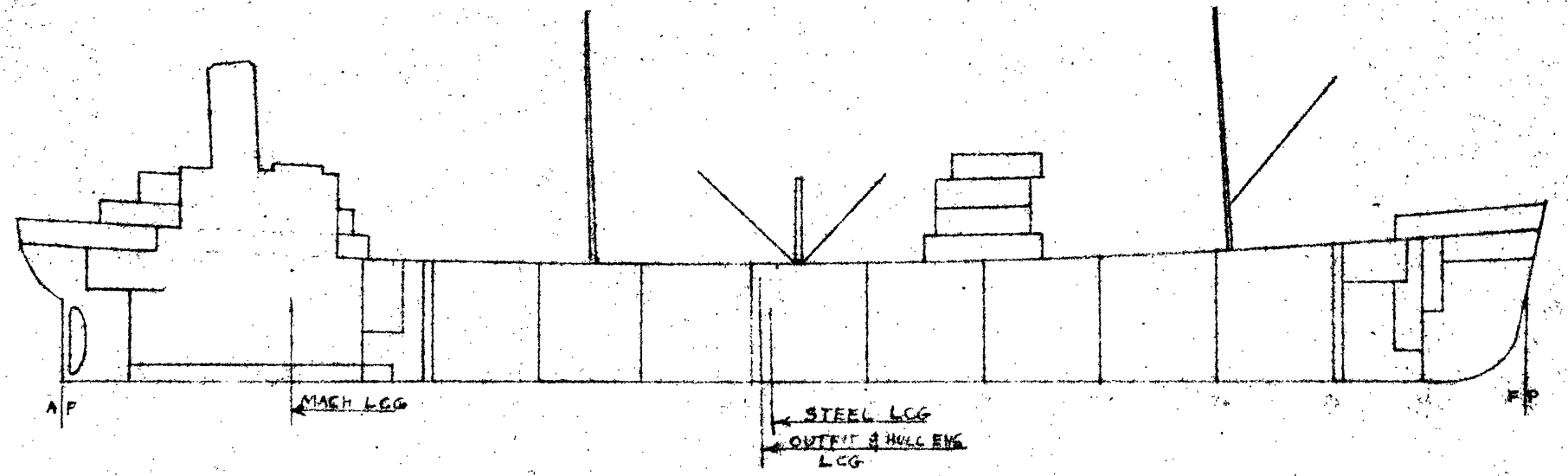


Figure 11 - Tanker 10 (LBP = 442')

H-10

Tanker - 13,000 tons

Referred to ℄ of L.b.P.

ITEM	Weight	V.C.G.(ft.)	L.C.G.(aft) ℄	L.C.G.(fwd) ℄
SUMMARY - ESTIMATED				
	Tons			
Hull Steel	2897.0		7.38	
Wood & Outfit	606.0		10.14	
Machinery (Wet)	517.0		152.0	
Margin				
Light Ship (Wet)	4020.0		26.4	
HULL STEEL				
	lbs/1000			
Framing	1352.9			6.95
Shell	1701.1			1.7
Decks	1239.0		15.5	
Bulkheads	1481.5			23.4
Foundations	115.0		123.5	
Superstructure	482.0		92.7	
Total Plates & Shapes	6371.5		4.88	
Milling	50.0			
Rivet Heads	95.0			
Welding	70.0			
deduct:	61.0 Rivets			
	128.5 Lightening			
Castings & Forgings	93.0		179.5	
Total Steel	6490.0		7.38	
	2897 Tons			
WOOD & OUTFIT				
	lbs/1000			
Metal Doors	11.4		79.0	
Metal Hatches	45.0			64.0
Manholes & Skylights	16.6		145.0	
Airports	11.1		68.5	
Caulked Wood Decks)				
Misc. Carp. Work)	116.0		77.0	
Joiner Work)				
HE Refrig. Spaces)				
Insulation	8.0		158.0	
Sheet Metal Bhds.				
Paint & Cement	123.0		-	-
HE Bilge & Ballast Sys.	78.3		7.4	
Firemain	21.1		52.0	
F.W. & Plumbing Sys.	15.7		127.0	
Scuppers & Drains	16.2		93.0	
Liquid Cargo Sys.	263.2		21.5	
Ventilation	49.2		105.0	
Electrical	65.1		82.0	
Masts & Spares	37.8			31.0

H-10 - continued

	Weight	V.C.G.(ft.)	Referred to ℄ of L.B.P. L.C.G.(aft)	L.C.G.(fwd)
WOOD & OUTFIT - cont.	lbs/1000			
Rigging	8.7			31.0
HE Steering Gear	26.5		208.0	
HE Winches	32.4		37.4	
Warping Gear	27.0		37.6	
Anchor Gear	181.5			195.0
Rail & Awning Stan.	16.5		20.0	
Ladders & Misc. Fittings	72.0			
Boats & Boat Gear	27.1		40.5	
Deck Covering	62.0		107.0	
Deck Outfit	13.2		54.0	
Hotel Outfit	11.5		180.0	
Total Wood & Outfit	1356.0		10.14	
	606 Tons			
MACHINERY			Referred to frame 48	
	lbs/1000			
Main Engine)	139.9		38.9	
Red. Gears)				
Install. Main Engine				
Main Prop. Wiring				
Aux. Power Gen.	45.0		38.9	
Main Condenser	27.2		32.2	
Pumps	104.0		23.6	
Boilers & Fittings	262.0		64.3	
Stacks & Uptakes	35.0		65.0	
Forced Draft	5.0		64.0	
Fuel Burning	16.5		64.0	
Steam Exh. & Air Piping	40.0		47.6	
Water Piping	39.3		45.3	
Lub. Oil Piping	8.9		47.6	
Misc. Mach. Piping	22.5			90.0
Oil Heating Piping	35.7			138.0
Heating System	9.5			23.2
Lagging	30.0		46.0	
Shafting	58.3		78.8	
Bearings	15.6		91.5	
Propellers	25.0		104.0	
Floors & Gratings	66.0		52.0	
Aux. Machinery	40.0		47.0	
Refrig. & Fire Ext.	22.0		35.9	
Tanks	30.0		32.0	
Tools & Instruments	10.0		54.3	
Spares				
Total Machinery - Dry	1107.5		39.6	
Water - Boilers)	51.5		54.5	
- Misc.)				
Total Machinery - Wet	1159.0		40.4 (152'	Aft ℄ LBP)

LBP = 442'
B = 64'
D = 34'-10"
H = 28'-4"

Frame 48 is 109'-3" fwd. of AP
LOA = 643'-1"

Refrigerated Cargo Vessel

STEEL WEIGHTS

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Wt/ft² ℄	Dimension Factor F	Wt in tons / F
STEEL BELOW MAIN SCANTLING ITEMS:								
Trans. fr. in D.B.	129.19	198.1	2.5	1067	0.629	18.35	(L/100)(B+d) = 280.9	0.460
Trans. fr. outside D.B.-incl. beam brkt.	150.00	239.2	19.1	621	1.255	9.76	(L/100)(2D) = 306	.490
Longl. fr. in D.B.-incl. ℄ pipe tunnel	52.33	176.9	2.6	209	1.301	3.59	(L/100)(kd) = 53.9	.971
Longl. fr. outside D.B. " " "	-	-	-	-	-	-	-	-
Shell pltg. & F.P.K.	618.78	222.6	14.9	3547	.907	29.13	(L/100)(B+2D) = 568.9	1.09
I.B. and margin	121.90	205.9	4.5	1154	.549	20.58	(L/100)(B) = 262.9	.464
Orlop deck pltg., beams, etc.	121.66	234.0	13.4	1277	.495	21.00	" "	.463
Lower " " " "	124.68	227.6	21.2	1332	.486	21.84	" "	.474
Main " " " "	192.12	234.1	29.1	1430	.698	23.44	" "	.731
Upper " " " "	254.79	244.5	37.1	2010	.659	33.16	" "	.969
Total of Main Scantling Items	1765.44	225.2	18.4	12647	.725	-	(L/100)(B+ 2D)=568.9	3.103
INTERNALS:								
Stem, stern fr. and struts etc.	52.48	380.0	11.7					
Trans. W.T. & O.T. bhds.	136.82	235.3	20.0					
Longl. W.T. & O.T. bhds.	49.23	266.6	12.0					
Misc. bhds. to upper dk. & mach. casings	15.71	274.1	24.2					
Girders	38.87	226.8	26.0					
Pillars	39.77	178.9	19.3					
Eng. & boiler found.	22.90	222.5	5.4					
Aux. foundations	34.74	278.8	18.4					
Machinery flats	24.80	244.6	18.5					
Vent. ducts	2.66	225.3	34.1					
Bilge keel, docking keel & fender	3.35	224.3	4.0					
Misc. - expanded metal bhds. & trks	4.82	304.7	29.7					
Match beams, coamings, H webs etc.	28.18	248.2	30.3					
Swash bulkheads	1.58	326.8	8.3					
Total internals	455.91	255.0	18.5					
Net steel below upper deck	2221.35	231.3	18.4					
Rivet heads & welds 2-1/2%	55.53	-	-					
Tolerance 1/2%	11.12	-	-					
TOTAL STEEL BELOW UPPER DECK	2288.00	231.3	18.4					

	Cu.No. LxBxD= 9,333	Wt/ft (L/100)(B+2D) = 12,647 × 568.92	(L/100)(nB+2D) = 1883.5
Coeff. of Mn. Sc. Items	0.189	0.725	3.103	0.937
Steel below coeff.	.245	.940	4.022	1.215
Total steel coeff.	.309	1.186	5.071	1.532

k = No. of double bottom longitudinals incl. CVK = 3
d = Depth of double bottom at center line = 6'
n = No. decks + inner bottom + shell = 6

STEEL WEIGHTS - cont.

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.
STEEL ABOVE UPPER DECK:			
Trans. fr. & brkts. - up.to br.dk	16.21	120.0	41.5
Shell plating	57.90	145.6	42.3
Bridge dk. pltg., beams etc.	162.30	158.4	45.4
Officers dk. pltg., beams, etc.	36.56	207.8	52.2
Navig. dk. pltg. beams, etc.	11.62	177.6	60.2
Top of Nav. dk. house	6.69	176.0	68.2
Tops of misc. houses - resis etc	6.90	343.1	48.0
Dk. houses up to bridge dk.	16.48	237.2	41.4
" " br. to officers	23.78	176.4	48.8
" " officers to nav. br.	7.05	177.2	56.4
" " nav. br. to top of house	4.64	177.3	63.8
Misc. bhds. above upper dk.	67.07	219.8	45.4
W.T. bhds. above up. deck	5.37	104.6	42.5
Machinery casings	20.22	217.4	46.0
Girders	7.14	138.0	50.3
Pillars	18.67	117.8	42.4
Hatch coaming & beams	11.51	107.9	47.0
Vent ducts	2.13	180.8	51.4
Bulwarks, curtain pl. & stanch.	16.00	128.9	46.0
Masts & derrick posts	59.90	216.0	62.5
Misc. - exp. metal bhds. & skylight coaming	.66	244.5	49.5
Aux. foundations	17.56	183.9	42.6
Net steel above upper dk.	576.36	180.5	48.0
Rivet heads & welds 2-1/2%	14.41		
Tolerance 1.08%	6.23		
TOTAL STEEL ABOVE UPPER DK.	597.00	180.5	48.0
TOTAL STEEL	2885.00	220.8	24.5

LOA = 455'-5"
LBP = 431'-0"
B_{mld} = 61'-0"
D = 35'-6" to upper deck
k = 3'; d = 4'-2"
n = 6
H = 27'-0" scantling
Δ = 12,624 L.tons
H/D = 0.7606
L/D = 12.1408
$\frac{\Delta}{(L/100)^3} = 157.68$
l = 0.6285
m = 0.9551
b = 0.6002

WOOD & OUTFIT Items:	Wt. in Wt. in L. tons	L.C.G. aft FP	V.C.G.
Rudder	26.44	432.5	15.1
Doors, hatches, scuttles etc.	40.48	228.4	36.5
Bitts, chocks, hawse pipes	38.69	197.4	44.3
Trolleys, hoists, & davits	.52	384.0	26.7
Draft marks, gratings, covers etc.	9.51	378.3	26.2
Airports & fixed lights	4.54	214.1	43.9
Deck drains, scuppers etc.	20.78	218.5	21.9
Caulked wood decks	98.42	248.9	44.6
Ceiling, battens, hatch covers etc.	69.62	199.6	31.1
Booms, yard arms, rigging & canvas	33.33	197.5	64.6
Ladders, rails, & stanchions	23.97	219.4	45.8
Boats, boat davits, & stowage	17.47	245.8	54.7
Joiner work in public spaces	5.20	165.9	43.6
Joiner work in stairways	2.93	208.1	39.8
Joiner work in pass. accomodations	9.11	175.5	50.8
Joiner work in crew, officer, & ship sp.	26.87	224.0	49.8
Joiner doors & frames	9.32	216.0	45.2
Furniture	18.28	218.0	47.5
Labeling & padlocks	0.07	220.0	48.0
Windows	3.47	205.8	51.5
Refrig. spaces	657.11	206.3	21.6
Deck covering	98.93	201.9	40.7
Insulation - heat, sound, & fire	19.03	222.3	39.1
Galley, pantry & scullery equip.	5.92	185.4	37.5
Equip. for utility shop spaces	0.94	240.5	26.3
Stowage & lockers	7.72	217.6	33.0
Deck & navig. outfit	3.61	182.6	53.7
Stewards outfit	8.77	218.0	44.6
Paint, decoration & cement	50.05	-	-
Anchors, chains, & lines	58.90	61.1	36.2
TOTAL W & O	1370.00	208.6	29.9

HULL ENGINEERING

Item	Wt.in lbs.
Steering engine	45,000
Steering gear, piping etc.	3,000
Windlass	35,000
Capstan - 4	50,000
Deck winches - 12	100,000
Accom. ladder winches - 2	5,000
Sliding WT doors - 3	5,000
Oil & water separator	5,500
Drainage system	100,000
Tank gauges	1,000
FW & SW systems	17,000
Firemain	30,000
Fire detecting & exting. sys	25,000
Hose racks & reels	1,500
Plumbing dr. & soil pipes	20,000
Plumbing fixtures	6,500
Steam heating system	8,000
(CONT.)	

	Wt.in lbs.
Misc. piping sys.	7,000
Generators	67,000
Switchboards & panels	25,000
Power wiring	50,000
Light wiring & fixtures	30,000
Inter commun. system	25,000
Mech. I.C. system	500
Radio	2,000
Cable racks	5,000
Refrig. machinery	400,000
Refrig. piping	210,000
Cargo cooling fans -18	60,000
Ventil. ducts	56,000
Ventil. fans & heaters	31,200
Total HE	1,426,200
Say	640 L. tons
Water	18 L. tons
	658 L.tons

Machinery (dry)	935
Water	62
Total mach. wet	997

SUMMARY

Item	Wt. in L. tons	L.C.G. aft FP	V.C.G.
Steel hull	2885	220.8	24.5
Wood & outfit	1370	208.6	29.9
Total hull	4255		
Hull eng. dry	640		
Water in HE	18		
Machinery dry	935		
Water in mach.	62		
Light ship (inclined)	5910	226.5'	25.3'
CONDITIONS - Full banana cargo & full tanks			
Pass. crew, & stores	50	205.5	48.0
Banana cargo at 110 cu. ft.	2815	206.4	25.6
Special refrig. cargo at 110 cu. ft	15	254.1	31.9
F.O. settling tanks 1/2 full	93	203.0	10.9
F.O. storage tanks full	1320	205.2	3.9
Fresh water full	172	346.1	8.8
Res. feed water full	137	336.5	5.9
#Aft peak SW	101	418.3	18.8
Total displacement	10613 L.T. SW	223.5	22.2
L.C.B. = 3.84' fwd.		L.C.G. = 0.55' fwd	Trim = 33'
#Deduct SW in AP			
Displacement	10512	221.6	22.2

LCB = 3.95' fwd. ℄ of 448' W.L.
LCG = 2.43' fwd.
trim = 15"
Mean draft = 22'-10 1/2"
GM (corr) = 2.67'

OTHER CONDITIONS - Full general cargo & full tanks

General cargo at 80 cu. ft.	3873	206.4	25.6
Other items same as above except no SW ballast			
Total displ. - no SW ballast	11671 L.T. SW	221.9	22.5

LCB = 2.75' fwd.
LCG = 2.10' fwd.
trim = 7"
Mean draft = 24'-11"
GM (corr) = 2.50'

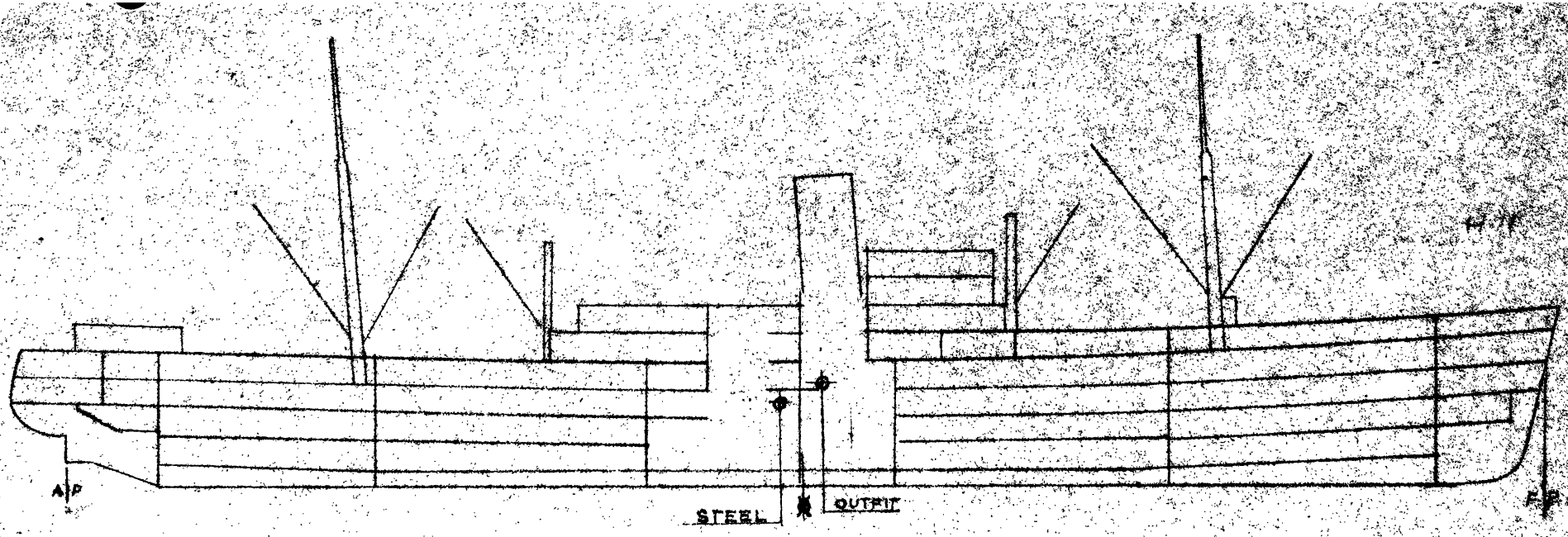


Figure 12 - Refrigerated-Cargo Vessel 11 (LBP = 431')

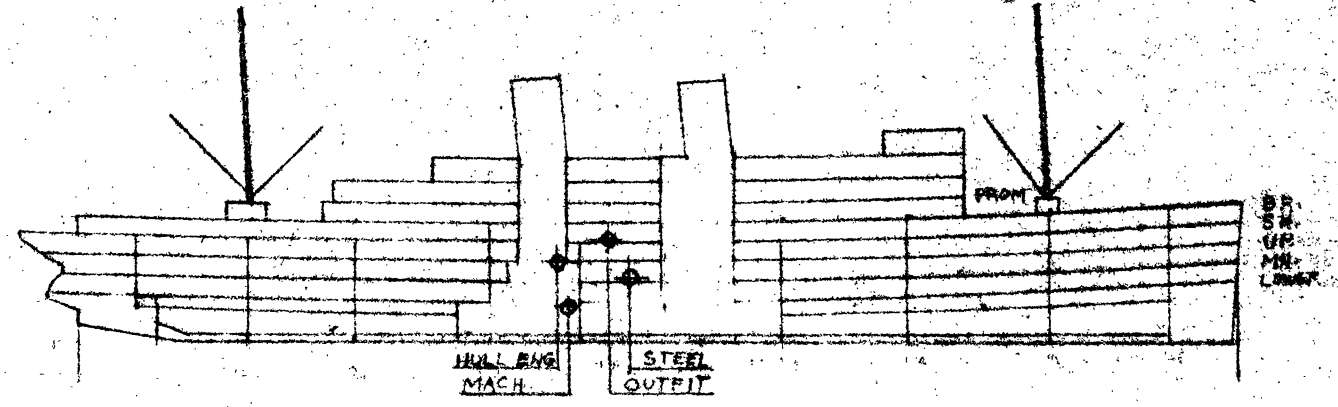


Figure 13 - Passenger-Cargo Vessel 12 (LBP = 615')

STEEL WEIGHTS — Passenger Cargo

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Wt/ft² ℄	Wt/ft net	Dimension Factor F	Wt in tons F
STEEL BELOW MAIN SCANTLING ITEMS:									0.867
Trans. fr. in D.B.	458	283.94	2.65	2398	0.684	28.68	34.27	(L/100)(B+d) = 529	[illegible]
Trans. fr. outside D.B.	398	326.62	23.89	1153	1.258	12.01	12.53	(L/100)(2D) = 642	.622
Longl. fr. inside D.B.	180	269.04	2.73	747	.876	5.38	13.49	(L/100)(kd) = 154.4	1.169
Shell plating & F.P.K.	1770	314.32	20.11	6864	.940	37.67	39.22	(L/100)(B+2D) = 1138	1.554
I.B. and Margin	370	291.76	5.04	2029	.664	24.3	27.7	(L/100)(B) = 498	.742
Shelter dk. plating, beams etc.	510	338.5	53.72	1829	1.005	23.2	29.2	" "	1.023
Upper dk. plating, beams, etc.	417	331.4	43.72	1747	.870	22	24.6	" "	.837
Main dk. plating, beams, etc.	375	327.2	34.5	1686	.810	20.95	24.2	" "	.752
Lower dk. plating, beams, etc.	212	338.26	26.4	1735	.445	21.4	23.2	" "	.425
Orlop dk. plating, beams, etc.	240	342.12	18.21	1736	.504	21.4	31.1	" "	.481
Total	4930	316.5	23.78	21924	.818			(L/100)(B+2D) = 1138	4.33
INTERNALS:									
Stem, stern fr. and struts	68	520	14.3						
Trans. bhds.	790	329.68	20.92						
Cofferdams	29	336.25	30.62						
Misc. bhds.	249	370	42.6						
Machinery casings	47	323.02	44.15						
Pillars & girders	223	329	35						
Hatch coamings & end beams	110	265	31.4						
Pipe tunnel	64	213.77	13.04						
Engine & boiler found.	185	365	8.5						
Aux. mach. found.	75	350	23.5						
Mach. flats	27	374.1	22.34						
Bilge keel	10	335	2.95						
Misc. steel and pipe boxing	14	298	25						
Stringers	19	331.23	22.74						
Total internals	1910	338.62	25.09						
Net steel below shelter deck	6840	322.67	24.14						
Rivet heads & welds & tol. 3.15%	215								
TOTAL STEEL BELOW SHELTER DECK	7055	322.67	24.14						

	Cu.No. LxBxD= 25,904	Wt/ft 21,924	(L/100)(B+2D) = 1138	(L/100)(nB+2D) = 4127
Coeff. of Mn. Sc. Items	0.1903	0.818	4.33	1.195
Steel below coeff.	.2724	1.171	6.20	1.71
Total steel coeff.	.3498	1.50	7.93	2.19

k = No. of double bottom longitudinals incl. CVK = 5
d = Depth of double bottom at center line = 5'
n = No. decks + inner bottom + shell = 7

STEEL WEIGHTS - cont.

Item	Wt.L tons	L.C.G. Aft F.P.	V.C.G.
STEEL ABOVE:			
Trans. fr.	36	233.4	61.47
Shell plating etc.	195	270.5	60.02
Bridge deck beams	505	310	62.6
Prom deck beams	220	302	70.81
Boat deck beams	155	295	82.25
Sun deck beams	69	286	92.3
House top & tourist lounge	31	498	71.3
Dk. houses - shelter to bridge	158	333.9	58.47
Dk. houses bridge to prom.	95	321.4	66.94
Dk. houses prom to boat	121	329.5	77.33
Dk. houses boat to sun	43	267.1	88.84
Machinery casings	72	325.9	70.81
Pillars & girders	82	286.7	70.49
Hatch coamings & end beams	18	401	64.15
Bulwarks etc.	22	176	81.35
Masts & derrick posts	60	320	89.10
Skylights	21	293.1	94.83
Net steel above main deck	1903	306.5	69.67
Rivet heads, welding & toler. 3.52%	67		
Total steel above shel. dk.	1970	306.5	69.67
TOTAL STEEL	9025	319.14	34.08

LBP = 615
B = 81'
D = 52' shelter deck
k = 5; d = 5
n = 7
H = 32' design; 33'-8" scantling
Δ = 31,441 at 32' draft
H/D = 0.647
L/D = 11.81

$$\frac{\Delta}{(L/100)^3} = 135$$

l = 0.677
m = 0.987
b = 0.669

WOOD AND OUTFIT

Item	W&O Above & Below Shelter Deck			W&O Above Shelter Dk.			W&O Below Shelter Deck		
	Wt L tons	LCG aft	FP VCG	Wt L tons	LCG aft	FP VCG	Wt L tons	LCG aft	FP VCG
13. Fittings by fitters	115	287.6	53.6	49	293.1	73.3	65	283.5	38.5
14. Fittings by ship carp.	177	329.8	76.4	160	356.5	79.3	17	78.0	49.3
15. Fittings by plumbers	95	321.1	62.5	60	297.5	73.5	35	361.5	43.8
16. Rudder	36	618.5	18.8	-	-	-	36	618.5	18.8
17. Cement	155	221.6	22.1	25	204.0	72.3	130	225.0	12.5
18. Carpenter work	380	339.8	67.3	285	347.5	74.3	95	316.5	46.3
19. Wood foundations & fenders	15	313.6	64.7	12	281.5	70.0	3	442.0	43.5
20. Joiner decks	1	164.0	101	1	164.0	101	-	-	-
21. Joiner work	650	334.5	61.6	440	314.0	70.0	210	360.3	43.8
22. Decorative joiner work	45	276.3	77.2	35	259.0	85.3	10	345.7	44.8
23. Paint	200	325.0	43.0	-	-	-	200	325.0	43.0
24. Rigging	41	296.7	104	40	299.0	106	1	203.0	38.0
241. Canvas work	4	390.0	78.3	4	390.0	78.3	-	-	-
25. Deck covering	815	344.1	53.5	480	315.5	63.5	335	385	39.3
26. Heat insulation	60	346.7	40.5	8	319.0	34.3	52	351.0	41.5
27. Portable furniture	135	345.7	57.8	90	307.5	64.8	45	422.0	44.0
28. Steward's outfit	82	354.4	51.3	35	335.0	62.8	47	368.0	43.3
29. Deck & navigating outfit	11	260.0	68.5	8	185.0	77.3	3	460.0	45.3
30. Lifeboats & rafts	45	355.0	87.3	45	355.0	87.3	-	-	-
31. Anchors, cables, & hawsers	130	60.7	38.6	10	255.0	67.3	120	44.5	36.3
32. Refrigeration cargo insulation	255	439.5	27.8	-	-	-	255	439.5	27.8
38. Sheet metal work	8	288.0	81.8	8	288.0	81.8	-	-	-
Ratproofing	5	275.0	12.0	-	-	-	5	275.0	12.0
TOTAL	3460	330.4	54.3	1781	320.5	70.8	1479	343.0	36.0

64

H-12 - cont.

HULL ENGINEERING

Item	Wt. L. tons
Sliding WT doors	38.8
Skylight lifting gear	5.4
Bracket fans	2.9
Punkah louvres	0.4
Ventilation ducts - mech.	49.2
Ventilation fans	31.7
Electric heaters, etc.	2.3
Heating system	62.5
Steering engine	38.0
Steering gear	8.3
Auxiliary steering gear	2.0
Oil & water separator	5.6
Drainage system	85.7
FW & SW system	145.0
Firemains	30.2
Hose reels	1.4
Plumbing fixtures	44.7
Hand pumps	0.2
Fire detecting system - Rich CO_2	0.5
Boiler room extinguishing system - CO_2	7.9
Laundry machinery	6.7
Windlass	53.5
Capstan	27.0
Boat winches	7.6
Deck winches	76.0
Elevators	20.0
Dumb waiters	1.3
Refrigeration machinery	160.0
Refrigeration piping, lagging etc.	27.9
Generators & engines	69.6
Switchboards & wiring	96.0
Searchlights & fixtures	8.9
Inter communication system	8.9
Gyro compass, fathometer etc.	2.7
Radio & batteries	5.4
Pneumercators	0.8
TOTAL HE	1115.0

H-12

SUMMARY

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.
Hull steel	9025	319.25	34.1
Wood & outfit	3460	330.4	54.3
Margin	160		
Total Hull	12645	322.37	39.71
Hull engineering	1115	356.13	42.06
Machinery	2340	350.62	19.64
Light ship	16100	328.88	36.93
Fuel oil	5020	261.80	11.75
Fresh water	1908	452.0	8.83
Make up feed water	412	374.9	2.59
Stores	450	374.2	40.2
Passengers, crew, & effects	160	315.0	55.0
Mail	130	497.4	21.5
Automobiles	70	138.0	48.0
Coconut oil	1222	228.7	19.76
Swimming pool water	148	485.0	67.78
Refrigerated cargo	700	438.4	28.14
General cargo	7029	252.1	27.30
Total displacement Full load leaving port	33350 L. tons	311.4	28.65

Draft Forward	33' - 10-1/2"
Draft Aft	34' - 1-1/2"
Mean Draft	34' - 0"
Moment to trim 1"	3400 Ft. Tons
Tons per inch	95
GM (Corrected)	3.80
T	15.64 sec.

PASSENGERS AND CREW:

First class	304 in 104 rooms
Tourist class	150 in 44 rooms
Steerage class	800
Total pass.	1254
Crew	325
	1579

LBP = 615'-0"
B = 81'
D = 52' to shelter deck

H-13 - BAY STEAMER

STEEL HULL 595 L. tons
(detail steel weights not available)

WOOD & OUTFIT

Item	Wt. in L. tons
13. Ports, doors, ladders, skylights & covers	7.1
14. Bitts, chocks, davits, hawse pipes & stanchions	18.4
15. Airports, fixed lights, & rails	5.5
16. Rudder	3.4
17. Cement	4.0
18. Carpenter work	129.4
19. Wood foundations etc.	12.7
20. Joiner decks	46.5
21. Joiner work	132.2
22. Decorative joiner work	2.2
23. Paint	26.8
24. Rigging	.9
241. Canvas work	.2
25. Deck covering	59.3
26. Heat insulation	2.4
27. Portable furniture	19.8
28. Steward's outfit	1.7
29. Deck & navigating outfit	2.3
30. Lifeboats & rafts	6.8
31. Anchors, etc.	9.6
38. Sheet metal work	5.2
Margin	3.6
TOTAL WOOD & OUTFIT	500.0

HULL ENGINEERING

Item	Wt. lbs.	Wt. L.tons	L.C.G. aft FP	V.C.G.
Skylight lifting gear	800	0.4	152	40
Heating system	25,000	11.2	137	30
Steering engine	8,300	3.7	48	24
Steering gear transmission	8,000	3.6	160	32
Auxiliary steering gear	3,000	1.3	264	32
Drainage system	7,600	3.4	144	4
Fresh & salt water system	28,000	12.5	154	29
Firemain & sprinkling system	6,000	2.7	111	25
Hose & reels	700	.3	137	35
Plumbing fixtures	24,000	10.7	154	33
Hand pumps	500	.2	137	21
Reilly heater & FW heater	500	.2	165	14.5
Windlass & capstan	7,500	3.4	14	25
Capstan aft	3,000	1.3	272	23
Deck winches	20,000	8.9	131	21
Electric generators	19,900	8.9	148	9
Switchboard & wiring	20,000	8.9	139	30
Searchlights & fixtures	5,000	2.2	132	30
Inter communication & fire alarm	6,000	2.7	137	30
TOTAL HE	193,800	(86.52 LT)	138.7	25.5
HE wet		(95.0 LT)		
Mach wet		(500 LT)		

SUMMARY

Item	Wt. in L. tons	L.C.G. aft FP	V.C.G.
Steel hull	595		
Wood & outfit	500		
Total hull	1095		
Hull engineering (wet)	95	138.8	25.5
Machinery (wet)	500	137.9	11.4
	1690	138.6	17.4
Fixed ballast forward	64	85.6	.9
Fixed ballast aft	19	182.5	1. 0
Light ship	1773	137.1	16.65
(Light ship from inclining test at mean draft = 10'-9" SW)			
GM_{LS} = 2.64' in SW			
Equipped vessel	1773	137.1	16.65
Coal - full	90	100.5	9.4
Forepeak - full fresh water	36	22.2	7.7
Aftpeak - full fresh water	40	253.4	15.6
Culinary tanks - full fresh water	37	164.7	9.0
Stores	15	72	30
Crew & effects	4	100	38.3
50 passengers & effects	5	72	30
TOTAL	2000	135.6	16.18
Cargo forward hold	70	76.8	10.55
Cargo aft hold	40	189.4	11.55
Cargo main deck	140	134.8	23.24
	2250	134.7	16.36

LOA = 277'-3"
LBP = 268'-10"
B_{mld} = 53' at dk.; 46' at 13' WL

D_{mld} = 18'

draft fwd. = 12'-9 1/4") in FW at Δ = 2250
draft aft = 13'-10 5/8")
cubic number = 2230

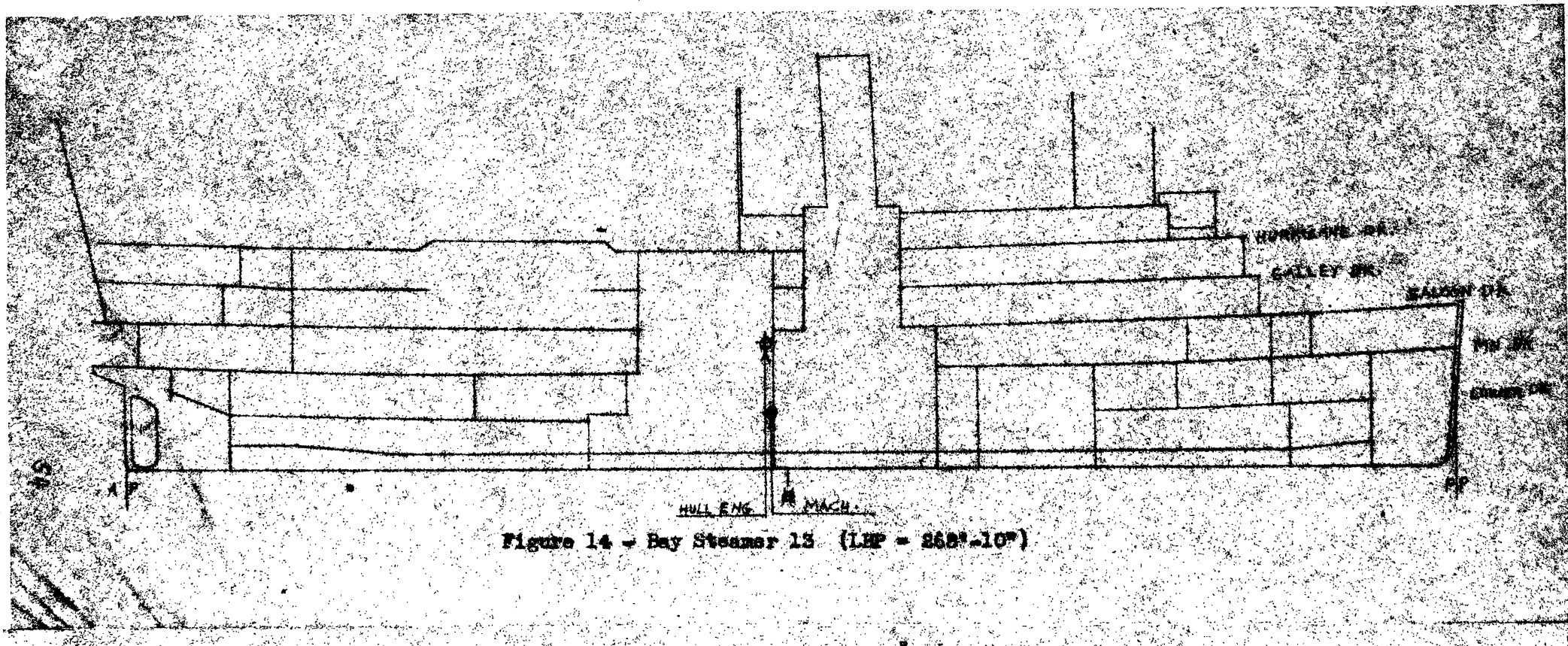


Figure 14 - Bay Steamer 13 (LBP = 268'-10")

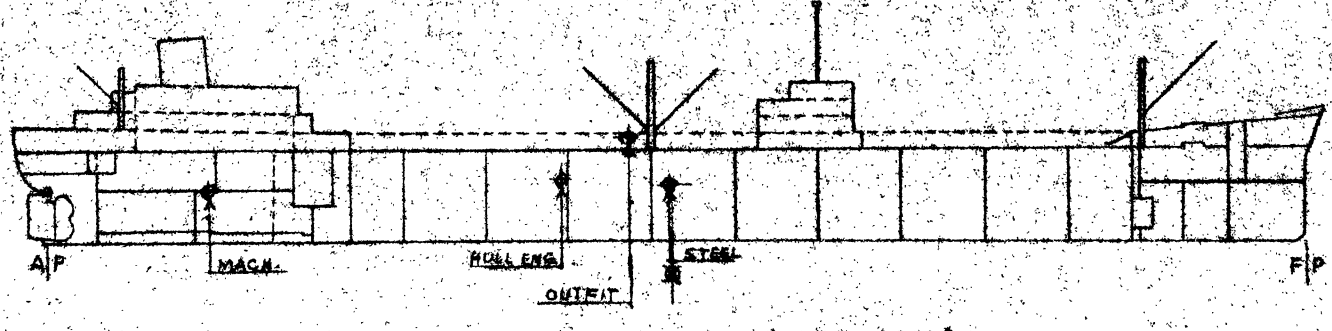


Figure 15 - Tanker 14 (LBP = 600')
(F in Reference 5)

STEEL WEIGHTS

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Wt/ft² ℄	Dimension Factor F	Wt in tons / F
STEEL BELOW MAIN SCANTLING ITEMS:								
Trans. fr. outside D.B.-incl. peak frg.	686.07	278.6	25.0	3208	0.798	1.31	(L/100)(2D+2B)=1500	0.457
Longl. fr. outside D.B.-excl. girders	363.83	269.6	9.5	1939	.701	11.94	(L/100)(B+2D)=1005	.362
Shell pltg & FPK	1465.22	287.8	13.7	6568	.833	40.46	" " " "	1.458
Upper dk plating, beams, etc.	938.69	297.1	43.4	4518	.776	54.76	(L/100)(B) = 495	.961
Twin O.T. long'l bulkheads	475.94	283.4	20.8	2558	.695	29.18	" " "	
Total Main Scantling Items	3929.75	286.2	23.2	18791	0.781		(L/100)(B+2D)=1005	3.910
INTERNALS:								
Stem & stern frame	35.30	521.0	13.5					
Trans. W.T. & O.T. bhds incl long.	891.08	280.2	21.5					
Misc. bulkheads	15.36	307.9	25.1					
Pillars & girders	12.20	406.0	26.3					
Steering gear flat & 2nd dk.	39.25	159.4	28.9					
Eng. & boiler found incl DB girds.	39.00	501.4	8.0					
Aux. foundations	43.50	494.2	17.0					
Machinery flats	53.16	525.0	25.0					
Bilge keel	8.03	275.0	1.0					
Misc. steel incl. pipe boxing	2.00	53.0	36.0					
I.B. pltg., floors, & CVK	93.08	511.5	3.8					
Longl. side girders in IB-5,12, 25, & 35 off ℄	56.10	279.3	2.0					
Longl. dk. girders - 5,12,25 & 35 off ℄	43.39	294.7	42.4					
Total Internals	1331.45	324.1	19.7					
Net steel below upper deck	5261.20	295.8	22.3					
Rivet heads & welds & tolerance 2.77%	145.80	-	-					
TOTAL STEEL BELOW UPPER DECK	5407.00	295.8	22.3					

	Cu.No. LxBxD= 21037	Wt/ft 18,791	(L/100)(B+2D) =1005	(L/100)(nB+2D)= 1500
Coeff. of Mn. Sc. Items	0.187	0.781	3.910	2.620
Steel below coeff.	.257	1.074	5.380	3.605
Total steel coeff.	.285	1.190	5.960	3.993

n= 1 dk. & shell, no IB = 2

14-2

STEEL WEIGHTS - cont.

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.
STEEL ABOVE UPPER DECK:			
Trans. framing	20.34	210.7	50.3
Shell plating	49.94	308.0	50.2
Focsle dk pltg, beams, etc.	34.38	44.4	55.6
Bridge " " " "	28.16	236.5	51.8
Poop " " " "	66.62	531.1	52.8
Boat ℄ " " " "	25.27	236.0	59.5
Boat aft " " " "	30.77	525.0	60.8
Nav.Br. " " " "	12.64	230.3	67.6
Top of house ℄" " "	3.60	226.3	76.0
" " " & fiddley top aft pltg. etc.	16.49	516.3	72.6
Deck house- upper to poop & br. decks	31.44	290.0	48.8
Deck house-poop to boat dk.	17.15	523.0	57.0
Deck house-boat to house top aft	7.75	514.0	65.1
Deck house- " " " " fwd	7.51	229.5	63.8
Deck house-bridge to nav. bridge	10.28	238.0	56.0
Deck house-Nav. br. to top of house	4.51	228.1	72.1
Misc. bulkheads	86.99	419.5	53.4
Fresh water tanks	12.24	414.0	48.4
Machinery casings	34.80	521.0	58.3
Pillars & girders	6.86	283.5	55.1
Hatch coamings, end beams & webs	13.46	233.0	45.0
Bulwarks, curtain plates & stanch.	14.53	236.5	58.5
Masts & derrick posts	16.75	271.2	69.3
Misc. steel (incl. pipe boxing)	3.00	269.4	44.0
Stack enclosure	8.53	531.7	85.0
Net steel above upper deck	564.01	359.7	56.1
Rivet hds, welds, & tol. 3.37%	18.99		
TOTAL STEEL ABOVE UP. DECK	583.00	359.7	56.1
TOTAL STEEL BELOW UP. DECK	5407.00	295.8	22.3
TOTAL STEEL	5990.00	302.0	25.6

LBP = 600'-0"
B_{mld} = 82'-6"
D = 42'-6" to upper deck
n = 2 (1 dk. & shell, no I.B.)
H = 32'-0" scantling; H = 31'-5" service (MLD)
Δ = 34,145 tons SW
H/D = 0.739
L/D = 14.118

$$\frac{\Delta}{(L/100)^3} = 158$$

l = 0.7690
m = 0.9940
b = 0.7630

WOOD & OUTFITTING:

Item	Est. Wt. L.tons	Return Wt. L.tons
Doors, hatches, manholes, etc.	53.00	51.50
Bitts, chocks, etc.	36.60	27.25
Trolley davits, etc.	2.46	12.81
Draft marks, gratings, etc.	2.68	1.41
Airports & windows, 175-15" AP	8.04	4.72
Deck drains & scuppers	1.78	4.07
Ceiling, battens, wood hatch covers, etc.	3.88	-
Booms, yard arms, rigging & canvas	16.80	21.30
Ladders, rails, & stanchions	80.00	75.70
Boats, boat davits, stowage, etc.	20.3	13.35
Joiner work - crew, officer & ship spaces	33.2	18.30
Joiner doors & frames	9.83	11.10
Furniture	23.10	17.80
Labeling & padlocks	0.54	0.12
Windows - 7	.58	.60
Refrigeration spaces	12.05	15.65
Deck covering	62.5	27.90
Insulation, heat, sound & fire	37.2	35.80
Galley, pantry, & scullery equipment	4.46	2.87
Utility & shop spaces	.89	3.61
Lockers & stowage	6.70	10.70
Deck & navigating outfit	1.79	1.34
Anchors, cables, & hawsers	92.00	96.00
Steward's outfit	1.56	0.25
Paint, decorations & cement	50.00	(50.00) est. only
Caulked wood decks	-	0.64
Stairways	-	0.72
TOTAL WOOD & OUTFIT	561.94	505.51
Say	562 L. tons	505 L. tons

HULL ENGINEERING:

Item	Wt. in L.tons
Steering engine - 2 - 50 HP	14.41
Steering gear	3.35
Windlass - steam	18.75
Deck winches - 5	33.50
Sliding WT doors 2 - 30"x60"	1.07
Drainage system & FO fill & transfer	44.70
FW & SW system	10.48
Fresh water tank	4.47
Firemain	17.40
Fire exting. system	4.48
Hose racks & reels	1.12
Plumbing drains & soil pipes	8.04
Plumbing fixtures	2.68

cont'd. next page

HULL ENGINEERING - cont'd.

Item	Wt. in L. tons
Cargo oil system	234.20
Steam heating system	11.15
Steam smothering, steaming out, & htg. coils	53.60
Misc. piping system	1.79
Generators - 2 turbo elect. 400 KW(AC), 2 - 5 KW MG - 1 - 60 KW diesel	25.00
Switchboards & panels	3.48
Power wiring	12.05
Light wiring & fixtures	14.72
Inter comm. system, radio, radar, etc.	8.05
Mech. inter comm. system	1.21
Hangers, brackets, etc.	8.04
Refrigeration machinery	3.35
Refrigeration piping	.67
Ventilation ducts	22.30
Ventilation fans	1.56
TOTAL HULL ENG.	565.62
say	565
Water in H.E.	8
TOTAL H.E. (wet)	573 L.tons
Machinery (wet) 800 L.T. + 70 T. water	870
	1443

SUMMARY:

Item	Wt. in L. tons	L.C.G.	V.C.G.
Steel	5990		
Wood & outfit (returned)	505	320.2	49.1
Total hull	6495		
Hull eng. (wet)	573	351.9	29.6
Mach. (wet)	870		
Light ship	7938 L. tons - this is high compared to inclined wt = 7881 L. tons		

Light ship (from incline test) = 7881 L. tons
MT 1" = 2795 trim = 10'-1" Mean H = 8'-1-1/2"
Conditions- summer draft, 60° API cargo, tanks 98% full except where noted

For Light ship: T = 4.8 sec. GM corr = 34.94
KM = 66.90 Tons/inch = 87.95
KG = 26.96

SUMMARY - continued

Item	Wt. L. tons	L.C.G. Fwd. AP	VCG
Light ship	7881	272.18	26.96
Cargo oil	25329		
Fuel oil	900		
Wash water (FW)	30	355.19	48.05
Potable water	68	38.30	48.94
Distilled water	97	27.00	39.10
Fresh water in DB & peaks	280		
Crew effects & stores	55	220.50	47.33
Deadweight	26759		
Displacement	34640		

L.C.G. to AP 308.38)
L.C.B. " " 308.89) even keel Mean draft 31' -11-1/4"
MT 1" 3626

KM = 33.10
KG = 22.6
GM Corr = 9.16
Tons/inch = 97.8
T = 10.1 sec.

F.O. 1 ton = 37.23 cu ft (15° API) = 6.63 bbl
Cargo " " = 46.68 " " (60° ") = 8.67 "
" " " = 41.04 " " (30° ") = 7.31 "
" " " = 36.47 " " (12° ") = 6.495 "

STEEL WEIGHTS — Shelter Dk. Cargo Vessel

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Wt/ft² ℄	Wt/ft net	Dimension Factor F	Wt in tons F
STEEL BELOW MAIN SCNATLING ITMES:									
Trans. fr. in D.B.	194.18	203.39	2.07	1321	0.756	21.65	25.0	L/100(B+d) = 291	0.664
Trans. fr. outside D.B.	229.25	210.63	21.26	884	1.335	11.67	13.2	L/100(2D) = 352	.650
Longl. fr. in D.B.	63.51	190.41	1.88	393	.832	6.45	8.18	L/100(kd) = 87	.730
Shell plating & F.P.K.	657.56	211.86	15.76	3651	.927	26.3	26.18	(L/100(B+2D) = 626	1.05
I.B. and margin	147.54	206.95	4.08	1185	.642	19.93	19.38	(L/100(B) = 274	.538
Shelt.dk. beams, plating, etc.	261.02	222.31	42.28	1857	.724	29.47	30.75	" "	.954
2nd dk. beams, plating, etc.	185.49	217.46	32.79	1429	.670	22.67	25.25	" "	.677
3rd dk. beams, plating, etc.	133.34	183.23	22.68	1430	.480	22.7	27.9	" "	.487
Total	1871.89	209.73	19.51	12150	.793			(L/100(B+2D) = 626	2.98
INTERNALS:									
Stem, stern fr. and struts	24.98	363.33	13.33						
Trans. WT & OT bhd. & recess	199.37	235.73	19.23						
Longl. WT & OT bhd. & recess	12.17	186.73	16.85						
Cofferdams (horiz) & diaphragms	7.21	266.20	6.21						
Misc. bhds.	48.35	250	30.7						
Pillars	20.46	220.31	22.44						
Steering gear flat	3.62	426.0	31.0						
Shaft tunnel recess	32.21	344.6	10.45						
Pipe tunnel	7.10	127	6.88						
Engine and boiler found.	27.44	262.5	10.24						
Aux. machinery found.	27.06	260.6	30.32						
Mach. flat	13.62	262	16.54						
Ventilation ducts	13.93	185.5	37.3						
Bilge keel	3.14	198.3	1.0						
Girders, H beams, etc. shelt. dk.	92.66	194.2	42.7						
Misc. steel	4.0	212	40						
Girders, H beams, etc. 2nd dk.	72.67	211	31.8						
Girders, H beams, etc. 3rd dk.	64.05	183.5	21.3						
Stores flat	8.06	428.0	39.0						
Total internals	682.1	235.8	24.68						
Net steel below shelter dk.	2553.99	216.7	20.89						
Rivet heads and welds 2%	51.08	216.7	20.89						
Tolerance 1-1/2%	37.42	216.7	20.89						
TOTAL STEEL BELOW UPPER DK.	2642.49	216.7	20.89						

	Cu.No. LxBxD= 11,099	Wt/ft 12,150	(L/100)(B+2D) =627	(L/100)(nB+2D) =1722
Coeff. of Mn. Sc. Items	0.169	0.793	2.98	1.087
Steel below coeff.	.238	1.121	4.21	1.554
Total steel coeff.	.258	1.212	4.56	1.66

k = No. of double bottom longitudinals incl. CVK = 5
d = Depth of double bottom at center line = 4'
n = No. decks + inner bottom + shell = 5

STEEL WEIGHTS - cont.

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.
STEEL ABOVE:			
Trans. fr., shelter dk. to boat deck	2.54	265.27	44.5
Shell plating	14.89	260.17	44.68
Boat dk. pl & beams etc.	35.67	260.57	48.45
Bridge pl. & beams etc.	16.56	265.84	56.46
House top beams etc.	4.36	260.79	63.91
Top of casing beams etc.	1.02	271.51	63.9
Deck houses, boat to bridge	10.75	263.21	52.51
Deck houses, bridge to house tops	5.97	264.14	60.58
Misc. bhd., shelter dk. to boat	13.79	265.61	44.59
Misc. bhd., boat to bridge	5.46	262.61	52.63
Misc. bhd., bridge to house top	.90	277.88	60.63
Resistor houses, house end bhd.	17.38	222.84	45.05
Machinery casings	14.64	268.44	50.95
Ventilation ducts	6.87	250.43	56.23
Bulwarks	1.67	255.42	56.76
Masts & derrick posts	54.84	209.09	64.26
Net steel above main deck	207.31	245.5	54.03
Rivet. heads & welds 2%	4.15	245.5	54.03
Tolerance 1-1/2%	3.56	245.5	54.03
Total steel above	215.02	245.5	54.03
Total steel	2857.51	218.9	23.38

LBP = 435'
B = 63'
D = 40'-6" to shelter deck
k = 5; d = 4'
n = 5
H = 25'-9"
Δ = 13,860 L. tons SW at 25'-9" draft
H/D = 0.635
L/D = 10.74

$$\frac{\Delta}{(L/100)^3} = 168.5$$

l = 0.697
m = 0.98
b = 0.683

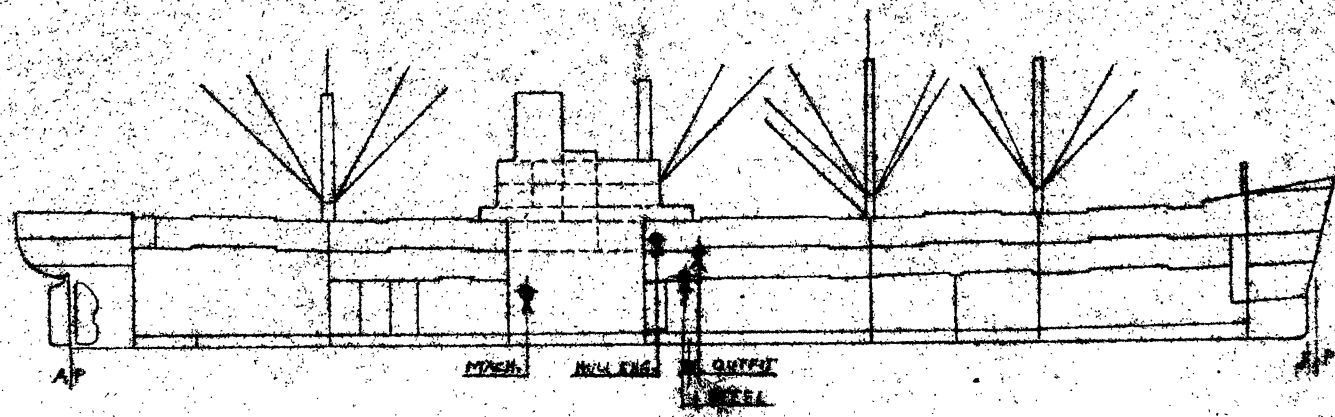
HULL ENGINEERING

Item	Wt. in lbs.	
Ventilating supply fans	6,500	
Skylight lifting gear	1,200	
Main generator	28,000	
Switchboard	6,000	
Emergency generator	2,000	
Emergency gen. switchboard	500	
Oil and water separator	3,500	
Refrigeration mach. & pipe	9,700	
Fresh water pressure tank	1,200	
Salt water pressure tank	2,000	
Sliding water tight doors	1,800	
Heating system	9,000	
Bracket fans	550	
Ventilation ducts	17,000	
Ventilation heaters	1,000	
Steering engines	30,000	
Steering gear	6,000	
Windlass & capstan	31,000	
Capstan	10,000	
Deck winch	85,000	
Drain system	100,000	
Fresh & salt water system	21,800	
Fire system	20,000	
Hose & reels	1,000	
Plumbing fixtures	4,500	
Tank gages	200	
Foam extinguisher system	3,600	
Wiring	38,500	
Searchlight & fixtures	3,500	
Inter communication	10,000	
Gyroscope & fathometer	2,500	
Hot water heaters	625	
Pumps	250	
Total	458,425	or 204.7 L.tons

H-15 - cont.

WOOD & OUTFIT

Item	Wt.L.tons	L.C.G. - Fwd.	L.C.G. - Aft	V.C.G.
Masts & spars (wood)	1		25'	100
Steel booms & fittings	24	3'		50
Steel pontoon hatches	93	1.7'		36.5
Carpenter work	125	9.5'		19
Furniture in dk. house	11		44.5'	48.7
Lights, doors, & hatch fittings	42		6'	32.2
Deck castings	33	64.7'		46
Misc. hull fittings	26		24.4	43.8
Mast fittings & R. tackle	1		90'	60
Cabin galley & P. outfit	4		34'	49
Laundry equip.	1		45'	35
Anchor chains, lines	58	169'		27.8
Deck outfit & navigating equip.	8		14.7'	50
Rigging & blocks	25	1.7		56
Canvas	2		26.36	46
Ventilation & heat system	4		60	50
Bilge & ballast system	45		10	18
Sanitary & fresh water system	3		45	48
Fire system	4		10	45.8
Paint & cement	130		0.2	17
Insulation (heat)	14		41.5	45.0
Insulation (refrigeration)	11		46.75	36.5
Scuppers	8		10	32
Enclosure steel bhds.	22		44	45.5
Windlass, winch & capstan	66	34.4		48.1
Dkl covering (no wood)	25		41.6	43.2
Steering gear	13		202	36
Joiner bhds. & doors	8		45	51
Metal ladders	3		40.6	45
Hardware	1		45.75	50
TOTAL	811			
Steel	2,858		218.9aft of FP	23.38
Margin	100	.56		40
Total steel & outfit	3,769	.56		24.9
Hull engineering	205			
Machinery	590		70.5	18.10
Fresh water	59		18.25	14
Feed & oil in D.B.	1,543	10		2.5
Distilled water	14		72	14
Stores	20		40	36
Crew & effects	8		30	46
F.O. in engine rm. storage	120		62.75	12
Light ship full tanks	6,328		5.42	18.7
Cargo	7,532	11.75		24.7
Total displacement	13,860 L. tons SW at 25' - 9" draft			



(A in Reference 5)

Figure 16 - Cargo Vessel 15 (LBP = 435')

H-16
TANKER

STEEL

Item	Wt. in L. tons	V.C.G.
Long. framing in deep tanks	13.43	2.0
Floors in D.T. & D.B.	63.70	3.3
Floors - W.T.	13.00	3.0
Trans. webs out of D.B.	478.23	19.0
Stern fr. & cants	43.75	20.0
Cant brackets, etc.	5.38	37.0
Stem & bow fr.	18.60	22.0
Center keelson	23.00	3.0
Keelsons and angles	59.84	3.0
Side stringers	3.97	28.0
Panting beams & stringers	17.78	23.0
Shell longitudinals	409.82	11.5
Shell plating	1396.69	12.0
Bridge deck bulwark	4.23	53.0
Bilge keel	8.98	1.3
Double bottom plating	64.40	6.5
Margin plating etc.	5.26	4.5
Shelter deck plating etc.	536.12	44.3
Upper deck plating etc.	254.50	36.0
Main deck plating etc.	46.20	29.0
Shelter deck beams etc.	120.00	44.0
Upper deck beams etc.	79.50	35.7
Main deck beams etc.	15.30	28.7
IB longitudinals	2.80	8.5
Cant beams & knees	2.98	38.0
WT & OT transverse bhds.	1007.50	20.0
Non WT longl. bhds.	21.84	40.0
Misc. bhds.	38.40	38.0
Chain locker & pipes	15.10	26.0
Expans. trunk bhds.	92.10	39.5
Eng. & boiler casing	46.20	44.0
Misc. bhds. in dk. house	5.29	50.0
Deck houses	135.00	53.0
Eng. & shaftfoundations	27.90	6.5
Boiler foundations	8.50	7.0
Aux. foundation	26.75	7.5
Deck machinery found.	3.30	46.0
Bitt & chock found.	18.22	46.0
Stanchions & girders - hull	24.00	22.0
Stanchions & girders - deck houses	5.11	54.0
Deck supports	3.65	60.0
F.W. tanks & found.	21.10	25.0
Vent ducts	5.07	38.0
Hatch coamings	26.95	44.0
Stiffeners in peaks	6.68	2 0.0
Steel masts	12.46	70.0
Steel derrick posts	4.88	53.0
Pipe covering	1.28	7.0
Hatch cover & boom rests	1.12	49.0
WT & OT longitudinal bhds.	302.00	20.0

continued

STEEL - continued

Item	Wt. in L. tons	V.C.G.
Fore & aft bridge	6.11	50
Coal bin	.91	47
Breakwater	1.35	51
Boat stowage foundations	1.15	55
Light towers	1.54	63
Stem	3.20	25
Stern frame	6.48	16
Struts	17.40	11
Total steel	5586.00	22.4
Rivets	375.00	
Margin	64.00	
Total steel	6025.00	22.4

WOOD & OUTFIT

Item	Wt. in L. tons	V.C.G.
13. Ports, doors, ladders, skylights & covers	54.6	40.9
14. Bitts, chocks, davits, hawse pipes, & stanchions	51.7	49.3
15. Airports, fixed lights, & rails	16.5	52.5
16. Rudder	23.7	30.0
17. Cement	88.6	4.0
18. Carpenter work	57.5	57.3
19. Wood foundations, etc.	2.0	40.0
21. Joiner work	53.4	48.9
22. Decorative joiner work	.2	48.0
23. Paint	68.1	25.0
24. Rigging	7.1	81.5
241. Canvas work	1.1	68.0
25. Deck covering	32.1	45.1
26. Heat insulation	-	-
27. Portable furniture	6.9	55.0
28. Steward's outfit	3.7	51.0
29. Deck & navigating outfit	1.8	44.0
30. Lifeboats & rafts	6.3	69.0
31. Anchors, etc.	100.5	26.3
38. Sheet metal work	10.2	48.0
Total wood & outfit	586.0	35.3

HULL ENGINEERING

Item	Wt. in L. tons
Mechanical ventilation	1.6
Heating system	6.5
Steering gear	11.4
Drainage etc.	45.6
Cargo oil system	192.4
Deck machinery	39.3
Refrigerating plant	2.9
Electric plant	19.4
Interior communication	2.4
Wireless outfit	1.0
Margin	9.5
	332.0

H-16 - cont'd.

MACHINERY

Item	Wt. in L. tons
Engine room	440
Boiler room	315
Spares	-
Water in machinery	115
Cargo oil pumps	50
Total machinery	920

SUMMARY

Item	Wt. in L. tons	L.C.G. aft FP	V.C.G.
Steel	6025		22.4
Wood & outfit	586		35.3
Total hull	6611		23.5
Hull engineering	332		23.5
Machinery	920		18.2
Light ship (from incline test)	7863	299.0	22.9
Crew	7	440.0	40.0
Stores	43	450.0	40.0
Reserve feed	255		3.0
Fresh water	60		24.0
Fuel oil	1235	291.5	21.0
Cargo oil at 40 cu. ft./ ton	19700		20.5
Total displacement	29163		21.1

Mean draft = 30'-4 1/4"
GM = 10.61
LOA = 572'-6"
LBP = 555'-0"

B_{mld} = 75'-0"
D_{mld} = 43.3' to shelter deck

speed = 10.75 knots
IHP = 3800

STEEL - BELOW

Item	Wt. L. Tons	L.C.G. aft FP
Bottom longls	26.95	104.0
Transverses	18.55	99.9
Girders in D.B.	4.55	170.5
OT bhds.	62.15	107.3
Misc. bhds. - AP, FP, pump rm. etc.	17.00	146.0
CL longl. OT bhd.	28.80	110.5
Side stringers	10.27	106.7
FP breast hooks	.14	2.0
Trans. framing outside DB	25.20	119.2
Webs	3.09	216.3
Trans. framingbrks.	4.21	126.1
Stanchions & girders	2.23	180.0
Aft peak floors	1.38	241.0
Fore peak floors & swash plts.	1.77	8.1
Transom & cant frames	1.70	250.7
Chain locker	3.08	12.4
Misc. longl. bhd.	6.16	187.0
Tank top plating	13.20	209.0
Floors in DB	4.63	208.0
Shell plating	148.20	124.0
Upper deck plating, beams, etc.	77.20	124.0
Bilge keel	1.55	132.0
Fender on up. dk.	13.52	124.0
Engine found.	8.93	206.0
Aux. found.	2.23	166.0
Stem	.40	1.5
Stern frame	3.13	247.5
Rudder carrier	.18	251.0
Vent trunks & ducts	2.23	188.0
FW tanks in E.R.	2.48	225.0
WT flat over AP	1.07	241.5
Steering gear flat	2.61	245.0
Misc. steel	5.13	128.2
TOTAL STEEL BELOW UPPER DECK	503.92	
STEEL ABOVE UPPER DECK:		
Shell and framing aft	4.12	213.0
Shell and framing ford	3.09	11.0
Casings	6.90	206.5
Division bhds	17.45	177.6
Passage bhds.	12.10	184.5
House pltg beams etc. & fidley	28.40	139.4
Nav. bridge pl & beams	3.71	84.0
Focsl. dk. pl & beams	1.98	13.0
Focsl. front bhd.	1.75	20.0
Bulwarks	2.13	144.6
Walkway	2.11	139.0
750 gal tank on house	.95	230.0
Doublers under bitts & chocks & capstan	1.56	97.3

cont'd next page

H -17 contd.

STEEL ABOVE UPPER DECK - contd.

Item	WT. L. Tons	L.C.G. aft FP
Anchor chain pipes	0.13	5.0
Companionway in capt.'s office	.57	80.0
W.R. partitions in off. house	.25	84.0
TOTAL STEEL ABOVE	87.00	149.8
TOTAL STEEL BELOW	504.00	
	591.00	
Welding & tolerance	14.00	
TOTAL STEEL	605.00	
WOOD & OUTFIT:		
Cement	1.2	67.8
Rudder	3.1	252
Steel hull fittings	21.8	141.5
Carpenter fittings	14.4	93.5
Plumbers fittings	3.7	154
Carpenter work	4.7	25
Joiner work	4.3	143.4
Portable furniture	2.7	171.5
Paint	8.5	165
Deck Covering	12.6	181.4
Rigging and canvas	1.0	150
Heat insulation	6.8	163.6
Refrigeration insulation	4.0	228
Steward outfit	1.0	240
Deck and navig. outfit	0.9	90
Boats	2.1	197
Anchors, etc.	15.2	28.9
Owner's outfit	2.0	159
TOTAL WOOD & OUTFIT	110.0	131.3
HULL ENGINEERING:		
Skylight lifting gear	0.27	204
Ventilation ducts	1.94	202
Ventilation fans	.26	182
Heating system	2.19	162
Steering gear	1.56	248
Steering engine	5.14	246
Drainage system	2.24	200
Fresh and salt water system	3.57	206
Firemains	1.43	140
CO_2 extinguishing system	2.32	190
Plumbing fixtures	.51	160
Bilge hand pump, drain pump and elect. heater	1.0	201

H-17 contd.

Item	Wt. L. Tons	L.C.G. aft FP
Cargo oil system	22.35	134
Pump room ladders and gratings	1.56	186
Winlass	4.55	14
Capstan	.94	248
Refrigeration machinery and pipe	2.10	226
Diesel generator	4.91	204
Searchlight and fixtures	.74	160
S. C. system	1.79	144
Switchboard and wiring	3.35	188
Total HE dry	64.72	164.9
Water in HE	11.3	224
Total HE wet	76.02	172.5
SUMMARY:		
Steel	605.0	149.8
Wood and Outfit	110.0	131.3
Hull Engineering (wet)	76.0	172.5
Machinery wet	150.0	208.5
(1)Light ship (estimated) hvy. oil	930.0	146.2
(2)Cargo tk #1 P&S part full " "	337	48.4
Cargo tk #2 P&S 98% full " "	468.9	72.0
Cargo tk #3 P&S 98% full " "	455.6	95.9
Cargo tk #4 P&S 98% full " "	448.6	120.0
Cargo tk #5 P&S full " "	450.7	144.0
(3)Cargo tk #6 P&S part full	432.0	167.9
FO bunkers (full)	49.5	186.6
Culinary FW tanks (full)	10.2	209.7
Engine room circ. water tk (full)	2.5	232.8
Crew and stores	5.0	210.0
Spare tailshaft	1.2	231.5
Spare propeller	2.5	24.3
TOTAL DISPLACEMENT	3581.0	120.9

H-17 contd.

LCB 120.9 (even keel)
Mean Draft 15'9-1/2" at 35.75 cu ft/ton
LBP = 250'-0" b = 0.741 $\Delta/(L/100)^3$ = 236
Effective Length 248'-0" ℓ = 0.753
Bmld 43'-6" m = 0.984 B/D = 2.75
WS total 15,300 ft^2

Notes:

(1) Light Ship from inclining experiment 906.3 L. tons
LCG from inclining experiment 146.9 ft.

(2) Full tank = 436.9 long tons

(3) Full tank = 442.5 long tons

STEEL WEIGHTS

Passenger Vessel

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℔	Wt/ft coeff	Wt/ft² ℔	Dimension Factor F	Wt in tons / F
STEEL BELOW MAIN SCANTLING ITEMS:								
Trans. fr. in D.B.	651	348.2	4.16	3064	0.72		(L/100)(B+d) = 656	0.992
Trans. fr. outside D.B.	584	367.0	25.27	1162	1.703		(L/100)(2D) = 737	.802
Longl. fr. inside D.B.	242	327.3	3.61	1170	.701		(L/100)(kd) = 277	.873
Shell & F.P.K.	2065	344.17	21.32	7605	.92		(L/100)(B+2d) = 1343	1.535
I.B. and Margin	414	322.96	6.74	2368	.592		(L/100)(B) = 616	.670
Main dk. beams, plating, etc.	615	390.6	56.6	8106	.99		" "	.997
A " " " "	420	381.1	47.3	1529	.931		" "	.681
B " " " "	364	400.5	37.8	1659	.744		" "	.590
C " " " "	256	398.2	29.8	1651	.525		" "	.415
D " " " "	251	388.4	20.3	1969	.432		" "	.408
Total	5862	359.97	24.96	24283	.817		(L/100)(B+2D) = 1343	4.37
INTERNALS:								
Stem, stern fr. and struts	136	614.5	16.34					
Trans. WT & OT bhd & recess	601	343.39	26.95					
Longl. " " " " " "	272	406.5	15.9					
Cofferdams (horiz.) & diaphragms	108	356.45	27.7					
Misc. bhd. A to Main dk.	158	407.15	52.0					
" " B " A "	175	405.9	43.4					
" " C " B "	119	426.69	34.69					
" " D " C "	24	231.34	26.42					
" " in hold	7	445.81	14.0					
Mach. casings	81	338.03	40.6					
Partial bhd. & webs over misc. bhd	35	358.82	56.51					
Swash bhds.	54	345.75	19.48					
Pillars and girders	315	358.1	35.7					
Hatch coamings, end beams	33	289.0	40.54					
Pipe tunnel & equalizing trunks	15	264.2	10.62					
Eng. & boiler foundations	166	338.3	10.63					
Aux. mach. foundations	106	389.52	20.8					
Machinery flats and bhds.	60	337.83	23.42					
Ventilation ducts	10	211.68	43.16					
Bilge keel	32	342	4.5					
Misc. steel and pipe boxing	15	335	38					
Swimming pool	16	417	23.7					
E deck plating etc.	11	73.7	17.01					
I.B. in mach. spaces	62	337.45	21.61					

	Cu.No. LxBxD= 33,880	Wt/ft 24,283	(L/100)(B+2D) = 1343	(L/100)(nB+2D) = 5030
Coeff. of Mn. Sc. Items	0.1730	0.817	4.37	1.165
Steel below coeff.	.2600	1.23	6.56	1.750
Total steel coeff.	.3535	1.67	8.92	2.28

k = No. of double bottom longitudinals incl. CVK = 7
d = Depth of double bottom at center line = 6'
n = No. decks + inner bottom + shell = 7

72

STEEL WEIGHTS - cont.

Passenger Vessel

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Wt/ft² ℄	Dimension Factor F	Wt in tons / F
Internals - cont.								
Stairway structure	23	367.9	40.92					
Total Internals	2634	376.51	28.41					
Net steel below main dk.	8496	365.09	26.03					
Rivet heads & welds 2-1/2%	202	-	-					
Tolerance 1-1/4%	106	-	-					
TOTAL STEEL BELOW MAIN DECK	8804	365.09	26.03					
STEEL ABOVE:								
Trans. fr.	59	281.2 7	66.02					
Shell plating	320	310.02	66.31					
Upper dk. plating, beams, etc.	679	354.87	66.23					
Prom. " " " "	490	333.66	74.87					
Sun " " " "	209	334.62	84.48					
Sports" " " "	173	316.11	94.46					
House tops """ " "	61	250.5	102.56					
Dk. house, main to Upper dk.	31	621.0	60.5					
" " upper to prom	42	345.53	71.93					
" " prom to boat	66	378.6	78.3					
" " prom to dk. encl.	58	285.24	79.51					
" " boat to sun	71	332.44	88.78					
" " sun to house top	43	293.0	100.2					
Misc. bhd. main to upper	153	345.33	61.93					
" " upper to prom	143	327	70.80					
" " prom to boat	36	321.7	80.5					
" " boat to sun	52	333.3	90					
" " sun to house top	21	252.36	98.93					
Partial bhd. & webs over main bhd.	33	312.0	78.4					
Mach. casings	58	336.0	76.5					
Pillars & girders	86	340.3	72.4					
Ventilation ducts	20	321.2	79.21					
Bulwarks	20	290.17	92.12					
Gun foundations	15	330.0	71					
Masts & derrick posts	32	312	102.5					
Misc. steel (steel dk. houses &	15	360	97.5					
Raised dk in ballroom tops)	12	446.5	73.5					
Struc. in fwd. stack	10	213.5	109					
Stair structure	20	319.3	72.29					

LBP = 660'-6"
B = 93'-[illegible]
D = 55' Main
k = 7; d = 6'
n = 7
H = 32'
Δ = 34,370 L.tons SW at 32' draft
H/D = 0.582
L/D = 12
$\frac{\Delta}{(L/100)^3} = 119$
l = 0.600
m = 0.978
b = 0.587

STEEL WEIGHTS - cont.

Passenger Vessel

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Wt/ft² ℄	Dimension Factor F	Wt in tons / F
STEEL ABOVE - cont.								
Fan room	20	356.25	102.5					
Net steel above main dk.	3048	334.01	75.3					
Rivet heads & welds 2/1/2%	81	-	-					
Tolerance 1-1/4%	38	-	-					
Total steel above main dk.	3167	334.01	75.3					
Total steel	11,971	356.87	39.06					

WOOD AND OUTFIT:

Item	Wt.L. tons	L.C.G. aft F.P.	V.C.G.
13. Ports, doors, ladders, skylights & covers	182	281.6	55.9
14. Bitts, chocks, davits, hawse pipes & stanchions	183	297.1	77.0
15. Airports, fixed lights, & rails	105	355.1	64.4
16. Rudder	45	664	15.2
17. Cement	130	378	7.0
18. Carpenter work	420	358.5	67.1
19. Wood foundations & fenders	15	332.4	34.3
20. Joiner decks	13	384.2	74.6
21. Joiner work	1180	362.2	61.9
22. Decorative joiner work	10	342.9	73.8
23. Paint	270	373.0	46.0
24. Rigging	26.7	264.0	88.7
241. Canvas work	3.3	390.0	90.7
25. Deck covering	980	369.7	53.6
26. Heat insulation	130	360.9	48.6
27. Portable furniture	255	371.9	57.6
28. Steward's outfit	205	373.6	50.4
29. Deck & navigating outfit	13	308.8	63.8
30. Lifeboats & rafts	95	347.3	91.8
31. Anchors, cables, & hawsers	121	115.1	44.0
32. Refrigeration cargo insulation	149	208.6	24.5
32. Refrigeration stores insulation	147	450.1	24.8
40. Utility & shop spaces	5	-	-
TOTAL WOOD & OUTFIT	4693	352.2	54.4

H-18 - cont.

HULL ENGINEERING:

Item	Wt. in L.tons	L.C.G. aft FP	V.C.G.
Sliding watertight doors	140.6	358	44.3
Heating system	100	356	50
Bracket fans	4.5	354	60
Ventilation fans	64.7	352	83
Ventilation duct	100.0	349	62
Ventilation heaters	5.6	352	85
Punkah louvres	2.2	332	56
Steering engine	54	643	28
Auxiliary steering gear	8.5	653	56
Steering gear piping etc.	12.5	659	28
Three windlasses - electric	103.0	100	66.5
Capstan	28.9	414	61.7
Deck winches	75	300	76.5
Elevators and dumb waiter	76.8	390	69.5
Refrigeration mach. and	76.4	410	11.1
Refrigeration pipe and	47.6	372	28.5
Oil and water separator	3	330	21.8
Drain, ballast fuel oil trans. sys.	162	343	19.5
Fresh and salt water system	291.3	359	50.5
Fire system	65.7	365	48.5
Hose and reels	2.4	325	58
Plumbing fixtures and sewage ejec'.	110	359	49
Hand pump	.2	345	50
Tank gages	1.3	362	12
Lux Rich fire equip. (bottles)	7.9	401	38
Generator	71.4	333.5	37
Switchboard and wiring	178.4	348	53.6
Searchlight and fixtures	11.2	347	65
Inter communication	75.9	336	52
Radio, motion picture, and sound equip	6.3	302	75
Gyroscope compass and fathometer	2.7	194	97
Laundry mach.	20	409	20
TOTAL HE dry	1910.0		
water	40	354	40
TOTAL wet	1950.0	352	48.8

SUMMARY

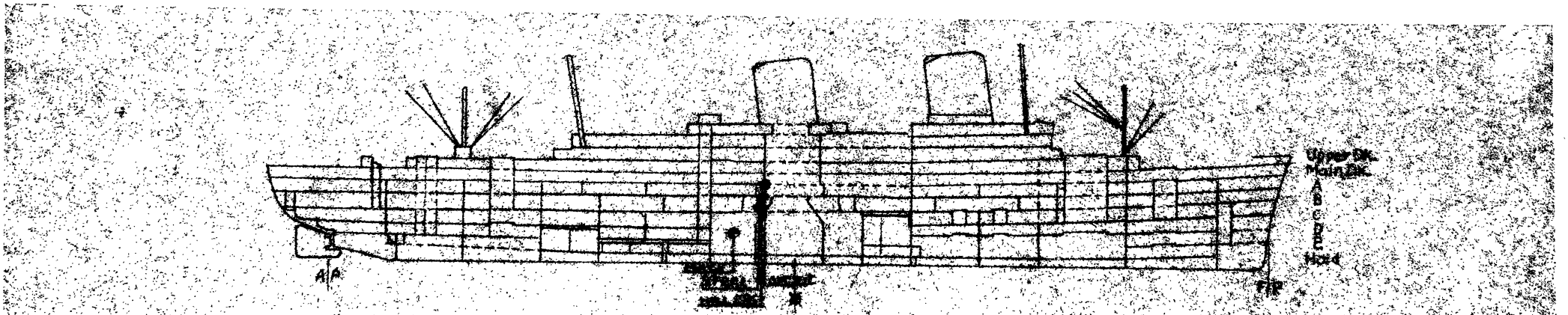
Item			Wt. in L.tons	L.C.G. aft F.P.	V.C.G.
Hull Steel			11,971	356.9	39.1
Wood & outfit			4,693	352.2	54.4
Total hull			16,664	355.6	43.4
Hull engineering (Wet)			1,950	352.0	48.8
Machinery			2,495	372.0	21.9
Light ship - FROM INCLINE TEST			21,109	357.5	41.8
Fuel oil		4456		301.3	13.3
Washing water	2302			363.9	9.3
Reserve feed	640			447.3	5.1
Distilled water	228			447.7	10.9
Drinking water	370			492.9	16.3
Culinary water	740			493.7	12.9
Total F.W.		4280		-	-
General cargo	1550			163.2	22.5
Refrig. cargo	375			209.8	26.1
Automobile cargo	75			240.5	44.7
Total cargo		2000		-	-
Swimming pool water		110		422.6	22.6
Passengers, crew & effects		150		411.5	51.7
Baggage		150		541.8	23.7
Mail & specie		100		591.4	26.2
Consumable stores		2000		442.5	26.0
Total deadweight			11,476	-	-
Total displacement			32,585 L. tons full load leaving port	348.8	32.5

1 ton = 2240#
F.O. = 37.10 cu ft/ton = 277.53 gal = 6.608 bbl/ton
F.W. = 36 cu ft/ton = 269.28 gal/ton
S.W. = 35 cu ft/ton = 261.80 gal/ton
Draft forward = 30'1 1/8"
Draft aft = 31'0 1/8"
Mean draft = 30'6 5/8" at Δ = 32,585 L.tons
GM corrected = 5.6'

LBP = 660'-0"
B = 93'-3"
D = 55' to main deck

PASSENGERS & CREW

Cabin class	543	in 191 rooms - 61 baths and 130 tubs & showers
Tourist class	418	in 142 rooms - 142 tubs and showers
Third class	241	in 74 rooms
Total pass.	1202	
Crew	643	



(D in Reference 8)
Figure 17 - Passenger-Cargo Vessel 18 (LBP = 560'-6")

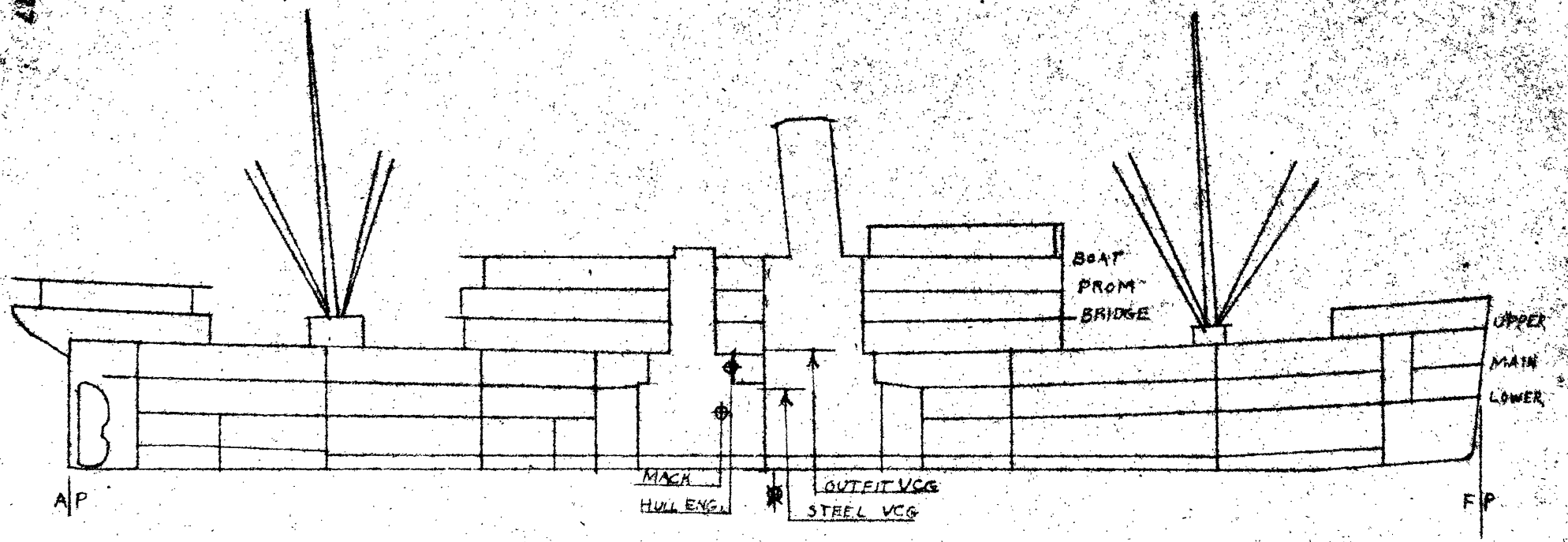


Figure 18 - Passenger-Cargo Vessel 19 (LBP = 585')

H-19

Cargo Passenger

WOOD AND OUTFIT

Item	Wt. in L. tons		V.C.G.
13. Fittings - fitters'	65		30.2
14. Fittings - Carpenters'	50		46.4
15. Fittings - plumbers'	25		40.8
16. Rudder	14		17.0
17. Cement	70		8.0
18. Carpenter work	166		30.0
20. Joiner decks	5		63.6
21. Joiner work	150		52.1
22. Decorations and glazing	3		51.23
23. Paint	65		26
24. Rigging	13		
241. Canvas work	2		
25. Deck covering	106		39.9
26. Heat insulation	35		33.0
27. Portable furniture	39		42.5
28. Steward's outfit	18		38.5
29. Deck and navigating outfit	8		50.0
30. Boats	11		59.8
31. Anchors, chains, and lines	55		28.7
32. Refrigeration, cargo insulation	219		22.9
38. Sheet metal work	10		42.0
Rat proofing	5		20.0
Misc. for 2' inc. in beam	10		23.6
TOTAL WOOD AND OUTFIT	1144		32.25

STEEL BELOW UPPER DECK

Item	Wt.L. tons	L.C.G.	V.C.G.	Ratio to Cubic no.	Wt/ft both sides
Trans. framing in D.B.	183.0		2.33	0.024	1318
Trans. framing outside D.B.	135		16.40	.019	601
Longitudinal fr. in D.B.	68		1.97	.0097	443
Shell plating & Fpk.	495		12.61	.071	2988 br. 3077
I.B. plating & margin	122		4.05	.0175	1020
Lower dk. & mach. flat	107		14.80	.0153	1169
Main dk.	150		23.35	.0215	1308
Upper deck	190		33.10	.0272	1417 1128
Total of main scantling items	1450		14.40	0.208	9975
Stem & stern frame	20		12.25	0.0029	
Main trans. & longl. bhds. OT & WT	195		15.50	.028	
Misc. bhds.	16		27.20	.0023	
Machinery casings	10		27.20	.0014	
Pillars & girders	46		21.00	.0066	
Hatch coamings & webs	35		25.50	-	
Engine & boiler foundations	35		7.40	.005	
Auxiliary mach. foundations	25		17.35	.0036	
Ventilation trunks & ducts	9		25.60	-	
Bilge keel	6		2.25	.0008	
Shaft alley	24		9.20	-	
Stringers in engine room	3		10.5	-	
Cofferdams	8		21.50	.0011	
Misc. steel	10		16.66	-	
Total internals	442		16.66	0.0634	
Total steel below upper deck	1892		14.93	0.272	
Rivet heads & tolerance	78		14.93		
	1970		14.93	0.282	
Total steel above upper deck	520		46.00)	.0778	
Rivet heads & tolerance	22		46.00)		
	2512		21.65	0.36	

First 4 items based on coeff. & all others estimated in detail.

H-19

Passenger Cargo Vessel

STEEL ABOVE UPPER DECK

Item	Wt.L.tons	L.C.G.aft FP	V.C.G.
Shell plating & framing	58.5		38.1
Focsl deck plating, beams, etc.	11.5		45.3
Poop deck plating, beams, etc.	18.1		42.6
Bridge deck plating, beams, etc.	74.0		40.6
Prom deck plating, beams, etc.	53.4		49.0
Boat deck plating, beams, etc.	42.6		57.0
House tops	13.2		55.3
Deck houses bridge to prom	34.7		44.6
Dk. houses prom to boat	23.8		53.1
Deck houses - boat	9.2		61.4
Deck houses - poop	7.4		46.1
House webs - upper to bridge	2.7		35.8
House webs - bridge to prom	2.2		44.6
House webs - prom to boat	1.9		52.8
Bulkheads - interior	57.3		41.8
Bulkheads - focsl	2.1		40.3
Bulkheads - bridge front	5.9		37.3
Bulkheads - bridge end	3.7		38.8
Bulkheads - poop front	4.0		
Mach. casing	23.1		44.6
Pillars & girders	16.7		33.2
Bulwarks	10.7		36.9
Masts, booms, davits & rests	37.0		59.4
Misc.	6.3		44.0
TOTAL STEEL ABOVE	520.0		46.0
Rivet heads & tolerance	22.0		46.0
	542.0		46.0

HULL ENGINEERING:	Wt. in lbs.	L.C.G. aft fr.69	V.C.G.
Sliding WT doors	10,000	66.2	20
Skylight lifting gear	800	63	62
Bracket fans	3,500	61	48
Punkah louvres	175	61	48
Ventilation ducts - mech.	75,000	61	45
Ventilation fans	25,000	67.5	43
Heating system	30,000	61	28
Ventilation heaters	6.000	58.5	38
Steering engine - electric-hydraulic	25,000	234	39.3
Steering engine - telemotor piping	3,500	100	50
Oil & water separator (water 9500)	15,000	36	26
Drainage system	70,000	46	5.5
Fresh & salt water system	33,000	50.5	40
Plumbing drains	42,000	46.5	35
Firemains	13,000	47	35
Rich, Lux, & fire detecting systems	3,500	42.5	32
Lux extinguishing system	9,500	42.5	32
Hose & reels	1,200	47	42
plumbing fixtures	23,000	46	41
Hand pumps	600	-34	30
Lux, rich bottles	16,500	83	25

continued...

HULL ENGINEERING - continued.

Item	Wt. in lbs.	L.C.G. aft fr.69	V.C.G.
Windlass	29,000	-127	47
Capstan	12,000	239	41
Deck winch motor	15,000	40.5	32.5
Deck winch	60,000	40.5	22.5
Refrigeration machinery & pipe	170,000	53.31	17.62
Refrigeration machinery	42,000	49	15
Generators & engines	52,000	54	21
Switchboard, wiring, & battery	85,000	45.5	27.5
Searchlights & fixtures	4,500	36.5	36
Inter communication system	11,500	7	40
Fathometer, gyroscope, & direction f.	2,000	-33	59
Radio	2,000	9	58
Pneumercators	1,000	21.6	9
TOTAL HE	882,275	52.47	27.49
	400 L.tons		

SUMMARY Condition - Full cargo, leaving port, no ballast.

	Wt.L.tons	L.C.G aft FP	V.C.G.
Steel above	542		46
Steel below	1970		14.9
TOTAL HULL STEEL	2512		21.7
Wood & outfit	1144		32.3
Margin	87		
TOTAL HULL	3743		
Hull engineering - wet	400	204.9	27.5
Machinery in ER - wet	455	231.6	13.0
Machinery in Blr. Rm. - wet	332	174.5	18.1
LIGHT SHIP	4910	200.6	25.0
(This light ship weight was obtained from incline test at mean draft of 13'-2.25")			
Fuel oil	865	150.6	8.1
Boiler feed etc.	150	215.5	1.9
Culinary water	100	240.2	14.1
Passengers, crew, & effects	90	186.0	33.94
Cargo - homogeneous to H = 23'-6"	3455	191.9	19.8
TOTAL DISPLACEMENT	9570 AT 23'-7.86"	195.5	21.0

Mean draft = 23' - 7.86" (draft forwd = 23'-5"; draft aft = 23'-11")
LCB = 3.5' aft
MT1" = 780 ft-tons
GM = 1.42'

Details of passengers, crew, & effects = 90
Stores = 40 tons
Baggage 15 tons
Passengers & effects = 20 tons
Crew & effects = 15 tons

PASSENGERS & CREW

First class	139 in 55 rooms
Tourist class	24 in 9 rooms
TOTAL PASS.	163
Crew	93
TOTAL ON BOARD	256

LBP = 385'
B = 57'-6"
D = 31'-6"
Cubic number = 6973

Design draft = 23'-6"
Δ = 9470 at 23'-6" draft
Speed = 15.5 knots

STEEL WEIGHTS

Passenger & Refrig. Fruit Vessel

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Dimension Factor F	Wt in tons F
STEEL BELOW MAIN SCANTLING ITEMS:							
Trans. fr. in D.B.	141.31	202.21	2.2	1260	0.606	(L/100)(B+d) = 264	0.530
Trans. fr. outside D.B.	186.89	238.32	16.69	750	1.347	(L/100)(2D) = 288	.650
Longl. fr. in D.B.	59.68	196.5	2.11	280	1.153	(L/100)(kd) = 46	1.30
Shell plating & F.P.K.	595.77	215.19	13.91	3380	.952	(L/100)(B+2D) = 537	1.105
I.B. and margin	136.16	207.21	3.63	423	.655	(L/100)(B) = 249	.548
Upper dk. beams, plating etc.	202.94	236.48	36.56	1270	.870	" "	.815
Main dk. beams, plating etc.	160.53	240.84	28.74	1176	.737	" "	.645
Lower dk. beams, plating etc.	105.53	245.37	21.23	1150	.495	" "	.423
Orlop dk. beams, plating etc.	89.18	222.97	13.62	1150	.418	" "	.358
Total	1677.99	222.7	16.56	11539	.784	(L/100)(B+2D) = 537	3.12
INTERNALS:							
Stem, stern fr. and struts	54.62	374.73	12.3				
Trans. WT & OT bhd. & recess	213.84	208.59	15.81				
Cofferdams	11.81	170.65	25.69				
Misc. bhds.	6.25	199.03	31.12				
Machinery casings	17.72	218.19	31.18				
Pillars & girders	76.49	216.97	22.52				
Hatch coamings	28.92	181.65	31.67				
Engine & boiler found.	131.04	248.85	10.82				
Aux. mach. found.	35.0	238.0	18				
Machinery flats	19.24	241.61	17.38				
Ventilation ducts	3.31	307.74	27.84				
Bilge keel	5.58	217.3	3.01				
Total internals	603.82	234.95	16.95				
Net steel below main dk.	2281.81	225.94	16.68				
Rivet heads & welds 3.63% and tolerance and	82.73	225.94	16.68				
TOTAL STEEL BELOW MAIN DECK	2363.0	225.94	16.68				

	Cu.No. LxBxD= 8,653	Wt/ft 11,539	(L/100)(B+2D) = 538	(L/100)(nB+2D) = 1781
Coeff. of Mn. Sc. Items	0.1960	0.784	3.12	0.943
Steel below coeff.	0.2733	1.115	4.40	1.33
Total steel coeff.	0.3723	1.520	5.98	1.81

k = No. of double bottom longitudinals incl. CVK = 3
d = Depth of double bottom at center line = 3'-8"
n = No. decks + inner bottom + shell = 6

STEEL WEIGHTS - cont.

Item	Wt.L tons	L.C.G. Aft F.P.	V.C.G.
STEEL ABOVE:			
Trans. fr.	25.04	214.46	40.82
Shell plating etc.	84.55	221.05	41.77
Foc. & bridge dk. plating beams	179.48	190.51	44.7
Poop dk. plating, beams etc.	24.78	410.17	46.93
Prom. dk. plating, beams etc.	68.14	213.37	51.88
Boat dk. plating, beams etc.	61.24	217.46	60.55
House top beams etc.	19.4	208.25	68.92
Dk. houses, bridge to prom.	34.08	205.72	47.8
" " on poop	4.52	410.44	52.76
" " prom to boat	27.97	208.01	56.31
" " boat	16.8	209.17	64.7
Misc. bhds.	120.43	258.30	45.64
Machinery casings	31.69	220	49.4
Pillars & girders	26.05	184.45	51.29
Hatch coamings	11.03	146.34	46.81
Ventilation ducts	11.99	235.95	53.38
Bulwarks	17.34	163.16	56.41
Gun found.	11.20	272.04	45.57
Masts, derrick posts & booms	38.20	178.86	71.97
Misc. steel	.99	50.14	48.65
Skylights	4.09	202.99	66.12
Swimming pool	7.16	352.66	40.48
Net steel above main dk.	826.44	220.16	49.91
Rivet hds. & welds 3.57% & toler.	29.56	220.16	49.91
Total steel above	856.0	220.16	49.91
TOTAL STEEL	3221.0	224.40	25.51

LBP = 415'-0"
B = 60'
D = 34'-9" upper deck
k = 3
n = 6
H = 25' (scantling)
Δ = 10,930 total
H/D = 0.719
L/D = 11.95
$\frac{\Delta}{(L/100)^3} = 135$
l = 0.622
m = 0.979
b = 0.609

Steel weights were calculated in detail from working drawings.

WOOD AND OUTFIT

Item	WOOD & OUTFIT ABOVE			WOOD & OUTFIT BELOW		
	Wt.L.tons	LCG aft FP	VCG	Wt.L.tons	LCG aft FP	VCG
13. Ports, doors, ladders, skylights & covers	20	241.3	50.5	26	207.9	29.4
14. Bitts, chocks, davits, hawse pipes & stanchions	65	210.7	51.0	2	184.5	27.3
15. Airports, fixed lights, & rails	50	215.4	49.3	0.5	395.0	35.0
16. Rudder	-	-	-	26	418.3	14.6
17. Cement	12	273.5	40.6	68	288.1	10.3
18. Carpenter work	115	239.1	51.0	17	217.8	24.4
19. Wood foundations, etc.	5	170.0	49.1	-	-	-
20. Joiner decks	-	-	-	-	-	-
21. Joiner work	147	211.5	50.7	24	168.5	31.0
22. Decorative joiner work	2	208.0	49.5	-	-	-
23. Paint	-	-	-	73	190.0	32
24. Rigging	13	212.9	62.1	-	-	-
241. Canvas work	2	259.1	58.3	-	-	-
25. Deck covering	150	230.8	43.8	-	-	-
26. Heat insulation	25	207.0	56.6	28	226.3	29.0
27. Portable furniture	48	225.8	47.7	-	-	-
28. Steward's outfit	30	250.6	42.3	-	-	-
29. Deck & navigating outfit	3	143.5	51.8	-	-	-
30. Lifeboats & rafts	11	247.3	61.9	-	-	-
31. Anchors, etc.	25	161.5	46.1	50.5	25.5	28.0
32. Refrigeration cargo insulation	-	-	-	600	210.0	22.7
38. Sheet metal work	5	221.5	63.0	-	-	-
Ratproofing	-	-	-	2	198	10
TOTAL WOOD & OUTFIT	728	222.7	49.0	915	208.0	21.6

HULL ENGINEERING

Item	Wt.in lbs.
Sliding WT doors	15,000
Skylight lifting gear	1,300
Bracket fans	2,000
Punkah louvres	1,000
Ventilation ducts - mech.	51,500
Thermo tanks	5,000
Ventilation fans	29,000
Heating system	45,000
Steering engine	38,000
Steering gear - piping etc.	16,000
Oil & water separator	8,000
Drainage system	75,000
FW & SW system	70,000
Fire extinguishing system	38,300
Hose & reels	1,500
Plumbing fixtures	32,000
Hand pumps	500
Windlass & capstan - electric	51,000
2 warping winches - electric	22,000
6 boat winches	7,500
8 deck winches - electric	55,000
2 capstans - electric	12,000
Refrigeration machinery	620,000
Refrigeration piping	86,000

Item	Wt.in lbs.
Generators & engines	180,000
Switchboards & wiring	120,000
Searchlights & fixtures	15,000
Inter communication system	17,000
Gyro compass, fathometer etc.	5,000
Radio set	4,000
4 Pneumercators	300
TOTAL HULL ENGINEERING	1,623,900
	725 L.tons

CONT. →

H-20

SUMMARY

Conditions - leaving port, homogeneous cargo, no ballast

Item	Wt.L.tons	L.C.G. aft F.P.	V.C.G.
Hull steel	3,221.0	224.4	25.5
Wood & outfit	1,643.0	214.5	33.8
TOTAL HULL	4,864.0	221.0	28.3
Hull engineering	725	226.0	26.5
Machinery in engine room	743	263.9	13.3
Machinery in boiler room	382	201.1	18.6
Water & oil - refrigeration plant	75	286.0	11.1
Shafting & spares	11	300.0	9.5
LIGHT SHIP	6,800	223.0- 6.0'aft ℄ WL	25.7
Fuel oil	600	47.0f	4.2
Fresh water	310	84.0a	11.4
Boiler feed	145	77.1a	2.5
Mail	20	27.0a	30.5
Passengers & baggage	20	5.0a	44.0
Crew & stores	30	30.0f	34.0
Cargo - 61 cubic ft/ton	2,965	0.9f	23.7
	10,890	4.31a	23.2

Mean draft 24'-0" AT Δ = 10,890 L.TONS

LCB = 3.62' aft
LCG = 4.31' aft
MTI" = 1030 ft-tons
Trim = 7" by stern
GM = 1.90'

LBP = 415'-0"
B = 60'
D = 34'-9" to upper deck

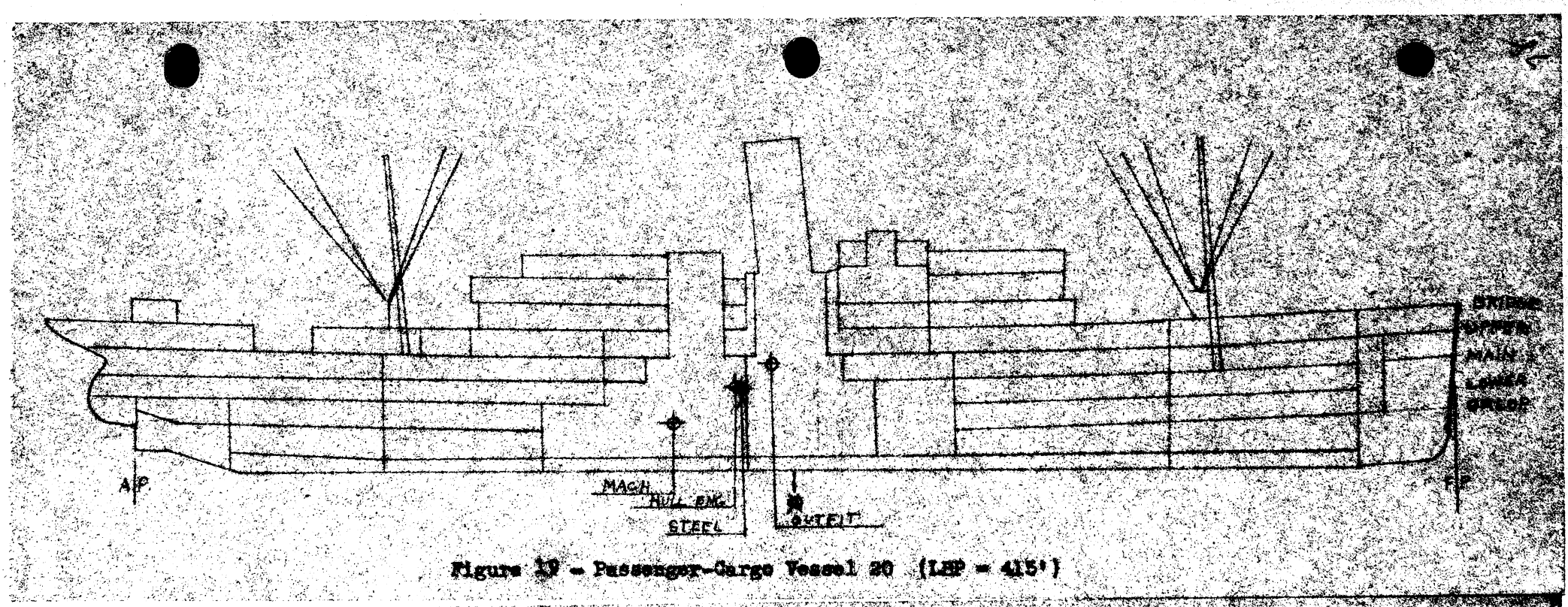


Figure 19 - Passenger-Cargo Vessel 20 (LBP = 415')

Figure 20 - Passenger-Cargo Vessel 21 (LBP = 385')

STEEL WEIGHTS

Passenger Cargo

Item	Wt. L tons	L.C.G. aft F.P.	V.C.G.	Wt/ft ℄	Wt/ft coeff	Wt/ft² ℄	Wt/ft net	Dimension Factor F	Wt in Tons F
STEEL BELOW - MAIN SCANTLING ITEMS:									
Trans. fr. in D.B.	118	188.35	2.44	1147	0.64	21.72	29.43	(L/100)(B+d) = 218	0.551
Trans. fr. outside D.B.	115	179.5	14.10	538	1.31	10.76	10.69	(L/100)(2D) = 208	.553
Longl. fr. in D.B.	40	185.3	1.95	269	.92	5.10	16.04	(L/100)(kd) = 36	1.111
Longl. outside D.B.									
Shell plating & F.P.K.	330	186.75	11.02	2224	.91	20.98	22.36	(L/100)(B+2D) = 413	.795
IB & margin	102	178.9	3.78	1012	.62	19.15	25.4	(L/100)(B) = 206.22	.495
Upper dk. beams, plating etc.	155	198.1	29.75	1131	.84	20.15	21.05	" "	.752
Main dk. beams, plating etc.	118	202.25	21	1127	.64	19.95	18.95	" "	.573
Lower dk. beams, plating etc.	67	229.5	12.75	1127	.37	19.95	21.20	" "	.325
Total	1045	191.49	13.35	8575	.746			(L/100)(B+2D) = 413	2.52
INTERNALS:									
Stem, stern frame and struts	37	2.87	10.1						
Trans. WT & OT bhd & recess	145	192.9	13.91						
Cofferdams (horiz) & diaphragms	13	170.72	17.41						
Misc. bhds.	44	260.25	24.3						
Pillars and girders	39	175	20.65						
Hatch coamings	1	94.5	20.8						
Engine & boiler found.	50	220	6.5						
Aux. mach. found.	27	205	16						
Ventil. ducts	3	186	23.5						
Bilge keel	4	187.3	4.75						
Misc. steel	5	185	19.5						
Fender	12	186.3	20.4						
Stringers	9	94.7	15.95						
False floor #1 hold	2	56.3	7.85						
Total internals	409	206.34	15.41						
Net steel below upper dk.	1454	195.64	13.93						
Rivet heads & welds & toler. 3.16%	46	195.64							
TOTAL STEEL BELOW UPPER DK.	1500	195.64	13.93						

	Cu.No. LxBxD= 5877.6	Wt/ft 8575	(L/100)(B+2D) =413	(L/100)(nB+2D) =1240
Coeff. of Mn. Sc. Items	0.1778	0.746	2.52	0.843
Steel below coeff.	.2552	1.073	3.61	1.21
Total steel coeff.	.3507	1.473	4.96	1.66

k = No. of double bottom longitudinals incl. CVK = 3
d = Depth of double bottom at center line = 3'-3"
n = No. decks + inner bottom + shell = 5

STEEL WEIGHTS - cont.

Item	Wt.L tons	L.C.G. aft F.P.	V.C.G.
STEEL ABOVE:			
Trans. fr.	18	163.6	34.42
Shell plating	70	177.8	33.6
Prom dk. pl. beams, etc.	144	185.9	39.03
Saloon pl. beams, etc.	91	213.9	46.86
Boat pl beams, etc.	30	192.3	55.01
Dk. houses	61	219.6	45.76
Misc. bhds.	35	174.4	39.87
Mach. casings	33	184.8	44
Pillars and girders	32	204.8	41.08
Ventil. ducts	12	249.2	43.88
Bulwarks, curtain plts, & stanch.	5	161.6	45
Masts & derrick posts	6	174.6	81.1
Misc. steel	10	194.4	42.27
Net steel above	547	194.4	42.27
Rivet heads & welds & toler. 2.38%	13		
Total steel above	560	194.75	42.35
Total steel	2060	195.4	21.65

LBP = 365'
B = 56.5'
D = 28'-6" (upper deck)
k = 3; d = 5'-3"
n = 5
H = 20'
Δ = 5886 long tons SW
H/D = 0.702
L/D = 12.8
$\frac{\Delta}{(L/100)^3} = 121$
l = 0.567
m = 0.932
b = 0.529

H-21

STEEL WEIGHTS AS WEIGHED

Comparison of Steel Weights as Calculated and as Weighed

Item	Weight in Long Tons	
	Calculated	Weighed
Transverse framing in D.B.	118	120.93
Transverse framing outside D.B. below & above	133	143.23
Longitudinal framing in D.B.	40	37.47
Shell plating below & above	400	396.15
Double bottom plating	102	102.63
Lower deck plating	67	70.49
Main deck plating	118	113.24
Upper deck plating	155	148.48
INTERNALS		
Stem, sternpost, struts, sterntubes	37	47.11
Main bhds - water tight and oil tight	145	150.51
Misc. bhds. below	44	21.40
Engine & boiler casings - below & above	51	45.53
Engine & boiler foundations	50	31.73
Auxiliary foundations	27	29.14
Stanchions & girders	39	39.29
Vent trunks & ducts	3	3.94
Cargo hatch coamings & webs	1	.89
Bilge keel	4	3.98
Misc. steel	5	-
Fender	12	10.55
Cofferdam over fuel oil tanks	13	10.13
Stringers	9	5.51
False floor in No. 1 hold	2	2.07
Promenade deck plating	144	141.39
Saloon deck plating	91	91.54
Boat deck plating	30	34.59
Deck stanchions & supports	5	13.82
Misc. bhds.	35	35.87
Deck houses	61	59.06
Pillars & girders	32	35.57
Vent trunks & ducts	12	11.84
Masts	6	5.71
	1991	1963.79
Total steel incl. Rivet hds.	2050 (3%)	2050 (5%)

H-21 - cont.

WOOD AND OUTFIT — Passenger Cargo

Item	Wt. L. tons	L.C.G. aft F.P.	V.C.G.
WOOD & OUTFIT ABOVE:			
13. Fittings by fitters	12	183	40.25
14. Fittings by ship carp.	50	207.5	50.75
15. Fittings by plumbers	25	192	39.5
17. Cement	8	169	30.5
18. Carpenter work	65	212	43.75
19. Wood fenders etc.	2	121	49
20. Joiner decks	80	197.5	51
21-22. Joiner work	210	196.5	44.25
24. Rigging	8	209	63.25
24I. Canvass work	1	223	55.25
25. Linings & dk. coverings	130	199.5	36.5
26. Heat insulation	10	209.5	42.5
27. Portable furniture	40	195	40.25
28. Stewards' outfit	18	187	41.5
29. Deck & navig. outfit	5	132.5	72.25
30. Lifeboats & rafts	30	198	58.5
31. Anchors, cables, & hawsers	12	91	42.5
38. Sheet metal work	5	188	57.75
TOTAL W & O ABOVE	711	196.25	44.4
WOOD & OUTFIT BELOW:			
13. Fittings by fitters	25	161	21.75
14. Fittings by ship carp.	3	136	17.75
15. Fittings by plumbers	4	256	26
16. Rudder	15	366	12
17. Cement	80	203.5	8.5
18. Carpenter work	30	109.5	12.25
19. Wood fenders etc.	2	118	20.25
21. Joiner work	35	200	25.75
25. Linings & dk. coverings	90	248	20.5
26. Heat insulation	10	181	23.5
27. Portable furniture	15	264	21.5
28. Steward's outfit	20	266	23.25
29. Deck & navig. outfit	3	93	26.25
31. Anchors, cables, & hawsers	35	41	12.5
TOTAL W & O BELOW	367	198.56	17.05
TOTAL W & O ABOVE	711	196.25	44.4
23. Painting	60	195.25	23
TOTAL	1138	196.04	34.45
Say	1140	197	34.5

H-21 - cont.

HULL ENGINEERING

Item	Wt. in lbs.	L.C.G. aft fr. 68	V.C.G.
Watertight doors	26,500	83.7	18.01
Skylight lifting gear	1,000	82	45
Bracket fans	5,000	60	42
Ventilation ducts	39,500	95	38
Ventilation fans	17,000	116	49
Heating system	25,000	68	36
Steering engine	19,000	225.5	25
Steering gear incl. crosshead etc	9,000	186	34.7
Drain system	50,000	54	4
Fresh & salt water systems	30,000	48.5	37
Firemains	10,000	50	33
Hose & reels	1,500	78	38.7
Plumbing fixtures	30,000	64	39
Hand pumps	400	155	21.5
Lux Rich system - outside	10,500	124	7.2
Windlass	17,000	-110	44.5
Capstan aft	19,140	221	27
Boat winch	2,400	52.8	55.5
Elevators	46,500	-4.0	20
Refrigeration machinery	31,000	116.7	7.82
Refrigeration pipe	5,400	110	13
Generators & engines	27,000	99	15.2
Switchboard, wiring, & battery	50,000	60	38
Searchlights & fixtures	6,000	60	33
Inter communication & fire alarms	15,000	60	40
Radio & direction finder	2,000	112	56
Pheumeracators	900	60	8
Lux Rich system - inside	6,500	25	19.5
10 KW main generators	1,710	102.2	14
Emergency generator - 10 KW	1,375	98	56
Plumbing drains	40,000	64	39
Total	546,525 L.	74.66	28.13
Say	245 tons	74.66	28.13

H-21 - cont.

MACHINERY

Item	Wt. L. tons
Engine room:	
Main turbine & reduction gears	181
Main condenser	39
Shafts and bearings	95
Propeller & spares	22
Pumps	45
Piping etc.	71
Floors, gratings, etc.	20
Water in engine room machinery	22
Misc.	30
Engine room total Wet	525
Boiler room:	
Main boilers (wet)	315
Stack uptakes, etc.	34
Oil fuel plant	10
Floors, gratings, etc;	12
Misc.	30
Total boiler room Wet	401
Machinery total	926
Equipped vessel (wet)	4371 = LS
Deadweight	2364
Δ =	6735 at 20'-1.63" max. draft

SUMMARY - Conditions full passenger list, full homogeneous cargo, tanks full except one FW and oneFO tank empty and settling tanks one-half full

Item	Wt.L. tons	L.C.G. aft F.P.	V.C.G.
Hull steel below	1500	195.64	13.93
Hull steel above	560	194.75	42.35
Total hull steel	2060	195.40	21.65
Wood & outfit	1140	196.94	34.45
Total hull	3200	195.88	26.24
Hull Engineering	245	210.94	28.13
Machinery	926	199.21	13.47
Light ship	4371	197.43	23.64
Light ship from incline test	4371	197.40	24.12
Fuel oil	650	148.33	5.87
F.W. - reserve feed etc.	476	251.79	5.78
Drinking water	48	281.12	9.11
742 - pass. & baggage	70	183.0	42.0
111 crew	10	200.0	27.0
Stores	25	256.31	25.10
Cargo at 83 cu. ft./ton	1015	118.90	18.08
S.W. ballast in AP tank	70	360.35	18.0
Total displacement	6735	187.22	20.18

Mean draft 20'-1.63" at Δ = 6735

LCB = 1.5' a LCG = 1.78' f Trim = 31.6" by head

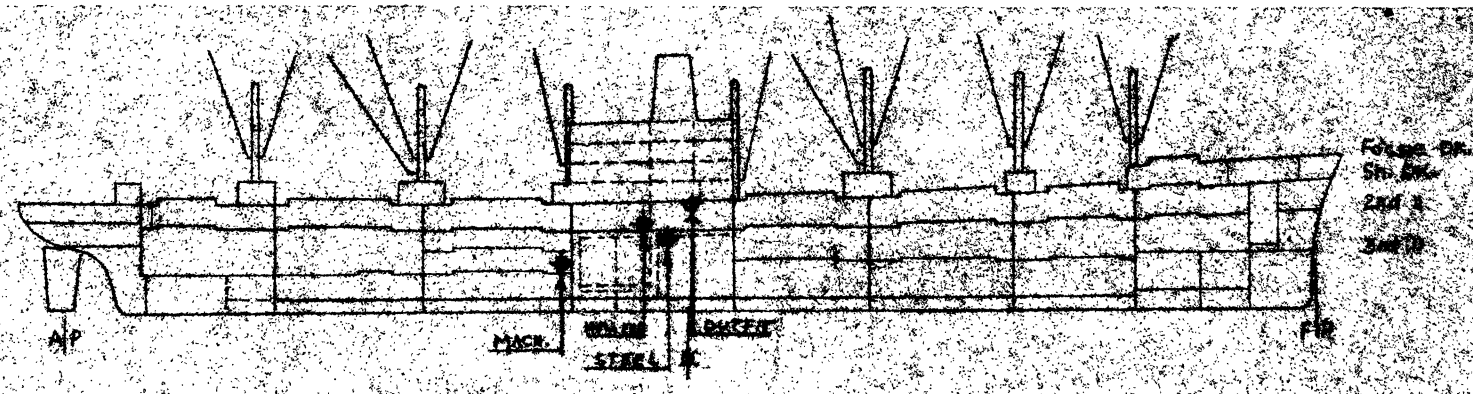


Figure 21 - Cargo Vessel B (LBP = 525'-0")

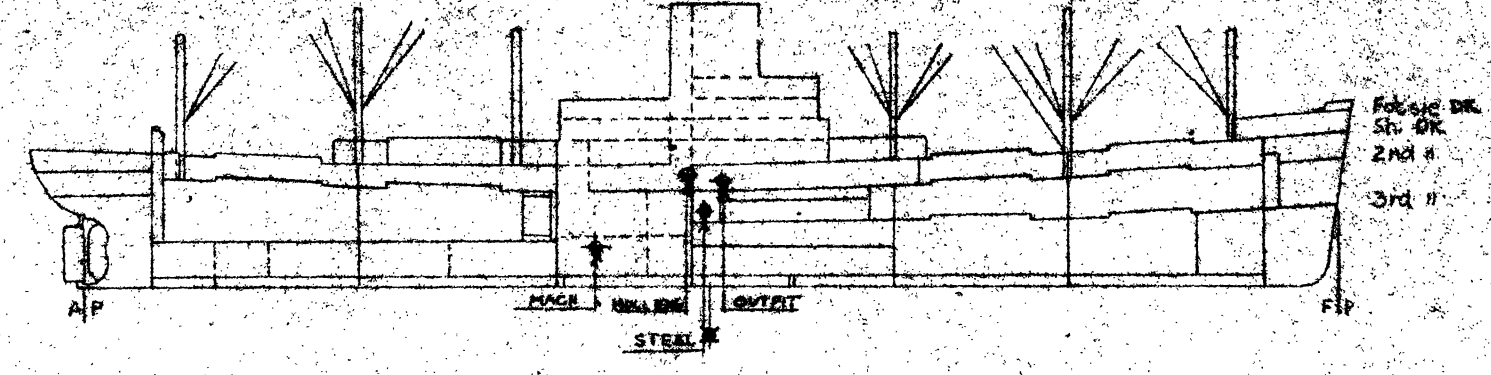


Figure 22 - Cargo-Passenger Vessel C (LBP = 465'-0")

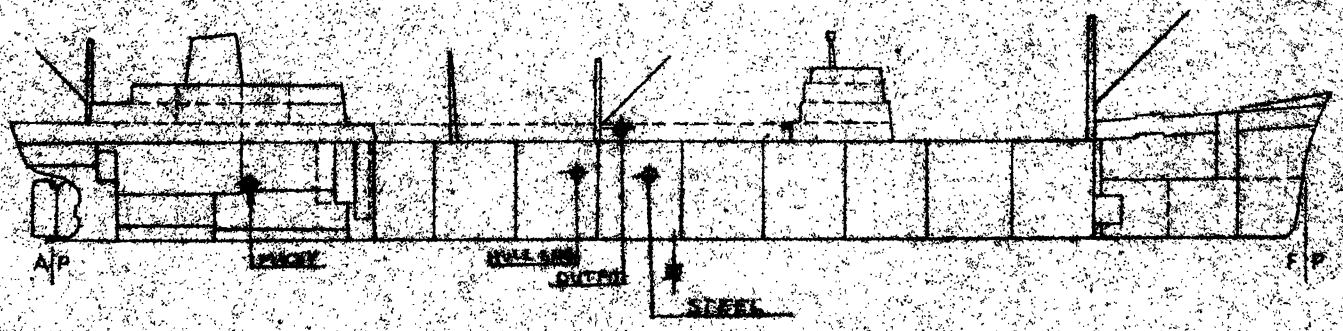


Figure 25 - Tanker E (LBP = 535'-0")

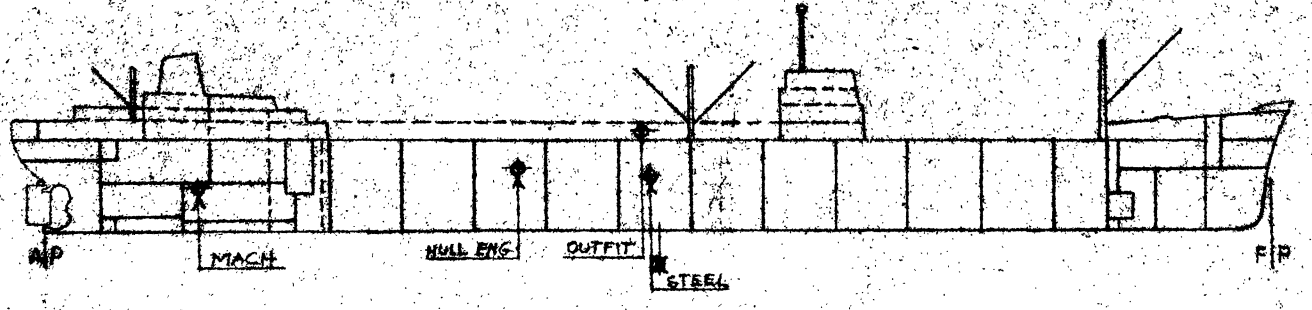


Figure 24 - Tanker G (LBP = 677'-0")

APPENDIX B

WEIGHT AND CENTER DATA, VESSELS I, II, AND III
(Vessels not used in study)

WEIGHTS AND CENTERS FOR 126' TOWBOAT

KNOWN AUXILIARY WEIGHTS

Item	Wt. in lbs.	Arm (From Fr. 0)
TANKS		
Fresh water - inner bott. fr. 15-20	23,370	35.00
Diesel oil - wing tanks (2)	238,400	47.51
Fresh water - drinking	11,660	31.00
MAIN ENGINE AND SHAFTING		
Main engines	75,840	60.29
Reduction gears	23,600	69.71
Propellers and caps	7,200	112.08
Intermed. shafts	3,450	77.65
Propeller shafts	7,920	99.84
Stern tube stuffing boxes	620	98.55
Couplings	1,140	86.00
Strut bearing	860	109.25
Bhd. stuffing boxes	1,150	78.00
Steady bearings	3,000	83.08
RUDDER ASSEMBLIES		
Ahead rudders	22,520	118.96
Ahead rudder posts	1,260	117.08
" " bearings	50	117.08
" " tillers	516	118.75
" " upper B. housings	372	117.08
Flanking rudders	14,038	104.41
" " bearings	226	103.16
" " tillers	516	101.16
" " upper B. housings	372	103.16
" " posts	1,834	103.16
STEERING RAMS		
Ahead rams	1,500	120.15
" " Crossh'ds	475	120.15
" " links	360	120.57
Flanking rams	1,500	100.10
" " crossh'ds	475	100.10
" " links	360	99.68
MISC. ITEMS		
Starting air tanks (4)	8,200	13.80
Main engine silencers (2)	3,000	62.84
Stern rope windlass	7,730	109.58
Galley stove and tank	450	84.22
Refrigeration compt.	11,500	97.00
60 K.W. Diesel generator	7,000	37.00
	482,564 lbs.	60.04 ft

KNOWN AUXILIARY WEIGHTS - Contd.

Item	Wt. in lbs.	Arm (From Fr. 0)
STEEL WEIGHT		
Main hull	361,600	57.69
Deck house	88,400	48.87
Total steel weight	450,000	55.96
SUMMARY		
Known auxiliary weights	482,564	60.04
Steel weight	450,000	55.96
Unknown auxiliary weights	153,874	46.83
TOTAL	1,086,438	56.48

LBP = 126'-0"
B_{mld} = 25'-0"

D_{mld} = 10'-2 3/4"

H = 7'-6"

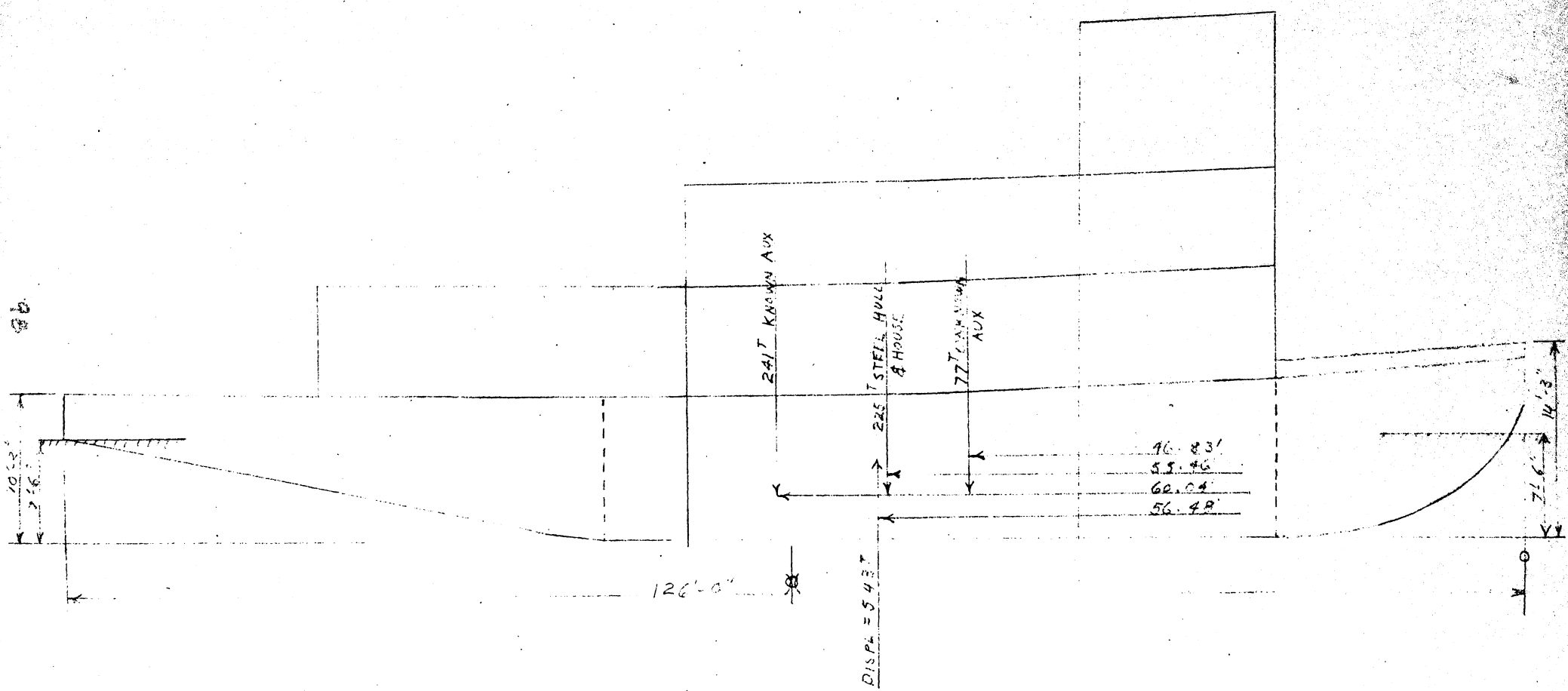


Figure 25 - River Towboat I (L = 126')

800 HP TOWBOAT

Item	Wt. L. tons	L.C.G. aft FP
Bottom plating - 2 sides	26.6	47.7
Transom	.5	97.0
Headlog	1.14	0
Trans. bhd. #10	.62	20.0
Trans. bhd. #30	1.88	60.0
6 wing bhds.	.94	41.4
2 trusses aft	1.15	78.0
Stem	.24	10.0
2 trusses fwd	.42	8.0
Trans. framing midbody	8.23	40.0
Framing fwd	4.19	10.8
Trans. framing aft	4.52	74.7
N.T. bhd. #40	.63	80.0
Fenders	1.66	51.0
Main dk. & bulwark	9.25	53.8
Main dk. house, bhd. 30-36, dk. hse. bhd #30	3.73	46.2
Towing knees	1.3	0
Engine girder	5.71	40.0
Engine room floor	.16	38.0
Upper deck	6.14	45.5
Stack	1.24	50.0
Upper deck house & OH	2.38	27.8
Pilot house & OH	.73	26.0
Rudders (3)	1.83	84.0
Deck castings fwd	1.01	9.2
Deck castings ϕ	.28	35.0
Deck castings aft	.87	73.6
Capstan	1.88	26.0
Main engine	35.6	42.7
Shafting	1.72	69.2
Propeller	.97	82.6
Strut & bearing	.87	80.8
Steering gear	.63	74.0
Piping	.35	70.2
Aux. generator	1.64	32.0
Air tanks		
Hot water boiler		
Batteries	Wts. not available	
Bilge pump		
Swbd. bd. & wiring		
San. water pressure set		

Block coeff (MLD) = 0.662
LCB = 42.74' aft of FP
MLD. length = 96'-0"
Beam MLD = 25'-0"
H_{FW} = 6'-6"

Displacement = 288 L. tons FW
Main dk. house - 50-6" X 16'-6"
Pilot house = 13'-0" X 13'-0"
Main dk. above BL:
9'-9" MLD at ℄ aft
12'-2-1/2" MLD at ℄ FWD

H-III
Diesel Trawler

Item	Wt. L.tons	L.C.G. aft FP	V.C.G.
STRUCTURAL MATERIAL:			
Trans. framing	21.44	69.65	6.01
Longl. "	2.01	63.52	8.69
Deck Beams	8.08	59.86	15.33
Deck Plating	19.55	60.29	15.18
Trans. Bulkheads	8.55	62.49	8.60
Longl. "	2.27	87.26	7.66
Shell Plating - Main Hull	49.10	67.14	7.62
" " - Forecastle	1.75	6.39	21.10
Found. for Prop. Machy.	6.67	88.66	4.70
Deck Houses - above Main Deck	18.57	97.58	22.58
" " - below " "	.47	107.05	12.30
Hatches	1.07	42.50	15.30
Ports and Doors	.49	89.98	20.80
Bilge Keels	1.07	70.33	3.41
Trunks for Air and Access	.27	27.82	5.08
Pipe Casings	.31	57.22	6.61
F.W. Tanks	.98	132.20	14.17
Found. for Hull Machy.	.95	69.26	14.77
Insulation Plating	10.30	49.28	8.34
Masts and Spars	.46	119.85	33.20
Bulwarks	7.39	72.26	17.90
Companionways, Skylights, and Domes	.71	55.65	23.27
Moulding and Fenders	2.41	67.34	12.07
Misc.	1.78	79.89	7.25
Stanchions and Girders - Supporting Decks	1.16	62.99	14.02
" " " in Fish Hold	2.63	46.72	8.23
" " " - Supporting Local Wts.	.22	37.33	7.97
Liners	2.19	64.20	7.44
Rivet Heads and Welding	2.16	69.17	11.16
Forgings and Castings	6.18	106.14	4.60
Total Steel Structure	181.19	70.43	10.94
PAINT AND CEMENT:			
Cement, Sand, Coke, Asphalt, Bitumastic	19.34	59.93	5.45
Paint and Varnish	2.07	64.05	10.90
Total Paint and Cement	21.41	52.21	5.98
CARPENTER WORK:			
Decking	7.25	61.55	15.14
Ceiling	6.17	46.96	9.57
Hatches	.20	48.32	15.78
Masts and Booms	1.10	51.67	41.60
Packing	.72	51.19	14.69
Misc.	.50	128.05	27.16
Total Carpenter Work	15.94	54.47	15.20

Item	Wt. L.tons	L.C.G. aft FP	V.C.G.
JOINER WORK:			
Flooring	4.16	87.33	12.42
Lining and Bulkheads	3.42	87.70	18.84
Lining for Refrig. Compts.	5.33	58.88	11.08
Windows and Doors	1.34	88.15	19.39
Fixed Furniture	1.06	85.76	14.19
Stairways and Ladders	.34	109.36	16.74
Rails and Awnings	.06	81.25	26.60
Hardware	.09	78.15	14.20
Total Joiner Work	15.80	78.16	14.21
HULL FITTINGS:			
General Forgings, and Castings	2.44	42.78	17.07
Side Lights, and Airports	.45	89.65	23.00
Fittings for Ports and Doors	.23	89.95	20.80
Rails and Awnings	.47	68.39	22.86
Rigging and Cargo Gear	10.07	64.66	21.15
Davits	2.22	117.20	24.55
Hawse and Chain Pipes	.19	4.45	24.80
Fittings for Hatches	.14	38.00	15.82
Ladders	.19	39.80	13.14
Misc.	.38	52.50	15.83
Total Hull Fittings	16.78	68.04	20.89
PERMANENT BALLAST:			
Fish Hold	12.60	60.25	1.12
Shaft Alley	9.50	113.35	1.67
Engine Room	12.33	79.50	2.40
Total Ballast	34.43	81.80	1.73
EQUIPMENT:			
Anchor and Warping Gear	.80	fwd 8.95	25.50
Boats and Rafts	1.10	128.05	25.70
Life Saving Equipment	.26	36.12	19.37
Fire and Wrecking Equip.	.04	65.97	16.18
Total Equipment	2.20	68.99	24.55
OUTFIT:			
Galley Outfit	.63	111.10	17.50
Crockery, Glass, Silverware, etc.	.18	115.25	17.50
Bedding and Linen	.36	88.65	16.00
Loose Furniture	.02	102.35	25.70
Navigating Outfit	.62	68.38	26.20
Interior Communication	not calc.		
Canvas and Bunting	.06	50.53	21.80
Wireless Outfit	not calc.		
Outfit of Special Character	13.14	67.19	19.49
Total Outfit (Incomplete)			

Item	Wt. L.tons	L.C.G. aft FP	V.C.G.
SUMMARY:			
Structural Steel	181.19	70.43	10.94
Paint and Cement	21.41	52.21	5.98
Carpenter Work	15.94	54.47	15.20
Joiner Work	15.80	78.16	14.21
Hull Fittings	16.78	68.04	20.89.
Hull Engineering - Wet	?		
Equipment	2.20	68.99	24.55
Outfit	?		
Propelling Machinery - Wet	?		
Permanent Ballast	34.43	81.80	1.73.
Vessel Light - (inclining exp.)	416.65	74.67	11.12
$H_{mean\ SW}$ = 9' - 9"; LCB = - 1.02';			
TRIM LVR = 6.40'; TRIM = 71" aft; T/in = 5.66;			
MT 1" = 37.7; KM = 12.33'; GM = + 1.21'			
Fuel Oil - $\mathbb{C}_L$ deep tks 95% 4590 gal	14.83	69.42	7.77
" " P and S " 7850 gal	25.38	69.42	8.50
Lube Oil 300 gal	1.03	91.45	17.30
Fresh Water $\mathbb{C}_L$ 31-34 full 722 gal	2.68	9.55	8.52
" " 3-10 P and S " 1820 gal	6.76	115.22	7.53
" " LAZ P and S " 662 gal	2.46	132.20	14.17
Ice in Fish Hold 100,000 lb	44.64	38.25	6.80
Galley Stores	1.00	110.25	19.50
Galley Coal	.40	108.95	18.80
Crew's Coal	.10	29.25	9.80
Crew and Effects 34 x 180 lb	2.73	60.25	14.50
Vessel Ready for Sea	518.66	71.64	10.53
$H_{mean\ SW}$ = 11' - 2 1/4"; LCB = - 1.04;			
TRIM LVR = 3.35'; TRIM 39" aft; T/in = 6.08;			
MT 1" = 45.0; KM = 12.37'; GM = + 1.84';			
$GM_{Corr.\ for\ free\ surf\ (FO.)}$ = + 1.80'			
Light Ship (inclining exp)	416.65	74.67	11.12
Fuel Oil - $\mathbb{C}_L$ deep tks 50% 2418 gal	7.79	69.42	4.14
" " P and S " " 4137 gal	13.33	69.42	5.37
Lube Oil 250 gal	.86	91.45	17.00
Fresh Water 3-10 P and S " " 910 gal	3.38	114.23	6.50
Iced fish in hold - cargo 7450 cu ft; 50 lb/cu ft	149.00	48.85	7.89
Galley Stores	.50	110.25	19.50
Galley Coal	.20	108.95	18.80

H-III

Item	Wt. L.tons	L.C.G. aft FP	V.C.G.
Crew's Coal	.05	29.25	9.80
Crew and Effects 34 x 180 lb	2.73	60.25	14.50
Vessel Loaded	594.49	68.23	10.10

$H_{mean\ SW}$ = 12' - 2 1/2"; LCB = - 1.11';

TRIM LVR = 0.13'; TRIM = 1 1/2" fwd; T/in = 6.33;

MT 1" = 49.4; KM = 12.54'; GM = 12.44';

$GM_{Corr.}$ for free surface in FW and FO = + 2.40'

VESSEL CHARACTERISTICS:

Single Screw Diesel Trawler classed to ABS
Built in 1937
LOA = 147' - 5"
LBP = 134' - 6"
B_{mld} = 25' - 0"
D_{mld} = 13' - 6"
H_{mld} = 11' - 2"

Deadwt = 138 L.tons at 11' - 2"
l = 0.600
b = 0.509
m = 0.847
Wetted Surface 4005 sq. ft. mld form
" " 415 sq. ft. appendages
Crew = 34

Displ SW = 555 L.tons
L/B = 5.38; L/D = 9.96
Cubic no. = 453.9

Engine - 1 Fairbanks Morse 7 cyl 300 rpm 735 BHP
Design Sea Speed - 11 1/2 knots at 555 L.tons displ. 610 SHP 260 rpm
Trial Speed - 12 knots at 460 L.tons displ 575 SHP 258 rpm
" " max 12.48 knots at 460 L.tons 723 SHP 272 rpm
Propeller 6' - 9" diam; 5' - 3" pitch; Dev. Area = 17.90 sq. ft; Proj. Area = 1610 sq.ft