QUEEN MARY HOTEL

- o HULL STRUCTURAL ANALYSIS
- o PIPING AND BALLAST SYSTEMS
- o MAINTENANCE STUDY

PREPARED BY:

RADOS INTERNATIONAL CORPORATION
POST OFFICE BOX 830
SAN PEDRO, CA 90733

RIC LETTER 117-90
DATED JUNE 27, 1990

DATE: SEPTEMBER 26, 1990

INDEX

PHASE I

Part 1: Determination of hog presently existing in hull structure.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 1: DETERMINATION OF AMOUNT OF HOGGING:

Introduction:

The Queen Mary was designed and constructed by John Brown Shipyard in Scotland. Exhaustive calculations were developed for proper distribution of weights and determination of maximum bending moments, deflections and stresses in an effort to keep the hogging and sagging both in still water and heavy seas at a minimum. Those volumes of calculations are not available as of this date.

The following principal characteristics of the Queen Mary are as follows:

Length Overall......................Lo........ 1,019.50 Feet

Length Between Perpendiculars......Lp........ 965.00 Feet

Length at Designed Waterline.......Lw........ 1,004.00 Feet

Beam, Molded.......................Bm........ 118.00 Feet

Depth, Molded, to "D"-Deck.........Dd........ 55.25 Feet

Depth, Molded, to "B"-Deck.........Db........ 74.50 Feet

Draft, Full Load...................Dw........ 34.50 Feet

Displacement, Full Load............Ds........ 66,000 L.Tons

Vertical Center of Gravity.........Kg........ 44.00 Feet

Longitudinal Center of Gravity.....Lg........ 20.00 Feet

In reviewing our files we found that the longitudinal bending moments and stresses for the Queen Mary as designed were as follows:

Section Modulus To Deck	Bending Moment Hogging	Stress on Bending Moment at Deck
Sq. In. x Ft.	Ft.-Tons	Tons/Sq. In.
279,100	2,602,500	9.32

During the conversion of the Queen Mary, extensive changes were made to the vessel, thus changing the distribution of weights and the longitudinal bending moments, deflection and stresses. The calculations were developed by Rados

International Corporation (RIC) and were turned over to the Port of Long Beach and Queen Mary; however, neither the Port nor the Queen Mary presently have these records in their files.

In recent years, weights have been removed from the structure and water ballast has been added to trim the vessel to desired requirements and needs.

References:

(1) Body Plan - No. 534 (200-1 C/P)
(2) Fore End Framing Elevation - No. 534 (S 105 - 3 C/P)
(3) Stern Cants and Aft End Framing - No. 534 (S 105 - 2 C/P)
(4) General Arrangement Inboard Profile - Rados Harco Forster RHF - QM H-26
(5) Lines - No. 552 RMS Queen Elizabeth - John Brown & Co. Drawing No. QE 36-Hull Lines-Body Plan-Sheet 4 (200-2)
(6) Body Plan - No. 534 (200-1)
(7) Structural Sections - AP-H-1153
(8) Midship Section - SS Queen Mary - Some Special Features of SS Queen Mary (no scale)

Findings:

To determine the amount of hogging and/or sagging that presently exists aboard the Queen Mary, a detail survey of the vessel was made, measurements taken and readings recorded as shown in the following enclosures.

The following draft marks presently exist aboard the Queen Mary:

Location	Mean Draft
Forward P/S	34.57 Feet
Midship P/S	33.98 Feet
Aft P/S	34.78 Feet

Mean midship draft between forward and aft:
= 34.68 feet

Present hogging condition of Queen Mary:
= 34.68 feet - 33.98 feet
= 0.70 feet or 8-1/2 inches

Recommendation:

The Queen Mary hull structural drawings were reviewed and parameters were compiled regarding frame spacing, deck heights, rise of floors and shell tumblehome. These readings were taken aboard the Queen Mary at specific locations, thus arriving at average draft marks for port and starboard, including the amount of list that presently exists.

The results of the following study indicates that the hull structure has developed a hogging effect of 0.70 feet, or 8-1/2 inches. Since the Queen Mary is floating in still water (minimum wave action) and is not subject to higher stresses that occur in open seas due to wave heights, it appears that the hog that presently exists does not exceed the original structural design stresses of the vessel and therefore should not result in any major structural problem to the hull structure.

It is recommended that should any major modifications or changes be made to the Queen Mary Hotel, studies should be performed to determine the amount of hogging and effect to hull structure.

QUEEN MARY HOTEL

STUDY AND CHECK FOR HOGGING

1. PARAMETERS COMPILED FROM EXISTING DRAWINGS:

Rise of Floor = 18" (at 59') (Ref. 6)

Shell Tumblehome = 21" (Ref. 7) ("D"-Deck to 2'-8" above "A"-Deck)

Deck Heights at Midship:

Deck			Ref
Sun Room to Promenade	=	10'-0"	(6)
Promenade to Main Deck	=	9'-3"	(6)
Main Deck to "A"-Deck	=	8'-9"	(6)
"A"-Deck to "B"-Deck	=	8'-9"	(6)
"B"-Deck to "R"-Deck	=	10'-6"	(6)
"R"-Deck to "C"-Deck	=	8'-9"	(7)
"C"-Deck to "D"-Deck	=	8'-6"	(7)
"D"-Deck to "E"-Deck	=	8'-0"	(6)
"E"-Deck to "F"-Deck	=	8'-0"	(6)
"F"-Deck to "G"-Deck	=	7'-3"	(6)

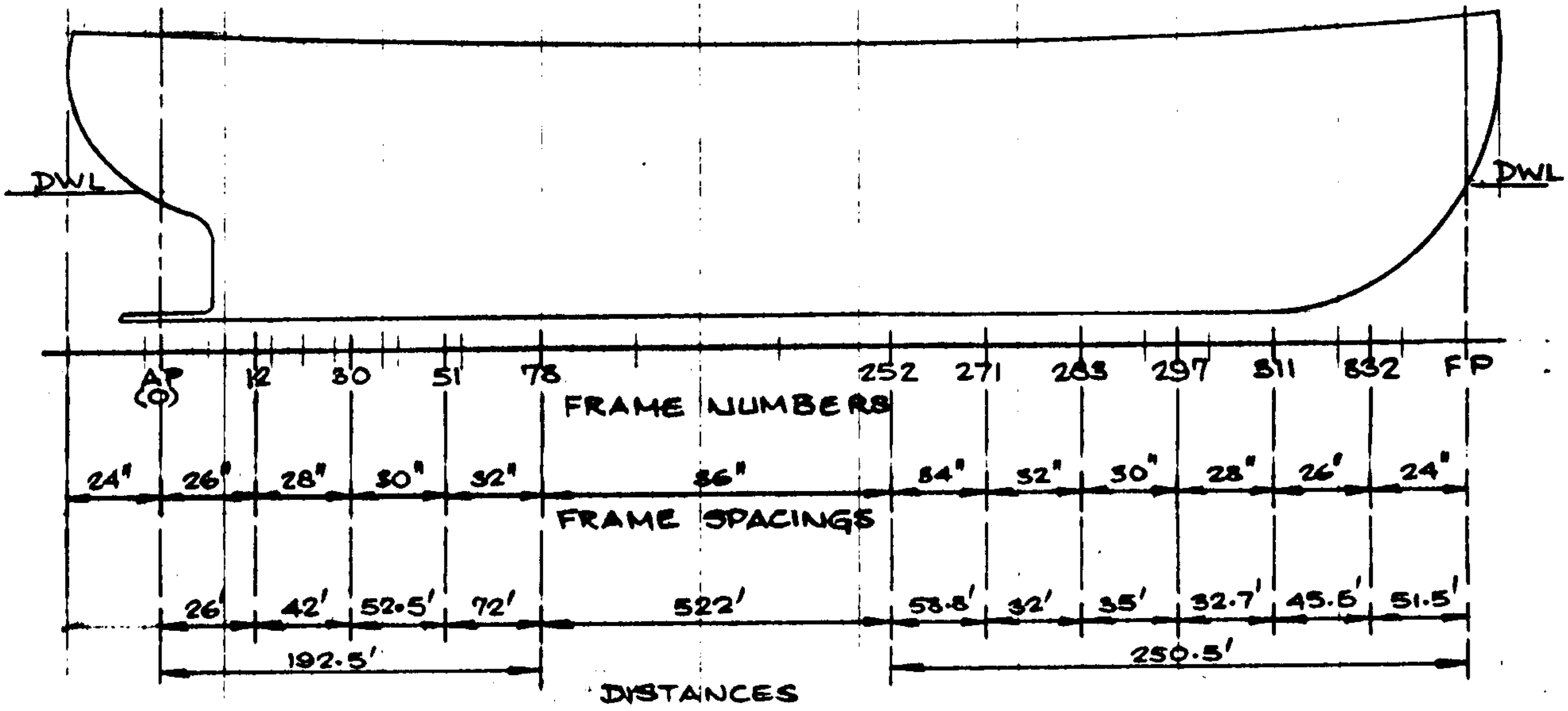
Deck Heights Above Molded Baseline:

Deck			Ref
Sun Room	=	N/A	
Promenade	=	92'-6"	(7)
Main Deck	=	83'-3"	(7)
"A"-Deck	=	74'-6"	(7)
"B"-Deck	=	65'-9"	(7)
"R"-Deck	=	55'-3"	(7)
"C"-Deck	=	46'-6"	(7)
"D"-Deck	=	38'-0"	(7)
"E"-Deck	=	N/A	
"F"-Deck	=	N/A	
"G"-Deck	=	N/A	

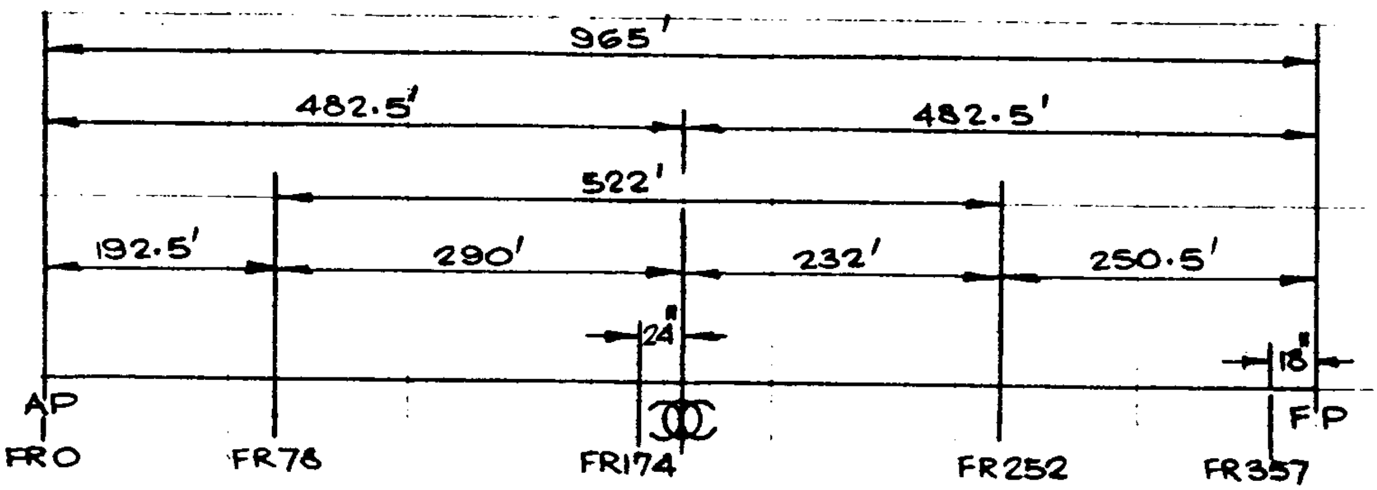
Scantling Draft = 38'-9"

SKETCH DEFINING FP AND AP
IN AS EXISTING CONDITION

(NOT TO SCALE)



SKETCH SHOWING LOCATIONS OF FP, AP AND MIDSHIP



FP = 18" Forward of Frame 357
AP = Frame 0

Deck Heights at FP:

"F"-Deck	= 40'-4" WL (Scale from Ref. 6 and Ref. 2)
"E"-Deck to "F"-Deck	= 8'-6" (Scale from Ref. 6 and Ref. 2)
"D"-Deck to "E"-Deck	= 8'-6" (Scale from Ref. 6 and Ref. 2)
"C"-Deck to "D"-Deck	= 8'-9" (Scale from Ref. 6 and Ref. 2)

Deck Heights at AP: (Frame 0)

"E"-Deck	= 38' WL (From Frame 12 to Aft)
"E"-Deck to "D"-Deck	= 9'-2"
"D"-Deck to "C"-Deck	= 8'-3"
"C"-Deck to "R"-Deck	= 8'-6"

2. <u>CALCULATION OF DRAFTS USING DECKS AND SIDE STRAKES AS REFERENCE</u>:

1) <u>Stern at Aft Peak at Frame 0</u>: (Width = 21'-6")

	PORT	STBD
Freeboard from "E"-Deck........................	3'- 0"	3'- 5"
"E"-Deck Height above Baseline.................	38'- 0"	38'- 0"
∴ Draft...........................	35'- 0"	34'- 7"
Freeboard from Lower P-Strake, Lower Edge......	1'-11"	2'- 5"
Height of Lower P-Strake, Lower Edge above B.L.	36'-11"	36'-11"
∴ Draft...........................	35'- 0"	34'- 6"
Draft Reading from Draft Marks.................	35'- 0"	34'- 7"

2) <u>Midship at 24", Forward of Frame 174</u>: (Width = 118'-0")

	PORT	STBD
Freeboard from "D"-Deck........................	3'- 1"	5'- 0"
"D"-Deck Height above Baseline.................	38'- 0"	38'- 0"
∴ Draft...........................	34'-11"	33'- 0"
Freeboard from Q-Strake, Upper Edge............	4'-11"	6'- 6"
Height of Q-Strake, Upper Edge above B.L.......	39'- 6"	39'- 6"
∴ Draft...........................	34'	33'- 0"

(No Draft Marks at Midship)

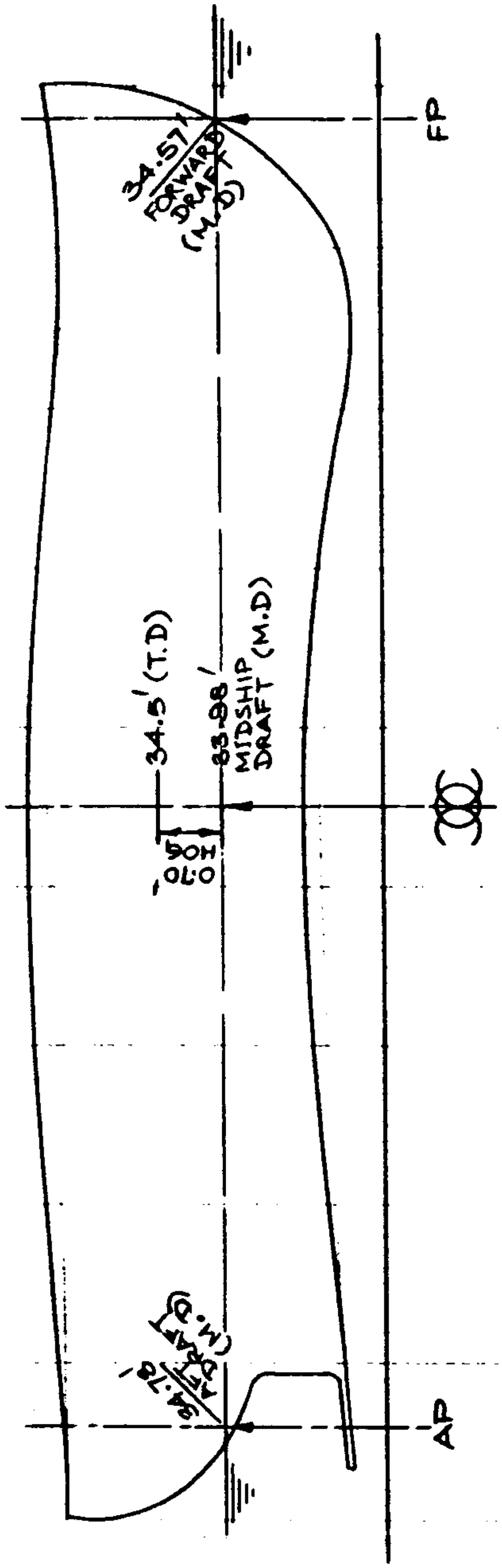
3) <u>Bow at Fore Peak at 18" Forward of Frame 357</u>:

	PORT	STBD
Freeboard from "F"-Deck........................	5'- 4"	5'- 5"
"F"-Deck Height above Baseline.................	40'- 0"	40'- 0"
∴ Draft...........................	34'- 8"	34'- 7"
Freeboard from N-Strake........................	2'- 3"	2'- 4"
Height of N-Strake, Lower Edge above B.L.......	36'-10"	36'-10"
∴ Draft...........................	34'- 7"	34'- 6"
Draft Reading from Draft Marks.................	34'- 7"	34'- 6"

4) <u>Average Drafts</u>:

			Mean Draft	List
Aft Port	= 35'-0"	= 35.00'	34.78'	1.17°
Aft Stbd	= 34'-6-5/8"	= 34.56'		
Midship Port	= 34'-11-1/2"	= 34.96'	33.98'	0.95°
Midship Stbd	= 33'-0"	= 33.00'		
Forward, Port/Stbd	= 34'-6-7/8"	= 34.57'	34.57'	---

Mean Midship Draft Between Forward and Aft = 34.68'
From above, the Ship is Hogging by (34.68'-33.98') = 0.70 '
= 8-1/2"



SKETCH ILLUSTRATING HOGGING EFFECT OF QUEEN MARY

(NOT TO SCALE)

M.D - MEASURED DRAFT

T.D - THEORETICAL DRAFT

PHASE I

Part 2: Determination whether hogging condition is within safe limits.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 2: DETERMINATION WHETHER HOGGING CONDITION IS WITHIN SAFE LIMITS:

Introduction:

In order to determine the longitudinal bending moments and deflections in the hull structure of the Queen Mary, a complete stress analysis of the hull structure is required.

A Proposal was submitted to Queen Mary Management to perform detail calculations to arrive at the maximum bending loads and stresses presently existing aboard subject structure. However, due to limited funds, the Proposal was not approved.

All ships are designed to withstand the hogging as well as the sagging moments when they encounter random waves at sea. As normal, the hogging moment is more severe than the sagging moment. The removal of all machineries and boilers around the ship's first-quarter to third-quarter of the length seemed to create some hogging effects on the ship.

References:

Principles of Naval Architecture, dated August 1983, pages 176-179.

Findings:

This study is prepared to check the existing condition of the ship which includes the following:

1) Measurement of amount of hog from the ship's draft.
2) Calculations of existing load distribution of the ship.
3) Calculations of ship's properties.
4) Shear and bending moment diagram of ship at still water.
5) Summary of findings and recommendations.

As the ship is moored in the dike and is not to be at sea, the total shear and bending moments due to wave and other sources are not included in this study.

The aim of this study is to investigate hull strength in terms of deflection due to hogging. Also, it is necessary to know the amount of hogging so that compensation can be made on all calculations and/or works on the ship.

The technical data in the calculations is to be used for the hogging analysis only. Most of the data is based on sound naval architecture assumptions due to lack of technical information available.

Recommendation:

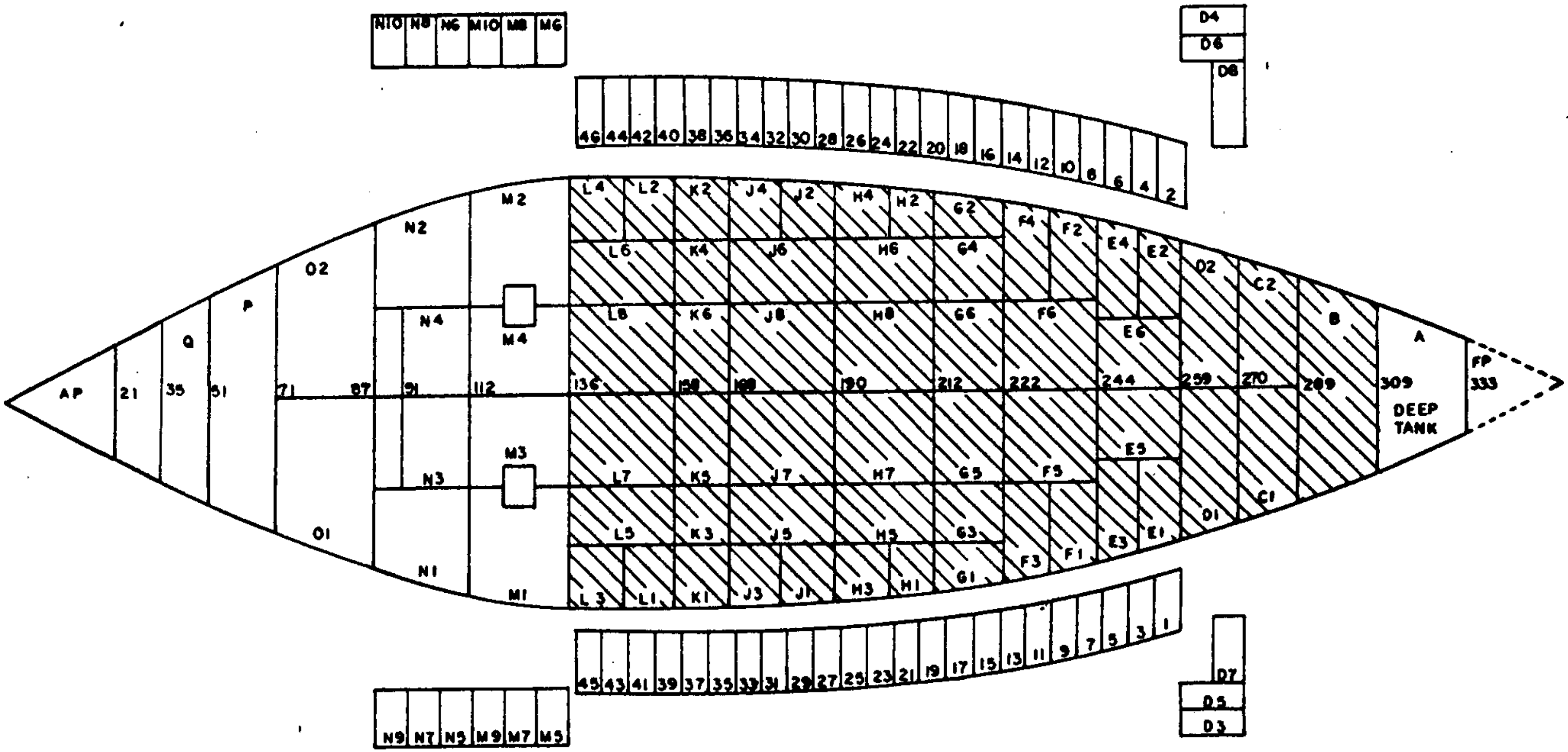
The original design of the Queen Mary midship section had a section modulus of 279,100 sq. inches-feet which could withstand a hogging moment of 2,602,500 feet-tons.

Based on the assumptions outlined in the following study and arriving at a section modulus for the existing vessel of 251,190 sq. inches-feet, the maximum allowable deflection is 11.92 inches.

Since the actual hogging condition of the Queen Mary is 8.50 inches and the maximum allowable deflection being 11.92 inches, the vessel can be considered safe within the design limits of the structure.

It is recommended that if any major modifications and/or shifting of weight occurs, a study should be made to assure the hogging condition does not exceed the design stresses of the subject vessel.

QUEEN MARY



TANK PLAN

NO SCALE

1. LOAD DISTRIBUTION

1. DOUBLE BOTTOM TANKS (FUEL AND SW BALLAST)

TANK	TANK DESIGNED FOR	FRAME LOCATION FROM	TO	LENGTH OF TANK in feet	WEIGHT of liq l.tons	TANK MODIFIED TO USE	WEIGHT in l.tons	WEIGHT PER FT tons/ft
B	S.W Blst	289	309	48	190	Mud ballast	428	8.91
C1¦C2	-do-	265	289	64	320	-do-	720	11.25
D1¦D2	-do-	257	265	23	275	-do-	619	27.26
E1-E6	-do-	246	257	32	475	-do-	1069	33.23
F1-F4	-do-	222	246	72	422	-do-	950	13.19
F5¦F6	Fuel	222	246	72	453	-do-	1049	14.57
G1-G4	S.W Blst	212	222	30	260	-do-	585	19.50
G5¦G6	Fuel	212	222	30	186	-do-	431	14.35
H1-H6	S.W Blst	190	212	66	642	-do-	1444	21.89
H7¦H8	Fuel	190	212	66	453	-do-	1049	15.89
J1-J6	S.W Blst	168	190	66	684	-do-	1539	23.32
J7¦J8	Fuel	168	190	66	453	-do-	1049	15.89
K1-K6	S.W Blst	158	168	30	489	-do-	1100	36.67
L1-L8	Fuel	135	158	69	1115	-do-	2581	37.41
						SUB TOTAL	14611	
M1¦M2	S.W Blst	112	135	69	454	S.W ballast	454	6.58
M3¦M4	Fuel	112	135	69	400	-do-	411	5.96
N1¦N2	S.W Blst	88	112	72	422	-do-	422	5.86
N3¦N4	Fuel	88	112	72	288	-do-	296	4.11
O1¦O2	S.W Blst	51	88	102	240	-do-	240	2.35
P	S.W Blst	27	51	60	166	-do-	166	2.79
Q	S.W Blst	0	27	61	72	-do-	72	1.18
						SUB TOTAL	2062	

2. WING TANKS (FUEL TANKS)

TANK S ¦ P	FRAME LOCATION FROM	TO	DESIGN CONDITION OF EACH TANK WEIGHT l.tons	LENGTH ft	SOUNDING OF S.W.BALLAST IN PERCENTAGE STBD	PORT	LIQUID WEIGHT in l.tons	WEIGHT PER FT in tons/ft
1¦ 2	257	259	47	6	98	0	47	8.31
3¦ 4	251	257	147	17	98	100	299	17.44
5¦ 6	244	251	148	21	95	95	289	13.77
7¦ 8	238	244	167	18	95	95	326	18.13
9¦10	232	238	136	18	95	95	266	14.77
11¦12	228	232	116	12	95	95	227	18.89
13¦14	222	228	164	18	95	95	321	17.81
15¦16	217	222	150	15	-	-	0	0.00
17¦18	214	217	54	9	95	-	53	5.86
19¦20	206	214	201	24	-	-	0	0.00
21¦22	203	206	113	9	100	90	221	24.54
23¦24	197	203	189	18	90	0	175	9.72
25¦26	190	197	285	21	0	-	0	0.00
27¦28	183	190	291	21	90	-	269	12.83
29¦30	177	183	204	18	0	X	0	0.00
31¦32	174	177	126	9	0	100	130	14.40
33¦34	168	174	240	18	X	X	0	0.00
35¦36	163	168	212	15	X	X	0	0.00
37¦38	160	163	104	9	X	X	0	0.00
39¦40	152	160	241	24	X	X	0	0.00
41¦42	149	152	127	9	X	95	124	13.79
43¦44	143	149	206	18	X	95	201	11.18
45¦46	137	143	251	18	X	95	245	13.63
						SUB TOTAL	3194	

3. WING TANKS (F.W TANKS)

TANK S ¦ P	FRAME LOCATION FROM	TO	DESIGN CONDITION OF EACH TANK WEIGHT l.tons	LENGTH ft	SOUNDING OF S.W.BALLAST IN PERCENTAGE STBD	PORT	LIQUID WEIGHT in l.tons	WEIGHT PER FT in tons/ft
D3¦D4	260	270	96	28	100	100	197	6.96
D5¦D6	260	270	91	28	100	97	184	6.50
D7¦D8	267	270	143	9	97	-	143	16.72
M5¦M6	128	137	110	27	100	99	225	8.34
M7¦M8	120	128	112	24	98	67	190	7.92
M9¦M10	107	120	109	39	100	0	112	2.87
N5¦N6	104	107	88	9	100	100	181	20.11
N7¦N8	95	104	95	27	100	100	195	7.24
N9¦N10	89	95	86	18	98	100	175	9.73
						SUB TOTAL	1604	

I

4. WATER ABOVE TANK TOPS (S.W)

Double bottom tank tops from Fr #212 to Fr #21 have standing water which is calculated in "TRIM AND BALLAST" study. These are summarized as follows:

Fr #21 to Fr #87	=	197.1 L.tons
Fr #87 to Fr #136	=	22.1 L.tons
Fr #136 to Fr #168	=	51.2 L.tons
Fr #168 to Fr #212	=	14.6 L.tons

Weight of water	=	285.0 tons

5. SUMMARY OF LIQUIDS AND BALLAST

From ship check measurement, the ship mean draft is about 34' 6". Corresponding displacement of the ship is:

Total displacement = 66726 L.tons

1	Double bottom tank	(mud ballast)	14611
2	-do-	(S.W ballast)	2062
3	Fuel wing tank	(S.W ballast)	3194
4	Fresh water wing tank	(unknown)	1604
5	Fresh water in propeller box		646
6	S.W above tank tops		285
7	Miscellaneous		100

Total liquid and ballast = 22501 L.tons

Ship weight without ballast and liquid 44225 L.tons

I

2. SHIP WEIGHT AND DISTRIBUTION CURVE DATA

Ship weight of 44225 L.tons is assumed distributed throughout the ship accordingly to its shape. The super structure and the main hull is considered separately. For simplicity, superstructure is considered from Fr #71 to Fr #270 and above "A" deck. Thus, the parameters of the two are as follows:

	Main Hull	Super-struct
Approx. half girth in feet	133	42
Ratio of half girth	3.17	1
Approx length in feet	1000	592
Ratio of length	1.69	1

The weight of main hull compared to that of superstructure is about 3 times in term of half girth and about 2 times in term of length. Thus, overall, the weight of main hull is 5 times that of superstructure. From Section 4, the weight of main hull and superstructure is 44225 L.tons.

The weight of main hull = 36854 L.tons

The weight of superstructure= 7371 L.tons

The weight distribution of main hull through out its entire length is assumed to be proportional to its half girth.

From hydrostatics data, half girths of stations to "R" deck are shown in the following table.

Sta	Half girth to R dk	R dk to A dk	Half girth to R dk	S.M	Product of area
FP	11.70	9.00	20.70	.5	10.35
.5	43.92	9.00	52.92	2.0	105.84
1.0	55.59	9.00	64.59	1.5	96.89
2.0	70.45	9.00	79.45	4.0	317.80
3.0	85.96	9.00	94.96	2.0	189.92
4.0	96.45	9.00	105.45	4.0	421.80
5.0	100.36	9.00	109.36	2.0	218.72
6.0	99.43	9.00	108.43	4.0	433.72
7.0	92.65	9.00	101.65	2.0	203.30
8.0	79.67	9.00	88.67	4.0	354.68
9.0	65.57	9.00	74.57	1.5	111.85
9.5	61.18	9.00	70.18	2.0	140.36
AP	58.96	9.00	67.96	.5	33.98
				Total, P	= 2639.21

Station spacing, h = 96.5 ft

Area under the curve, A = P x h / 3
= 84895

A factor is to be determined so that when multiplied with the ordinates of "half girth to R deck" will be equivalent to the weight unit, tons/ft, whose area under the curve has to be 36854 L.tons. This can be done by trial and error method and the factor, f, is found to be .45068.

Sta	Half girth to R dk y	Weight unit t/ft R dk w=fxy	S.M m	Product of area p=mxw
FP	20.70	9.33	.5	4.66
.5	52.92	23.85	2.0	47.70
1.0	64.59	29.11	1.5	43.66
2.0	79.45	35.81	4.0	143.23
3.0	94.96	42.80	2.0	85.59
4.0	105.45	47.52	4.0	190.10
5.0	109.36	49.29	2.0	98.57
6.0	108.43	48.87	4.0	195.47
7.0	101.65	45.81	2.0	91.62
8.0	88.67	39.96	4.0	159.85
9.0	74.57	33.61	1.5	50.41
9.5	70.18	31.63	2.0	63.26
AP	67.96	30.63	.5	15.31
			Total, P =	1189.44

Station spacing, h = 96.5 ft

Area under the curve, A = 38260 tons

Thus the data in "weight unit" column gives the weight per unit length of the main hull.

For the superstructure, the weight per unit length is just simply its weight, 7371 tons, divided by its length, 592 ft, which is equal to 12.46 tons/ft

The weight distributions of the main hull, the superstructure and the liquid ballast are plotted as shown and then the resultant of weight/ft at each half station is compiled in a table.

Station	Main Hull	Super-structure	Liquid and Ballast	Total tons/ft
FP to 0.5	17.9	0.0	0.0	17.85
0.5 to 1.0	26.7	0.0	0.0	26.67
1.0 to 1.5	30.1	0.0	5.1	35.20
1.5 to 2.0	34.4	0.0	11.2	45.60
2.0 to 2.5	37.7	12.5	35.2	85.36
2.5 to 3.0	41.0	12.5	47.9	101.36
3.0 to 3.5	44.0	12.5	48.5	104.96
3.5 to 4.0	46.4	12.5	48.5	107.36
4.0 to 4.5	48.1	12.5	39.2	99.76
4.5 to 5.0	49.1	12.5	44.0	105.56
5.0 to 5.5	49.4	12.5	40.7	102.56
5.5 to 6.0	49.2	12.5	42.8	104.46
6.0 to 6.5	48.3	12.5	31.8	92.56
6.5 to 7.0	46.9	12.5	14.1	73.46
7.0 to 7.5	44.8	12.5	23.9	81.16
7.5 to 8.0	41.9	12.5	6.2	60.56
8.0 to 8.5	38.1	6.2	1.7	46.03
8.5 to 9.0	35.1	0.0	1.7	36.80
9.0 to 9.5	32.6	0.0	1.7	34.30
9.5 to AP	31.2	0.0	1.7	32.90
			Total, T =	1394.44 tons/ft

Spacing, S = 48.25 ft

Total area under curve, A = S x T

= 67282 L.tons

The weight distribution data are plotted against the whole length (length between perpendiculars) of the ship as shown in the sketch.

3. BUOYANCY DATA AND CURVE

Ordinates for the buoyancy data are converted from the Bonjean's data to 35 feet draft and approximately about the same longitudinal centers of the ship displacement and buoyancy.

Station	Half area in sq ft A	Buoyancy load in tons/ft B=2A/35
FP	0.0	0.00
0.5	144.7	8.27
1.0	391.0	22.34
1.5	669.1	38.24
2.0	962.2	54.98
3.0	1503.2	85.89
4.0	1856.1	106.07
5.0	1955.3	111.73
6.0	1942.1	110.98
7.0	1738.5	99.35
8.0	1248.9	71.37
9.0	618.1	35.32
9.5	324.4	18.54
AP	100.3	5.73

4. LOAD, SHEAR AND BENDING MOMENT CURVE

The load curve is developed by using the ordinates of the resultant of the weight and buoyancy loads. Negative sign applies to excessive weight load and vice versa. The shear curve is then developed from the load curve by calculating the area under the load curve. The bending moment curve is again developed from the area under shear curve. These data are summarized in the following table. The ordinates of buoyancy and weight are adjusted by using corresponding factors so that the summation of the ordinates will yield the same value as that of the displacement. The factors for buoyancy and weight are

.84 and .859

Station	Buoy-ancy load tons/ft	Weight load tons/ft	Load tons/ft	Shear (area under load curve)	Bending moment (area under shear curve)
	B	W	B-W	x 10 tons	x 10000
FP	0.00	7.67	-7.67	0.0	0.00
0.5	6.94	19.12	-12.18	-47.9	1.15
1.0	18.77	26.57	-7.81	-96.1	4.63
1.5	32.12	34.70	-2.58	-121.2	9.87
2.0	46.18	56.25	-10.06	-151.7	16.45
2.5	59.64	80.19	-20.55	-225.5	25.55
3.0	72.15	88.61	-16.46	-314.8	38.59
3.5	81.65	91.19	-9.54	-377.6	55.29
4.0	89.09	88.96	.14	-400.2	74.05
4.5	92.57	88.18	4.38	-389.3	93.10
5.0	93.85	89.39	4.47	-368.0	111.37
5.5	94.08	88.91	5.17	-344.7	128.57
6.0	93.22	84.62	8.60	-311.5	144.40
6.5	90.05	71.30	18.74	-245.5	157.83
7.0	83.45	66.41	17.04	-159.2	167.60
7.5	73.25	60.87	12.38	-88.2	173.57
8.0	59.95	45.78	14.17	-24.1	176.28
8.5	46.54	35.58	10.96	36.5	175.98
9.0	29.67	30.54	-.87	60.8	158.38
9.5	15.57	28.86	-13.29	26.7	118.79
AP	4.81	14.13	-9.32	-27.9	0.00

Product = 4133 4149

Load = 66720 66968 tons,

Displacement = 66726 L.tons

The buoyancy and weight loads are checked to make sure that the area under the curves will maintain the same as the displacement of the ship. The product indicates the total sum of products after applying Simpson's rule for integration and the load indicates the application of the multiplier to complete the integration.

5. SUMMARY

From the strength curves, it can be concluded that the ship is under hogging moment. The maximum moment is at about three quarter of the length of the ship (aft) with a magnitude of 1762763 ft tons. As measured on site, the ship is hogging about 8 inches. If assuming that this hog is caused due to the calculated moment and considering the ship as a simple beam, then

$$Me = w\,l^{2} / 8 \quad \text{and} \quad d = 5\,w\,l^{4} / 384\,E\,I$$

where

	Me	= maximum bending moment	=	1.763×10^{6} ft tons
	w	= distributed load per length		
	l	= length of ship	=	965 feet
	E	= modulus of elasticity	=	29000000 psi
	d	= deflection of ship	=	8 inches

so that

$$I = 40\,Me\,l^{2} / 384\,E\,d$$

$$= 18.868 \times 10^{6}\ in^{2}\ ft^{2}$$

From the original design, the ship midship section had a section modulus of 279100 sq in-ft which could withstand a hogging moment of 2602500 ft-tons. For this study, an assumption is made for the section modulus of the existing structural section of the ship. The bottom shell plate, the double bottom tank top and A deck plating contribute most of the strength. Based on the corrosion report by CORRPRO COMPANIES, INC, these main structures have no major corrosion and most major conversions made on the ship were properly reinforced, an approximate of 90% on the design section modulus is chosen for this study.

Section modulus of existing, Sm = 279100 x .9

= 251190 sq in-ft

Allowable stress for steel, Sa = 21600 psi

Max allowable bending moment, Mb = Sa x Sm / 2240 ft-tons
= 2422189 ft-tons

Maximum allowable deflection, dm, then can be determined by

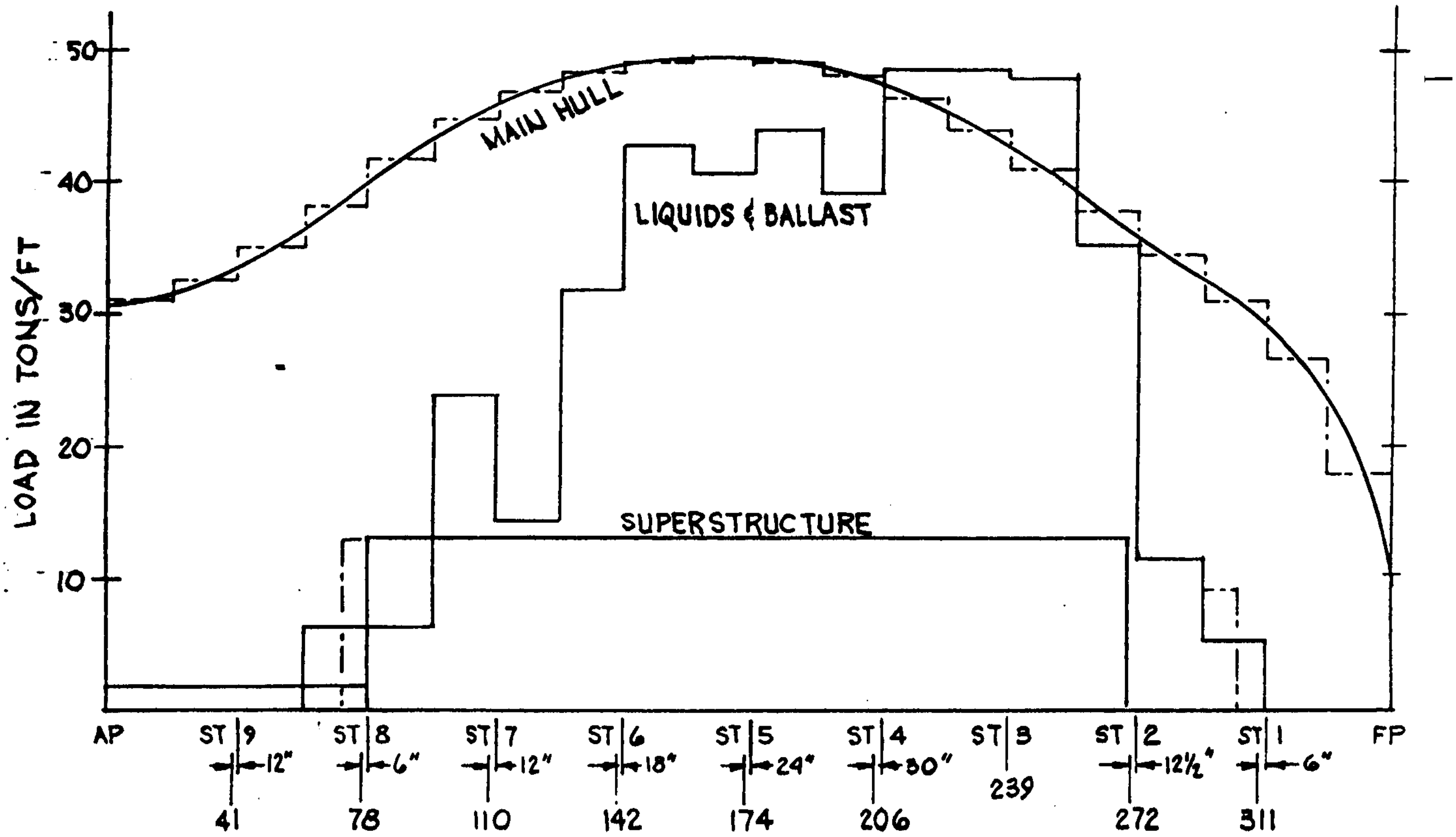
$$dm = 40 \times Mb \times l^2 / 384\ E\ I$$

where l, E and I are as shown before.

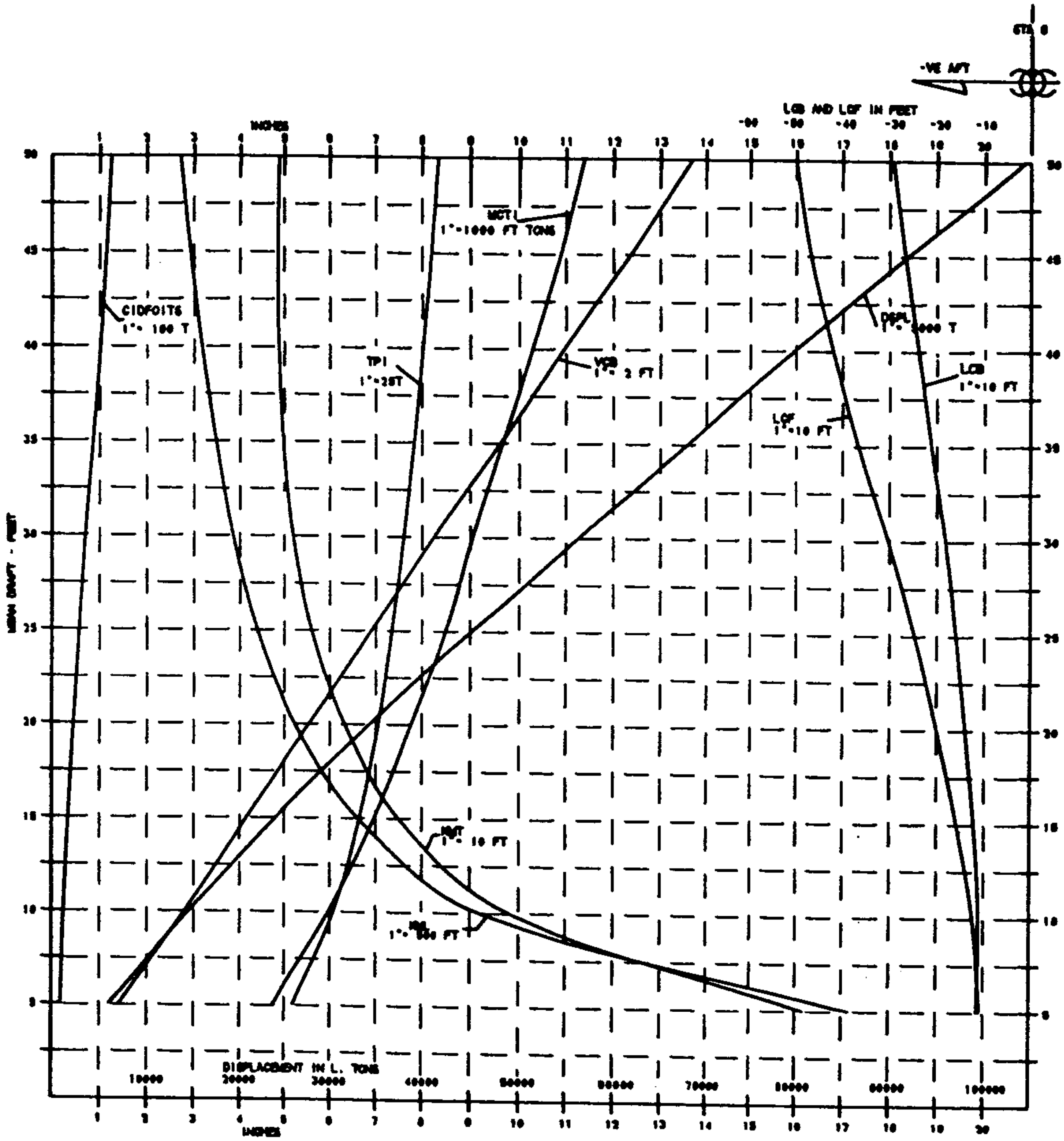
dm = 11.54 inches

6. CONCLUSION

1) The weight and buoyancy curves developed are not in a normal standard form of load distribution. This is because of the approximation on main hull weight. An actual weight analysis will move the weight curve further back to the stern.
2) The existing deflection due to hogging of 8 inches is well under allowable deflection of 12 inches.
3) The strength of the main hull girder depends on various parameters. The deflection, which is one of these, cannot be judged alone for the strength of the ship.
4) The calculation is based on the still water bending moment only. It is not covered for conditions at sea whether stationary or towed.



HULL WEIGHT DISTRIBUTION

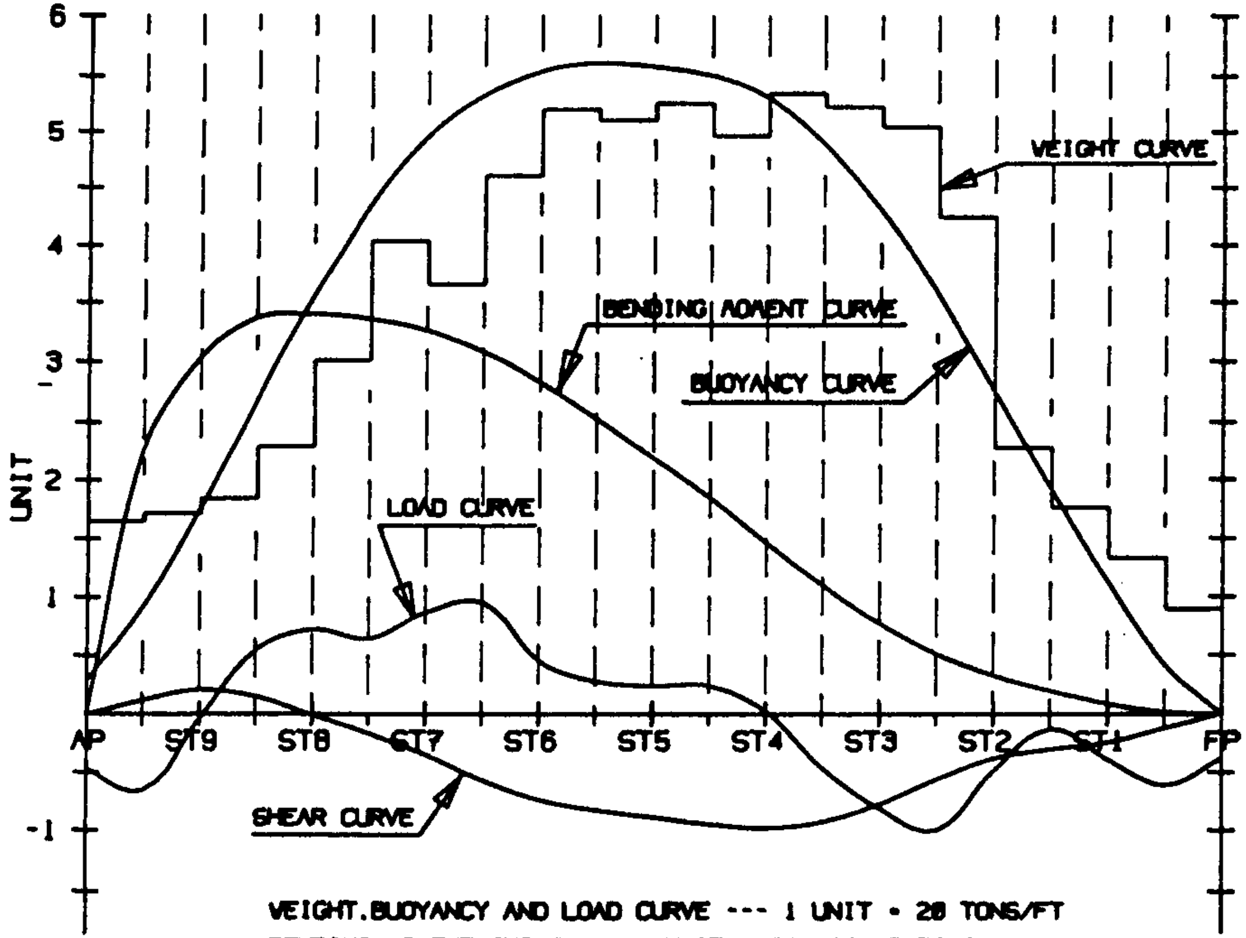


CURVES OF FORM

LEGEND

DSPL - DISPLACEMENT IN SEA WATER IN LONG TONS.
TPI - TONS PER INCH IMMERSION IN LONG TONS.
MTI - MOMENT TO CHANGE TRIM ONE INCH IN FOOT-TONS.
KMT - TRANSVERSE METACENTER ABOVE EXISTING B.L. IN FEET.
KML - LONGITUDINAL METACENTER ABOVE EXISTING B.L. IN FEET.
KB - CENTER OF BUOYANCY ABOVE EXISTING B.L. IN FEET.
LCB - CENTER OF BUOYANCY FROM MIDSHIP IN FEET.
LCF - CENTER OF FLOTATION FROM MIDSHIP IN FEET.
CIDOFT- CHANGE IN DISPLACEMENT FOR ONE FOOT TRIM BY STERN IN TONS.

QUEEN MARY/DISNEYLAND



VEIGHT.BUOYANCY AND LOAD CURVE --- 1 UNIT = 20 TONS/FT
BENDING MOMENT CURVE --- 1 UNIT = 500000 FT-TONS
SHEAR CURVE --- 1 UNIT = 4000 TONS
STATION SPACING = 96.5 FEET

STRENGTH CURVES IN STILL VATER

6. SUMMARY

From the strength curves, it can be concluded that the ship is under hogging moment. The maximum moment is at about three quarter of the length of the ship (aft) with a magnitude of 1705781 ft tons. As measured on site, the ship is hogging for about 8 inches. If assuming that this hog is caused due to the calculated moment and considering the ship as a simple beam, then

$$Me = w\,l^2 / 8 \quad \text{and} \quad d = 5\,w\,l^4 / 384\,E\,I$$

where			
	Me	= maximum bending moment	= 1.706×10^6 ft tons
	w	= distributed load per length	
	l	= length of ship	= 965 feet
	E	= modulus of elasticity	= 29000000 psi
	d	= deflection of ship	= 8 inches

so that

$$I = 40\,Me\,l^2 / 384\,E\,d$$

$$= 18.258 \times 10^6 \text{ in}^2 \text{ ft}^2$$

From the original design, the ship midship section had a section modulus of 279100 sq in-ft which could withstand a hogging moment of 2602500 ft-tons. For this study, an assumption is made for the section modulus of the existing structural section of the ship. The bottom shell plate, the double bottom tank top and A deck plating contribute most of the strength. Based on the corrosion report by CORRPRO COMPANIES, INC, these main structures has no major corrosion and most major conversion made on the ship were properly reinforced, an approximate of 90% on the design section modulus is chosen for this study.

Section modulus of existing, Sm = 279100 x .9

= 251190 sq in-ft

Allowable stress for steel, Sa = 21600 psi

Max allowable bending moment, Mb = Sa x Sm / 2240 ft-tons
= 2422189 ft-tons

Maximum allowable deflection, dm, then can be determined by

$$dm = 40 \times Mb \times l^2 / 384 E I$$

where l, E and I are as shown before.

dm = 11.92 inches

7. CONCLUSION

1) The weight and buoyancy curves developed are not in a normal standard form of load distribution. This is because of the approximation on main hull weight. An actual weight analysis will move the weight curve further back to the stern.
2) The existing deflection due to hogging of 8 inches is well under allowable deflection of 12 inches.
3) The strength of the main hull girder depends on various parameters. The deflection, which is one of these, cannot be judged alone for the strength of the ship.
4) The calculation is based on the still water bending moment only. It is not covered for conditions at sea whether stationary or towed.

PHASE I

Part 3: Analysis on deck buckling effect on "A" Deck, Frames 255-258.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 3: ANALYSIS OF DECK BUCKLING EFFECT ON "A"-DECK, FRAMES 255-258:

Introduction:

An investigation of "A"-Deck, Frames 255-258, shows evidence of overstress in the form of deck buckling and distortion in an area of 3 feet x 5 feet on the port side of the vessel.

Reference:

Rados International Corporation's "Analysis of Deck Buckling Resulting from the Fendering System" photographs of "A"-Deck.

Findings:

The buckling appears near the middle of a structural deck area (panel) between Frames 255 and 261 and from the ships centerline to the inboard longitudinal system at 14'-6" starboard. Originally this panel had suport assistance (albeit not structural bulkheads) from bulkheads over and under at 10'-0" off centerline. These bullkheads were removed. Then the panel size was doubled by removal of the centerline structural bulkhead. (Note: Some wooden joiner bulkheads were put back in but there is no structural support.

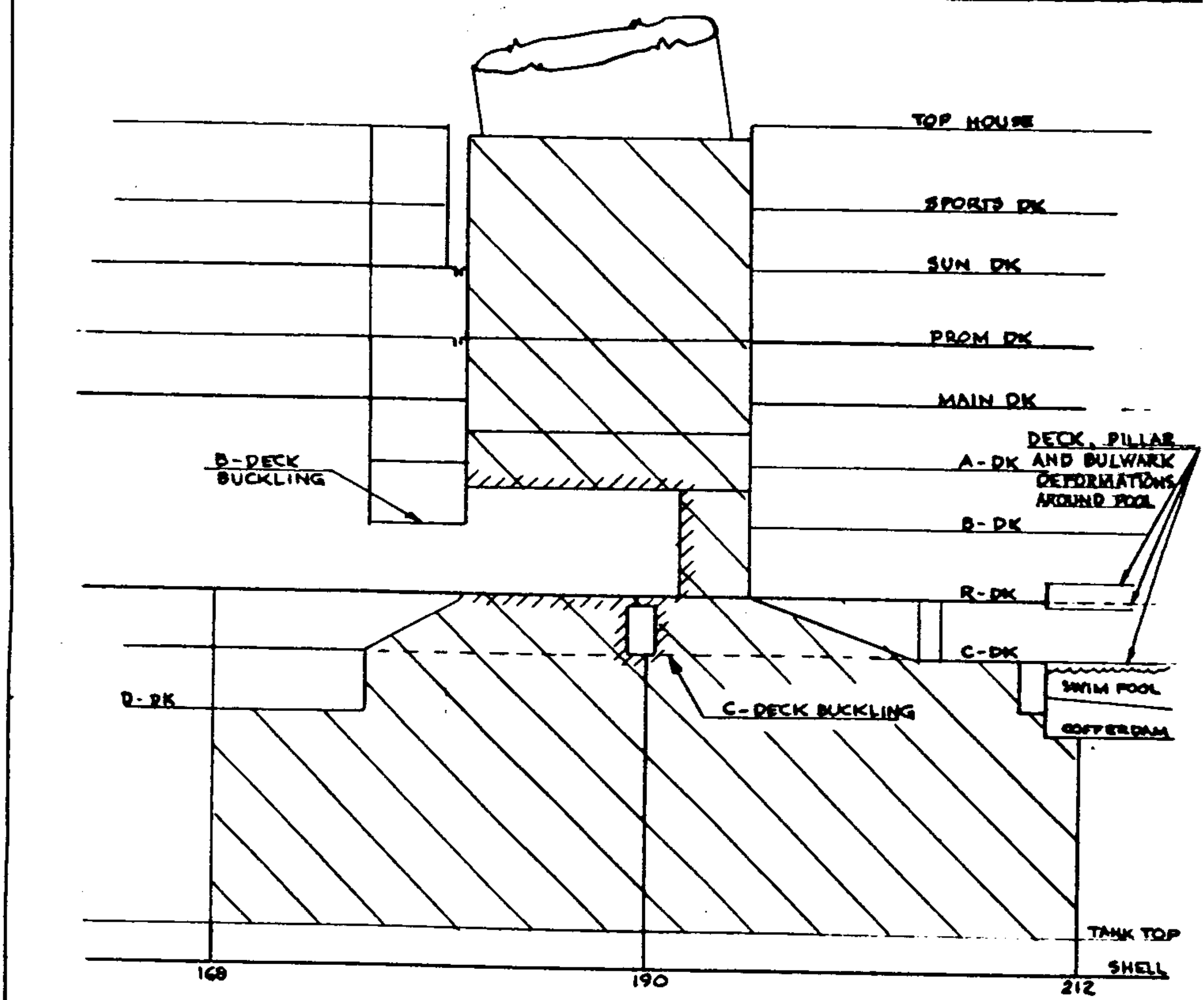
Deck Panel Summary:

Original: 14'-6" wide x 17'-0" long with/intermed support
Revised: 29'-0" wide x 17'-0" long with/no support

Thus, normal loads over the years have caused this deck to buckle the weakened deck. No further buckling is expected.

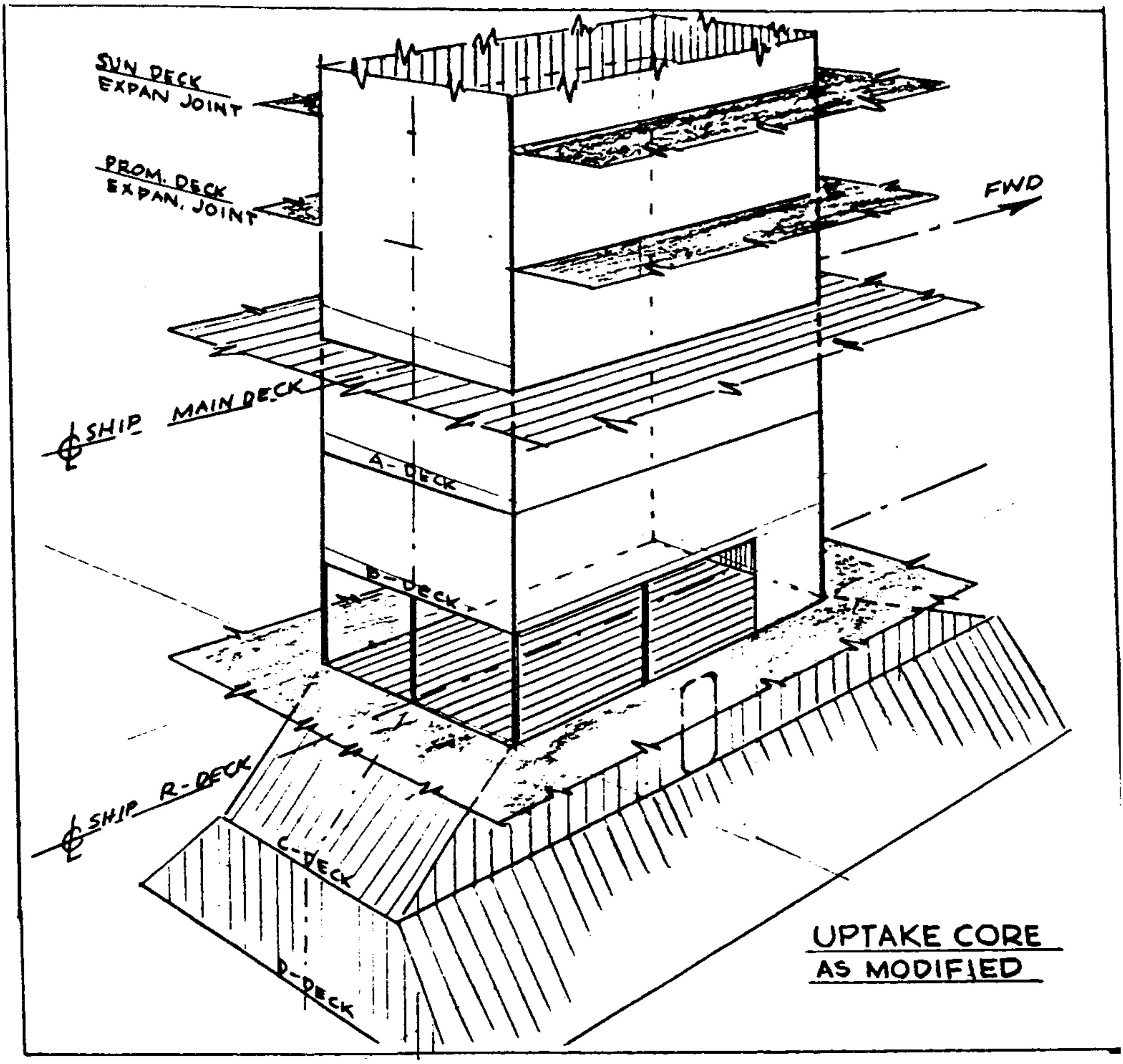
Recommendation:

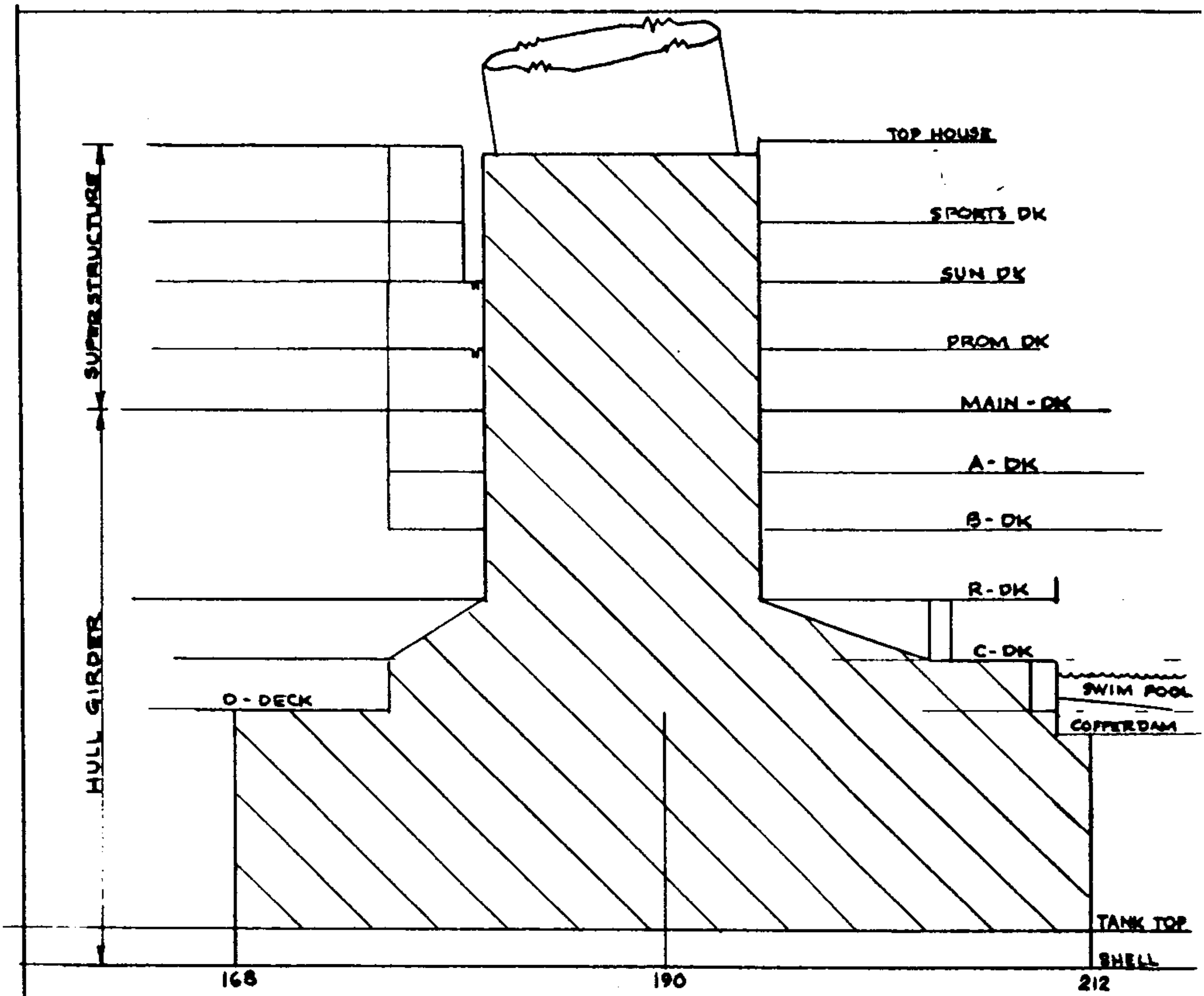
The buckled "A"-Deck at Frames 255-258 is located in a public restroom. If repairs, other than cosmetic deck fillers and retiling of the "A"-Deck restroom, then it would be worth the addition of a 3"-schedule 40 pipe stantion between "A"-Deck and "B"-Deck at Frame 257. This would not impair the use of the lock shop existing on "B"-Deck below. A bulkhead below "B"-Deck would carry out this loading.



QUEEN MARY - CONVERTED CONDITION

UPTAKE CORE STRUCTURE CUT AWAY FOR WINDSOR RM. (NOTE: STAN. NOT SHOWN), R-DK FILLED-IN SOLID, ARCHES CUT FOR TOUR.


SUN DECK
EXPAN JOINT
PROM. DECK
EXPAN. JOINT
FWD
℄ SHIP MAIN DECK
A-DECK
B-DECK
℄ SHIP R-DECK
C-DECK
D-DECK
UPTAKE CORE
AS MODIFIED



QUEEN MARY INBOARD PROFILE

ORIGINAL STRUCTURE

UPTAKE CORE TO STIFFEN HULL GIRDER

PHASE I

Part 4: Analysis on deck buckling effect on "B" Deck, Frames 177-180.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 4: ANALYSIS OF DECK BUCKLING EFFECT ON "B"-DECK, FRAMES 177-180:

Introduction:

An investigation of "B"-Deck, Frame 178, shows evidence of overstress in the form of deck buckling and distortion in an area about 5 feet x 5 feet in the Fan Room near centerline. This area is occupied by ship's personnel.

Reference:

Rados International Corporation's "Analysis of Deck Buckling Resulting from the Fendering System" photographs of "B"-Deck (see Part 3).

Findings:

This 15-foot section of decking on "B"-Deck separates two (2) large openings, namely the uptake trunk No. 2 and open area providing the high overhead for the Main Convention Hall. This deck was originally supported by the uptake trunk bulkheads. With the removal of the trunk, stanchions were installed to carry vertical loads, but they give little support for horizontal loads, either fore-and-aft or transverse. The horizontal loads would come from twisting loads on the ship's fendering loads and some combined loads due to hogging.

Recommendation:

Since any stiffening or cross bracing in the middle of the Windsor Room would be unacceptable, it is recommended to just keep a periodic review of the deck area. It is not anticipated that the buckling and distortion will continue if no additional loads or excess hogging conditions occur and if the fendering system is modified to use rubber fenders. Recommend areas be paved over the ripples on "B"-Deck to eliminate possible tripping hazards.

PHASE I

Part 5: Analysis on deck buckling effect on "C" Deck, Frame 191.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 5: ANALYSIS OF DECK BUCKLING EFFECT ON "C"-DECK, FRAME 191:

Introduction:

An investigation of the "C"-Deck, Frame 191, approximately 28 feet, port side, shows evidence of overstress in the form of deck buckling and distortion. This area is approximately 2 feet x 3 feet and is located in a passageway used by the ship's tour.

Reference:

Rados International Corporation's "Analysis of Deck Buckling Resulting from the Fendering System" photographs of "C"-Deck (see Part 3).

Findings:

The "C"-Deck was originally designed near the neutral-axis of the hull girder and therefore did not receive much loading from hogging and sagging of the hull. During the conversion, the "R"-Deck was decked-in solid and became the new "upper flange" of the girder.

With much of the uptake trunk structure removed, it effectively formed an expansion joint down to the "R"-Deck to work with the existing expansion joint at Frame 180-1/2, thus relieving the Main Deck as the upper flange.

Cutting away of large arches through the main longitudinal bulkheads, 14'-6" port and starboard at Frames 190-192, has occurred for tour viewing of the Boiler Room spaces. Even though stanchions were installed to carry vertical loads, they are not effective when resisting the new hogging, torsional loads and fender loads.

Recommendation:

It is not anticipated that the buckling and distortion will continue if no additional loads are added to the vessel and if the fendering system is modified with rubber fenders, therefore no structural modifications or repairs are necessary at this date.

PHASE I

Part 6: Analysis on deck buckling effect on "D" Deck, Frame 111.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 6: ANALYSIS OF DECK BUCKLING EFFECT ON "D"-DECK, FRAME 111:

Introduction:

An investigation of "D"-Deck, Frame 111, shows evidence of overstress in the form of deck buckling and distortion in an area of 3 feet x 8 feet, about 44 feet on the port side of the vessel.

Reference:

Rados International Corporation's "Analysis of Deck Buckling Resulting from the Fendering System" photographs of "D"-Deck (see Part 3).

Findings:

An investigation of "D"-Deck at Frame 111 revealed that the only buckling and torsion that occurred was due to the underlayment of cement. The underside of the decking appeared to be free from undue stress and buckling effect. With the modification to the fendering system there should be no concern regarding deformation of "D"-Deck and its related structure.

Recommendation:

Remove and clean section of carpet on "D"-Deck, remove underlayment cement, coat decking with primer paint and reinstall cement and carpet.

PHASE I

Part 7: Analysis of fendering system in relation to buckling areas.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 7: ANALYSIS OF THE FENDERING SYSTEM:

Introduction:

An investigation of the fendering system at Frames 92-104 and Frames 231-244 shows that the log "camels" are not properly positioned to distribute the proper loads throughout the hull structure. Since decks and structure have been removed prior to and after conversion of the vessel, certain areas are being overstressed, causing distortion and buckling.

Reference:

Rados International Corporation's "Analysis of Deck Buckling Resulting from the Fendering System" sketches for after and forward breasting dolphin.

Findings:

As a result of the ship's survey, the Queen Mary shows evidence of overstress in the form of deck buckling and distortion in specific areas of the hull structure. The causes of these bucklings were generally due to one or a combination of the following situations:

- o Some of the structural bulkheads were cut out and removed without adequate compensation for strength due to increased loads on upper decks.
- o Due to the age of the vessel, some structures are deteriorated and corroded. No structural reinforcement was made to compensate for loss of strength.
- o The shore fendering system was not properly used for proper distribution of horizontal loads.

The loads in question are mostly transverse and longitudinal lateral loads. The lateral loads are generally caused due to external loads created by wind and wave. The transverse lateral load is more severe than the longitudinal lateral load. In performing the calculations that follow, the worst condition is considered.

No stress calculations are provided to verify causes of deck buckling since the previously proposed Hull Stress Analysis Study was not approved by Queen Mary Management.

Recommendation:

The shore fendering system was designed and constructed to receive lateral loads from the upper steel structure. For reasons unknown, log "camels" were installed, thus distributing excess loads in areas of the hull that have been cut and removed, such as decks, bulkheads etc.

As a result of the calculations performed in the following pages, the fender loads on the hull structure can be reduced approximately 50% if rubber fenders are installed on upper steel fender structures.

It is recommended that if the Queen Mary should be moved or relocated, provisions should be made to install rubber fenders on both aft and forward steel fender structures as outlined in the following RIC Sketch.

PRINCIPAL CHARACTERISTICS OF THE SHIP

Length overall	Lo	1019.50 feet
Length between perpendiculars	Lp	965.00 feet
Length at designed waterline	Lw	1004.00 feet
Beam, molded	Bm	118.00 feet
Depth, molded, to D deck	Dd	55.25 feet
Depth, molded, to B deck	Db	74.50 feet
Draft, full load	Dw	34.50 feet
Displacement, full load	Ds	66000 l.tons
Vertical center of gravity	Kg	44.00 feet
Longitudinal center of gravity	Lg	20.00 feet

QUEEN MARY HOTEL

ANALYSIS OF LOADS RESULTING FROM FENDERING SYSTEM

LATERAL LOADS

The loads involved in the buckling of deck plates of the ship are

1) wind load at 30 knots (which is commonly used for coastal areas)
2) current drag assumed 1/4 knot (since the ship is in the dike)
3) wave action load at about 1.5 degrees roll

WIND LOAD

Wind load can be calculated by the general formula such as:

Wind load, $W = C \times (1/2)\ R\ A\ V^2$ where

C = drag coefficient = 1.28

R = mass density of air = $.00238\ slugs/ft^3$

A = projected area above water in square feet

V = wind speed in feet/second = 30 x 1.6889 knots
= 50.667 ft/sec

A = 1019.50 x (83.5-34.5) + (674+576) x 21 + 54x36x3
= 82037.5 sq ft

W = 320789 lbs = 320.8 kips

CURRENT DRAG

Current drag can be calculated also by the same formula:

Current drag, D = $C \times (1/2) R A V^2$ where

C = drag coefficient = 1.28

R = mass density of water = 1.9905 lbs sec^2 / ft^4

A = projected area under water in square feet

V = current speed in ft/second = .25 x 1.6889
= .422 ft/sec

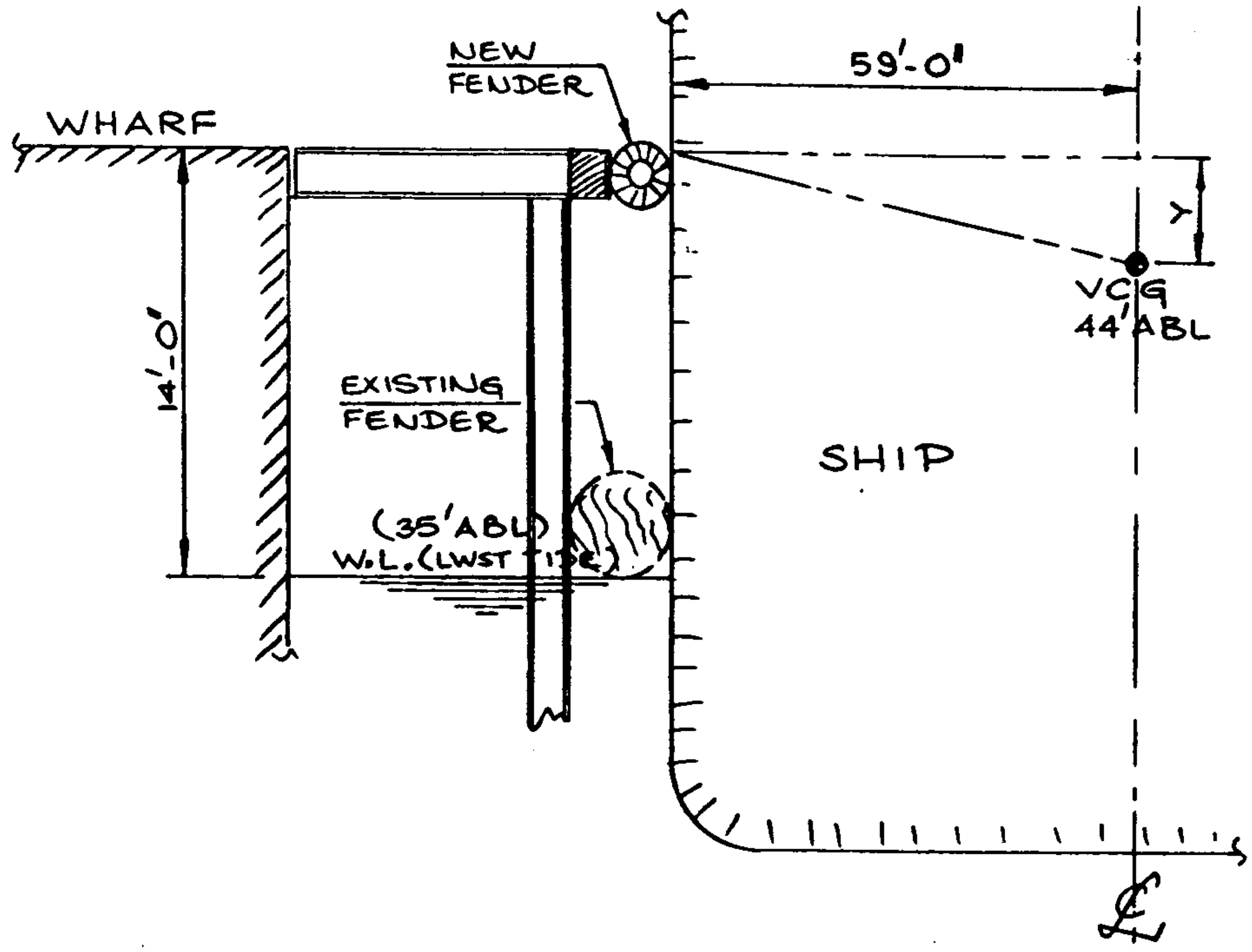
A = 34.50 x 1004.00 x 0.80
= 27710.4 sq ft

W = 6293 lbs = 6.3 kips

WAVE ACTION LOAD

Wave action load is applied to the ship when she rolls due to the action of wave. The axis of rolling is near the center of gravity of the ship which is, from TRIM AND STABILITY REPORT, about 44 feet above baseline. The maximum wharf height above the waterline is about 14 feet. Since the new fenders are about level with the wharf, they are about 14 feet above the ship waterline at the lowest tide. The draft of the ship is about 35 feet and so the new fenders are about 5 feet above the center of gravity of ship at the lowest tide which will cause the highest wave action load.

QUEEN MARY HOTEL



SECTION VIEW LOOKING FORWARD OF SHIP

(Recommended location of fenders)

QUEEN MARY HOTEL

From the sketch, the distance y = 5.00 feet

The resultant wave action load, Rr, is given by the equation:

$$Rr = 4 \times (PI^2) \times (W/g) \times R \times (Phi) / T^2$$

where

W = Displacement = 66000 L.Tons

g = Earth's gravity = 32.2 ft/sec^2

R = Distance of fender from ship's center of gravity

$= (59^2 + 5^2)^{1/2}$

= 59.21 ft

Phi = Angle of roll = 1.5 degrees

= .03 radian

T = Period of roll = 20 secs (assumed)

Rr = 313.59 L.tons = 702.4 kips

Components along X-X axis, Rx = Rr x y / R

= 59.32 kips

Total lateral load = 386.40 kips

Using the coefficient of restitution for rubber fenders as 0.5, then the total force exerted on the ship is 115.92 kips.

Total load on the each fender is 57.96 kips.

QUEEN MARY HOTEL

FENDER SUPPORT

The fenders are supported by horizontal struts fabricated by 14x14.5x136 lbs WF. The struts are spaced about 16 feet with 3 struts at each unit. A total of two units are fendering the ship, one forward and one aft.

The properties of the WF are

section area, A = 39.98 sq inches

min radius of gyration, r = 3.77 inches

unsupported span, L = 16 ft
= 192 inches

L/r = 50.93

Using allowable stress, Sa, for L/r < 120 as

$$Sa = 17000 - .485 \times (L/r)^2$$
$$= 15742 \text{ psi}$$

Maximum compressive load, Fc = Sa x A = 629367 lbs

For total three struts, maximum compressive load it can support is 6 x Fc = 3776204 lbs
= 3776.20 kips

The support structure can hold a lateral load of 3776 kips.

From the manufacturer's chart table, the deflection due to the load from Section 2 of 57.96 kips onto the cylindrical rubber fender of 24" O.D. x 12" I.D. is approximately about 14 inches and the corresponding kinetic energy is about 75000 ft-lbs.

ENERGY OF IMPACT

The corresponding energy of impact and speed of the ship are as follows:

Since the coefficient of restitution is .50 then the impact energy, Et = 75000 / .5 = 150000 ft-lbs

The impact energy is given by the equation,

$Et = W \times V^2 / (2 \times g)$ and so the speed of ship, V is

$V = (2 \times g \times Et / W)^{1/2}$ where

W = Ship displacement = 66000 L.Tons

g = Earth's gravity = 32.2 ft/sec^2

V = .26 ft/sec = .15 knot

SHIP STRUCTURE

The most critical structures resisting these loads are the longitudinal girders in the vicinity of the fenders. The main function of a girder is to support the transverse deck beams. The critical girder at the vicinity of the forward fender is the outboard one fabricated out of two 8"x3"x20 lb channels with 18"x1/2" flat bar in between and a 3"x3"x1/2" angle at the deck. The vicinity of the aft fender is also the outboard one with 36 WF x 230 lbs. The span of the forward fender is about 12 feet while that of aft girder is about 22.5 feet.

The actual fender load of 57.96 kips = 57960 lbs is actually distributed across the length of the fender of 33 feet. So, the compressive load per inch is 128802 / (12x33) which is 146.36 lbs/inch.

Using a continuous beam formula on the girder, the maximum bending moment, Bm = $w\,l^2 / 12$ where

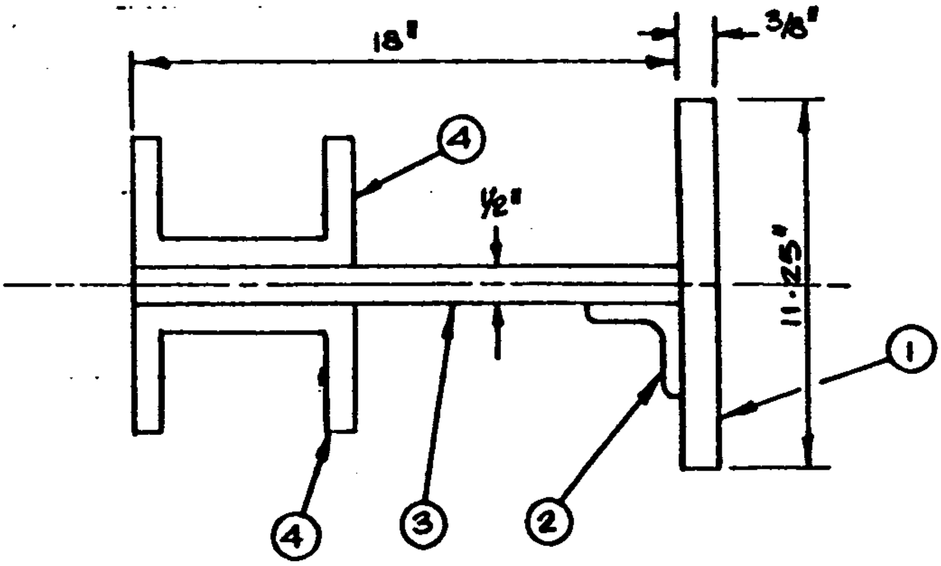
w = 146.36 lbs/inch and

l = span in inches

For forward girder,

l = 12.00 feet = 144.00 inches

Bm = 252916 lbs inch



P.C No	Item	Area	Arm	Moment	M of I
1	3/8" deck plate	4.22	0.000	0.00	44.49
2	3"x3"x1/2" angle	2.75	1.180	3.25	2.20
3	1/2" plate	9.00	0.000	0.00	.19
4	2x8"x3"x20 lbs ch.	11.66	1.110	12.94	9.400
		27.63	.586	16.19	56.282

$A \times d^2$ = 1.448 + .971
3.089 + 3.203

= $8.711\ in^4$

M of Ig = 8.711 + 56.282

= $64.993\ in^4$

C = 6.286 inches

Sm = $10.34\ in^3$

Thus, the bending stress, Bs = 24461 psi

Safety factor = 36000 / (Bs) = **1.47**

For aft girder,

l = 22.50 feet = 270.00 inches

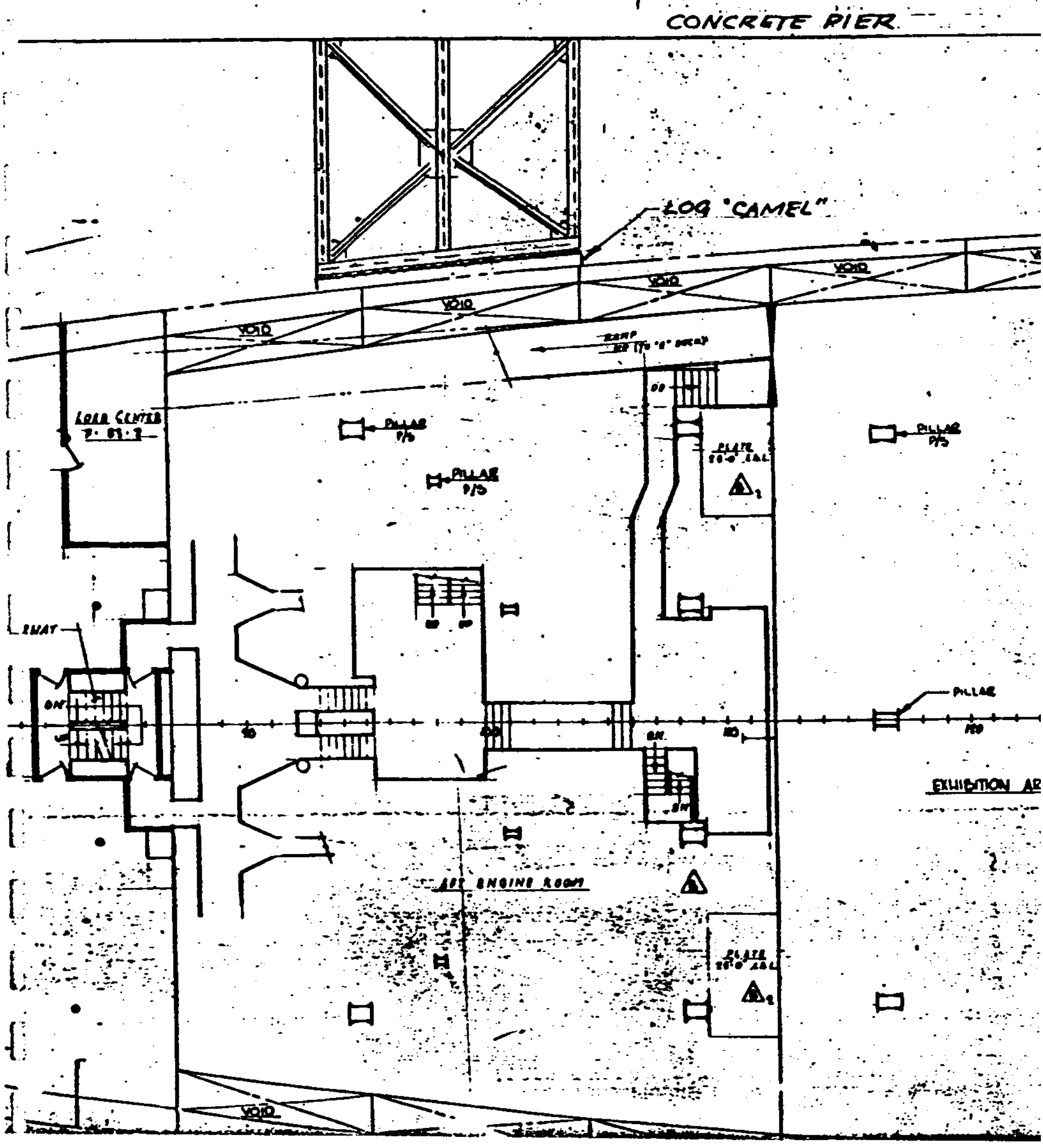
Bm = 889156 lbs inch

The section modulus of this WF is $105.70\ inch^3$ which is high enough to use by itself without considering the attached deck plate.

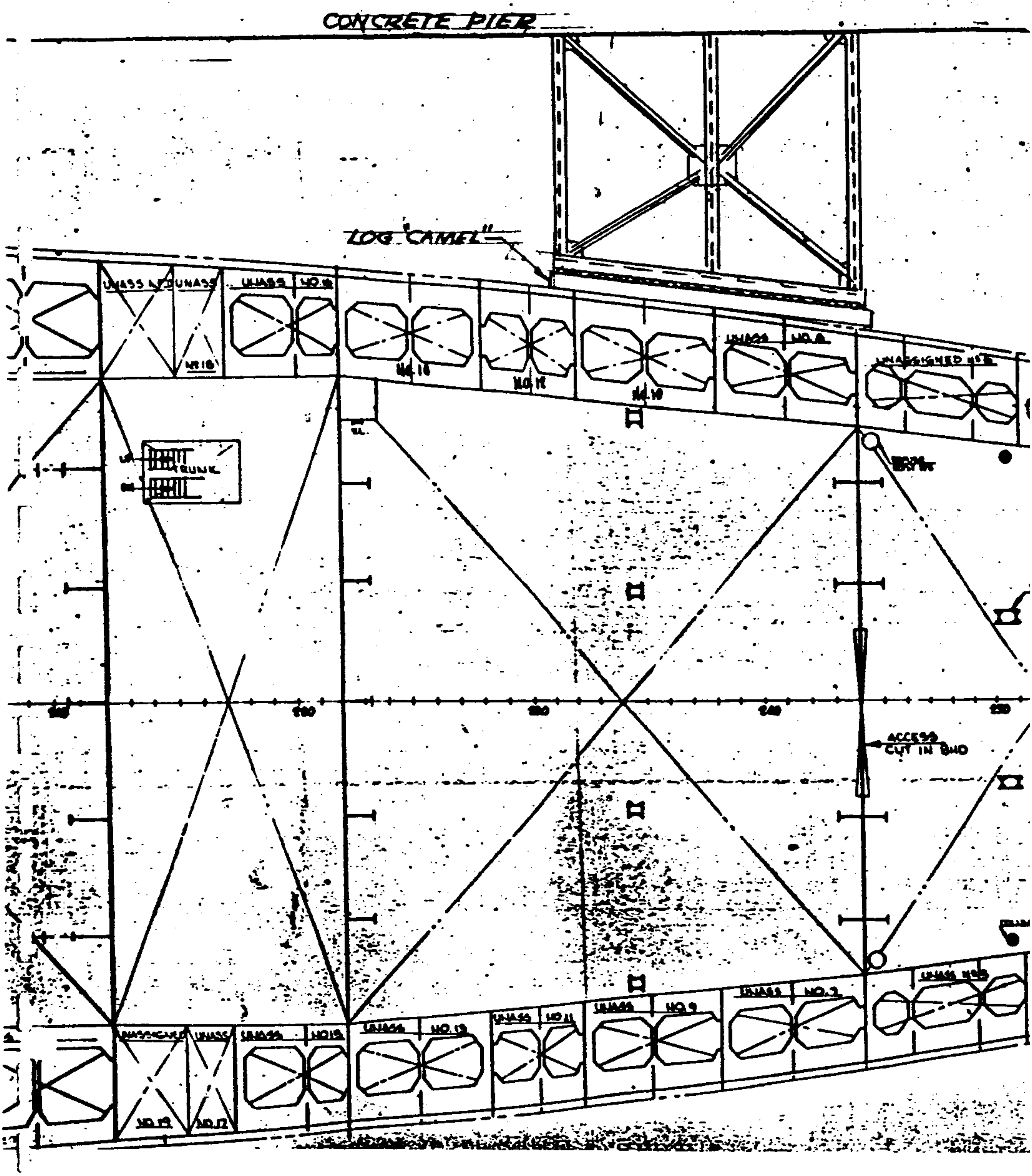
Thus, the bending stress = 8412 psi

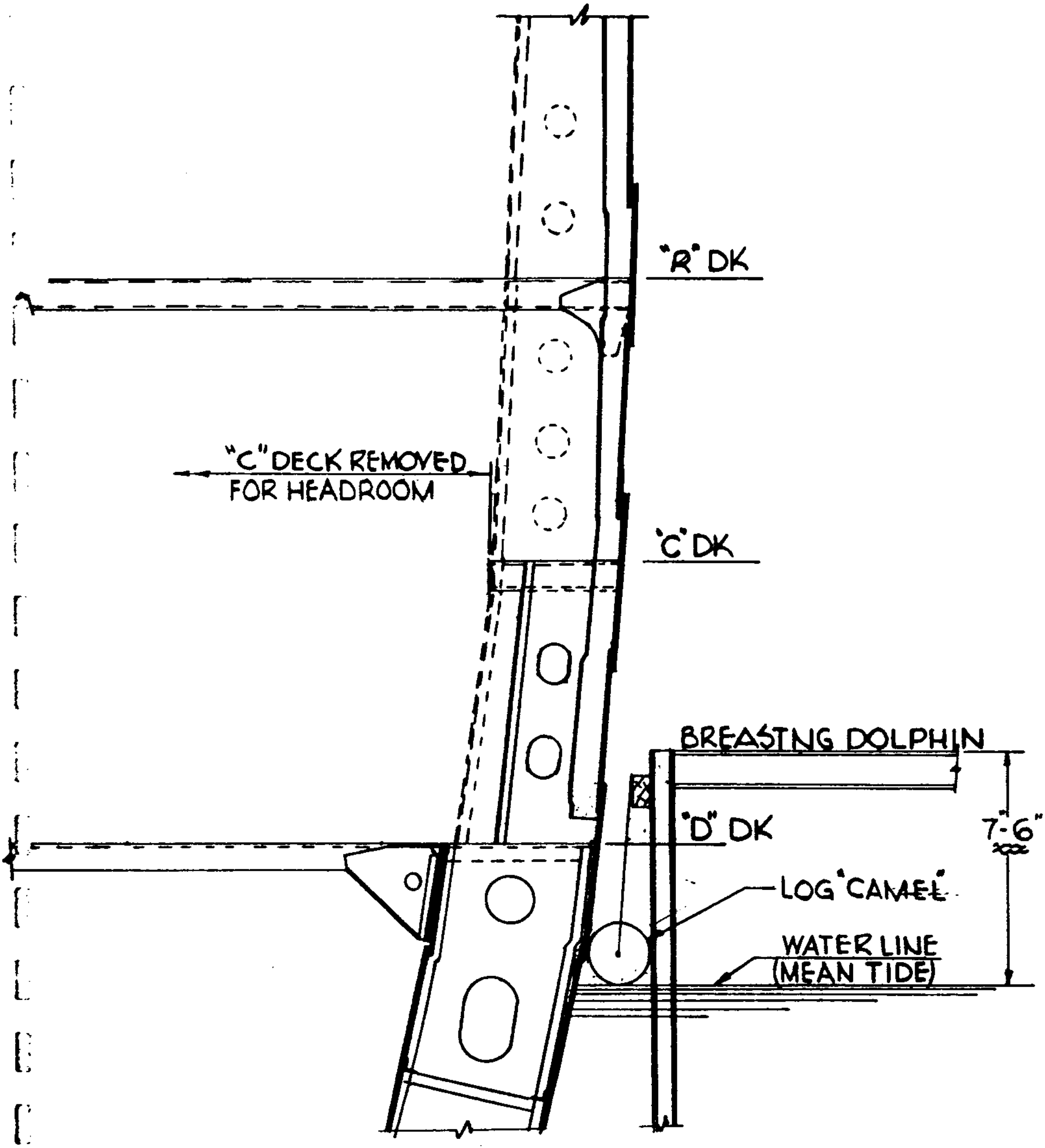
and the Safety Factor = **4.28**

AFTER BREASTING DOLPHIN



FORWARD BREASTING DOLPHIN





SECTION NEAR FR. 100 AT EXISTING AFT BREASTING DOLPHIN

PHASE I

Part 8: Study of trim and ballast required aboard Queen Mary.

PHASE I: HULL STRUCTURE ANALYSIS:

PART 8: STUDY OF TRIM AND BALLAST:

Introduction:

The purpose of this study is to find the effect of water inside the shaft alley compartment, Frames 21 to 87. The water is contaminated and needs to be removed. The removal can effect the trim and stability of the ship's existing condition. The study includes calculations for:

1) Capacity and centers of gravity of water in individual tanks.
2) Trim and stability of the ship when water is removed.
3) Ways to modify if extreme condition exists.

Double bottom tanks from Frames 35 to 51 at centerline, from Frames 51 to 71 at centerline and from Frames 71 to 87, port and starboard, are built as individual tanks, but the existing condition of water levels seems to have no more watertightness than in between the tanks. The study checks for both cases.

Reference:

"Ballasting for Move to Pier J" by Engineering Branch, Queen Mary Department, dated December 9, 1970.

Findings:

Inspection of the Queen Mary's double bottom tanks and shaft alley compartment were made

Recommendation:

To determine the amount of free-surface water that presently exists in the shaft alley, engine room and boiler compartments an investigation and analysis was performed.

The results of the study revealed that there exists 285 tons of water distributed between frames number 21 to 212.

Evaluation of the reballasting requirements resulted in a recommendation of using non-toxic drilling mud (density of 144 pounds per cubic foot) in specific tanks to offset the weight of the free surface water.

It is recommended that the removal of water and reballasting of the Queen Mary Hotel be performed in strict accordance with the following enclosures and that a qualified naval architecture firm assigned to the project to assure performance of contractor.

TRIM AND BALLAST

1. WATER IN SHAFT ALLEY - FR #21 TO FR #87

1) Fr #21 to Fr #35

Starting Frame Number	=	21
Ending Frame Number	=	35
Distance between Frames, H	=	33.50 feet
Approx Frame Number in between	=	28

A) Section at Fr #21

Depth of water	=	103.0 inches
Half width at waterline	=	45.0 inches
Half width at bottom	=	24.0 inches
Section area, A	=	49.35 sq ft (P/S)

B) Section at Fr #28

Depth of water	=	103.0 inches
Half width at waterline	=	60.0 inches
Half width at bottom	=	24.0 inches
Section area, B	=	60.08 sq ft (P/S)

C) Section at Fr #35

Depth of water	=	103.0 inches
Half width at waterline	=	83.0 inches
Half width at bottom	=	24.0 inches
Section area, C	=	76.53 sq ft (P/S)

Vol.from Fr #21 to #35 = (A + 4xB + C) x H / 6
= 2044.7 cu ft

Long'l vol mom abt Fr #35 = (Ax2 + 4xB) x [(H/2)^2] / 3
= 31707 ft4

Long'l center from Fr #35 = 15.51 ft

2) Fr #35 to Fr #51
===============

Starting Frame Number = 35
Ending Frame Number = 51

Distance between Frames, H = 40.00 feet

Approx Frame Number in between = 43

A) Section at Fr #35

From Sect 2 - C, Area = 76.53 sq ft (P/S)

B) Section at Fr #43

Depth of water = 103.0 inches

Half width at waterline = 111.0 inches
Half width at bottom = 27.0 inches

Section area = 98.71 sq ft (P/S)

C) Section at Fr #51

Depth of water = 103.0 inches

Half width at waterline = 142.0 inches
Half width at bottom = 30.0 inches

Section area = 123.03 sq ft (P/S)

Vol.from Fr #35 to #51 = 3452.4 cu ft

Long'l vol mom abt Fr #51 = 52644 ft4

Long'l center from Fr #51 = 15.25 ft

3) Fr #51 to Fr #71

Standing water is just at the outboard side of the double bottom tanks, port and starboard. No water is above tank top level.

Starting Frame Number	=	51
Ending Frame Number	=	71
Distance between Frames, H	=	53.33 feet
Approx Frame Number in between	=	61

A) Section at Fr #51

Half width at waterline	=	69.0 inches	
Depth of Vee trough	=	34.0 inches	
Section area	=	16.29 sq ft	(P/S)

B) Section at Fr #61

Half width at waterline	=	84.0 inches	
Depth of Vee trough	=	38.0 inches	
Section area	=	22.17 sq ft	(P/S)

C) Section at Fr #71

Half width at waterline	=	99.0 inches	
Depth of Vee trough	=	37.0 inches	
Section area	=	25.44 sq ft	(P/S)

Vol.from Fr #35 to #51	=	1159.1 cu ft
Long'l vol mom abt Fr #71	=	28741 ft4
Long'l center from Fr #71	=	24.80 ft

4) Fr #71 to Fr #87
===============

Port side is almost dry around the tank top. Water is standing on starboard side only.

Starting Frame Number	=	71
Ending Frame Number	=	81
Distance between Frames, H	=	27.67 feet

A) Section at Fr #71

Half width at waterline	=	99.0 inches	
Depth of Vee trough	=	37.0 inches	
Section area	=	12.72 sq ft	(Starboard)

B) Section at Fr #87

Half width at waterline	=	123.0 inches	
Depth of Vee trough	=	52.0 inches	
Section area	=	22.21 sq ft	(Starboard)

Vol.from Fr #71 to #87 = 241.6 cu ft

$$\text{Long'l center from Fr \#87} = \frac{Ab + 2\ /(AbxAt) + 3\ At}{Ab + /(AbxAt) + At} \times \frac{H}{4}$$

where At = 12.72 sq ft
Ab = 22.21 sq ft

/(AbxAt) = 16.81

Long'l center from Fr #87 = 12.56 ft

5) Total water in shaft alley

Section	Tank location from Fr to Fr	Vol. cu ft	Weight l.tons	LCG fr Fr 87 in ft	Moment ft-tons
1	#21 to #35	2044.74	58.42	136.51	7975
2	#35 to #51	3452.41	98.64	96.25	9494
3	#51 to #71	1159.07	33.12	52.46	1737
4	#71 to #87	241.58	6.90	12.56	87
Total	#21 to #87	6897.80	197.08	297.78	19293

Total amount of water outside D.B.tanks = 197.08 L.tons

Longitudinal center of gravity from Fr #87 is 97.89 ft

Long'l center from midship is then 263.00 + 52.79 = 360.89 ft and the vertical center above baseline is about 6.50 ft.

From the table, C.G.s OF TANKS AND CARGO SPACES , (REVISED DEC, 1952), Q.S.T.S. "QUEEN MARY", weights and CGs of double bottom tanks from Fr #35 to #87 are as follows:

DB tank	Tank location from Fr to Fr	P or S or CL	Weight l.tons in ft	Vert Moment ft-tons	Long'l Moment ft-tons
Q	#21 to #51	CL	72.00	288.0	27396
P	#51 to #71	CL	166.00	664.0	55112
O.1	#71 to #87	S	120.00	456.0	34080
O.2	#71 to #87	P	120.00	456.0	34080
Total	#35 to #87		478.00	1864.00	150668

The weights are for sea water. The vertical moment axis is the base line and longitudinal moment axis is the vertical line through midship, 12" aft of Fr #175.

Total amount of water and its center of gravity are:

Total weight = 675.08 L.tons

Vertical moment = 3145 ft-tons

Longitudinal mom = 221793 ft-tons

VCG = 4.66 ft above baseline

LCG = 328.54 ft from midship

2. WATER IN ENGINE ROOM COMPARTMENT - FR #87 TO FR #136

From the table, C.G.s OF TANKS AND CARGO SPACES , (REVISED DEC, 1952), Q.S.T.S. "QUEEN MARY", weights and CGs of double bottom tanks from Fr #87 to #136 are as follows:

DB tank	Tank location from Fr to Fr	P or S or CL	Weight l.tons in ft	Vert Moment ft-tons	Long'l Moment ft-tons
N1 & N2	#87 to #112	OUTBD,P+S	422.00	3249.4	94106
N3 & N4	#87 to #112	INBD, P+S	288.00	921.6	60480
M1 & M2	#112 to #136	OUTBD,P+S	454.00	2270.0	68100
M3 & M4	#112 to #136	INBD, P+S	400.00	1280.0	60800
Total	#97 to #136		1564.00	7721.0	283486

Total weight = 1564.00 L.tons

Longitudinal center of gravity = 181.26 feet

Vertical center of gravity = 4.94 feet

The weights are for sea water. The vertical moment axis is the base line and longitudinal moment axis is the vertical line through midship, 12" aft of Fr #175.

There are some water average about 4 inches above tank top.

The area of water level is

31' x 75' = 2325.0 sq ft

Volume of water for 4" depth = 775 cu ft

Weight of that amount of water = 22.14 L.tons

Total weight and moments inside forward engine room are

Weight of water = 1586.14 L.tons
Longitudinal CG = 181.26 feet
Vertical CG = 4.94 feet

3. WATER IN ORIGINAL BOILER ROOMS - FR #136 TO FR #212

A) FR #136 TO FR #168

Depth of water above tank top = 4.00 inches
Length of compartment = 96.00 feet
Width above tank top = 56.00 feet

Total volume of water = 1792.0 cu ft
LCG from midship = -68.00 feet
VCG from baseline = 6.75 feet

B) FR #168 TO FR #212

Depth of water above tank top = 1.50 inches
Length of compartment = 132.00 feet
Width above tank top = 31.00 feet

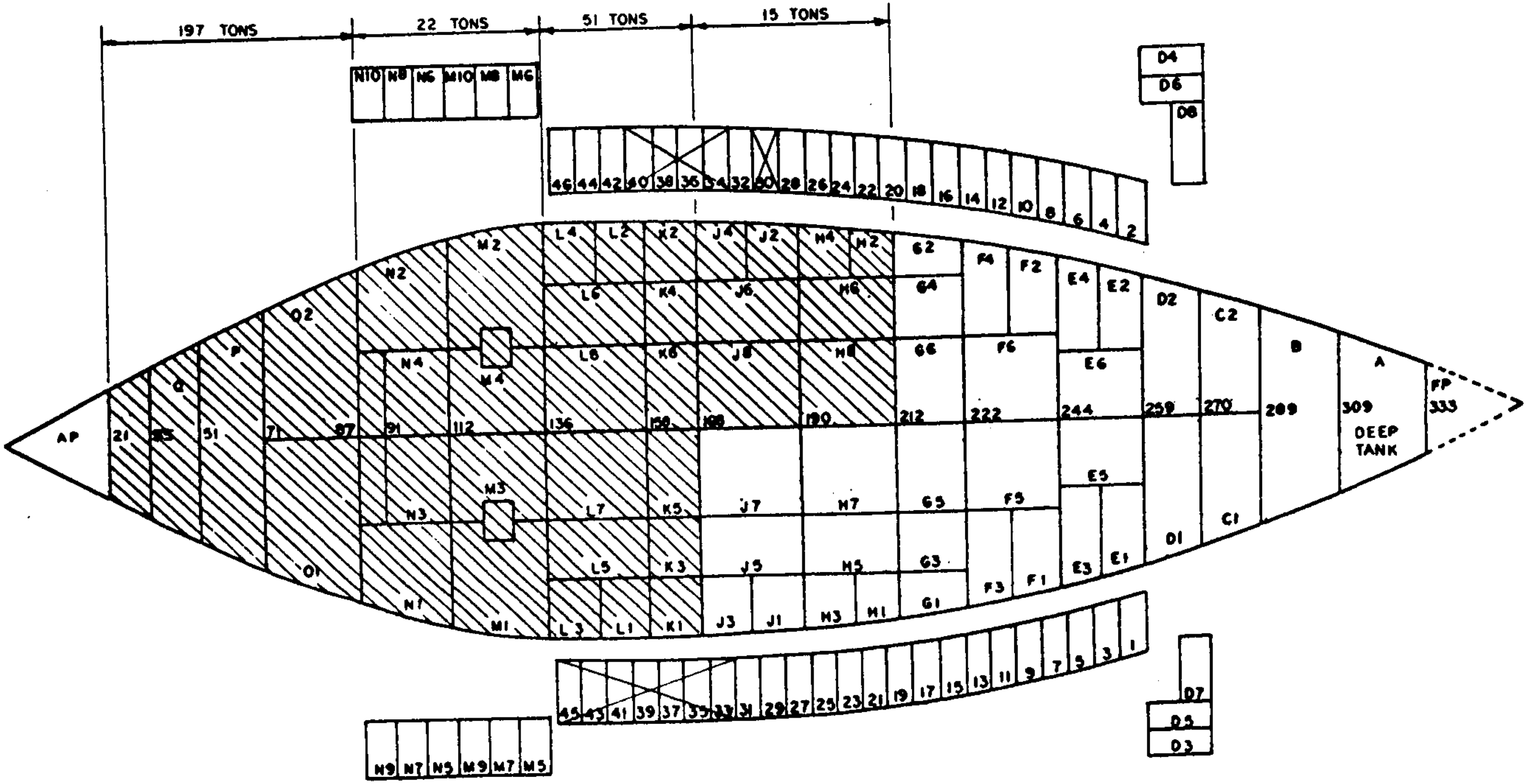
Total volume of water = 511.5 cu ft
LCG from midship = 46.00 feet
VCG from baseline = 7.00 feet

C) Total water above tank top in Boiler Rooms

Total volume = 2303.5 cu ft
Total weight = 65.81 tons
Total vertical moment = 15676.5 ft-cu ft
VCG above baseline = 6.81 feet
Total longitudinal moment = -121298 ft-cuft
LCG from midship = -52.66 ft

QUEEN MARY

SHIPCHECK DATE: 10/3/90



STANDING WATER ABOVE TANK TOPS

NO SCALE

4. EXISTING CONDITION OF SHIP

The conventions of signs used in the calculation are as follows:

1) From midship, 12" aft of Fr #175, all parameters toward aft are negative and toward forward are positive.
2) From ship centerline, all parameters toward port side are negative and toward starboard are positive.
3) From ship existing baseline, all parameters below are negative and above are positive.

The followings are the drafts of the ship measured as of October 3, 1990 at 13.00 hours.

Draft forward =	34.40 feet	=	34 feet	-	4.800 inches
Draft aft =	34.78 feet	=	34 feet	-	9.360 inches
Draft amidship=	33.98 feet	=	33 feet	-	11.760 inches

The followings are the properties of the ship:

Length between perpendiculars .... 965.000 feet

Maximum beam .... 118.000 feet

Estimated vertical center of gravity .... 43.800 feet

This vertical center of gravity is estimated from

(a) DWG NO. QB - QM - H - 1200, REV R
TRIM AND STABILITY MONTHLY REPORT and

(b) SKETCH NO. 120270, DATE: DEC 2, 1970
DISPLACEMENT AND TRIM STUDY

Mean of forward and aft draft	34.590 feet
Hog (negative) or sag (positive)	-.610 feet
Trim (positive forward, negative aft)	-.380 feet
Longitudinal center of flotation from midship	-36.304 feet
Difference between LCF and midship draft	.014 feet
Draft at center of flotation	34.604 feet
Tons per inch immersion	195.155 tons
Water plane coefficient	.720
Draft correction in percentage for hog or sag	72.08 %
LCF draft corrected for hog or sag	34.165 feet
Total displacement in sea water at above draft	65941.87 L.tons
Longitudinal metacenter above baseline	1755.210 feet
Longitudinal metacenter above center of gravity ...	1711.410 feet
Moment to change trim one foot	116946.7 ft-tons
Trimming lever (- for aft trim)	-.674 feet
Longitudinal center of buoyancy from midship	-20.857 feet
Longitudinal center of gravity from midship	-21.531 feet

5. CONDITION 1 - REMOVAL OF ALL WATER FROM SECTION 1,2 AND 3

No.	Item	Weight in tons	VCG in ft	V.Mom ft-tons	LCG in ft	L.Mom ft-tons
1.	Ship in exst condition	65941.87	43.80	2888254	-21.53	-1419806
2.	S.W in shaft alley	675.08	4.66	3145	-328.54	-221793
3.	S.W in engine room	1586.14	4.94	7830	-181.26	-287500
4.	S.W in boiler room	65.81	6.81	448	-52.66	-3466
	Total to remove	2327.0	4.91	11423	-220.35	-512758
	New condition of ship	63614.8	45.22	2876831	-14.26	-907048

Ship displacement	63614.8 L.tons
LCF draft above existing baseline	33.166 feet
Tons per inch immersion	193.611 tons
Water plane coefficient	.714
Draft correction in percentage for hog or sag	72.37 %
Hog (negative) or sag (positive)	-.610 feet
Correction in fwd and aft draft due to hog or sag .	.441 feet
Longitudinal metacenter above existing baseline ...	1791.047 feet
Longitudinal metacenter above CG at LCF draft	1745.824 feet
Moment to change trim one foot	115088.4 ft-tons
Longitudinal center of buoyancy from midship	-20.328 feet
Longitudinal center of gravity from midship	-14.258 feet
Trim lever (negative for aft trim)	6.069 feet
Trim (+ forward and - aft)	3.355 feet
Longitudinal center of flotation from midship	-34.547 feet
Difference between LCF and midship draft	.120 feet
Midship draft above existing baseline	33.286 feet
Forward draft at forward perpendicular	35.083 feet
Forward draft on draft marks	35.525 feet
FORWARD DRAFT .... 35 feet -	6.297 inches
Aft draft at aft perpendicular	31.728 feet
Aft draft on draft marks	32.170 feet
AFT DRAFT .... 32 feet -	2.039 inches
Transv metacenter abv BL, uncorrected for trim	50.285 feet
Transv metacenter abv BL, corrected for trim	50.140 feet
Center of gravity above existing baseline	45.223 feet
Metacentric Height, GM	4.917 feet

NOTE: GM shown is without any correction for the free surface effect of water in the wing tanks.

6. CONDITION 2 - REBALLAST WITH MUD TO RETURN TO EXISTING CONDITION

Density of mud ballast = 144 lbs/cu ft

DB tank	Tank location from Fr to Fr	P or S or CL	Weight l.tons in ft	Vert Moment ft-tons	Long'l Moment ft-tons
Q	#21 to #51	CL	0.00	0.0	0
P	#51 to #71	CL	0.00	0.0	0
O.1	#71 to #87	S	0.00	0.0	0
O.2	#71 to #87	P	0.00	0.0	0
N1 & N2	#87 to #112	OUTBD,P+S	949.50	7311.2	-211738
N3 & N4	#87 to #112	INBD, P+S	0.00	0.0	0
M1 & M2	#112 to #136	OUTBD,P+S	1021.50	5107.5	-153225
M3 & M4	#112 to #136	INBD, P+S	900.00	2880.0	-136800
			2871.00	15298.7	-501764

Total weight of drilling mud = 2871.00 L.tons

Total volume of drilling mud = 44660 cu ft

Vertical center of gravity = 5.33 feet

Longitudinal center of gravity = -174.77 feet

No.	Item	Weight in tons	VCG in ft	V.Mom ft-tons	LCG in ft	L.Mom ft-tons
1.	Ship in condition 1	63614.84	45.22	2876831	-14.26	-907048
2.	Mud ballast from above	2871.00 ✓	5.33	15299	-174.77	-501764
	New condition of ship	66485.84 ✓	43.50	2892129	-21.19	-1408811

Ship displacement	66485.8 L.tons
LCF draft above existing baseline	34.397 feet
Tons per inch immersion	194.937 tons
Water plane coefficient	.719
Draft correction in percentage for hog or sag	72.12 %
Hog (negative) or sag (positive)	-.610 feet
Correction in fwd and aft draft due to hog or sag .	.440 feet
Longitudinal metacenter above existing baseline ...	1747.218 feet
Longitudinal metacenter above CG at LCF draft	1703.718 feet
Moment to change trim one foot	117381.4 ft-tons
Longitudinal center of buoyancy from midship	-20.980 feet
Longitudinal center of gravity from midship	-21.190 feet
Trim lever (negative for aft trim)	-.209 feet
Trim (+ forward and - aft)	-.118 feet
Longitudinal center of flotation from midship	-36.070 feet
Difference between LCF and midship draft	-.004 feet
Midship draft above existing baseline	34.393 feet
Forward draft at forward perpendicular	34.329 feet
Forward draft on draft marks	34.769 feet
FORWARD DRAFT .... 34 feet -	9.227 inches
Aft draft at aft perpendicular	34.447 feet
Aft draft on draft marks	34.887 feet
AFT DRAFT .... 34 feet -	10.649 inches
Transv metacenter abv BL, uncorrected for trim	49.821 feet
Transv metacenter abv BL, corrected for trim	49.826 feet
Center of gravity above existing baseline	43.500 feet
Metacentric Height, GM	6.326 feet

NOTE: GM shown is without any correction for the free surface effect of water in the wing tanks.

7. SEQUENCE OF WORK

The following ballasting sequence is to be done prior to SEQUENCE E,F AND G of PHASE II: MAINTENANCE STUDY: PART 1.

1) Empty standing water on top of double bottom tank tops from Fr #87 to Fr #212. Result of trim will be about 4 inches by the stern.
2) Empty double bottom tanks, M3 and M4. Trim will be about even (zero trim).
3) Empty double bottom tanks, M1 and M2. Trim will be about 6 inch by the bow.
4) Fill double bottom tanks, M3 and M4, with drilling mud. Trim will be about 5 inches by the stern.
5) Empty double bottom tanks, N3 and N4. Trim will be about even (zero trim).
6) Empty double bottom tanks, N1 and N2. Trim will be about 8 inches by the bow.
7) Fill double bottom tanks, M1 and M2, with drilling mud. Trim will be about 4 inches by the stern.
8) Empty double bottom tanks, O1 and O2. Trim will be about 3 inches by the bow.
9) Empty double bottom tank, P. Trim will be about 8 inches by the bow.
10) Fill double bottom tanks, N1 and N2, with drilling mud. Trim will be about 10 inches by the stern.
11) Empty double bottom tank, Q, and spaces between deep floors to Fr #21. Trim will be about 2 inches by stern.

8. CONCLUSION

1) The ballasting sequence of work is calculated to keep the trim of the ship within 12 inches by the bow or by the stern.

2) The calculations of trim in the sequence of work are approximated. The actual trim shall be checked using the condition of the ship at that time.

3) The tanks, N3, N4, O1, O2, P and Q, are necessary to be left empty for future ballasting for bow and aft trim as there are no tank available at forward of ship.

4) The final condition of the ship will have a capability of ballasting the ship for bow and aft trim of a maximum of about 24 inches.

5) Displacements are corrected for hogging based on U.S.C.G Navigation and Vessel Inspection Circular No 1-67 for Stability Test.

6) The minimum metacentric height that the ship can encounter will be about 4.92 feet without consideration for free surface effect in the wing tanks. This can be assumed satisfactory.

7) Ballasting sequence for heeling and trimming which is necessary for maintenance work at exterior shell at waterline is not included in this study.

PHASE I

Part 9: Examination of existing piping systems for pumping of bilge water.

PHASE I: HULL STRUCTURE ANALYSIS:

PART 9: EXAMINATION OF EXISTING PIPING SYSTEMS FOR PUMPING OF BILGE WATER:

Introduction:

The existing Bilge System, as shown on the Bilge Diagram, extends from the chain locker forward, at Frame 328, to the shaft alley aft, at Frame 19, and consists of a suction main, branches and three (3) electric-driven centrifugal pumps of 800 GPM capacity at 40 feet discharge head. One is located at about Frame 248, port, one at about Frame 182, port side and one at about frame 110, starboard side. There are two (2) emergency diesel pumps, neither of which is in operation. Also, portable submer- sible stripping pumps are used to pump the bilges.

References:

Bilge System Diagram - RHF-QM-M-136
Bilge System Piping Deck Plan - QB-QM-M-3101 E

Findings:

The Bilge System main and some branches are generally in poor condition, some branches have holes in the pipe, rendering them useless (see photos). Other branches, which were installed during the "conversion", are in good condition except for the strainers in the sumps which are plugged with rust.

There are several areas at the tank top level which have from 6-inches to 18-inches of water. As far as can be determined, the bulk of this water is coming from air conditioning units discharging the condensate drains either directly or indirectly to the bilge area, creating a corrosion problem. Some of the water is from leaking piping in the sewage tank rooms. In one area, the Fan Room on "R" Deck, Frame 200 (under the stairs), a hole has been made in the deck to relieve the puddling of water in the space. This water finds its way through the overhead of what was Fire Room No. 3, then drips down into the bilge area. This space was the worst of the air conditioning spaces surveyed, but is indicative of the extent of the problem.

In the shaft alley area, between Frame 21 and Frame 87, there is approximately 8-feet of water above the tank tops. This water has been left there to ballast the vessel, according to the Ship's Engineers. This problem is addressed on the stability portion of this Report.

The Bilge Piping System as originally designed could pump water from any or all of various compartments below the waterline, said compartments being segregated by watertight bulkheads, thus restricting the flooding to a specific compartment or compartments. As the system is today, the compartment watertightness is non-existent since holes have been cut in bulkheads, other bulkheads removed and some with openings within a foot of the tank tops. Flooding of the ship for any reason, such as fire or some other disaster, would then extend the length of the ship. This scenario may be somewhat mitigated by the fact that in 20 years of being in this condition, there has been no such occurrence. However, the possibility remains. At the time this Report was made, the bilge pumps were not operable. This should be corrected and the bilge pipes, valves, strainers, etc., repaired or replaced to make the system properly operable.

Recommendation:

To keep the bilge area dry, first of all the water from the air conditioning units must be eliminated. This can be done by rerouting the condensate drains to either weather or interior deck drains for units located above the waterline. For those units located below the waterline, the condensate can be drained into small sump tanks equipped with a float operated pump to discharge overboard. Alarms would be installed to warn maintenance personnel of a pumping failure. All other piping leaks should be rectified to keep water out of the bilge area.

In the sewage tank area, water has filled the space to within 18-inches of the door sill. It is assumed this water is from either leaking pipes, a leaky sewage tank, or both. A float operated pump is installed in the space to drain the water to the sewage tank. This arrangement is satisfactory for an emergency situation, but the proper solution is to take steps to prevent the accumulation of water.

It is recommended that a thorough examination of the System be made and a detailed remedial plan prepared and executed.

PHASE I

Part 10: Examination of piping systems for transfer of water to wing tanks and double bottoms.

QUEEN MARY HOTEL

PHASE I: HULL STRUCTURE ANALYSIS:

PART 10: EXAMINATION OF PIPING SYSTEMS FOR TRANSFER OF WATER TO WING TANKS AND DOUBLE BOTTOMS:

Introduction:

The Ballast System, as presently connected, consists of an electric motor-driven pump (800 GPM @ 68 Ft. head) located in Wing Tank 30 port side and a diesel engine-driven pump located at about Frame 225 port side, both piped to the Bilge System and to 12 wing tanks arranged in groups of three (3) with two (2) groups on the starboard side, and two (2) groups on the port side.

These four (4) groups shall be referred to in this Report as A, B, C and D and are so indicated on the "Emergency Bilge and Ballast System Diagram", Enclosure 1.

The diesel engine-driven pump is not operable at this writing, although the piping is connected. This pump should be made operable to back-up the electric pump and to provide emergency bilge service.

References:

Sketch of Ballast System provided by Queen Mary Engineering Department.

Findings:

The Ballast System is not sufficiently flexible to satisfy the various conditions of ballast transfer. At the very minimum, each starboard group should be capable of being transferred to any of the port groups and vice versa. The ideal condition would be that ballast in any tank can be transferred to any other tank.

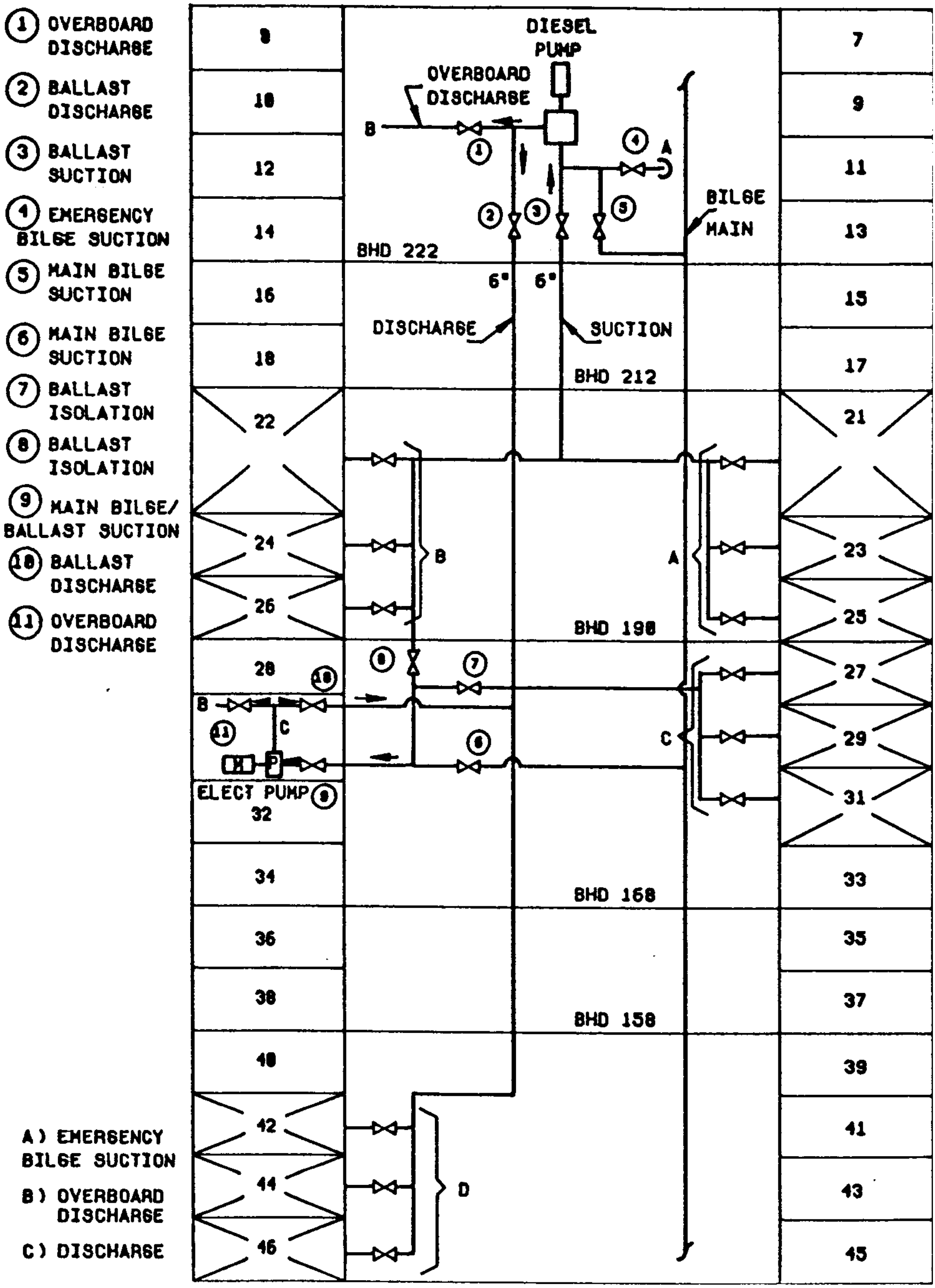
Recommendation:

As the system is now connected and referring to Enclosure 1, Tank Group "A" can be transferred to Tank Group "C" or "D", but not to "B". Tank Group "B" can be transferred to Tank Group "C" or "D", but not to "A". Tank Group "C" or "D" cannot be transferred to any other tank. Filling of tanks is via the firemain which is fresh water. All tanks can be pumped overboard, so water in Tank Group "C" and "D" must be pumped to the sea each time these tanks are to be deballasted. The Operating Chart, Enclosure 3, illustrates the valve operations.

To attain the flexibility for transfer of water from port tanks to starboard tanks and vice versa, the existing system must be modified as indicated on the "Modified Emergency Bilge and Ballast System Diagram", Enclosure 2.

An Operating Chart, Enclosures 4 and 5, denoting the valve status for each operation is provided to demonstrate the valve status for each operation of ballasting, one using the electric motor-driven pump, Enclosure 4, and one using the diesel engine-driven pump, Enclosure 5.

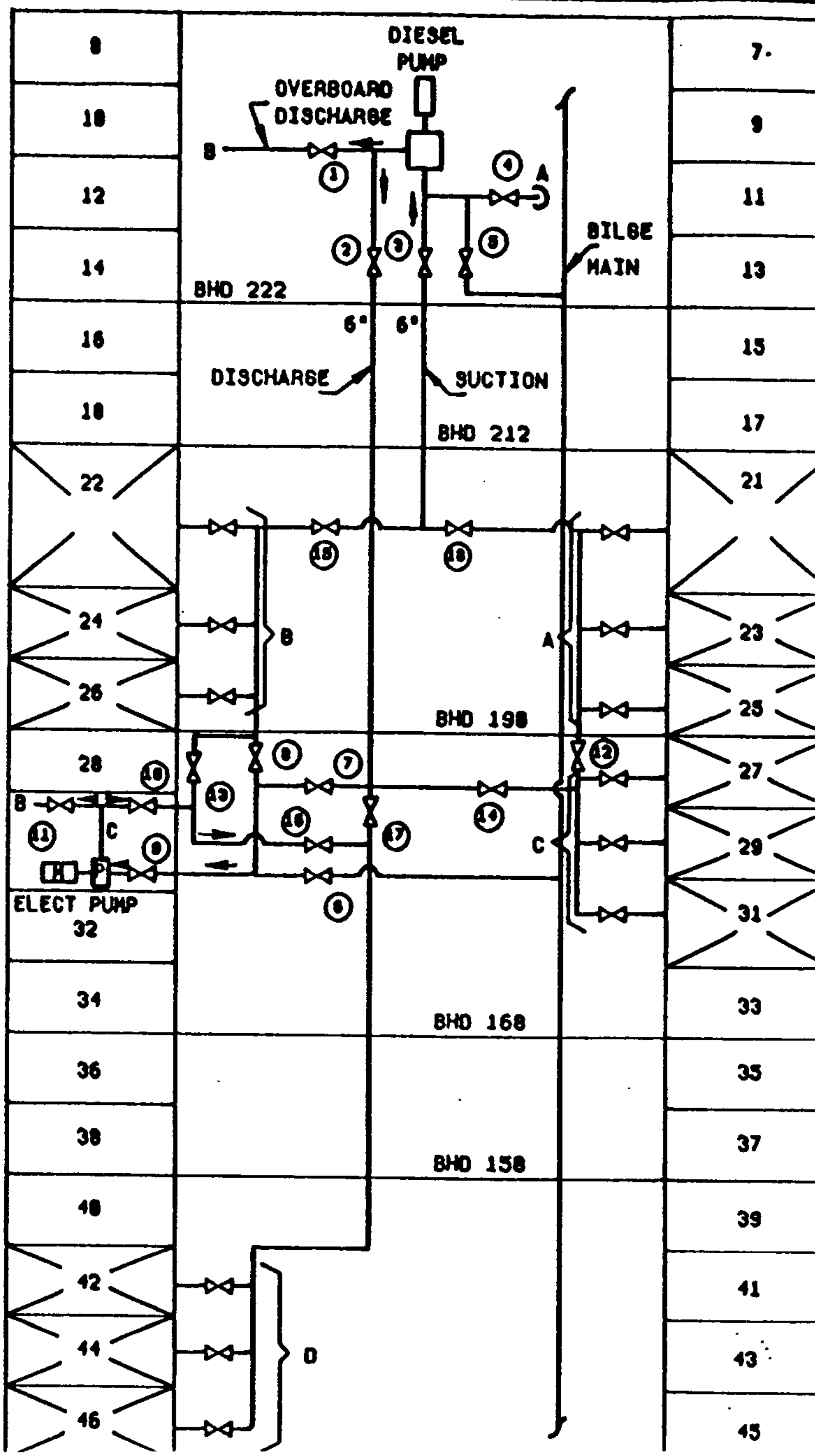
EXISTING EMERGENCY BILGE & BALLAST SYSTE



MODIFIED EMERGENCY BILGE & BALLAST SYST

1. OVERBOARD DISCHARGE
2. BALLAST DISCHARGE
3. BALLAST SUCTION
4. EMERGENCY BILGE SUCTION
5. MAIN BILGE SUCTION
6. MAIN BILGE SUCTION
7. BALLAST ISOLATION
8. BALLAST ISOLATION
9. MAIN BILGE/ BALLAST SUCTION
10. BALLAST DISCHARGE
11. OVERBOARD DISCHARGE
12. BALLAST ISOLATION
13. BALLAST DISCHARGE
14. BALLAST DISCHARGE
15. BALLAST DISCHARGE
16. BALLAST DISCHARGE
17. BALLAST ISOLATION
18. BALLAST ISOLATION

A) EMERGENCY BILGE SUCTION
B) OVERBOARD DISCHARGE
C) DISCHARGE



EXISTING SYSTEM

TABLE A

(USING THE ELECTRIC MOTOR-DRIVEN PUMP)

OPERATION	VALVE 1	2	3	4	5	6	7	8	9	10	11
A OVBD						C	C	O	O	C	O
B OVBD						C	C	O	O	C	O
C OVBD						C	O	C	O	C	O
D OVBD						C	O	C	O	C	O
A TO B	NOT POSSIBLE										
A TO C						C	C	O	O	O	C
A TO D						C	C	O	O	O	C
B TO A	NOT POSSIBLE										
B TO C						C	C	O	O	O	C
B TO D						C	C	O	O	O	C
C TO A	NOT POSSIBLE										
C TO B	NOT POSSIBLE										
C TO D	NOT POSSIBLE										
D TO A	NOT POSSIBLE										
D TO B	NOT POSSIBLE										
D TO C	NOT POSSIBLE										

LEGEND: O = OPEN
C = CLOSED
/ = NOT USED.

EXISTING SYSTEM

TABLE B

(USING THE DIESEL ENGINE-DRIVEN PUMP)

OPERATION	VALVE										
	1	2	3	4	5	6	7	8	9	10	11
A OVBD	O	C	O	C	C	/	/	C	/	/	/
B OVBD	O	C	O	C	C	/	/	C	/	/	/
C OVBD	O	C	O	C	C	C	O	O	C	/	/
D OVBD	O	C	O	C	C	C	O	O	C	/	/
A TO B	- - - - NOT POSSIBLE - - - -										
A TO C	C	O	O	C	C	C	C	/	/	C	/
A TO D	C	O	O	C	C	/	C	/	/	C	/
B TO A	- - - - NOT POSSIBLE - - - -										
B TO C	C	O	O	C	C	/	C	/	/	C	/
B TO D	C	O	O	C	C	/	C	/	/	C	/
C TO A	- - - - NOT POSSIBLE - - - -										
C TO B	- - - - NOT POSSIBLE - - - -										
C TO D	- - - - NOT POSSIBLE - - - -										
D TO A	- - - - NOT POSSIBLE - - - -										
D TO B	- - - - NOT POSSIBLE - - - -										
D TO C	- - - - NOT POSSIBLE - - - -										

LEGEND: O = OPEN
C = CLOSED
/ = NOT USED

MODIFIED SYSTEM

TABLE C

(USING THE ELECTRIC MOTOR-DRIVEN PUMP)

OPERATION	VALVE																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A OVBD	/	C	/	/	/	C	O	C	O	C	O	O	/	O	/	/	C	C
B OVBD	/	/	/	/	/	C	C	O	O	C	O	/	C	/	C	/	/	/
C OVBD	/	C	/	/	/	C	O	C	O	C	O	C	/	O	/	/	C	/
D OVBD	/	C	/	/	/	C	O	C	O	C	O	/	/	C	/	/	O	/
A TO B	/	C	/	/	/	C	O	C	O	O	C	O	O	O	C	C	C	C
A TO C	/	C	C	/	/	C	C	O	O	O	C	C	C	O	O	O	C	O
A TO D	/	C	C	/	/	C	C	O	O	O	C	C	C	C	O	O	C	O
B TO A	/	C	/	/	/	C	C	O	O	O	C	O	C	O	C	O	O	C
B TO C	/	C	/	/	/	C	C	O	O	O	C	C	C	O	C	O	O	/
B TO D	/	/	/	/	/	C	C	O	O	O	O	/	C	/	C	O	C	/
C TO A	/	C	C	/	/	C	O	C	O	O	C	C	O	O	O	C	C	O
C TO B	/	C	/	/	/	C	O	C	O	O	C	C	O	O	C	C	C	/
C TO D	/	/	/	/	/	C	O	C	O	O	C	C	C	O	/	O	C	/
D TO A	/	/	C	/	/	C	O	C	O	O	C	C	O	C	O	C	O	O
D TO B	/	C	/	/	/	C	O	C	O	O	C	/	O	C	C	C	O	/
D TO C	/	C	C	/	/	C	O	C	O	O	C	O	O	C	O	C	O	O

LEGEND: O = OPEN
C = CLOSED
/ = NOT USED

PHASE I

Part 11: Examination of First Class Pool structure.

PHASE I: HULL STRUCTURE ANALYSIS:

PART 11: INVESTIGATE AND DEVELOP STRUCTURAL DRAWINGS FOR REINFORCEMENT OF FIRST CLASS SWIMMING POOL:

Introduction:

The pool is of rectangular shape 35-feet long and 22-feet-6-inches wide. The depth varies due to the sloped bottom plate which measured from 7-feet to 8-feet-6-inches. It is designed for a water level of 36-inches from the top of the pool. The capacity of water to the designed water level is about 29,000 gallons and the weight is about 109 long tons.

The pool is located between "C"- and "D"-Decks from Frame 212 to 222 at the centerline of the ship. The top of the pool is flush with "C"-Deck while the bottom is sloped fore and aft and also athwartship. The lowest point is about 6-inches below the "D"-Deck between Frame 218 and 219. To support the pool tank a cofferdam is formed underneath; the bottom of which is 42-inches below "D"-Deck level.

Findings:

During general rip-out of non-structural partitions between "C" and "D"-Decks, a structural web frame, at Frame 214 (port), was also cut away. This was a major component of the structure that supported the port side of the pool, plus carrying part of the vertical load from the pillar that held the "R"-Deck balcony around the pool, plus the considerable loads from the "B"-Deck (overhead) above the pool and other loads translated down through the inboard girder system from the entire superstructure. The local deflection of the pool side (when it was loaded with water) would have forced a deflection into the "C"-Deck pool edge and, through the pillar structure, up to deflect the "R"-Deck edge (with its bulwark-type railing showing the effect). Tile mortar cracks in way of the deflected decks and pillars would follow.

References:

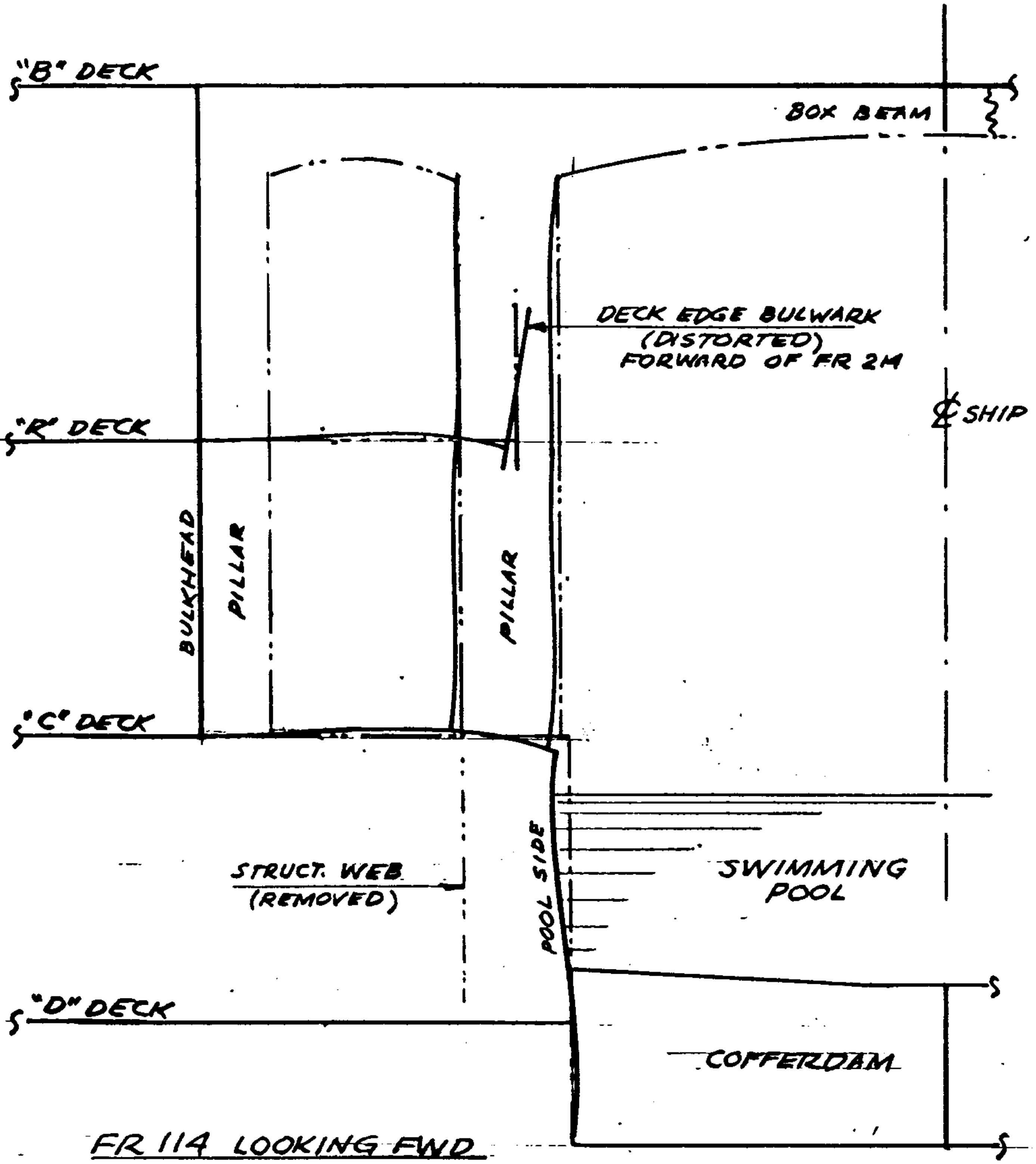
Rados International Corporation's "Feasibility Study for Disneyland Engineering", dated October 13, 1989.

Recommendation:

Replacement of the web frame at Frame 214 should be mandatory prior to filling the pool with water again.

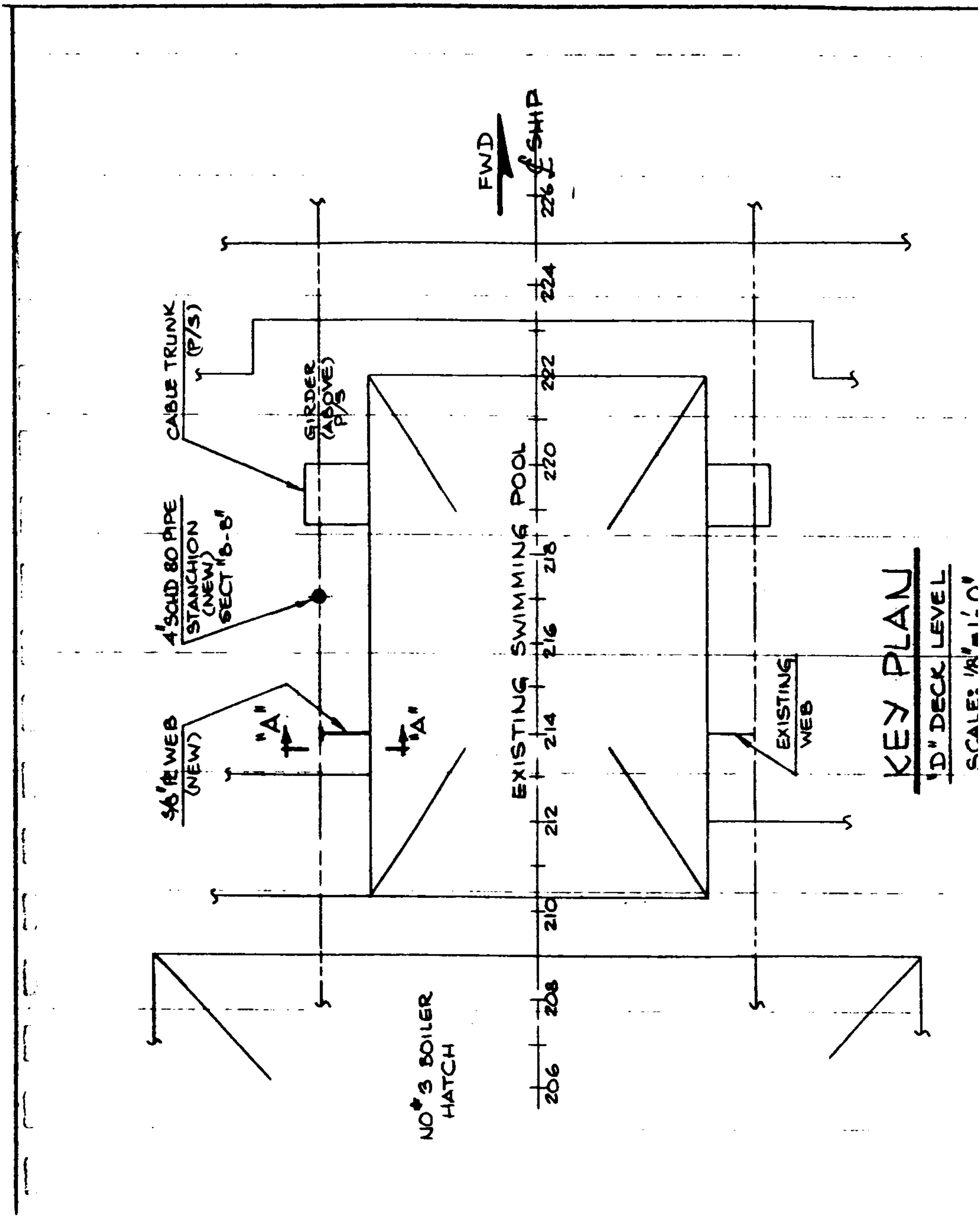
No imminent danger exists with this condition, only aesthetics. For full use of the pool, tiling repairs would be required after the structural modification.

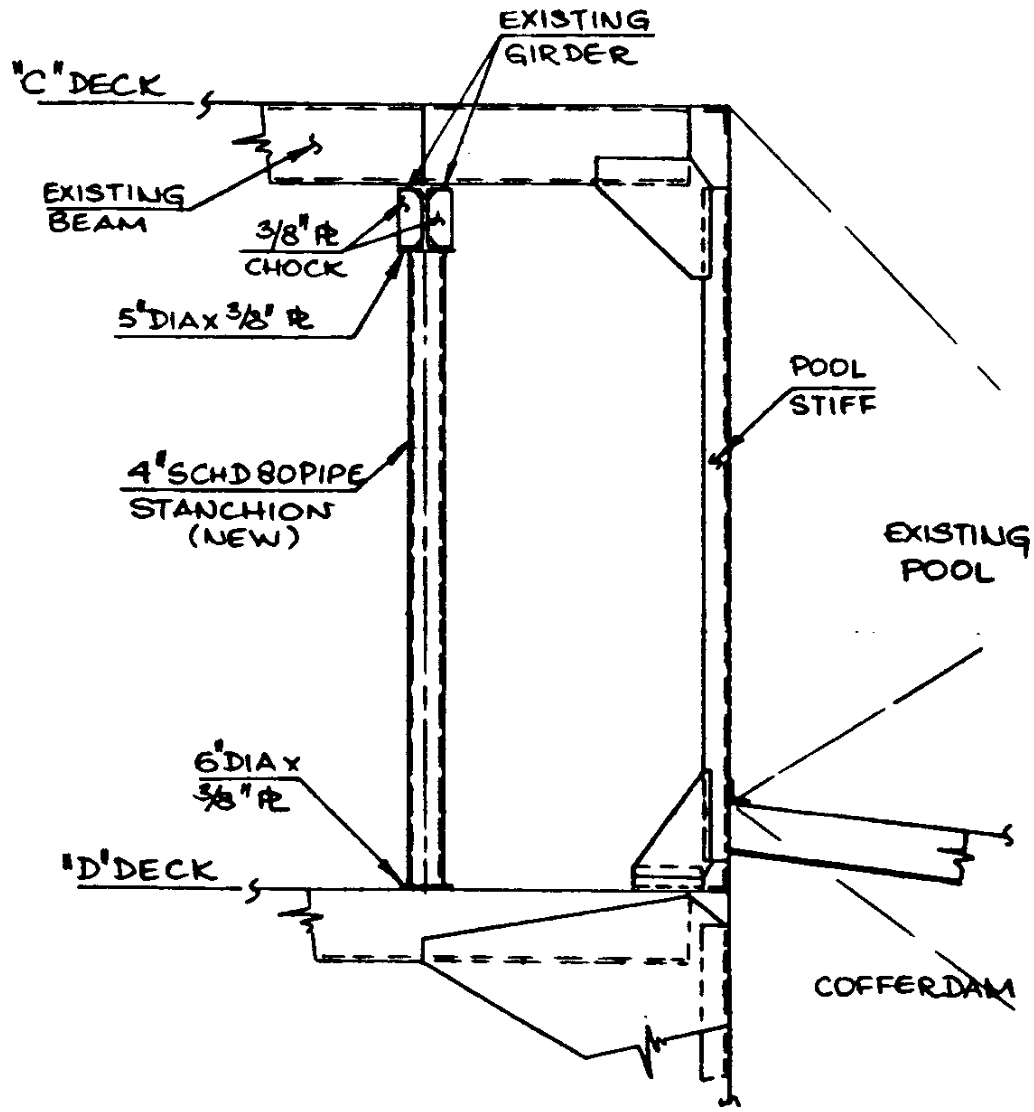
SECTION THRU 1ST CLASS SWIMMING POOL



FR 114 LOOKING FWD

STRUCTURAL DEFLECTIONS SHOWN DUE TO WATER PRESSURE
(EXAGGERATED VIEW)


FWD
℄ SHIP
CABLE TRUNK (P/S)
GIRDER (ABOVE) P/S
4" SCHD 80 PIPE STANCHION (NEW) SECT "B-B"
5/16" PL WEB (NEW)
"A"
"A"
EXISTING SWIMMING POOL
EXISTING WEB
NO # 3 BOILER HATCH
206
208
210
212
214
216
218
220
222
224
226
KEY PLAN
'D' DECK LEVEL
SCALE: 1/8" = 1'-0"

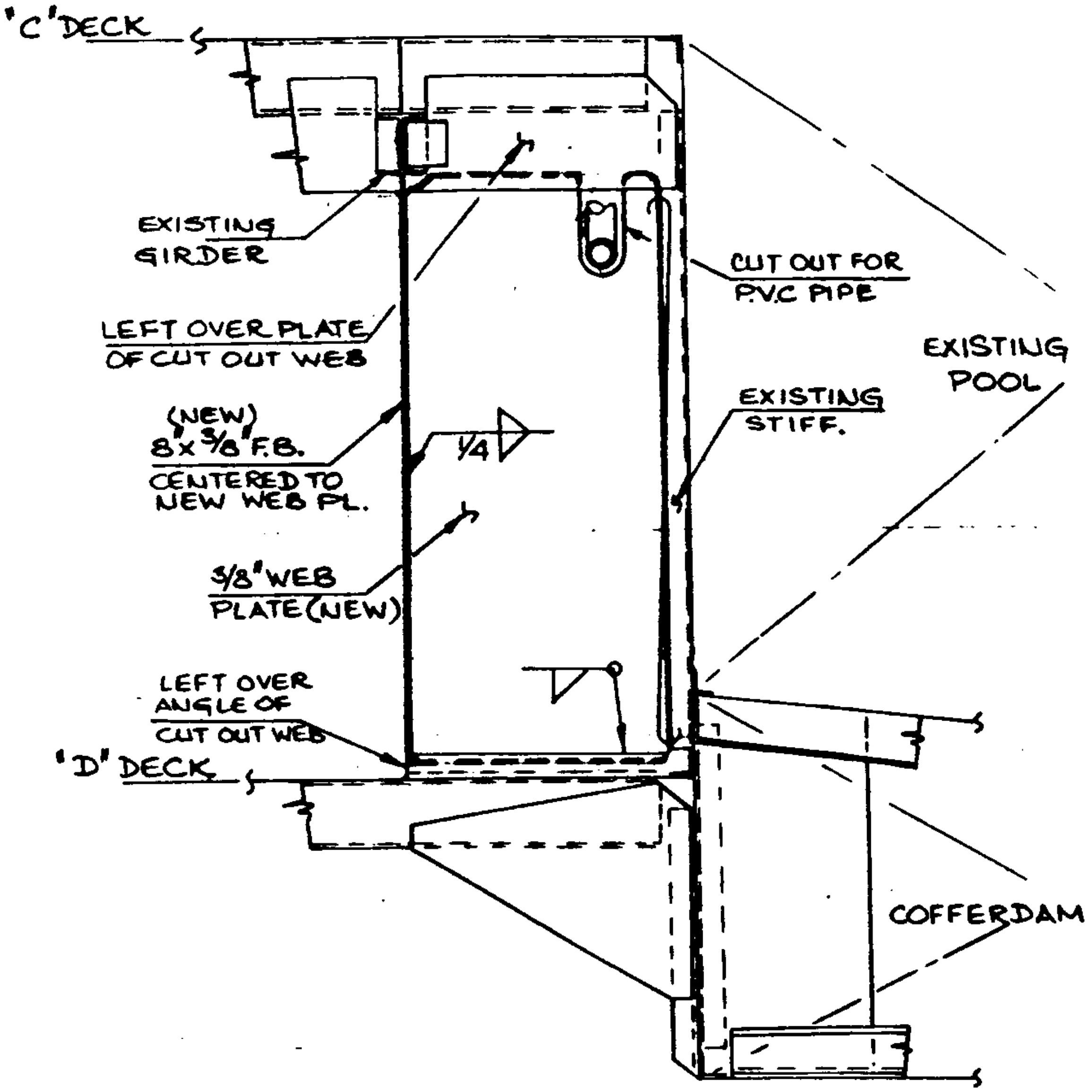


SECTION "B-B"

FR # 217, PORT SIDE, LOOKING FORWARD

SCALE: 1/2" = 1'-0"

QUEEN MARY/DISNEYLAND



SECTION "A - A"

FR# 214, PORT SIDE, LOOKING FORWARD

SCALE: 1/2" = 1'- 0"

1. INTRODUCTION

The following calculations were developed to support the FEASIBILITY STUDY of the existing pool at "C" deck forward and are not to be used as design calculations. Due to the age of the existing structural shapes used in the ship, their standard properties are not available. Therefore, presently used standard shapes or built-up shapes which are closest to the original configurations were selected for use in these calculations.

2. LOAD DUE TO WATER IN THE POOL

The transverse loads at the top, (Ft), and at the bottom, (Fb), of the longitudinal sides of the swimming pool are:

$$Ft = (1/6) \times B \times D^2 \times 62.5 \text{ pounds}$$

$$Fb = (1/3) \times B \times D^2 \times 62.5 \text{ pounds}$$

where B is the distance in fore and aft direction of the pool and D the depth of water at the location under consideration.

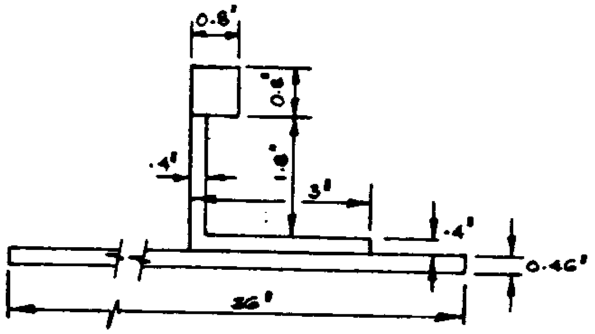
Thus it is seen that both the transverse and longitudinal fore and aft loads are proportional to the square of the depth of water. An increase in water level of 6 inches, on the design depth of water of 50 inches, will increase the loads by

$$((56/50)^2 - 1) \times 100 \text{ percent} = 25.4 \text{ percent}$$

3. STRENGTH ON POOL SIDE STIFFENERS

In calculating the strength of the secondary structural members, the effective width of the plate associated with the stiffeners is the spacing of the stiffeners. When the stiffeners are spaced too wide, deterioration on the plate will have a great effect on the total strength of the members.

Since the properties of the bulb angle, 3"x3"x.4", are not available, we shall assume the shape to be built up of flat bars as shown:



The accumulation of properties for the structural members are shown below:

Members	Area	CG	Moment	M of I	AxD^2
36"x.46" plate	16.56	.23	3.81	.29	.53
3"x.40" f.bar	1.20	.66	.79	.02	.08
1.8"x.40" f.bar	.72	1.76	1.27	.19	1.31
.8"x.8" f.bar	.64	3.06	1.96	.00	4.50
	19.12		7.83	.50	6.42

The previous summation results in the following:

Resultant CG = .41 inches

M of I = 6.92 in^4

Section Modulus = 6.92 / (3.46 - .41) = 2.269 in^3

Assuming the corrosion on the thickness of the plate to be 50% of the original thickness, then the new sectional modulus will be as follows:

Members	Area	CG	Moment	M of I	AxD^2
36"x.23" plate	8.28	.12	.95	.04	.69
3"x.40" f.bar	1.20	.43	.52	.02	.00
1.8"x.40" f.bar	.72	1.53	1.10	.19	.91
.8"x.8" f.bar	.64	2.83	1.81	.00	3.77
	10.84		4.38	.25	5.37

Resultant CG = .40 inches

M of I = 5.62 in^4

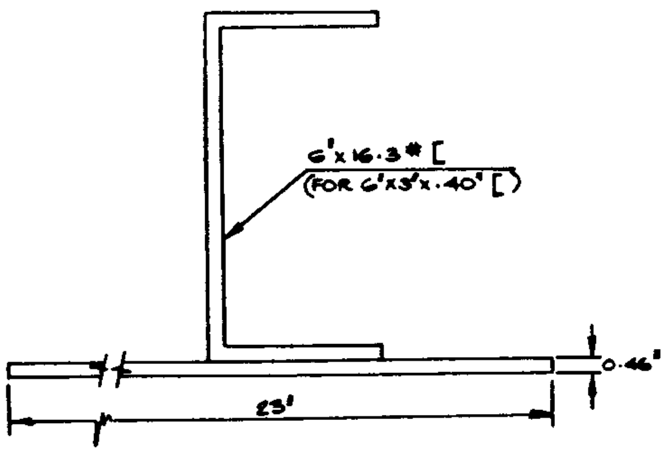
Section Modulus = 5.62 / (3.23 - .40) = 1.989 in^3

Compared to the previous sectional modulus, the loss in strength due to 50% deterioration on the plate is about 12.3 percent.

4. STRENGTH ON POOL SIDE WEB

The main structural members of the pool side plate also lose strength when the plates deteriorate. The effective width of the plate for main structural members is usually taken as 50 times the thickness of the plating. The existing transverse webs are composed of 6"x3"x0.40" bulb angle. The properties of this bulb angle is not available, therefore, 6"x16.3# channel was used to calculate the strength.

The sectional modulus as designed is as follows:



Members	Area	CG	Moment	M of I	AxD^2
23"x.46" plate	10.58	.23	2.43	.19	10.60
6"x16.3# ch	4.75	3.46	16.43	25.80	23.60
	15.33		18.87	25.99	34.20

The previous summation results in the following:

Resultant CG = 1.23 inches

M of I = 60.19 in^4

Section Modulus = 60.19 / (6.46 - 1.23) = 11.510 in^3

Section modulus with 50 % corrosion in the thickness of the plate is as follows:

Members	Area	CG	Moment	M of I	AxD^2
11.5"x.23" pl	2.65	.12	.30	.01	10.59
6"x16.3# ch	4.75	3.23	15.34	25.80	5.90
	7.39		15.65	25.81	16.49

Resultant CG = 2.12 inches

M of I = 42.30 in^4

Section Modulus = 42.30 / (6.23 - 2.12) = 10.281 in^3

Summary:

for a thickness of .46", the section modulus = 11.51 in^3 and

for a thickness of .23", the section modulus = 10.28 in^3

Thus, the loss in strength due to 50% corrosion on the thickness of the plating is approximately 10.7 percent.

5. STRENGTH ON DECK GIRDER

When the transverse web was mistakenly removed from the port side plate of the pool, the span of the girder which was supported by the transverse web, was lengthened from 14 feet to 17 feet. Since the strength of the girder is proportional to the square of its span, the loss in strength due to lengthening the span is

$$((17/14)^2 - 1) \times 100 = 47.4 \text{ percent}$$

6. STRENGTH ON DECK BEAMS

From the previous section, the girder loses its strength about 47.4 % due to the lengthening of the span. This amount is sufficiently high to easily yield into permanent deflection above its limit at the middle part of its span. The girder then loses its capability to adequately support the beams.

When considering the case that a beam loses its support, when the span is increased from 12 feet to 15 feet-6 inches, the strength of the beam is reduced by the squares of its span, which is:

$$((15.5/12)^2 - 1) \times 100 = 66.8 \text{ percent}$$

7. CONCLUSION

Summarizing all the sections:

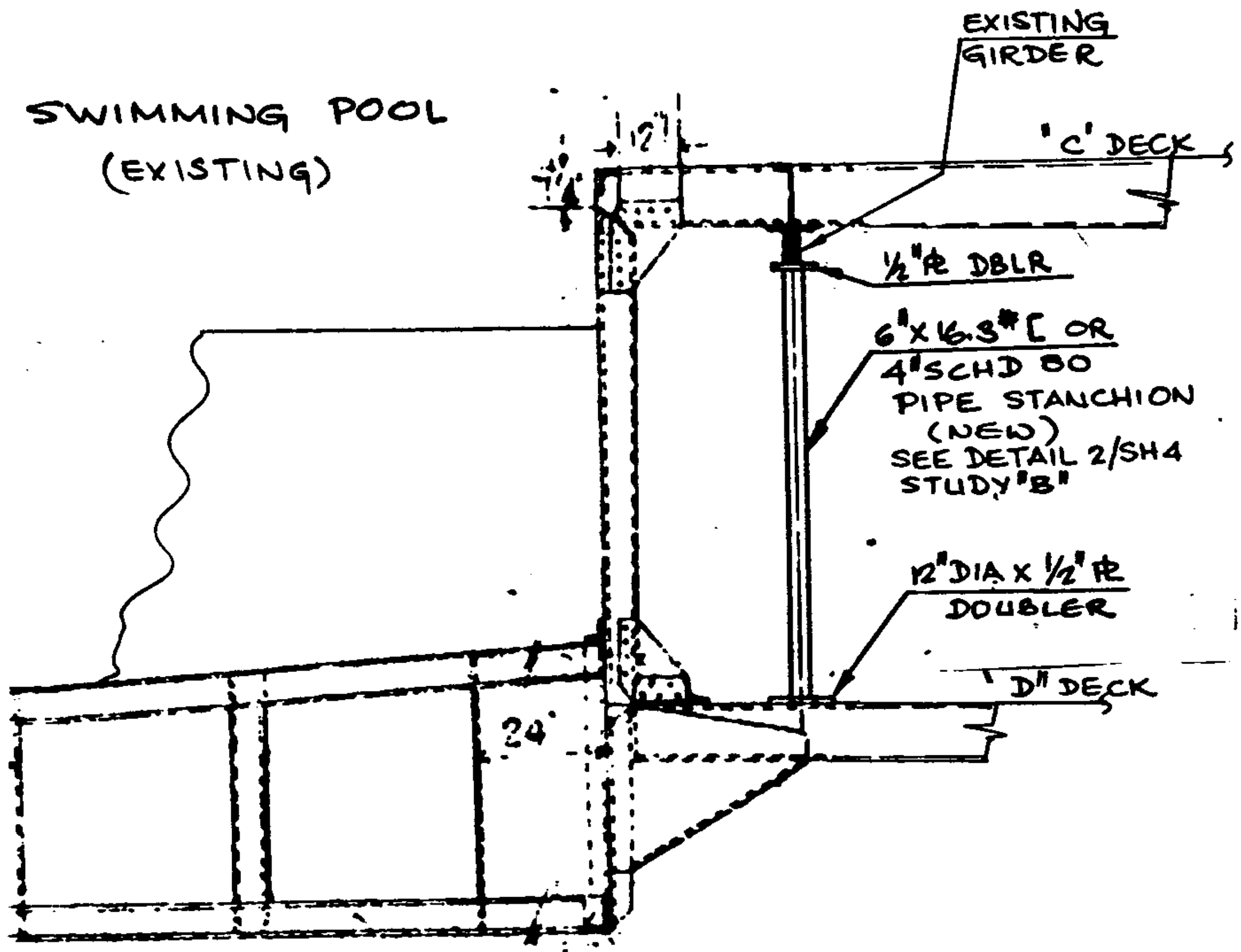
a. Due to the increment of water level by about 6 inches, the load acting on the port side of the plate is increased by 25.4 %.

b. Due to corrosion on the side plates (50% deterioration), the stiffeners and webs lose their strength by about 12.3 % and 10.7 % respectively.

c. Due to the lengthening of the span, the port side deck girder loses its strength by about 47.4 % and consequently loses the strength of the beams near the center of the girder by about 66.8 %.

Due to these facts the decking on the port side was sagged and created the cracks on the tiles and cements.

STUDY "A"
HOTEL QUEEN MARY



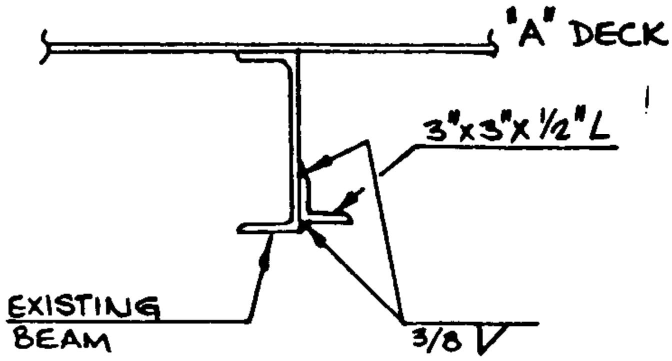
SECTION AT FR 216

PORT SIDE LOOKING AFT

NO SCALE

TEMPORARY MODIFICATION TO EXISTING GIRDER
AT THE EXISTING SWIMMING POOL

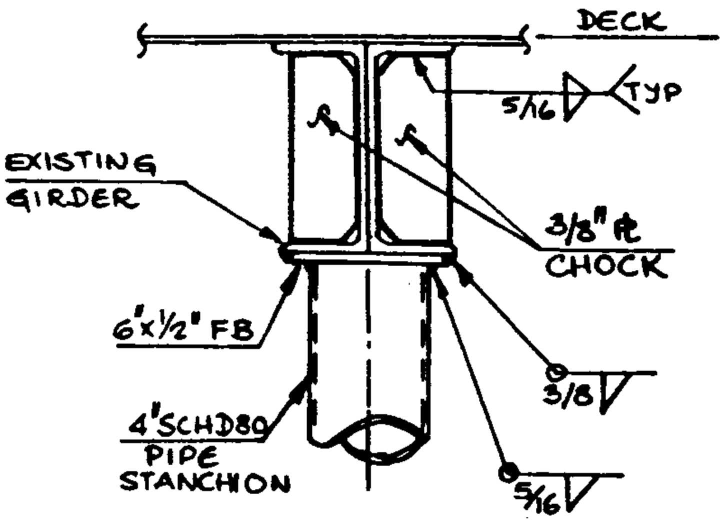
HOTEL QUEEN MARY



DETAIL 1

BEAM REINFORCEMENT

NO SCALE



DETAIL 2

STANCHION DETAIL

NO SCALE

PHASE II

Part 1: Recommended repairs and maintenance to tanks, alleys and waterline.

QUEEN MARY HOTEL

PHASE II: MAINTENANCE STUDY:

PART 1: RECOMMENDED REPAIRS AND MAINTENANCE TO TANKS, ALLEYS AND WATERLINE:

Introduction:

A survey was conducted to inspect the condition of the Queen Mary Hotel bilge area (tank top plating, from aft peak tank at Frame 21 to Bulkhead 289), holding tanks, alleys and waterline areas, and to determine the required repairs and maintenance to protect from further deterioration of the ship's structure.

References:

SSPC SP6 Commercial Blast Cleaning
Proline Paint Specifications
Photographs of Interior Tanks

Findings:

General:

The entire bilge area (top of the double bottom tanks, plus some of the interior shell and framing that is exposed aft) is in poor condition, yet for nearly two-thirds of that area, a complete inspection and determination is not possible as it is covered with water. The water has not been removed due to a Bilge Piping and Pumping System that is incapable due to its state of repair, plus a concern regarding the stability and trim if this considerable tonnage of water were removed. This report will develop a procedure for repairing the sources of this water, providing ballast as necessary to compensate for the removal of the water, provide for a Bilge System to accomplish the removal, thence continuing the deterioration analysis, but providing for the blast-cleaning and recoating of this critical area indicated by the portion that is visible.

Recommendation:

Exterior Waterline:

All around the ship this zone should be scraped and repainted at an early date. A schedule should be planned by the ship's Maintenance Department to shift, add, or subtract ballast from the several trimming tanks available port and starboard, and forward and aft, so as to expose at least two-feet of bottom paint below the existing plane of flotation in reasonable painting sectors in a sequential schedule. In the way of the breasting dolphins (with their log camels) the chafed area of bottom paint should also be recoated at the same time. (Herein we recommend a change to a rubber fender system, instead of the log camel, so this modification should be accomplished simultaneously.)

Breasting Dolphins:

The tidal range, plus splash zone of the steel piling for each breasting dolphin, should have a sand-blast (or at least brush-off blast cleaning to SSPC-SP7), an analytic review as to the rate of deterioration and recoating from low-low water to the top. If substantial steel loss is evident, then consideration should be given to new pilings. (All of this should be done with coordination with the master plan for relocating the ship along the pier.)

Bilge System:

The Bilge System is generally in poor condition. Deteriorated branches need to be repaired, as well as the strainers which are plugged with rust (see Phase I - Part 9).

Air Conditioning System:

Units discharge condensate directly or indirectly to the bilge area. Re-route condensate drains to either weather or interior deck drains for units located above the waterline. Below the waterline, condensate should be drained into a small sump tank equipped with a float-operated pump to discharge overboard (see Phase I - Part 9).

Sewage System:

The sewage tank area is fitted to within 18" of door sill. Repair any leaks in the system caused by piping, valves or tanks (see Phase I - Part 9).

Ballast System:

The Ballast System is not sufficiently flexible to satisfy the various conditions of ballast transfer. Each starboard group should be capable of being transferred to any port group and vice versa.

Notes:

1) All ballast removal from aft tanks should be accomplished with a naval architect continually monitoring trim and ballast conditions.

2) Many pipes in the Engine Room are covered with asbestos. Extreme caution should be used when sand-blasting this area.

The following procedure and sequence of work is recommended to repair and perform maintenance requirements for tank tops, bilges and alleys.

Procedure:

A. Remove all loose debris.

B. Repair or divert all water sources (air conditioning condensate drips, piping leaks, etc.).

C. Pump out water to sewer tanks - for removal to shore.

D. Dry out excess water (mop, rags, etc.).

E. Sand-blast to No. 6 Commercial Blast Standard (SSPC Specification).

   1. All tank top surfaces (top horizontal surface of double bottom tanks).:

      a. includes double bottom tank sides (margin plates) in after areas, where exposed within height specified.
      b. includes inner surface of the adjacent shell plating, where exposed within height specified.
      c. includes the curved upper surface of the double bottom tank, forward, up to the specified height above the horizontal tank top.

   2. All connecting vertical surfaces - to height specified:

      a. bulkhead faces.
      b. wing tank surfaces.
      c. bulkhead web stiffeners and connecting brackets.
      d. other bulkhead stiffeners within blast zone.

   3. All raised manholes and their covers.

   4. All pillar surfaces to specified height.

   5. No bulkhead penetrations, valves or piping (including hangers).

   6. No tank connections, valves or piping (including hangers).

   7. No foundation components attached to tank top.

F. Remove all blast material (vacuum, sweep, etc.)

G. Audio gage the metal thickness (chart location of test).

1. Tank top surfaces:

   a. six (6) places (minimum) between adjacent bulkheads:
      (1) aft port near corner.
      (2) forward port near corner.
      (3) near centerline forward.
      (4) near centerline aft.
      (5) aft starboard near corner.
      (6) forward starboard near corner.

   b. other areas of apparent deterioration.

   c. near any of the above locations that show a remaining thickness of 0.125", or less.
      (1) to determine necessity for:
         (a) filling with weld material.
         (b) spray metalizing.
         (c) patching.
         (d) removal and replacement.

2. Adjacent vertical surfaces:

   a. test one (1) place (minimum) on each bounding surface.

   b. same as 1.b, and 1.c, above.

3. Any other area where exposed metal shows evidence of severe deterioration.

   a. handle per 1.c, above.

H. Make structural steel repairs:

1. Replace deteriorated areas deemed, from Paragraph G, above, to be below a safe standard under the vessel's current loading condition.

2. Fill cut-out areas of each transverse bulkhead to make watertight up to the level of the walk-through arches (former watertight doors).

   a. Provide welded spools (or other watertight penetration) where usable pipes penetrate this zone. Blank off any unused pipes (if closed shut-off valve does not exist).

I. Coat with 16 dry mils of epoxy system:

J. Allow to dry per manufacturing specifications prior to using this space for ballast, if required.

Sequence:

A. General:

Proceed at the forward end of the open interior, Bulkhead 289, and continue aft in compartment sized increments (or 2-3 adjacent compartments if there is not much water to shift around). Toward the aft end, as the amount of standing water increases, it becomes more important to follow the sequence for assuring that adequate ballast has been added prior to the removal of the excess water. And, of course, it is important to divert those sources of bilge water prior to the removal as well.

B. Frames 224-289 (125'-10" long):

Original Boiler Room No. 1, through water purification area and including aft baggage hold: This area has the hatch to the Weather Deck for bringing equipment on board. There is little water to remove and the general condition is fair. One obvious water drip to divert (starboard side of hatch near Frame 279). Not much water to remove and condition is fair, 12" above tank top (minimum) for blast and review.

C. Frames 212-244 (96'-0" long):

Original Boiler Room No. 2 and Generator Room, aft: Not much water to remove and condition is fair.

D. Frames 168-212 (132'-0" long):

Original Boiler Rooms No. 3 and 4: This will require fixing sewage leaks and other air conditioning condensate diversions. Pumping out the considerable standing water will not be a stability or trim problem. The poor condition indicates a sand-blast and check 24" above tank top in this area. (Note: There is a wooden deck "dance floor" in this area, the removal of which might be advantageous during sand-blast and coating, however, permission for this must be granted by the ship operators.)

E. Frames 112-168 (168'-0" long):

Original forward Engine Room, Boiler Room No. 5 and a Generator Room: This area is in fair condition with water that doesn't stand much more than 12-inches at any point, hence water removal can be done without compensating ballast. Blast-cleaning of 12-inches (average) above tank top, with possible increase to 18-inches at indicated areas. The big complexity with this zone is that it has been decked over with nominal head room of about 4-feet at the side (increasing to

6-feet at the center). Then, too, the points of access are very limited, so getting hoses and equipment into the area (as well as ventilation air to the workers) will be very difficult.

F. Frames 87-112 (75'-0" long):

After Engine Room and currently part of the tour: There is some water in this area, yet removal will not require compensation. Condition appears reasonable, so a blast-clean height of 18-inches should be sufficient. However, access to the tank top regions, considering all of the equipment (including foundations) is obviously difficult. Then a complicating fact to be aware of is that any existing piping insulation will be of the asbestos type, hence the added care will have to be taken.

G. Frames 21-87 (172'-6" long):

Three (3) watertight zones (up to about 13-feet above baseline) that form the shaft alleys (port/starboard): The starboard side from about 75-feet aft of the Engine Room is open as part of the tour.

1. Frames 71-87: There is a modest amount of water that could be pumped without affecting trim. The condition is fair and it should be blast-cleaned to a height of 18-inches above the tank top at the side.

2. Frames 51-71: The water here (and in the last space aft) gets increasingly deep, so the water, with its trimming moments, is significant and should not be pumped until the ballast changes (see section regarding ballast changes) have been accomplished. The interior condition is fair and the indicated height for blast-cleaning is about 18-inches.

3. Frames 21-51: There is substantial water here and the steel condition is poor. This area will be awkward to work because of the complexity of steel work, also a large air conditioning unit makes access difficult. (The condensate removal problem from this unit must be addressed prior to blast-cleaning this area. This cleaning should be done to a height of about 2-feet above the tank top.

F. Remove all blast material (vacuum, sweep, etc.)

G. Audio gage the metal thickness (chart location of test).

1. Tank top surfaces:

   a. six (6) places (minimum) between adjacent bulkheads:
      (1) aft port near corner.
      (2) forward port near corner.
      (3) near centerline forward.
      (4) near centerline aft.
      (5) aft starboard near corner.
      (6) forward starboard near corner.
   b. other areas of apparent deterioration.
   c. near any of the above locations that show a remaining thickness of 0.125", or less.
      (1) to determine necessity for:
         (a) filling with weld material.
         (b) spray metalizing.
         (c) patching.
         (d) removal and replacement.

2. Adjacent vertical surfaces:

   a. test one (1) place (minimum) on each bounding surface.
   b. same as 1.b, and 1.c, above.

3. Any other area where exposed metal shows evidence of severe deterioration.

   a. handle per 1.c, above.

H. Make structural steel repairs:

1. Replace deteriorated areas deemed, from Paragraph G, above, to be below a safe standard under the vessel's current loading condition.

2. Fill cut-out areas of each transverse bulkhead to make watertight up to the level of the walk-through arches (former watertight doors).

   a. Provide welded spools (or other watertight penetration) where usable pipes penetrate this zone. Blank off any unused pipes (if closed shut-off valve does not exist).

I. Coat with 16 dry mils of epoxy system:

J. Allow to dry per manufacturing specifications prior to using this space for ballast, if required.

Sequence:

A. General:

Proceed at the forward end of the open interior, Bulkhead 289, and continue aft in compartment sized increments (or 2-3 adjacent compartments if there is not much water to shift around). Toward the aft end, as the amount of standing water increases, it becomes more important to follow the sequence for assuring that adequate ballast has been added prior to the removal of the excess water. And, of course, it is important to divert those sources of bilge water prior to the removal as well.

B. Frames 224-289 (125'-10" long):

Original Boiler Room No. 1, through water purification area and including aft baggage hold: This area has the hatch to the Weather Deck for bringing equipment on board. There is little water to remove and the general condition is fair. One obvious water drip to divert (starboard side of hatch near Frame 279). Not much water to remove and condition is fair, 12" above tank top (minimum) for blast and review.

C. Frames 212-244 (96'-0" long):

Original Boiler Room No. 2 and Generator Room, aft: Not much water to remove and condition is fair.

D. Frames 168-212 (132'-0" long):

Original Boiler Rooms No. 3 and 4: This will require fixing sewage leaks and other air conditioning condensate diversions. Pumping out the considerable standing water will not be a stability or trim problem. The poor condition indicates a sand-blast and check 24" above tank top in this area. (Note: There is a wooden deck "dance floor" in this area, the removal of which might be advantageous during sand-blast and coating, however, permission for this must be granted by the ship operators.)

E. Frames 112-168 (168'-0" long):

Original forward Engine Room, Boiler Room No. 5 and a Generator Room: This area is in fair condition with water that doesn't stand much more than 12-inches at any point, hence water removal can be done without compensating ballast. Blast-cleaning of 12-inches (average) above tank top, with possible increase to 18-inches at indicated areas. The big complexity with this zone is that it has been decked over with nominal head room of about 4-feet at the side (increasing to

6-feet at the center). Then, too, the points of access are very limited, so getting hoses and equipment into the area (as well as ventilation air to the workers) will be very difficult.

F. <u>Frames 87-112 (75'-0" long)</u>:

After Engine Room and currently part of the tour: There is some water in this area, yet removal will not require compensation. Condition appears reasonable, so a blast-clean height of 18-inches should be sufficient. However, access to the tank top regions, considering all of the equipment (including foundations) is obviously difficult. Then a complicating fact to be aware of is that any existing piping insulation will be of the asbestos type, hence the added care will have to be taken.

G. <u>Frames 21-87 (172'-6" long)</u>:

Three (3) watertight zones (up to about 13-feet above baseline) that form the shaft alleys (port/starboard): The starboard side from about 75-feet aft of the Engine Room is open as part of the tour.

1. Frames 71-87: There is a modest amount of water that could be pumped without affecting trim. The condition is fair and it should be blast-cleaned to a height of 18-inches above the tank top at the side.

2. Frames 51-71: The water here (and in the last space aft) gets increasingly deep, so the water, with its trimming moments, is significant and should not be pumped until the ballast changes (see section regarding ballast changes) have been accomplished. The interior condition is fair and the indicated height for blast-cleaning is about 18-inches.

3. Frames 21-51: There is substantial water here and the steel condition is poor. This area will be awkward to work because of the complexity of steel work, also a large air conditioning unit makes access difficult. (The condensate removal problem from this unit must be addressed prior to blast-cleaning this area. This cleaning should be done to a height of about 2-feet above the tank top.

PHASE II

Part 2: Develop maintenance chart and paint schedule.

QUEEN MARY HOTEL

PHASE II: MAINTENANCE STUDY:

PART 2: MAINTENANCE CHART AND PAINT SCHEDULE:

Introduction:

A survey was conducted to inspect the condition of the Queen Mary Hotel bilge area, waterline, bilge and ballast pump, piping system, and steel piling structure to determine the proper sandblasting, paint schedule and maintenance to keep the Queen Mary Hotel from further deterioration.

Phase II Part 1 recommends repairs and maintenance to bilge areas, waterline and piling structure.

References:

Sandblasting Specifications -
SSPC SP6 Commercial Blast Standard
Proline Paint Specifications

Recommendations:

To maintain the Queen Mary Hotel areas that have been repaired, replaced and refinished, the following schedule is recommended for periodic inspection and performance of work as required.

A recommended paint schedule is submitted to protect the Queen Mary Hotel from further deterioration to its bilges, decks, waterlines and fender steel pilings.

Three (3) ranges of paint systems are submitted, namely Top-Range, Mid-Range and Economy System.

MAINTENANCE SCHEDULE

ITEM	SEMI-ANNUAL	ANNUALY	REMARKS/DATA
WATERLINE	X		
Propeller Box	X		
Anodes	X		
BREASTING DOLPHINS	X		
Camels	X		
EXT. PIPING CONNECTIONS	X		

QUEEN MARY BILGE & BALLAST MAINTENANCE PROCEDURES

The bilge and ballast pumps should be checked for proper operation and unobstructed flow. The checking procedure should include start-up, suction and pressure readings, lubrication, leakage, vibration and unusual noises which may indicate bearing wear.

The bilge drainwell at each suction point should be cleaned of trash and the suction strainers cleaned.

Valves on the system should be checked for proper operation such as verifying that valve is not "frozen".

Piping should be periodically checked for leaks, particularly at flanged connections which may admit air into the system and other systems leaking water to the bilges.

The diesel engine driven pumps should be checked the same as the electric driven pumps with additional checks made on the engine such as battery condition, fuel supply and fuel system kept drained of water (condensate).

Water in the equipment and sewage rooms should be monitored and if necessary pumped out to a dry condition. Float operated stripping pumps in the sewage rooms should be checked for proper on-off operation (float) in addition to the normal check of the unit.

The Schedule below indicates the recommended time span for these checks.

MAINTENANCE SCHEDULE

ITEM	WEEKLY	MONTHLY	REMARKS/DATA
PUMPS			
Start-Up	X		
Pressure (Suct)	X		
Pressure (Disch)	X		
Lube	X		
Leaks	X		
Noise	X		
VALVES		X	
PIPE		X	
STRAINERS		X	
DIESEL ENGINE			
Start-Up	X		
Fuel	X		
Condensate	X		
Batteries	X		
BILGE WELLS		X	

MAINTENANCE SCHEDULE

ITEM	SEMI-ANNUAL	ANNUALY	REMARKS/DATA
WATERLINE	X		
Propeller Box	X		
Anodes	X		
BREASTING DOLPHINS	X		
Camels	X		
EXT. PIPING CONNECTIONS	X		

PAINT SCHEDULE - QUEEN MARY

SPECIFICATIONS FOR THE QUEEN MARY BY RADOS INTERNATIONAL

Pro-Line Technical Rep Service is available at no additional charge

ITEM	LOCATION	SURFACE PREP	COATS	PRODUCT NUMBER/ DESCRIPTION	COLOR	WET MIL THICKNESS	DRY MIL THICKNESS	OVERCOAT TIME @ 70F
				TOP-RANGE SYSTEM				
1)	ALL BILGES UP TO CUT-OFF POINT ON BULKHEAD	SSPC SP-10 Near White Metal Blast	1st Full	221 Organic Zinc Primer	Green	5	3	12 Hrs Min
			2nd	5001-02 Hi-Build Epoxy	Egg Shell	10	6	12 Hrs Min 72 Hrs Max
			3rd	4501 Polyurethane Non-Yellowing	White	3 - 4	1.5 - 2.0	-----

NOTES: To insure that a more uniform mil thickness is achievedd that will be moisture free, all products should be applied by using an airless spraay gun.

ITEM	LOCATION	SURFACE PREP	COATS	PRODUCT NUMBER/ DESCRIPTION	COLOR	WET MIL THICKNESS	DRY MIL THICKNESS	OVERCOAT TIME @ 70F
				MID-RANGE SYSTEM				
2)	ALL BILGES UP TO CUT-OFF POINT ON BULKHEAD	SSPC 6 Commercial Blast	1st	5001-02 Hi-Build Epoxy	Egg Shell	10 - 12	6 - 7	12 Hrs Min 72 Hrs Max
			2nd	4501 Polyurethane Non-Yellowing	White	3 - 4	1.5 - 2.0	-----
				ECONOMY SYSTEM				
3)	ALL BILGES UP TO CUT-OFF POINT ON BULKHEAD	SSPC 6 Commercial Blast	1st	5001-02 Hi-Build Epoxy	Egg Shell	10 - 12	6 - 7	
4)	ENGINE ROOM BILGE	SSPC 6* Commercial Blast	1st Full	221 Organic Zinc Primer	Green	5	3	12 Hrs Min
			2nd	5001-04 Hi-Build Epoxy	Tile Red	10 - 12	6 - 7	------

* If unable to sandblast due to confined spaces, follow speci fication in 4A.

ITEM	LOCATION	SURFACE PREP	COATS	PRODUCT NUMBER/ DESCRIPTION	COLOR	WET MIL THICKNESS	DRY MIL THICKNESS	OVERCOAT TIME @ 70F
4A)	ENGINE ROOM BILGE	Mechanically clean to remove all dust and loose material	1st* Full	801 Rust Conversion Coating. Color is white while wet, dries black.	Black	5 - 6	2 - 3	12 Hrs Min
			2nd	5001-04 Hi-Build Epoxy	Tile Red	10 - 12	6 - 7	------

* For best results, brush out 801 Rust Conversion Coating.

PAINT SCHEDULE - QUEEN MARY

ITEM	LOCATION	SURFACE PREP	COATS	PRODUCT NUMBER/ DESCRIPTION	COLOR	WET MIL THICKNESS	DRY MIL THICKNESS	OVERCOAT TIME @ 70F
5)	A-DECK	SSPC SP-10 Near White Metal Blast	1st	221 Organic Zinc Primer	Green	5	3	12 Hrs Min
			2nd	5001-04 Hi-Build Epoxy	Tile Red	10 - 12	6 - 7	- - - - - -
6)	KEEL TO WATERLINE	SSPC SP-10 Near White Metal Blast	1st	5001-02 Hi-Build Epoxy	Egg Shell	10 - 12	6 - 7	4 Hrs Min
			2nd	5008-01 Hi-Build Epoxy	Blue	10 - 12	6 - 7	4 Hrs Min
			3rd	5001-02 Hi-Build Epoxy	Egg Shell	10 - 12	6 - 7	Tacky State Generally 4 - 6 Hrs.
			4th	1080 Special Vinyl Ablative Antifouling	Black	10 - 12	5 - 6	6 Hours
			5th	1080 Special Vinyl Ablative Antifouling	Red	10 - 12	5 - 6	Overnight To Launch
7)	STEEL PILINGS	Mechanically clean to remove all dust and loose material	1st*	801 Rust Conversion Coating Color is white while wet, dries black.	Black	5 - 6	2 - 3	12 Hrs Min
			2nd	5008-05 Hi-Build Epoxy	Black	10 - 12	6 - 7	12 hrs Min 72 Hrs Max
			3rd	4504 Polyurethane	Black	3 - 4	1.5 - 2	- - - - -

* For best results, brush out 801 Rust Conversion Coating.