City of Long Beach
Working Together to Serve

Memorandum

Date: November 4, 2019

To: Thomas B. Modica, City Manager

From: John Keisler, Director of Economic Development

For: Mayor and Members of the City Council

Subject: **Update on Queen Mary Lease Management - REVISED**

On October 1, 2019, the City of Long Beach (City) sent a letter to Urban Commons, LLC (Urban Commons), current operator of the Queen Mary (Attachment A), indicating it was falling short its obligations under the terms and provisions of Lease No. 34432: Amended and Restated Lease and Operations Agreement of Queen Mary, Adjacent Lands and Improvements, Dome and Queen's Marketplace (Lease No. 22697) (Lease). The purpose of this memorandum is to provide an update regarding this notification and the response from Urban Commons.

Background

Formal documentation of issues between landlord and tenant is a normal practice of good lease management. Although misrepresented by some external media publications, the City's request for information was not considered a notice of default. Rather, it was a request for written updates regarding the following issues identified in the City's monthly inspection reports:

- Condition of exterior paint on the hull, funnels, and top of house areas;
- Replacement of expansion joints;
- Bilge repair and rust remediation;
- Side shell repair and lifeboats removal; and,
- General maintenance (various issues).

In addition to the maintenance and capital replacement issues identified above, the City also requested updates regarding the following administrative items required by the Lease:

- Annual Audited Financials for 2018; and,
- Evidence of Base Maintenance and Replacement Plan (BMRP) Fund account deposits and balance.

The City requested Urban Commons to respond in writing within 30 days (no later than November 1, 2019), with plans to address specific deficiencies described above; and, that if Urban Commons failed to respond within the deadline, it may be found in default per Section 14 of the Lease.

Eagle Hospitality Suspension of Trading

Urban Commons formed Eagle Hospitality Trust (Eagle Hospitality) in May 2019 and offered shares to the public on the Singapore Stock Exchange with the goal of generating up to $566 million for its portfolio of 13 hotel properties it owns or manages, including the Queen Mary. On October 24, 2019, Urban Commons notified the City it would temporarily halt trading of Eagle Hospitality stock to address investor concerns about media reports related to the Lease and the condition of the Queen Mary. Specifically, media reports about the City's notification caused investor concerns that Urban Commons may be found in default. Although brief, the halt in trading had a significant impact on the value of Eagle Hospitality stock. At present, Urban Commons remains in good standing and has proven to be a good partner to the City and the community. The trading halt allowed time for this clarification to be made to the public.

Urban Commons Response

On October 22, 2019, prior to the City's requested response date of November 1, 2019, the City received a written summary of plans for addressing the identified engineering issues along with supplemental engineering reports (Attachment B). In their response, Urban Commons noted they have contracted for exterior paint repairs which have already begun. Completion of the final expansion joint work is expected to begin on November 15, 2019, and a supplemental maintenance plan has been developed to remove standing water, investigate and repair water intrusion sources, and reapply rust inhibitor where needed. These activities will be funded by Urban Commons and no additional HPCIP funds will be utilized.

To address the most critical issues identified by the City's monthly inspection reports, Urban Commons provided a construction bid of $4.8 million for side shell repair and life boat removal by a third-party contractor (Attachment C). As follow-up, City staff will work with an independent third-party marine engineering firm to independently confirm the condition of side shell, review the scope of work and timing proposed by the third-party contractor, and verify the $4.8 million cost estimate to conduct its work. The City is confident that Urban Commons now has a plan in place to resolve the remaining structural issues identified in the Marine Survey and will schedule a meeting with Urban Commons staff once its analysis is complete.

Additionally, as requested, Urban Commons delivered a both a draft copy of the audited consolidated financial statement for 2018 and a summary of the BMRP Fund account balance. Although the independent auditor notes concern about cash flow, liquidity, and overall debt load, the 2018 financial statement indicates a $24 million (or 67 percent) increase in revenue-generating activity within the Lease area from the year before Urban Commons assumed responsibility for the Lease. Reported revenue has increased from approximately $36 million in 2015 to over $60 million in 2019, reflecting substantial growth in activities and special events. Revenue-generating activities include attractions, special events, food, beverage, hotel rooms, and other rental payments to Urban Commons. City staff is currently engaging accounting expertise to assist with review of the draft audited financial statement and will meet with Urban Commons staff once its analysis is complete.

Peer Review

Preserving an historic asset like the Queen Mary requires an elevated level of due-diligence and technical expertise. Although the City currently employs an independent third-party engineer to conduct monthly inspections of the Ship, there are specific issues identified in the monthly inspection reports that require a deeper dive. To conduct this investigation, the City has executed a scope of work with an experienced local engineering firm with the capacity and expertise to conduct a peer review of critical issues identified in monthly inspection reports. It is anticipated that this peer review will be completed in November 2019.

Conclusion

The City values the continued progress Urban Commons has made to improve the structural integrity of the historic Queen Mary on behalf of Long Beach residents and visitors. As directed by the City Council, staff will continue to meet with Urban Commons monthly to inspect maintenance, review construction plans, identify funding sources, and provide approvals as needed. Additionally, staff will continue to meet with the City Auditor on a quarterly basis to provide status reports on key elements of the Lease.

For any questions regarding these matters, please contact Business Operations Manager Johnny M. Vallejo at (562) 570-6792 or by email at johnny.vallejo@longbeach.gov.

ATTACHMENT

cc: CHARLES PARKIN, CITY ATTORNEY
LAURA L. DOUD, CITY AUDITOR
REBECCA GARNER, ASSISTANT CITY MANAGER
KEVIN JACKSON, DEPUTY CITY MANAGER
TERESA CHANDLER. INTERIM DEPUTY CITY MANAGER
ANDREW VIALPANDO, ACTING ADMINISTRATIVE DEPUTY TO THE CITY MANAGER
DEPARTMENT HEADS
MONIQUE DE LA GARZA (REF. FILE. #18-0841)

Attachment A

CITY OF LONG BEACH

Economic Development Department
411 West Ocean Boulevard, 10th Floor Long Beach, CA 90802
(562) 570-6099

— Via USPS and Email —

October 1, 2019

Taylor Woods
Urban Commons Queensway, LLC
10250 Constellation Blvd., Suite 1750
Los Angeles, CA 90067

Re: Amended and Restated Lease and Operations Agreement of Queen Mary, Adjacent Lands and Improvements, Dome and Queen's Marketplace (Lease No. 22697)

Dear Mr. Woods,

The purpose of this letter is to inform you that Urban Commons, LLC, has failed to meet its obligations under the terms and provisions of Agreement No. 34432: Amended and Restated Lease and Operations Agreement of Queen Mary, Adjacent Lands and Improvements, Dome and Queen's Marketplace (Lease No. 22697) ("Lease"). Specifically, Urban Commons has not met its obligation related to Section 7.2 of the Lease to maintain the Premises, including improvements, in first class condition and repair.

The following deficiencies have been documented in Queen Mary Inspection Reports and discussed with City staff and should be immediately addressed to be considered in compliance with the Lease:

Exterior Paint on the Hull, Funnels, and Top of House Areas: As documented in Queen Mary Inspection Reports 384 through 389, among others, areas of the exterior hull port and starboard, the aft funnel, and top of house, including vents and scuppers, require painting.

Expansion Joints: As documented in Queen Mary Inspection Reports 388 and 389, among others, at least one of the expansion joints requires plate installation, fasteners, water testing, and repair of caulking.

Bilge Repair and Rust Remediation: Standing water and intrusion of rust, despite the application of a rust remediator, has been documented in Reports 384, 387, and 388, among others previous, and must be repaired.

Side shell and Lifeboats: Identified by the City's Landlord Representative as the most critical priority for the long-term viability of the ship, removal of deteriorating lifeboats and repair of the ship side shell must be prioritized. As referenced in Reports 383, 385, 387, and 388, the continued corrosion represents a serious threat to the ship's structural integrity and the safety of guests and employees.

General Maintenance: As documented in Queen Mary Inspection Reports during 2018 and 2019 provide evidence of insufficient resources being dedicated to ongoing upkeep of the ship, including maintenance of improvements completed or partially funded through the HPCIP Fund. As specifically documented in Queen Mary Inspection Reports 379, 384, and 388, the number of staff hours dedicated to the Base Maintenance Plan appear to be insufficient to maintain the Premises in first class condition and repair. Please provide a current Base Maintenance Plan as a reference for staffing requirements.

In addition, the following items are currently outstanding under the terms and provisions of the Lease:

Annual Audited Financials for 2018 — Section 4.3, Schedule 1
Evidence of Base Maintenance and Replacement Plan (BMRP) Fund account deposits and balance — Section 7.3.1

Although I understand that Urban Commons staff have been responsive in taking steps to obtain the above-referenced financials, you are hereby notified that these two outstanding items are due no later than October 30, 2019.

Please respond to this letter within 30 days and provide a plan to address the deficiencies described above. If you fail to respond within 30 days, Urban Commons may be found in default per Section 14.1.b of the Lease, with the right to cure pursuant to Section 14.2.

Thank you for your cooperation in this matter. Please do not hesitate to call me if you have any questions or need additional information or clarification.

Sincerely,

JOHN KEISLER
DIRECTOR OF ECONOMIC DEVELOPMENT
CITY OF LONG BEACH

JK:JMV:LCC

cc: Howard Wu, Urban Commons Queensway, LLC
Thomas B. Modica, Acting City Manager
Richard F. Anthony, Deputy City Attorney
Johnny M. Vallejo, Business Operations Manager

Attachment B

JOHN KEISLER
DIRECTOR OF ECONOMIC DEVELOPMENT
CITY OF LONG BEACH
Date: 10/22/2019

Mr. Keisler,

We are writing in response to the points highlighted in your letter dated October 1, 2019. This response is intended to address items per section 14. 1. B of the Lease, and to provide the City with additional clarity about Urban Commons' plans to address other repairs identified in the Queen Mary Marine Survey.

When Urban Commons took over the lease of the Queen Mary in 2016, Urban Commons recognized the important task ahead in preserving the Queen Mary and the opportunity to work with the City of Long Beach on such a high-profile project for the public and for the community. Based on the Marine Survey released in 2017, both Urban Commons as well as the City recognized the necessary and deferred items that needed either immediate attention or a long-term plan. We created and established a historic preservation plan that included a significant perpetual capitalization mechanism for maintaining the ship for decades to come. Additionally, through a $23M fund, we prioritized the list of repairs and immediately began work on what we agreed were the important items in stabilizing the ship and the safety issues that were prevailing based on that same report. Since our takeover, we have been able to ensure the safety and security for guests and we are continuing to be committed to doing so. With these capitalization and coordination mechanisms now in place, we will continue to improve the longevity and stability of the ship for many years to come. We think we can all agree that the ship is in the best shape it has been in for many years.

Many of the items set forth in the letter have either been done, are being done, or will be done according to this process. According to the Marine Survey, the ship has been deemed structurally safe. In every case, we will continue to work with the City and its independent engineer to track and address the most important items in the proper order of priority.

Urban Commons has worked closely with the City and established different options in using the Historic Preservation and Capital Investment Plan Fund (the "HPCIP Fund") for funding of necessary immediate repairs. Furthermore, once we have updated the Base Maintenance Plan, we will be even better positioned to address of future needs. With that said, below are specific responses to your concerns as they relate to the Queen Mary and its continued preservation.

1. **Exterior Paint**
Urban Commons has hired a supplemental painting company which specializes in inaccessible areas. The work to repair the peeling areas of the ship has started and work will move to the Starboard Hull once completed. We will then work on the rear funnel and the large vents as mentioned in the letter. The completion of this project is being funded solely by Urban Commons and no further HPCIP funds are being utilized.

2. **Expansion Joints**

There was a 30-foot ramp on the Sundeck covering one Expansion Joint that was removed. Urban Commons will execute a contract with United Metals with a deposit by October 31, 2019, to begin fabrication and installation. The final work on the other Expansion Joints is scheduled to begin November 15, 2019. The completion of this project is being funded solely by Urban Commons and no further HPCIP funds are being utilized.

3. **Standing Water and Rust**
   Urban Commons is putting together a Supplemental Maintenance Plan and will have it in place by November 15, 2019, to ensure that there is a process to monitor and manage this area even more closely. We currently have a Preventive Maintenance Plan in place with objectives that include the removal of existing standing water, conducting water intrusion investigations, repairing any water source points, reapplying rust inhibitor and conducting daily inspections of the area to avoid any future water intrusion incidents. The completion of this project is being funded solely by Urban Commons and no further HPCIP funds are being utilized.

4. **Side Shell and Lifeboats**
   The Side Shell and Lifeboat project has been given a high priority. Urban Commons will deliver a scope of work and related project proposal with estimated costs be provided to the City by November 30, 2019. Included in the scope will be a recommended prevention/replication plan for Lifeboats 2 and 4 and replication of remaining Lifeboats to replace existing failing boats on the ship. We will work with the city to explore using funds based on the ongoing income sources created at the onset of our lease.

5. **Base Maintenance Plan (BMP) Update**
   Urban Commons will work with the City's independent engineer to revise the Base Maintenance Plan (BMP) by January 1, 2020. The revised BMP will include the evaluation of staff hours assigned to maintenance duties and new maintenance categories. There are regular monthly meetings between Urban Commons and Evolution Hospitality managers to discuss and address priorities that include reviewing the City Monthly Inspection Reports, assigning repair duties to staff or outside vendors and approval of costs associated with the repair work. The primary objective is to ensure a response to these dynamic reports as soon as possible.

6. **Annual Audited Financials for 2018**
   Draft annual financials have been provided and final audited financials will be submitted by November 15, 2019.

7. **Evidence of Base Maintenance and Replacement Plan (BMRP) Fund**
   Evidence of account deposits will be submitted by October 31, 2019.

The estimated cost for all of the items stated above is approximately $5M - $7M based on the scope of the work provided. Although the organization has learned a great deal about the challenges associated with maintaining a historic asset such as the Queen Mary, Urban Commons remains dedicated to its partnership with the City of Long Beach and to the long-term preservation, maintenance, and development of the historic ship on behalf of the residents of and visitors to the city. We recognize that historic preservation will be costly and that it will require creative partnerships to develop the funding to make needed repairs. We also realize that ongoing inspection and public dialogue about the condition of the historic ship is important to the community and we are happy to maintain ongoing communication about this beloved community asset.

Our organizational goal from the outset has been, and continues to be, that we collectively establish an updated and workable plan to ensure the Queen Mary is preserved and remains a majestic symbol of the City of Long Beach for future generations, so residents and guests alike can enjoy its beauty and the unique leisure and entertainment experience. We look forward to continuing our joint efforts with the City to develop creative solutions that support this goal.

Taylor Woods

Urban Commons Queensway, LLC

JOHN KEISLER
DIRECTOR OF ECONOMIC DEVELOPMENT
CITY OF LONG BEACH
Date: 10/22/2019

Mr. Keisler,

Attached you will find an engineering report for the hull and the tank top that was done in February of 2018. This report continues to support the fact that the ship is structurally safe and in no danger of being unsalvageable. The cover letter also states that the testing was thorough and adequate for determining the reliability of the ship's hull and in line within industry standards. The structural integrity of the ship has been addressed by the JAMA report, and most of the work suggested in the report has been performed over the past several years.

You will also see a proposal for the scope of repairing the ship's side shell and removal of the lifeboats. This proposal does not include the replacement of any of the lifeboats in fiberglass or the refurbishing of lifeboats 2 & 4 which are the only remaining original lifeboats on the ship. At this moment we are having another recent proposal done which would include the restoration of the lifeboats and the new fiberglass lifeboats to replace the ones taken down.

Taylor Woods

Urban Commons Queensway, LLC

F Roberts Construction
19300 Hamilton Ave Suite#100
Gardena, CA 90248
949.686.6711 (o) 949.544.0437 (f)
Lic# 998591 Dosh# 1165

PROPOSAL

Attachment C

CONTRACT IF EXECUTED

CLIENT:	URBAN COMMONS	**PROJECT:**	QM - SIDE SHELL REHAB
	777 FIGUEROA SUITE 2870	**ADDRESS**	1126 QUEENS HWY
	LOS ANGELES, CA 90017	**CITY**	LONG BEACH, CA
TELEPHONE:	(213) 260-9111	**EMAIL:**	james@urban-commons.com
FAX:	(213) 260-9116	**ATTENTION:**	JAMES JONES

We will provide materials, labor & equipment to complete the following scope of work for the sum of: **$ See Below**

Payment due within thirty (30) days upon substantial completion of the work. Payment for work completed the preceding month shall be received by the tenth (10th) of the following month and payment in full shall be made within thirty (30) days of completion. A charge of 1½% per month (18% per year) will be charged on past due accounts. Payment in full shall be made if a break of continuity of work exceeds thirty-five (35) days. If legal action should be necessary to collect unpaid amounts, the prevailing party shall be entitled to attorney's fees, interest and all costs

ROM BUDGET SCOPE: **$ 4,798,000.00**

SIDE SHELL REPLACEMENT

PLANS:
SIDE SHELL S SHEET PLANS DATED 4/14/2017
SHEETS S.0-S4.0

IT IS THE INTENT OF THIS SCOPE TO ALIGN WITH THE OWNER PROVIDED PLANS FOR THE SIDE SHELL REPAIR, BRIDGE WING REPAIR AND LIFE BOAT REMOVAL & SALVAGE.

THE BRONE WINDOW SASHES ARE TO BE MAINTIANED AND WILL ATTEMPT TO BE KEPT IN PLACE.
THIS SCOPE DOES NOT INCLUDE ANY LIFE BOAT OR COMPONENT REPLACEMENT

GENERAL: **$ 550,000.00**
GENERAL OVERHEAD & ADMINISTRATION
INSURANCE
PROVIDE PROJECT MANAGEMENT
PROVIDE FULL TIME SITE SUPERINTENDENT
PROVIDE WEEKLY REPORTING

PROTECTIONS: **$ 200,000.00**
PROVIDE WIND SCREEN TO DETER EXTERIOR VISABILITY OF REPAIR SECTIONS
PROVIDE SAFETY BARRICADES AND PROTECTIONS AS NEEDED

CRANE: **$ 325,000.00**
CONTRACTOR TO PROVIDE CRANE AND RIGGING FOR THE REMOVAL OF (22) LIFE BOATS IN COORDINATION WITH ABATEMENT CONTRATOR
BOATS WILL BE LIFTED WITH SLINGS AND SPREADER BARS AND NOT BY THE FISH HOOKS

ABATEMENT: **$ 200,000.00**
SHRINK WRAP (22) LIFE BOATS FOR UNLOADING
REMOVE LOOSE & FLAKEY LEAD PAINT DURING UNLOADING
VISUALLY INSPECT SWING AREA FOR LOOSE LEAD PAINT
REMOVE LEAD BASED PAINT IN AREAS NEEDED TO BE CUT & REMOVED

DEMOLITION: **$ 100,000.00**
DEMO & REMOVE LIFE BOATS AFTER ABATEMENT
REMOVE INTERIOR FINISHES OBSTRUCTING EXTERIOR WALL - EXCLUDING ALL MEPs
CUT & REMOVE STEEL SECTIONS FOR NEW STEEL INSTALL

PROVIDE 3RD PARTY VISUAL INSPECTION OF LIFE BOAT REMOVALS, SWING AREA AND DEMOLITION SITE FOR VISUAL CLEARANCE OF LEAD DEBRIS

SCAFFOLDING & SHORING:	**$**	**400,000.00**
ERECTION OF UNDERHANGING SCAFFOLDING TO OBTAIN ACCESS TO THE BRIDGE WINGS		
ERECTION OF CANTILEVERED SCAFFOLDING FOR ACCESS TO THE EXTERIOR SIDE SHELL STEEL REPLACEMENT		
TO BE CARRIED OUT IN 60' SECTION		
SUPPORT THE SUN DECK VIA SUPPORT JACKS WHILE ROKING IN EACH 60' LOCATION		
PLUMBING:	**$**	**175,000.00**
DRAIN LINES AT EACH SCUPPER TO BE REMOVED AND REATTACHED		
COLLAR RING TO BE FIT AND WELDED IN PLACE - SEE DETAIL 8		
SCUPPERS TO BE BLANKED OFF		
BELL MOUTH REDUCERS TO BE DESCALED AND REPAINTED		
STEEL REPAIR:	**$**	**2,225,000.00**
(N) STEEL REPLACEMENT SECTIONS OF THE EXISTING DAVITS WILL BE DONE WITH GRADE A36 STEEL		
REPLACEMENT OF FACIA DOUBLER PLATE ON THE (48) DAVIT ARMS		
REMOVAL OF DELAMINATING & DETERIORATING UPPER FACIA PLATES		
PELICAN HOOKS AND EYE BOLTS TO BE SALVAGED FOR REUSE BY FUTURE LIFE BOAT REPLICAS		
HOOKS & EYE BOLTS TO BE PAINTED PER THE SHIPS PAINT SCHEME		
BRIDGE WING OUTER SIDING TO BE REPAIRED		
EXPOSED STEEL WILL MIMIC HISTORICAL APPEARANCE WHERE NEEDED		
THE INTENT IS TO HAVE THE SAME LOOK AS THE EXISTING SHIP		
REPLICATION SAMPLE BOARD TO BE APPROVED PRIOR TO THE INSTALLATION OF REPLACEMENT SECTION		
(N) STEEL SIDE SHELL WILL BE 3/8" THICK AND WILL BE "LAPPED" AT THE SAME LOCATIONS		
INTERNAL FRAMING IS TO BE CUT AND REPLACED 30" ON THE SIDE SHELL PANELING		
(N) 5"X3"X1/2" IRON TO BE LAPPED 6" TO THE STIFFNER		
(48) DAVIT ARMS ARE TO BE CROPPED 24" TO REMOVE WASTED SECTION AND REPLACED		
WOOD REPAIR:	**$**	**225,000.00**
WOOD PANELING TO BE REMOVED & REPLACED ON THE PROM DECK LEVEL WHERE IN CONFLICT WITH THE SIDE SHEEL STEEL REPLACEMENT		
IT IS THE INTENT TO RESTORE THE SHIP TO HISTORICAL "LIKE" CONDITION		
PANELING TO BE REPAIRED AND REPAINTED		
DRYWALL REPAIR	**$**	**48,000.00**
REPLACE DRYWALL IN THE STARBOARD RESTRAUNTS		
DOES NOT INCLUDE FINISHES BEYOND PAINT		
PAINT:	**$**	**350,000.00**
THE EXTERIOR SIDE SHELL 30" SECTION REPLACED WILL BE PAINTED AND FEATHERED IN TO THE RECENT RENOVATED PAINT		
DOES NOT INCLUDE SAND BLASTING		
INTERIOR WOOD SECTIONS TO BE REPAINTED IN ACCORDANCE WITH SHIP HISTORIAN		
DAVIT ARMS TO BE REPAINTED - NO SAND BLASTING		
ALL PAINT WILL BE PAINT OVER PAINT CONDITION AND CAN BE SAND BLASTED AT AN ADDITIONAL CHARGE		

CONDITIONS & EXCLUSIONS

All items to be protected/ salvaged done prior to start by others - salvage material not excluded has been incorporated into this proposal and rights of sale belong to F Roberts Construction
All utility & fire sprinkler capping/ demo/ disconnections/ marking/ protection/ relocating/ safe off done by others
Barricades/ fencing by others prior to start
Excludes removal of all hazardous material/ liquids not identified & quantified in the provided survey
Excludes all asphalt, soil and land repair due to crane weight and ground force pressure
Excludes all items hidden/concealed
Excludes all floor grinding / prep/ bonded concrete removal & bead blasting
Excludes all GC imposed billing fees for programs such as Textura (or similar) - fees by others
Finish removals are based on single layers
Inert materials that have been comingled with non inert materials such as CMU block filled with foam, petromat vapor barriers will be considered "unforeseen" if they cause the disposal to change or cause additional time to separate
Layout by others
Non-prevailing wage rates applied

Permits by others
Price subject to change if the county landfill disposal rates increase
Schedule must be mutually agreed upon. Changes will be viewed as a change of condition and could result in a cost impact
Shoring & bracing by others
Site water/ power supplied by others – application by F Roberts Construction
Traffic control, plans, barricades by others
Work stoppage by others billed at hourly rate
Work not noted for removal on demolition sheets is excluded unless specifically noted above

CONDITIONS/EXCLUSIONS: All additional mobilizations will be billed at a minumum of $50,000.00. F Roberts Construction dumpsters and trucks are to be loaded by F Roberts Construction employees only, loading by others will result in additional charges. Excludes excavation, backfill, grading, weather protection, erosion control or compaction; shoring or bracing; fencing; barricades, protective covers or canopies; underpinning or false work removal; protection of finished surfaces; floor preparation, grinding or mastic removal; bushing / roughening of surfaces; removal of hazardous waste (unless called out in scope above). Demolition, removals, concrete cutting or drilling for other trades. Excludes all tree relocation and root removal; landscaping protection; noise protection; rerouting of irrigation/ utility/ electrical lines. Work outside of scope above not included. All Conditions/ Exclusions apply unless otherwise indicated above. Excludes all acts of God. No retention for values under $10,000. Where retention is witheld it will due within sixty (60) days of completion of F Roberts Construction scope of work. F Roberts Construction shall retain ALL salvage rights for materials it removes - including all items present at the time of bid. F Roberts Construction proposal and scope of work shall be incorporated into any subcontract. F Roberts Construction shall not be obligated to complete T&M or force account work. Payments due within forty-five (45) days of F Roberts Construction invoice. Additional charges shall apply for added phasing, mobilizations, acceleration, etc. F Roberts Construction reserves the right to refuse to execute a subcontract. The schedule must be mutually agreed upon prior to construction. OUR CONDITIONS/EXCLUSIONS SHALL BECOME A PART OF THE SUBJECT CONTRACT AGREEMENT SHOULD WE BE THE SUCCESSFUL BIDDER ON THIS PROJECT.

SUBMITTED BY:		**APPROVED BY:**	
JOSH STOFLE			
Vice President		**SIGNATURE:**	______________
F Roberts Construction		**PRINT NAME:**	______________
714.931.1398 (CELL)			
DATE OF SUBMITTAL:	4/12/2019	**DATE OF ACCEPTANCE**	______________

1955 Nettlebrook Street
Westlake Village
California 91361
19th January 2018

Ben Rogowski
John A Martin & Associates
950 south Grand Avenue,
Suite 400
Los Angeles
CA 90015

I have considered the report entitled "Critical Structural Repairs – Structural Analysis : Stress Results – Queen Mary Long Beach" prepared by John A. Martin & Associates, Inc. (JAMA Project No. 17057) located at the above address.

The approach of using Finite Element modelling is very applicable to this type of analysis. The method of approximating the buoyancy forces along the length of the vessel by using forces referred to in the FEA model as "Springs" to create the known deflection of the vessel that exists at present, is a reasonable approach to the modelling of these buoyancy forces and thus the stresses that will be present in the hull.

The model created for this analysis is thorough and adequate for determining reliable estimates of the stresses of the hull of this vessel. The Waterline Survey and Draft Calculations are sound approaches and the Material Testing is in line with current industry standards and practices.

The conclusions that the calculated stresses are reasonably below the yield stresses of the material present can be considered accurate with a high degree of confidence, particularly with regard to the conservative approach of this analysis.

The calculations and subsequent recommendation to allow flooding through the bulkhead at frame 112 in the event of flooding aft of frame 112, produces a condition that is more favourable than if the bulkhead was to be intact, for this vessel in its current stationary location. This condition of "Cross-flooding" is an established aspect of ship design to reduce stresses and minimize the list and trim of a vessel during flooding.

The recommended repairs to areas of the Tank Top by the addition, by welding, of plate material in way of the areas of the Tank Top where material thickness has been reduced by corrosion, is an established method of ship repair. The plate dimensions, thickness and welding arrangements for these repairs are adequate for the continued operation of this vessel in its current stationary location.

R. Maddison CEng. MPhil
Naval Architect

CRITICAL STRUCTURAL REPAIRS STRUCTURAL ANALYSIS: STRESS RESULTS & TANK TOP REPAIR

QUEEN MARY
LONG BEACH, CALIFORNIA

prepared for
Urban Commons
777 South Figueroa Street, Suite 2850
Los Angeles, California 90017

prepared by
John A. Martin & Associates, Inc.
950 South Grand Avenue, Suite 400
Los Angeles, California 90015

JAMA Project No.17057

February 8, 2018

Table of Contents

1. General Project Information

1.1 Objective

John A. Martin & Associates, Inc. (JAMA) has been retained to evaluate the Queen Mary as it relates to the critical structural repairs outlined in the report by Simpson Gumpertz & Heger, Inc. (SGH), dated 01/25/17. As such, this document outlines the assumptions, methodology, criteria for loading, and establishes support conditions used to create a finite element analysis (FEA) model. The FEA model is used as a tool to evaluate the structural behavior of the ship and to ultimately report structural demands used to check stresses and determine if repairs are required. This document is limited to the criteria and approach to establish the FEA modeling that will be used to further evaluate and repair various elements of the ship. A subsequent report will address the SGH critical structural repairs and will further document our analytical findings and recommendations for any items requiring repair.

1.2 Introduction & General Ship Description

The R.M.S. Queen Mary was built in the 1930's as a commercial vessel. It has been permanently docked at the Port of Long Beach, California since 1967, and is classified as a permanent floating structure. The Queen Mary was designed and constructed by the John Brown & Company Shipyard in Clydebank, Scotland in the 1930's. See Table 1 for the overall dimensions and significant attributes of the ship.

Length overall	1,019'-6"
Length between perpendiculars	965'
Breadth moulded (beam)	118'
Height	115'-6"
Keel to promenade deck	92'-6"
Keel to top superstructure	124'
Keel to top forward funnel	181'
Keel to masthead top	237'
Draft	39'-4-9/16"
Gross tonnage	81,237
No of decks	12
Passenger capacity	1,957 persons
No. of cabins (949)	321 1st class cabins
	347 cabin class cabins
	281 tourists class cabins
Officers and crew	1,174
Rudder weight	140 tons
Anchors (3)	16 tons each with 9,901 chains for each
Lifeboat (24)	With high speed diesel engines

Table 1. Significant Attributes of the R.M.S. Queen Mary

The Queen Mary was designed with twelve decks. The "A" deck is the uppermost deck that is continuous over the entire length of the ship. The "A" deck is also known as the "strength" deck and is generally made up of thicker steel plate material than the rest of the decks. The decks are constructed using steel plates that span to steel beams and girders. The girders span to steel pillars and in some cases, the beams span to the hull of the ship. The steel pillars are supported at the bottom by the hull. The ship was constructed with a double hull using an outer and inner hull. The outer and inner hulls are separated by vertical steel plates roughly six feet tall. The vertical steel plates that run transverse to the ship, known as the transverse frames, are spaced at 36 inches on center in the middle of the ship and 24 inches on center at the ends of the ship. There are more than 300 transverse frames along the length of the ship. The frame numbering starts at 0 at the stern of the ship and goes up as you move towards the bow of the ship. The transverse frame numbers are commonly used to identify a location in the ship. The vertical steel plates that run in the longitudinal direction of the ship are known as the longitudinal girders. There is a centerline longitudinal girder that runs the entire length of the ship and there are seven additional girders on each side of this centerline girder. The longitudinal girders are spaced roughly 7 feet apart from one another. The inner and outer hulls are connected to both the longitudinal girders and transverse frames with double angles that are riveted together. Some of the transverse frames and longitudinal girders have lightening holes, as well as to create larger tanks for fuel and water storage.

In the late 1960's, the Queen Mary was placed in the Long Beach Naval Shipyard drydock. During this time, extensive changes were made to convert the ship from a seaworthy vessel to a stationary floating structure. A joint venture of Naval Architects and Engineers, Rados-Harco-Foster, were responsible for developing the conversion drawings. The renovation included the removal of equipment from the machine areas, including the five boiler rooms, two turbo-generating rooms, water softening plant and forward engine room. To remove this equipment, most of the watertight bulkheads were also removed or heavily modified. Watertight bulkheads not only resisted water pressure during the event of a leak, but also supported floor loads from the decks above the "R" deck. Therefore, the conversion drawings show the installation of new steel girders and pillars below the "R" to support the decks and pillars above. When the conversion process was complete, the Queen Mary was permanently moored in still water by a rock dike (minimum wave action) at the Port of Long Beach.

In the early 1990's, the City of Long Beach contracted the Rados International Corporation (RIC) to inspect and analyze the condition of the Queen Mary. The results of their findings were summarized in several reports. The most recent report was issued by RIC on 11/06/92. According to the report, they had current drafts surveyed at the aft, amidships, and forward, as well as a sounding of the fuel and ballast tanks. This information was used to determine the total displacement (weight) of the ship.

1.3 Reference Documents

There were many drawings produced over the years to document the original design of the ship, as well as the conversion of the ship. Unfortunately, the record drawings were never organized properly, and were stored in several locations throughout the ship. JAMA sorted through and scanned many of the drawings. There are two main sets of drawings we referenced to create our FEA model. One set includes the original drawings produced by John Brown & Company in the 1930's, and the other includes the conversion drawings produced by Rados-Harco-Forster in the

1960's. Most of the original drawings are titled "No 534", which was the original hull number of the ship, and some are stamped with a John Brown & Co. stamp. The conversion drawings are easily identified because they all have a title block with a title, date, and Professional Engineer's stamp.

1.4 Deck Naming Convention

During the conversion process in the 1960's, the deck names were changed. In the 1960's drawings, the "C" deck was renamed to be the "R" deck, and all the decks below the "R" deck were renamed as well. This is a common point of confusion, so to avoid this, the deck naming convention used in this report will always follow the 1960's drawings. This is the naming convention that is currently used on the ship. Table 2 below summaries the original naming convention, as well as the current naming convention.

Original Deck Name in 1930s	Current Deck Name	Height Above Base	Deck Heights at Amidships
Sports	Sports	115'-6"	-
Sun	Sun	102'-6"	9'-0"
Promenade	Promenade	92'-6"	14'-0"
Main	Main	83'-3"	9'-3"
A	A	74'-6"	8'-9"
B	B	65'-9"	8'-9"
C	R	55'-3"	10'-6"
D	C	46'-6"	8'-9"
E	D	38'-0"	8'-6"
F	E	30'-0"	8'-0"
G	F	22'-0"	8'-0"
H	G	14'-9"	7'-3"

Table 2. Floor Deck Naming Convention

2. Finite Element Analysis Model Elements

2.1 Overview

JAMA has prepared an FEA model of the Queen Mary using SAP2000. The geometry for the model was referenced from existing drawings found aboard the ship as previously mentioned. The FEA model contains over 100,000 shell elements, 5,000 frame elements, and 50,000 joints. The decks, interior hull, exterior hull, transverse frames, transverse frames and longitudinal girders are all modeled using shell elements. The beams, girders and pillars are modeled using area elements.

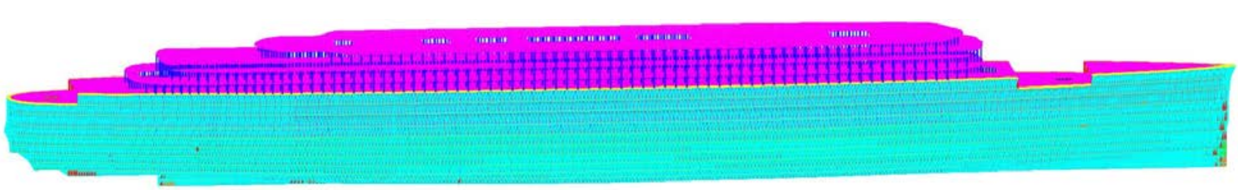


Figure 1. Overall 3D View of Queen Mary SAP2000 FEA model

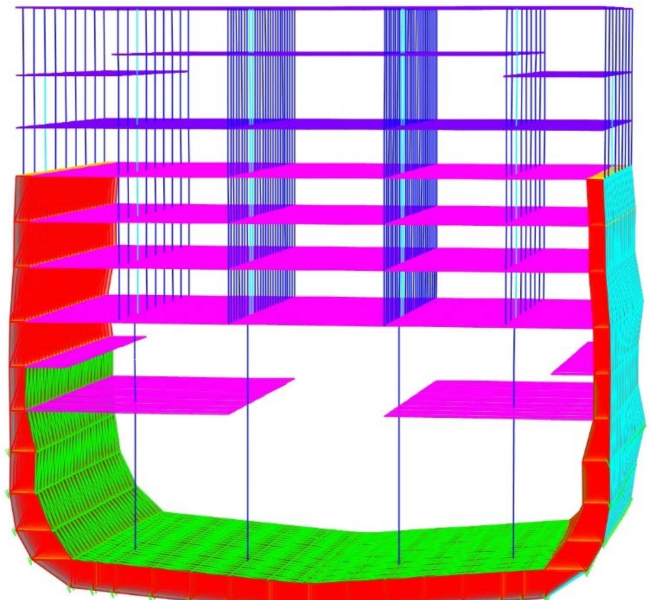


Figure 2. 3D Section of Queen Mary SAP2000 FEA model

2.2 Material Properties

All shell and frame sections in our FEA model use the same material property assignment of A36 steel. This material has a modulus of elasticity (E) of 29,000 kips per square inch (ksi) and a yield stress (Fy) of 36,000 ksi. This information was not directly stated in any of the as-built drawings we found. However, the 1992 Rados report indicates "the hull structural elements (plates, shapes, rivets) were constructed using mild steel No. 28-32. This material is roughly equivalent A-36 structural steel with yield strength of 33 ksi (kips per square inch)." As of September 2017, testing is being performed to assess the current yield strength of the Queen Mary's steel plates. Results of that testing program will be given in a subsequent report.

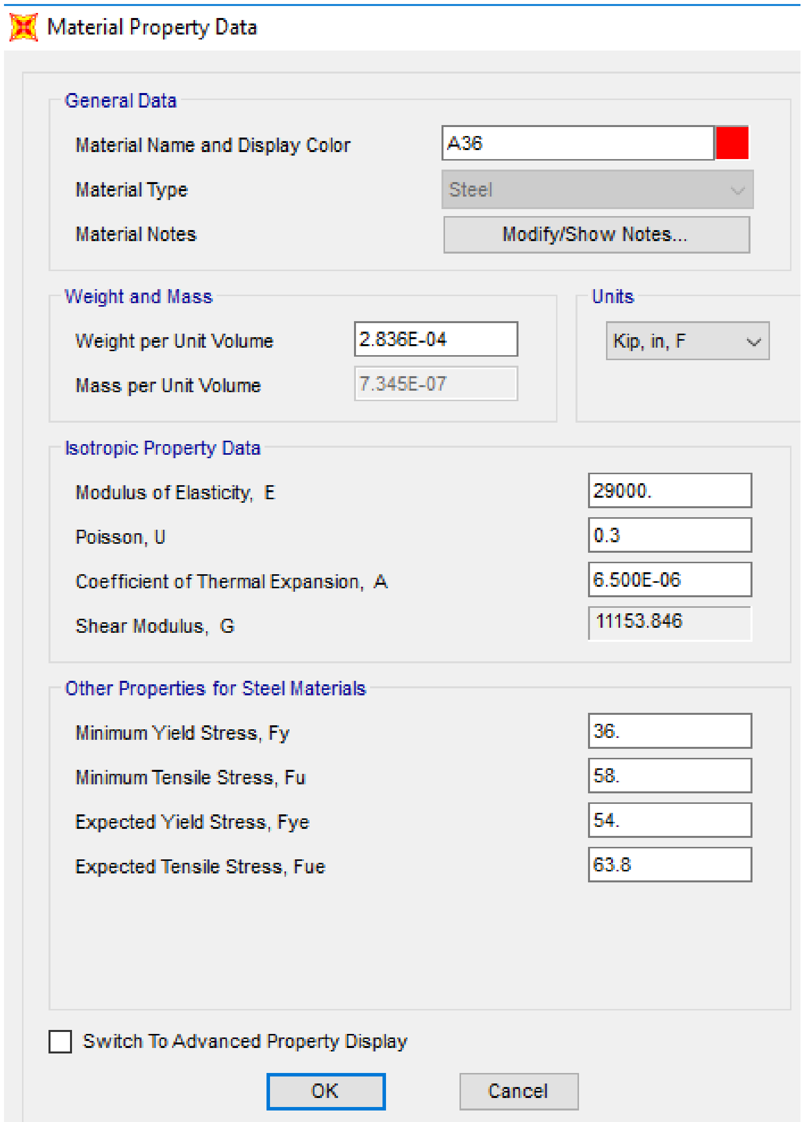


Figure 3. Material property input in SAP2000

2.3 Decks

2.3.1 Deck Plate Thickness

The deck plate thicknesses vary widely throughout the ship. We found several 1930's drawings that denote plate thicknesses. According to these drawings, the plate thickness on each deck are varied throughout. There are localized spots with thicker plates. See Figure 4 below. The blue locations around the amidships call out 0.48-inch-thick plates, the green locations around the bow are 0.56-inch-thick plates, and the red locations around the openings are 0.60-inch-thick plates. Our model conservatively uses the thinnest most common plate thickness identified in the 1930's drawings for the entire deck plate. Below are screenshots from the model showing the floor plate thickness used, as well as the overall geometry.

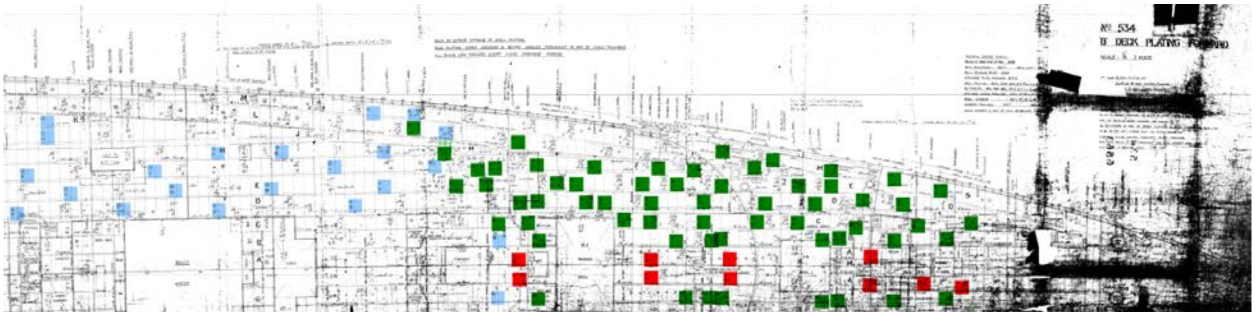
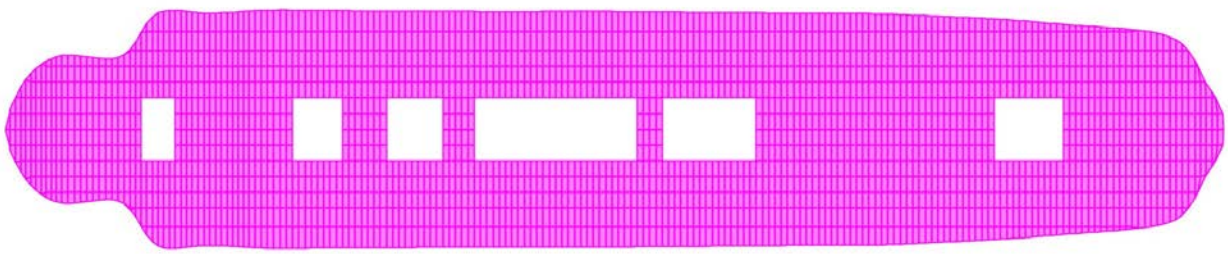
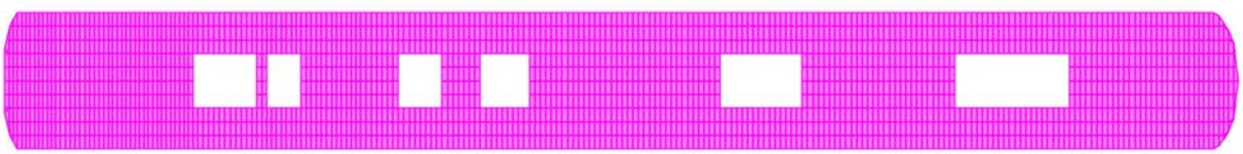


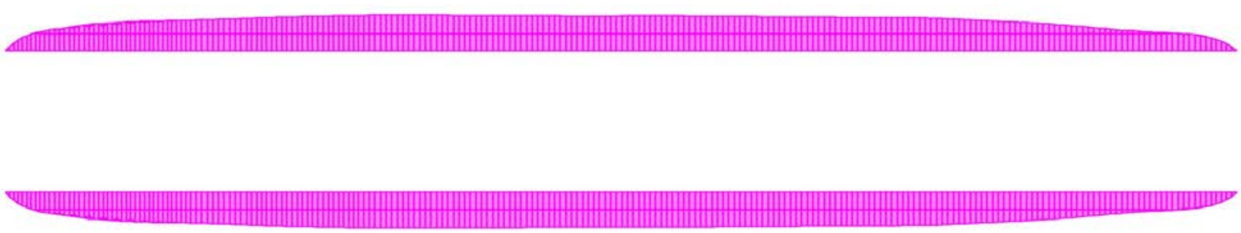
Figure 4. Example of varying deck plate thickness on drawing "No 534 B DECK PLATING FORWARD"



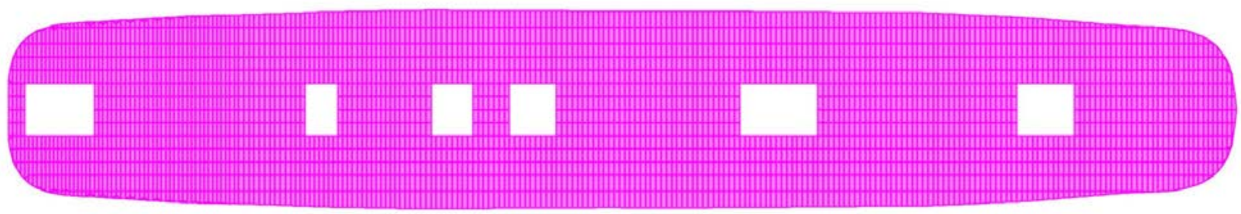
Sports Deck (elevation 115'-6", plating 0.38")



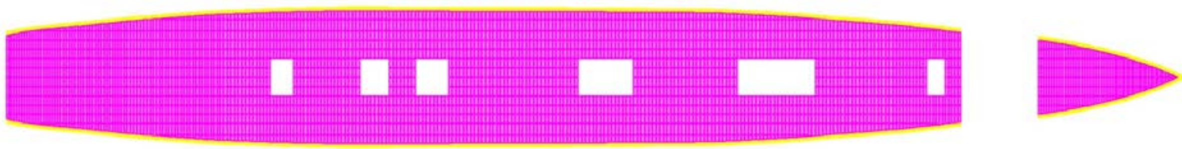
Upper Sun Deck (elevation 106'-5", plating 0.38")



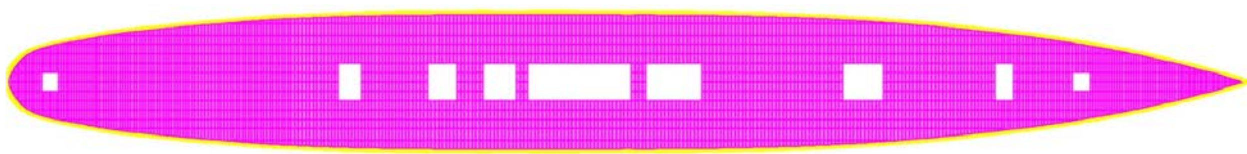
Lower Sun Deck (elevation 102'-6", plating 0.38")



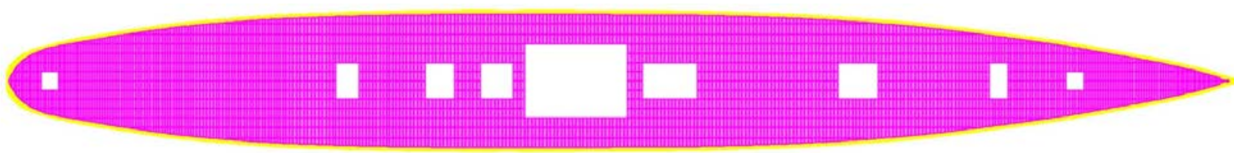
Promenade Deck (elevation 92’-6”, plating 0.67”)



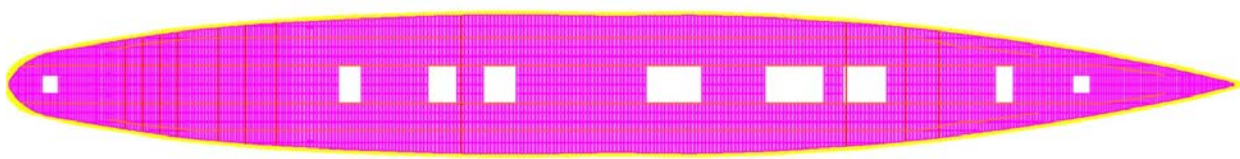
Main Deck (elevation 83’-3”, plating 0.67”)



A Deck (elevation 74’-6”, plating 0.67”)

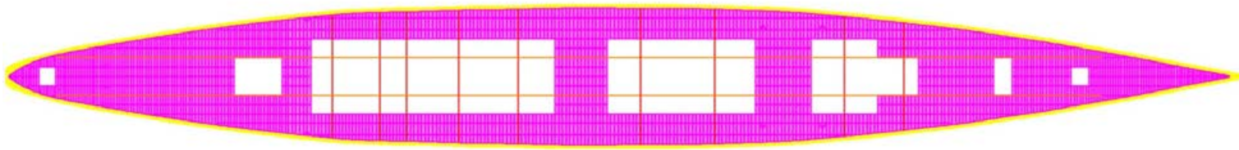


B Deck (elevation 65’-9”, plating 0.44”)



R Deck (elevation 55’-3”, plating 0.38”)

C Deck (elevation 46’-6”, plating 0.38”)



D Deck (elevation 38'-0", plating 0.38")

E Deck (elevation 30'-0", plating 0.38")

F Deck (elevation 22'-0", plating 0.38")

G Deck (elevation 14'-9", plating 0.38")

Figure 5. Floor Deck Plan Views

2.3.2 Deck Cutouts

The original Queen Mary had many large deck openings cut for engine hatches, funnel hatches, trunk hatches, etc. We reviewed the 1930's drawings to locate these openings in our FEA model. When the Queen Mary was converted into a hotel, additional large deck openings were cut out of the R, C, and D decks. We reviewed the 1960's drawings to locate these openings in our FEA model. Currently we have not identified smaller openings for mechanical shafts, elevator shafts, etc. These small openings are considered insignificant as it relates to overall analysis.

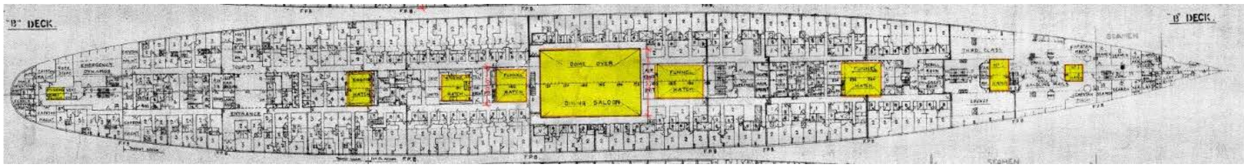


Figure 6. Example of Large Hatch Openings on "B" Deck from Original Drawings (yellow highlighting deck cutout)

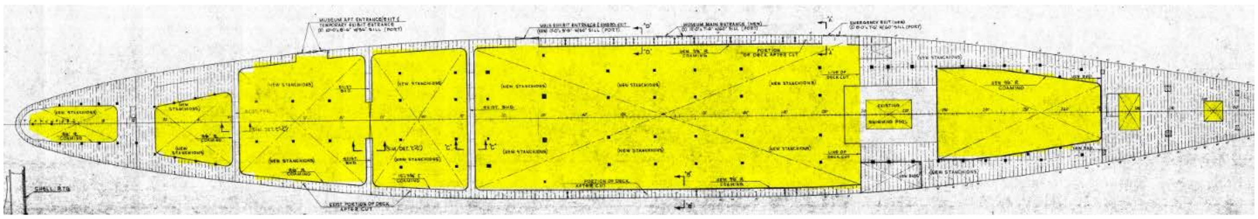


Figure 7. Example of "C" Deck Removed During the Conversion from Conversion Drawings (yellow highlighting deck cutout)

2.3.3 Deck Shell Properties

The decks were modeled in SAP2000 using thin-shell elements. These elements capture in-plane bending, out-of-plane (O-O-P) bending, and in-plane shear deformations and stresses. As previously mentioned, the typical decks are supported with steel beams and girders. We simplified the modeling effort by excluding most of the typical deck beams. As an alternate, we modified the O-O-P stiffness properties for all the deck elements to limit the excessive O-O-P floor deflections to more accurately distribute load to the pillars.

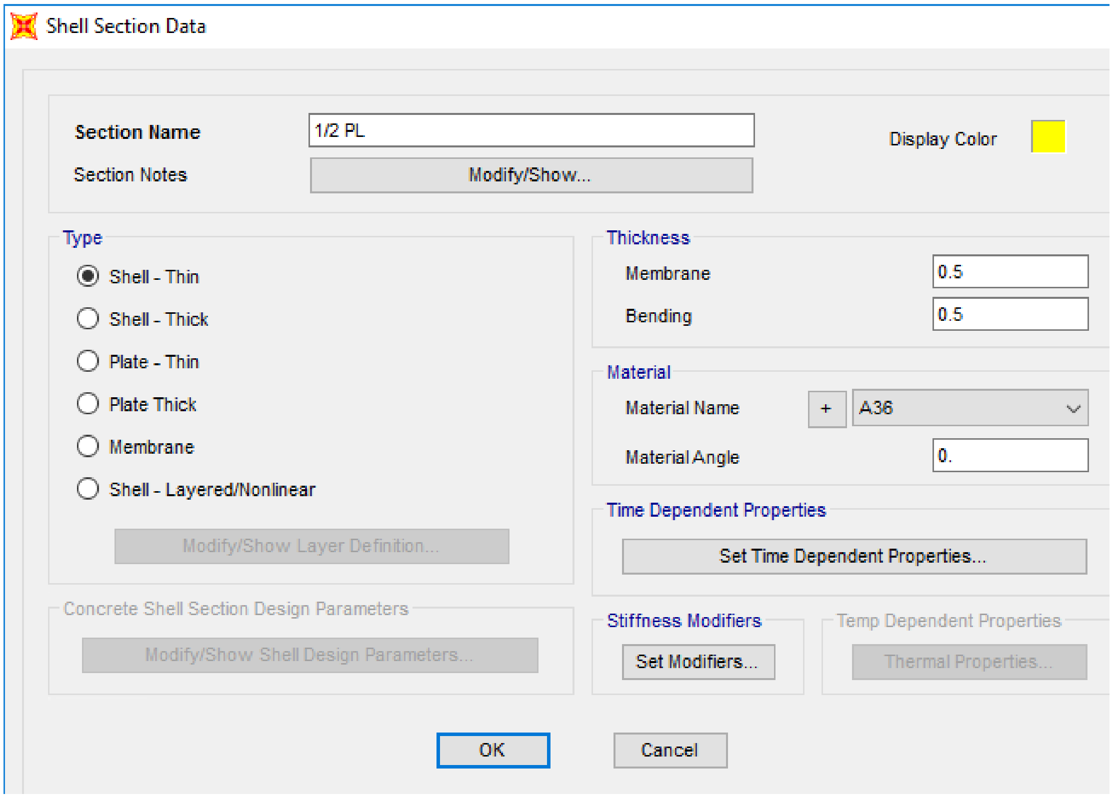


Figure 8. Example of SAP2000 shell element properties

We choose to use an O-O-P modification factor of M22=5,500. With this modification factor applied, the shell deflection decreased to roughly ½ inch at the upper decks where the pillars are spaced every 9 feet on center, and 2 inches at the floors below the "R" deck where pillar spacing is less frequent.

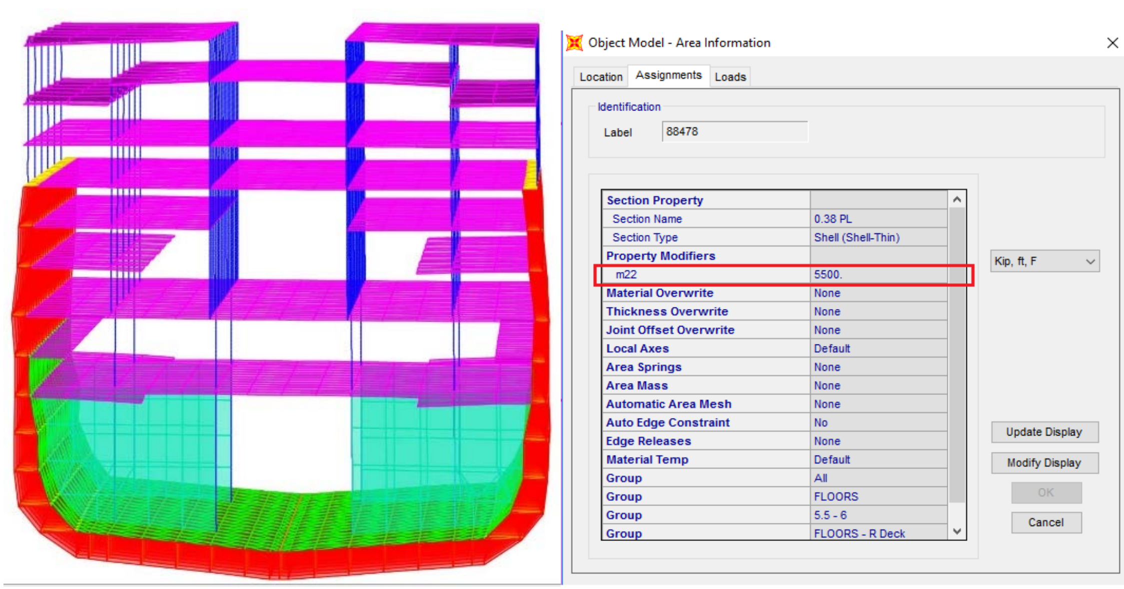


Figure 9. Deck elements with O-O-P modication factor applied (5 scale factor)

2.4 Pillars and Beams

In the FEA model, the deck elements distribute the ships weight to beams, girders and pillars, and ultimately the tank top. We modeled the pillars, beams and girders as frame elements in SAP2000. Beams, girders and pillars are meshed with all deck elements. Moments are released at the ends of all beams and girders, and at the bases of all pillars. We used sizes shown in the as-built drawings when available. In some cases, the conversion drawings call out an existing pillar or girder, but do not indicate the size, and the original as-built drawing that identified the size could not be located. When this occurred, we assumed a beam size with similar properties as a girder with similar span and loading conditions. This is not a concern because the goal of this analysis is to determine the adequacy of the tank top elements (hull and frame elements). The individual framing members that load the tank top are outside of the scope of this analysis.

Per the original drawings, there are four main pillars lines that run the length of the ship in the longitudinal direction. The pillars above the "R" deck are spaced every 3rd frame (9 feet on center typically). When the ship was converted in the 1960's, the bulkheads were removed and large double W36x girders were added below the "R" deck along these 4 lines. The girders are supported by new and existing pillars, and the pillars are sitting on the tank top. Based on the current conditions, it appears that the pillars are spanning between multiple transverse frames. However, we currently have the pillar frame elements modeled to sit on a single transverse frame. We may need to revisit this assumption when we start looking at stresses in the frames.

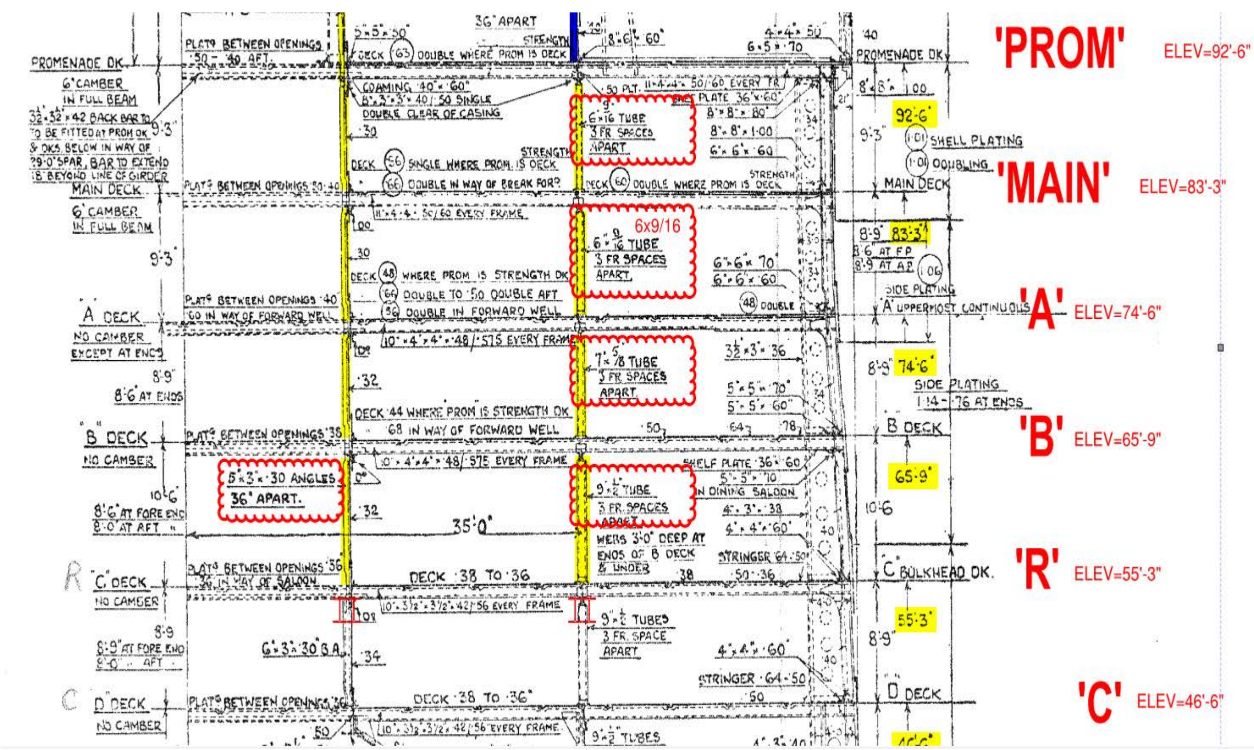


Figure 10. Midship section – Frame 174 (1942): column sizing and layout

Figure 11. Photo of pillar supported on tank top

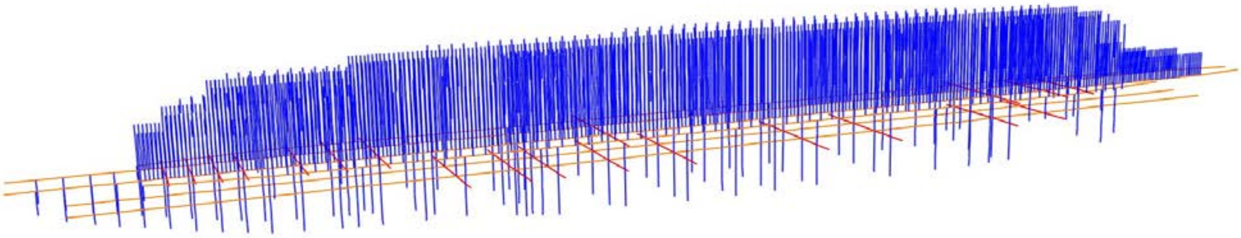


Figure 12. 3D view of beam and pillar frame elements (all shell elements hidden)

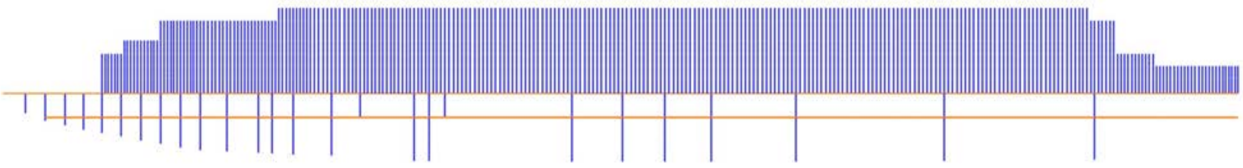


Figure 13. Longitudinal elevation view 15 feet off center-line

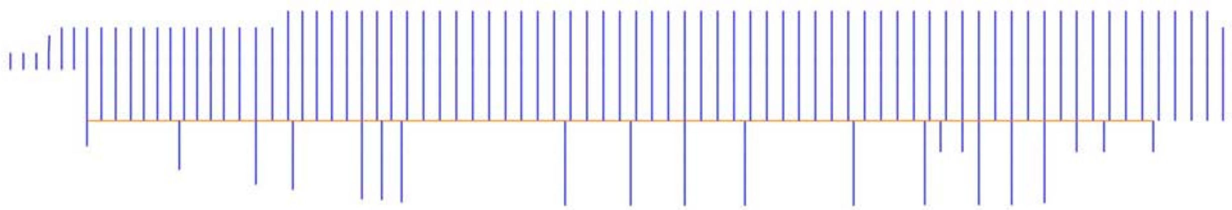


Figure 14. Longitudinal elevation view 37.5 feet off center-line

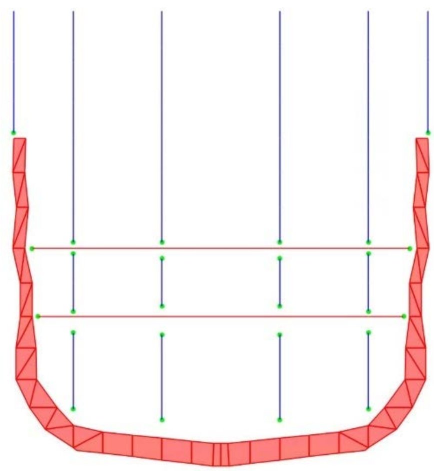


Figure 15. Typical transverse elevation view showing pillar connected to single transverse frame

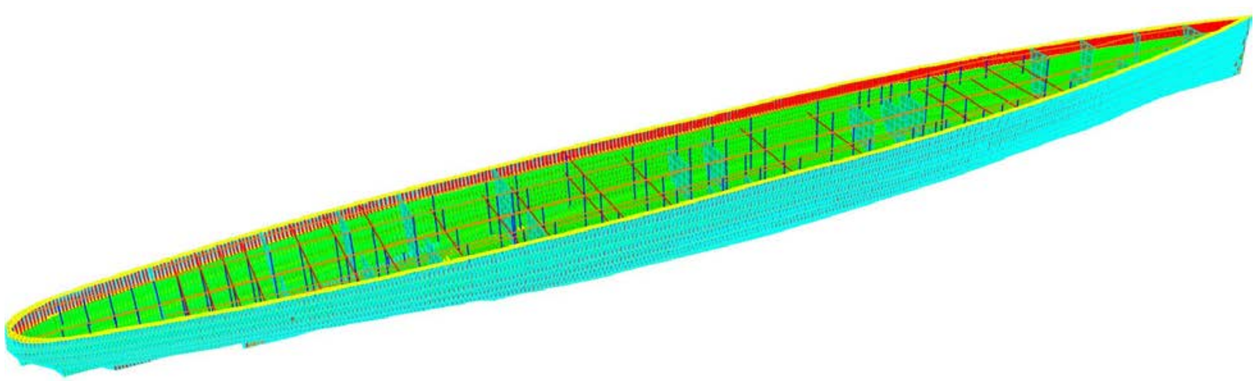


Figure 16. 3D view with all decks and hull elements above the "R" deck hidden

2.5 Bulkheads

We modeled bulkheads in the SAP2000 model using thin-shell elements meshed with the transverse frames and the decks. Large portions of the bulkheads were removed during the conversion; therefore, the bulkheads should not contribute much stiffness to the FEA model.

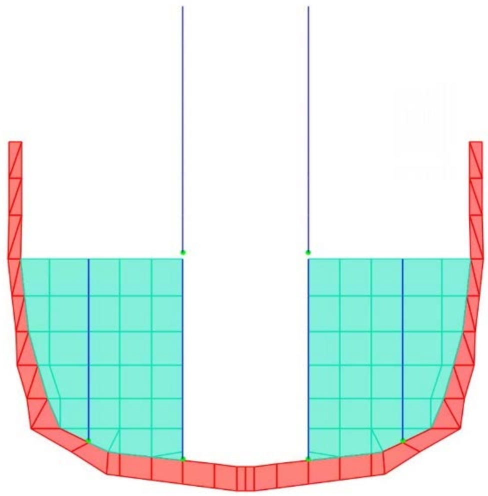


Figure 17. Typical transverse elevation view at bulkhead

2.6 Transverse Frames

We modeled the transverse frames in our FEA model using thin-shell elements meshed with each deck and the longitudinal girders. The transverse frames are spaced at 3 foot intervals from Frame 78 to 252. Forward of frame 252 and aft of frame 78, the transverse frames gradually reduce to 2 foot intervals. The original drawings call out the transverse frame thickness to be just over 0.50 inch typical at amidships. The bow and stern have transverse frames with a thicker plate thickness. Conservatively, we modeled all the transverse frames with a 0.50 inch thickness. All transverse frame shell elements are modeled solid. Lighten holes are not currently modeled.

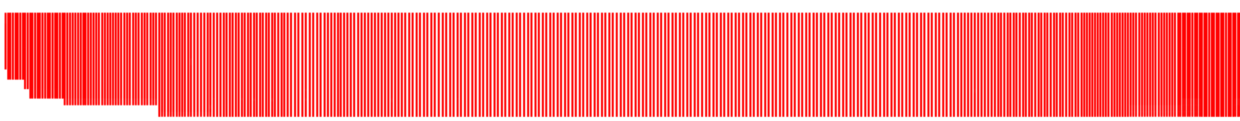


Figure 18. Elevation view of the transverse frames

2.7 Longitudinal Girders

The longitudinal girders are modeled as thin-shell elements. They are meshed with every transverse frame. The centerline girder has a thickness of 1.04 inch. The original drawings show seven longitudinal girders on each side of the centerline girder at amidships. Our FEA model has six girders on each side of the centerline girder. This is due to complicated 3D geometry at the outer edges of the ship. We believe that excluding the outermost longitudinal girder is a conservative modeling assumption. The typical longitudinal girders are spaced 7.5 feet apart and have a thickness of 0.50 inch. Again, this is a conservative assumption because the thickness increases toward the bow and stern of the ship. The longitudinal girders are terminated approximately where they meet the exterior hull of the ship.

Figure 19. 3D view of longitudinal girders with everything else hidden

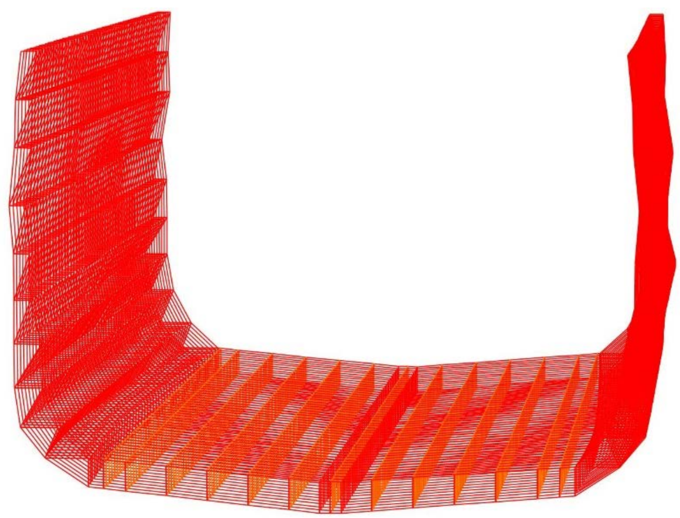


Figure 20. 3D view of only the longitudinal girders and transverse frames

2.8 Inner Hull

The inner hull is modeled using thin-shell elements. All the inner hull elements are 3 node triangular shapes due to the constant changing geometry of the transverse frames. The outer edges of the transverse frames narrow as you move away from the amidships. It is gradual in the middle of the ship, but more dramatic towards the ends of the ship. All the inner hull shells are modeled using a plate thickness of 0.62 inch. This is the minimum plate thickness found in the original drawings, and therefore conservative. The inner hull stops at the underside of the “C” deck.

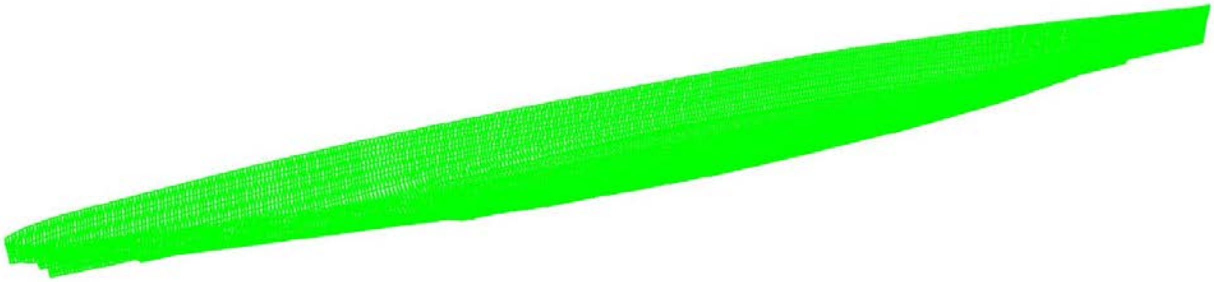


Figure 21. 3D view of inner hull

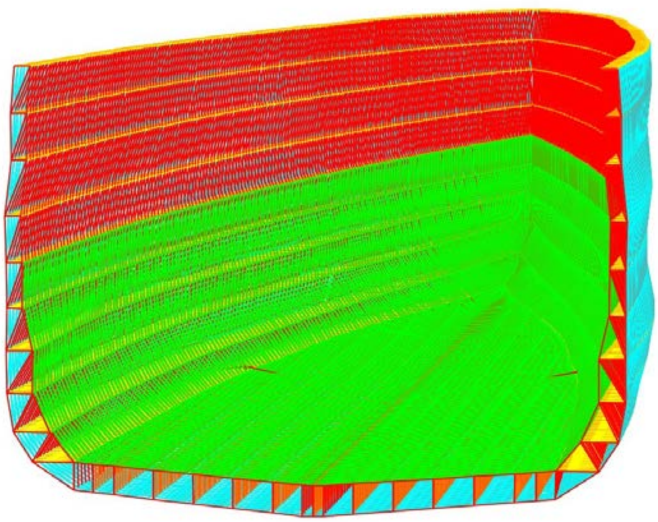


Figure 22. 3D section illustrating where the inner hull stops

2.9 Outer Hull

Just like the inner hull, the outer hull is meshed with 3 node triangular thin-shell elements. All the outer hull shells are modeled using a plate thickness of 1.0 inch (conservative). The outer hull stops at the underside of the “Main” deck. The outer hull shell elements along the bottom of the ship (z=0) have a 4 foot wide strip of shells that have a thickness of 3.55 inches. This is to represent the triple plated keel shown in the original 1930’s drawings.

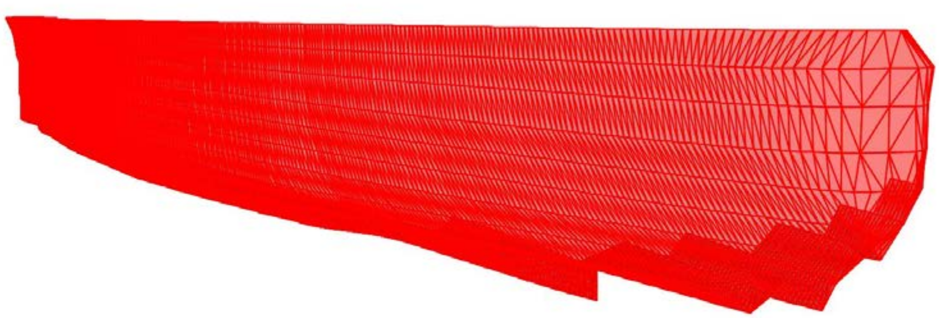


Figure 23. 3D view of outer hull

3. Finite Element Analysis Model Loads

3.1 Ship Weight

The weight of the Queen Mary has changed since it was originally built. The last time a survey was conducted to determine the weight and draft of the ship was in the 1990's. In 1992, Rados reported the current total weight of the ship, as well as the current draft at the aft, forward, and amidships. Per the report, the total weight is 65,651 long tons. In U.S. customary units, that is equal to 147,058 kips. They also did a comprehensive sounding of each one of the double bottom and wings tanks to determine the total weight of the liquid and ballast. The weight reported for the liquid and ballast is 48,321 kips. The liquid and ballast weight was subtracted from the total to approximate the weight of just the ship. The ship weight was divided into main hull and superstructure (structure above "A" deck) based on the ratio of the two areas. The weight for the main hull and superstructure is 82,282 kips and 16,457 kips respectively. The liquid and ballast, main hull, and superstructure weight were then divided up into twenty-one stations of equal length between the ship's perpendiculars. In the report, this information was used to determine the shear and moment demand on the ship using simple beam formulas.

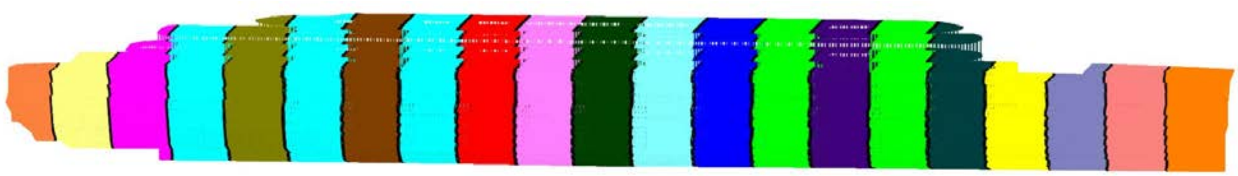


Figure 24. Visual of twenty-one equal stations for weight distribution

Our approach is to use the weight distribution from the Rados report in our FEA model by separating the ship into twenty-one equal lengths (see Figure 24) and assigning the total weight for each station evenly amongst all the joints in that station. Our FEA model does not include self-weight of the elements that are modeled. A full breakdown of weight per station, as well as weight per joint is shown in Table 3. For example, the orange group shown in Figure 24 has a total station weight of 865 kips. There are 1,310 joints in this group, so the weight applied to each joint in the vertical direction is 0.66 kips/joint.

1	2	3	4	5	6
Station Division	**Weight Distribution (L Ton/ft.)**	**Weight Distribution (k/ft.)**	**Total Station Weight (k)**	**# of Joints (from SAP)**	**Weight per Joint (k)**
FP - 0.5	8	17.9	865	1,310	0.66
0.5 - 1	20.7	46.4	2,237	1,621	1.38
1 - 1.5	28	62.7	3,026	1,854	1.63
1.5 - 2	39.1	87.6	4,226	2,218	1.91
2 - 2.5	52	116.5	5,620	2,569	2.19
2.5 - 3	63.6	142.5	6,874	2,665	2.58
3 - 3.5	75.4	168.9	8,149	2,505	3.25
3.5 - 4	85.4	191.3	9,230	3,028	3.05
4 - 4.5	95.9	214.8	10,365	2,966	3.49
4.5 - 5	100.8	225.8	10,894	2,749	3.96
5 - 5.5	103.3	231.4	11,165	2,825	3.95
5.5 - 6	104.5	234.1	11,294	2,791	4.05
6 - 6.5	98.3	220.2	10,624	2,666	3.99
6.5 - 7	97.9	219.3	10,581	2,623	4.03
7 - 7.5	102	228.5	11,024	2,975	3.71
7.5 - 8	92.5	207.2	9,997	2,813	3.55
8 - 8.5	65.6	146.9	7,090	3,512	2.02
8.5 - 9	45.3	101.5	4,896	2,959	1.65
9 - 9.5	37	82.9	3,999	2,495	1.60
9.5 – AP	30.6	68.5	3,307	1,859	1.78
AP	14.9	33.4	1,610	811	1.99
Totals			**147,075 kips 65,659 L tons**	**51,814**	

Table 3. Weight distribution

We compared the total vertical reaction reported in the FEA model with the weight from the Rados report to check that our input was correct (Table 4). As of September 2017, we are in the process of procuring current draft measurements of the ship. Once current drafts are surveyed, these values will be compared with the drafts from the 1992 Rados report to determine the approximate current weight of the ship.

OutputCase	**CaseType**	**F1**	**F2**	**F3**
		Kip	Kip	Kip
Weight	Combination	0.0060	0.0389	147,061

Table 4. Total Reaction from SAP2000

4. Finite Element Analysis Model Supports

4.1 Springs

To mimic the effects of water pressure and buoyant force on the outer hull to resist the weight applied to the ship, we assigned area springs to the outer hull shell elements. The area spring stiffness is assigned orthogonal to the face of the outer hull shell element. We only assigned area springs to outer hull shells from the bottom of the ship up to an elevation of 30 feet. This was a common joint line all the way around the ship in our FEA model, and it is roughly where the current draft of the ship is located (see Figure 25). Similarly, we also assigned point springs to the joints of these same shell elements. These point springs were assigned a relatively weak stiffness of 1 kip/foot in the x-direction (longitudinal direction) only. As we tune the area springs, we observed the ship translates longitudinally. We believe this is a result of very few shell elements orthogonal to the x-axis. Therefore, the slightest weight imbalance translates the ship. As a result, the x-direction point springs solved this issue without any major localized stress concentrations.

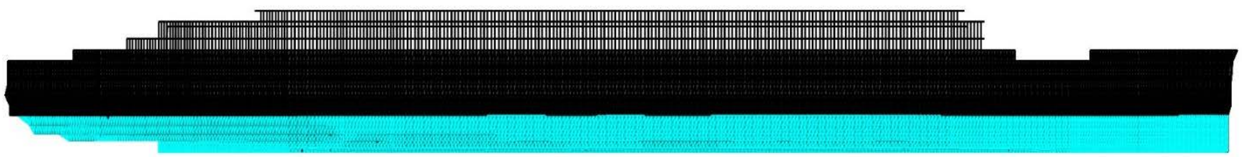


Figure 25. 3d elevation of outer hull. (blue shells denote area spring assignments)

To tune the area springs, we started by assigning the same uniform area spring stiffness to all the shells. Our goal was to force the model's deflected shape (aft, amidships, and forward) to be the same as the drafts reported by the 1992 Rados report. To achieve this, we ended up breaking the outer hull shell springs into seven transverse groups along the length of the ship, and fine-tuned the spring stiffness in each of those groups. Results of the final spring stiffness assignments are given in Table 5. Using this approach, we were able to closely match the deflected shape reported by Rados (see Figure 26 and Table 6).

Frame Location	**AP - FR88**	**FR88 - 125**	**FR125-153**	**FR153-207**	**FR207-236**	**FR236-270**	**FR270-FP**
Spring Stiffness (k/ft/ft^2)	0.0563	0.580	0.065	0.0767	0.065	0.0432	0.0352

Table 5. Area Spring Assignments on Outer Shell Elements

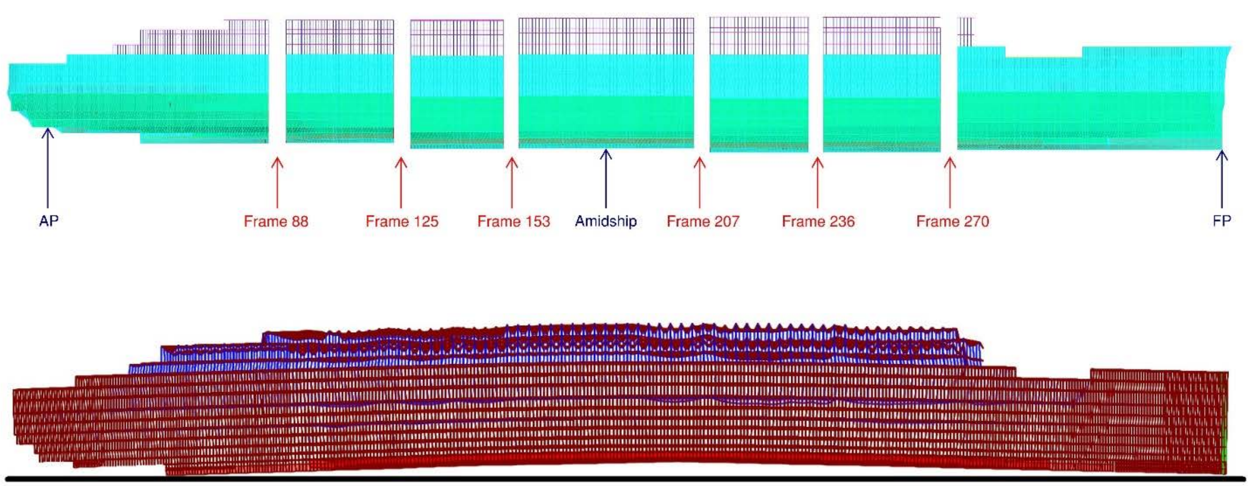


Figure 26. Overall deflected shape (20x scale factor)

Location	Rados Report (1992)	SAP2000 Model
AP	34.67’	34.62’
Amidships	33.83’	33.93’
FP	34.42’	34.42’

Table 6. Draft deflections table at forward, aft, and amidships

We assigned the same area stiffness throughout the entire transverse spring group. We did not vary the spring stiffness based on depth of hull element relative to the “waterline” as would be the case in reality. Although this may slightly underestimate the out-of-plane stresses on the outer hull elements, we do not believe this will significantly increase the overall stress on the elements. These outer hull elements are 1 inch thick and only span 3 feet between transverse frames. We will confirm this assumption in a subsequent report when we look in-depth at stresses.

References

Existing drawings from the 1930s, the modifications for war duty in 1940s, and the decommissioning and transition to a hotel in the years 1968-1972

Radio International Corporation’s report titled “Queen Mary - Analysis of the Physical Condition and Cost to Maintain,” dated July, 1992

Simpson Gumpertz & Heger’s report titled “Limited Marine Survey of The Queen Mary, Long Beach,” dated January 25, 2017

“The Anatomy of the Ship: The Cunard Linear – Queen Mary” by Ross Watton (1989)

5. Finite Element Analysis Model Results

5.1 Deflected Shape

The internal stress on the structural elements of the finite element analysis (FEA) model is dependent upon the deflected shape of the ship. To accurately determine these stresses, the model's deflected shape must be reasonably close to the Queen Mary's actual shape. Using survey data from Bill Carr's Waterline Survey Report dated October 11, 2017 (Appendix A) and original as-built drawings (Appendix B), we were able to calculate the drafts (distance from the baseline of the ship to the waterline) of the ship at the bow, amidships, and stern (Appendix C). The results of our draft calculations are similar to the results in the Rados International Corporation Report dated November 6, 1992. We adjusted the support springs in our FEA model to match the results of the current survey, and thus create a model that accurately reflects the current deformed shape of the ship (see Table 1).

Table 7. Draft deflections table at forward, aft, and amidships

Location	Rados Report (1992)	Current Waterline Survey	SAP2000 Model
AP	34.67'	34.35'	34.35'
Amidships	33.83'	33.30'	33.30'
FP	34.42'	34.57'	34.56'

5.2 Allowable Stress Criteria

A stress analysis was performed throughout the entire ship. However, the primary focus of this report is on the interior hull tank top in the exhibition area between frames 112 to 168. Material property testing for the exhibition area was performed in September 2017 by Smith-Emery Laboratories (Appendix D). Their testing results report dated October 3, 2017 give the chemical composition, tested yield stress, and tested tensile stress of the plates as follows:

> "The tensile properties are generally comparable to ASTM A 36-14 specification for Carbon Structural steel, although the yield strength is often marginally lower than that specified. The chemical compositions are also similar to ASTM A 36 for material up to ¾ inch thick. These compositions are typical of plain (un-alloyed) low-carbon steel."

The minimum tested yield stress of the inner hull plates is 34.0 kips per square inch (ksi) and the outer hull plates are 29.0 ksi. In order to capture all of the in-plane and out-of-plane stresses on the structural elements of the model, we compared the reported von Mises stress in the model with the tested yield stress. Von Mises stresses are commonly compared to directly against the yield stress of the material. Being conservative in our analysis, we used the lowest tested yield stress of 29.0 ksi with a 0.9 factor for an allowable stress of 26.1 ksi.

5.3 Stress Analysis Results

Per existing 1930's drawings, the interior hull tank top plate thickness in the exhibition area varies anywhere from 0.42 to 0.8 inches. The thinnest most common plate thickness was 0.67 inches. To address for possible corrosion, we created an additional FEA model that conservatively uses a reduced plate thickness of 0.25 inches for the entire inner hull. We enveloped our analysis by checking stresses for both inner hull thicknesses. Plate reduction from the thinnest most common plate thickness of 0.67 inches to 0.25 inches increased the von Mises stresses an average of 35%. The highest von Mises stress demand for the interior hull is 23.8 ksi (elements 40556 and 37375; see Table 2, column 13), which is below the allowable stress capacity of 26.1 ksi. Most of the stresses on the inner hull plates are well below this with the average being around 10-12 ksi. See the stress heat maps shown in Figures 1 and 2 below.

TABLE: Element Stresses - Area Shells																				
1	2	3	4	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Area	AreaEle	ShellType	Joint	S11Top	S22Top	S12Top	SMaxTop	SMinTop	SAngleTop	SVMTop	S11Bot	S22Bot	S12Bot	SMaxBot	SMinBot	SAngleBot	SVMBot	S13Avg	S23Avg	SMaxAvg
Text	Text	Text	Text	Kip/in2	Kip/in2	Kip/in2	Kip/in2	Kip/in2	Degrees	Kip/in2	Kip/in2	Kip/in2	Kip/in2	Kip/in2	Kip/in2	Degrees	Kip/in2	Kip/in2	Kip/in2	Kip/in2
40556	40556	Shell-Thin	6693	-9.4929	-11.5766	-12.308	1.8173	-22.8868	-42.581	23.8474	-9.7494	-11.642	-12.1702	1.5113	-22.9027	-42.777	23.6945	0.000622	0.00003642	0.0006231
37375	37375	Shell-Thin	6793	-9.5009	-11.5686	12.3069	1.8155	-22.885	42.599	23.8447	-9.7567	-11.6408	12.1712	1.5088	-22.9063	42.787	23.6968	-0.000593	0.00002205	0.0005934
652	652	Shell-Thin	68462	-5.7744	19.6469	2.3156	19.8561	-5.9836	84.838	23.4282	-17.4772	-17.2248	1.3407	-16.0043	-18.6976	47.688	17.507	-0.0141	-0.1035	0.1045
647	647	Shell-Thin	68463	-5.806	19.5291	-2.3113	19.7382	-6.0151	-84.83	23.3346	-17.3965	-16.983	-1.3502	-15.8238	-18.5557	-49.354	17.3518	0.014	-0.1025	0.1034
651	651	Shell-Thin	68462	-3.8208	19.7821	4.3055	20.5429	-4.5817	79.978	23.176	-16.1214	-17.3156	0.0852	-16.1153	-17.3216	4.06	16.7511	-0.0149	-0.1057	0.1067
40555	40555	Shell-Thin	6693	-9.3859	-11.2626	-11.8907	1.6034	-22.2519	-42.744	23.0954	-9.5271	-11.4589	-11.7684	1.315	-22.301	-42.654	22.9867	0.00008823	-0.0003161	0.0003281
648	648	Shell-Thin	68463	-3.8466	19.6556	-4.2644	20.4054	-4.5964	-80.027	23.0499	-16.0799	-17.0951	-0.0983	-16.0705	-17.1045	-5.481	16.6116	0.0147	-0.1046	0.1057
37376	37376	Shell-Thin	6793	-9.3224	-11.171	11.8437	1.633	-22.1264	42.769	22.9864	-9.4626	-11.3657	11.7207	1.3451	-22.1734	42.679	22.8757	-0.00008122	-0.0003155	0.0003257
40555	40555	Shell-Thin	6193	-8.9588	-9.3688	-11.7666	2.6046	-20.9322	-44.501	22.3486	-8.9912	-9.6143	-11.6746	2.376	-20.9815	-44.236	22.2648	0.00008823	-0.0003161	0.0003281
37376	37376	Shell-Thin	6313	-8.8874	-9.2732	11.7212	2.6425	-20.8031	44.529	22.2424	-8.9308	-9.5196	11.6312	2.4097	-20.8601	44.275	22.1634	-0.00008122	-0.0003155	0.0003257
37374	37374	Shell-Thin	8208	-8.5727	-11.0299	11.2395	1.5051	-21.1077	41.881	21.8991	-8.4999	-10.9032	11.181	1.5438	-20.9469	41.933	21.7559	0.00009455	-0.000116	0.0001496
40581	40581	Shell-Thin	8198	-8.5549	-11.0261	-11.2297	1.507	-21.0879	-41.86	21.8804	-8.4845	-10.9	-11.1711	1.544	-20.9285	-41.915	21.7416	-0.00009476	-0.0001117	0.0001465
37375	37375	Shell-Thin	36908	-8.1776	-10.8104	11.1506	1.7341	-20.722	41.633	21.6412	-8.501	-10.7215	11.1144	1.5585	-20.7809	42.148	21.6023	-0.000593	0.00002205	0.0005934
40556	40556	Shell-Thin	37368	-8.1529	-10.8085	-11.1521	1.7501	-20.7115	-41.605	21.6397	-8.5	-10.7318	-11.1177	1.5577	-20.7894	-42.134	21.6104	0.000622	0.00003642	0.0006231
37374	37374	Shell-Thin	6793	-7.9532	-9.1727	11.4123	2.8656	-19.9915	43.471	21.5676	-7.9986	-9.22	11.345	2.7521	-19.9708	43.459	21.4794	0.00009455	-0.000116	0.0001496
40581	40581	Shell-Thin	6693	-7.9358	-9.1776	-11.4035	2.8637	-19.9771	-43.442	21.5521	-7.9849	-9.2205	-11.3376	2.7517	-19.9571	-43.44	21.4657	-0.00009476	-0.0001117	0.0001465
37373	37373	Shell-Thin	8208	-7.6144	-9.6365	11.0412	2.462	-19.7128	42.384	21.0521	-7.5756	-9.5978	11.0194	2.4789	-19.6524	42.379	21.0019	0.0006711	-0.0002399	0.0007127
40582	40582	Shell-Thin	8198	-7.6046	-9.6231	-11.0297	2.462	-19.6897	-42.386	21.029	-7.5665	-9.5835	-11.007	2.4781	-19.6282	-42.383	20.9773	-0.0006694	-0.000238	0.0007105
37396	37396	Shell-Thin	8256	-8.581	-9.787	10.767	1.5999	-19.9679	43.397	20.814	-8.5139	-9.6121	10.7389	1.69	-19.816	43.536	20.7127	0.0001424	-0.00003074	0.0001457
40583	40583	Shell-Thin	8246	-8.5682	-9.7716	-10.7502	1.5971	-19.9369	-43.398	20.7815	-8.4974	-9.5933	-10.7234	1.692	-19.7828	-43.537	20.6808	-0.0001434	-0.00002832	0.0001461
40556	40556	Shell-Thin	37370	-7.9867	-8.8215	-10.8989	2.5028	-19.311	-43.903	20.6763	-7.3367	-8.2869	-10.771	2.9696	-18.5932	-43.737	20.2421	0.000622	0.00003642	0.0006231
37375	37375	Shell-Thin	36907	-7.9862	-8.8074	10.8951	2.506	-19.2996	43.921	20.6669	-7.3594	-8.2814	10.7729	2.9624	-18.6031	43.775	20.2475	-0.000593	0.00002205	0.0005934
37396	37396	Shell-Thin	8208	-7.9431	-8.0015	10.9606	2.9883	-18.9329	44.924	20.5903	-8.055	-8.0003	10.921	2.8934	-18.9487	45.072	20.5488	0.0001424	-0.00003074	0.0001457
40583	40583	Shell-Thin	8198	-7.9306	-7.9881	-10.9452	2.9859	-18.9046	-44.925	20.5608	-8.0392	-7.9854	-10.9058	2.8935	-18.9181	-45.071	20.5185	-0.0001434	-0.00002832	0.0001461
40555	40555	Shell-Thin	37370	-8.1389	-9.0651	-10.6899	2.098	-19.3019	-43.76	20.4319	-7.7311	-8.5179	-10.6097	2.4925	-18.7415	-43.938	20.104	0.00008823	-0.0003161	0.0003281
37376	37376	Shell-Thin	36907	-8.0813	-8.9696	10.644	2.1278	-19.1787	43.805	20.3263	-7.6815	-8.4295	10.5656	2.5167	-18.6277	43.986	20.0051	-0.00008122	-0.0003155	0.0003257
36433	36433	Shell-Thin	66444	-21.0249	-16.9709	3.494	-14.9585	-23.0373	60.06	20.2452	-21.0781	-17.2319	3.6479	-15.0313	-23.2788	58.899	20.4434	-0.0008451	0.0003421	0.0009117
39692	39692	Shell-Thin	66433	-21.0284	-17.0189	-3.4365	-15.0451	-23.0022	-60.129	20.2333	-21.0845	-17.2815	-3.5937	-15.1172	-23.2488	-58.942	20.4348	0.0008408	0.0003391	0.0009066
39808	39808	Shell-Thin	37456	-17.1043	-14.2033	-7.2462	-8.2639	-23.0438	-50.66	20.2207	-16.8764	-13.9437	-7.1976	-8.0645	-22.7555	-50.758	19.9834	-0.00004739	-0.0001655	0.0001721
908	908	Shell-Thin	37372	-6.1057	-7.2948	10.9961	4.3119	-17.7124	43.453	20.2162	-4.8535	-6.7725	10.4227	4.6538	-16.2798	42.37	19.0382	-0.0015	0.0006815	0.0016
36543	36543	Shell-Thin	36864	-17.0826	-14.1585	7.2446	-8.2299	-23.0112	50.705	20.1957	-16.8576	-13.8974	7.1986	-8.0283	-22.7267	50.809	19.9624	0.00004769	-0.0001719	0.0001784
899	899	Shell-Thin	36906	-6.1299	-7.2753	-10.9775	4.2898	-17.695	-43.507	20.1848	-4.883	-6.7552	-10.406	4.629	-16.2671	-42.43	19.0091	0.0015	0.0006786	0.0016
37374	37374	Shell-Thin	36908	-8.1723	-8.9788	10.5035	1.9357	-19.0868	43.901	20.1246	-8.1673	-8.7666	10.3818	1.9192	-18.8531	44.173	19.8823	0.00009455	-0.000116	0.0001496
40581	40581	Shell-Thin	37368	-8.1642	-8.982	-10.4978	1.9327	-19.0789	-43.885	20.115	-8.1634	-8.7772	-10.3793	1.9136	-18.8541	-44.153	19.8801	-0.00009476	-0.0001117	0.0001465
37373	37373	Shell-Thin	36909	-8.1363	-9.4546	10.2852	1.5108	-19.1018	43.167	19.9003	-7.6485	-9.2276	10.2127	1.8051	-18.6812	42.79	19.646	0.0006711	-0.0002399	0.0007127
37394	37394	Shell-Thin	9464	-9.4242	-8.5933	10.2317	1.2314	-19.2483	46.163	19.8931	-9.0858	-8.2225	10.1603	1.5153	-18.8236	46.216	19.6252	0.0003848	-0.00003514	0.0003864
40582	40582	Shell-Thin	37366	-8.129	-9.4412	-10.2751	1.5109	-19.0811	-43.173	19.8797	-7.6428	-9.2164	-10.2023	1.8031	-18.6622	-42.795	19.626	-0.0006694	-0.000238	0.0007105
37394	37394	Shell-Thin	8256	-8.6166	-6.7366	10.4298	2.7955	-18.1487	47.575	19.6958	-8.7926	-6.7208	10.3796	2.6745	-18.1879	47.85	19.662	0.0003848	-0.00003514	0.0003864
37395	37395	Shell-Thin	8256	-7.2243	-8.1743	10.4503	2.7618	-18.1604	43.699	19.6872	-7.089	-8.0764	10.4247	2.8536	-18.0191	43.644	19.6023	0.0009993	-0.0003087	0.001

Table 8. von Mises Stresses of the interior hull in the exhibition area (columns 13, 20)

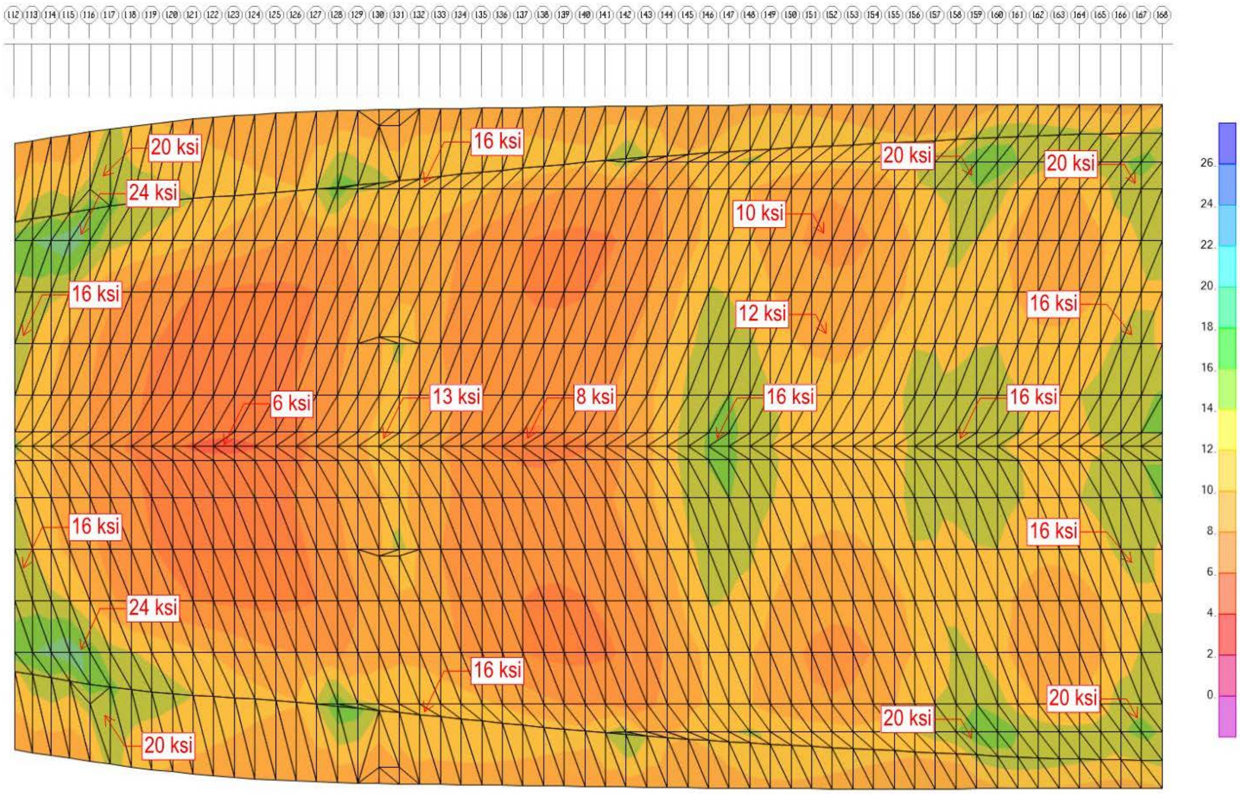


Figure 27. Heat map of the von Mises stresses in the interior hull in the exhibition area (values in the legend are in ksi) [plan view]

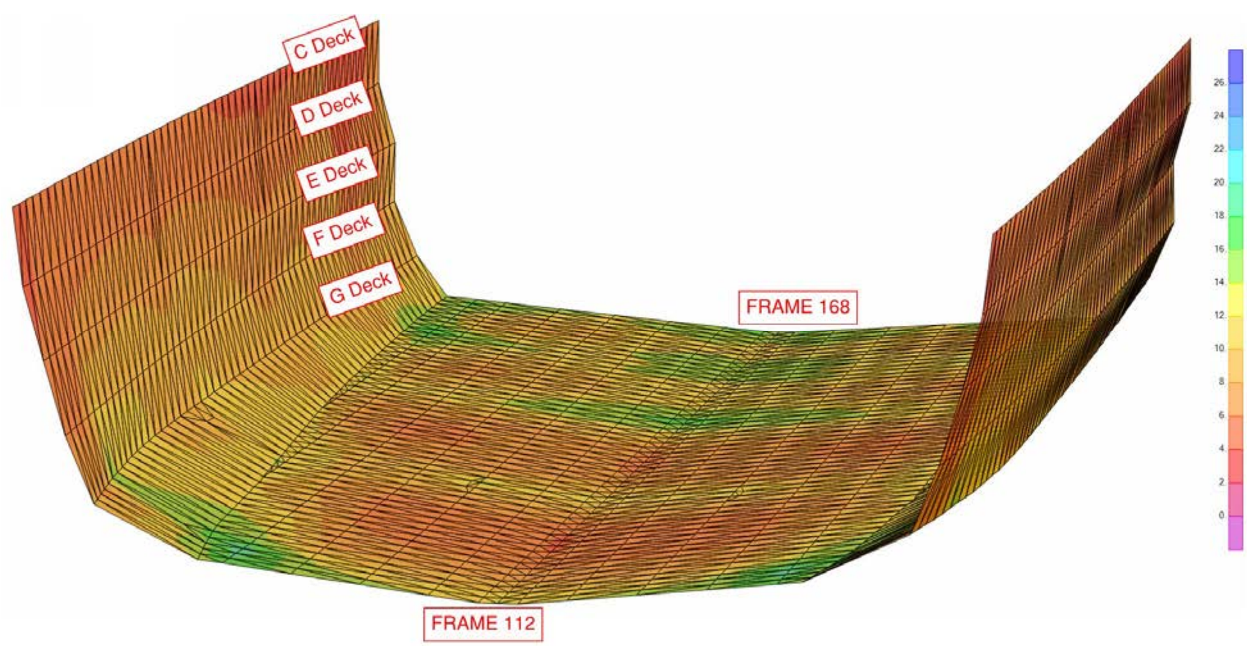


Figure 28. Heat map of the von Mises stresses in the interior hull in the exhibition area (values in the legend are in ksi) [3D view]

Over the length of the ship, there are no interior hull elements exceeding the allowable stress of 26.1 ksi (see Figure 3). The heat map of the entire inner hulls shows that the higher stress concentrations are generally in the middle of the ship. This is a reasonable result since the deflected shape of the ship is hogging 14 inches.

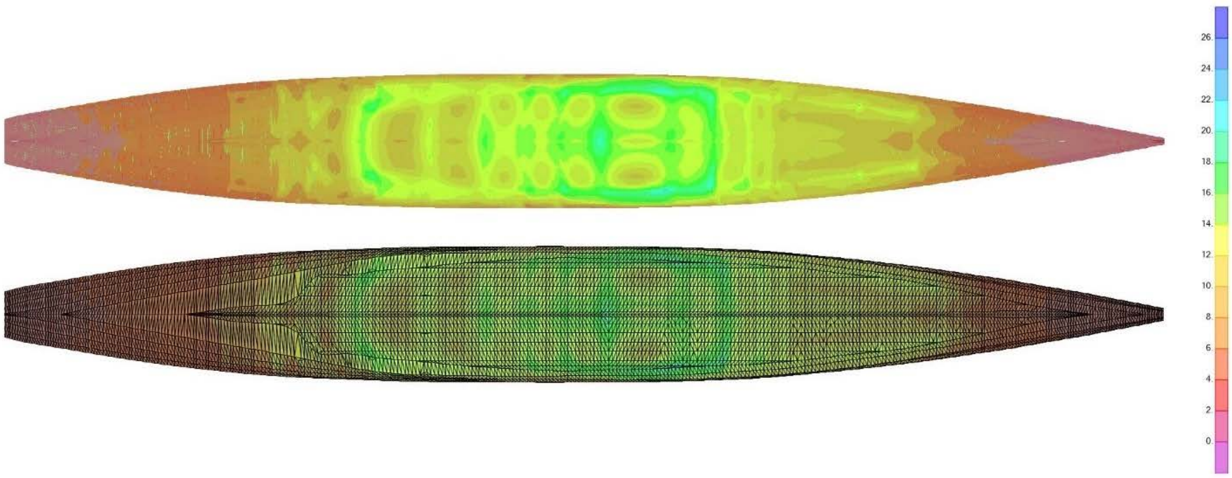


Figure 29. Heat map of the von Mises stresses on the entire interior hull
(values in the legend are in ksi)
[plan view]

5.4 Bulkhead 112 Study

In the event of a puncture in the hull, JAMA investigated the differences between sealing bulkhead 112 such that water can accumulate up to a height of 20 ft. above the tank top, versus not sealing bulkhead 112 and letting water flow uniformly across the entire vessel. Based on our engineering assessment, it is preferable to allow water flow uniformly across the entire vessel. 20 ft. of water behind bulkhead 112 is approximately equivalent to 4.8 ft. of water across the length of the vessel. If cross flooding were allowed up to a height of 4.8 ft., based on the JAMA FEA model it is estimated that on average the entire vessel would be submerged by an additional 5.2 ft. The stresses are estimated to increase by 14 percent on the exterior hull, and by 15 percent on the interior hull, which are within acceptable material strength limits based on minimum tested values. The increase in stresses in the cross-flooding scenario that is observed in the FEA model is corroborated by similar demand increases using simple beam analogy that was adopted by the Rados report.

If bulkhead 112 were sealed and water could accumulate up to a height of 20 ft., based on the FEA model it is estimated that the AP segment of the vessel would be submerged by an additional 11 ft., which means the vessel could potentially hit the bottom of the lagoon. Based on the FEA model, the stresses on the exterior hull would increase by 19%, and by 25% on the interior hull. The stress increase on the interior hull would exceed the allowable material strength limits. Due to the uneven loading conditions created by adding 20 ft. of water behind bulkhead 112, a simple beam analogy approach is no longer valid for this scenario. Therefore, the conclusions drawn for the second scenario are based on the FEA model, and cannot be corroborated by a simple beam analogy.

Based on the performed analyses, it is JAMA's belief that cross-flooding should be allowed in lieu of sealing bulkhead 112.

MARTIN & associates

JOHN A. MARTIN and ASSOCIATES, INC. □ STRUCTURAL ENGINEERS

Architect:	Urban Commons	Sheet:	1
Project:	Queen Mary	Job no:	17057
	Critical Projects	Date:	1/12/2018
	Bulkhead 112 Moment Demands	Engineer:	PB

Model Type	Location	Draft [ft]	Avg AP FP Draft [ft]	Hogging Δ relative [in]	Moment Demand [ft-kip]	Moment Demand [ft-l. ton]	Change in Moment	Moment Capacity [ft- l. ton]	Moment DCR
Original - based on survey	AP	34.34	34.5	13.44	6,320,000	2,830,000		3,252,013	0.87
	Amidships	33.33							
	FP	34.56							
4.8' Uniform water	AP	39.37	40.0	15.66	7,370,000	3,300,000	17%	3,252,013	1.01
	Amidships	38.72							
	FP	40.68							

$$\Delta_{relative} = \frac{\Delta_{AP} + \Delta_{FP}}{2} - \Delta_{Amidships} \qquad M = \frac{384EI\Delta_{relative}}{40l^2}$$

E =	29,000	ksi	[Modulus of Elasticity]
I =	18,868,000	$in^2 ft^2$	[Moment of Inertia from 1990 Rados Report]
S =	3,014,280	in^3	[Section Modulus from Rados Report = 279100 x 0.9 x 12 in^3]
Δ =			[Relative Displacement - from FEA]
L =	965	ft	[length of ship]
Fy =	29	ksi	[allowable stress for exterior hull based on Smith Emery material testing]
M_{allow} =	7,284,510	ft-kip	[F_y x S]
	3,252,013	ft-l. ton	

Figure 30. Calculation showing drafts and difference in moment demands using simple beam equations.

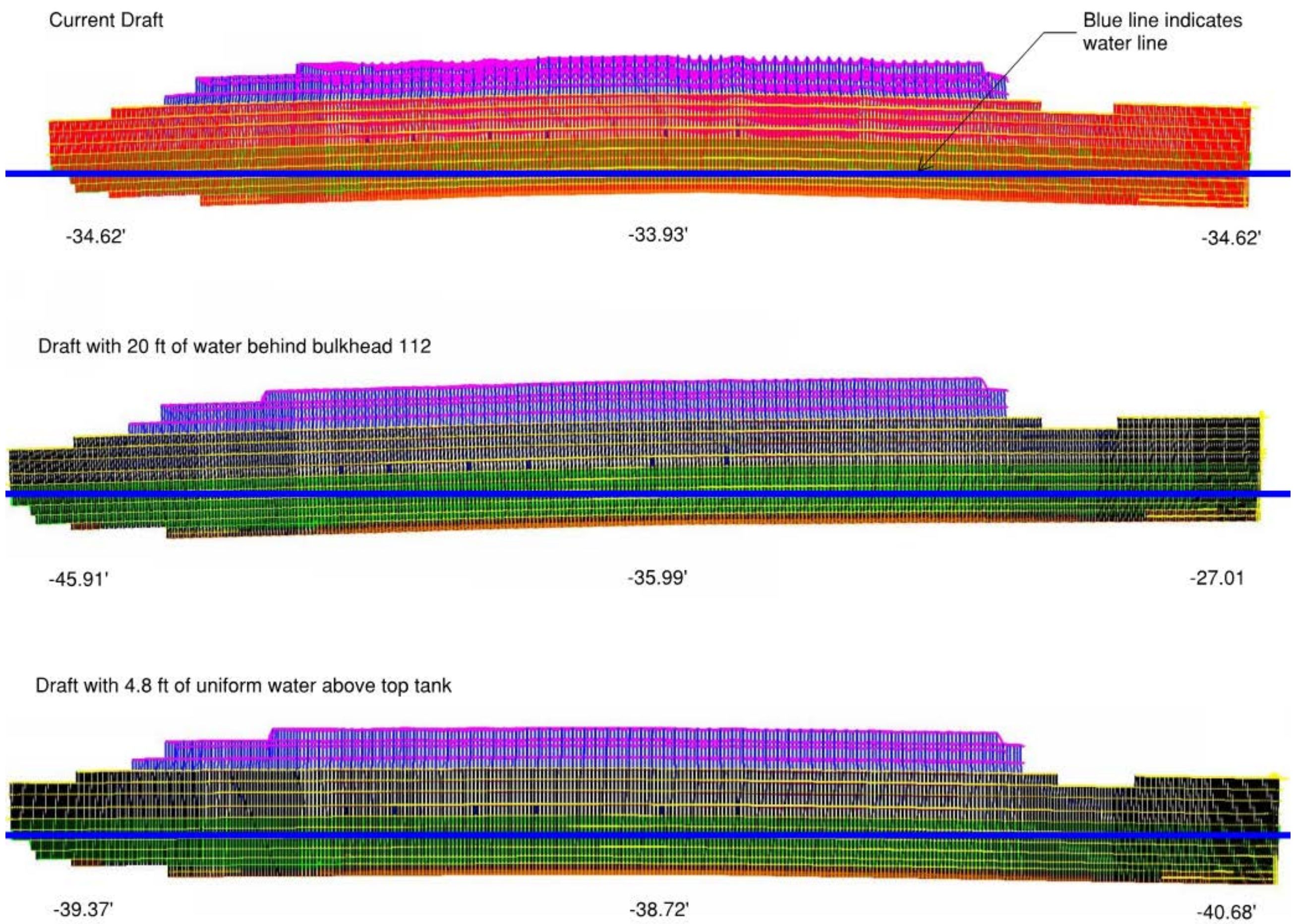


Figure 31. Relative drafts of the three scenarios

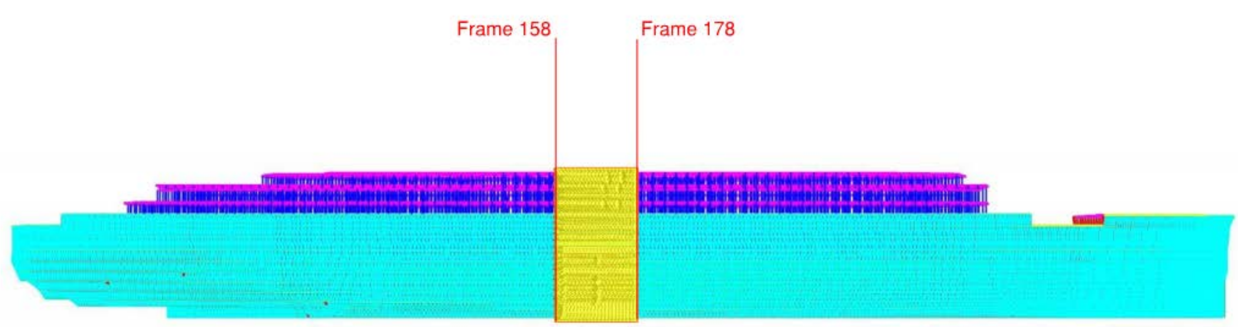


Figure 32. Key showing segment of vessel where stresses are checked in the bulkhead study, shown on the following pages.

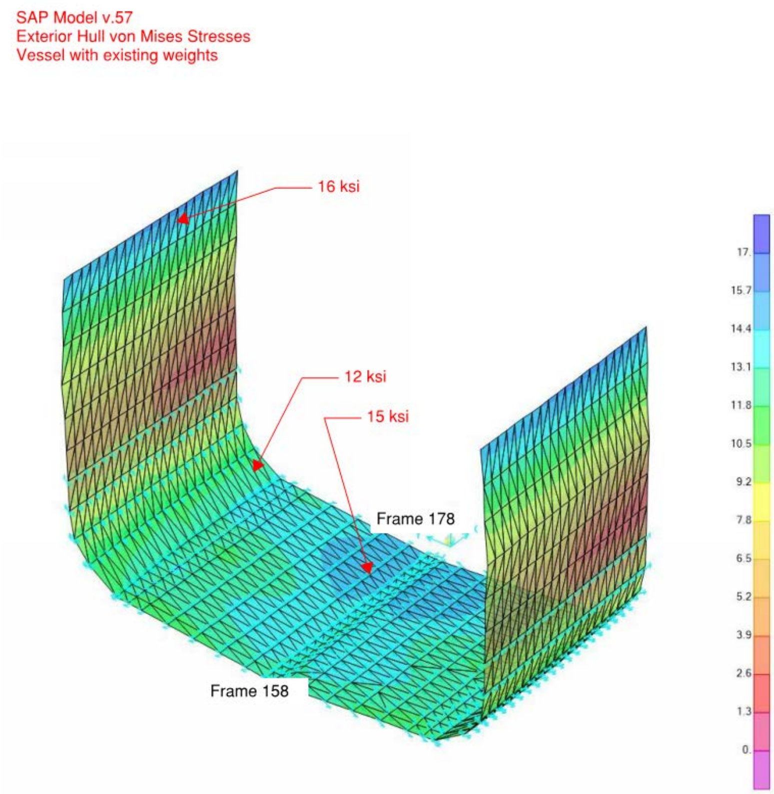


Figure 33. Von Mises stresses in the exterior hull of the original model [Max stress = 15 ksi].

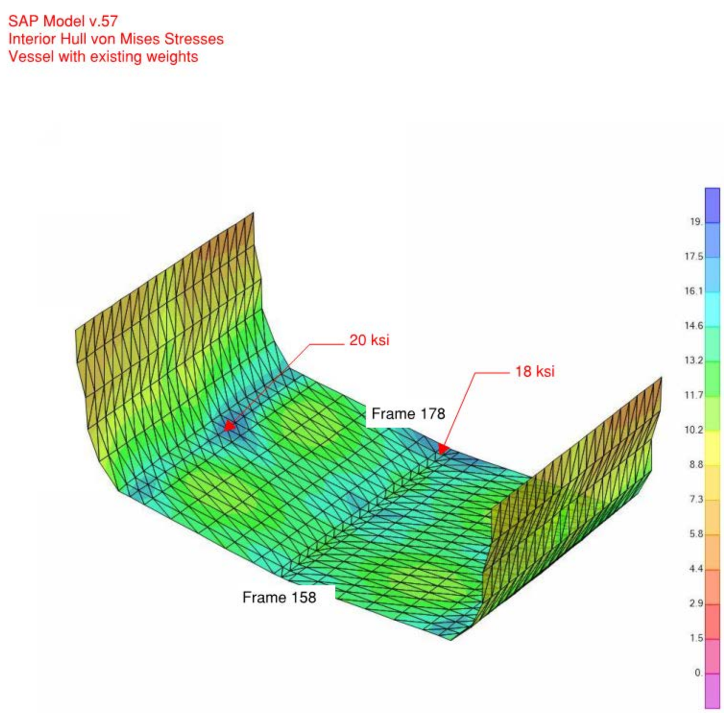


Figure 34. Von Mises stresses in the interior hull of the original model [Max stress = 20 ksi].

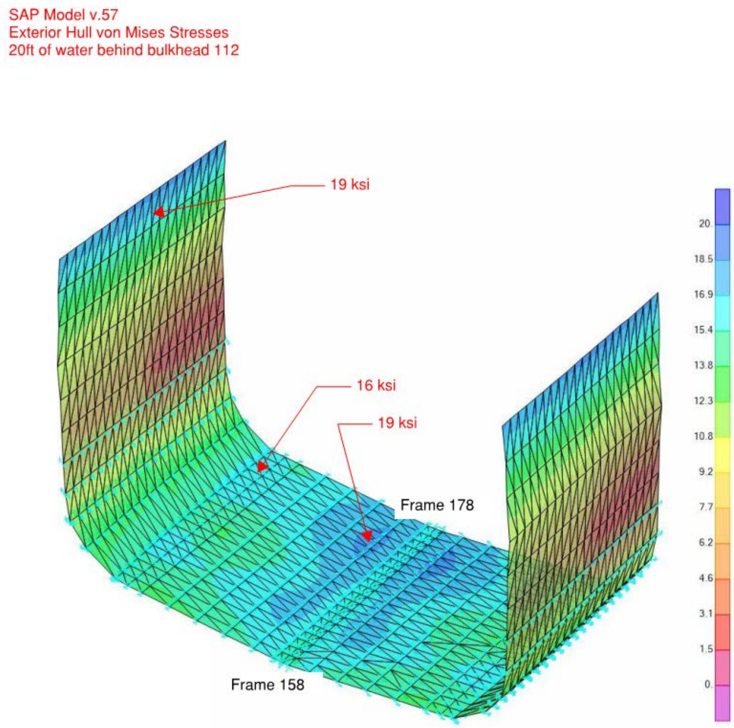


Figure 35. Von Mises stresses in the exterior hull of the model with 20 ft of water behind bulkhead 112 [Max stress = 19 ksi].

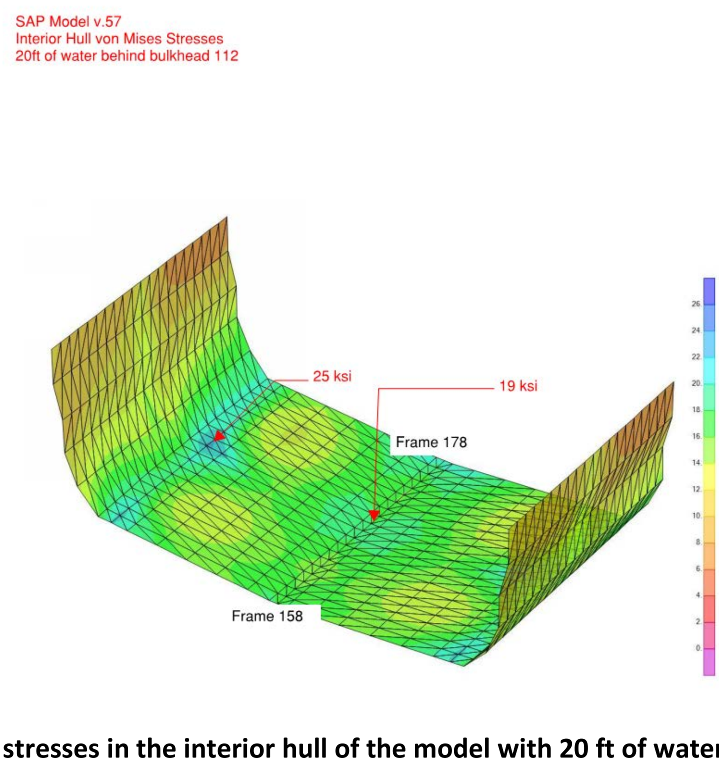


Figure 36. Von Mises stresses in the interior hull of the model with 20 ft of water behind bulkhead 112 [Max stress = 25 ksi].

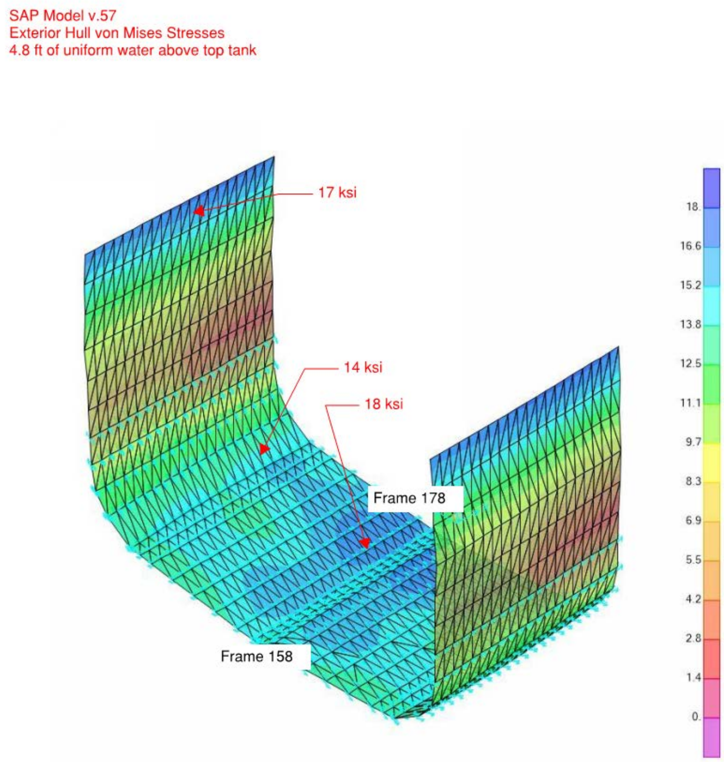


Figure 37. Von Mises stresses in the exterior hull of the model with uniform water [Max stress = 18 ksi].

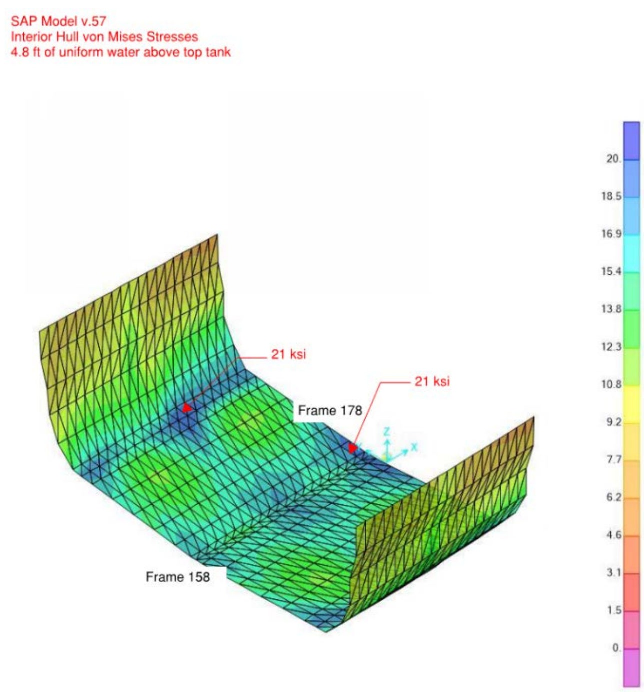


Figure 38. Von Mises stresses in the interior hull of the model with uniform water [Max stress = 21 ksi].

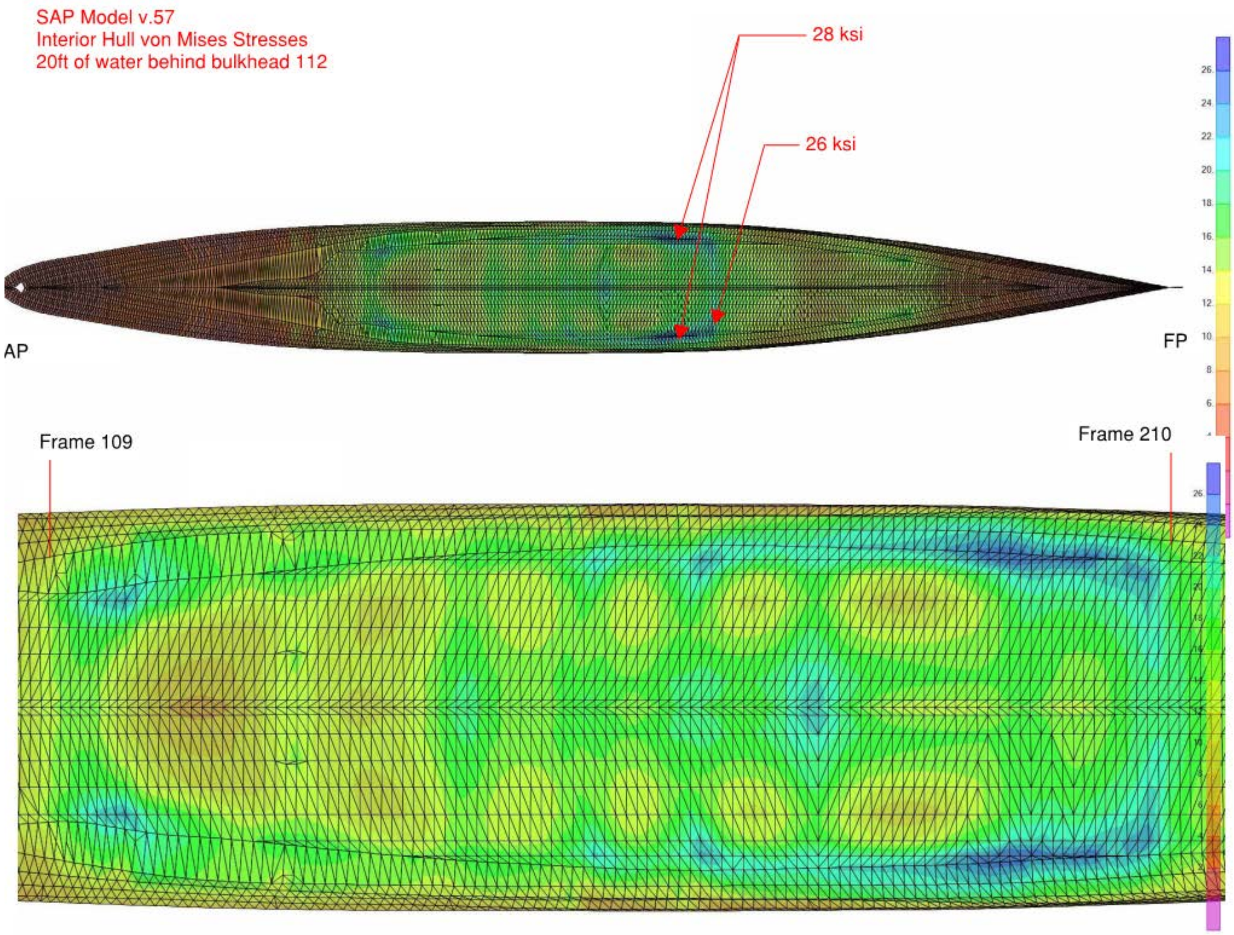


Figure 39. Von Mises heat map showing locations where allowable stresses on exceeded on the interior hull in the case with 20 ft. of water behind bulkhead 112.

6. Conclusion

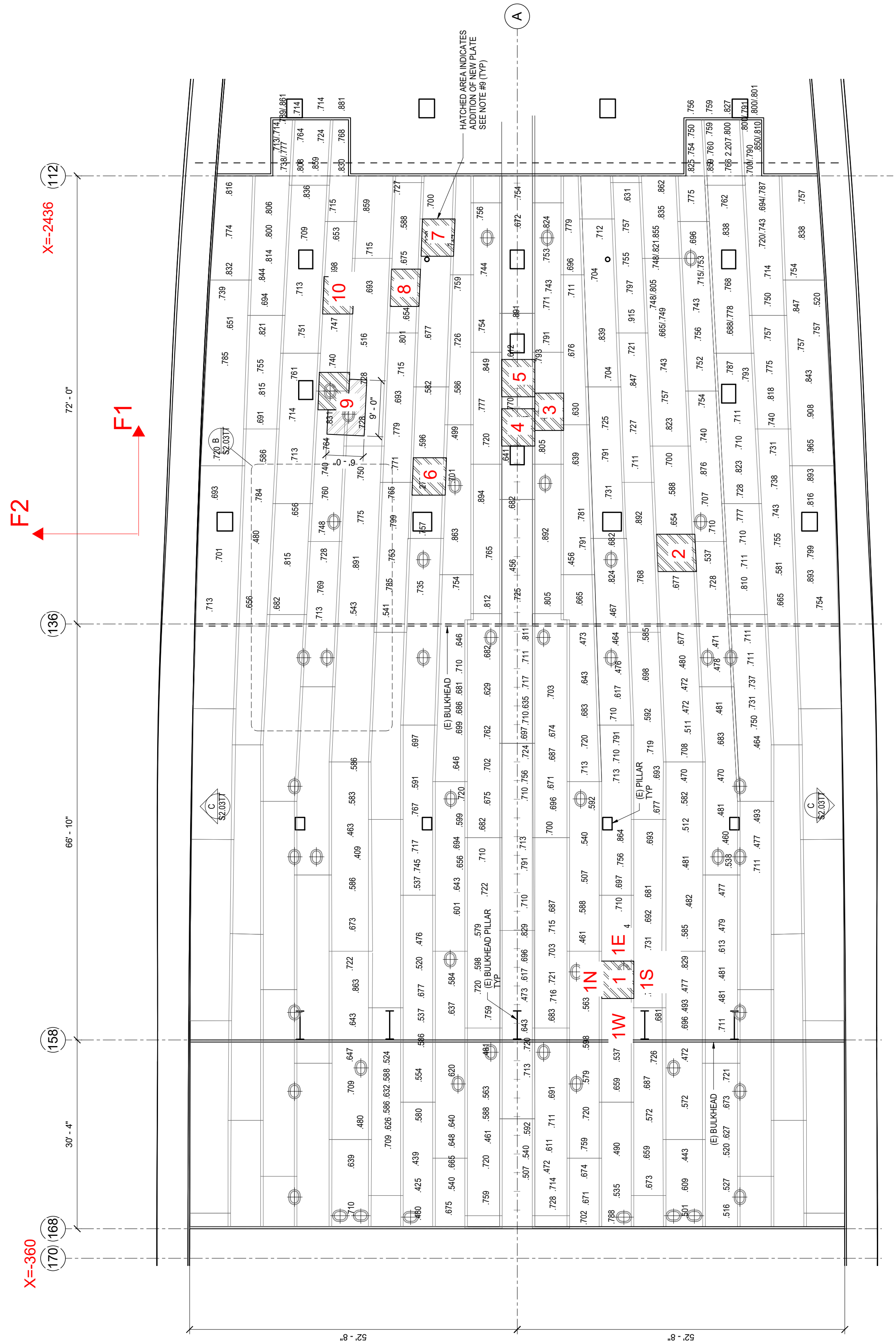
Based on the results of the material testing program and the FEA model, we can conclude that the minimum satisfactory inner hull plate thickness shall be 0.25 inches. The inner hull plating must be ultrasonically tested at a reasonable frequency to ensure that all inner hull plates in the exhibition hall area (frames 112 to frames 168) meet this minimum thickness. All holes in inner hull plating must be patched with 0.25 inch plate.

Tank Top Repair Weld Calculations

MARTIN & associates

JOHN A. MARTIN and ASSOCIATES, INC. □ STRUCTURAL ENGINEERS

Architect:	Urban Commons	Sheet:	1
Project:	Queen Mary	Job no:	17057
	Critical Projects	Date:	1/12/2018
	Tank Top Repair Weld Calcs	Engineer:	PB



Weld Calculation Key Plan

JOHN A. MARTIN and ASSOCIATES, INC. □ STRUCTURAL ENGINEERS

Architect:	Urban Commons	Sheet:	1
Project:	Queen Mary	Job no:	17057
	Critical Projects	Date:	1/12/2018
	Tank Top Repair Weld Calcs	Engineer:	PB

TABLE: Section Cut Forces - Analysis						Adjusted for PL length								
Section Cut	Section Cut Length	Plate Length	F1	F2	F3	F1	F2	F3	Fu_{weld} = 1.4* SRSS(F1,F2,F3)	ϕr_n	ϕr_n x PL length	ϕR_n w/ 1/4" weld	1/4" weld DCR	
Text	ft	ft	Kip	Kip	Kip	kip	kip	kip	kip	kip/in /in	kip/in	kip		
1E	7.5	4	206	37	-3	110	19	2	156	1.392	67	267	0.6	OK
1N	6	4	-30	58	-5	20	39	3	61	1.392	67	267	0.2	OK
1S	6	4	30	-58	5	20	39	3	61	1.392	67	267	0.2	OK
1W	7.5	4	-238	-37	3	127	20	2	180	1.392	67	267	0.7	OK
2E	7.5	4	182	82	-9	97	44	5	149	1.392	67	267	0.6	OK
2N	6	4	-64	31	-2	42	21	2	66	1.392	67	267	0.2	OK
2S	6	4	64	-31	2	42	21	2	66	1.392	67	267	0.2	OK
2W	7.5	4	-161	-76	8	86	41	4	133	1.392	67	267	0.5	OK
3E	5.4	4	65	11	-1	48	8	1	68	1.392	67	267	0.3	OK
3N	6	4	-13	79	-8	9	53	5	75	1.392	67	267	0.3	OK
3S	6	4	13	-79	8	9	53	5	75	1.392	67	267	0.3	OK
3W	5.4	4	-73	-12	1	54	9	1	77	1.392	67	267	0.3	OK
4E	4.2	4	55	0	0	53	0	0	74	1.392	67	267	0.3	OK
4N	6	4	5	36	0	3	24	0	34	1.392	67	267	0.1	OK
4S	6	4	5	-36	0	3	24	0	34	1.392	67	267	0.1	OK
4W	4.2	4	-60	0	0	57	0	0	79	1.392	67	267	0.3	OK
5E	4.2	4	76	0	0	72	0	0	101	1.392	67	267	0.4	OK
5N	6	4	-2	47	0	1	31	0	44	1.392	67	267	0.2	OK
5S	6	4	-1	-47	0	1	31	0	44	1.392	67	267	0.2	OK
5W	4.2	4	-87	0	0	83	0	0	116	1.392	67	267	0.4	OK
6E	7.5	4	181	-40	-4	97	21	2	139	1.392	67	267	0.5	OK
6N	6	4	30	34	3	20	22	2	42	1.392	67	267	0.2	OK
6S	6	4	-30	-34	-3	20	22	2	42	1.392	67	267	0.2	OK
6W	7.5	4	-241	37	4	128	20	2	182	1.392	67	267	0.7	OK
7E	7.5	4	189	-46	-6	101	24	3	146	1.392	67	267	0.5	OK
7N	6	4	35	49	5	24	33	3	56	1.392	67	267	0.2	OK
7S	6	4	-35	-49	-5	24	33	3	56	1.392	67	267	0.2	OK
7W	7.5	4	-156	43	5	83	23	3	121	1.392	67	267	0.5	OK
8E	7.5	4	122	-65	-7	65	34	4	103	1.392	67	267	0.4	OK
8N	6	4	52	45	4	34	30	3	64	1.392	67	267	0.2	OK
8S	6	4	-52	-45	-4	34	30	3	64	1.392	67	267	0.2	OK
8W	7.5	4	-105	63	7	56	34	4	91	1.392	67	267	0.3	OK
9E	15	4	209	-121	-13	56	32	4	90	1.392	67	267	0.3	OK
9N	12	8	99	21	2	66	14	1	95	1.392	134	535	0.2	OK
9S	12	8	-67	-114	-11	45	76	7	124	1.392	134	535	0.2	OK
9W	15	4	-302	90	11	81	24	3	118	1.392	67	267	0.4	OK
10E	7.5	4	140	-101	-11	75	54	6	129	1.392	67	267	0.5	OK
10N	6	4	77	-14	-2	51	9	1	73	1.392	67	267	0.3	OK
10S	6	4	-77	14	2	51	9	1	73	1.392	67	267	0.3	OK
10W	7.5	4	-128	98	11	68	52	6	121	1.392	67	267	0.5	OK

Aft Mast Repair Calculations

Queen Mary Aft Mast Repair
Structural Narrative

Scope of Work

The scope of work for this portion of the renovation is to provide remedial repair details for the aft mast cable anchorage damage caused by corrosion of the supporting steel (see Figure 1 for mast location on ship). Based on findings in the "Marine Survey of the Queen Mary" report prepared by Simpson, Gumpertz & Heger (SGH) dated January 25, 2017, the aft mast cable anchorage plates were assessed as being corroded and were recommended to be replaced along with, bolts, brackets, and any missing pins.

Complete review of existing conditions at each mast cable anchorage was not possible as they were all covered by waterproofing. Based on damage recorded in photos taken prior to waterproofing being re-applied after the SGH review, a repair sketch was generated to remediate the corrosion damage of the supporting bent plate to which the mast cable clevises are attached. Upon uncovering anchorage damage later, further repair details may be needed based on different types of damage found. At this time, only the bent plate connecting the cable clevis to the ship's beams is being repaired based on assumed corrosion damage.

Design Criteria

Governing Building Codes:

- 2016 California Building Code
- AISC Steel Construction Manual, 14^{th} edition
- ASCE 7-16

Materials:

I. New Structural Steel

a.	Rolled Sections	ASTM A572 Grade 50
b.	Plates	ASTM A572 Grade 50
c.	Angles	ASTM A36
d.	High Strength Bolts	ASTM F3125 (formerly A325)
e.	Rods	ASTM A572 Grade 50

II. Existing Structural Steel

a.	Rolled Sections	Grade 33 assumed
b.	Plates	Grade 33 assumed
c.	Rods	Grade 35 assumed

III. Welding electrodes

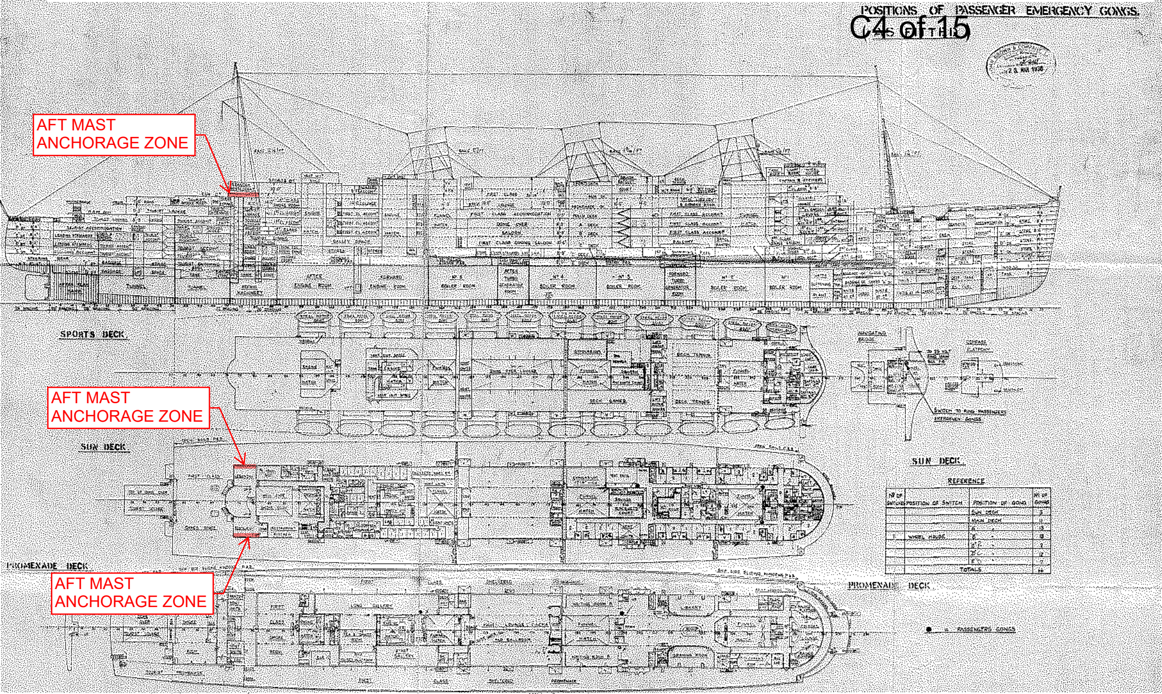
a.	Structural Steel	E70XX
b.	Reinforcing Steel	E90XX

Design Approach

Based on our structural observations subsequent to those by SGH and after exposed areas were re-waterproofed, little damage was visible, thus our assumption is only the anchorage plates are damaged, and the deck and supporting beams below the anchorage plates are structurally sound and sufficient to resist cable loads. Photos by SGH show corrosion damage to the base of existing anchorage plates near the deck surface (Photos 1 through 7, attached). This damage reduces the ability of the plate to transfer cable loads to rolled structural steel deck beams below.

Assuming the plate damage is significant, a reinforcing bent plate has been designed to transfer the load of a single cable to two beams below the deck surface. New plates used to reinforce the damaged plate are designed to span the load from existing cables to the beams below. Existing details showing the attachment of cables to the deck are shown in Figure 2. As the original design loads are not known (loading was likely based on unknown sailing conditions), cables are assumed to carry loads equal to the root area at the threads multiplied by the cable yield stress. This is a conservative assumption that is safe and relatively easy to apply, but not too egregious. This plate will be notched around the existing cable clevis and designed to span between existing beams below the deck surface. To engage the plate with existing framing, the plate will be welded above the deck to the damaged plate, and it will be bolted through the new bent plate into existing beams supporting the deck (See Figures 3 and 4). Bolts are called out as twist-off bolts, installed from below the deck and requiring access only from the top to tighten, and will be galvanized to delay any possible future corrosion and the entire connection will be waterproofed again.

Figure 1 - Aft mass anchorage location in elevation (top) and plans (lower two plans)



This photo was taken on the starboard side which was in far better shape than the port side.

Photo 1 - Existing continuous bent plate corrosion

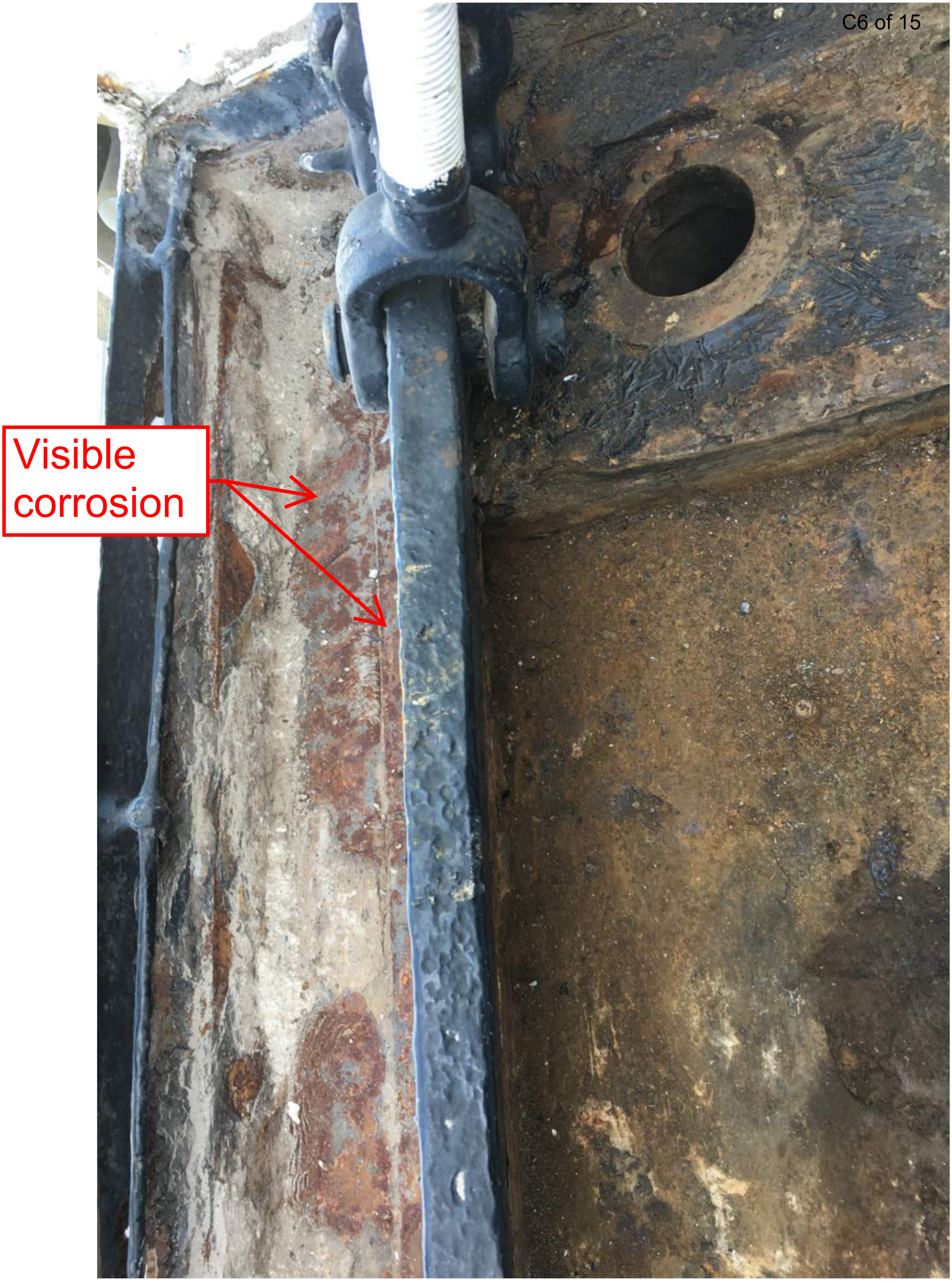


Photo 2 - Existing continuous bent plate corrosion

Photo 3 - Existing continuous bent plate corrosion

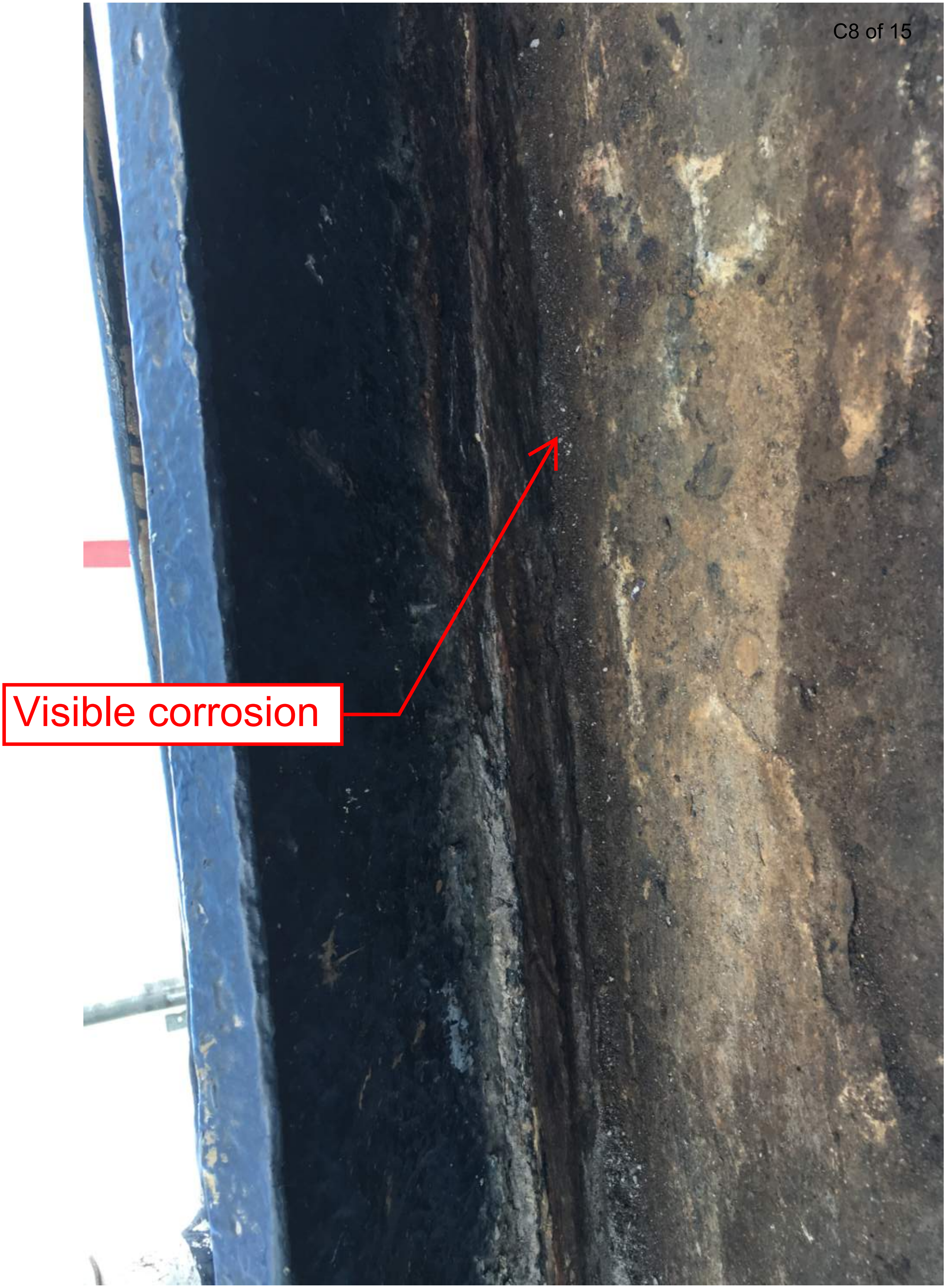


Photo 4 - Existing continuous bent plate corrosion

Photo 5 - Existing continuous bent plate in current weatherproofed condition

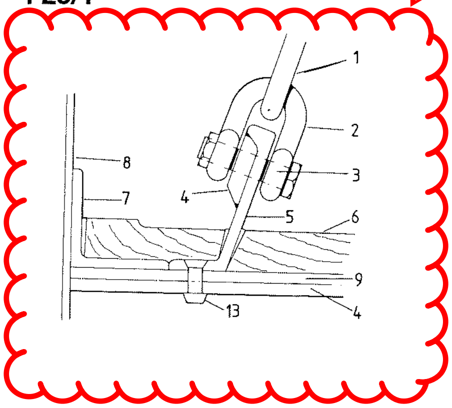
Photo 6 - Existing continuous bent plate in current weatherproofed condition

Photo 7 - Rod, clevis, and pin attachment to weatherproofed plates

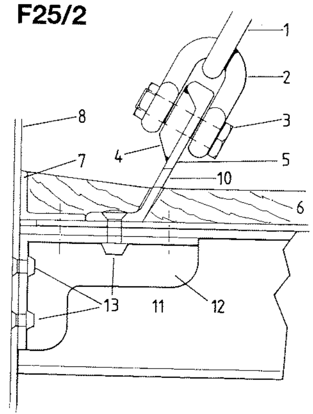
AFT MAST ANCHORAGE CONDITION

F Rig

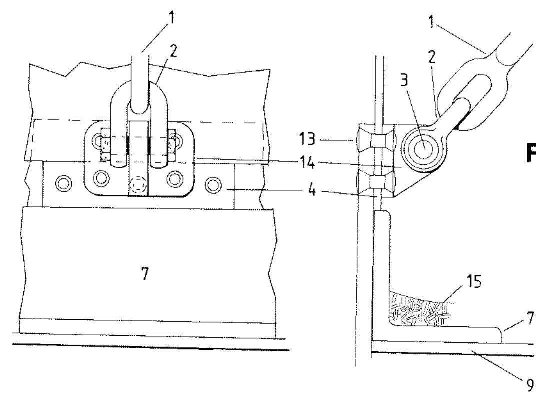
F25/1



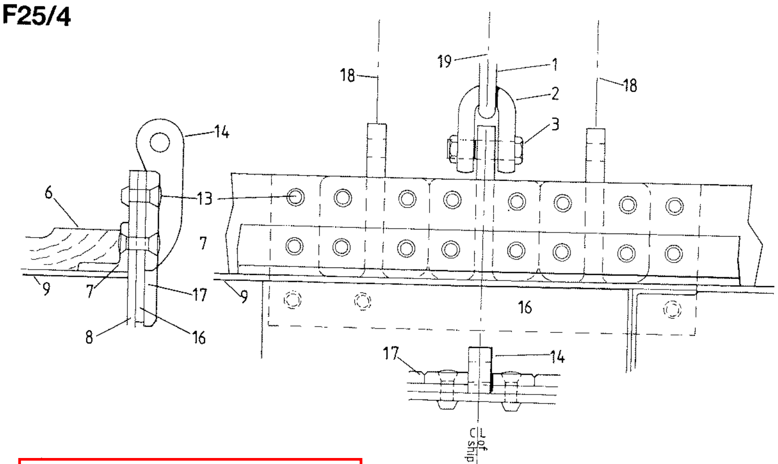
F25/2



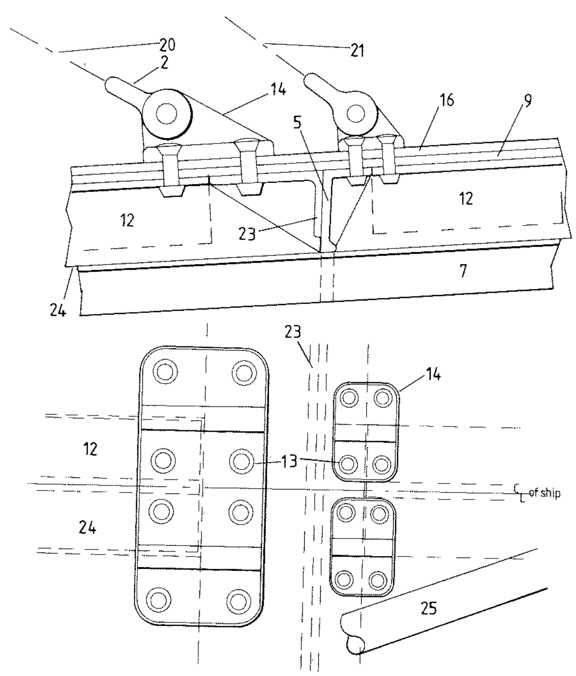
F25/3



F25/4



F25/5



1. BOLT-SCREW RIGGING SLIP
2. SHACKLE
3. PIN
4. FILLING PIECE
5. BULB ANGLE
6. WOODEN DECK
7. STRINGER ANGLE
8. SIDE PLATING
9. DECK PLATING
10. DRAINAGE HOLE
11. CHANNEL BEAM
12. LUG
13. RIVET
14. EYEPLATE
15. CEMENT
16. DOUBLING PLATE
17. PALM
18. MAINSTAY
19. MAIN TOPMAST STAY
20. FORESTAY
21. FORE TOPMAST STAY
22. FILLET
23. BACKPIECE
25. HINGED JACKSTAFF
26. CARGO SPAN

F25 **MAST RIGGING MOUNTINGS** **(1/10 scale, except as noted)**

F25/1 **Section in way of bulb angle to take foremast shrouds**

F25/2 **Section in way of bulb angle to take mainmast shrouds and backstay**

F25/3 **Eyeplates to take foremast backstays (side elevation and end elevation)**

F25/4 **Eyeplates to take main topmast stay and mainstay (elevations and plan)**

F25/5 **Eyeplates to take fore and topmast stays and forestay (elevation and plan)**

Figure 2 - Existing mast anchorage details from "The Anatomy of the Ship: The Cunard Linear – Queen Mary" by Ross Watton (1989)

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JOHN A. MARTIN & ASSOCIATES, INC. □ STRUCTURAL ENGINEERS

Architect ______ Sheet ______ of ______

Project: QUEEN MARY — Job No. 17057

AFT MAST ANCHORAGE — Date ______

REPAIR CORRODED PL — Engineer: BJ

EX. CABLE $1\frac{1}{4}$"ϕ ASSUME $F_y = 35^{ksi}$

$T_u(max) = A_{ROOT}(.9F_y) = .908(.9 \times 35) = 28.6^k$

NEW BENT PL 7"/60° 4" MIN — ASSUME $3\frac{1}{2}$" NOTCH IN 7" LEG — 24.8^k, 28.6^k, 14.3^k, 5"

EFFECTIVE DEPTH OF BENT PL ≈ $5\frac{1}{2}$"

SPAN PL BETWEEN EX. BEAMS @ 3' OC ± CONSIDERING CONTINUITY]9" 3" 5/16" CH. @ 3' OC

$M_{max} = 28.6(3)/8 = 10.73'^k \Rightarrow Z_R = 10.73/.9(50) \times 12"/' = 2.86\ in^3$

BENT PL 7/16" THK $Z = .500(5.5)^2/4 = 3.31\ in^3 > Z_R$ OK

BOLTS - $P_{BOLT} = 24.8^k\left(\frac{1.69" \text{ ecc}}{2.75 \text{ couple}} + 1\right) = 40.0^k$ $V_{BOLT} = 14.3^k$ WORST CASE

7/8"ϕ A325SC $P_{ALLOW} = 40.6^k$ $V_{ALLOW} = 16.6^k$ W/5" BOTT LEG

USE 7/8"ϕ A325 SC @ BEAMS, 7/8"ϕ @ 24" TO DECK

$DCR = 40/40.6 = 0.99 < 1.0$ OK

WELD (N) PL TO EX. 1" PL @ CLEVIS 5/16" FILLET $V_{ALLOW} = 6.96^k/"$

$L_{WELD} = 28.6^k/6.96 = 4.1" \Rightarrow 2\frac{1}{2}"$ E.S. MIN. OK

WELD (N) PL TO EX. BENT PL 5/16" FILLET 2" @ 12" OK BY INSPECTION.

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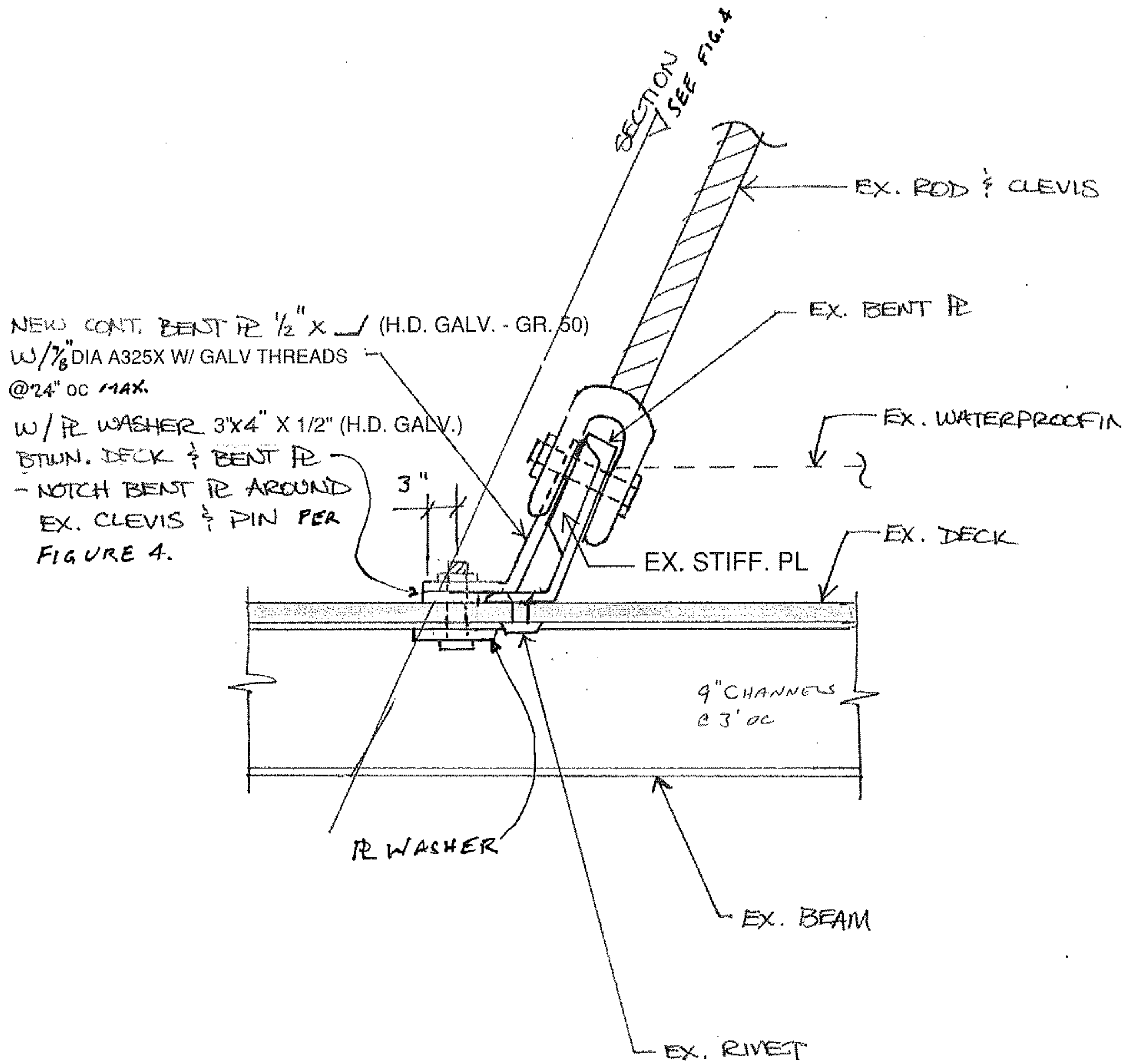
Architect ______ Sheet ____ of ____

Project QUEEN MARY Job No. 17057

AFT MAST SUPPORT PLATE Date 8/15/17

Engineer SJD



NOTE: REMOVE ALL PAINT AND CORROSION FROM EXISTING PLATE AND NEW BENT PLATE, EOR TO REVEIW EXISTING CONDITION OF EXISTING BENT PLATE AND BASE SUPPORT CONDITION PRIOR TO INSTALLING NEW BENT PLATE

950 SOUTH GRAND AVENUE FOURTH FLOOR LOS ANGELES CALIFORNIA 90015 (213) 483-6490

MARTIN & ASSOCIATES
JOHN A. MARTIN & ASSOCIATES, INC. □ STRUCTURAL ENGINEERS

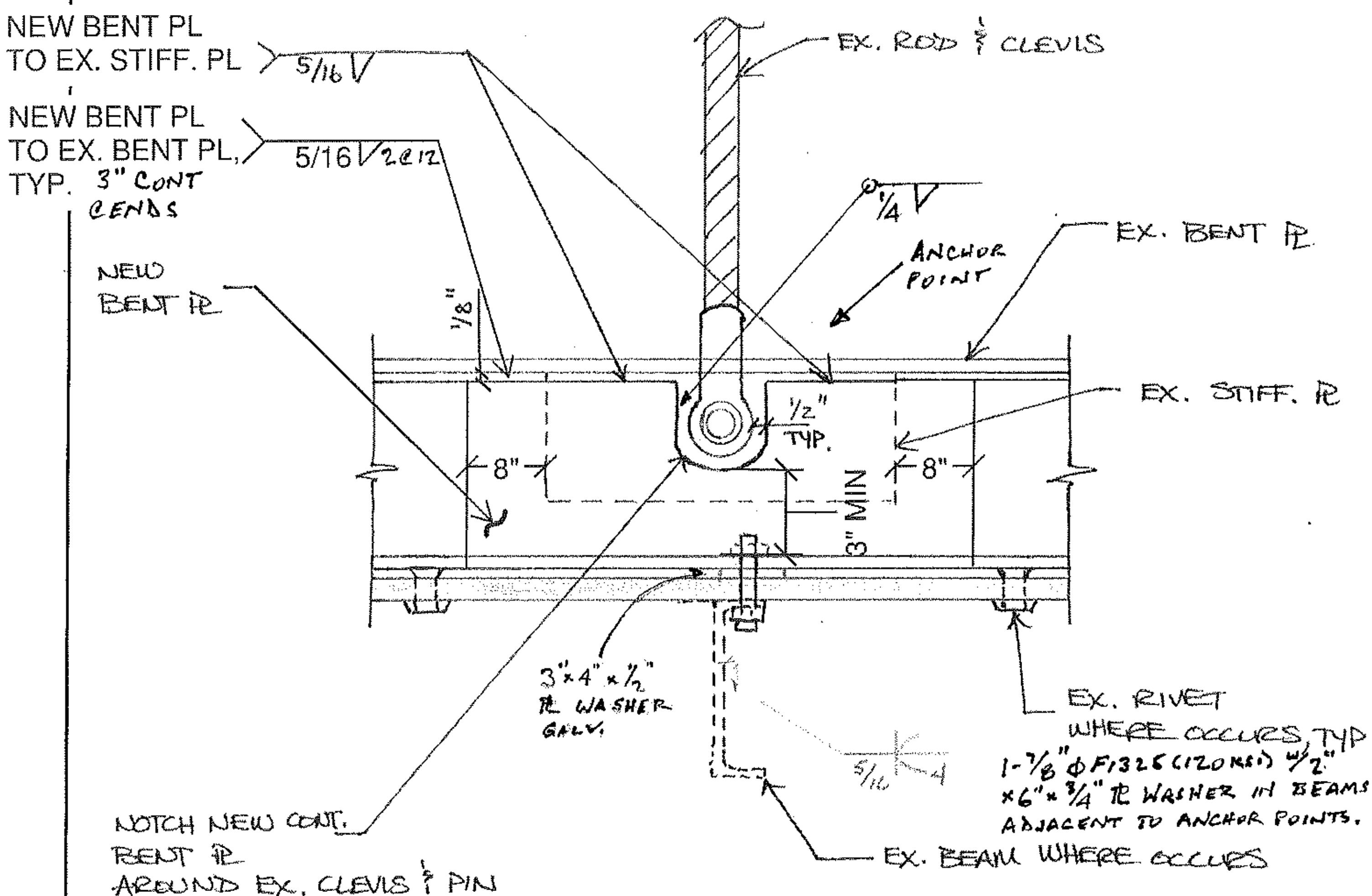
Architect ____________ Sheet ______ of ______

Project QUEEN MARY — Job No. 17057

AFT MAST SUPPORT PLATE — Date 8/15/17

Engineer SJD

NOTE: REMOVE ALL PAINT AND CORROSION FROM EXISTING PLATE AND NEW BENT PLATE, EOR TO REVEIW EXISTING CONDITION OF EXISTING BENT PLATE AND BASE SUPPORT CONDITION PRIOR TO INSTALLING NEW BENT PLATE



SECTION

Appendix D1

Bill Carr Surveys, Inc.
Waterline Survey Report

dated October 11, 2017

QUEEN MARY WATERLINE SURVEY

QUEEN MARY WATERLINE SURVEY

BILL CARR SURVEYS, INC.

DANIEL GARCIA, CEO, PLS# 9038

REVISED OCTOBER 11, 2017

BILL CARR SURVEYS, INC.

615 N. Poplar Street, Orange, CA 92868
(714) 978-3889 / Fax (714) 978-3890
Email: bcarr@billcarrsurveys.com

TABLE OF CONTENTS

BILL CARR SURVEYS, INC.

615 N. Poplar Street, Orange, CA 92868
(714) 978-3889 / Fax (714) 978-3890
Email: bcarr@billcarrsurveys.com

October 6, 2017

Attn: James Jones (Urban Commons)
Jaime Garza (John Martin)
Ben Rogowski (John Martin)

Re: **Narrative**- Queen Mary Waterline to D-Deck Rivet-line Survey

Thank you for the opportunity to conduct this survey and analysis for your project. Our field crews' procedure on this survey was as follows:

- Control was recovered from a nearby Port of Long Beach (POLB) Control Point so that the project horizontal data and vertical datum could be related back to "real world" coordinates and elevations. This may be useful for dropping points into Google Earth or to be relatable to future port development civil documents.
- A control system of control points was run around the ship in a traverse and level circuit to establish a continuous system from which measurements could be made and be related to one another in 3-dimensional CAD space.
- Readings were taken simultaneously by 2 separate crews on opposite sides and ends of the ship so as to minimize drift error. Shots were also timed to be as close to the projected low tide (slack tide) as possible to minimize the amount of tidal variation error that could affect readings.
- The overall ship length was measured from top of bow tip (shot #1000) to furthest back tip of stern (shot #1002) overall length was measured at 1019.40'
- Shots were taken at waterline and at the exterior D-deck rivet-line at locations specified during our initial project job walk. Please review the field notes and pictures carefully because the rivet line configuration differed at bow, mid-ship, and stern locations.
- Shots were taken on the interior of the ship aft of the mid-ship at the locations identified in our initial project job walk. Please note that the locations are behind doors and that the precise locations were marked for future identification if needed. Review pictures for visual. These points may help in confirming the elevation delta between the centerline of a rivet-line and the actual metal floor of the D-Deck.
- Data was brought into office for preliminary analysis
- Another field visit was made to verify data
- Final Analysis of data was made, including this report

Please feel free to call me if you have any questions or concerns. We're here to help.

Best Regards,

Daniel G. Garcia

Daniel G. Garcia, CEO, PLS #9038
Bill Carr Surveys, Inc.

CONTROL INFORMATION

POLB Control Point used:

GPS Station 6044

Northing: 1733166.02

Easting: 6502251.02

Elevation: 14.06 (2006 Adj.)

Description: Found Gear Spike and Washer in the northeasterly part of the Intersection of Harbor Plaza and Queensway Drive

Horizontal Datum:

CCS83 Zone 5, Epoch 2007.00

Vertical Datum:

NGVD29 MLLW

WATERLINE TO RIVET LINE ANALYSIS

WATER ELEVATION AVERAGES*

*Note: only port side shots used ; the waterline was better sighted due to closer proximity

BOW WATERLINE AT 1:30 PM +/-

100	1732707.281	6503519.241	2.910	PORT BOW WTR @ 1:30 +/-
101	1732706.188	6503519.679	2.878	PORT BOW WTR @ 1:30 +/-
102	1732705.146	6503521.353	2.913	PORT BOW WTR @ 1:30 +/-
103	1732704.400	6503522.529	2.905	PORT BOW WTR @ 1:30 +/-
104	1732702.881	6503524.916	2.895	PORT BOW WTR @ 1:30 +/-
		BOW WATERLINE AVERAGE ELEV.	2.900	

MIDSHIP WATERLINE AT 2:02 PM +/-

300	1732459.027	6503934.987	2.817	PORT MID WTR @ 2:02 +/-
301	1732458.602	6503935.976	2.817	PORT MID WTR @ 2:02 +/-
302	1732458.315	6503936.668	2.816	PORT MID WTR @ 2:02 +/-
303	1732457.876	6503937.682	2.792	PORT MID WTR @ 2:02 +/-
304	1732457.505	6503938.495	2.808	PORT MID WTR @ 2:02 +/-
		MID WATERLINE AVERAGE ELEV.	2.810	

STERN WATERLINE AT 2:25 PM +/-

500	1732309.938	6504395.338	2.729	PORT STRN WTR @ 2:25+/-
501	1732309.750	6504396.695	2.745	PORT STRN WTR @ 2:25+/-
502	1732309.642	6504397.597	2.731	PORT STRN WTR @ 2:25+/-
503	1732309.437	6504398.627	2.731	PORT STRN WTR @ 2:25+/-
504	1732309.314	6504399.645	2.730	PORT STRN WTR @ 2:25+/-
		STERN WATERLINE AVERAGE ELEV.	2.733	

WATERLINE TO RIVET LINE DELTAS

	SHOT#	ELEVATION	DELTA
BOW PORT D-DECK RIVET LINE ELEVATION	108	24.28	21.38
BOW STARBOARD D-DECK RIVET LINE ELEVATION	210	24.29	21.39
MIDSHIP PORT D-DECK RIVET LINE ELEVATION	309	6.98	4.17
MIDSHIP STARBOARD D-DECK RIVET LINE ELEVATION	409	7.96	5.15
STERN PORT D-DECK RIVET LINE ELEVATION	509	15.80	13.07
STERN STARBOARD D-DECK RIVET LINE ELEVATION	609	16.02	13.29

STATION AND OFFSET ANALYSIS

Station and offset from baseline for relevant shots

Baseline points (calc'd from lowest number and stamp shots and bow and stern tip shots):

1008	1732711.865	6503508.667	0.000	BASELINE CALC
1009	1732300.309	6504441.299	0.000	BASELINE CALC

Distance between baseline points:
1019.402 (THE MEASURED LENGTH OF THE SHIP)

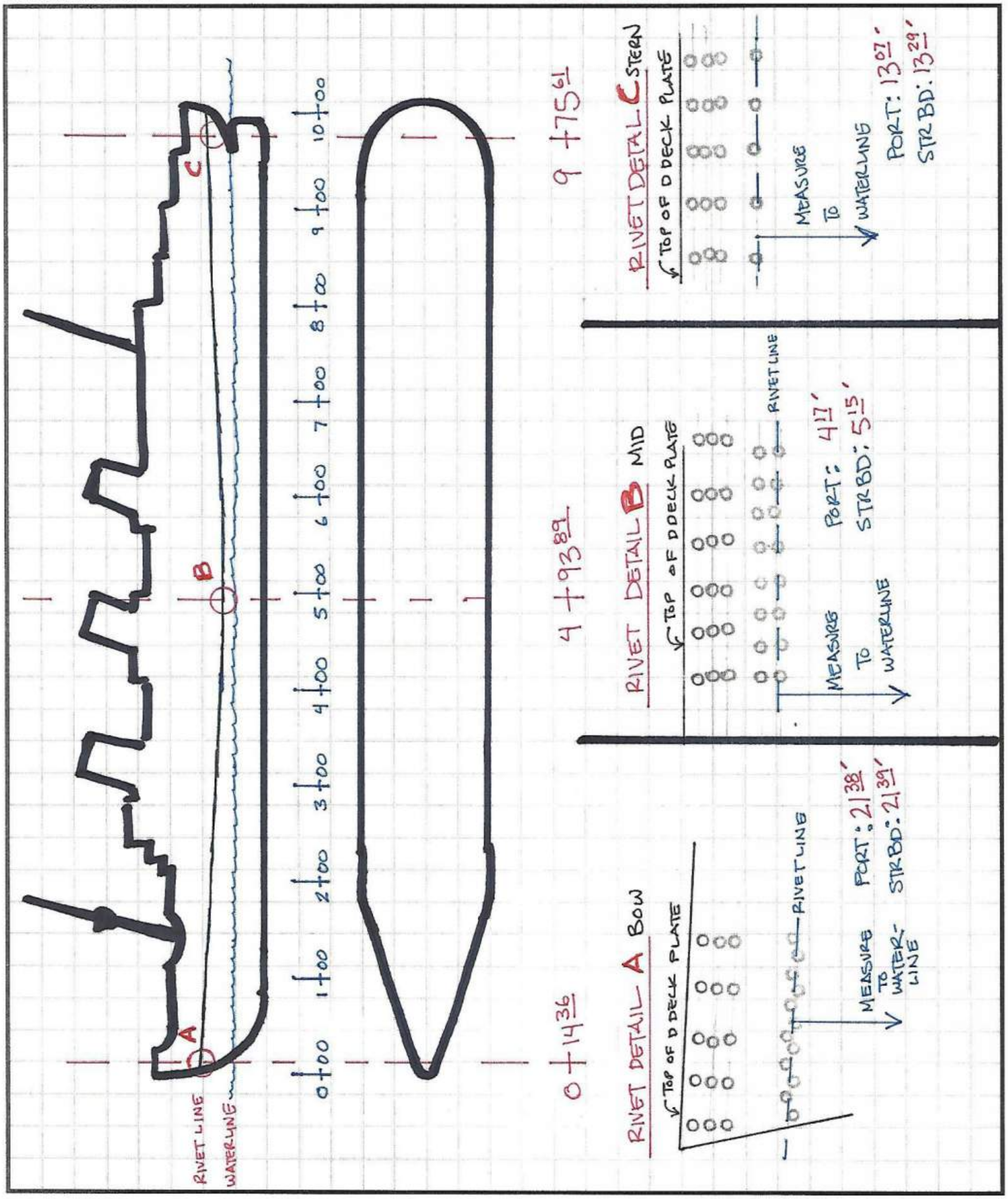
PT	STATION	OFFSET		ELEV	DESCRIPTION
1008	0+00		0.000	0.000	BASELINE CALC AT BOW
1009	10+19.402		0.000	0.000	BASELINE CALC AT STERN
107	0+14.438	R1.086		4.003	PORT BOW CL #S @ 1:32 +/-
207	0+14.282	L1.086		4.419	STRBD BOW CL #S @ 1:32 +/-
108	0+10.73	R1.483		24.276	PORT BOW RIVET CL @ 1:38 +/-
210	0+12.296	L1.472		24.289	STRBD BOW RIVET CL @ 1:38 +/-
307	4+93.881	R59.235		7.170	PORT MID CL STAMP @ 2:06 +/-
407	4+93.890	L59.256		4.391	STRBD MID CL STAMP @ 2:06 +/-
309	4+93.864	R59.219		6.978	PORT MID RIVET CL @ 2:09 +/-
409	4+94.020	L59.224		7.958	STRBD MID RIVET CL @ 2:09 +/-
507	9+75.572	R10.359		3.862	PORT STRN CL #S @ 2:28 +/-
607	9+75.641	L10.359		3.799	STRBD STRN CL #S @ 2:28 +/-
509	9+75.577	R19.965		15.801	PORT STRN RIVET CL @ 2:31 +/-
609	9+75.471	L19.831		16.016	STRBD STRN RIVET CL @ 2:31 +/-
2000	6+08.152	R59.125		8.365	INTERIOR PORT RIVET @11:45+/-
2001	6+08.361	R58.309		8.161	INTERIOR PORT D-DECK @11:45+/-
2002	5+90.967	L58.942		9.333	INTERIOR STRBD RIVET @12:00+/-
2003	5+90.437	L58.124		9.093	INTERIOR STRBD D-DECK @12:00+/-

* Please note: these “L” and “Rs” (Left and Rights) are in relation to the baseline running from bow to stern so they are flipped in relation to marine terminology. In this case, Left is Starboard and Right is Port, as if you are standing on the baseline, facing aft -towards the back of the ship. Surveyors refer to this as “up-station” because the stations increase running toward the stern.

BILL CARR SURVEYS
MAIN OFFICE:
615 N. Poplar Street, Orange, CA 92868
(714) 978-3889 • FAX (714) 978-3890
Email: bcarr@billcarrsurveys.com

LICENSED LAND SURVEYOR

JOB: QUEEN MARY SURVEY
SHEET NO. ______ OF ______
CALCULATED BY: DG DATE: 10/6/17
CHECKED BY ______ DATE ______
SCALE: NTS



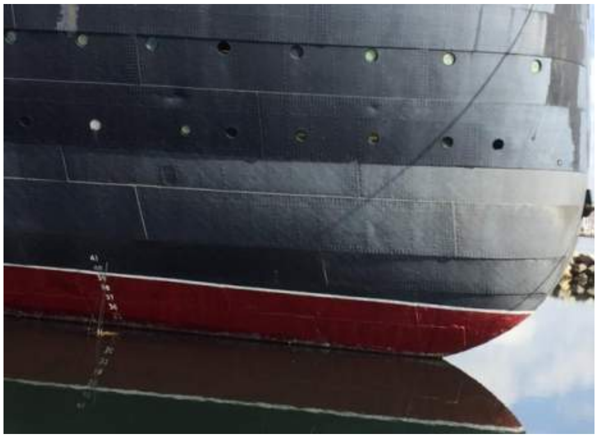
PORT BOW

STARBOARD BOW

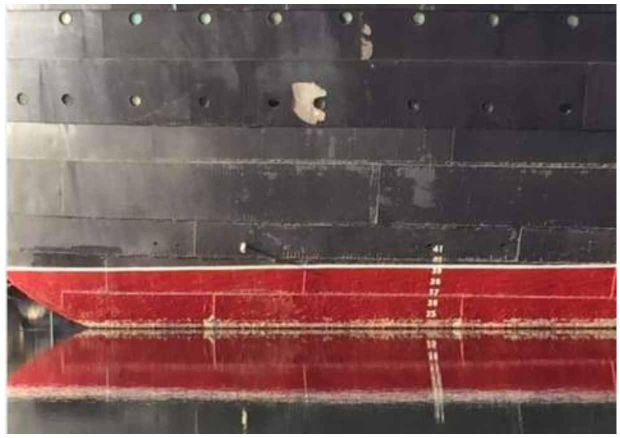
PORT MIDSHIP

STARBOARD MIDSHIP

PORT STERN



STARBOARD STERN



PORT INTERIOR SHOTS (2000, 2001)

STARBOARD INTERIOR SHOTS (2002, 2003)

RAW POINT DATA

LEGEND

- EXTERIOR CONTROL POINTS
- INTERIOR CONTROL POINTS
- EXTERIOR PORT SIDE SURVEY SHOTS
- EXTERIOR STARBOARD SIDE SURVEY SHOTS
- BASELINE AT CALCULATED SHIP CENTERLINE
- INTERIOR SURVEY SHOTS

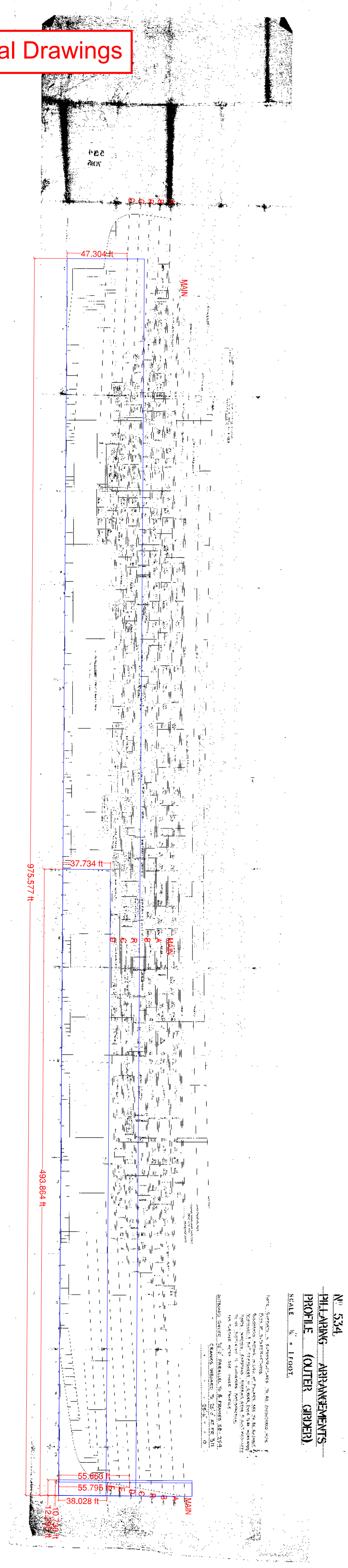
PT	NORTHING	EASTING	ELEV	DESCRIPTION
1	1732613.850	6503292.520	13.720	CTL PT MAG SW
2	1732717.003	6503326.127	10.340	CTL PT CONC PAD X WEST
3	1732830.455	6503478.033	10.970	CTL PT ROCKS X NW
4	1732714.783	6504041.444	11.550	CTL PT ROCKS X N MID
5	1732519.397	6504487.482	11.070	CTL PT ROCKS X NE
6	1732231.630	6504588.316	10.830	CTL PT ROCKS X EAST
7	1732185.370	6504335.246	13.260	CTL PT CONC X SE
8	1732234.611	6504150.809	12.720	CTL PT X SE
9	1732344.952	6503900.959	12.280	CTL PT MAG S MID
10	1732427.384	6503921.905	12.070	CTL PT X S MID
11	1732406.059	6504076.077	13.481	CTL PT INTERIOR @ 11:30 +/-
12	1732419.659	6504041.503	8.387	CTL PT INTERIOR @ 11:30 +/-
13	1732519.388	6504062.646	9.124	CTL PT INTERIOR @ 11:30 +/-
100	1732707.281	6503519.241	2.910	PORT BOW WTR @ 1:30 +/-
101	1732706.188	6503519.679	2.878	PORT BOW WTR @ 1:30 +/-
102	1732705.146	6503521.353	2.913	PORT BOW WTR @ 1:30 +/-
103	1732704.400	6503522.529	2.905	PORT BOW WTR @ 1:30 +/-
104	1732702.881	6503524.916	2.895	PORT BOW WTR @ 1:30 +/-
105	1732705.261	6503520.533	9.793	PORT BOW CL #S @ 1:32 +/-
106	1732705.167	6503521.132	5.768	PORT BOW CL #S @ 1:32 +/-
107	1732705.042	6503521.437	4.003	PORT BOW CL #S @ 1:32 +/-
108	1732706.176	6503517.885	24.276	PORT BOW RIVET CL @ 1:38 +/-
109	1732705.291	6503518.805	28.069	WRONG RIVET LINE
110	1732704.152	6503520.416	27.923	WRONG RIVET LINE
200	1732707.269	6503521.354	2.988	STRBD BOW WTR @ 1:30 +/-
201	1732707.115	6503521.888	3.009	STRBD BOW WTR @ 1:30 +/-
202	1732707.005	6503522.292	2.986	STRBD BOW WTR @ 1:30 +/-
203	1732706.855	6503522.845	2.965	STRBD BOW WTR @ 1:30 +/-
204	1732706.714	6503523.357	2.991	STRBD BOW WTR @ 1:30 +/-
205	1732707.379	6503521.573	8.998	STRBD BOW CL #S @ 1:32 +/-
206	1732707.215	6503521.868	6.439	STRBD BOW CL #S @ 1:32 +/-
207	1732707.092	6503522.172	4.419	STRBD BOW CL #S @ 1:32 +/-
208	1732708.647	6503518.564	24.306	STRBD BOW RIVET CL @ 1:38 +/-
209	1732708.515	6503519.363	24.428	STRBD BOW RIVET CL @ 1:38 +/-

210	1732708.247	6503520.510	24.289	STRBD BOW RIVET CL @ 1:38 +/-
300	1732459.027	6503934.987	2.817	PORT MID WTR @ 2:02 +/-
301	1732458.602	6503935.976	2.817	PORT MID WTR @ 2:02 +/-
302	1732458.315	6503936.668	2.816	PORT MID WTR @ 2:02 +/-
303	1732457.876	6503937.682	2.792	PORT MID WTR @ 2:02 +/-
304	1732457.505	6503938.495	2.808	PORT MID WTR @ 2:02 +/-
305	1732458.358	6503936.634	9.878	PORT MID CL STAMP @ 2:06 +/-
306	1732458.282	6503936.597	7.682	PORT MID CL STAMP @ 2:06 +/-
307	1732458.280	6503936.595	7.170	PORT MID CL STAMP @ 2:06 +/-
308	1732458.792	6503935.456	7.012	PORT MID RIVET CL @ 2:09 +/-
309	1732458.302	6503936.586	6.978	PORT MID RIVET CL @ 2:09 +/-
310	1732457.927	6503937.440	6.999	PORT MID RIVET CL @ 2:09 +/-
400	1732567.566	6503982.265	2.902	STRBD MID WTR @ 2:02 +/-
401	1732567.073	6503983.416	2.884	STRBD MID WTR @ 2:02 +/-
402	1732566.662	6503984.450	2.890	STRBD MID WTR @ 2:02 +/-
403	1732566.000	6503985.753	2.874	STRBD MID WTR @ 2:02 +/-
404	1732565.405	6503987.090	2.880	STRBD MID WTR @ 2:02 +/-
405	1732566.396	6503984.330	10.169	STRBD MID CL STAMP @ 2:06 +/-
406	1732566.653	6503984.430	7.522	STRBD MID CL STAMP @ 2:06 +/-
407	1732566.682	6503984.441	4.391	STRBD MID CL STAMP @ 2:06 +/-
408	1732567.502	6503982.538	7.964	STRBD MID RIVET CL @ 2:09 +/-
409	1732566.600	6503984.546	7.958	STRBD MID RIVET CL @ 2:09 +/-
410	1732565.916	6503986.081	7.951	STRBD MID RIVET CL @ 2:09 +/-
500	1732309.938	6504395.338	2.729	PORT STRN WTR @ 2:25+/-
501	1732309.750	6504396.695	2.745	PORT STRN WTR @ 2:25+/-
502	1732309.642	6504397.597	2.731	PORT STRN WTR @ 2:25+/-
503	1732309.437	6504398.627	2.731	PORT STRN WTR @ 2:25+/-
504	1732309.314	6504399.645	2.730	PORT STRN WTR @ 2:25+/-
505	1732303.495	6504394.973	9.826	PORT STRN CL #S @ 2:28 +/-
506	1732305.894	6504395.879	6.879	PORT STRN CL #S @ 2:28 +/-
507	1732308.526	6504397.017	3.862	PORT STRN CL #S @ 2:28 +/-
508	1732299.904	6504392.352	15.768	PORT STRN RIVET CL @ 2:31 +/-
509	1732299.736	6504393.144	15.801	PORT STRN RIVET CL @ 2:31 +/-
510	1732299.580	6504394.025	15.800	PORT STRN RIVET CL @ 2:31 +/-
600	1732328.450	6504402.820	2.860	STRBD STRN WTR @ 2:25+/-
601	1732327.369	6504404.065	2.828	STRBD STRN WTR @ 2:25+/-
602	1732326.549	6504405.023	2.805	STRBD STRN WTR @ 2:25+/-
603	1732325.955	6504405.793	2.786	STRBD STRN WTR @ 2:25+/-
604	1732325.058	6504406.906	2.758	STRBD STRN WTR @ 2:25+/-
605	1732332.687	6504407.728	10.377	STRBD STRN CL #S @ 2:28 +/-
606	1732329.594	6504406.360	6.386	STRBD STRN CL #S @ 2:28 +/-
607	1732327.453	6504405.445	3.799	STRBD STRN CL #S @ 2:28 +/-
608	1732336.733	6504408.649	16.291	STRBD STRN RIVET CL @ 2:31 +/-
609	1732336.187	6504409.113	16.016	STRBD STRN RIVET CL @ 2:31 +/-
610	1732335.317	6504410.210	16.016	STRBD STRN RIVET CL @ 2:31 +/-
1000	1732711.419	6503508.470	72.847	TOP TIP BOW @ 12:20

1001	1732707.131	6503519.166	3.264	BOW TIP WATER @ 12:22
1002	1732300.358	6504441.320	21.532	BACK STRN TIP 12:20
1003	1732305.576	6504430.159	3.531	BACK TIP WATER +/- (BAD ANGLE-DON'T USE)
1004	1732711.877	6503508.672	0.000	TEMP CALC- DONT USE
1005	1732706.067	6503521.805	0.000	CL CALC
1006	1732512.481	6503960.518	0.000	CL CALC
1007	1732317.990	6504401.231	0.000	CL CALC
1008	1732711.865	6503508.667	0.000	BASELINE CALC
1009	1732300.309	6504441.299	0.000	BASELINE CALC
2000	1732412.247	6504041.184	8.365	INTERIOR PORT RIVET @11:45+/-
2001	1732412.909	6504041.704	8.161	INTERIOR PORT D-DECK @11:45+/-
2002	1732527.202	6504073.128	9.333	INTERIOR STRBD RIVET @12:00+/-
2003	1732526.668	6504072.313	9.093	INTERIOR STRBD D-DECK @12:00+/-

Appendix D2

Original as-built drawings


47.304 ft
MAIN
37.734 ft
975.577 ft
493.864 ft
55.660 ft
55.796 ft
38.028 ft
Nº 534
PILLARING ARRANGEMENTS
PROFILE (OUTER GIRDER)
SCALE 1/8" = 1 FOOT.

Appendix D3

Current Draft Calculations from Waterline Survey Data

(bow, amidships, and stern)

JOHN A. MARTIN and ASSOCIATES, INC. □ STRUCTURAL ENGINEERS

Client:	Urban Commons	Sheet	
Project:	Queen Mary	Job no	17057
		Date	10/17/2017
	Waterline Survey	Engineer	BR

Calculation of Drafts using Decks Heights from As-Built and Bill Carr Survey (dated October 6, 2017)

	Port	Starboard
Distance from Center of Rivet to Top of Deck (Survey Data) =	0.20'	0.24'

Bow at 14.417' from Fore Peak (6" Forward of Frame 356)

	Port	Starboard
Freeboard from "D"-Deck Rivet Line (Survey Data) =	21.38'	21.39'
Freeboard from "D"-Deck =	21.18'	21.15'
"D"-deck Height above Baseline (Scaled form Drawing) =	55.66'	55.80'
Draft =	34.49'	34.65'

Midship at 493.890' from Fore Peak (18" Forward of Frame 175) (Width = 118.443')

	Port	Starboard
Freeboard from "D"-Deck Rivet Line (Survey Data) =	4.17'	5.15'
Freeboard from "D"-Deck =	3.97'	4.91'
"D"-deck Height above Baseline (Scaled form Drawing) =	37.73'	37.73'
Draft =	33.77'	32.82'

Aft at 975.577' from Fore Peak (Frame 2) (Width = 39.796')

	Port	Starboard
Freeboard from "D"-Deck Rivet Line (Survey Data) =	13.07'	13.29'
Freeboard from "D"-Deck =	12.87'	13.05'
"D"-deck Height above Baseline (Scaled form Drawing) =	47.30'	47.30'
Draft =	34.44'	34.25'

Average Drafts and List

	Mean Draft	List
Forward =	34.57'	-
Midship =	33.30'	0.46°
Aft =	34.35'	0.26°

Average Draft at the ends of the ship =	34.46'	
Difference between the average end Draft and the middle =	1.16'	13.92in

Appendix D4

Smith-Emery Laboratories
Material Property Testing Report

dated October 3, 2017

SMITH-EMERY LABORATORIES
An Independent Commercial Testing Laboratory, Established 1904
781 East Washington Boulevard, Los Angeles, California 90021 ♦ Phone (213) 749-3411 ♦ Fax (213) 741-8626

JAMES JONES
URBAN COMMONS LLC
777 FIGUEROA STREET SUITE 2870
LOS ANGELES, CA 90017

Date: October 3, 2017
Project No.: 44822 - 1
Lab. Report.: M17 - 251

QUEEN MARY MATERIAL TESTING PROGRAM

1.0 BULKHEAD AND OUTER HULL MATERIAL TESTS

TENSILE RESULT OF BULKHEAD SPECIMEN

ID	Nom. Thk.	*Tensile Properties		
		Elon. 2-in Gage	Yield Stress, psi	Tensile Stress, psi
BH 112	½-in	36 %	39, 060	61, 530
ASTM A 36 - 14		**23 %**	**36,000min**	**58,000 - 80,000**

* 0.2% offset yield stress

TENSILE RESULT OF OUTER HULL SPECIMENS

ID	Nom. Thk.	Tensile Properties		
		Elon. 2-in Gage	*Yield Stress, psi	Tensile Stress, psi
32 - 33	1.0-in	40 %	29, 975	57, 655
108 - 109	1-1/8-in	38 %	30, 045	56, 425
177 - 178	1-1/2-in	38 %	29, 010	56, 840
208 - 209	1-1/8-in	39 %	29, 865	56, 980
261 - 262	1-1/8-in	37 %	29, 855	56, 995
322 - 323	7/8-in	39 %	31, 695	59, 275

*0.2% offset yield stress

IMPACT ENERGY AT +70 ^{o}F

Sample ID	*Impact Energy, ft·lbf	
	Tested	Average
BH 112	40, 32, 30	34
32 - 33	56, 28, 42	42
108 - 109	70, 60, 76	69
177 - 178	48, 38, 36	41
208 - 209	66, 48, 54	56
261 - 262	50, 30, 34	38
322 - 323	44, 52, 66	54

*Full-size specimens in L-T orientation

cont'd

***CHEMICAL COMPOSITIONS OF STRUCTURAL STEEL, wt %**

Element, wt %	C	Mn	Si	P	S	Cr	Ni	Mo	Nb	Cu	Co	Al	**C.E
BH 112	0.16	0.59	0.05	0.030	0.029	0.01	0.03	<0.01	--	0.05	0.01	<0.01	***0.28***
32 - 33	0.17	0.55	0.07	0.017	0.036	0.02	0.06	<0.01	--	0.09	0.01	<0.01	***0.29***
108 - 109	0.16	0.60	0.08	0.013	0.030	0.02	0.06	<0.01	--	0.08	0.01	0.01	***0.29***
177 - 178	0.16	0.60	0.08	0.014	0.040	0.02	0.07	<0.01	--	0.08	0.01	0.01	***0.29***
208 - 209	0.15	0.55	0.06	0.013	0.043	0.02	0.10	<0.01	--	0.10	0.01	<0.01	***0.27***
261 - 262	0.15	0.56	0.06	0.013	0.043	0.02	0.10	<0.01	--	0.10	0.01	<0.01	***0.27***
322 - 323	0.18	0.57	0.07	0.023	0.050	0.02	0.05	<0.01	--	0.09	0.01	<0.01	***0.30***
ASTM A 36-14	**0.25**	**NR**	**0.40**	**0.030**	**0.030**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	***NR***

NR = No Requirement
* Chemical analyses performed under our direction by our approved ISO:17025 accredited sub-contractor
** C.E = Carbon Equivalent in accordance with AWS D1.1:2015 Structural Welding Code - Steel

2.0 TOP PLATES

TENSILE RESULTS OF TOP PLATES

ID	Nom. Thk.	Tensile Properties: Elon. 2-in Gage	Tensile Properties: *Yield Stress, psi	Tensile Properties: Tensile Stress, psi
114 C	5/8-in	38 %	34, 155	64, 905
173 B	½-in	34 %	36, 565	65, 385
238 A	½-in	37 %	34, 010	61, 375

*0.2% offset yield stress

CVN AT +70 ^{0}F OF TOP PLATES

ID	Impact Energy, ft·lbf: Tested	Impact Energy, ft·lbf: Average
114 C	24, 28, 26	26
173 B*	24, 24, 20	23
238 A	24, 22, 26	24

* ¾-size specimens in L-T orientation;
All others are full-size

cont'd

***CHEMICAL COMPOSITIONS OF TOP PLATES, wt %**

Element, wt %	C	Mn	Si	P	S	Cr	Ni	Mo	V	Cu	Co	Al	**C.E
114 C	0.22	0.60	0.08	0.018	0.038	0.01	0.05	<0.01	<0.01	0.05	0.01	<0.01	***0.35***
173 B	0.20	0.58	0.08	0.013	0.030	0.01	0.05	<0.01	<0.01	0.09	0.01	<0.01	***0.32***
238 A	0.20	0.55	0.07	0.016	0.024	0.02	0.07	<0.01	<0.01	0.09	0.01	<0.01	***0.32***
ASTM A 36-14	**0.25**	**NR**	**0.40**	**0.030**	**0.030**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	***NR***

NR = No Requirement
* Chemical analyses performed under our direction by our approved ISO:17025 accredited sub-contractor
** C.E = Carbon Equivalent in accordance with AWS D1.1:2015 Structural Welding Code - Steel

3.0 GIRDER PLATES

TENSILE RESULTS OF GIRDER PLATES

		Tensile Properties		
ID	Nom. Thk.	Elon. 2-in Gage	*Yield Stress, psi	Tensile Stress, psi
114 C	½-in	41 %	36, 060	60, 360
173 B	5/8-in	36 %	33, 695	63, 305
238 A	½-in	42 %	34, 275	55, 310

*0.2% offset yield stress

CVN AT +70 ^{0}F OF GIRDERS

	*Impact Energy, ft·lbf	
ID	Tested	Average
114 C	66, 78, 69	71
173 B	26, 35, 48	36
238 A	60, 38, 64	54

*Full-size specimens in L-T orientation

cont’d

***CHEMICAL COMPOSITIONS OF GIRDER PLATES, wt %**

Element, wt %	C	Mn	Si	P	S	Cr	Ni	Mo	V	Cu	Co	Al	**C.E
114 C	0.18	0.57	0.08	0.016	0.032	0.01	0.03	<0.01	<0.01	0.08	0.01	<0.01	***0.30***
173 B	0.20	0.58	0.08	0.013	0.030	0.01	0.05	<0.01	<0.01	0.09	0.01	<0.01	***0.33***
238 A	0.18	0.49	0.07	0.014	0.044	0.02	0.05	<0.01	<0.01	0.11	0.01	<0.01	***0.32***
ASTM A 36-14	**0.25**	**NR**	**0.40**	**0.030**	**0.030**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	***NR***

NR = No Requirement
* Chemical analyses performed under our direction by our approved ISO:17025 accredited sub-contractor
** C.E = Carbon Equivalent in accordance with AWS D1.1:2015 Structural Welding Code - Steel

4.0 ANGLES

TENSILE RESULTS OF ANGLES

		Tensile Properties		
ID	Nom. Thk.	Elon. 2-in Gage	*Yield Stress, psi	Tensile Stress, psi
114 C	5/18-in	30 %	35, 710	63, 045
173 B	9/16-in	38 %	37, 230	64, 505
238 A	9/16-in	38 %	37, 745	60, 390

*0.2% offset yield stress

CVN AT +70 ^{0}F OF ANGLES

	*Impact Energy, ft·lbf	
ID	Tested	Average
114 C	16, 14, 20	17
173 B	26, 34, 28	29
238 A	22, 20, 20	21

*Full-size specimens in L-T orientation

cont'd

***CHEMICAL COMPOSITIONS OF ANGLES, wt %**

Element, wt %	C	Mn	Si	P	S	Cr	Ni	Mo	V	Cu	Co	Al	**C.E
114 C	0.24	0.47	0.07	0.009	0.003	0.04	0.04	<0.01	<0.01	0.08	0.01	0.01	***0.35***
173 B	0.26	0.55	0.07	0.015	0.028	0.03	0.03	<0.01	<0.01	0.06	0.01	0.01	***0.37***
238 A	0.22	0.57	0.09	0.010	0.032	0.02	0.04	<0.01	<0.01	0.04	0.01	0.01	***0.34***
ASTM A 36-14	**0.25**	**NR**	**0.40**	**0.030**	**0.030**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	**NR**	***NR***

NR = No Requirement
* Chemical analyses performed under our direction by our approved ISO:17025 accredited sub-contractor
** C.E = Carbon Equivalent in accordance with AWS D1.1:2015 Structural Welding Code - Steel

5.0 RIVETS

TENSILE TEST RESULTS FOR RIVETS

Section - ID	*Tensile Properties Elon. 1-in Gage	Yield Stress, psi	Tensile Stress, psi
173 B - Rivet # 1	34 %	47, 970	73, 090

*Sub-size tensile specimens, 0.250-in diameter and 1.0-in gage length; Specimen preparation and testing performed by Smith-Emery approved ISO:17025/NADCAP sub-contractor

TENSILE TEST RESULTS FOR RIVETS

Section - ID	*Tensile Properties Elon. 0.640-in Gage	Yield Stress, psi	Tensile Stress, psi
173 B - Rivet # 2	43 %	64, 300	66, 620
173 B - Rivet # 3	38 %	48, 460	68, 390

*Sub-size tensile specimens, 0.160-in diameter and 0.640-in gage length; Specimen preparation and testing performed by Smith-Emery approved ISO:17025/NADCAP sub-contractor

***CHEMICAL COMPOSITIONS OF RIVETS, wt %**

Element, wt %	C	Mn	Si	P	S	Cr	Ni	Mo	V	Cu	Co	Al	C.E
173 B - Rivet # 1	0.23	0.56	0.01	0.025	0.025	0.01	0.03	<0.01	<0.01	0.09	0.02	<0.01	***N/A***
173 B - Rivet # 2	0.19	0.50	0.01	0.019	0.027	0.01	0.03	<0.01	<0.01	0.10	0.01	<0.01	***N/A***
173 B - Rivet # 3	0.18	0.56	0.01	0.018	0.023	0.01	0.03	<0.01	<0.01	0.19	0.02	<0.01	***N/A***

* Chemical analyses performed under our direction by our approved ISO:17025 accredited sub-contractor

cont'd

Concluding Summary

The tensile properties are generally comparable to ASTM A 36-14 specification for Carbon Structural steel, although the yield strength is often marginally lower than that specified. The chemical compositions are also similar to ASTM A 36 for material up to ¾-in thick. These compositions are typical of plain (un-alloyed) low-carbon steel.

The ultimate tensile strength is in the range 58, 000 - 80, 000 psi and equivalent to that specified in ASTM A 36 -14. In accordance with AWS D1.1:2015 Structural Welding Code-Steel, ASTM A 36-14 material up to ¾-in thick is categorized as Group I base metal and is readily weldable with E60XX or E70XX low-hydrogen electrodes. The structural steel tested has a maximum Carbon Equivalent of 0.37 and therefore is considered weldable. However, the contractor should following the guidelines in the applicable welding code to review his WPS (Welding Procedure Specification) and/or test sample welds before qualifying a welding procedure.

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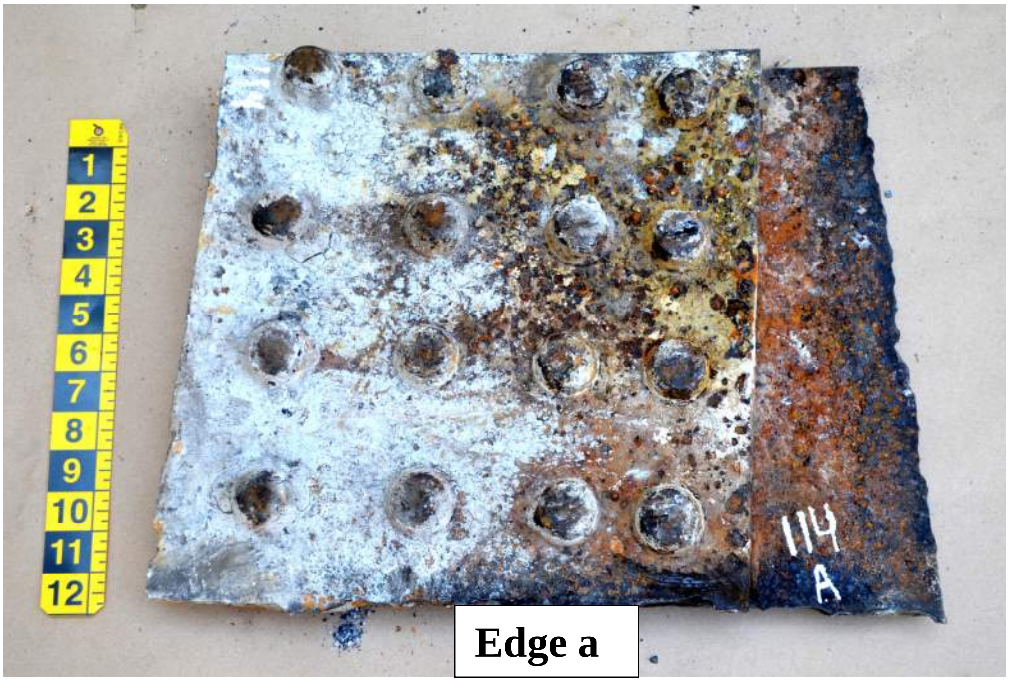
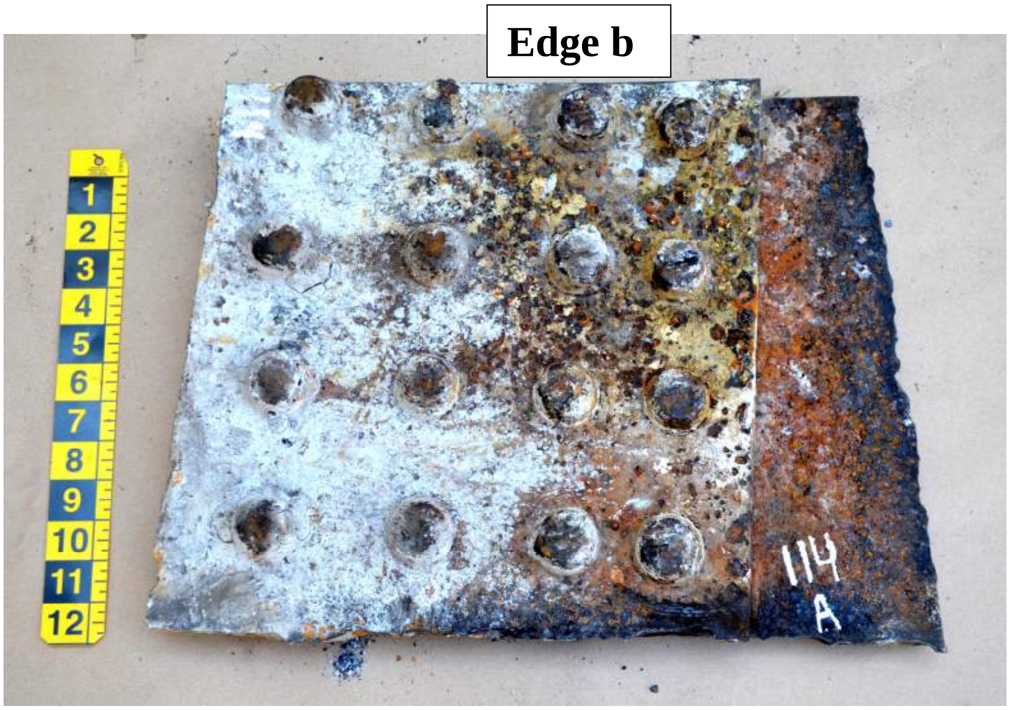
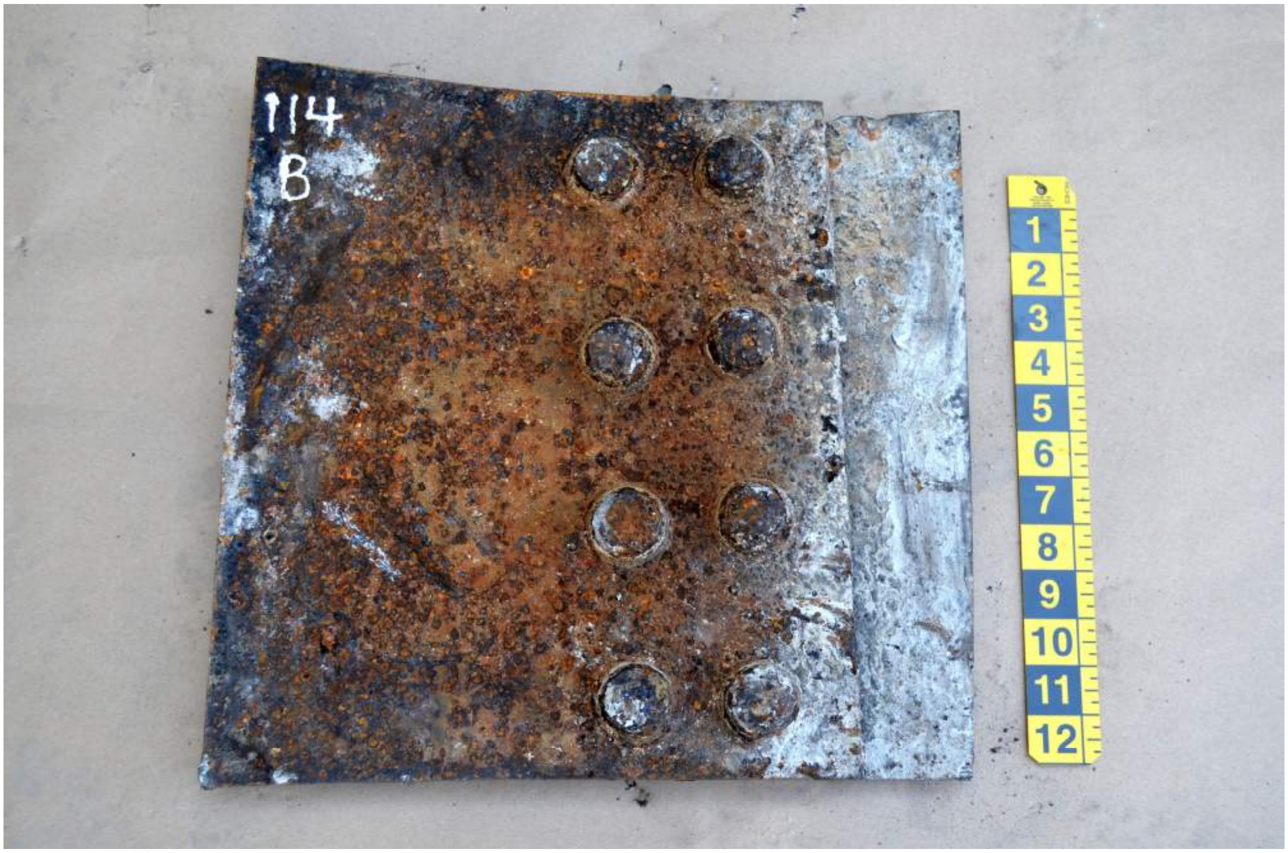


114 A - At Edge a

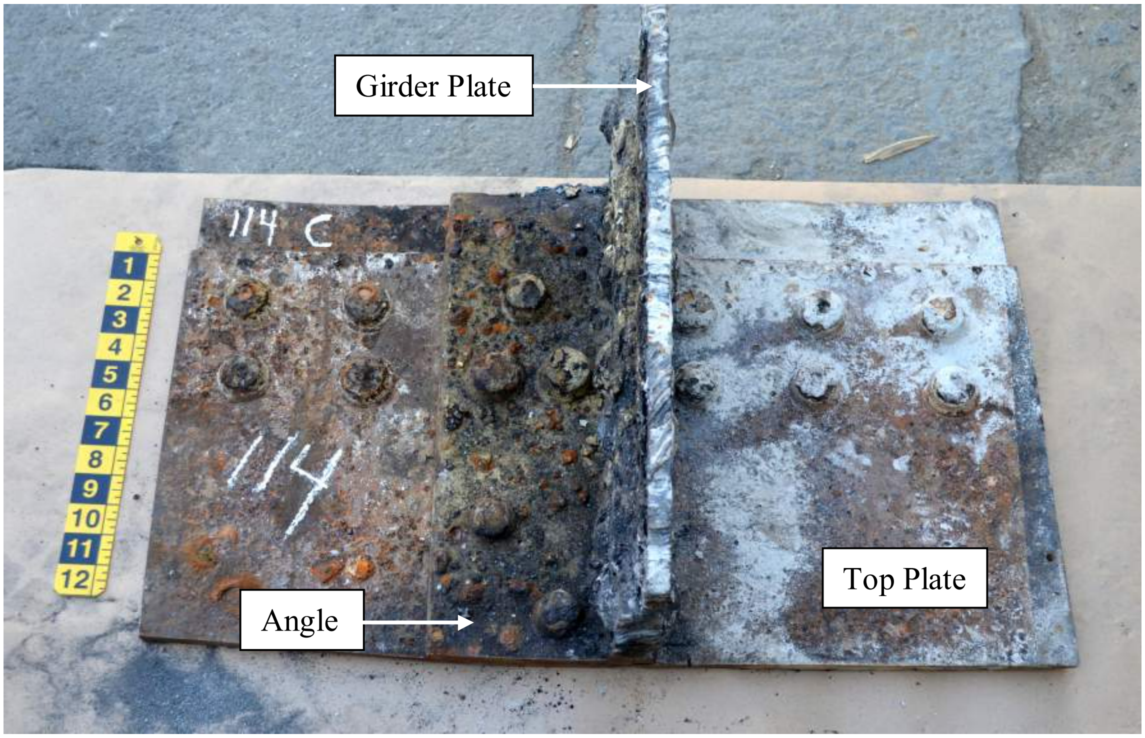


114 A - At Edge b



114 B

114 B - Side View



114 C

Right-Hand Side View Of Above

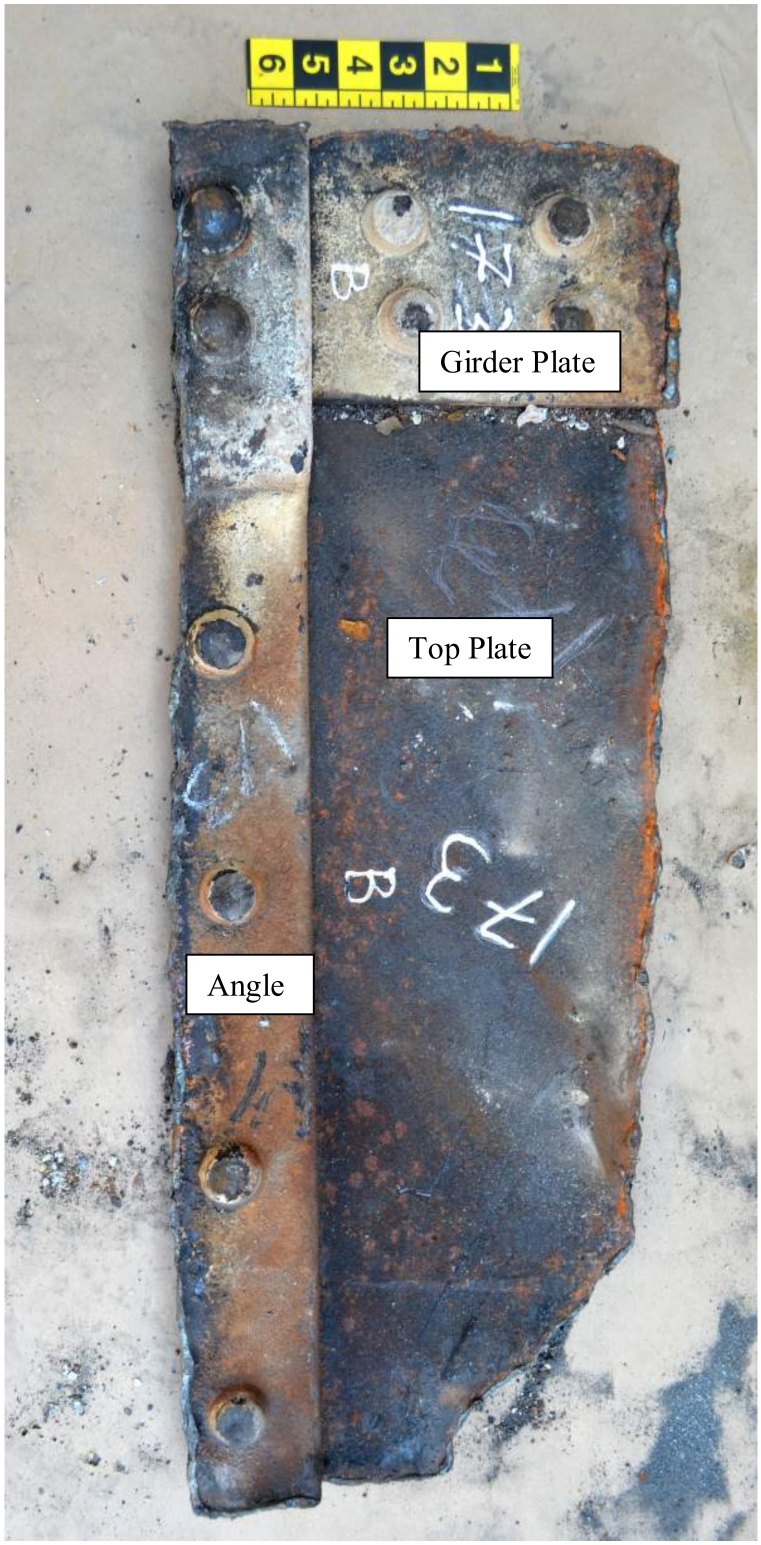
114 C

Left-Hand Side View Of Above

114 C Edge View

173 A

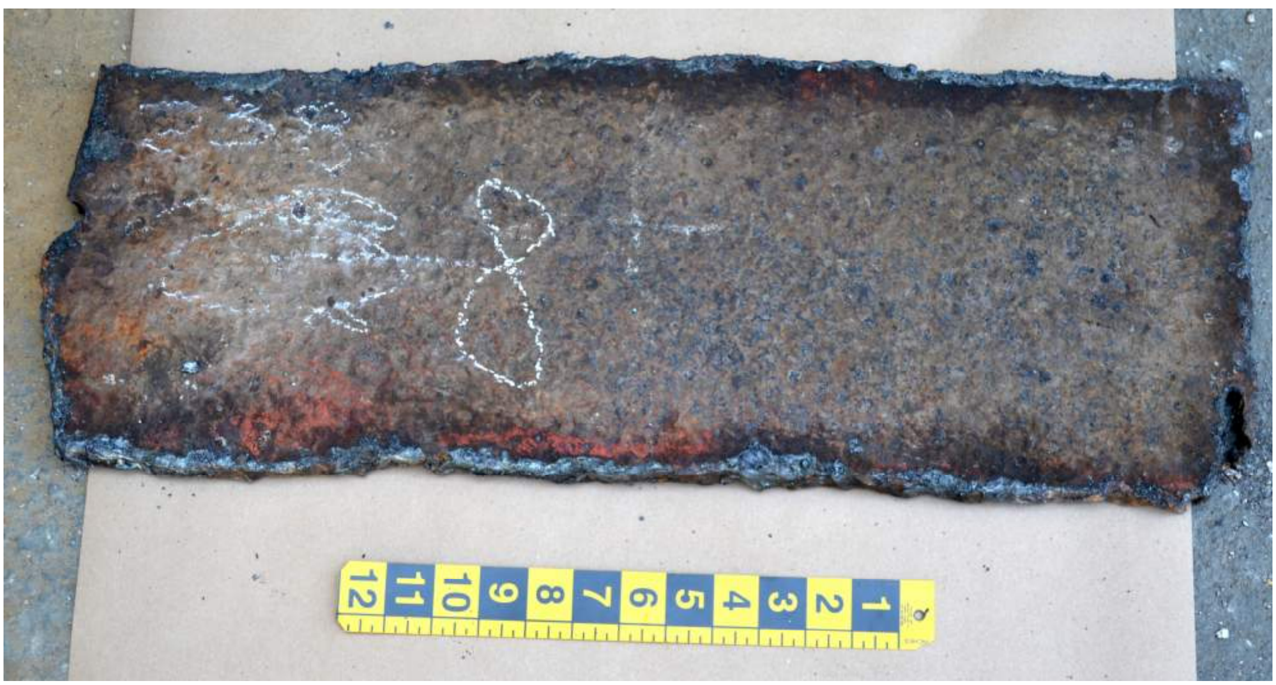
Right-Hand View Of Above



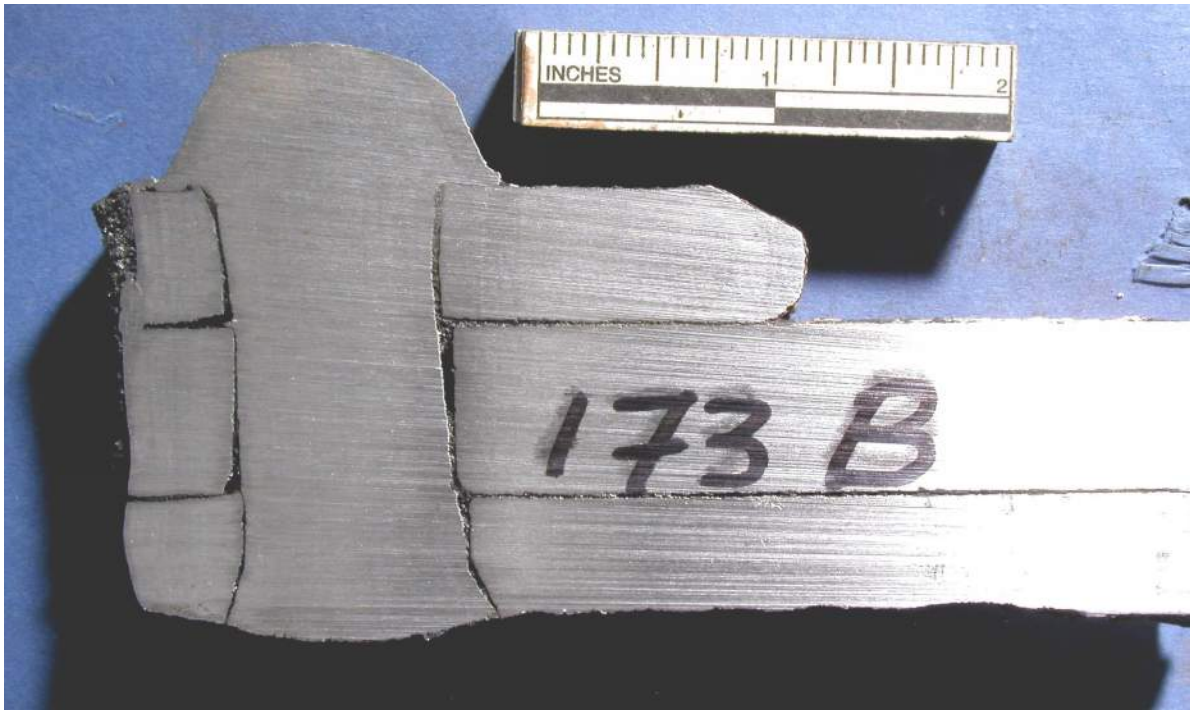
173 B

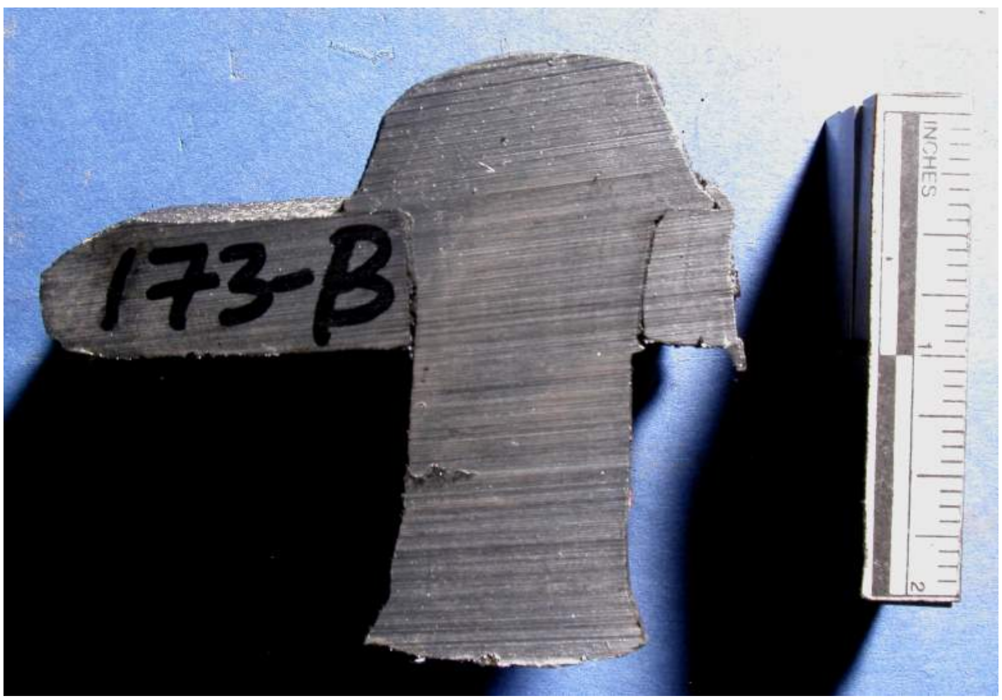

Girder Plate
Angle
Top Plate
12
11
10
9
8
7
6
5
4
3
2
1

238 A

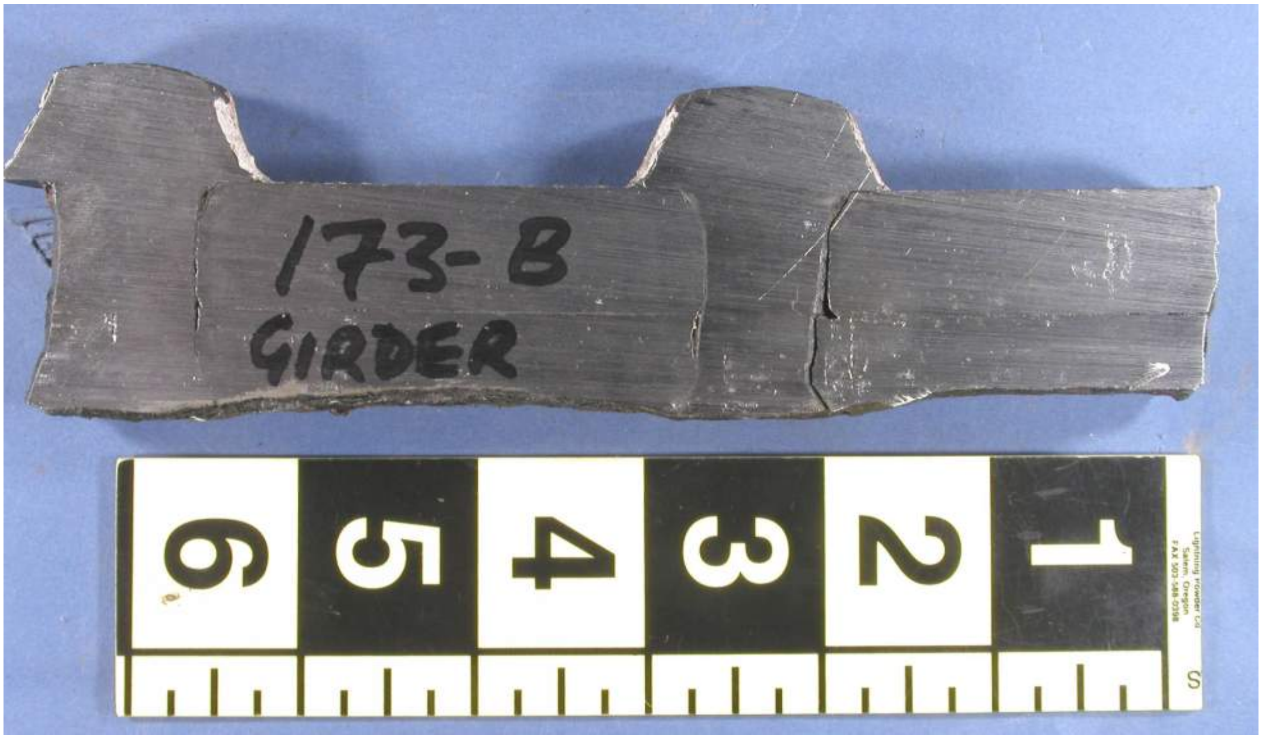

12
11
10
9
8
7
6
5
4
3
2
1

238 B





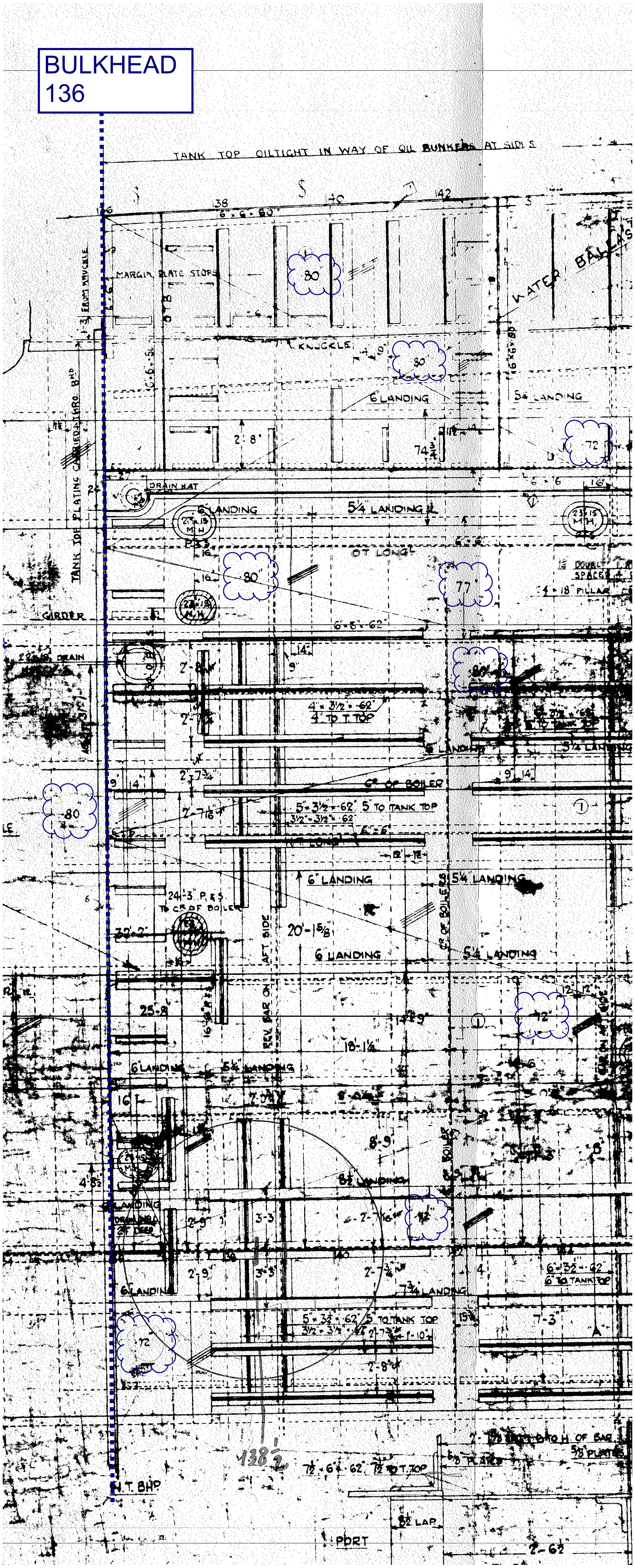
Rivet From Section 173 - B

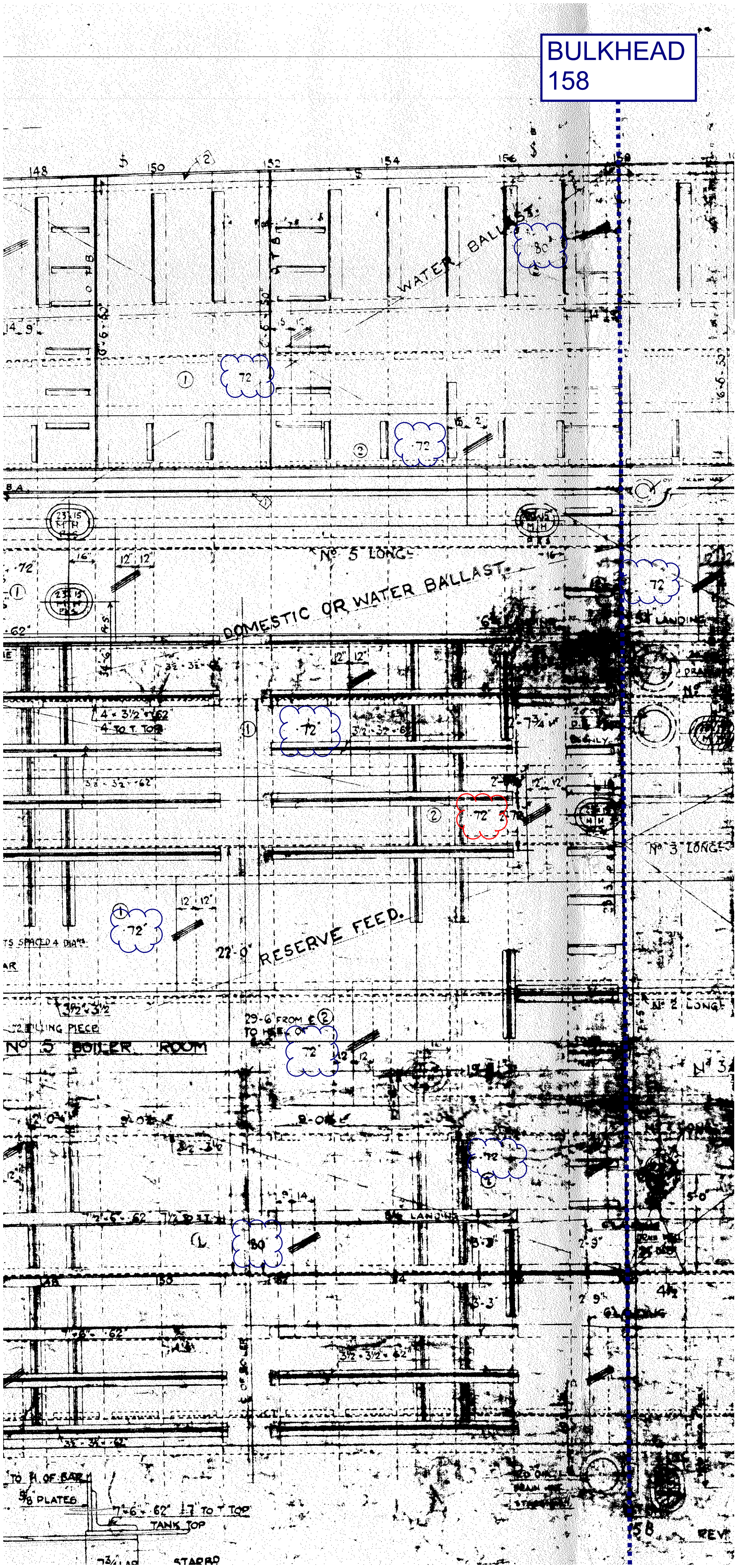


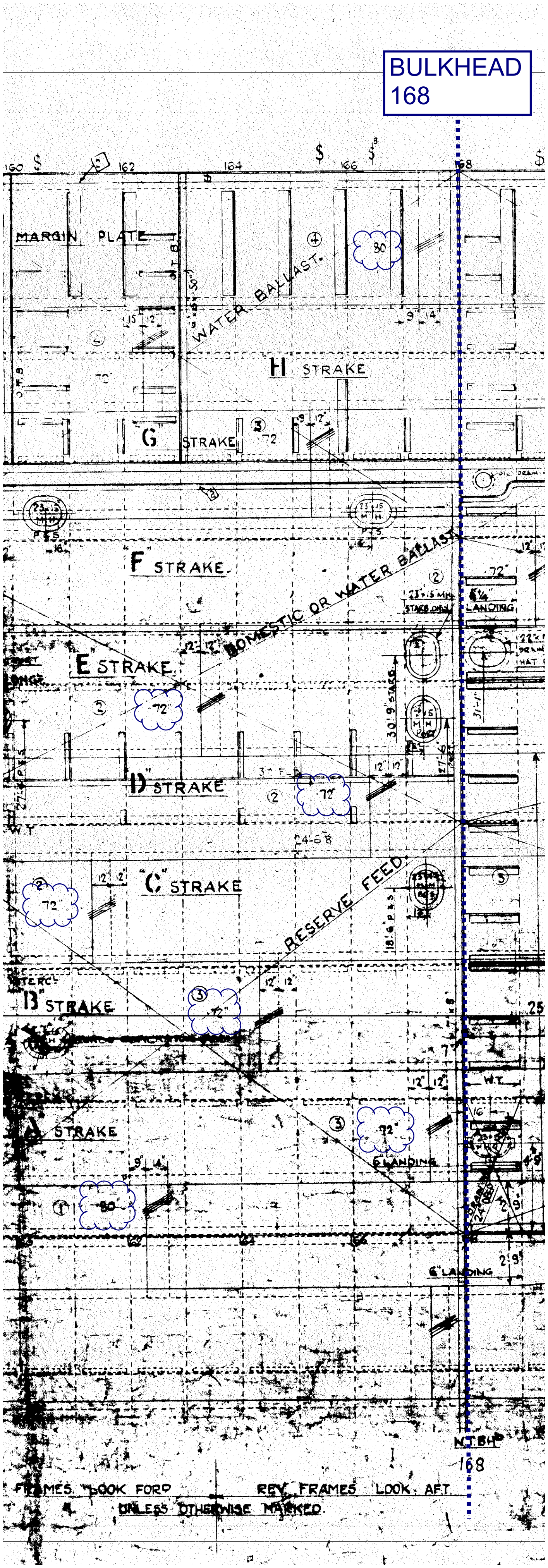
Rivets From Girder Of Section 173 - B

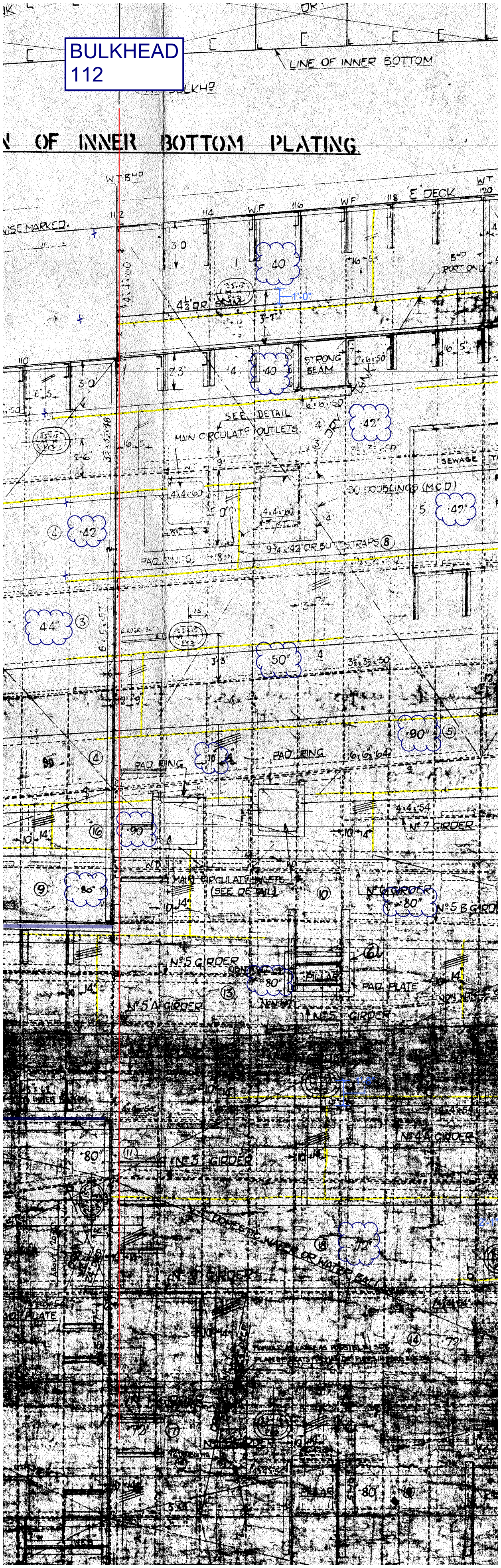
Appendix D5

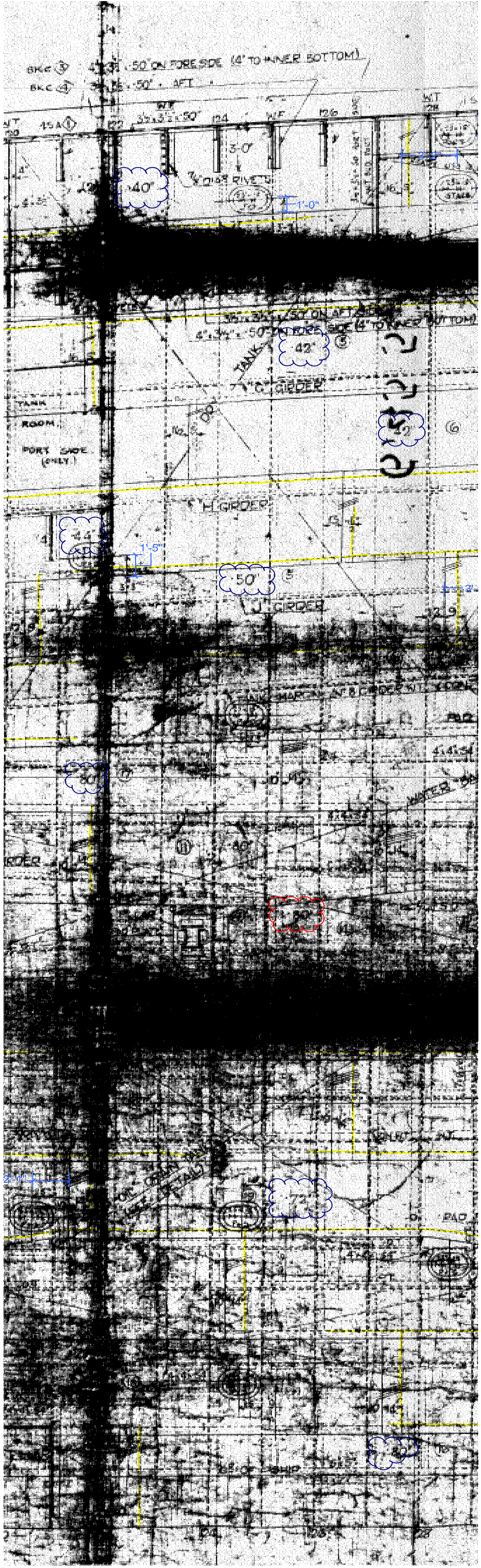
Reference Drawings for Tank Top Repair

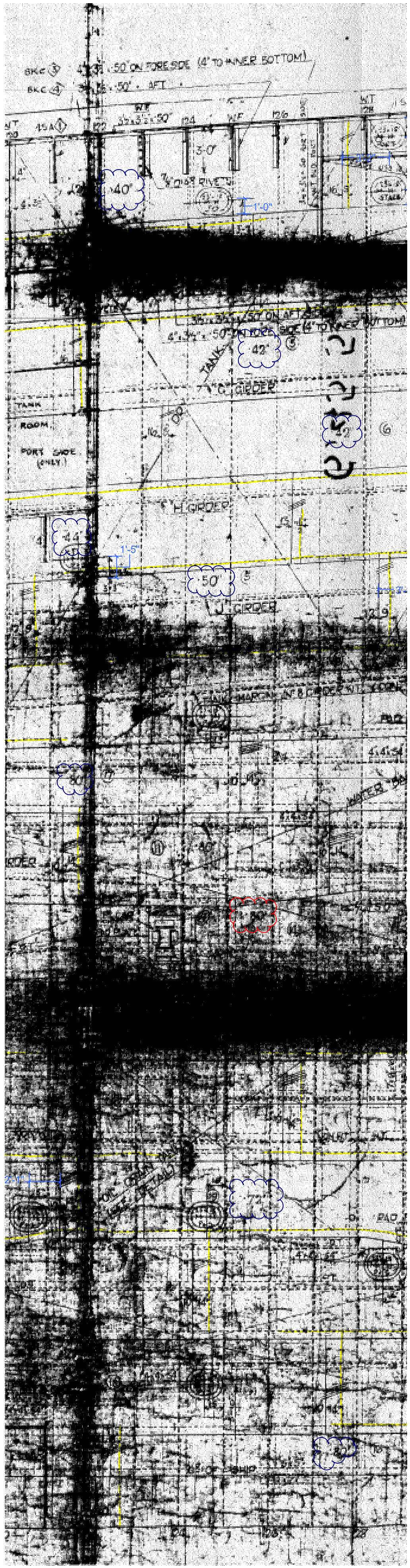

BULKHEAD
136
TANK TOP OILTIGHT IN WAY OF OIL BUNKERS AT SIDES
MARGIN PLATE STOPS
KNUCKLE
WATER BALLAST
6" LANDING
5¼ LANDING
DRAIN HAT
OT LONG
GIRDER
C² OF BOILER
AFT SIDE
N.T. BHD
PORT
138½


BULKHEAD
158
WATER BALLAST
No 5 LONG
DOMESTIC OR WATER BALLAST
RESERVE FEED.
No 3 LONG
No 2 LONG
No 5 BOILER ROOM
TANK TOP
5/8 PLATES


BULKHEAD
168
MARGIN PLATE
WATER BALLAST.
H STRAKE
"G" STRAKE
F" STRAKE
DOMESTIC OR WATER BALLAST
E" STRAKE
D" STRAKE
"C" STRAKE
RESERVE FEED.
B" STRAKE
A" STRAKE
6" LANDING
N.T.BH'D
168
FRAMES LOOK FORD
REV. FRAMES LOOK AFT
UNLESS OTHERWISE MARKED.


BULKHEAD
112
LINE OF INNER BOTTOM
OF INNER BOTTOM PLATING
E DECK
STRONG BEAM
SEE DETAIL
MAIN CIRCULATG OUTLETS
SEWAGE
DOUBLINGS (M.C.D.)
PAD RING
N° 7 GIRDER
MAIN CIRCULATG INLETS
(SEE DETAIL)
N° 5 B GIRDER
N° 5 GIRDER
N° 5 A GIRDER
PILLAR
PAD PLATE
N° 3 GIRDER
N° 4 A GIRDER
DOMESTIC WATER OR WATER BALLAST


3'-0"
1'-0"
TANK
ROOM
PORT SIDE (ONLY)
"H" GIRDER
"J" GIRDER
1'-5"


.50" ON FORESIDE (4" TO INNER BOTTOM)
.50" AFT
3/4" Ø RIVETS
.40"
.42"
"G" GIRDER
TANK
ROOM
PORT SIDE
(ONLY)
"H" GIRDER
.44"
.50"
"J" GIRDER
.50"
.72"