DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Equipment Stress Analysis/8D430	Date December 12, 1994
Project Title/Work Order		EDT No. 608386
Miscellaneous Component Design for Tank 241SY101 Pump Removal N2B2K		ECN No. NA

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
R. M. Boger	L4-90		X		
J. S. Burgess	G2-03		X		
C. E. Hanson	H5-09		X		
F. H. Huang	H5-67	X			
R. L. Jorissen	H5-53	X			
J. W. Lentsch	S7-15		X		
M. L. McElroy	S1-51		X		
G. E. McPherson	S2-41		X		
T. C. Mackey	S2-03	X			
M. J. Ostrom	H5-68	X			
R. B. Pan	H5-53		X		
Central Files (2 Copies)	L8-04	X			
O.S.T.I. (2 Copies)	L8-07	X			

MASTER

A-6000-135 (01/93) WEF067

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

35

MAR 2 1995

Sta #3

58 **ENGINEERING DATA TRANSMITTAL**

Page 1 of 1

1. EDT 608386

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Equipment Stress Analysis/8D430	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: ~~N226A~~ N2B2K	6. Cog. Engr.:	7. Purchase Order No.: NA
8. Originator Remarks: Aprroval/Release		9. Equip./Component No.: NA
		10. System/Bldg./Facility: NA
11. Receiver Remarks:		12. Major Assm. Dwg. No.: H-2-821397, Rev. 0
		13. Permit/Permit Application No.: NA
		14. Required Response Date: NA

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1.	WHC-SD-WM-DA-168	NA	0	Miscellaneous Component Design for Tank 241SY101 Pump Removal	SQ	1,4	1	

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. M. J. Ostrom	Mike J. Ostrom	2-24-95	H5-68	R. L. Jorissen	Randy Jorissen	12/21/94	H5-53	1	1
1	1	Cog. Mgr. C. E. Hanson	Carl Hanson	2/24/95	H5-09	ESA Mngr. R.B. Pan	R.B. P	2/8/95	H5-53	1	1
1	1	QA M. L. McElroy	M. L. McElroy	2/23/95	S1-57						
1	1	Safety G. E. McPherson	G. E. Mc	1-03-94	~~I4-10~~ S2-41						
1	1	T. C. Mackey	T. C. Mackey	1/3/94	S2-03						
1	1	Indep. Review J. S. Burgess	J S Burgess	12/9/94	H5-53						

18.	19.	20.	21. DOE APPROVAL (if required)
F. H. Huang F.H. Huang 12/9/94 Signature of EDT Originator Date	Mike J. Ostrom M. J. Ostrom 2-24-95 Authorized Representative for Receiving Organization Date	C. E. Hanson Carl Hanson 2/24/95 Cognizant/Project Engineer's Manager Date	Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-1 (07/91)

DISCLAIMER

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-DA-168, REV 0
Document Title:	Miscellaneous Component Design for Tank 241SY101 Pump Removal
Release Date:	2/28/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz

Kara M. Broz   February 28, 1995

This report has been reproduced from the best available copy. Available in paper copy and microfiche. Printed in the United States of America. Available to the U.S. Department of Energy and its contractors from:

U.S. Department of Energy
Office of Scientific and Technical Information (OSTI)
P.O. Box 62
Oak Ridge, TN 37831
Telephone: (615) 576-8401

Available to the public from:

U.S. Department of Commerce
National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Telephone: (703) 487-4650

DISCLAIMER

SUPPORTING DOCUMENT

1. Total Pages 213		
2. Title Miscellaneous Component Design for Tank 241SY101 Pump Removal	3. Number WHC-SD-WM-DA-168	4. Rev No. 0
5. Key Words Analysis, Bending, Mock-up pump Test weight, Support saddle, Spreader beam, Safety factor weld strength, lifting lug	6. Author Name: F. H. Huang Signature Organization/Charge Code 8D430/~~N226A~~ N2B2K	

APPROVED FOR PUBLIC RELEASE

CH 2/24/95

7. Abstract

The disposal equipment is designed for use in removing the hydrogen mixer pump from tank 241SY101. The design of the structural elements of the equipment is based on the design criteria established for this task as shown in Reference WHC-SD-WM-DA-165. AEC designed and analyzed the lifting beam, support saddles, test weight, and modified mock-up pump. WHC conducted additional analyses on the test weight, mock-up pump, removable support, and saddle modification for air pallets. The calculations meet the strength requirements and verify the equipment with the load chart for the equipment removal system (ERS) for tank 241SY101.

KMS 2/28/95

9. Impact Level SQ

10. RELEASE STAMP

OFFICIAL RELEASE 58
BY WHC
DATE MAR 2 1995
Sta # 3

WHC-SD-WM-DA-168
Rev. 0

MISCELLANEOUS COMPONENT DESIGN FOR TANK 241SY101 PUMP REMOVAL

December 1994

PREPARED BY: F. H. Huang Date 12/9/94
F. H. Huang
Materials Engineering

REVIEWED BY: J. S. Burgess Date 12/9/94
J. S. Burgess
Equipment Stress Analysis

APPROVED BY: R. B. Pan Date 12/15/94
R. B. Pan, Manager
Equipment Stress Analysis

Westinghouse Hanford Company
Hanford Operations and Engineering Contractor
for the
U. S. Department of Energy

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DESIGN VERIFICATION METHOD

The need for design verification has been reviewed with the method selected as indicated below:

x	Independent Review
	Alternate Calculations
	Qualification Testing
	Formal Design Review

R. B. Pan
Cognizant/Project/Design Manager

SD #WHC-SD-WM-DA-168

ECN # NA

TYPICAL CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed WHC-SD-WM-DA-168

Author F. H. Huang

Yes	No	N/A	
[✓]	[ ]	[ ]	Problem completely defined.
[✓]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
[ ]	[ ]	[✓]	Computer codes and data files documented.
[✓]	[ ]	[ ]	Data used in calculations explicitly stated in document.
[✓]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[ ]	[ ]	[✓]	Mathematical derivations checked including dimensional consistency of results.
[ ]	[ ]	[✓]	Models appropriate and used within range of validity or use outside range of established validity justified.
[✓]	[ ]	[ ]	Hand calculations checked for errors.
[ ]	[ ]	[✓]	Code run streams correct and consistent with analysis documentation.
[~~✓~~]	[ ]	[✓]	Code output consistent with input and with results reported in analysis documentation.
[✓]	[ ]	[ ]	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
[✓]	[ ]	[ ]	Safety margins consistent with good engineering practices.
[✓]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
[✓]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.

MANDATORY Software QA Log Number N/A

J. S. Burgess *JSBurgess*
Reviewer

12/9/94
Date

CONTENTS

FIGURE

MISCELLANEOUS COMPONENT DESIGN FOR TANK 241SY101 PUMP REMOVAL

1.0 INTRODUCTION

A mixer pump has been used to mitigate the hydrogen build-up in tank 241SY101 (SY101), located in the 200 West Area of the Hanford Site. New equipment is being prepared for the removal, transport, storage, and disposal of the test pump. The disposal equipment for the test pump now in tank SY101 includes a shipping container, a strongback, a lifting beam, a test weight, container support stands, a modified mock-up pump, a flexible receiver blast shield, a lifting yoke, and a yoke brace. The structural evaluations of container and strongback are detailed in another supporting document (WHC 1994a), the engineering analyses of flexible receiver blast shield/lifting yoke and yoke brace are given in other supporting documents (WHC 1994b, WHC 1994c), respectively. Engineering tasks that were contracted to Advanced Engineering Consultants (AEC) include the design and analysis of the following.

- Two spreader-beam lifting devices.
- Container test weight.
- Container support saddles.
- Mock-up pump modification.

This report documents the work description, design basis, assumptions, and design calculations provided by AEC for the above components. All AEC documents appear in Appendix A. Additional work conducted by Westinghouse Hanford Company (WHC) on the modified container test weight, modification to the mock-up pump, the removable support for the transport assembly, and saddle modification for air pallets also are included in this document.

This supporting document reports on the structural analysis of the equipment based on requirements for safety class 3 (DOE-RL 1993a), the *Manual of Steel Construction* (AISC 1989), and the *Hanford Hoisting and Rigging Manual* (DOE-RL 1993b).

2.0 SUMMARY

The disposal equipment is designed for use in removing the hydrogen mixer pump from tank SY101. The design of the structural elements of the equipment is based on the design criteria established for this task as shown in WHC 1994a. AEC designed and analyzed the lifting beam, support saddles, test weight, and modified mock-up pump. WHC conducted additional analyses on the test weight, mock-up pump, removable support, and saddle modification. The calculations meet the strength requirements and verify the equipment with the load chart for the equipment removal system (ERS) for the tank, as shown in Figure 1, which illustrates the design wind, live, and dead loads for the trailer and strongback.

3.0 DISCUSSION

The design criteria are listed in WHC 1994a and in Appendix A. The following allowable stresses are used for the structural calculations of steel members and connections in those critical components of tank SY101 that are of A-36 steel or other mild steels: 12,000 lbf/in^2 for bending, tension, axial compression, and bearing stresses; 7,200 lbf/in^2 for shear stress; 7,200 lbf/in^2 on the effective area for welds; and one-half the allowable stresses given in AISC 1989 for bolts. Basically, the allowable stresses are one-third the yield strength.

3.1 Spreader Beam

The major part of the 7.5-ft-long spreader beam is made of W18X106. A 3-in-thick lug with a 2 13/16-in diameter hole is full-penetration welded to the top of the W beam. Underneath the lug plate are two ½-in. stiffener plates welded to each side of the beam to ensure that stress is transferred from the flange to the web. The calculations consider the stresses of the spreader beam for a design load of 125 kips and a rated load of 100 kips per DOE-RL-92-36 (DOE-RL 1993b).

3.2 Support Saddle

The container support saddles are designed to withstand a linear uniform load of 2,455 lb/ft, concentrated loads of 5,000 and 7,000 lb, and a wind load of 11.43 lbf/ft^2. The 2,455 lb/ft uniform load is not shown in the Figure 1 load chart because the weight of the radiation shielding material is not included in Figure 1. Also, the 11.43 lbf/ft^2 wind load differs from the Figure 1 load chart value of 10 lbf/ft^2 because the container is subjected to different design wind velocities in the vertical position versus the horizontal storage position. Each saddle, measuring 4 by 8 by 1.5 ft in height, is designed to ensure that the Central Waste Complex floor slab is not damaged. Two lugs are welded at the tops of the saddle ends to hold the container with a chain. The calculations check the bending and the tear-out stresses on the lugs. The sliding force and overturning moment from wind meet the required safety factor of 1.5.

3.3 Test Weight

The test weight assembly, used for testing the hydraulic system on the trailer, is designed to simulate the pump weight. During testing, the test weights are attached at the top of the container. The total weight of the test weight assembly (16,324 lb) was determined by evaluating the load chart in Figure 1. Placing the test weight assembly at the top of the container simulates the load on the hydraulic system as if the pump was actually in the container. This weight is equivalent to 125% of the actual weight of the pump lifted by the hydraulic system. The weight assembly consists of a bulkhead plate, removable filler plates, and support legs. Six 5-ft by 5-ft by 2-in. filler plates are required to make a test weight assembly of 16,324 lb. The center of gravity (C.G.) for the assembly is calculated to determine the location of hole of each filler plate through which a 3-in.-diameter rod is used for horizontal lift. The AEC calculations check the tear-out resistance of the vertical and horizontal lugs. The calculations also check the weld strengths and bending stresses of the support legs (W8X28 beams) and the lug plates. After AEC completed the design, a live load of 3,000 lb was added at the top of the container near the test weight, so the weight of the test weight had to be recalculated. With a hydraulic force of 203,600 lb and an updated container uniform load of 928 lb/ft compared to 1,000 lb/ft shown in Figure 1, the weight of the new test weight is calculated to be 20,657 lb. A slight modification on the AEC design was made by adding two 2-in.-thick filler plates. This change necessitated a reanalysis of the weld strengths and bending stresses of the support legs and the lug plates to ensure that the AISC requirements were still met (see Appendix B).

3.4 Mock-up Pump Modification

A mock-up pump is used to simulate installation and removal of the actual pump. To verify the lifting capacity of the cradle and for testing the hydraulic trailer, the mock-up pump is made with its dimensions, weight, and C.G. equivalent to those of the actual pump. AEC made some modifications to the existing mock-up pump to simulate the weight and C.G. of the actual pump and designed removable disks that can be attached to the mock-up pump. To simplify lifting the mock-up pump, a two-point lifting was designed. Both lifting points are at the locations 14 ft from the two ends of the mock-up pump.

The dimensions of the pump sections and the locations of the disks are shown in drawing H-2-83749. The maximum bending stress with an impact factor of 125% during horizontal lifting is 9,200 lbf/in^2, less than the allowable stress of 12,000 lbf/in^2 (Appendix C).

3.5 Removable Support for the Transport Assembly

The temporary container support will be attached to the lateral support cradle for the container after the container is raised hydraulically to the vertical position to accept the experimental pump. Once the pump is inserted into the container, both pump and container are rotated and lowered to rest on the removable support, which is inclined 7° with respect to the ground. The container support is inclined to prevent fluid from draining from the contaminated pump while it rests on the support to allow the following tasks: removing the external container funnel from the container inner flange, cutting off the 16-in. pump column, and installing the inner and outer container caps. To minimize contamination during work, an 11- by 11-ft shielding plate is attached vertically to the trailer support. After these tasks are completed, the container is raised and the removable support for the transport assembly is removed. The container then is lowered to the horizontal position and transported to the shot loading area designated to receive it.

The total weight of the container and pump with an impact factor of 125% is 83,000 lb. The bearing stress of the W30x191 beams, which support the container, the pump, and the shielding plate, is checked to be within the allowable stress. The web crippling of the beams also is found to be below the load limit. Standing above the beams is the shielding plate, which has a face 11 by 11 ft receiving significant wind load. The wind pressure acting on the 11- by 11-ft shielding plate is 19.35 lbf/ft^2, or a total force of 2,340 lb against the plate, estimated on the basis of SDC 4.1 (DOE-RL 1993a) for safety class 3 structures. Analysis that shows bending of the 1-in. shielding plate as a result of wind load meets the strength requirements of the AISC (1989).

The vertical shielding plate is supported by two braces that consist of L4x3 and L3x3. The strength of each brace is found to satisfy the design criterion. Analysis also shows that the strength of eight 1-in. bolts used to fasten the shielding plate to the existing trailer support is adequate to support the weights of the plate (4,940 lb) and the vertical load of the inclined container (41,347 lb). A significant moment acting on the shielding plate as a result of the eccentric container reactions indicates a need to add stiffeners to reinforce the plate. Calculations determine that three stiffeners ¾-in. thick and 5-in. wide with a spacing of 5 ⅝ in. meet the strength requirements of the AISC for the combined axial and bending stresses of the reinforced shielding plate (see Appendix D for calculation details). All welds in the removable support are found to have adequate strength.

3.6 Saddle Modification for Air Pallets

Because air pallets will be used to move the container and pump into the 2403WD storage building, the container support saddles are modified to accept two air pallets for each support. The size of the air pallets is determined from the reaction force at a location 68 in. from the top cap of the container. On the basis of the linear uniform load of 2,455 lb/ft and concentrated loads of 5,000 and 7,000 lb, the reaction force is found to be 73,053 lb. With the allowable soil bearing pressure of 2,600 lb/ft^2, calculations determine that two 5- by 5-ft air pallets are needed to withstand a load of 80,000 lb, which is slightly higher than the half-weight of the container assembly.

The container and pump will be chained to the supports, which rest on the concrete pad. The support is designed to have two air pallets installed underneath and to be capable of resting on the concrete pad without damaging the facility floor. Calculations show that the support need a contact area with the floor of 20 by 120 in. on each side before the air pallets are activated. Thus, the support requires dimensions of 102 by 120 in. with center base area of 62 by 120 in. above the floor to accommodate the two pallets. To satisfy the AISC strength requirement for bending of the support with a span of 62 in., five W12x19 beams are needed to support the container and pump before the air pallets are inflated. The bending and shear stresses on the 1-in. support plate placed above the beams are calculated to be smaller than the allowable stresses (see Appendix E).

Two fork lifts will guide the assembled container, pump, and saddle support into the facility building after the air pallets are activated and the assembly clears the floor by approximately 1 in. A tow bar is designed to attach to the W12x19 beams on the container support; the end of the tow bar has an eye for connection to the fork lift with a trailer hitch pin. The tow bar eye is located at the intersection of two square tubes (5 by 5 by 1/4 in.) that weld to vertical 1 ⅜-in.-thick plates. With pins inserted through the vertical plates and held by the support structure, the tow bar eye is capable of rotating so that it can reach the connector of the fork lift, which is 6 to 12 in. higher than the container support. Because the square tube is much stiffer than the plate, the structural evaluations for the tow bar consider the combined bending and compression of the vertical plate subjected to a maximum load of 18,000 lb and restrained by the square tube. Analysis of an elastic straight beam with one end guided and the other end simply supported (Young 1989) determines that the combined maximum bending and compression stresses of the plate satisfy the strength requirements of the AISC for structural members subjected to combined stresses. Details of the calculations appear in Appendix E.

4.0 REFERENCES

AISC, 1989, *Manual for Steel Construction*, Ninth Edition, American Institute of Steel Construction, Chicago, Illinois.

ASNI, 1986, *Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More*, American National Standard Institute, New York, New York.

DOE-RL, 1993a, *Standard Arch-Civil Design Criteria, Design Loads for Facilities*, Hanford Plant Standard SDC-4.1, Rev. 12, U.S. Department of Energy-Richland Field Office, Richland, Washington.

DOE-RL, 1993b, *Hanford Site Hoisting and Rigging Manual*, DOE-RL-92-36, U.S. Department of Energy, Richland Field Office, Richland, Washington.

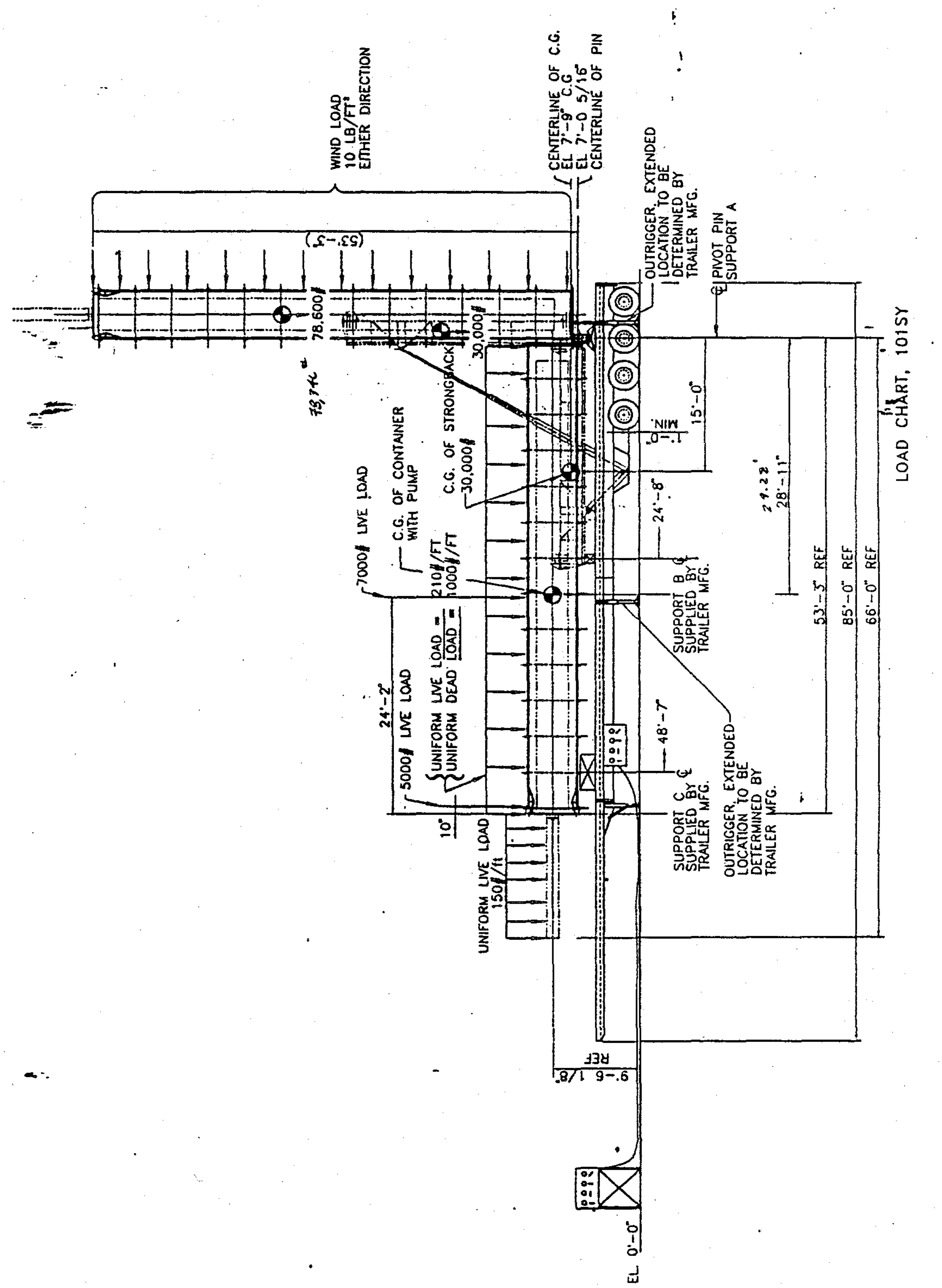
WHC, 1994a, *Analysis of Container and Strongback for Pump Removal from Tank 241SY101*, WHC-SD-WM-DA-165, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994b, *Analysis of the Flexible Receiver Lifting Yoke and Blast Shield Assembly (Tank 241SY101)*, WHC-SD-WM-DA-160, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994c, *Structural Analysis: Flexible Receiver Yoke Brace for the 241SY101 Mixer Pump*, WHC-SD-WM-DA-157, Westinghouse Hanford Company, Richland, Washington.

Young, 1989, *Roark's Formulas for Stress and Strain*, McGraw-Hill, Inc., New York, New York.

Figure 1 Load Chart of the Equipment Removal System for Tank 241SY101.



Appendix A

Temporary Pump 2 Structural Engineering Support of Hydrogen Mitigation in Tank SY-101

Advanced Engineering Consultants
San Francisco, California

Advanced
Engineering
Consultants
180 Montgomery Street, Suite 850 San Francisco, CA 94104
Telephone: (415) 291-9600 Fax: (415) 291-9696

July 15, 1994

Mr. Randy Jorissen
Westinghouse Hanford Company
P.O. Box 1970, H5-56
Richland, WA 99352

Subject: Calculations for Temporary Pump 2 Structural Engineering Support of Hydrogen Mitigation in Tank SY101, Task 2 of BOA 322666

Dear Mr. Jorissen:

Enclosed is the final set of the subject calculations. This completes our work scope for this Task Order. This has been a challenging and interesting project. Mike Chiao and I have enjoyed working with you and Mr. Tom Mackey on this project, and hope to be able to work with you on future projects.

Please call me if you have any questions.

Very truly yours,

Lincoln E. Malik
President

LEM:rm

Enclosure

Form 3.3-3
Advanced Engineering Consultants
Calculation Cover Sheet

SHEET i

Job Number: 4001-02

Calculation Number: CA 4001-02-1

Client: WESTINGHOUSE HANFORD COMPANY

Project: 241 SY101 MIXER PUMP PROJECT

Title: TEMPORARY PUMP 2 STRUCTURAL ENGG SUPPORT FOR HYDROGEN MITIGATION

Total number or pages (Including cover sheet): 126 (1 SHT, COVER; 3 SHTS, TABLE OF CONTENTS; 99 SHTS., CALCS AND; 23 SHTS, ATTACHMENTS)

Total number of computer runs: —

Description: TANK 241SY101 (SY101), LOCATED ON THE HANFORD SITE, IS AN UNDERGROUND REINFORCED CONCRETE STORAGE FACILITY CONTAINING HIGHLY RADIOACTIVE LIQUID AND SEMI-SOLID WASTE. A LONG, SLENDER MIXER PUMP IS INSTALLED IN THE TANK. IF THE PUMP FAILS, IT MUST BE REMOVED IMMEDIATELY AND REPLACED WITH A DIFFERENT PUMP. AEC PROVIDES ENGINEERING SUPPORT FOR THE REMOVAL & INSTALLATION OPERATION; SPECIFICALLY, DESIGNS OF SPREAD-BEAMS, SUPPORT SADDLES FOR CONTAINER IN WHICH THE REMOVED PUMP WILL BE ENCLOSED, AND CONTAINER TEST WEIGHTS THAT SIMULATE ACTUAL PUMP WEIGHTS AND MODIFICATION OF THE EXISTING DUMMY PUMP WILL BE DONE

Design bases/references:

1. ALLOWABLE STRESSES CONTAINED IN DESIGN CRITERIA USED IN WHC C-106 PROJECT ARE USED.
2. REVISED LOAD CHART - 101SY DATED 5/10/94 BY RANDY JORISSEN
3. LOAD CHART, 101SY
4. DWG. H-2-83734, R0, TITLE: HYDROGEN MIXER PUMP STORAGE CONTAINER
5. MPA DUMMY, DWG. SK-2-24086 R0
6. DWG. H-2-80901, R2 BY US DEPT. OF ENERGY, STRL. FOUNDATION, PLAN & DET.S

Revision No.	Description of revision	Approved by/date
0		[signature] 7/4/94

Advanced Engineering Consultants

Sheet No.	ii		
Job/Calc. No.	CA 4001-02-1		
Rev. No.	0		
By	M. CHIAO	Date	6/7/94
Chk'd	W. KAU	Date	6/7/94

Subject: TEMPORARY PUMP 2 - TABLE OF CONTENTS

TABLE OF CONTENTS

(CONTINUED)

Advanced Engineering Consultants

Sheet No.	iii		
Job/Calc. No.	CA 4001-02-1		
Rev. No.	0		
By	MLM	Date	6/7/94
Chk'd	W. KAU	Date	6/7/94

Subject TEMPORARY PUMP 2 - TABLE CONTENTS

TABLE CONTENTS (CONTINUATION)

(CONTINUED)

Advanced Engineering Consultants

Sheet No. iv
Job/Calc. No. CA4001-02-1
Rev. No. 0

Subject TEMPORARY PUMP 2 - TABLE CONTENTS

By MGS. Date 6/13/94
Chk'd WTK Date 6/13/94

TABLE CONTENTS (CONTINUATION)

Advanced Engineering Consultants

Sheet No. 1-1
Job/Calc. No. CA4001-02-1
Rev. No. 0
By M. CHIAO Date 6/7/94
Chk'd W. KAN Date 6/7/94

Subject TEMPORARY PUMP 2 - INTRODUCTION

1. INTRODUCTION

TANK 241 SY 101 (SY101), LOCATED ON THE HANFORD SITE, IS AN UNDERGROUND REINFORCED CONCRETE STORAGE FACILITY CONTAINING HIGHLY RADIOACTIVE LIQUID AND SEMI-SOLID WASTE. A LONG, SLENDER MIXER PUMP IS INSTALLED IN THE TANK. IF THE PUMP FAILS, IT MUST BE REMOVED IMMEDIATELY AND REPLACED WITH A DIFFERENT PUMP.

THE DESIGN CALCULATION DOCUMENTS THE WORK PERFORMED BY THE ADVANCED ENGINEERING CONSULTANTS (AEC) ON FIVE ENGINEERING TASKS, LISTED BELOW AND AGREED WITH WHC IN "WORK PLAN" DOCUMENT. AEC PROVIDES:

TASK 1: DESIGN CALCULATIONS AND SKETCHES FOR TWO SPREADER-BEAM LIFTING DEVICES;

TASK 2: DESIGN OF CONTAINER SUPPORT SADDLES;

TASK 3: CONTAINER TEST WEIGHTS

TASK 4: CRADLE TEST LOADS

TASK 5: REVIEW OF FINAL DWGS. BY WHC PER DESIGN.

Advanced Engineering Consultants

Sheet No.	1-2		
Job/Calc. No.	CA 4001-02-1		
Rev. No.	0		
By	MCS	Date	6/7/94
Chk'd	W. KAU	Date	6/7/94

Subject TEMPORARY PUMP 2 - REFERENCES

1.1 REFERENCES

1. ALLOWABLE STRESSES CONTAINED IN DESIGN CRITERIA USED IN WHC C-106 PROJECT.
2. REVISED LOAD CHART-101SY DATED 5/10/94 BY RANDY JORISSEN, WHC & LOAD CHART 101SY
3. DWG. H-2-83734, R0, TITLE: HYDROGEN MIXER PUMP STORAGE CONTAINER BY WHC
4. DWG SK-2-24086, R0, MPA DUMMY BY WHC
5. DWG H-2-80901, R2, TITLE: STRL FOUNDATION, PLAN & DETAILS BY U.S. DEPT. OF ENERGY
6. CORRESPONDENCES BETWEEN AEC & WHC
7. AISC, ASD, NINE EDITION, STEEL CONSTRUCTION MANUAL
8. UBC, 1991 EDITION
9. "FORMULAS FOR STRESS AND STRAIN" BY ROARK

Advanced Engineering Consultants

Sheet No. 1-3
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [illegible] Date 6/7/94
Chk'd W. Kau Date 6/7/94

Subject TEMPORARY PUMP 2 - DESIGN CRITERIA

1.2 DESIGN CRITERIA (FROM PROJECT C106, UNLESS NOTED)

STRESSES

ALLOWABLE BENDING, TENSION & COMPRESSION:

$F_b = 12^{ksi}$

$F_t = 12^{ksi}$

$F_a = 12^{ksi}$ (WHERE BUCKLING IS NOT A CONCERN & THERE ARE NO BENDING MOMENTS)

SHEAR: $F_v = 7.2$ ksi

BEARING: $F_p = 12^{ksi}$

CONNECTIONS:

BOLTS - USE HALF THE CAPACITY OF AISC, ASD 9TH ALLOWABLES.

PINS - $F_p = \frac{0.9F_y}{2} = 0.45F_y = 16.2^{ksi}$

RODS -

$F_t = \frac{0.33F_u}{2} = 0.16F_u = 9.57^{ksi}$ (AISC)

$F_b = \frac{0.75F_y}{2} = 13.5$ ksi (AISC)

(CONTINUED)

Advanced Engineering Consultants

Sheet No. 1-4
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 6/7/94
Chk'd W. KAU Date 6/7/94

Subject: TEMPORARY PUMP 2 - DESIGN CRITERIA (CONTINUATION)

WELDS - 7.2 KSI ON EFFECTIVE AREA WHICH EQUALS TO EFFECTIVE THROAT x WELD LENGTH.

SPECIAL CASE FOR FILLET WELDS - CHECK STRESS ON WELD LEG, NOT WELD THROAT (DO NOT USE 0.707 FACTOR TO DETERMINE THROAT AREA)

LOADS

WIND (UBC)

IMPACT = 25% (CORRESPONDENCES)

LOADS ON SADDLE & TEST WEIGHTS (REVISED 101SY LOAD CHART)

LOADS ON LIFTING BEAM = 125^{K} (CORRESPONDENCE)

CONSIDER WIND LOAD ONLY, NO SEISMIC LOAD (CORRESPONDENCE)

SPEC USE AISC, ASD. MANUAL FOR STEEL DESIGN

Advanced Engineering Consultants

Sheet No.	2-1
Job/Calc. No.	CA4001-02-1
Rev. No.	0
By	Mcm
Date	5/23/94
Chk'd	[illegible]
Date	[illegible]

Subject: TEMP. PUMP 2
LIFTING BEAM ASSEMBLIES

2. LIFTING BEAM ASSEMBLIES

2.1 GEOMETRY & LOADS

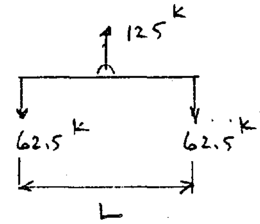
AS PER CORRESPONDENCE (A FOLLOW-UP TO LINCOLN MALIK & RANDY JORISSEN'S CONVERSATION ON 5/13/94):

- EACH LIFTING BEAM $\frac{150}{2} \times 1.25 \simeq 94^k$
  BUT INCREASES TO 125^k FOR DESIGN
- LIFTING LUG AT THE CENTER OF LIFTING BEAM WILL HAVE A $2\frac{13}{16}''\,\phi$ HOLE FOR $2\frac{3}{4}''\,\phi$ PIN
- LIFTING LUGS ON THE SIDES OF THE CANISTER HAVE BEEN MOVED OUTBOARD; THE REVISED LOCATION IS 3'-2" FROM CENTERLINE OF CANISTER TO INSIDE FACE OF LUG PLATE.

DISTANCE BETWEEN CENTERLINES OF LIFTING LUGS

L = 2 × (3'-2") + 2" (LUG PLATE THICKNESS ON CANISTER)

= 6'-6"



Advanced Engineering Consultants

Sheet No.	2-2		
Job/Calc. No.	CA4001-02-1		
Rev. No.	0		
By	MCG	Date	5/23/94
Chk'd	[illegible]	Date	[illegible]

Subject: TEMP. PUMP 2
LIFTING BEAM ASSEMBLIES

LENGTH OF BEAM

$= (6'-6'') + 1'$ (6" EACH END TO ACCOMODATE CLEVISES & END PLATES)

$= 7'-6''$

2.2 LIFTING BEAMS

IGNORE DEAD WT OF THE BEAM ($1^{k}\pm$)

$M = \frac{1}{4} \times 125 \times 78 = 2,437.5^{k-''}$

$S = \frac{2,437.5}{12} = 203.1 \text{ IN}^3$

$V = 62.5^{k}$

MIN. WEB THICKNESS REQ'D, WEB YIELDING CRITERIA:

ASSUME $k = 1\frac{1}{2}''$, 12" BASE DIMENSION FOR 125^{k}

$F_t \cdot t_w (12 + 5 \times 1.5) = 125^{k}$

$t_w = 0.534''$

CHOOSE W18 x 106, $L_c = 11.8' > 6.5'$

$t_w = 0.590''$, $d = 18.73''$, $b_f = 11.20''$, $t_f = 0.94''$

$S = 204 \text{ IN}^3 > 203.1 \text{ IN}^4$

$k = 1\frac{5}{8}'' > 1\frac{1}{2}''$ (ASSUMED)

OK!

Advanced Engineering Consultants

Sheet No.	2-3
Job/Calc. No.	CA4001-02-1
Rev. No.	0
By	MCW
Date	5/23/94
Chk'd	[illegible]
Date	[illegible]

Subject: TEMP PUMP 2 LIFTING BEAM ASSEMBLIES

$$ALL.\ V = 0.59 \times 18.73 \times 7.2 = 79.6^{k} > 62.5^{k}$$

ok!

2.3 LIFTING LUGS (LUG PLATES & PINS)

(i) LUG FOR 125^{k}:

AS PER WHC, PIN SIZE $2\frac{3}{4}''\phi$

MIN. LUG PLATE THICKNESS

$$F_p = 16.2^{ksi}, \quad t = \frac{125}{2.75 \times 16.2} = 2.81''$$

USE $3''$

NET AREA AT CROSS SECTION TRANSVERSE TO THE HOLE ($2\frac{3}{4} + \frac{1}{16} = 2\frac{13}{16}''\phi$) AND NORMAL TO THE LOAD:

$$A_n = \frac{125}{12} = 10.42^{\square''}$$

$$\text{EDGE DISTANCE} = \frac{1}{2} \times \frac{10.42}{2.875} = 1.81'' < 4 \times 3$$

ok!

EDGE DISTANCE PARALLEL TO THE LOAD:

MAX EDGE DISTANCE ALLOWED

$$= 0.8 \times 2\frac{13}{16} = 2.25''$$

Advanced Engineering Consultants

Sheet No. 2-4
Job/Calc. No. CA4001-02-1
Rev. No. 0
By MCW Date 5/23/94
Chk'd [illegible] Date 5/24/94

Subject TEMP. PUMP 2
LIFTING BEAM ASSEMBLIES

ALLOWABLE SHEAR CAPACITY

$$= 2 \times 3 \times \left(2.25 + \frac{2.75}{2}\right) \times 7.2$$

$$= 156.6^{k} > 125^{k}$$

ok

CROSS SECTIONAL AREA // LOAD REQ'D

$$A = \frac{2}{3} \times 10.42^{\square''} = 6.95^{\square''}$$

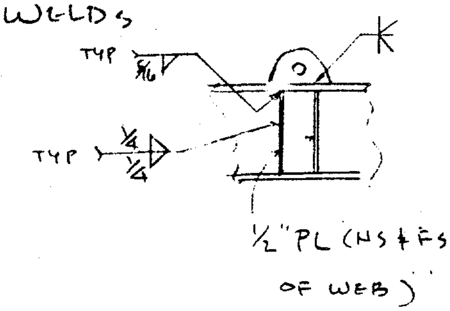
$$\text{EDGE DISTANCE} = \frac{6.95}{3} = 2.32'' \approx 2.25''$$

$$\text{RADIUS} = 2.32 + \frac{1}{2} \times 2\tfrac{13}{16} = 3.72''$$

USE 4"R, PL 3" THICK.

USE FULL PENETRATION TO WELD THE LUG PLATE TO THE BEAM.

ADD 4 - 1/2" STIFFENER PLATES CENTERED ON LUG PLATE AND WELD TO THE BEAM WITH FILLET WELDS TO INSURE THE STRESS TRANSFER FROM FLANGE TO WEB.

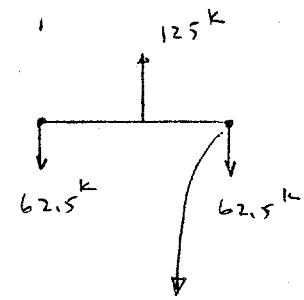


Advanced Engineering Consultants

Sheet No. 2-5
Job/Calc. No. CA4001-02-1
Rev. No. 0
By MLW Date 5/23/94
Chk'd W. Kau Date 5/24/94

Subject TEMP. PUMP 2
LIFTING BEAM ASSEMBLIES

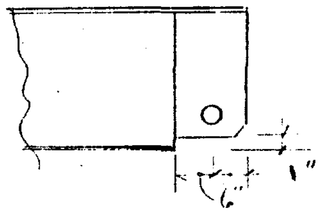
(ii) LUGS @ BOTH ENDS OF BEAM



USE WEB OF BEAM & ADD REINFORCING PLATES.

PIN -

IT IS SUBJECTED TO DOUBLE SHEAR.



$$A_v = \frac{62.5}{2} \times \frac{1}{7.2} = 4.34^{\square''}$$

$$\frac{\pi d^2}{4} = 4.34 \qquad d = 2.35''$$

USE $2\frac{1}{2}'' \phi$

LUG PLATES -

BEARING $F_p = 16.2^{ksi}$

$$t = \frac{62.5}{2.5 \times 16.2} = 1.54''$$

USE $1\frac{3}{4}''$

CHECK NET AREA @ CROSS SECTION THROUGH PIN-HOLE IN ⊥ TO THE LOAD DIRECTION.

EDGE DISTANCE FURNISHED

$$a = \left[6 - \frac{1}{2}\left(2.5 + \frac{1}{16}\right)\right] = 4.72''$$

1

TELEPHONE CONFERENCE M

Company: WESTINGHOUSE HANFORD Address: HANFORD 200 EAST

[ ] INCOMING [X] OUTGOING DATE: 8/25/94 TIME: 9:30

WITH: LINCOLN K. MALIK OF: AEC PHONE: 415-291-9696

WITH: TOM MACKEY OF: WHC PHONE: 509-373-3823

Copies to: Name Address

Subject: PINS FOR LIFTING BEAMS

Department Telephone #

Summary of Conference

THE PINS "AS PROVIDED" ARE OK.
DESIGN OF PINS WAS BASED ON A36
AND ACTUAL PINS ARE HIGH STRENGTH.
SEE ATTACHED SHEET.

54-7600-098 (5/90) (EF) GEF017
Telephone Conference Memorandum

1. As required by AISC pg 4-151
   2 pins @ 2½"ø × 6¼" LONG
   4¼" between holes
   2 pins @ 2½"ø × 6" Long
   4" between holes

2. As called out on drawing
   2 pins @ 2½"ø × 6¾" Long
   4¾" between holes
   2 pins @ 2½"ø × 7" Long
   5" between holes

3. As provided
   4 pins @ 2½"ø × 6½" Long
   5¼" between holes
   AISI 1035 Material per
   Andrea @ Cleveland City Forge

Advanced Engineering Consultants

Sheet No. 2-6
Job/Calc. No. CA4001-02-1
Rev. No. 0
By MCW Date 5/23/94
Chk'd W. Kan Date 5/24/94

Subject TEMP. PUMP 2
LIFTING BEAM ASSEMBLIES

$$a = 4.72'' < 4 \times 1.75 = 7.00''$$

OK!!

A_n REQUIRED

$$= \frac{62.5}{12} = 5.21 \square''$$

MIN. EDGE DISTANCE REQ'D

$$a = \frac{1}{2}\frac{5.21}{1.75} = 1.49'' < 4.72''$$

OK!

EDGE DISTANCE // LOAD (MIN.)

$$a = \frac{2}{3} \times 5.21 \times \frac{1}{1.75} = 1.98'' < 0.8 \times (2.5 + \frac{1}{16}) = 2.05''$$

REQ'D PER TEAR-OFF RESISTANCE

$$P = 62.5^{k} = 2 \times t \times (a + \frac{d}{2}) \times F_v$$

$$a = \frac{62.5}{2 \times 7.2 \times 1.75} - \frac{2.5}{2} = 1.23''$$

$$\therefore \quad a = 1.98''$$

FROM CENTER OF PIN-HOLE TO LOWER EDGE OF WEB

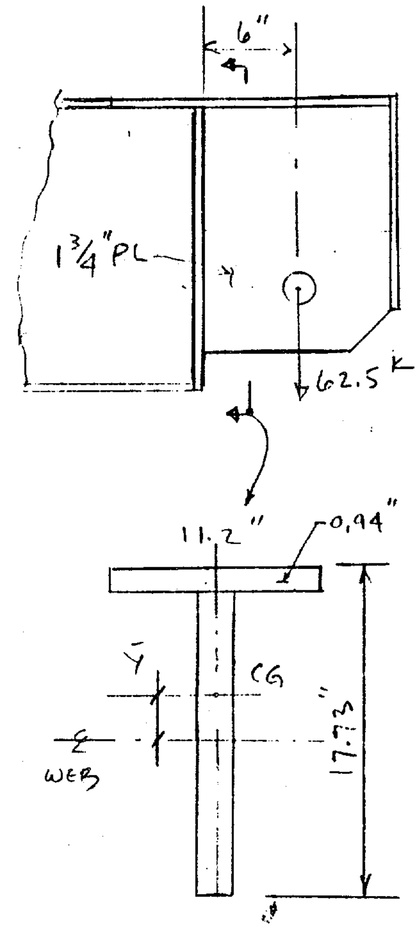
$$= \frac{1}{2}(2.5 + \frac{1}{16}) + 1.98$$

$$= 3.26'' \quad \text{USE} \quad 4''$$

Advanced Engineering Consultants

Sheet No. 2-7
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By NCW Date 5/23/94
Chk'd Date

Subject TEMP. PUMP 2
LIFTING BEAM ASSEMBLIES



CHECK LOCAL STRESSES

$V = 62.5^{k}$

$$f_v = \frac{62.5}{(17.73 - 2.5 - \frac{1}{16}) \times 1.75}$$

$= 2.35^{ksi} < 7.2^{ksi}$

ok

I : STATIC MOMENT ABT. ℄ OF WEB

$(11.2 \times 0.94 + 17.73 \times 1.75)\,\bar{Y}$

$= 11.2 \times 0.94 \times \frac{17.73}{2} = 93.33$

$\bar{Y} = 2.25''$

$$I = \frac{1}{12} \times 1.75 \times (17.73 - 0.94)^3$$

$+ (17.73 - 0.94) \times 1.75 \times 2.25^2$ WEB

$+ (11.2 \times 0.94) \times \left(\frac{17.73}{2} - 2.25\right)^2$ FLANGE

$= 1{,}300^{\ IN^4}$

SHEAR STRESS @ FLANGE + WEB JUNCTION AREA

$Q = AY = 11.2 \times 0.94 \times 6.62 = 69.70^{\ IN^3}$

$$v = \frac{62.5 \times 69.70}{1{,}300} = 3.35^{k}/_{''}$$

Advanced Engineering Consultants

Sheet No. 2-8
Job/Calc. No. CA1001 02-1
Rev. No. 0

Subject: TEMP PUMP 2 LIFTING BEAM ASSEMBLIES

By MCW Date 5/23/94
Chk'd Date

FILLET WELD PER $\frac{1}{16}$", ALL $v = \frac{1}{16} \times 7.2 = .45$ k/"

WELD BOTH SIDES, SIZE WELD "D" IN 1/16"

$\therefore \quad 2 \times 0.45 \times D = 3.35$

$\therefore \quad D = 3.7$ OR 4/16" BUT MIN 5/16" FOR PL > 3/4"

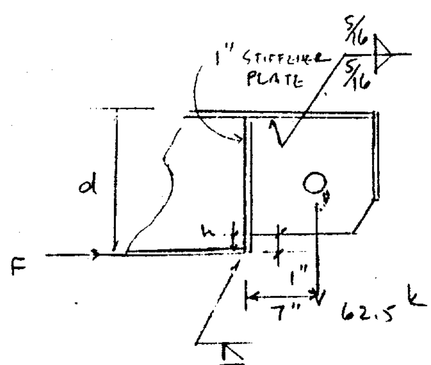
FLEXURAL STRESS

$M = 62.5 \times 6 = 375^{k-''}$

$f_b = \frac{375}{1300} \times \left(\frac{17.73 - 0.94}{2} + 2.25 \right)$

$= 3.1^{ksi} << 12^{ksi}$ LOW

CHECK 1" STIFFENER PLATE @ 1" OFFSET



$h = 1 - 0.94/2 = 0.53"$

$F = \frac{62.5 \times 7}{18.73 - 0.94} = 24.6^{k}$

$S = \frac{1}{6} \times 11.2 \times 1^2 = 1.87^{ksi}$

$f_b = \frac{24.6 \times 0.53}{1.87} = 7.0^{ksi} < 12^{ksi}$

ok!

Advanced Engineering Consultants

Sheet No. 2-9
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MLW Date 6/1/94
Chk'd W.A. Date 6/2/94

Subject TEMP PUMP 2 - LIFTING BEAM ASSEMBLIES

WELDS:

1. SEE FOR DETAIL OF LUG @ CENTER OF THE BEAM.

2. LUGS @ BOTH ENDS OF THE BEAM

a.) WEB PLATE $1\frac{3}{4}''$

- TO FLANGE $\frac{5}{16}''$ FILLET WELDS, SEE P. 10
- TO $\frac{1}{2}''$ END PLATE, USE $\frac{5}{16}''$ FILLET WELDS (MIN. AISC REQUIREMENT)
- TO $1''$ STIFFENER PLATE

TO BE CONSERVATIVE, IGNORE FLANGE AND USE FILLET WELDS ON WEB TO RESIST

$V = 62.5^{k}$, $M = 375^{k-''}$

16.79

$$f_v = \frac{62.5}{2 \times 16.79} = 1.87^{k}/''$$

$$S = 2 \times \frac{1}{6} \times (16.79)^2 = 94.0^{in^3}$$

$$f_b = \frac{375}{94.0} = 3.99^{k}/''$$

$$f = [1.87^2 + 3.99^2]^{1/2} = 4.39^{k}/''$$

Advanced Engineering Consultants

Sheet No. 2-10
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCZ Date 6/1/94
Chk'd W. Kam Date 6/2/94

Subject LIFTING BEAM ASSEMBLIES

SIZE OF WELD = $\frac{4.39}{7.2} = 0.61'' > \frac{5}{16}''$

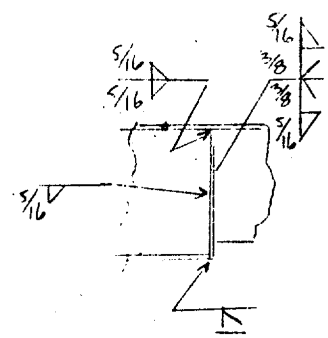
USE PARTIAL PENETRATION

E = 0.31" FOR $1\frac{3}{4}''$ PLATE, MIN E = $\frac{3}{8}''$

$2 \times \frac{3}{8} < 1''$ (STIFFENER PLATE)

USE $\frac{3}{8}''$ PARTIAL PENETRATION & REINFORCING $\frac{5}{16}''$ FILLET WELDS TO ALLOW FOR TWISTING RESULTED FROM MISALIGNING OF $1\frac{3}{4}''$ WEB PLATE & BEAM WEB ℄.

b) 1" STIFFENER PLATE



- TO TOP FLANGE

USE MIN. $\frac{5}{16}''$ FILLET WELDS

- TO BOTTOM FLANGE

FULL PENETRATION AND GRIND FLUSH

- TOP WEB

USE MIN. $\frac{5}{16}''$ FILLET WELDS

$2 \times \frac{5}{16}'' > t_w - 0.59''$

Advanced Engineering Consultants

Sheet No. 2-11
Job/Calc. No. CA001-02-1
Rev. No. 0
Subject: TEMP PUMP 2 LIFTING BEAM ASSEMBLIES
By MCSL Date 5/23/94
Chk'd [illegible] Date 6/2/94

2.4 CLEVISES & RODS

RODS: $F_t = 9.57$ ksi

$$\frac{\pi}{4}d^2 = \frac{62.5}{9.57} \qquad d = 2.88"\phi$$

USE 3" ϕ ROD

CLEVISES -

PIN $2\frac{1}{2}"\phi$ & ROD $3"\phi$

7 CLEVIS PER AISC 4-148

CAPACITY $= 68.5^k > 62.5^k$

RETAIN THE PINS w/ RECESSED PIN NUTS

Advanced Engineering Consultants

Sheet No.	2-12
Job/Calc. No.	CA4001-02-1
Rev. No.	0
By	[illegible] — Date 5/23/94
Chk'd	[illegible] — Date 5/23/94

Subject: TEMP PUMP 2
LIFTING BEAM ASSEMBLIES

GRIP

BEAM SIDE

$$GRIP = \frac{1}{4}'' + 1.75 = 2.0''$$

USE 2"

CANISTER SIDE

$$GRIP = \frac{1}{4} + 2 = 2\tfrac{1}{4}''$$

CHECK BENDING ON PIN

BEAM SIDE IS MORE CRITICAL.

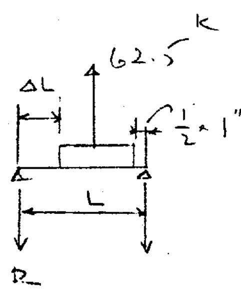
$$L = 2 + 1 = 3''$$

LOAD @ MID-SPAN

$$M = \frac{1}{2} \times 62.5 \times \frac{1}{2} \times \left(\frac{1}{4} + 1\right)$$

$$= 19.5^{k-''}$$

LOAD @ LUG PLATE AGAINST CLEVIS CONDITION



$$\Delta L = \frac{1}{2} \times 1 + \frac{1}{4} = 0.75''$$

$$R = 62.5 \times \frac{1}{2}(1.75 + 1) \times \frac{1}{3} = 28.6^{k}$$

$$M = R \cdot \Delta L = 0.75 \times 28.6 = 21.45^{k-''}$$ ← CONTROLS

$$F_b = \frac{0.75}{2} F_y = 13.5 \text{ KSI}$$

Advanced Engineering Consultants

Sheet No.	2-13
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCW
Date	5/24/94
Chk'd	W. [illegible]
Date	5/25/94

Subject: TEMP PUMP 2 - LIFTING BEAM ASSEMBLIES

$$S_{REQ'D} = \frac{21.45}{13.5} = 1.59 \text{ IN}^3$$

$$\frac{\pi R^3}{4} = 1.59 \qquad R = 1.26''$$

$$\therefore \quad d = 2.52'' \approx 2\tfrac{1}{2}''$$

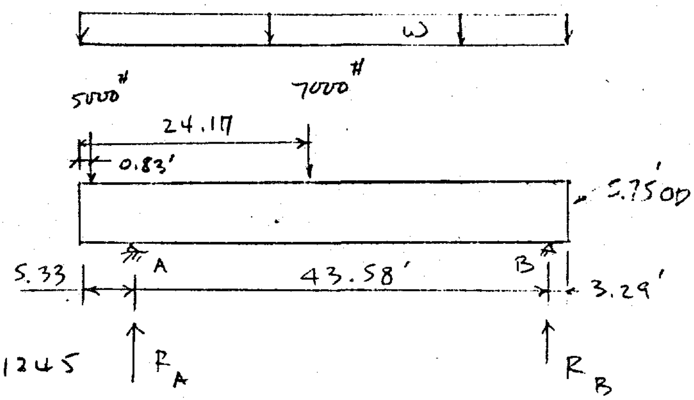
OK!

Advanced Engineering Consultants

Sheet No.	3-1
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCW — Date 5/11/94
Chk'd	WKW — Date 6/3/94

Subject: TEMP PUMP 2 - SADDLES

3. SADDLES



3.1 GEOMETRY & LOADS

DL:

LOAD CHART 101 SY

UNIF LOAD = 210 + 1000 + 1245

w = 2455 PLF

CONCENTRATED LOAD: 5,000 + 7,000 = 12,000#

TOTAL UNIF LOAD: 52.20 × 2455 = 128,151# ≐ 128.2k

RESULTANT @ $\frac{52.20}{2} - 5.33 = 20.77'$
FROM SUPPORT A

$\Sigma M_A = 0$ $\quad R_B = \left[128.2 \times 20.77 + 7 \times (24.17 - 5.33) - 5 \times (5.33 - 0.83)\right] \times \frac{1}{43.58}$

$= 63.6^k$

$R_A = 12 + 128.2 - 63.6 = 76.6^k$ ← CONTROLS

DESIGN DL = 76.6 PLUS DL OF SADDLE = 80^k

WIND LOAD: UBC

$p = C_e C_q q_s I$

C_e: 1.06 (EXPOSURE C)

q_s = 12.6 PSF (70 MPH)

C_q = 0.8 (ROUND)

I = 1.07

Advanced Engineering Consultants

Sheet No. 3-2
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [illegible] Date 5/11/94
Chk'd W. Kan Date 6/3/94

Subject TEMP. PUMP 2 - SADDLES

$$p = 1.06 \times 12.6 \times 0.8 \times 1.07 = 11.43 \text{ PSF}$$

TOTAL WIND LOAD $= 11.43 \times 52.20 \times 5.75 = 4{,}436^{\#}$

$= 3.43^{k}$

$$H_B = \frac{3.43 \times 20.77}{43.58} = 1.63^{k}$$

$H_A = 3.43 - 1.63 = 1.8^{k}$ ← CONTROLS

OVERTURNING MOMENT

$= 1.8 \times (\frac{1}{2} \times 71.625 + 1 + 4.75 + 1 + \frac{3}{4}) \times \frac{1}{12}$ (LEVELING)

$= 6.5^{k-1}$

@ SUPPORT A, COL 4 & 5 RING ($1\frac{1}{2}''$ EA)

@ SUPPORT B, COL 22-23 RING ($1\frac{1}{2}''$ EA)

OD OF THE RING $= 5'-11\frac{5}{8} = 71.625''$

TRY SADDLE TO SUPPORT 1/4 OF RING.

ARC LENGTH $= \frac{\pi \times 71.625}{4} = 56.254''$

CHORD $= 2R \sin\frac{A}{2} = 71.625 \sin\frac{90}{2} = 50.65''$

RISE $: \frac{50.65}{2} \times \tan\frac{90}{4} = 10.49''$

3.2 SIZE OF SADDLES

MIN. HEIGHT OF SADDLES:

$= 10.49'' + 1 + 4.75 + 1 = 17.24''$

USE $1'-6''$

Advanced Engineering Consultants

Sheet No.	3-3
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	[illegible] Date 5/11/94
Chk'd	W Kan Date 6/3/94

Subject: TEMP PUMP 2 - SADDLES

TOP OF SADDLE, MIN. WIDTH REQ'D.

11"	OUT TO OUT RING SPACING
2	1" CLEARANCE BETWEEN RING & RING KEEPER BARS
2	RING KEEPER BARS, 1"x1" EACH
$2 \times \frac{1}{2}$	SPACE FOR WELDS

TOTAL 16"

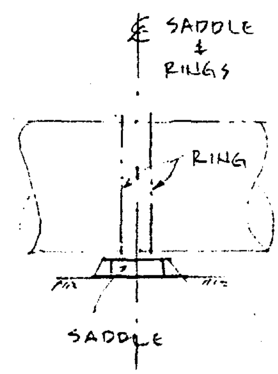
Advanced Engineering Consultants

Sheet No. 3-4
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 5/16/94
Chk'd [illegible] Date [illegible]

Subject TEMP. PUMP 2 - SADDLES

DESIGN:

INVESTIGATE TWO LOADING CONDITIONS AND LIMIT SOIL BEARING PRESSURE TO 2.6 KSF.



1. DEAD LOAD ONLY

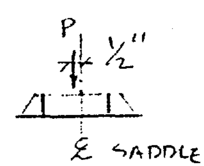
$P = 80^{k}$

BEARING AREA REQ'D $= \frac{80}{2.6} = 30.8^{\square'}$

TRY 8' LONG SADDLE

MIN. WIDTH $= \frac{30.8}{8} = 3.85' = 46.2''$

USE 4'-0"



CHECK W/ 1/2" ECCENTRICITY

$S = \frac{1}{6} \times 8 \times 4^{2} = 21.33\ FT^{3}$

$p = \frac{80}{8 \times 4} + \frac{80 \times 1/2}{21.33 \times 12} = 2.66\ KSF$ 2% OVER ALLOWABLE PRESSURE

SAY OK!

2. DEAD LOAD PLUS WIND

ALLOWABLE PRESSURE = $2.6 \times 1.33 = 3.46^{KSF}$

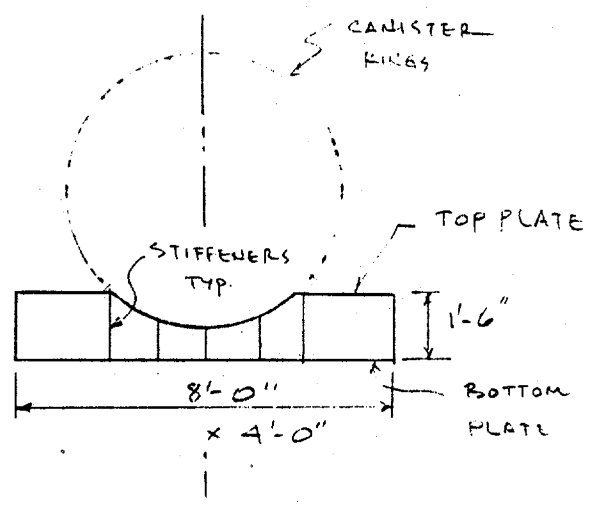
$P = 80^{k}, \quad M = 6.5^{k-'}$

$S = 21.33\ FT^3$

$p = \frac{80}{8 \times 4} + \frac{6.5}{21.33} = 2.80^{KSF} < 3.46^{KSF}$

OK!

SUMMARY: USE 4' x 8' x 1'-6" SADDLE



CROSS SECTION

Advanced Engineering Consultants

Sheet No.	3-6
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	[illegible]
Date	5/16/94
Chk'd	[illegible]
Date	[illegible]

Subject TEMP. PUMP 2 - SADDLES

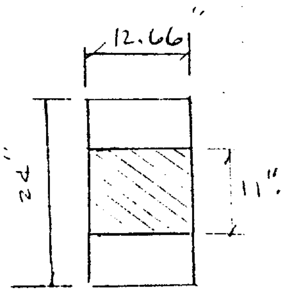
TOP PLATE

TRY 5 STIFFENERS, 4 EQUALLY SPACED

$$SPACING = \frac{50.65}{4} = 12.66''$$

$$UNIT\ PRESSURE\ ON\ PLATE = \frac{77}{50.65} = 1.58\ ^{k}/_{''}$$

$$W = 1.52 \times 12.66 = 19.24^{k}$$



USE FORMULAS FOR FLAT PLATES
IN "FORMULAS FOR STRESS & STRAIN"
BY ROAK

$b = 12.66''$, $a = 24''$

$b_1 = 12.66''$, $a_1 = 11''$

$a/b = 1.9$, $a_1/b = \frac{11}{12.66} = 0.87$, $b_1/b = 1$

	$a = 1.4b$	β $a = 2b$	$a = 1.9b$
$a_1/b = 0.87$ $b_1/b = 1$	0.454	0.516	0.506

$$f_b = \beta \frac{W}{t^2} \quad OR \quad t^2 = 0.506 \times \frac{19.24}{12}$$

$\therefore t = 0.9''$, USE 1" PLATE

CHECK SHEAR

$$v = 1.5 \times \frac{19.24}{2} \times \frac{1}{1 \times 11} = 1.3^{ksi} << 7.2^{ksi}$$

OK!

CHECK LOCAL WEB YIELDING

$P = 77^k$

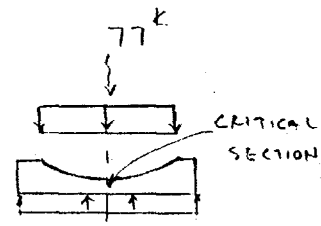
IGNORE STIFFENERS (CONSERVATIVE)

TWO WEB EACH $50.65'' \times \frac{1}{2}''$ $(25t = 12.5'' \approx 12.66'')$

$$f_a = \frac{77}{2} \times \frac{1}{50.65 \times 0.5} = 1.52^{ksi}$$

STRESS IS VERY LOW

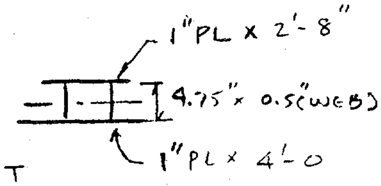
CHECK FLEXURAL OF BUILT-UP SECTION



M_{max} @ CENTER

$$= \frac{77}{2} \times \left(\frac{4}{2} \times 12 - \frac{50.65}{2} \times \frac{1}{2} \right)$$

$$= 436.5^{k-''}$$



STATIC MOMENT @ MIDHEIGHT

$$(1 \times 32 + 2 \times 4.75 \times 0.5 + 1 \times 48)\bar{Y} = \left(\frac{4.75}{2} + 0.5\right) \times (32 - 48)$$

$$84.75 \bar{Y} = -2.875 \times 16$$

$$\bar{Y} = 0.54''$$

$$I = 1 \times 32 \times \left(\frac{4.75}{2} + 0.5 + 0.54 \right)^2 \quad \text{TOP FLANGE}$$

$$2 \times \frac{1}{12} \times 0.5 \times 4.75^3 + 2 \times 4.75 \times 0.5 \times (0.54)^2 \quad \text{WEBS}$$

$$+ 1 \times 48 \times \left(\frac{4.75}{2} + 0.5 - 0.54 \right)^2 \quad \text{BOTTOM FLANGE}$$

$$= 373.2 + 8.9 + 1.4 + 261.7$$

$$= 645.2 \text{ in}^4$$

Advanced Engineering Consultants

Sheet No. 5-8

Job/Calc. No. CA 6001-02-1

Rev. No. 0

Subject TEMP. PUMP 2 - SADDLES

By [illegible] Date 5/16/[illegible]

Chk'd [illegible] Date [illegible]

$$f_b = \frac{436.5 \times \left(\frac{6.75}{2} + 0.54\right)}{645.12}$$

$$= 2.6^{ksi} << 12^{ksi}$$

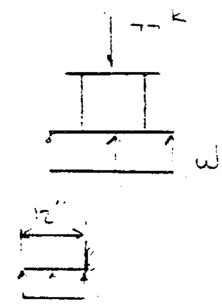
ASSUME 77^k AS A POINT LOAD, $M = \frac{77}{2} \times 2' \times 12 = 924^{k-in}$

$$f_b = 5.6^{ksi} << 12^{ksi} \quad ok!$$

BOTTOM PLATE

FLEXURAL DEMAND ON THE BASE PLATE IS LESS CRITICAL THAN TOP FLANGE PLATE EXCEPT 1' OVERHANGE THAT NEEDS CHECKING

$$\omega = \frac{80}{8 \times 12 \times 48} = 0.02^{k}/_{\square''}$$



$$M = 0.02 \times 12 \times \frac{12}{2} = 1.44^{k-in}$$

$$M_R = \frac{1 \times 1^3}{6} \times 12^{ksi} = 2^{k-in} > 1.44^{k-in}$$

ok!

$$v = 1.5 \times \frac{0.02 \times 12}{1 \times 1} = 0.36^{ksi} << 7.2^{ksi}$$

Advanced Engineering Consultants

Sheet No. 3-9
Job/Calc. No. [illegible] 4001-02-1
Rev. No. 0
By [illegible] Date 5/16/94
Chk'd [illegible] Date [illegible]

Subject TEMP. PUMP 2 - SADDLES

3.3 TOTAL WEIGHT OF SADDLE (ACTUAL HEIGHT = 18")

TOP PLATE $\left(\frac{\pi(3.03)}{2} \times \frac{32}{12} + \frac{2\times 22.68 \times 32}{144}\right. \frac{1}{12} = 1.90\ FT^3$

BOTTOM PLATE

$4 \times 8 \times \frac{1}{12} = 2.67$

WEBS $2\left(1.5 - \frac{2}{12}\right) \times \left(8' - \frac{1}{12}\right) \times \frac{0.5}{12}$

$- 2 \times \frac{1}{2}\left[\left(\frac{56.25}{12} \times 3.07\right) - 4.34\,(3.07 - 0.90)\right] \times \frac{0.5}{12}$ 0.21

$= 0.67$

KEEPER BARS $2 \times .1 \times 1 \times \frac{\pi \times 2.94}{2} \times \frac{1}{144} = 0.06$

STIFFENERS $2 \times \left(\frac{2.67 + 4}{2}\right) \times 1.5 \times \frac{0.5}{12} = 0.42$

$\left(\frac{32 + 48}{2} \times \frac{1}{12}\right)\left(\frac{4.75}{12} + 2 \times 0.65 + 2 \times 1.33\right) \times \frac{0.5}{12}$

$= 0.60$

TOTAL $6.32\ FT^3$

$WT. = 6.32 \times 490 = 3{,}097\ \# \approx 3.1^K$

$< 3.4^K$ (ASSUMED)

ok

Advanced Engineering Consultants

Sheet No. 3-10
Job/Calc. No. CA 4021-02-1
Rev. No. 0
By [illegible] Date 5/16/94
Chk'd [illegible] Date 6/6/94

Subject TEMP PUMP 2 - SADDLES

3.4 STABILITY

FACTOR OF SAFETY AGAINST

SLIDING :

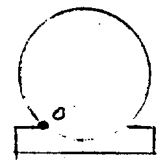
$$\text{LATERAL FORCE} = 3.43^{k} + \frac{4 + 2.67}{2} \times 1.5 \times \frac{11.43}{1000} = 3.5^{k}$$

$$\text{RESISTING FORCE} = (76.6 + 3.0) \times 0.2 = 15.92^{k}$$

$$SF = \frac{15.92}{3.5} = 4.5 \quad >> 1.5 \quad (UBC)$$

OVERTURNING :

PIVOT AT PT "O"



OVERTURNING MOMENT =

$$\left(\frac{71.625}{2} - 10.49\right) \times \frac{1}{12} \times 3.43 = 7.25^{k-l}$$

RESTORING MOMENT =

$$76.6 \times \frac{50.65}{2 \times 12} = 161.7^{k-l}$$

$$FS = \frac{161.7}{7.25} = 22 \quad >> 1.5$$

ok !

Advanced Engineering Consultants

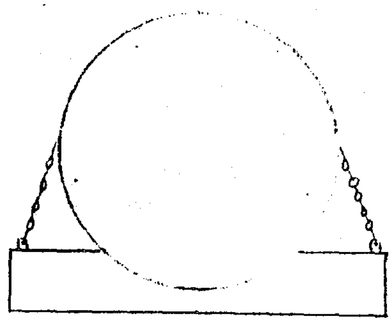
Subject	TEMP PUMP 2 - SADDLES
Sheet No.	3-11
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCW
Date	6/17/94
Chk'd	[illegible]
Date	[illegible]

3-5 LUGS

PROVIDE LUGS FOR SHACKLES

TO INTERCONNECT THE SADDLE

& THE CONTAINER WITH A CHAIN.



LOAD =

SADDLE WEIGHT 3.1^k

DESIGN LOAD $= 3.1 \times \frac{1}{2} \times 1.25 = 1.94^k$

SELECT SHACKLE:

CROSBY FORGED SHACKLES

G209, WORKING LOAD LIMIT 3/4 TONS

PIN SIZE $\frac{3}{4}''\phi$, FOR EASE OF OPERATION.

USE 1/2" LUG.

$$f_p = \frac{1.94}{\frac{1}{2} \cdot 0.75} = 5.2^{ksi} < 16.2^{ksi}$$

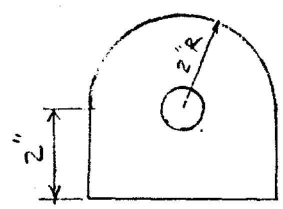
OK!

MAX. 4t EDGE DISTANCE NORMAL TO FORCE

ACTUAL TOTAL EDGE DISTANCE

$= 4 - \frac{13}{16} = 3.19'' > 4t = 2''$

USE 2"



ALL TENSION CAPACITY $= 2 \times \frac{1}{2} \times 12$

$= 12^k >> 1.94^k$

Advanced Engineering Consultants

Sheet No. 3 - 12
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By Mcw Date 6/17/94
Chk'd M. Kim Date

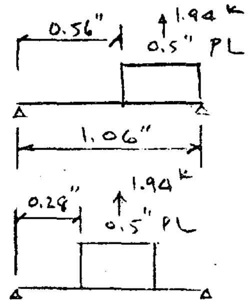
Subject TEMP PUMP 2 - SADDLE 4

BENDING ON SHACKLE PIN

CASE 1. MOMENT @ FACE OF PLATE

$$= \frac{1.94 \times 0.25}{1.06} \times 0.56$$

$$= 0.26^{k-''}$$



CASE 2 $M = \frac{1.94}{2} \times 0.28 = 0.27^{k-''}$

CONTROLS

$$S = \frac{\pi D^3}{32} = 0.0414 \ IN^3$$

$$\therefore f_b = \frac{0.27}{0.0414} = 6.6 \ ksi \quad << \quad \frac{0.75 F_Y}{2} = 13.5 \ ksi$$

ASSUME CHAIN 60° W/ HORIZ

$$f_b = 6.6 \times \frac{1}{\sin 60°} = 7.6 \ ksi$$

ok!

CHECK TEAR-OFF

MAX EDGE DISTANCE PERMITTED

$$= 0.8 \times 3/4 = 0.6'' < \quad \text{ACTUAL } 2 - \frac{1}{2} \times \frac{13}{16} = 1.59''$$

USE 0.6"

$$A_v = 2 \times \frac{1}{2} \times \left(0.6 + \frac{1}{2} \times \frac{3}{4}\right) = 0.98 \ \square''$$

ALLOWABLE CAPACITY = $0.98 \times 7.2 = 7.02 > 1.94^k$

ok

CHECK BENDING ON LUG

$$M = 1.94 \times 2'' = 3.88^{k-''}$$

$$S = \frac{1}{6} \times 0.5 \times (4)^2 = 1.33 \ IN^3$$

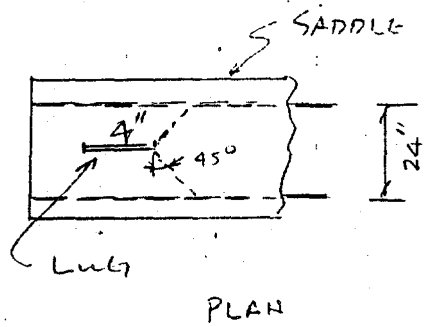
$$f_b = \frac{3.88}{1.33} = 2.9 \ ksi \quad << 12 \ ksi$$

ok!

Advanced Engineering Consultants

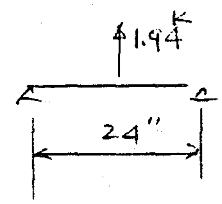
Sheet No. 3-13
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 6/17/94
Chk'd [illegible] Date 6/21/94

Subject TEMP PUMP 2 - SADDLES



CHECK SADDLE PLATE, 1" THICK,
BENDING, EFFECTIVE WIDTH
E = 4+12 = 16"

USE 10"



$\therefore \quad P/_{''} = \frac{1.94}{10} = 0.2\ ^{k}/_{''}$

$\text{MAX.} \quad M = \frac{1}{4} PL$

$= \frac{1}{4} \times 0.2 \times 24 = 1.2\ ^{k-''}/_{''}$

$V = 0.10\ ^{k}/_{''}$

$S = \frac{1}{6} \times 1 \times 1^2 = \frac{1}{6}\ in^3$

$f_b = \frac{1.2}{S} = 7.2^{ksi} < 12^{ksi}$ ok!

$f_v = 1.5 \times \frac{V}{bd} = 1.5 \times \frac{0.1}{1 \times 1} = 0.15^{ksi} < 7.2^{ksi}$ ok!

WELDS:

USE FILLET WELDS 1/4"

$M = 1.94 \times 2 = 3.88^{k-''}$
$V = 1.94^{k}$

$f_v = \frac{1.94}{2 \times 4} = 0.24\ ^{k}/_{''}$, $S = 2 \times \frac{1}{6} \times 4^2 = 5.33\ in^2$

$f_b = \frac{3.88}{5.33} = 0.73\ ^{k}/_{''}$

$f = (0.73^2 + 0.24^2)^{1/2} = 0.77\ ^{k}/_{''} <$ ALL $\frac{1}{4} \times 7.2 = 1.80\ ^{k}/_{''}$ ok

Advanced Engineering Consultants

Sheet No. 4-1
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MGL Date 5/27/94
Chk'd W. Kau Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

4. CONTAINER TEST WEIGHTS

4.1 PURPOSE: THE TEST WEIGHTS WILL BE USED TO TEST THE HYDRAULIC SYSTEM OF A TRAILER SPECIFICALLY DESIGNED TO LIFT A PUMP CONTAINED IN A CANISTER & ITS SUPPORTING COMPONENTS. THE WEIGHTS WILL BE ADDED TO THE TOP OF THE CANISTER VESSEL TO SIMULATE THE PUMP DURING THIS TEST. THE PURPOSE OF THIS DESIGN IS:

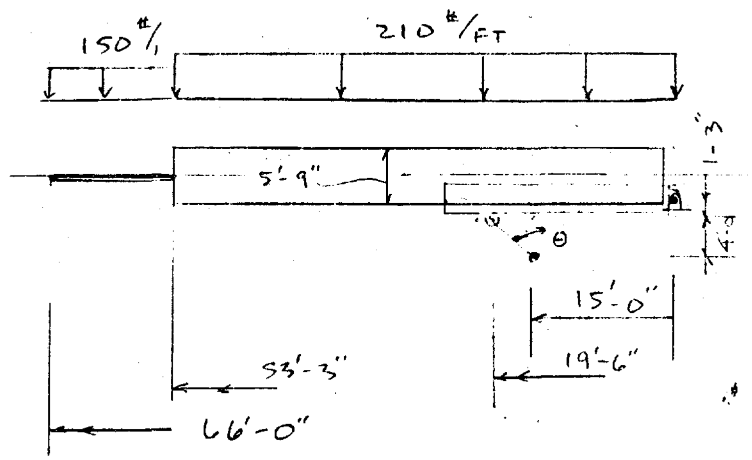
- TO FIND EQUIVALENT PUMP WEIGHTS THAT WILL SIMULATE SAME EFFECT ON JACK SYSTEM BY THE ACTUAL PUMP;
- TO DESIGN TEST WEIGHTS THAT INCLUDE REMOVABLE WEIGHTS PLUS THEIR HOLDER.

Advanced Engineering Consultants

Sheet No. 4-2
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 5/21/94
Chk'd W.Kaus Date 6/3/94

Subject TEMP. PUMP 2
CONTAINER TEST WEIGHTS

4.2 GEOMETRY & EQUIVALENT WEIGHTS



TOTAL WT. OF PUMP = 12.75 x 150 + 53.25 x 210 + 5000
+ 7000 = 25,096#

PURPOSE: FIND TEST WTS TO SIMULATE PUMP WT. DURING TESTING OF TRAILER ON JACKETING OPERATION.

LOADS: 101 SY LOAD CHART

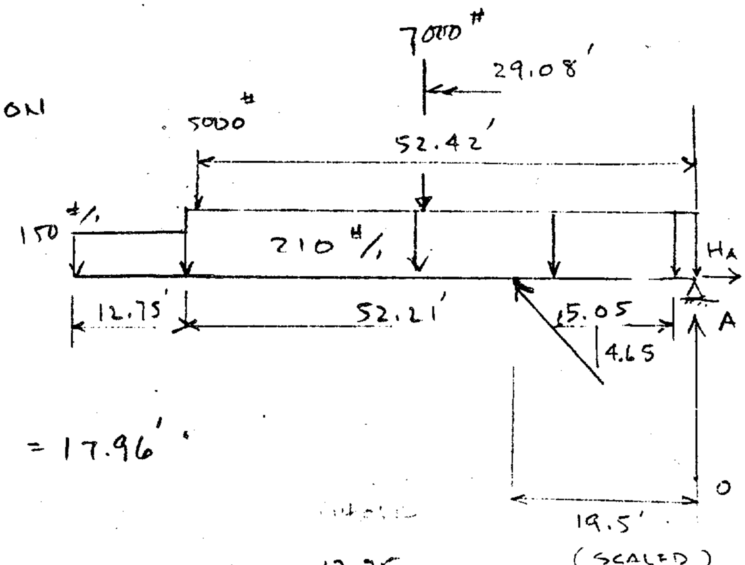
Advanced Engineering Consultants

Sheet No. 4-3
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 5/27/94
Chk'd [illegible] Date 6/3/94

Subject TEMP PUMP 2
CONTAINER TEST WEIGHTS

ANALYSIS:

(i) HORIZONTAL POSITION



$\Sigma M_O = 0$

$\overline{AO} = 19.5 \times \frac{4.65}{5.05} = 17.96'$

$H_A \times 17.96 = 150 \times 12.75 \left(66 - \frac{12.75}{2}\right)$

$+ 210 \times 53.25 \times \left(53.25 - \frac{53.25}{2}\right)$

$+ 5000 \times 52.42 + 7000 \times 29.08$

262,100 203,560

$= 877{,}426^{\#\text{-}'}$

$H_A = 48{,}854^{\#}$

@ JACK

$H = 48{,}854^{\#}$, $V = \frac{4.65}{5.05} \times 48{,}854 = 44{,}984^{\#}$

$V_A = 25{,}096 - 44{,}984 = -19{,}888^{\#} \downarrow$

TO CREATE SAME REACTION @ HYDRAULIC JACK

WTS. ARE PLACED AT 53'-3" FROM SUPPORT "A"

TOTAL THICKNESS OF WEIGHT = 12"

$W \times (53.25 + \frac{1}{2}) = 877{,}426$

$W = 16{,}324^{\#}$

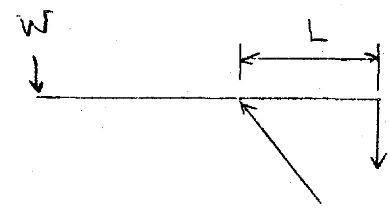
Advanced Engineering Consultants

Sheet No. 4-4
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 5/27/94
Chk'd WKan Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WTS

TO CREATE SAME VERTICAL REACTION @ A.

$V_A =$ # ↓



$$L = \frac{\bar{AD}}{4.65} \times 5.05$$

$$= 19.5'$$

TEST WTS. REQ'D

$$W \times (53.25 - 19.5 + 0.5) = 19,909 \times 19.5$$

$$W = 11,335^{\#} < 16,324^{\#}$$

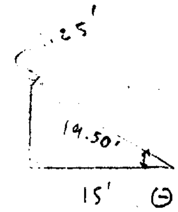
Advanced Engineering Consultants

Sheet No.	4-5
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCSL
Date	5/27/94
Chk'd	WTK
Date	6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WT.

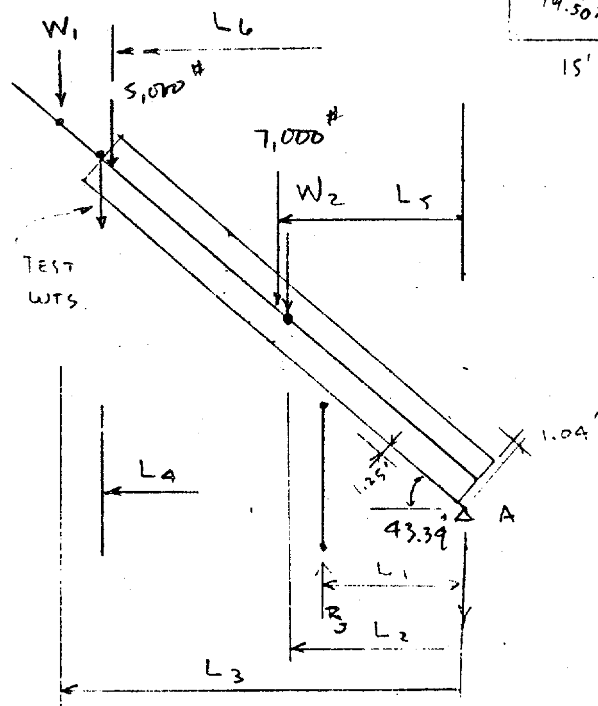
(ii) HYDRAULIC JACK IN VERTICAL POSITION

$$\theta = \cos^{-1}\frac{15}{19.5} + \sin^{-1}\frac{1.25}{19.5} = 43.39^\circ$$



$W_1 = 150 \times 12.75$
$= 1{,}913^{\#}$

$W_2 = 53.25 \times 210$
$= 11{,}183^{\#}$



$L_1 = 15'$

$$L_2 = \left(53.25 - \frac{53.25}{2}\right)\cos 43.39 - \frac{5.75}{2}\sin 43.39^\circ$$
$$= 17.38'$$

$$L_3 = \left(66.00 - \frac{12.75}{2}\right)\cos 43.39^\circ - \frac{5.75}{2}\sin 43.39^\circ$$
$$= 41.37'$$

$$L_4 = 53.25\cos 43.39 - \frac{5.75}{2}\sin 43.39^\circ$$
$$= 36.73'$$

Advanced Engineering Consultants

Sheet No.	4-6
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCR
Date	5/27/94
Chk'd	H. Kan
Date	6/3/94

Subject: TEMP. PUMP 2 CONTAINER TEST WEIGHTS

$$L_5 = 29.08 \times \cos 43.39^\circ - 1.98 = 19.16'$$

$$L_6 = 52.42 \times \cos 43.39^\circ - 1.98 = 36.13'$$

$\Sigma M_A = 0$

$$R_J \times 15 = 1{,}913 \times 41.37 + 11{,}183 \times 17.38 + 5{,}000 \times 36.13 + 7000 \times 19.16 = 588{,}271$$

$$R_J = 39{,}218^{\#} \quad , \quad V_A = 25{,}096 - 39{,}218 = -14{,}122^{\#}$$

TEST WEIGHTS TO CREATE SAME R_J

$$W \times (36.73 + 0.5 \cos 43.39^\circ) = 588{,}271$$

$$W = 15{,}861^{\#} < 16{,}324^{\#}$$

TEST WEIGHTS TO CREATE SAME V_A

$$W \times (37.09 - 15) = 14{,}122 \times 15$$

$$W = 9{,}589^{\#} < 16{,}324^{\#}$$

SUMMARY:

EQUIVALENT PUMP WEIGHTS

$= 16{,}324^{\#}$

Advanced Engineering Consultants

Sheet No. 4-7
Job/Calc. No. CA 4001-02-1
Rev. No. 0
Subject TEMP PUMP 2 - CONTAINER TEST WEIGHTS
By [illegible] Date 5/27/94
Chk'd WTK Date 6/3/94

4.3. WEIGHT HOLDERS & REMOVABLE WEIGHTS

DESIGN LOAD = TEST WEIGHTS x 1.25

TOTAL WEIGHTS = 16,324# (P. 4-6)

SAY 16,400#

WITH IMPACT = 16,400 x 1.25

= 20,500#

USE 21,000#

WEIGHT HOLDER CONSISTS OF:

- BULKHEAD PLATE (2" THICK)
- FILLER PLATE (2" THICK)
- VERTICAL LIFTING LUG
- HORIZONTAL LIFTING LUG
- SUPPORT LEG (TWO WIDE FLANGE BEAMS)

Advanced Engineering Consultants

Sheet No. 4-8
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [illegible] Date 5/27/94
Chk'd [illegible] Date 6/3/94

Subject TEMP PUMP 2 - CONTAINER TEST WEIGHTS

TEST WEIGHT HOLDER:

BULKHEAD PLATE:

BOLT CIRCLE 5'-1" Φ

SIZE OF BOLT = 1" Φ

MIN. EDGE DISTANCE $1\frac{1}{4}$"

USE $2\frac{1}{2}$"

OUTER EDGE DIMENSION = (5'-1") + 2×2.5

= 5'-6"

INSIDE DIAMETER OF OUTER CONTAINER FLANGE = 4'-10" ID

FILLER PLATE DIA = 4'-$10\frac{3}{8}$"

HOLDER BEAMS:

USE W 8×28

$d = 8.06"$, $b_f = 6.54"$ $t_f = 0.465"$

$t_w = 0.285"$

Advanced Engineering Consultants

Sheet No. 4-9
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 5/27/94
Chk'd WKan Date 6/3/94

Subject TEMP. PUMP 2 -
CONTAINER TEST WEIGHTS

WEIGHTS OF HOLDER (SEE DESIGN SKETCHES 6-7 THRU 6-10)

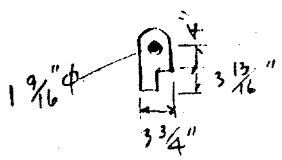
BULKHEAD:

$$6.08 \times 5.5 \times \frac{2}{12} \times 490 = 2730.9$$

FILLER:

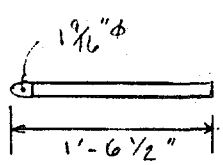
$$\frac{\pi}{4}(4.86)^2 \times \frac{2}{12} \times 490 = 1515.0$$

VERTICAL LUG (1" THICK)



$$\left[\frac{\pi}{8}(3.75)^2 + (4.0 \times 3.75) - \frac{\pi}{4}(1.563)^2 + \frac{1}{2} \times 3.75 \times 3.813\right] \times \frac{1}{1728} \times 490 = 7.3$$

HORIZONTAL LUG (3"φ SOLID ROD)



ROD LENGTH (FROM FACE OF PLATES) $1.54' \times 24.05 = 37.1$

LESS $\frac{\pi}{4} \times (1.563)^2 \times 3 \times \frac{1}{1728} \times 490 = -1.6$

SUPPORT LEGS (1'-8" PLUS STIFFENER PLS)

BEAM $1.67 \times 28 \times 2 = 93.5$

STIFFENER PLS: $8.06 \times 6.54 \times \frac{1}{4} \times \frac{490}{1728} \times 2 = 7.5$

Advanced Engineering Consultants

Sheet No.	4-10
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCW	Date 5/27/94
Chk'd	WKan	Date 6/3/94

Subject: TEMP PUMP 2 - CONTAINER TEST WEIGHTS

$$4 \times 7.19 \times 3.13 \times \frac{1}{4} \times \frac{490}{1728} = 6.4^{\#}$$

TOTAL 4396.1#

REMOVABLE WEIGHTS:

TOTAL EQUIV. WT. = 16,330#

TRY 6 PIECES OF WEIGHTS

$$\text{EACH} = \frac{16330 - 4396.1}{6}$$

$$= 1989.0^{\#} \approx 1990^{\#}$$

USE 2" THICK,

HEIGHT FROM TOP OF SUPPORT LEGS TO ℄ OF CANISTER = 2'-6"

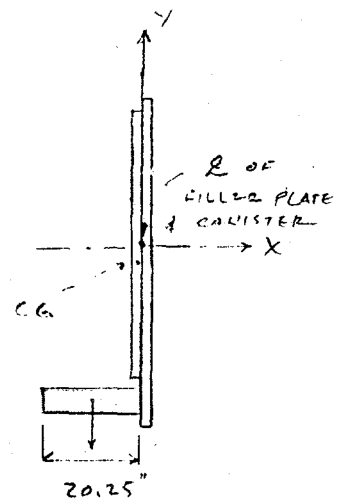
HEIGHT 5'

$$\text{WIDTH REQ'D} = \frac{1990}{5 \times 490 \times \frac{2}{12}} = 4.87'$$

USE 5'-0"

USE 6 - PL 2" × 60" × 5'-0"

EACH WT = 2041.7#



FIND C.G. IN "X" DIRECTION, HOLDER ONLY

$$(2730.9)\cdot 1'' - 1515.0 \times 1 - (93.5 + 7.5 + 6.4) \times 10.125$$
$$-(35.5)(9.25 + 2) = 4396.1\,\bar{x}$$

$$\bar{x} = -0.06 \approx -\frac{1}{16}''$$

Advanced Engineering Consultants

Sheet No. 4-11
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 5/27/94
Chk'd [illegible] Date 6/3/94

Subject TEMP. PUMP2 - CONTAINER TEST WEIGHTS

FIND CG IN "Y" DIRECTION, HOLDER, PLUS ALL REMOVABLE WEIGHTS — LOCATING LIFTING PT. FOR THE HORIZONTAL LUG.

DESCRIPTION	W (#)	$\bar{Y}$ (")	WY
BULKHEAD	2730.9	$-\left(\frac{73}{2}-33\right)=-3.5$	-9,558.2
FILLER	1515	0	0
VERTICAL LUG	7.3	≈ 34"	248.2
HORIZ LUG	35.5	TYP - 1"	-35.5
SUPPORT LEGS	(93.5+7.5+6.4) = 107.4	$-\left(30+\frac{8.06}{2}\right)=-34.03$	-3641.2
TEST WTS	6 x 2041.7 = 12250.2 + 130# (SHACKLES & LUGS) ESTIMATED	0	0
	16,776.3#		-12,986.7
	>16,400#		

$\bar{Y} = -.77 \approx -\frac{3}{4}''$

Advanced Engineering Consultants

Sheet No. 4-12
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCR Date 5/27/94
Chk'd WKan Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

CG IN "X" DIRECTION, HOLDER IS FULLY LOAD.

STATIC MOMENT ABOUT AXIS THRU INTERFACE OF HOLDER PLATES.

$$4396.1(-0.06) + 12{,}250 \times (-6-2) = 16{,}776.3\,\bar{x}$$

$$\bar{x} = -5.9''$$

Advanced Engineering Consultants

Sheet No. 4-13
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kau Date 5/26/94
Chk'd [illegible] Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WTS

Vert. LIFTING LUGS

DESIGN LOAD = 21,000#

DESIGN CRITERIA:

$F_b = F_t = F_a = 12^{ksi}$ (Allow. Bending, Tension and Comp. Stresses)

$F_v = 7.2^{ksi}$ (Allow. Shear)

$F_p = 12^{ksi}$ (Allow. Bearing)

Bolts

$F_p = \frac{0.9}{2} F_y = 0.45^{Fy} = 16.2^{ksi}$

$F_t = \frac{0.33 F_u}{2} = 9.57^{ksi}$

PINS

Double Shear

$A_v = \frac{21}{2} \times \frac{1}{7.2} = 1.46^{\square''}$

$\frac{\pi}{4} d^2 = 1.46$ $d = 1.36''$

USE $1\frac{1}{2}'' \phi$

Advanced Engineering Consultants

Sheet No. 4-14
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kan Date 5/26/94
Chk'd [illegible] Date 6/3/94

Subject TEMP PUMP 2 - CONTAINER TEST WTS

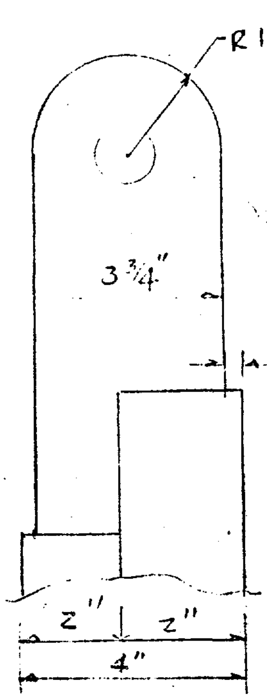
Lug plates

Bearing $F_p = 16.2^{ksi}$

$$t = \frac{21}{1.5 \times 16.2} = 0.86''$$

use $1\frac{1}{2}''$ PL TO ALLOW. LOCAL BENDING

Check net area @ cross section through pin-hole and ⊥ load



$\phi(1\frac{1}{2}+\frac{1}{16}) = 1\frac{9}{16}''\phi$

$$A_{net} = \frac{P}{F_t} = \frac{21}{12} = 1.75^{\square''}$$

$$\text{edge distance} = \frac{1}{2} \times \frac{1.75}{1.5} = 0.58'' < 4 \times 1.5$$

OK

FURNISHED EDGE DISTANCE

$$= \frac{1}{2}(3\tfrac{3}{4} - 1\tfrac{9}{16}) = \frac{1}{2}(3.75 - 1.56) = 1.10'' > 0.8 \times 1\tfrac{9}{16} = 1.25$$

OK

Allow. Shear Capacity

$$= 2 \times 1.5 \times (1.10 + \frac{1.5}{2}) \times 7.2$$

$$= 39.9^k > 21^k \quad \text{o.k.}$$

Advanced Engineering Consultants

PAGE A-53

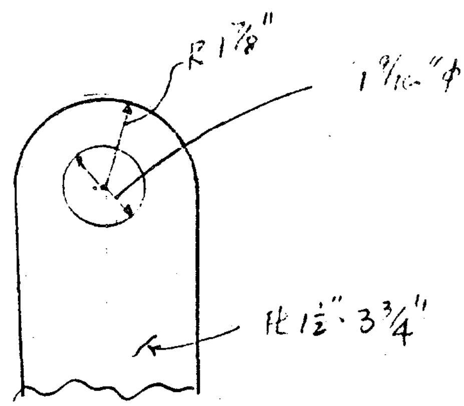
Sheet No. 4-15
Job/Calc. No. CA 4001-02-1
Rev. No. 0
Subject TEMP. PUMP 2 - CONTAINER TEST UNIT
By W. Kan Date 5/26/94
Chk'd [illegible] Date 6/3/94

Cross Section Area // Load Req'd

$A = 2/3 \times 1.75 = 1.17 \square''$

Edge Distance $= \frac{1.17}{1.5} = 0.78'' < 0.8 \times 1\,9/16 = 1.25''$ O.K

FURNISHED $= 1.10'' < 1.25''$ O.K



Advanced Engineering Consultants

Sheet No.	4-16
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	W. Kan
Date	5/27/94
Chk'd	MCW
Date	6/3/94

Subject: TEMP. PUMP 2 - Horiz. Lifting Lug, Test wt

Horizontal Lifting Lugs

Design Load = 21 K

ROD

$$A = \frac{21}{9.57} = 2.19 \ \square''$$

use 3"ϕ Rod $A = \frac{\pi}{4}(3)^2 = 7.07 \ \square'' > 2.19 \ \square''$ OK

w/ 11/16"ϕ hole $A = 7.07 - 3 \times 11/16 = 5.01 \ \square'' > 2.19 \ \square''$ ok

PIN

Double Shear

$$A_v = \frac{21}{2} \times \frac{1}{7.2} = 1.46 \ \square''$$

$$\frac{\pi}{4} d^2 = 1.46 \qquad d = 1.36''$$

use $1\frac{1}{2}$"ϕ

Lug GRIND END OF THE ROD TO BE USED AS A LIFTING LUG.

Bearing F_p = 16.2 ksi

$$t_{min} = \frac{21}{1.5 \times 16.2} = 0.86'' \qquad \text{use } 1\tfrac{1}{2}''$$

CHECK NET AREA @ CROSS SECTION THROUGH PIN-HOLE AND ⊥ LOAD

$$A_{net} = \frac{P}{F_t} = \frac{21}{12} = 1.75 \ \square''$$

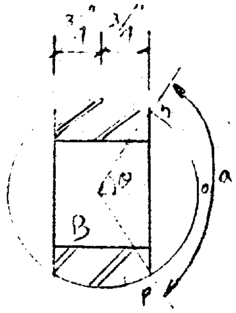
Advanced Engineering Consultants

PAGE A-55

Sheet No. 4-17
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kan Date 5/31/94
Chk'd MLR Date 6/2/94

Subject TEMP. PUMP 2 - Horizontal Lifting Lug, TEST Wt

Check net area @ the end of 3"φ Rod



1) $1\frac{1}{2}$" Lifting Lug

$$\theta = \cos^{-1}\frac{0.75}{1.5} = \cos^{-1}\frac{1}{2} = 60^\circ$$

$$2\theta = 120^\circ = A^\circ$$

$$\text{arc } a = \frac{\pi r A^\circ}{180} = \frac{\pi(1.5)120}{180} = 3.14$$

$$X = \text{chord} = 2\sqrt{2br - b^2}$$

$$= 2\sqrt{2(0.75)(1.5) - (0.75)^2}$$

$$= 2\sqrt{2.25 - 0.56}$$

$$= 2.6''$$

$$\text{Area}_{\text{hcp}} = \frac{(3.14 \times 1.5) - 2.6(1.5 - 0.75)}{2}$$

$$= \frac{4.71 - 1.95}{2}$$

$$= 1.38^{\square''}$$

$$\text{Area } B = \frac{\pi}{4}(3)^2 - 2(1.38) = 4.31^{\square''}$$

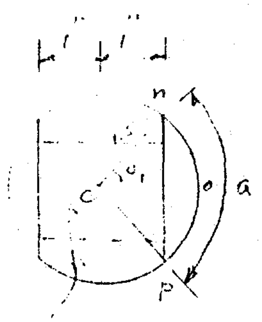
$$\text{Net Area} = 4.31 - 1.5\left(1\tfrac{1}{2} + \tfrac{1}{16}\right) = 1.97^{\square''} \doteq 1.75^{\square''}$$

NEEDS ALLOWANCE FOR FABRICATING TOLERANCES. TRY 2" LIFTING LUG

Advanced Engineering Consultants

Sheet No. 4-18
Job/Calc. No. CA 4021-02-1
Rev. No. 0
By W. Kan Date 5/31/94
Chk'd Mu Date 6/2/94

Subject TEMP. PUMP 2 - CONTAINER TEST WT



ii) 2" Lifting Lug

$\theta = \cos^{-1}\frac{1}{1.5} = \cos^{-1}\frac{2}{3} = \cos^{-1} 0.667 = 48.2^\circ$

$A = 2\theta = 96.4^\circ$

$\text{arc } a = \frac{\pi r A^\circ}{180} = \frac{\pi(1.5)96.4}{180} = 2.52''$

Area B

$\text{Area } nop = \frac{(2.52 \times 1.5) - 2.24(1.5 - 0.5)}{2} = 0.77''$

$\text{Chord } X = 2\sqrt{2br - b^2}$

$= 2\sqrt{2(0.5)(1.5) - (0.5)^2}$

$= 2\sqrt{1.5 - 0.25}$

$= 2.24''$

$\text{Area B} = \frac{\pi}{4}(3)^2 - 2(0.77) = 5.53^{\square''}$

$\text{Net Area} = 5.53 - 2 \times (1\tfrac{1}{2} + \tfrac{1}{16}) = 2.40^{\square''} > 1.75^{\square''}$ O.K.

Use 2" thick lifting lug

Advanced Engineering Consultants

Sheet No.	A-19
Job/Calc. No.	CA4001-02-1
Rev. No.	0
By	W. Kau
Date	5/27/94
Chk'd	MCM
Date	6/2/94

Subject: TEMP PUMP 2
HORIZ. LIFTING LUG, TEST WT.

EDGE DISTANCE ∥ TO THE LOAD

MAX ALLOW $= 0.8 \times (1\frac{1}{2} + \frac{1}{16}) = 1.25''$

FURNISHED $= 2 - \frac{1}{2}(1.5 + \frac{1}{16}) = 1.22'' < 1.25''$ OK

ALLOW. SHEAR CAPACITY

$= 2 \times 1.5 \times (1.22 + \frac{1.5}{2}) \times 7.2 = 42.6^{K} > 21^{K}$ O.K.

CROSS SECTIONAL AREA ∥ LOAD REQ'D

$A = \frac{2}{3} \times 1.75 = 1.17\,\square''$

EDGE DISTANCE $= \frac{1.17}{1.5} = 0.78'' < 1.22''$ O.K.

HITCH PIN ON 3"φ ROD

6 PCS WT $= 12.2^{K}$

TOTAL HORIZ LOAD $= 12.2^{K} \times 1.25 \times \sin 8.88^{\circ} = 2.35^{K}$

USE PLATED OVAL RING HITCH PIN, $\frac{3}{8}''\phi \times 4\frac{3}{8}$ W/
4" GRIP

SHEAR CAPACITY $= 9.74^{K} >> 2.35^{K}$

OK!

Advanced Engineering Consultants

Sheet No. 4-20
Job/Calc. No. CAC001-02-1
Rev. No. 0
By W Kau Date 5/27/94
Chk'd MCR Date 6/3/94

Subject TEMP PUMP 2 - HORIZ LIFTING LUG, TEST WT

3"ϕ ROD WELDING TO PL   MIN EFFECTIVE THROAT T = 3/8"

$$2 \times 3/8 \times 7.2 \times \frac{\pi}{4}(3)^2 = 38.2^k > 21^k \quad \text{O.K.}$$

USE 3/8" PARTIAL PENE WELDS AT BOTH PL

SHACKLE ON HORIZ. LUG.

$T = 21^k$

USE CROSBY FORGED SHACKLE

WORKING LOAD LIMIT = $13\frac{1}{2}^T$

$= 27^k > 21^k$

OK

Advanced Engineering Consultants

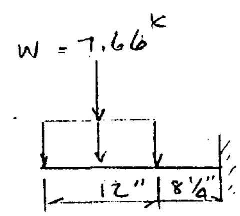
Sheet No.	4-21
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCW — Date 5/27/94
Chk'd	WKam — Date 6/3/94

Subject: TEMP PUMP 2 - CONTAINER TEST WEIGHTS

SUPPORT LEGS

$$\text{REMOVABLE WTS.} = \frac{12{,}250}{2} \times \underset{\text{IMPACT}}{1.25} = 7.66^{k}$$

$$\text{BEAM WT} = \frac{107.4}{2} = 54^{\#}$$



$$M_{max} = 7.66 \times (6 + 8.25)$$

$$+ .054 \times \frac{20.25}{2}$$

$$= 109.7^{k-''}$$

EXTREME CONDITION

$$S_{REQ'D} = \frac{109.7}{12} = 9.1 \text{ IN}^3$$

$$V = 7.66^{k}$$

REQ'D MIN. BEAM ELEMENTS $\geq$ 5/16" TO MEET AISC REQUIREMENT TO WELD THE BEAM TO 2" PLATE.

ASSUMED W 8 x 28 MEETS REQUIREMENTS

$$S = 24.3^{IN^3} >> 9.1$$

$$t_w = 5/16'', \quad t_f = 7/16, \quad d = 8.06''$$

Advanced Engineering Consultants

Sheet No. 4-22
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 5/27/94
Chk'd G/Kaic Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

$$\text{ALL } V = \tfrac{5}{16} \times 8.06 \times 7.2 = 18.1^{k} \gg 7.6^{k}$$

ok!

BENDING ON PLATE (2")

18" EFFECTIVE WIDTH = 9t

$$S = \frac{1}{6} \times 18 \times 2^{2} = 12^{\,\text{IN}^3}$$

$$f_b = \frac{109.7}{12} = 9.1^{\text{ KSI}}$$

$$f_t = \frac{7.66}{18 \times 2} = 0.2^{\text{ KSI}}$$

$$f = f_b + f_t = 9.3^{\text{KSI}} < 12^{\text{KSI}}$$

ok!

WEB YIELDING

$$\text{ALL } P = (12 + 2.5 \times \underbrace{k}_{\text{WIDTH OF WTS}}) \times 12^{\text{KSI}}$$

$$= \left(12 + 2.5 \times \tfrac{15}{16}\right) \times 12 = 172^{k} > 7.68^{k}$$

NO STIFFENERS REQ'D.

TO INCREASE TORSIONAL RESISTANCE, ADD ONE 1/4" END PLATE & TWO 1/4" STIFFENER PLATES NEAR MID-SPAN, EACH LEG.

USE MIN. FILLET WELDS 3/16"

Advanced Engineering Consultants

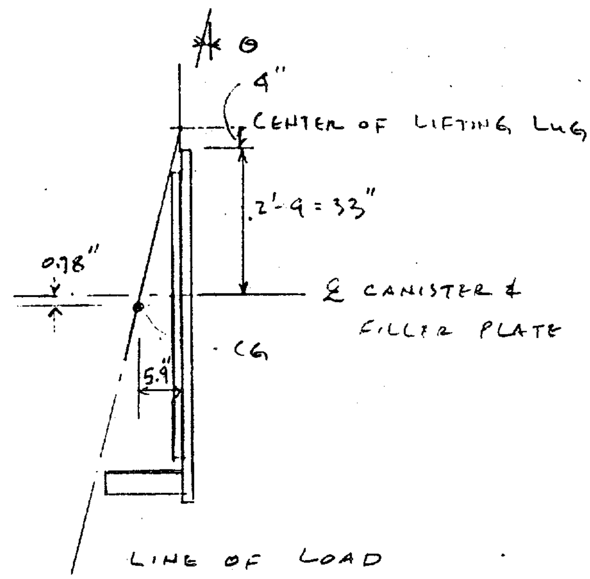
Sheet No. 4-23
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 5/27/94
Chk'd [illegible] Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

VERTICAL LUG BENDING

$$\theta = \tan^{-1} \frac{5.9}{0.78 + 33 + 4}$$

$$= 8.88^\circ$$



ECCENTRICITY @ 4" BELOW ℄ OF LUG

$e = 4 \times \sin 8.88$

$= 0.62''$

@ $4 + 3\frac{13}{16} = 7.81''$

$e = 7.81 \sin 8.88 = 1.20''$

LUG PLATE SUBJECT TO

@ 4" BELOW ℄ OF LUG

AXIAL $= 21^k$

MOMENT $= 21 \times 0.62'' = 13.0^{k-''}$

@ 7.81"

AXIAL $= 21^k$

MOMENT $= 21 \times 1.20 = 25.2^{k-''}$

Advanced Engineering Consultants

Sheet No.	4-24		
Job/Calc. No.	CA 4001-02-1		
Rev. No.	0		
By	MCG	Date	5/27/94
Chk'd		Date	6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

LUG PLATE

$1'' \times 3\frac{5}{8}''$

$A = 3.625^{\square''}$

$S = \frac{1}{6} \times (3.625)^2 = 2.2 \ IN^3$

$f = \frac{21}{3.625} + \frac{25.2}{2.2} = 17.2^{KSI}$

NG

TRY

$1\frac{1}{2}'' \times 3\frac{3}{4}$

$A = 5.63^{\square''}$

$S = \frac{1}{6} \times 1.5 \times (3.75)^2 = 3.52 \ IN^3$

$f = \frac{21}{5.63} + \frac{25.2}{3.52} = 10.89^{KSI} < 12^{KSI}$

OK

Advanced Engineering Consultants

Sheet No.	4-25
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCR — Date 6/1/94
Chk'd	WKan — Date 6/3/94

Subject: TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

HOIST RING BOLTS FOR REMOVABLE PLATES

EACH REMOVABLE WT. = 2042#

DESIGN LOAD = 2042 × 1.25 = 2553#

TENSION PER RING = 1277#

All F_t = $\frac{19.1}{2}$ (A36)

= 9.6 ksi

$\frac{\pi}{4} \times d^2 \times 9.6 = 1.3^k$

$d = 0.42''$

use ½" φ

USE AMERICAN SAFETY HOIST RINGS

ASSEMBLY PART # 23301, CAPACITY 2500# EACH

TOTAL CAPACITY 2 × 2500# > 2553#

ok

Advanced Engineering Consultants

Sheet No.	A-26
Job/Calc. No.	CAC001-02-1
Rev. No.	0
By	MCL
Date	6/6/94
Chk'd	UKon
Date	6/6/94

Subject: TEMP PUMP 2 - TEST WEIGHTS

TIE-DOWN LUGS

TOTAL WEIGHTS =

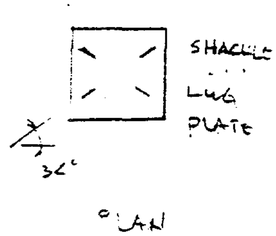
HOLDER ASSEMBLY	4396.1 #
REMOVABLE WT.	12,250.2 #
TIE-DOWN LUGS PLUS SHACKLES (ESTIMATED)	150 #
	16,796.3 #

USE CROSBY FORGED SHACKLES G-209, 4 REQ'D, ORIENTED AT 45° WITH RESPECT TO SIDES OF REMOVABLE PLATE, MIN. WORKING LOAD 17 TONS

ALLOWABLE CENTRIFUGAL FORCE OR FORCES FROM ACCELERATING OR DECCELATING (2 ACTIVE)

$= 2 \times 17^{T} \times 2 \times \sin 34°$

$= 38.0^{K}$



Advanced Engineering Consultants

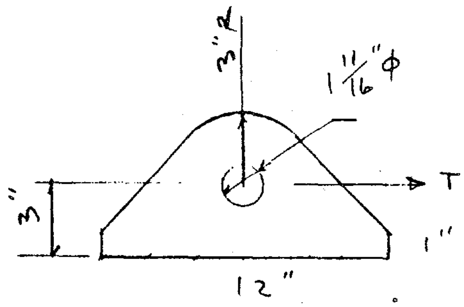
Sheet No. 4-27
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 6/6/94
Chk'd W/Kan Date 6/6/94

Subject TEMP PUMP 2 - CONTAINER TEST WEIGHTS

OR NUMBERS OF GRAVITIONAL ACCELATION

$$= \frac{38.0}{16.8} = 2.26\ g > 1.5\ g$$ (PER TELECON 6/6/94 W/ RANDY JORISSEN)

$T = 2 \times 17^{T} = 34^{k}$



NET AREA REQ'D ⊥ FORCE

$$A_n = \frac{34}{12} = 2.83^{\square''}$$

USE 1" PLATE & $1\frac{11}{16}"$ ϕ HOLE

MIN. EDGE DISTANCE REQ'D

$$= \frac{2.83}{1} = 2.83''$$

MAX. ALLOWED EDGE DISTANCE = 8t = 8"

USE 3" FROM CENTER LINE OF HOLE TO EDGES

$$\text{EDGE} = 6 - 1\tfrac{11}{16} = 4.31'' > 2.83''$$
$$< 8''$$

OK!

EDGE // FORCE

$$= \tfrac{2}{3} \times 2.83 \times \frac{1}{1} = 1.89'' > 0.8 \times 1\tfrac{5}{8} = 1.3''$$

PIN ϕ

FURNISHED 3"±

USE 1.3" TO CHECK SHEAR

Advanced Engineering Consultants

Sheet No. 4-28
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By Mw Date 6/6/94
Chk'd W Kan Date 6/6/94

Subject TEMP. PUMP 2 - TEST WEIGHTS

$$\text{ALLOWABLE SHEAR} = 2 \cdot t \cdot \left(1.3 + \frac{1\frac{5}{8}}{2}\right) \times 7.2$$

PIN ϕ

$$= 2 \times 1 \times (1.3 + 0.8125) \times 7.2$$

$$= 30.42^{k} < 34^{k}$$

INCREASE PLATE TO $t = \frac{34}{30.42} \times 1 = 1.12''$

USE $1\frac{1}{8}''$

CHECK BEARING ON PIN

$$f_p = \frac{34}{1.125 \times 1.625} = 18.6^{ksi} > 16.2^{ksi}$$

INCREASE THICKNESS TO $\frac{18.6}{16.2} \times 1.125'' = 1.29''$.

USE $1\frac{3}{8}''$ PLATE

CHECK BENDING ON 12" BASE

$$S = \frac{1}{6} \times 1.375 \times 12^2 = 33 \text{ in}^3$$

$$M = T \times 3 = 34 \times 3 = 102^{k-''}$$

$$f_b = \frac{102}{33} = 3.1^{ksi} << 12^{ksi}$$

OK!

SUMMARY: USE $1\frac{3}{8}''$ LUG PLATE, OTHER DIMENSIONS SEE SKETCHES (ATTACHMENTS)

Advanced Engineering Consultants

Sheet No.	4-29
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	[illegible] Date 5/27/94
Chk'd	W. Kau Date 6/3/94

Subject TEMP. PUMP 2.
CONTAINER TEST WEIGHTS

4.4 BOLT PATTERNS

CHECK BOLT CIRCLE, 1"ϕ BOLT, USE 14 BOLTS

$$M = 16{,}646.1 \times (2 + 5.90) = 131{,}504 \text{ \#-''}$$

WITH IMPACT $= 131{,}504 \times 1.25$
$= 164{,}380$ #-"

$$V = 16{,}646.1 \times 1.25 = 20{,}808 \text{ \#}$$

21^{k} USED IN DESIGN

ASSUME NEUTRAL AXIS AT C.G. OF BOLT PATTERN

$$I = 4 \times (13.23^2 + 23.85^2 + 29.74^2) \frac{\pi}{4} \times 1^2$$
$$= 5116 \text{ IN}^4$$

$$S = \frac{I}{c} = \frac{5116}{29.74} = 172 \text{ IN}^3$$

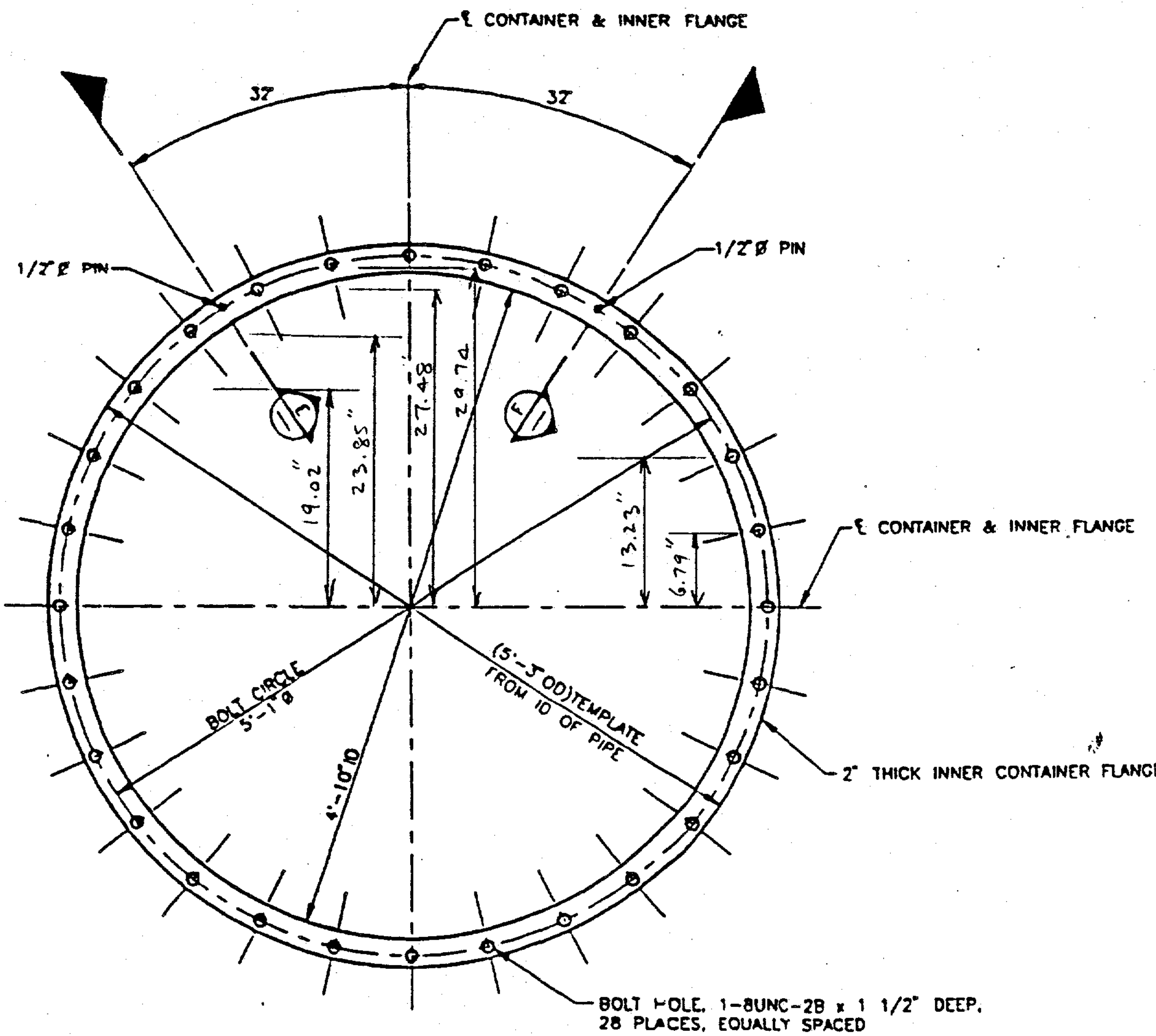
USE HALF OF BOLTS FOR: SHEAR

$$A_v = 7 \times \frac{\pi}{4} \times (1)^2 = 5.50 \text{ □''}$$

Advanced Engineering Consultants

Sheet No. 1-30
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 5/27/94
Chk'd WKau Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINED TEST WEIGHTS



A325 BEARING TYPE

12/9 DETAIL
SCALE: 1 1/2" = 1'-0"

BOLT PATTERN
&
DETAIL

Advanced Engineering Consultants

Sheet No. 4-31.
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCL Date 5/27/94
Chk'd W. Kaa Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

$$f_v = \frac{21}{5.5} = 3.82^{ksi}$$

$$f_t = \frac{164^{k-''}}{172} = 0.95^{ksi}$$

A 325 BEARING-TYPE CONNECTION, THREADS INCLUDED IN SHEAR PLANE, ALL F_t:

$$F_t = (44^2 - 4.39 \times f_v^2)^{1/2}$$

$$= (44^2 - 4.39 \times 3.82^2)^{1/2} = 43.26^{ksi}$$

USE HALF FOR $F_t = 21.63^{ksi} >> 0.95^{ksi}$

ok!

CHECK THE EFFECT OF 3/8" PLYWOOD [illegible] ON LOCAL BENDING OF THE BOLTS

$$M = \frac{21}{14} \times \frac{1}{2} \times \frac{3}{8} = .28^{k-''}$$

1" ϕ

$$S = \frac{\pi d^3}{32} = 0.098 \text{ IN}^3$$

$$f_b = \frac{0.28}{0.098} = 2.86^{ksi}$$

MAX $f_t = 0.95 + 2.86 = 3.81^{ksi} << 21.63^{ksi}$

ok!

Sheet No. 4-32
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 6/1/94
Chk'd W. Kim Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

4.5 WELDS:

1.) FILLER PLATE TO BULKHEAD PLATE

USE MIN 5/16" FILLET WELDS ALL ROUND.

WELD CAPACITY:

$$\text{All } V = \frac{1}{2} \times (\pi \times 58.375) \times \frac{5}{16} \times 7.2^{\text{ksi}}$$

$$= 206.3^{k}$$

DEMAND

V = WEIGHT OF FILLER PLATE × 1.25

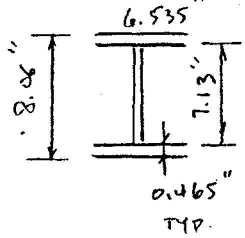
$$= 1.515^{k} \times 1.25 \quad << 206.3^{k}$$

OK!

2.) SUPPORT LEGS.

WELD TO 2" PLATE, PER AISC MIN. WELD 5/16". USE ALL ROUND THE W 8 × 28 MEMBER.

PER UNIT 1" WELD



$$A = 4 \times 6.535 + 2 \times 7.13 = 40.4$$

$$I = \frac{1}{12} \times \overset{30.21}{7.13^3} \quad \text{WEB}$$

$$+ 2 \times 6.535 \times (\overset{378.84}{4.03^2 + 3.57^2}) \quad \text{FLGE}$$

$$= 409.05$$

Advanced Engineering Consultants

Sheet No.	4-33
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	[illegible] Date 6/3/94
Chk'd	W. Karl Date 6/3/94

Subject TEMP PUMP 2 - CONTAINER TEST WEIGHTS

$M = 109.7^{k-''}$ $V = 7.66^{k}$

$$f_t = \frac{109.7 \times 4.03}{409.05} = 1.08\ ^k/''$$

$$f_v = \frac{7.66}{40.4} = 0.19\ ^k/''$$

$$f = (1.08^2 + 0.19^2)^{1/2} = 1.10\ ^k/''$$

ALL. WELD CAPACITY = $\frac{5}{16} \times 7.2 = 2.77\ ^k/'' >> 1.10\ ^k/''$

OK!

3. VERTICAL AND HORIZONAL LIFTING LUGS SEE LUG DESIGN

Advanced Engineering Consultants

Sheet No. 4-34
Job/Calc. No. CA-4001-02-1
Rev. No. 0
By MCM Date 6/1/94
Chk'd W. Kau Date 6/3/94

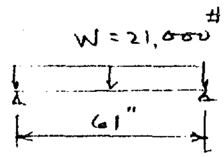
Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

4.6 CHECK BULKHEAD PLATE

BENDING STRESS

CONSERVATELY USE TOTAL WEIGHTS + IMPACT

$$WT/\square'' = \frac{21{,}000}{\frac{\pi}{4}(61)^2} = 7.2\ \#/\square''$$



USE CIRCULAR DISK, EDGES SUPPORTED

UNIFORM LOAD OVER ENTIRE SURFACE.

AT CENTER $f_r = f_t = -\frac{3W}{8\pi m t^2}(3m+1)$ (FORMULAS FOR STRESS & STRAIN BY ROARK)

ν = POISSON'S RATIO = 0.26

$m = \frac{1}{\nu} = 3.85$, $t = 2''$

f_r (RADIAL STRESS) = f_t (TANGENTIAL STRESS)

$$= \frac{3 \times 21{,}000}{8\pi \cdot 3.85 \cdot 2^2}(3 \times 3.85 + 1)$$

$= 2{,}042\ \#/\square'' \ll 12{,}000\ \#/\square''$

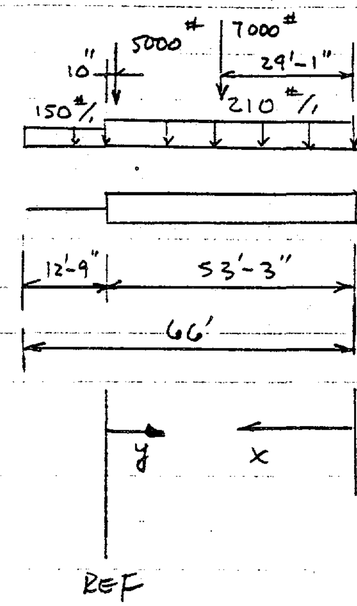
ok!

Advanced Engineering Consultants

Sheet No. 5-1.
Job/Calc. No. CA4001-02-1
Rev. No. 0
By [illegible] Date 6/8/94
Chk'd W Kau Date 6/10/94

Subject TEMP PUMP 2
5.0 DUMMY PUMP

5.1 GEOMETRY & EXISTING DUMMY PUMP WEIGHT



101 SY LOAD CHART

C.G.
-BASED ON 101 SY LOAD CHART
(ACTUAL PUMP)

W (#)	x (')	Wx (#-')
210 x 53.25' = 11,182.5	26.625	297,734
150 x 12.75 = 1912.5	59.625	114,033
5000#	52.42	262,083
7000	29.08	203,583
25,095 #		877,433 lb-ft = 10,529,196 lb-"

$\bar{x}$ = 34.96' (NOT USED IN THE CALCS)
SEE EXPLAINATION P. 5-31 ~ 5-32

W = 25,095#

$\bar{y}$ = 53.25' − 34.96' = 18.29' = 18'-3½"

$W\bar{y}$ = 25,095 × 18.29 × 12 = 5,507,851 lb-in

Advanced Engineering Consultants

Sheet No. 5-2

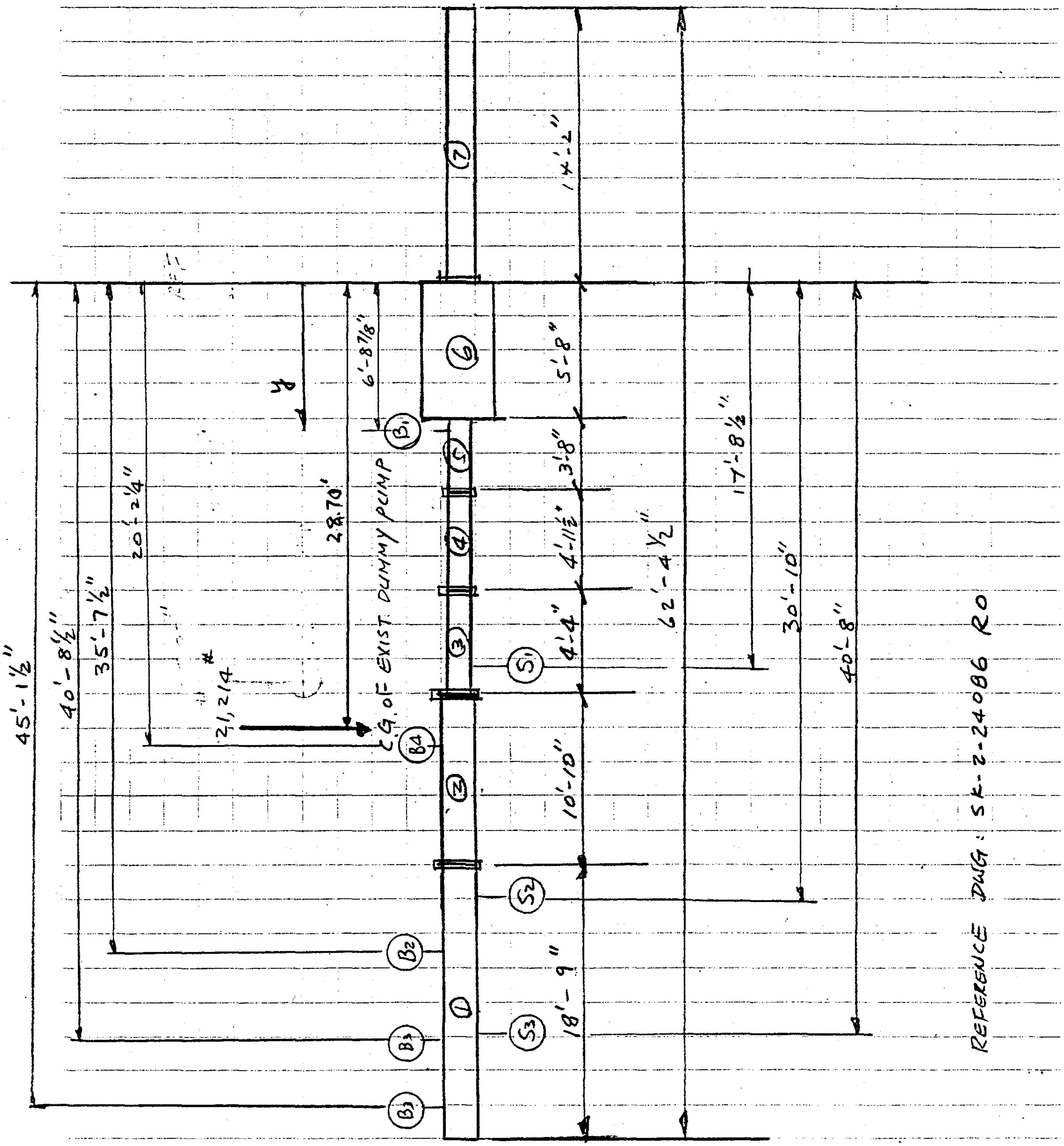
Job/Calc. No. CA4001-02-1

Rev. No. 0

By W Kau Date 6/3/94

Chk'd [illegible] Date 6/8/94

Subject TEMP PUMP 2
EXIST. DUMMY PUMP



Advanced Engineering Consultants

Sheet No. 5-3
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kau Date 6/6/94
Chk'd [illegible] Date 6/8/94

Subject TEMP PUMP 2
EXIST. DUMMY PUMP

① 20"φ Sch 20. w/concrete, $L = 19'-11\frac{1}{2}"$

weight = 78.6 lb/ft inside area = 291 in²

Weight/FT w/concrete $78.6 + \frac{291 \times 145}{144} = 372$ lb/ft

WEIGHT = 372 × 18.75 = $\underline{\underline{6975}}$ lbs

② 20"φ XS w/o Concrete $L = 10'-10"$

WT./FT = 104 lb/ft

WEIGHT = 104 × 10.83 = $\underline{\underline{1126}}$ lbs

③ 16"φ Sch 30 w/concrete $L = 4'-4"$

Weight = 62.58 lb/ft inside area = 182.6 in²

weight/FT w/concrete = $62.58 + \frac{182.6 \times 145}{144} = 246$ lb/ft

Weight = 246 × 4.33 = $\underline{\underline{1065}}$ lbs

④ 16"φ Sch 30 w/o Concrete $L = 4'-11\frac{1}{2}"$

Weight = 62.58 × 4.96 = $\underline{\underline{310}}$ lbs

⑤ 16"φ Sch 30 w/concrete $L = 3'-8"$

Weight = 246 × 3.67 = $\underline{\underline{903}}$ lbs

Advanced Engineering Consultants

Sheet No. 5-4
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kau Date 6/6/94
Chk'd Date 6/8/94

Subject TEMP PUMP & EXIST. DUMMY PUMP

(6) 36"ϕ Sch 20 w/concrete L = 5'-8"

Weight = 143 lb/ft, inside area = 975.8 in²

$$\text{Weight/Ft w/Concrete} = 143 + \frac{975.8 \times 145}{144} = 1126 \text{ lb/ft}$$

WEIGHT = 1126 × 5.67 = 6384 lbs

(7) 16"ϕ Sch 30 w/o concrete L = 14'-2"

Weight = 62.58 × 14.17 = 887 lbs

SUMMARY: EXISTING DUMMY PUMP WITHOUT WT. OF ATTACH. & FLANGES

SECTION	LENGTH	WEIGHT (lbs)	REMARKS
1	18'-9"	6975	w/concrete
2	10'-10"	1,126	No concrete
3	4'-4"	1,065	w/concrete
4	4'-11½"	310	No concrete
5	3'-8"	903	w/concrete
6	5'-8"	6384	w/concrete
7	14'-2"	887	No concrete
	62'-4½"	17,650	

Actual weight of Pump = 25,095 lbs

Advanced Engineering Consultants

Sheet No. 5-5
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kau Date 6/7/94
Chk'd [illegible] Date 6/7/94.

Subject TEMP PUMP 2
EXIST DUMMY PUMP

BUMPER PLATE ASSEMBLY

B1

$\frac{1}{2} \times (4\frac{5}{8} + 24) \times 9.75 \times \frac{1}{2} = 69.8 \ in^3$

$+ \frac{1}{2} \times 1\frac{1}{4} \times 6 \times 4 = 15.0$

$\frac{1}{2} \times 1\frac{1}{4} \times 5 \times 2 = 6.3$

$\frac{\pi}{4}(4)^2 \times (4 - 0.5 - 2 \times 0.75) = 25.1$

$6 \times 6 \times \frac{3}{4} \times 2 = 54.0$

$170.2 \times \frac{490}{1728} = 48.3 \ lbs$

B2

$\frac{1}{2}(4\frac{5}{8} + 21\frac{1}{2}) \times 9.69 \times \frac{1}{2} = 63.3 \ in^3$

$+ \frac{1}{2} \times 1\frac{1}{4} \times 6 \times 4 = +15.0$

$\frac{1}{2} \times 1\frac{1}{4} \times 5 \times 2 = 6.3$

$\frac{\pi}{4}(4)^2 \times (4 - 0.5 - 1.5) = 25.1$

$6 \times 6 \times \frac{3}{4} \times 2 = 54.0$

$163.7 \times \frac{490}{1728} = 46.4 \ lbs$

B3

$\frac{1}{2}(10 + 18) \times 5.375 \times \frac{1}{2} = 37.6$

$\frac{1}{2} \times 1\frac{1}{4} \times 10 \times 2 = 12.5$

$2 \times 2 \times \frac{1}{2} \times 2 = 4.0$

$54.1 \times \frac{490}{1728} = 15.3 \ lbs$

Advanced Engineering Consultants

Sheet No. 5-6
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. KAU Date 6/7/94
Chk'd [signature] Date 6/8/94

Subject TEMP PUMP 2
EXIST DUMMY PUMP

(B4)

$\frac{1}{2} \times (8+15) \times 12 \times \frac{1}{2} = 69.0$

$\frac{\pi}{4}(4)^2 \times (4-0.5-1.5) = 25.1$

$6 \times 6 \times 3/4 \times 2 = 54.0$

$148.1 \times \frac{490}{1728} = 42.0$ lbs

SADDLE ASSY

(S1) 6"ϕ pipe sch 80 $32.71 \times 1.83 = 59.8$ lbs

PL 3/8" $\doteqdot 3/8 \times \frac{1}{2}(6+14) \times 10 \times 490/1728 = 10.6$

End Cap $3 \times 3 \times 1/2 \times 490/1728 = 1.3$

71.7 lbs

(S2) 6"ϕ pipe sch 80 $32.71 \times 1.83 = 59.8$ lbs

3/8" PL $3/8 \times \frac{\pi}{4}(6.19)^2 \times 2 \times \frac{490}{1728} = 6.4$

$3/8 \times 6 \times 13.625 \times 2 \times \frac{490}{1728} = 17.4$

$\doteqdot 3/8 \times \frac{1}{2}(3.3+8) \times 13 \times \frac{490}{1728} \times 2 = 15.6$

1/2" PL $1/2 \times 3 \times 3 \times 490/1728 = 1.3$

100.5 lbs

(S3) 6"ϕ pipe sch 80 $32.71 \times 1.83 = 59.8$ lb

3/8 PL $\approx 3/8 \times \frac{1}{2}(8+13) \times 10 \times 2 \times \frac{490}{1728} = 22.3$

1/2" PL $1/2 \times 3 \times 3 \times 2 \times \frac{490}{1728} = 2.6$

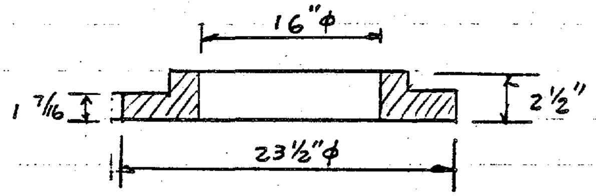
84.7 lbs

Advanced Engineering Consultants

Sheet No.	5-7
Job/Calc. No.	CA4001-02-1
Rev. No.	0
By	W. KAU
Date	6/7/94
Chk'd	mcm
Date	6/8/94

Subject: TEMP PUMP 2
EXIST DUMMY PUMP

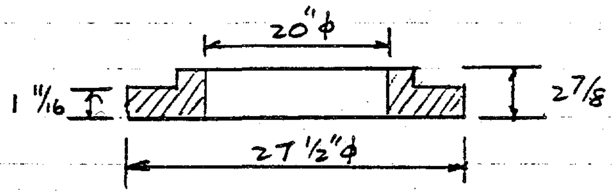
16"φ Slip-on Flange



150 lb Flanges

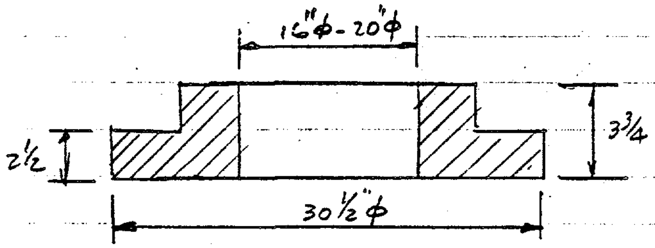
$$\frac{\pi}{4}(23.5^2 - 16^2) \times \frac{(1.44+2.5)}{2} \times \frac{490}{1728} = 130^{\text{lbs}}$$

20"φ Slip-on Flange



150 lb Flanges

$$\frac{\pi}{4}(27.5^2 - 20^2) \times \frac{1.69+2.875}{2} \times \frac{490}{1728} = 181^{\text{lbs}}$$



300 lb Flanges reducer

$$\frac{\pi}{4}(30.5^2 - 18^2) \times \frac{2.5+3.75}{2} \times \frac{490}{1728} = 422^{\text{lbs}}$$

SEAL PLATE RINGS

#2, 3, 8, 14, 15, 16, & 17 NO DETAILS & DIMENSIONS ON THE DWG.

PLATES ON SECTION 6

Stiff.	$3 \times 3/8 \times 10 \times 10$	$= 112.5 \text{ in}^3$
1/4" END PL	$\frac{\pi}{4}(36)^2 \times 1/4$	$= 254.5$
3/4" END PL	$\frac{\pi}{4}(53)^2 \times 3/4$	$= 1,654.6$
1" PL	$\pi \times \frac{53}{2}(1 \times 3.25 + 1 \times 8)$	$= 936.6$
		2,958.2

$2,958.2 \times 490/1728 = 839^{\text{lbs}}$

END PL ON SECTION 7

$$\frac{\pi}{4}(16)^2 \times 3/8 \times 490/1728 = 21.4^{\text{lbs}}$$

Advanced Engineering Consultants

Sheet No. 5-8
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By WTK Date 6/7/94
Chk'd [illegible] Date 6/8/94

Subject TEMP PUMP 2
EXIST. DUMMY PUMP

CALCULATE C.G. OF EXIST DUMMY PUMP

SECTION	WEIGHT (w)(lbs)	y (ins)	wy
1	6975	466	3,250,350
2	1,126	288.5	324,851
3	1,065	197.5	210,338
4	310	141.75	43,943
5	903	90.	81,270
6	6,384+839	34	245,582
7	887+21	-85	-77,180
B1	49	80.875	3,963
B2	47	427.5	20,093
B3	15	488.5	7,328
B3	15	541.5	8,123
B4	42	242.25	10,175
S1	72	212.5	15,300
S2	101	370.0	37,370
S3	85	488.0	41,480
1 @ 16"ϕ Flange	130	0	0
2 @ 16"ϕ F.	260	112	29,120
2 @ 16"ϕ F.	260	171.5	44,590
2 @ 20"ϕ Reducer	844	223.5	188,634
2 @ 20"ϕ F	362	353.5	127,967
Σ	20,792		4,613,297

$$\bar{y} = \frac{4,613,297}{20,792} = 221.9'' \text{ OR } 18.5'$$

OR $x = 356.6''$

Advanced Engineering Consultants

Sheet No. 5-9
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 6/16/94
Chk'd WKan Date 6/24/94

Subject TEMP PUMP 2
DUMMY PUMP

INCLUSION OF DISKS THAT ARE SHOWN IN THE SK-2-24086 R0.
AS # 2, 3, 8, 14, 15, 16 & 17, TO ADJUST FOR CG OF
THE EXISTING DUMMY PUMP PER AS-BUILT MARK-UPS.

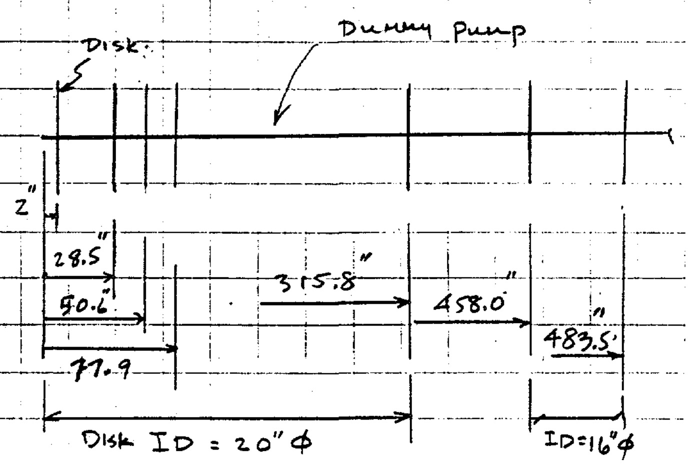
WEIGHT OF DISK (38" OD, 1/4 THICK PL)

20" OD PIPE

$$= \frac{\pi}{4}(38^2 - 20^2) \times \frac{1}{4} \times 0.283 = 58^{\#}$$

16" OD PIPE

$$= \frac{\pi}{4}(38^2 - 16^2) \times \frac{1}{4} \times 0.283 = 66^{\#}$$



WT OF DISKS = 5 × 58 + 2 × 66
= 422#

$$58 \times \underbrace{(2 + 28.5 + 50.6 + 77.9 + 315.8)}_{27,538} + \underbrace{66(458 + 483.5)}_{62,139}$$

$$\underbrace{20,792 \times 356.6}_{7,414,427.2} = (20,792 + 422)x$$

$$x = 353.7" = 29.51'$$

REVISED PUMP WT = 21,214#

Advanced Engineering Consultants

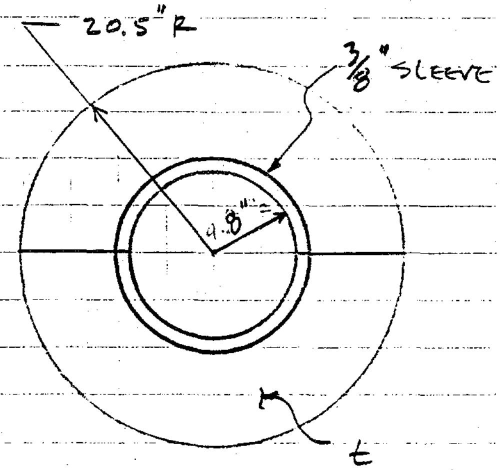
Sheet No. 5-10
Job/Calc. No. CA-4001-02-1
Rev. No. 0
By [illegible] Date 6/9/94
Chk'd WKaw Date 6/13/94

Subject TEMP. PUMP 2- DUMMY PUMP

5.2 REMOVABLE DISKS

41" DISK : D = 16" ϕ (CONTROLS)

UNSUPPORTED DISK HEIGHT



$h = 20.5 - 8 - 0.375$

$= 12.125''$

$k = 2.1$

TO LIMIT (AISC)

$\frac{kh}{r} = 200$

$r = \frac{2.1 \times 12.13}{200} = 0.13''$

$r = \frac{t}{\sqrt{12}}$ $\quad t = 0.13 \times (12)^{1/2} = 0.45''$ (MIN)

USE 1/2"

$r = \frac{0.5}{\sqrt{12}} = .144''$

$C_c = 126.1$ (A36)

$\frac{kh/r}{C_c} = \frac{2.1 \times 12.13}{0.144 \times 126.1} = 1.40 > 1.0$

$\therefore F_a = \frac{12\pi^2 E}{23(kh/r)^2} = \frac{12 \times \pi^2 \times 30 \times 10^3}{23\left(\frac{2.1 \times 12.13}{0.144}\right)^2}$

$= 4.94$ KSI

Advanced Engineering Consultants

Sheet No.	5-11
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	mr Date 6/9/94
Chk'd	W Kan Date 6/13/94

Subject: TEMP. PUMP 2 - DUMMY PUMP

AREA BEARING ON THE DISK

$\doteq 2 \times (.8) \times t$

CONSERVATIVE TO USE ONLY HALF OF AREA

ALLOWABLE CAPACITY PER DISK

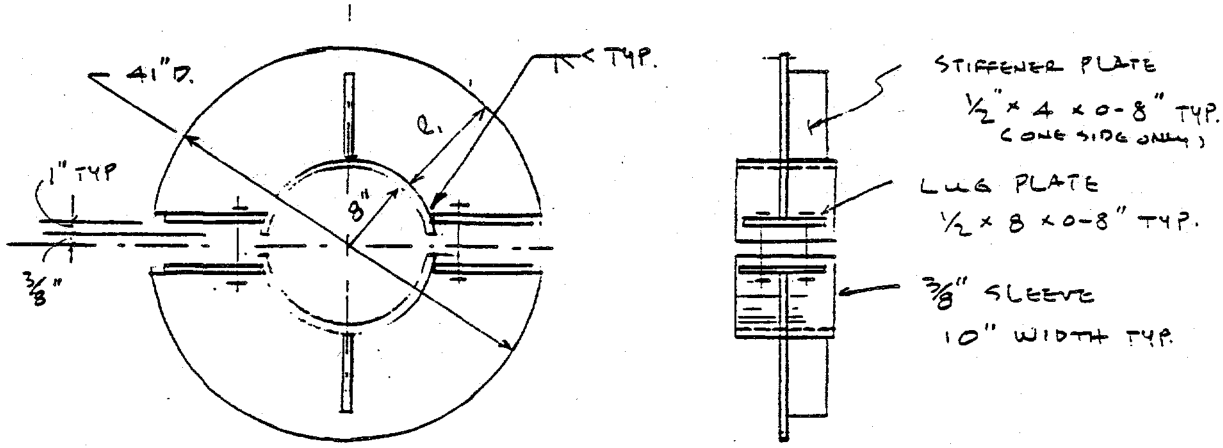
$P \doteq 8 \times \frac{1}{2} \times 4.94 = 19.8^{k}$

ESTIMATE MAX. REACTION $\doteq 25/2 = 13^{k} < 19.8^{k}$

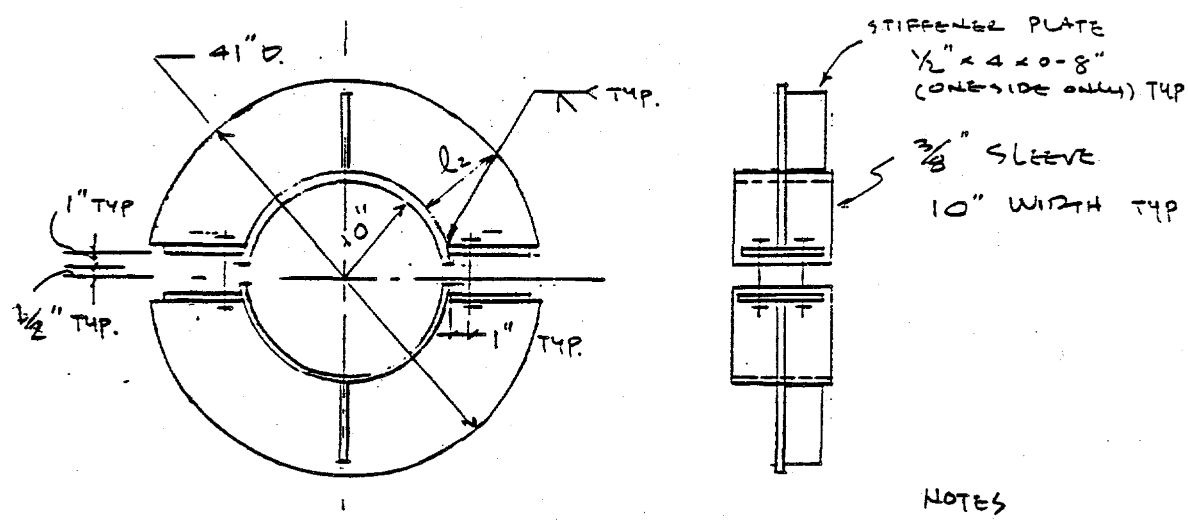
OK!

WEIGHT OF REMOVABLE DISK ASSEMBLY

$$l_1 = (41-16)/2 - .375 = 12\tfrac{1}{8}''$$



16" φ



20" φ

NOTES

1. UNLESS NOTED OTHERWISE, USE MIN. FILLET WELDS.
2. BOLTS TO BE 5/8" φ W/ HEX. NUTS OR BETTER

Disk: $A = \frac{\pi}{4}(41^2 - 16.75^2) \times \frac{1}{2} = 550\ in^3$

3/8" sleeve: $3/8 \times \pi(16.375) \times 10 = 193$

stiff. pl: $1/2 \times 4 \times 8 \times 10 = 160$

$$903 \times 490/1728 = 256\ lbs.$$

use 265 lbs to account for weld & bolts

Advanced Engineering Consultants

Subject: TEMP. PUMP 2 - DUMMY PUMP

Sheet No. 5-13
Job/Calc. No. CA4001-02-1
Rev. No. 0
By MCN Date 6/17/94
Chk'd W. Kan Date 6/24/94

REMOVABLE DISKS FOR 16"φ (2" - THICK DISK)

IN ORDER TO CUT DOWN NUMBERS OF DISKS OF ONE TYPE, INTRODUCE ONE MORE TYPE

NEW TYPE WEIGHT = 3 x 265 = 795#

REFER TO 1/2" THICK DISK, MATERIAL TAKE-UP

USE 5/8" SLEEVE $= \frac{193}{3/8} \times 5/8 = 322\ IN^3$

STIFF. PLS. 1/2" $= 160\ IN^3$

REQ'D VOL OF STEEL $= \frac{795}{490} \times 1728 = 2804\ IN^3$

DISK VOL. REQ'D $= 2804 - 322 - 160 = 2322\ IN^3$

MIN. DISK THICKNESS $= \frac{1/2}{550} \times 2322 = 2.11''$

INCREASE STIFF PL TO 1"

$VOL. = \frac{160}{1/2} \times 1 = 320\ IN^3$

MIN DISK THICKNESS

$t = \frac{1/2}{550} \times (2322 - 160) = 1.965''$

USE 2"

ACTUAL WT. $= \left(322 + 320 + \frac{550}{1/2} \times 2\right) \times \frac{490}{1728} = 806\#$

Advanced Engineering Consultants

Sheet No. 5-14
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [illegible] Date 6/17/94
Chk'd W Kan Date 6/20/94

Subject Temp. pump 2 - Dummy pump

Less

$(41-16.25)\times 2\times 3\times \frac{490}{1728} = -41.3^{\#}$

Plus

$5/8"\phi$ Bolts $\frac{4\times 68.7}{100} = 3$

$768^{\#}$

Total Wt., Plus welds $775^{\#}$ (used)

Advanced Engineering Consultants

Sheet No. 5-15
Job/Calc. No. CA 4001-02-1
Rev. No.
By [illegible] Date 6/17/94
Chk'd W. Kan Date 6/20/94

Subject TEMP. PUMP 2 - DUMMY PUMP

REMOVABLE DISK FOR 20"φ (2"-THICK DISK)

COMBINE THREE 265# DISKS INTO ONE

WT. REQ'D = 795#

USE 2" DISK
5/8" SLEEVE
1" STIFF.

DISK $A = \frac{\pi}{4}(41^2 - 21.25^2) \times 2 = 1931.2 \ IN^3$

5/8" SLEEVE $\frac{5}{8} \times \pi \times (20.63) \times 10 = 405.1 \ IN^3$

STIFF. $1 \times 4 \times 8 \times 10 = 320 \ IN^3$

TOTAL 2656.3

$WT. = 2656.3 \times \frac{490}{1728} = 753^{\#}$

LESS $(41 - 21.25) \times 2 \times 2 \times 1.5 \times \frac{490}{1728}$ -34

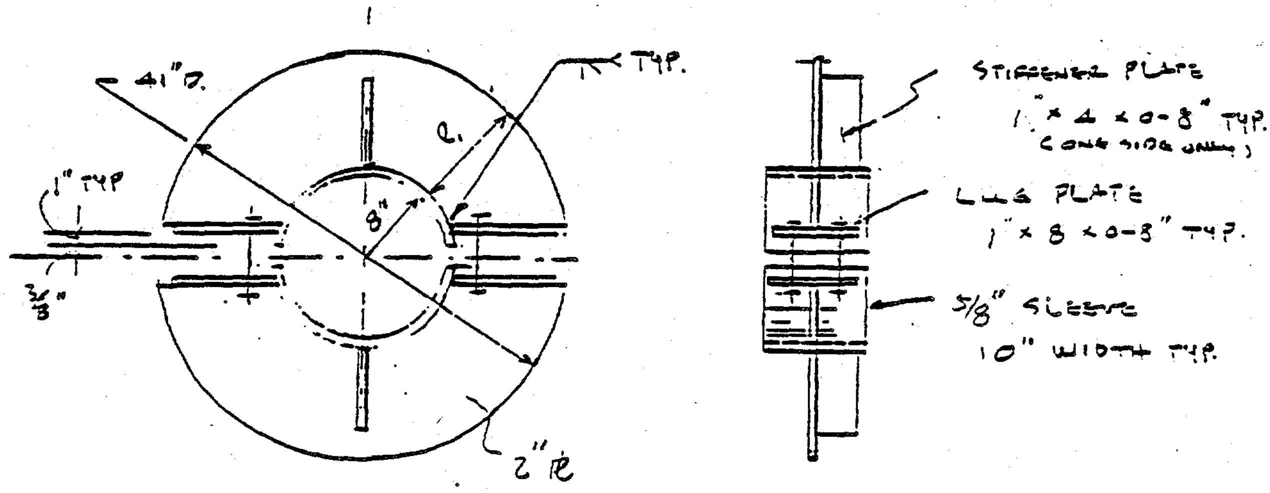
$719^{\#}$

BOLT 5/8"φ $\frac{4 \times 68.7}{100}$ $+3$

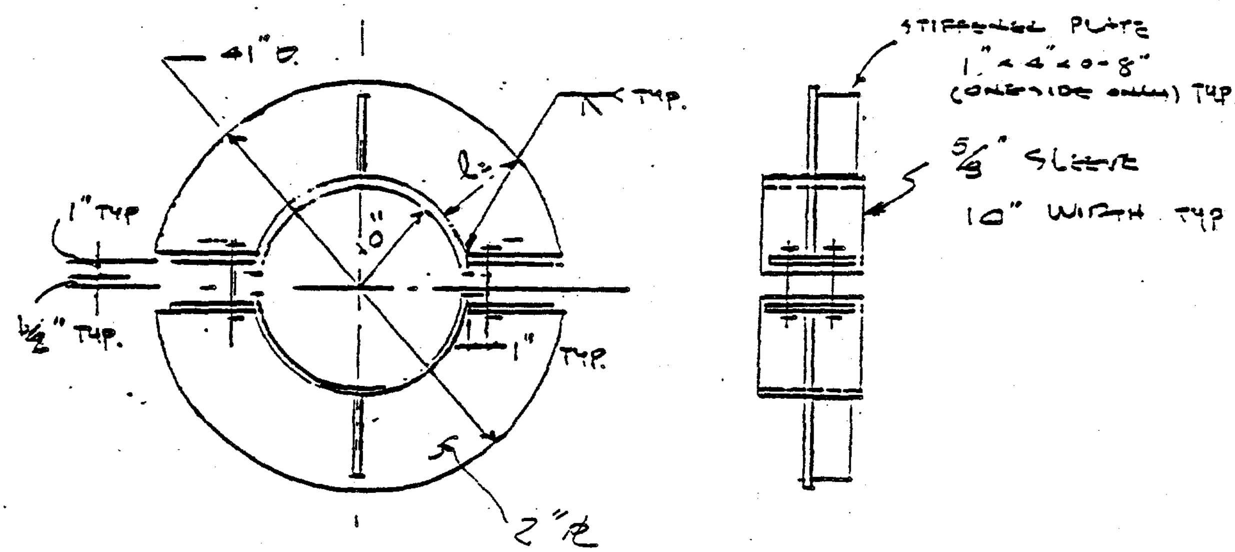
$722^{\#}$

∴ INCLUDE WELDS,
SAY $\underline{730^{\#}}$

WEIGHT OF REMOVABLE DISK ASSEMBLY (2" PL)



16" ϕ



20" ϕ

NOTES:

1. UNLESS NOTED OTHERWISE, USE MIN. FILLET WELDS.
2. BOLTS TO BE 5/8" ϕ w/ HEX NU[T] A 307 OR BETTER

Advanced Engineering Consultants

Sheet No. S-18
Job/Calc. No. CA-4001-02-1
Rev. No. 0
By [illegible] Date 6/9/94
Chk'd WKan Date 6/13/94

Subject TEMP PUMP 2 - DUMMY PUMP

USE 5/8"ϕ BOLTS FOR REMOVABLE DISK ASSEMBLY

TIGHTEN TO 2^{K} EACH (A307) OR BETTER

TORQUE REQ'D $= 0.2 \times 2 \times 5/8 \times \frac{1}{12} \times 1000 = 20.8^{\#-'}$

USE $20.^{\#-'}$

GAP BETWEEN HALF-DISK

TOLERANCE OF SLEEVE RADIUS $+1/8"$

ALONG ARC $\Delta s = \pi \times 1/8 \doteq 3/8"$

HOOP TENSION 12^{K}

ASSUME 8" EFFECTIVE $\times$ 3/8" THICK

$$f = \frac{12}{8 \times 3/8} = 4^{ksi}$$

$$STRAIN = \frac{4}{30 \times 10^3}$$

$$\Delta s = \frac{\pi \cdot 20}{2} \times \frac{4}{30 \times 10^3} = 0.004" \text{ (NEGLIGIBLE)}$$

$$GAP = 2\left(3/16 + 1/16 + \frac{1}{8}\right) + \underbrace{\frac{1}{4}}_{\text{ADDITIONAL MARGIN}} \quad \text{USE } 1"$$

LUG PLATES

USE ALLOWABLE 12^{ksi}, FOR BENDING SINCE THIS A TEMPORARY COMPONENT

$M = 2^{K-"}$ USE 4" EFF WIDTH 2^{K} 1"

$$S = \frac{2}{12} = \frac{1}{6} \times 4" \times t^2$$

$t = 0.50"$ USE 1/2"

Advanced Engineering Consultants

Sheet No. 5-18
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [signature] Date 6/17/94
Chk'd W. Kan Date 6/20/94

Subject TEMP. PUMP 2 - DUMMY PUMP

CHECK - FRICTION RESISTANCE RESULTED FROM $20^{\text{1-\#}}$ TIGHTENING

SLIDING FORCE = 775 X 1.25 = 969^{K}

FRICTION COEFF STEEL TO STEEL = 0.15

AVAILABLE RESISTANCE = $4 \times 2^{K} \times 0.15$

$= 1.2^{K}$

$SF = \frac{1.2}{10.97} = 1.2$

TO INSURE NO SLIPPING OF DISKS, ADD 4-$\frac{3}{8}''\phi$ SCREWS W/ SQUARE WASHERS TO ASSEMBLY; WHERE TWO ASSEMBLIES ARE TOO CLOSE, TWO ASSEMBLIES SHARE 4-$\frac{3}{8}''\phi$ SCREWS

CHECK LOCAL STRESS IN $20''\phi$ PIPE: STD PIPE FILLED W/ CONCRETE IS NOT CRITICAL; CHECK XS W/O CONCRETE

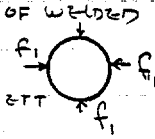
$t = 0.5''$ $r_c = 19/2 = 9.5''$

e (WIDTH) EACH SIDE OF SLEEVE $= \frac{\sqrt{t\, r_c}}{2} = 1.09''$

f_1 (COMPRESSION /") $= \frac{4 \times 2}{2(10 + e)} = 0.36^{K}/''$

MAX. $M_R = 0.318\, f_1 r_c$

(DESIGN OF WELDED STRUCTURE) BY BLODGETT



$S = \frac{1}{6} \times 1 \times (0.5)^2 = 0.042^{IN^3}$

$f_b = \frac{0.318 \times 0.36 \times 9.5}{0.042} = 26^{KSI} < 36^{KSI}$

OK!

WHC-SD-WM-DA-168
REV. 0

PAGE A-91

Advanced Engineering Consultants

Sheet No. 5-19

Job/Calc. No. CA 4001-02-1

Rev. No. 0

Subject TEMP PUMP 2 DUMMY PUMP

By MCZ Date 6/9/94

Chk'd WTK Date 6/13/94

5.3. GEOMETRY AND MODIFICATION TO THE DUMMY PUMP

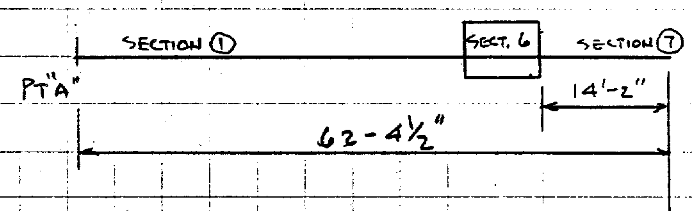
ACTUAL PUMP WEIGHT C.G. MEASURED FROM THE END OF THE CANISTER

$x = 34.96 - \frac{17''}{12} = 33.54'$ (REFERENCE ONLY NEVER USED IN CALCS)

ACTUAL 31.1' USED

EXISTING DUMMY PUMP C.G. MEASURED FROM LEFT END OF SECTION 1

$x = 353.7''$ OR $29.51'$

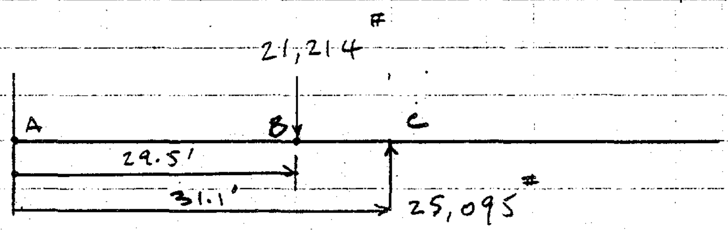


IN CRADLE TEST LOADS, THE DUMMY PUMP C.G. + TOTAL WEIGHT MUST MATCH THOSE OF THE ACTUAL PUMP, AND THE END OF SECTION 1, PT"A", MATCHES THAT OF THE ACTUAL PUMP. THE MATCHING WILL BE ACHIEVED BY ATTACHING A SERIES OF REMOVABLE DISKS TO THE EXISTING DUMMY PUMP.

Advanced Engineering Consultants

Sheet No. 5-20
Job/Calc. No. CA-4001-02-1
Rev. No. 0
By MCR Date 6/16/94
Chk'd W. Kan Date 6/20/94

Subject: TEMP PUMP 2 - DUMMY PUMP



PT. B, CG LOCATION OF DUMMY PUMP

PT. C, CG LOCATION OF ACTUAL PUMP
PER J.J. SISK CALCS. 3/9/94

$\Delta W = 25,095 - 21,214 = 3881^{\#}$

LOCATION OF ΔW FROM PT C.

$$x = \frac{21,214\,(31.1 - 29.5)}{3881} = 8.75'$$

THICKEN SECTION 6 END PLATE $53''\phi \times \frac{3}{4}''$
TO $53''\phi \times 2''$

$$\text{WT. ADDED} = \frac{\pi}{4}(53)^2 \times 1.25 \times 0.283$$
$$= 780^{\#}$$ (WHC TO VERIFY)

NO. DISKS REQ'D (DISKS, SEE P. 5-13)

$$N = \frac{3881 - 780}{265} = 11.7$$

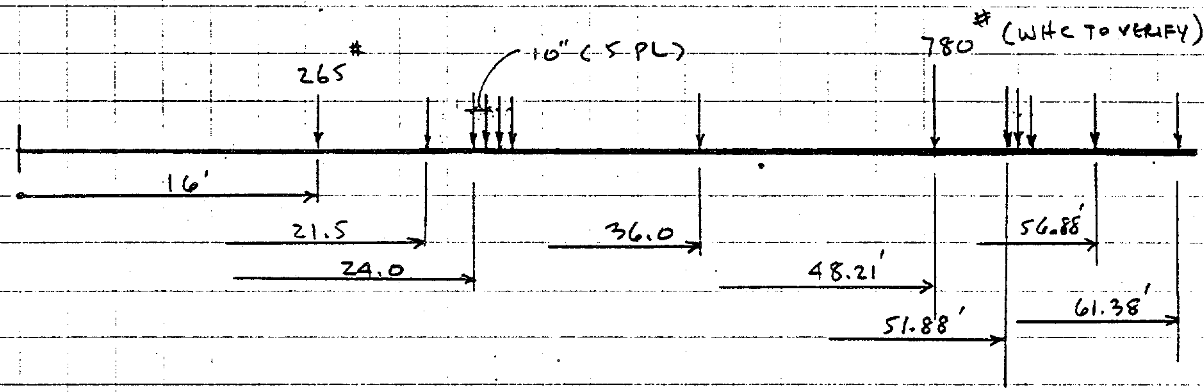
SAY 12

Advanced Engineering Consultants

Sheet No. 5-21
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [illegible] Date 6/16/94
Chk'd W. Kan Date 6/24/94

Subject TEMP PUMP 2 - DUMMY PUMP

BY TRIAL & ERROR, ARRIVE A LAYOUT OF REMOVABLE SETS OF WEIGHT.



CHECK THE MODIFIED DUMMY PUMP

TOTAL WT. = 21,214 + 12 × 265 + 780 = 25,174#

25,174x = 21,214 × 29.5 = 625,813
+ 265 × 16 = 4,240
+ 265 × 21.5 = 5,698
+ 265 × (24 + 24.83 + 25.67 + 26.5) = 26,765
+ 265 × 36 = 9,540
+ 780 × 48.21 = 37,604
+ 265 × (51.88 + 52.71 + 53.55) = 41,907
+ 265 × 56.88 = 15,073
+ 265 × 61.38 = 16,266

782,906

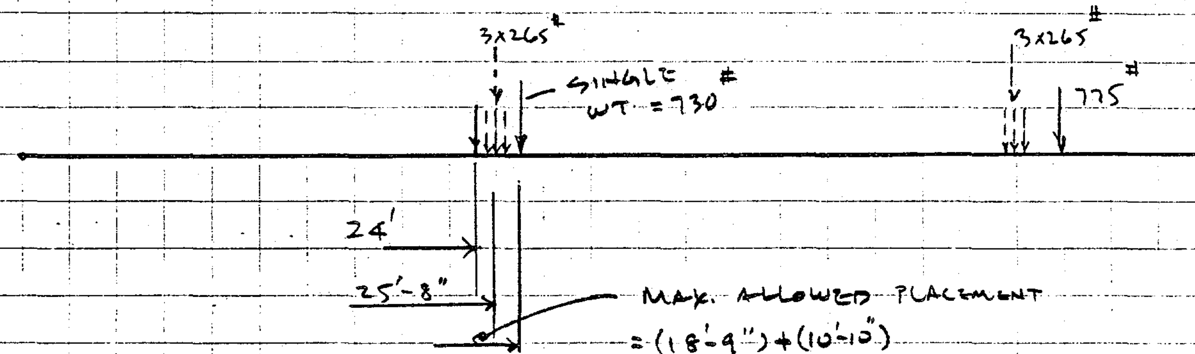
x = 31.1' CHECK

Advanced Engineering Consultants

Sheet No. 5-22
Job/Calc. No. CA4001-02-1
Rev. No. 0
By [illegible] Date 6/16/94
Chk'd W. Kan Date 6/24/94

Subject Temp. Pump

ADJUSTMENT FOR COMBINING THREE DISKS INTO ONE



MAX. ALLOWED PLACEMENT
= (18'-9") + (10'-10")
− (3'-3¼") − (5')
= 25'-10¾" = 25.90'

BALANCE MOMENT

3 x 265 x (25.66 + 52.71)

= 730 x 25.90 + 775 x x

x = 56.0'

APPROX.
TOTAL NEWLY MODIFIED DUMMY PUMP WEIGHT

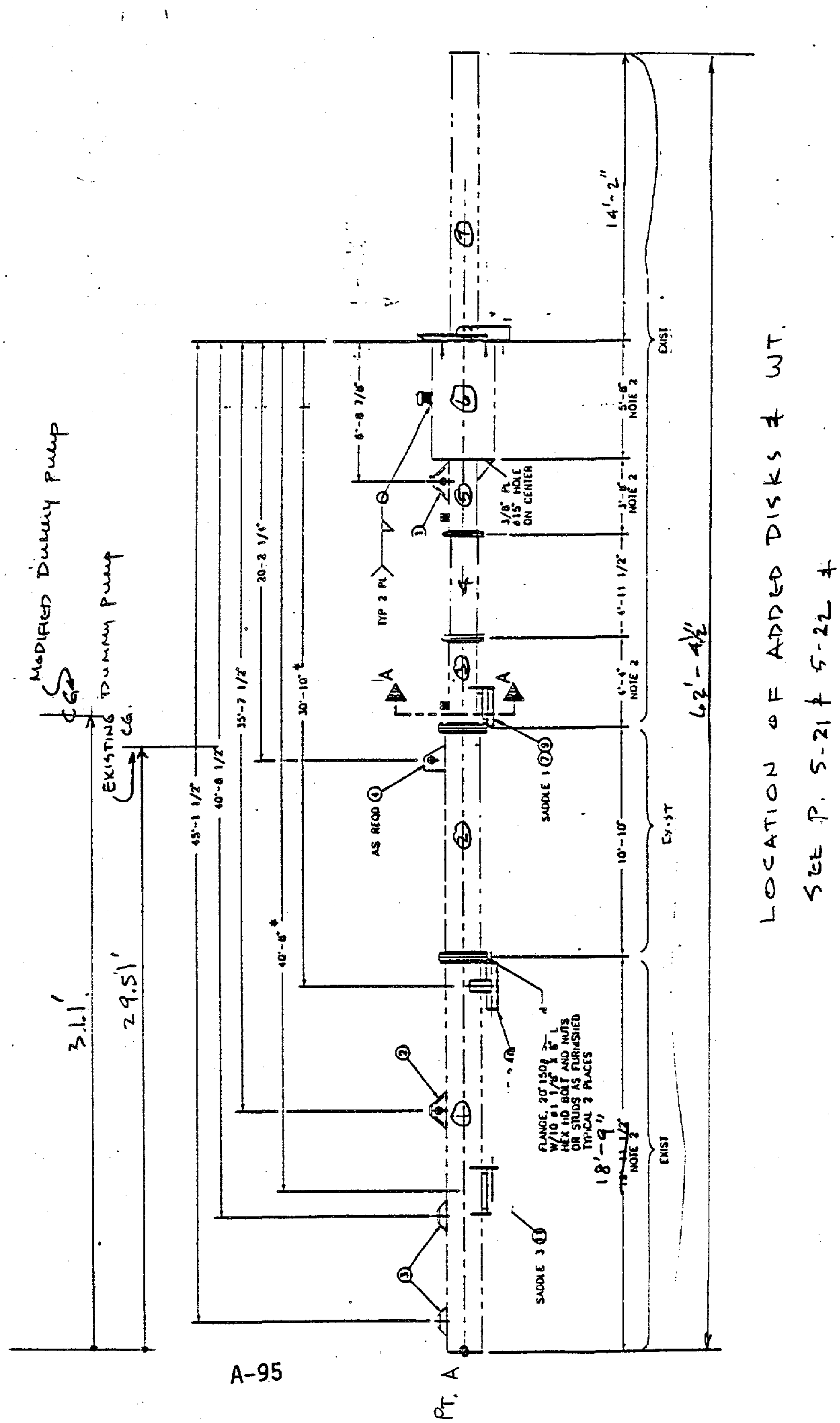
= 21,214 + 6 x 265 + 780 + 730 + 775

= 25,089#

Advanced Engineering Consultants

Sheet No.	5-23
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	[illegible] — Date 6/9/94
Chk'd	W. Kan — Date 6/13/94

Subject: TEMP. DUMMY PUMP



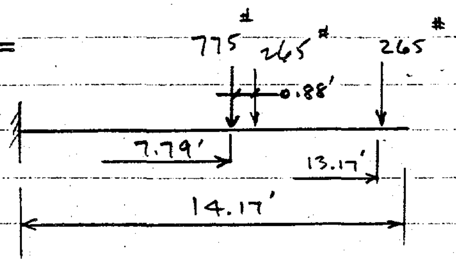
Advanced Engineering Consultants

Sheet No. 5-24
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCG Date 6/17/94
Chk'd WKam Date 6/24/94

Subject: TEMP PUMP 2 - DUMMY PUMP

5.4 STRUCTURAL INTEGRITY OF PUMP

CHECK SECTION 7



WELDS, 1/4" FILLETS

$$S = \pi r^2$$

$$A_v = \frac{1}{2}(2\pi r) = \pi r$$

MOMENT:

PIPE WT. $62.6\ \#/' \times 14.17 \times \frac{14.17}{2} \times \frac{1}{1000} = 6.3^{k-'}$

WTS. $265\,(13.17 + 8.67) \times \frac{1}{1000} = 5.8$

$775 \times 7.79 \times \frac{1}{1000} = 6.0$

$18.1^{k-'}$

INCREASE FOR 25% IMPACT

$$M_{max} = 18.1 \times 1.25 = 22.6^{k-'}$$

$$V = (62.6 \times 14.17 + 2 \times 265 + 775) \times 1.25 \times \frac{1}{1000}$$

$$= 2.7^{k}$$

CHECK 1/4" FILLET WELDS:
USE 16" ϕ, ACTUAL FLANGE DIAMETER IS LARGER

$$f_v = \frac{2.7}{\pi \times 16} = 0.055\ ^{k}/_{''}$$

$$f_b = \frac{22.6 \times 12}{\pi \times 16^2} = 0.34\ ^{k}/_{''} \qquad f = (f_v^2 + f_b^2)^{1/2} = 0.34\ ^{k}/_{''}$$

$$\text{ALLOWABLE} = \frac{1}{4} \times 7.2 = 1.8\ ^{k}/_{''} \gg 0.34\ ^{k}/_{''}$$

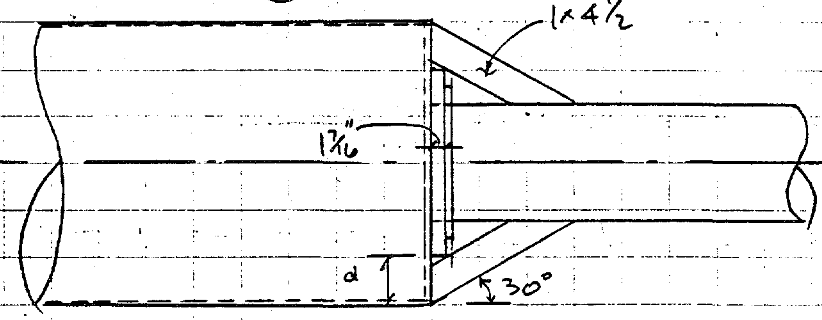
OK!

Advanced Engineering Consultants

Sheet No. 5-25
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By Mcw Date 6/21/94
Chk'd WKau Date 6/20/94

Subject: TEMP PUMP 2 - DUMMY PUMP

CHECK JOINT DETAIL PROPOSED BY WHC
@ SECTION 6 & 7



STIFFENERS TREATED AS PIN-END CONDITION

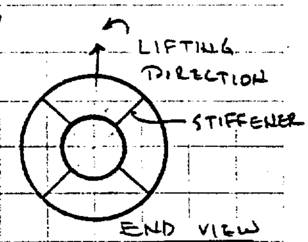
MAX WIDTH OF STIFFENER PLATE (4 TOTAL)

EDGE OF FLANGE TO 36" OD

$$d = (36 - 23\tfrac{1}{2})\tfrac{1}{2} = 6.25''$$

$$\text{MAX. WIDTH} = (6.25 - 1.44 \times \tan 30)\times \sin 60^\circ$$

$$= 4.69'' \qquad \text{USE } 4\tfrac{1}{2}''$$



LEVER ARM TO RESIST MOMENT

$$= (36 - 4.5)\times \sin 45^\circ = 22.3''$$

HORIZ. COMPONENT OF FORCE IN STIFFENER

$$H = \frac{1}{2}(22.6 \times 12)\times \frac{1}{22.3} = 6.1^{k}$$

VERTICAL COMPONENT

$$V = 6.1 \tan 30^\circ = 3.5^{k}$$

$$\text{FORCE IN THE STIFFENER} = (6.1^2 + 3.5^2)^{1/2} = 7.0^{k}$$

$$\text{STRESS} = \frac{7.0}{1 \times 4.5} = 1.6^{ksi} \qquad \text{NEGLIGIBLE}$$

Advanced Engineering Consultants

Sheet No. 5-26
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By Mcm Date 6/21/94
Chk'd WKan Date 6/24/94

Subject: TEMP. PUMP 2 - DUMMY PUMP

16"ϕ, CHECK WALL FOR LOCAL BENDING

STIFFENER & 16"ϕ CONTACT LENGTH

$$L = 4.5 \times \frac{1}{\sin 30} = 9''$$

EQUIV. EFFECTIVE WIDTH IN ADDITION TO L

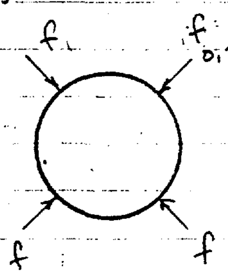
$$e = \frac{\sqrt{t r_c}}{2} \qquad t = .375'', \quad r_c = \frac{15.25}{2} = 7.63''$$

$$= \frac{1}{2}(.375 \times 7.63)^{1/2} = 0.85''$$

$\therefore$ TOTAL BEARING LENGTH = 9 + 0.85 = 9.85"

$$f \text{ (BEARING PER LINEAL INCH)} = \frac{V}{9.85} = 0.36^{k}/''$$

ROUGH ESIMATE LOCAL BENDING STRESS



$$M_R = k f r_c$$

$$= 0.136 \times 0.36 \times 7.63 = 0.37^{k\text{-}''}/''$$

$$S = \frac{1}{6} \times 1 \times (0.375)^2$$

$$f_b = \frac{M_R}{S} = \frac{0.37}{\frac{1}{6} \times (.375)^2} = 15.9^{KSI}$$

STRESS LEVEL IS ok!

SAME JOINT STRENGTHENING

APPLIES TO OTHER END OF 36"ϕ PIPE

Advanced Engineering Consultants

Sheet No.	5-27
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	[illegible] Date 6/10/94
Chk'd W/Kau	Date 6/13/94

Subject TEMPORARY PUMP 2. DUMMY PUMP

CHECK BOLTS 16"Φ PIPE, BOLT CONNECTION
BOLT CIRCLE 21 1/4"Φ

8 - 1"Φ, A325

$I = 4 \times (4.07^2 + 9.82^2) A_{BOLT}$

$= 452 \times \frac{\pi}{4} \times (1)^2$

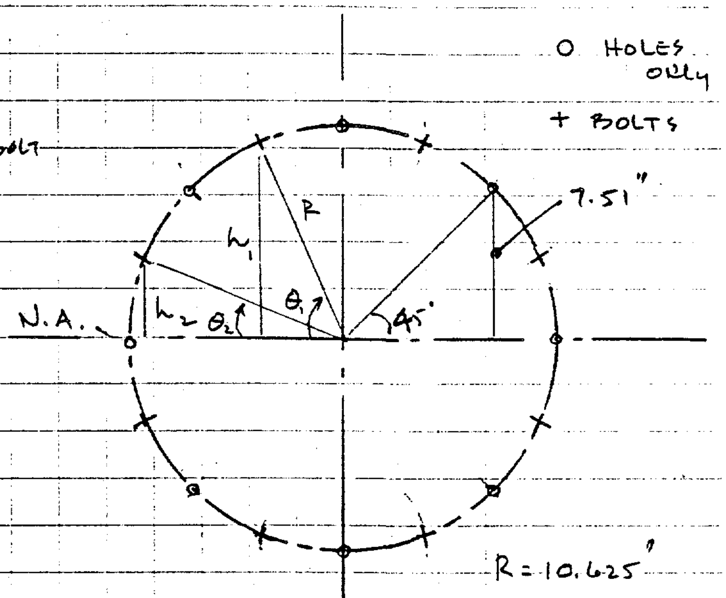
$= 355^{IN^4}$

$S = \frac{355}{h_1} = 36.1^{IN^3}$

SHEAR AREA

$= \frac{1}{2} \times 8 \times \frac{\pi}{4} \times (1)^2$

$= 3.14^{\square"}$



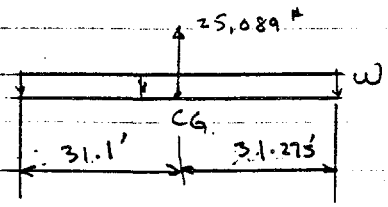
$R = 10.625"$

$\theta_1 = 67.5°, \theta_1 = 22.5°$

$h_1 = 10.625 \times S \cdot 67.5 = 9.82"$

$h_2 = 10.625 \times S \cdot 22.5 = 4.07"$

<u>CRITICAL LIFTING CONDITION</u> (ASSUME LIFTING @ CG)



APPROX.

$V = \frac{25.1}{2} \times 1.25 = 16^{k}$

$MOMENT = 16 \times \frac{31.3}{2} = 250^{k-1}$

Advanced Engineering Consultants

Sheet No. 5-28
Job/Calc. No. CA-4001-02-1
Rev. No. 0
By [illegible] Date 6/10/94
Chk'd [illegible] Date 6/24/94

Subject TEMPORARY PUMP 2 - DUMMY PUMP

$$f_v = \frac{16}{3.14} = 5.1^{ksi}$$

$$f_t = \frac{250 \times 12}{36.1} = 83.1^{ksi} >> 44^{ksi}$$

NG !

PROVIDE ADDITIONAL 8-1"ϕ BOLTS A325

$$I = 355 + (2 \times 10.625^2 + 4 \times 7.51^2) \times \frac{\pi}{4}$$

$$= 710 \text{ IN}^4$$

$$S = \frac{710}{10.625} = 66.8^{IN^3}$$

$$f_t = \frac{250 \times 12}{66.8} = 44.9^{ksi} > 44^{ksi}$$

NG !

CHECK PIPE 16"ϕ ITSELF

$S = 70.3 \text{ IN}^3$, $A_v = \frac{1}{2}(18.41) = 9.21^{\square''}$

$$f_b = \frac{250 \times 12}{70.3} = 42.7^{ksi}$$ TOO HIGH

NG !

$$f_v = \frac{16}{9.21} = 1.7^{ksi}$$

CONCLUSION: ONE-POINT LIFTING @ C.G. OF THE NEWLY-MODIFIED DUMMY PUMP IS UNACCEPTABLE.

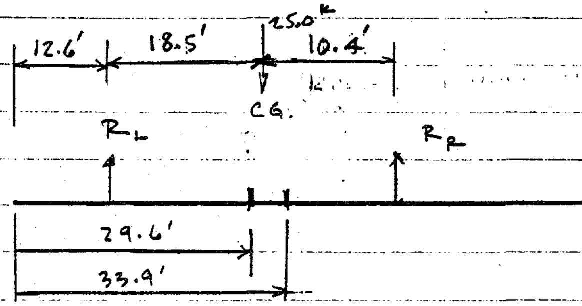
Advanced Engineering Consultants

Sheet No. 5-29
Job/Calc. No. CA 4001-02-1
Rev. No. 0

Subject: TEMP. PUMP 2 – DUMMY PUMP

By: MW Date: 6/24/94
Chk'd: W. Kan Date: 6/24/94

CHECK CONNECTION & PIPE W/ TWO LIFTING PTS. (LUGS 1 & 2, SEE SK-2-24086 R0)



$R_L = 25 \times 10.4 / 28.9 = 9.0^k$, $R_R = 25 - 9 = 16.0^k$

SHEAR & MOMENTS

@ 20"φ & 16"φ FLANGE

$V = 9.0 - 3 \times 0.3 - 0.7 - 7.0 - 1.1$ (1) (2)

$= -0.7^k$

OR $0.7 \times 1.25 = 0.9^k$ (W/ IMPACT)

$M = R_L \times \overset{153.0}{(29.6 - 12.6)} =$

$- 7.0 \times \overset{141.6}{\left(29.6 - \frac{18.75}{2}\right)}$

$- 1.1 \times \overset{6.0}{\left(29.6 - 18.75 - \frac{10.8}{2}\right)}$

$- 0.3 \times \overset{3.6}{(29.6 - 16)}$

$- 0.3 \times \overset{2.4}{(29.6 - 21.5)}$

$- 0.3 \times \overset{2.0}{(29.6 - 24.0)}$

$- 0.7 \times \overset{2.6}{(29.6 - 25.9)} = 5.2^{k-1}$

OR $5.2 \times 1.25 = 6.5^{k-1}$, (W/ IMPACT)

@ 16"φ FLANGE OF SECTION (5)

USE MOMENT @ R_R SECTION (6) THICKENING PLATE

$M \approx 21.4 + 2.7 \times 5.7 + 1.1 \times \frac{5.7}{2} \times 1.25 + 0.8 \times 5.7 \times 1.25$

$\doteq 46.4^{k-1}$

Advanced Engineering Consultants

Sheet No. 5-30
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [illegible] Date 6/24/94
Chk'd W. Kan Date 6/24/94

Subject TEMP. PUMP 2 - DUMMY PUMP

$V = 16 \times 1.25 - 2.7 - (1.1 + 0.8) \times 1.25 = 14.9^k$

20" ϕ FLANGE - BOLT CONNECTION

SEE P. 5-24

$M = 91^{k\text{-}1} > 6.5^{k\text{-}1}$

$V = 9.9^k >> 0.9^k$ OK BY COMPARISON

16" ϕ FLANGE - BOLT CONNECTION

$S = 36.1\ \text{IN}^3$, $A_v = 3.14\ \square''$ (P. 5-21)

$V = 14.9^k$, $M = 46.4^{k\text{-}1}$

$f_v = \frac{14.9^k}{3.14} = 4.7^{ksi}$

$f_t = \frac{46.4 \times 12}{36.1} = 15.4^{ksi}$

$\text{All } F_t = (44^2 - 4.39 \times f_v^2)^{1/2} \doteq 42.9^{ksi}$

$f_t = 15.4^{ksi} < \frac{42.9^k}{2} = 21.5^{ksi}$

OK !

16" ϕ PIPE ITSELF ($S = 70.3\ \text{IN}^3$, $A_v = 9.21\ \square''$)

$f_b = \frac{46.4 \times 12}{70.3} = 7.9^{ksi}$, $f_v = \frac{14.9}{9.21} = 1.6^{ksi}$

OK !

Advanced Engineering Consultants

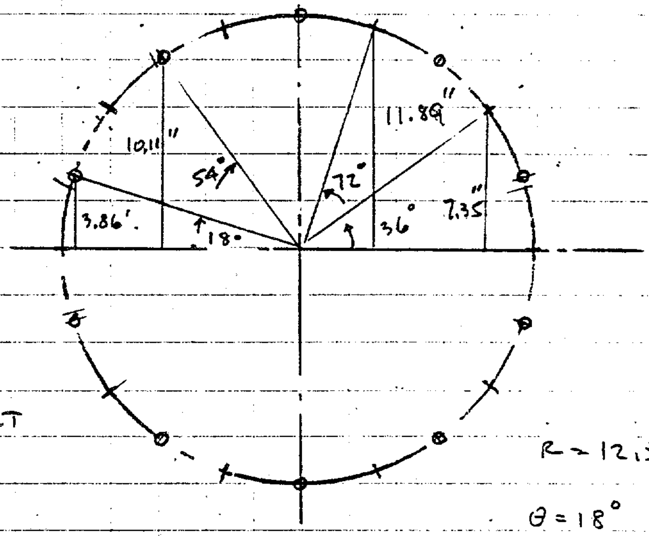
Sheet No. S-31
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCW Date 6/10/94
Chk'd WKan Date 6/13/94

Subject TEMPORARY PUMP 2 - DUMMY PUMP

CHECK BOLTS @ 20" φ PIPE CONNECTION, A325 BOLTS

BOLT CIRCLE = 25" φ

o - HOLES
+ BOLTS



10 - 1 1/8" φ BOLT

R = 12.5"

θ = 18°

$$I = 4\,(11.89^2 + 7.35^2) \times \frac{\pi}{4} \times (1.125)^2$$

$$= 776.9 \text{ IN}^4$$

$$S = \frac{776.9}{11.88} = 65.3 \text{ IN}^3$$

SHEAR AREA $A_v = \frac{1}{2} \times 10 \times \frac{\pi}{4} \times (1.125)^2$

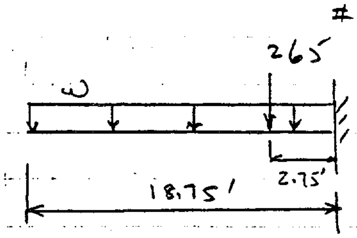
$$= 4.97 \square''$$

ω (PIPE & CONCRETE WT.)

$= 372$ #/'

PLUS MISC. ATTACHMENTS 10%

$= 409$ #/'



IMPACT

$$V = (409 \times 18.75 + 265) \times 1.25 \times \frac{1}{1000} = 9.9^k$$

Advanced Engineering Consultants

Sheet No. 5-32
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [signature] Date 6/10/94
Chk'd W. Kan Date 6/24/94

Subject TEMPORARY PUMP 2 - DUMMY PUMP

$$M = (0.41 \times 18.75^2 \times \frac{1}{2} + 0.27 \times 2.75) \times 1.25$$

$$= 91.0^{k-1}$$

$$f_v = \frac{9.9}{4.97} = 2.0^{ksi}$$

$$f_t = \frac{91.0 \times 12}{65.3} = 16.7^{ksi}$$

$$All\ F_t = (44^2 - 4.39 f_v^2)^{1/2} = 43.8^{ksi}$$

PER CRITERIA: $All\ F_t = \frac{1}{2} \times 43.8 = 21.9^{ksi}$

$> 16.7^{ksi}$

ok!

Advanced Engineering Consultants

Sheet No. 5-33
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [signature] Date 6/24/94
Chk'd W Kan Date 6/24/94

Subject TEMP. PUMP 2 - DUMMY PUMP

5.5 SUMMARY =

1. THE DUMMY PUMP MODIFICATION DESIGN IS BASED ON THE FOLLOWING INFORMATION and/or assumptions FURNISHED TO AEC FROM WHC.

A) EXISTING DUMMY PUMP

- A COPY OF SK-2-24086 RO;
- A COPY OF SAME DWG. WITH AS-BUILT MARK-UPS: INCLUDE DIMENSIONS, LUGS & DISKS. (SEE 6-23)
- DISK DIMENSIONS GIVEN VERBALLY; AND
- ACTUAL TOTAL WEIGHT OF THE PUMP WAS NOT GIVEN IN THE AS-BUILT MARK-UPS.

B) ACTUAL PUMP (TO BE SIMULATED BY MODIFYING THE EXISTING DUMMY PUMP)

- TOTAL WEIGHT OF PUMP IS GIVEN IN LOAD CHART, 101 SY;
- ACTUAL LENGTH OF THE PUMP CAN BE SCALE OFF THE LOAD CHART; ASSUMING IT IS DRAWN TO SCALE.

Advanced Engineering Consultants

Sheet No.	5-34
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	[illegible] Date 6/24/94
Chk'd	W. Kan Date 6/24/94

Subject TEMP. PUMP 2 - DUMMY PUMP

[CONTINUATION OF (1), (B)]

- THE LOCATION OF THE PUMP CG. WAS INSTRUCTED BY T.C. MACKEY VERBALLY TO USE THE VALUE CALCULATED BY J.J. SISK ON 3/7/94

2. DUMMY PUMP MODIFICATION DESIGN

- THE MODIFICATION SIMULATES TOTAL WEIGHT AND LOCATION OF C.G. BUT NOT LENGTH THAT WAS VERBALLY INSTRUCTED FROM RANDY JORISSEN; CONSEQUENTALLY, THE LENGTH OF THE MODIFIED PUMP REMAINS UNCHANGED;

- END PLATE OF SECTION 6, $53''\phi \times \frac{3}{4}''$, IS PROPOSED TO BE THICKENED TO $53''\phi \times 1\frac{3}{4}''$ PER WHC AEC REQUESTED THAT BE INCREASED TO 2" THICK, WEIGH 780 LBS.

- ADDED WEIGHT (EXCEPT ITEM MENTIONED ABOVE). IS SIMULATED WITH A SERIES UNIFORM SIZE OF DISKS - OD 41", $\frac{1}{2}''$-THICK DISK PER RANDY'S

Sheet 5-34a
Job/Calc No. CA4001-02-1
Rev. 0
LEM 6/27/94
MCSC 6/27/94

The dummy pump is to be used by WHC to simulate installation and removal of the actual pump. This requires that general dimensions, weight and C.G. of the dummy pump simulate those of the actual pump.

AEC started with a dummy pump designed by others, and was asked in this project to make the changes necessary such that the modified dummy pump will simulate the actual pump weight and C.G.

To accomplish this, AEC needed data on the actual pump, as well as the dummy pump design that is to be modified. The information received from WHC, both documented data and data passed to AEC verbally from WHC engineering staff, is documented on pages 5-33 through 5-35.

Based on the data received, AEC calculated the weight of the dummy pump design based on a materials take off from the design calcs/Dwgs. Actual as-built weights were not available. AEC designed and located eight disks to be added to the dummy pump (as shown in Sheet 6-13) to simulate the weight and C.G. of the actual pump, per data given to AEC.

AEC assumes:

1. The thickness of the end plate of Section 6 (sheet 5-2) will be increased from 3/4 in. to 2 in. such that the weight will be increased by 780 lb., and this change will be shown on Dwg. H-2-821397.

Sheet 5-34b
Job/Calc No. CA4001-02-1
Rev. 0
LEM 6/27/94
MCR 6/27/94

2. WHC will assess impact of any changes made to AEC designed dummy pump weights (disks) and/or their locations that might be required.

3. The dummy pump will be lifted at two points when the pump is in horizontal position.

4. 36 in. and 16 in. pipe diameter joints will be strengthened by WHC and modifications shown on Dwg. H-2-821397.

Advanced Engineering Consultants

Sheet No. 5-35
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By Mcw Date
Chk'd W. Kan Date 6/24/94

Subject TEMP PUMP 2 -
DUMMY PUMP

REQUEST, AND THE DISKS ARE SO LOCATED AND ATTACHED TO THE PUMP THAT THE MODIFIED PUMP SIMULATES THE LOCATION OF C.G. OF THE ACTUAL PUMP.

- REQUIRED NUMBERS OF DISKS (12) ARE CONSIDERED TOO NUMEROUS BY WHC; DISKS OF 2"- THICK ARE USED TO SUBSTITUTE 6-1/2" THICK DISKS.
- JOINT @ SECTIONS 6 & 7 IS BEING STRENGTHENING BY WHC FOR LIFTING OPERATION REQUIREMENTS.

3. OPERATIONAL LIMITATION

- THE MODIFIED PUMP MUST NEVER BE LIFTED UP AT ONE POINT AND STAYS IN THE HORIZONTAL POSITION;
- LIFTING @ LUGS 1 & 2 SHOWN IN SK 2-24086, 20 IS ACCEPTABLE FOR THE PUMP STRUCTUAL INTEGRITY. HOWEVER, BOTH ENDS OF 36"ϕ SECTION JOINING WITH 16"ϕ PIPE MUST BE REINFORCED PER DETAILS ON PAGE S-25.

Advanced Engineering Consultants

Sheet No.	6-i		
Job/Calc. No.	CA 4001-02-1		
Rev. No.	0		
By	MCM	Date	6/7/94
Chk'd	[illegible]	Date	6/7/94

Subject: TEMPORARY PUMP 2 - ATTACHMENTS

6.0 ATTACHMENTS

ATTACHMENT 6.1 : LIFTING BEAM ASSEMBLIES SKETCHES (PAGES 6-1 THRU 6-3)

ATTACHMENT 6.2 : SADDLES SKETCHES (P. 6-4 THRU 6-6)

ATTACHMENT 6.3 : CONTAINER TEST WEIGHT SKETCHES (P. 6-7 THRU 6-12)

ATTACHMENT 6.4 : DUMMY PUMP SKETCHE (P. 6-13)

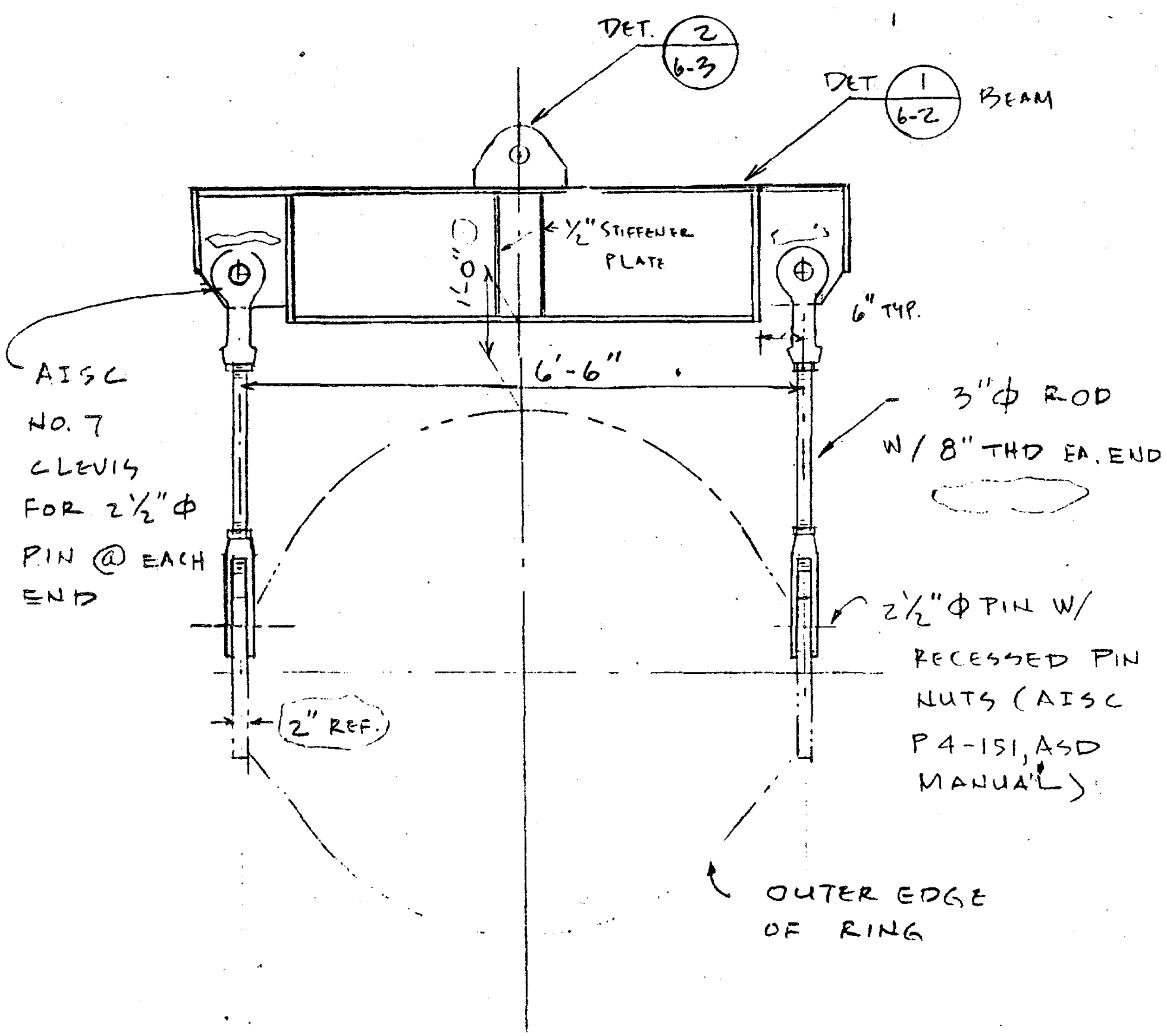
ATTACHMENT 6.5 : RELEVANT CORRESPONDENCES TELECONS & AS-BUILT (P. 6-14 THRU 6-23)

Advanced Engineering Consultants

Sheet No.	6-1
Job/Calc. No.	94001-02-1
Rev. No.	0
By	M. CHIAO Date 5/17/94
Chk'd	W. Kan Date 5/18/94

Subject TEMP. PUMP 2 LIFTING BEAM ASSEMBLIES

6.1 LIFTING BEAM DESIGN SKETCHES



LIFTING BEAM

ELEVATION

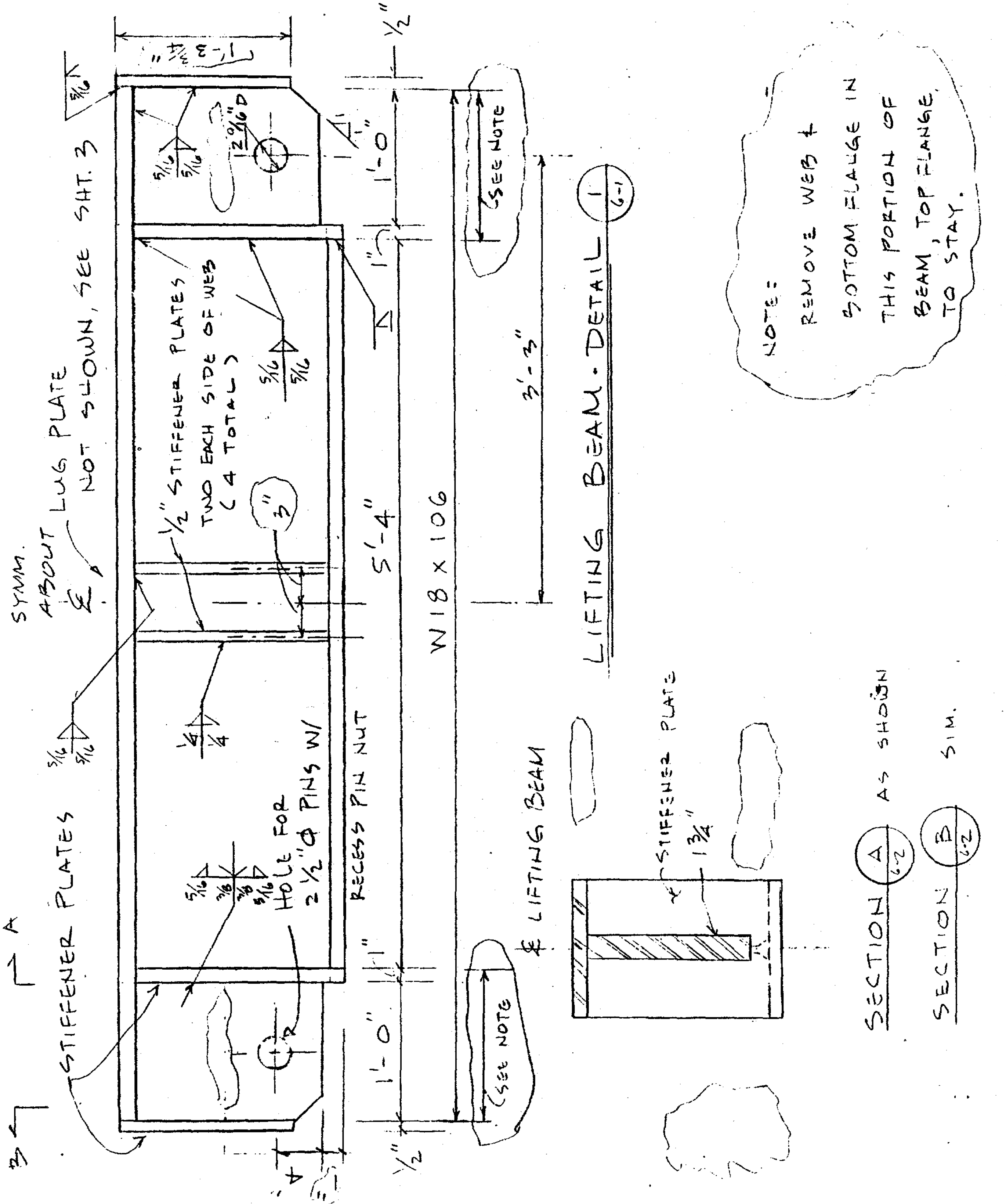
WHC-SD-WM-DA-168
REV. 0

PAGE A-112

Advanced Engineering Consultants

Sheet No.	6-2
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	M. CHIAO
Date	5/17/94
Chk'd	W. Kau
Date	5/25/94

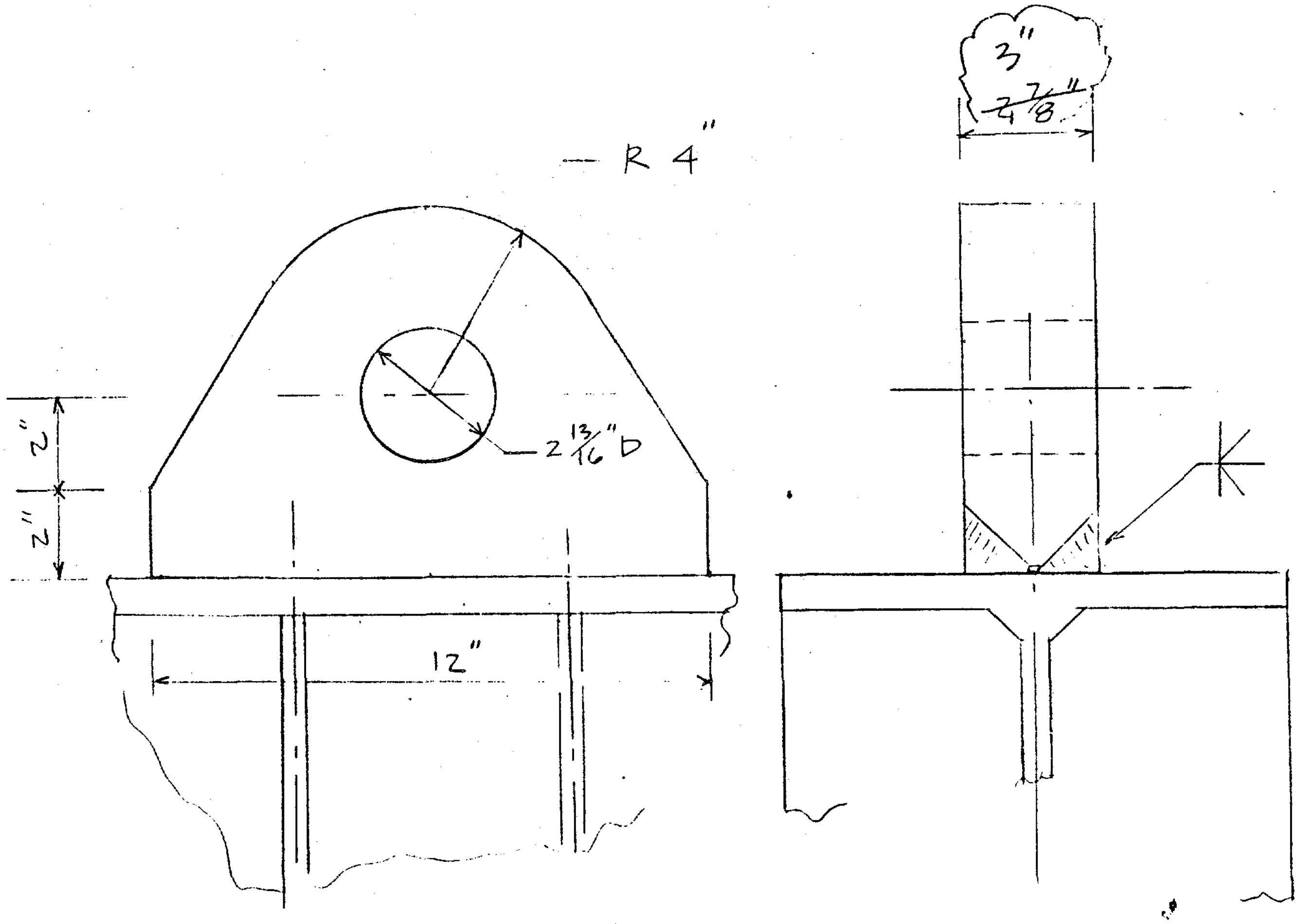
Subject: TEMPORARY PUMP 2 - LIFTING BEAM ASSEMBLIES



Advanced Engineering Consultants

Sheet No. 6-3
Job/Calc. No. CA-4001-02-1
Rev. No. 0
By MCW Date 5/17/94
Chk'd W. Kan Date 5/--/94

Subject LIFTING BEAM ASSEMBLIES



DETAIL 1/6-1

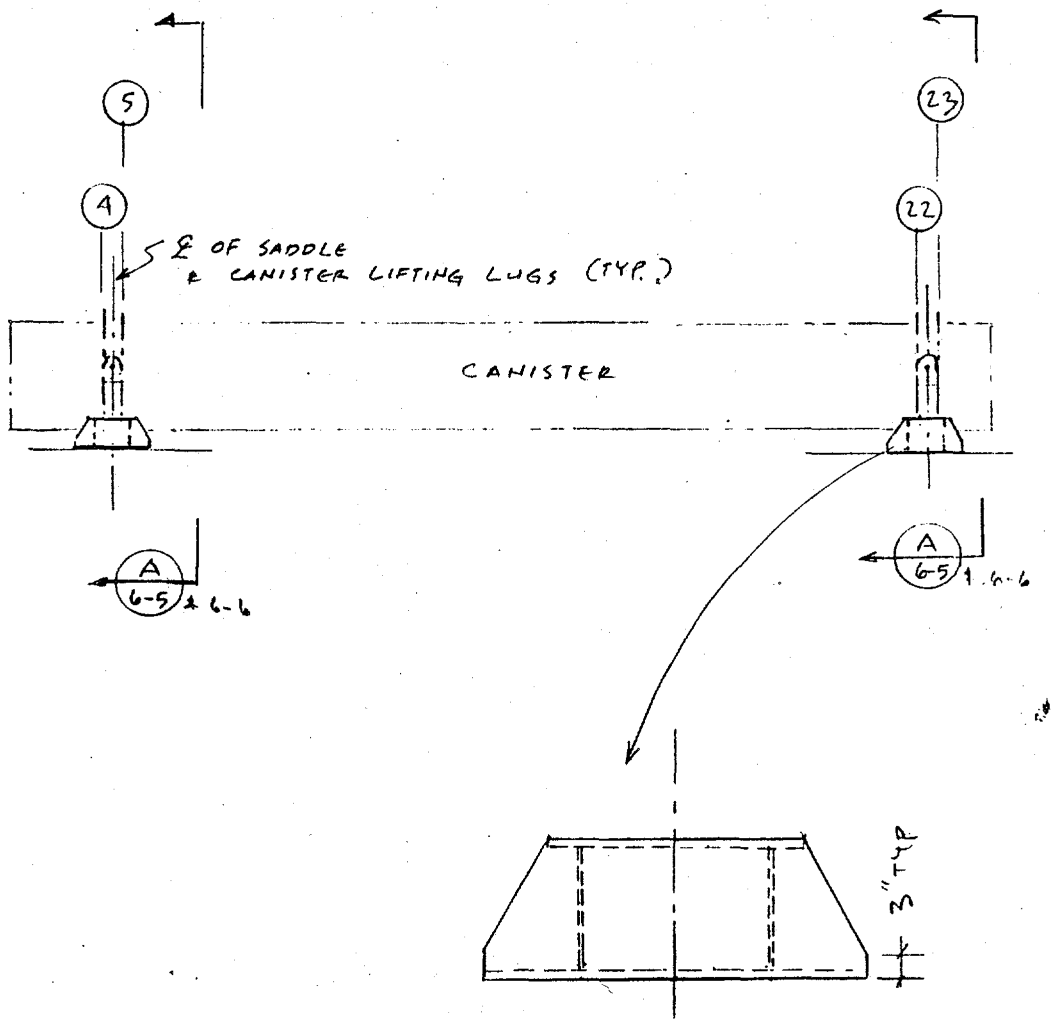
Advanced Engineering Consultants

Sheet No. 6-4
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By [illegible] Date 5/27/94
Chk'd WKau Date 6/6/94

Subject TEMP. PUMP 2 - SADDLES

6.2 SADDLE DESIGN SKETCHES

CANISTER REFERENCE DWGS: H-2-83734 SHTS. 1~3



NTS.

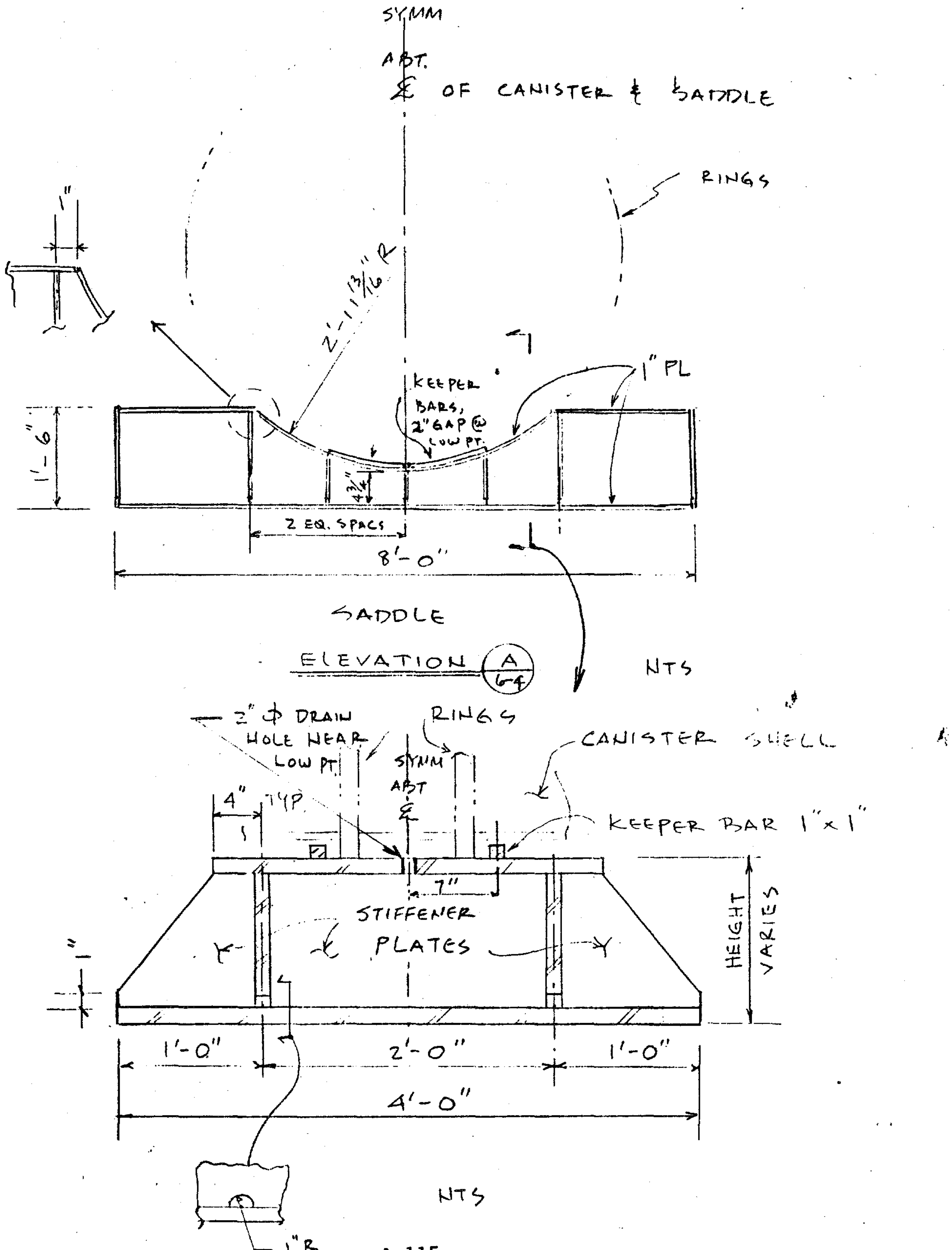
NOTES:

1. ALL PLATES SHALL BE A36 STEEL AND 1/2" THICK UNLESS NOTED OTHERWISE.
2. APPROX. WEIGHT PER SADDLE EQUAL 2 3/4 KIPS

Advanced Engineering Consultants

Sheet No. 6-5
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By U. CHIAO Date 5/16/94
Chk'd W. KAO Date 6/6/94

Subject TEMP. PUMP 2 - REMOVAL & INSTALLATION SADDLES

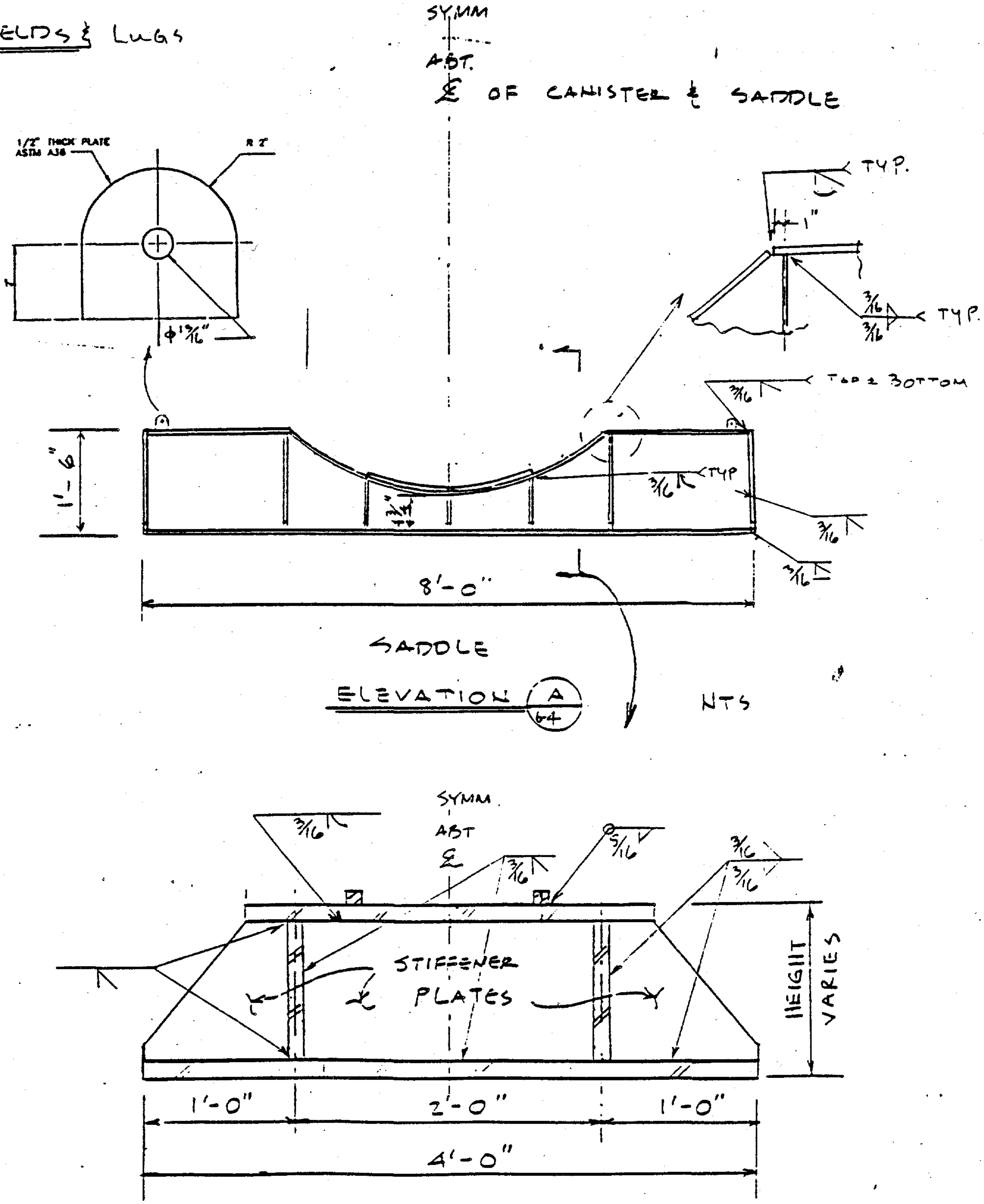


Advanced Engineering Consultants

Sheet No. 6-6
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 6/2/94
Chk'd WKaw Date 6/6/94

Subject TEMP PUMP 2 - REMOVAL & INSTALLATION SADDLES

WELDS & LUGS



NTS

Advanced Engineering Consultants

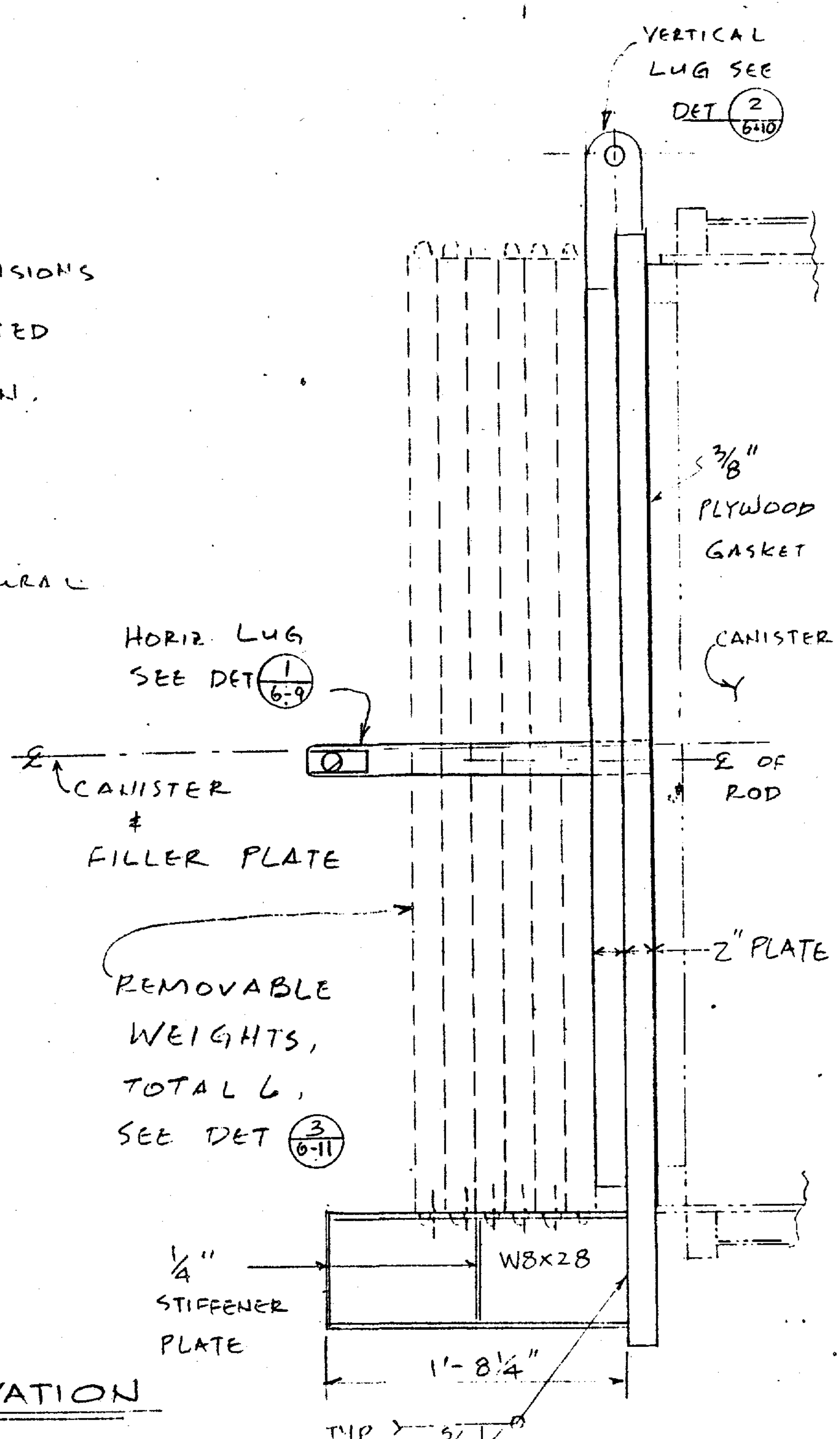
Sheet No.	6-7
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	M. CHIAO
Date	5/27/94
Chk'd	W. Kau
Date	6/3/94

Subject: TEMP PUMP 2 CONTAINER TEST WEIGHT HOLDER

6.3 CONTAINER TEST WEIGHTS

NOTES:

1. SOME OF DIMENSIONS MAY BE ADJUSTED IN FINAL DESIGN.
2. WELDS ARE NOT SHOWN.
3. A36 STRUCTURAL STEEL



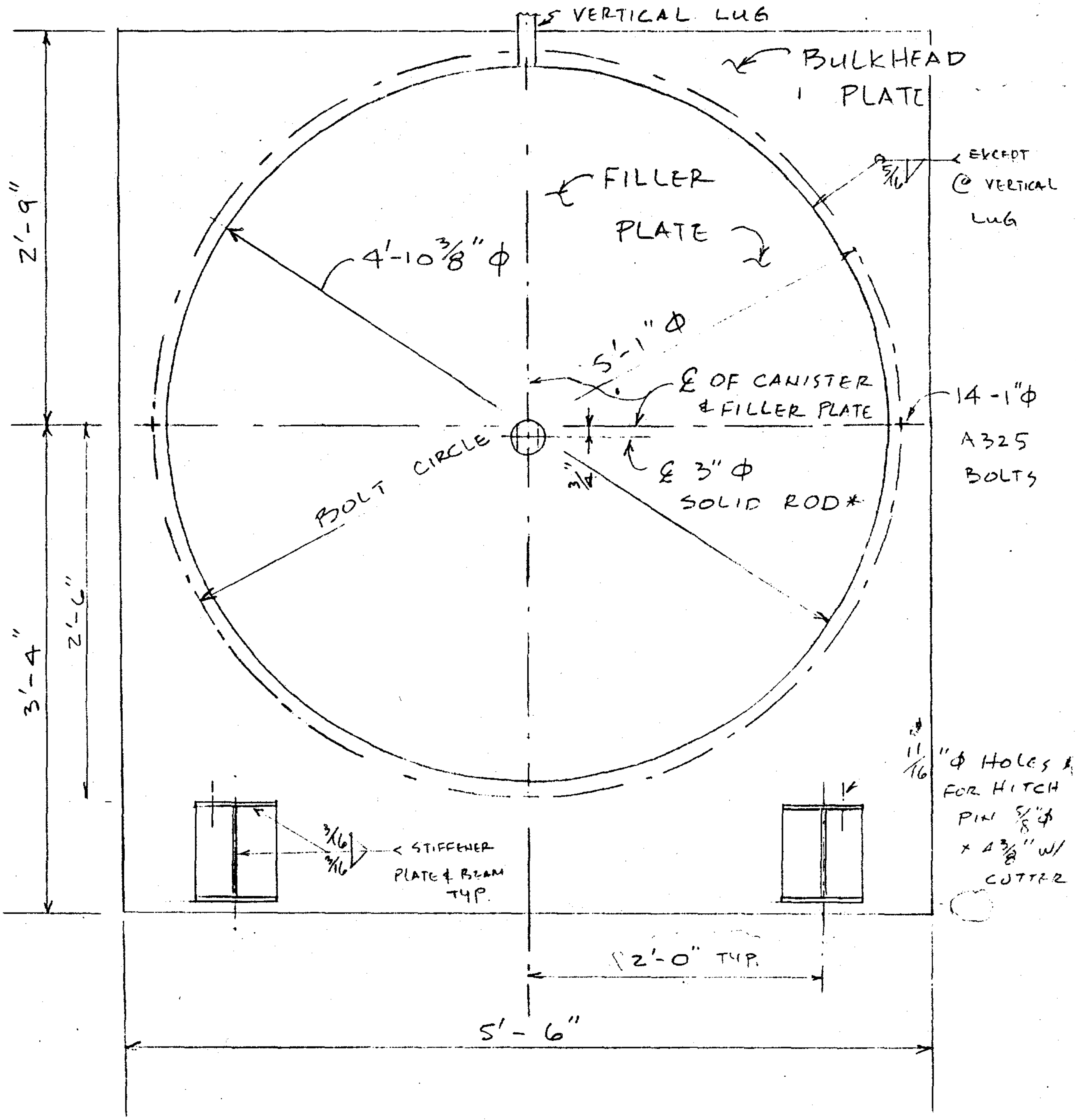
SIDE ELEVATION

(HOLDER)

Advanced Engineering Consultants

Sheet No.	6-8
Job/Calc. No.	CA 4001-02-1
Rev. No.	0
By	MCW
Date	5/27/94
Chk'd	W Kan
Date	6/3/94

Subject: TEMP. PUMP 2 CONTAINER TEST WEIGHT HOLDER



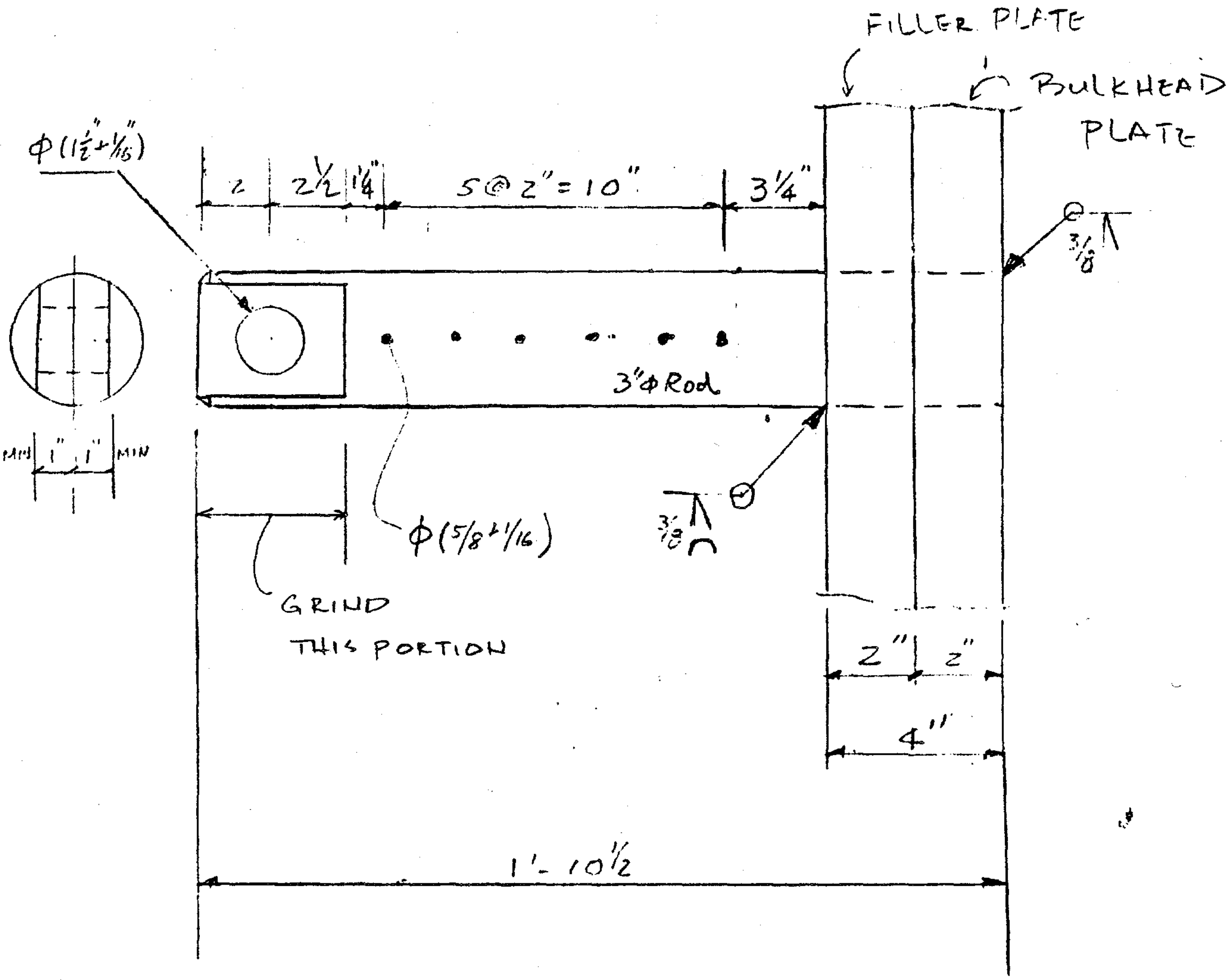
FRONT ELEVATION

* LINE UP W/ CG OF FULLY LOAD CONDITION

Advanced Engineering Consultants

Sheet No. 6-9
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kaw Date 5/27/94
Chk'd ______ Date ______

Subject TEMP. PUMP 2 - Horizontal Lifting Lug, TEST WT

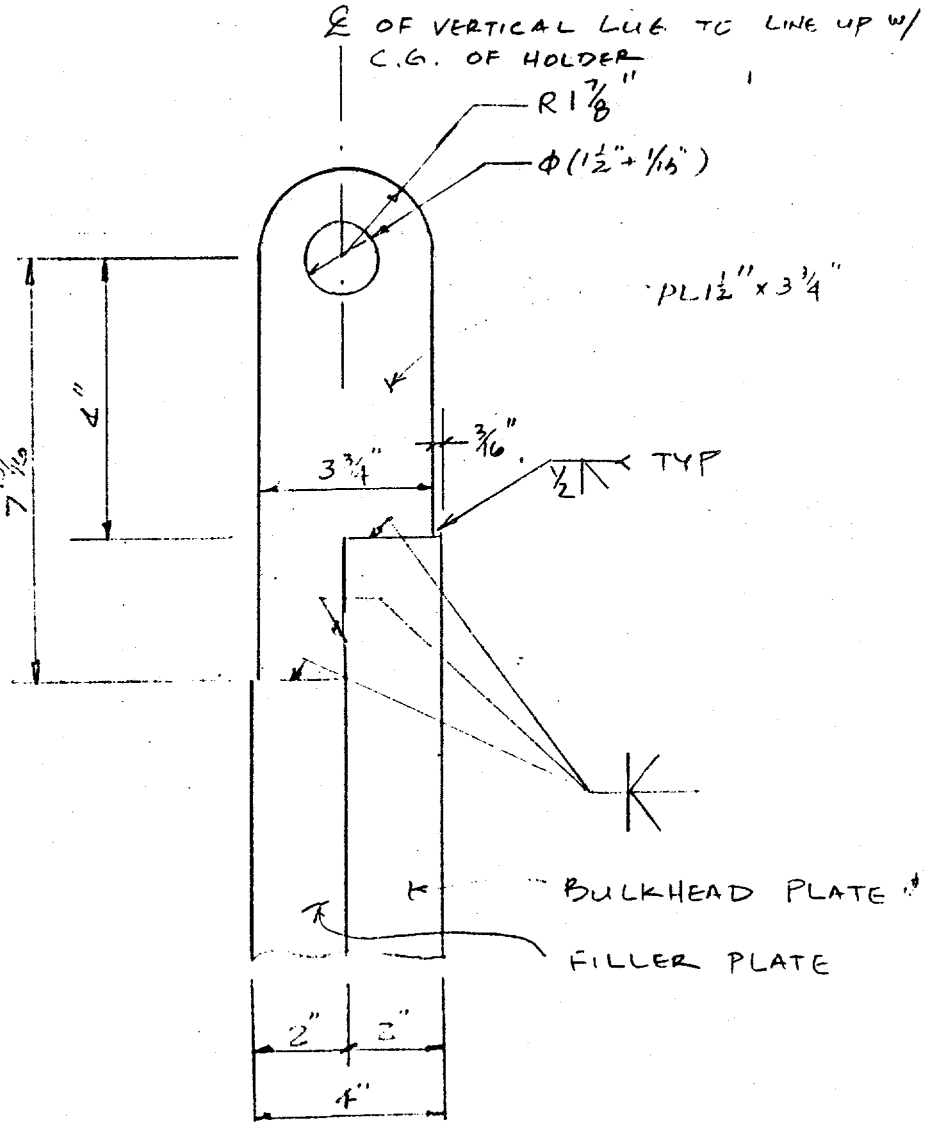


DETAIL 1/6-7

Advanced Engineering Consultants

Sheet No. 6-10
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By W. Kan Date 5/27/94
Chk'd MCW Date 6/3/94

Subject TEMP. PUMP 2 - CONTAINER TEST WTS.



DETAIL 2/6-7

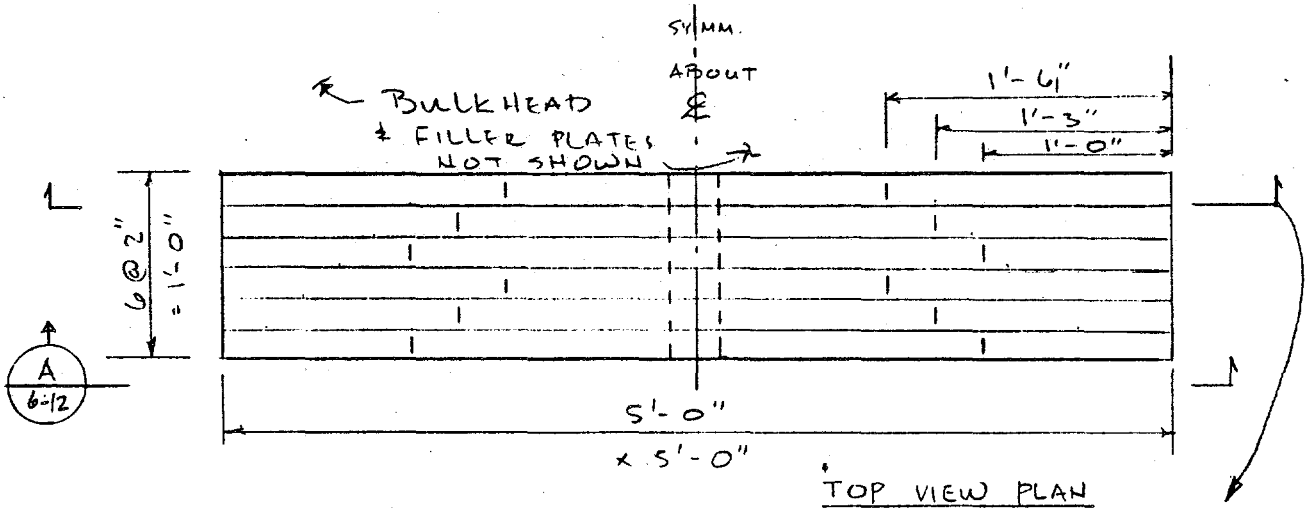
WHC-SD-WM-DA-168
REV. 0

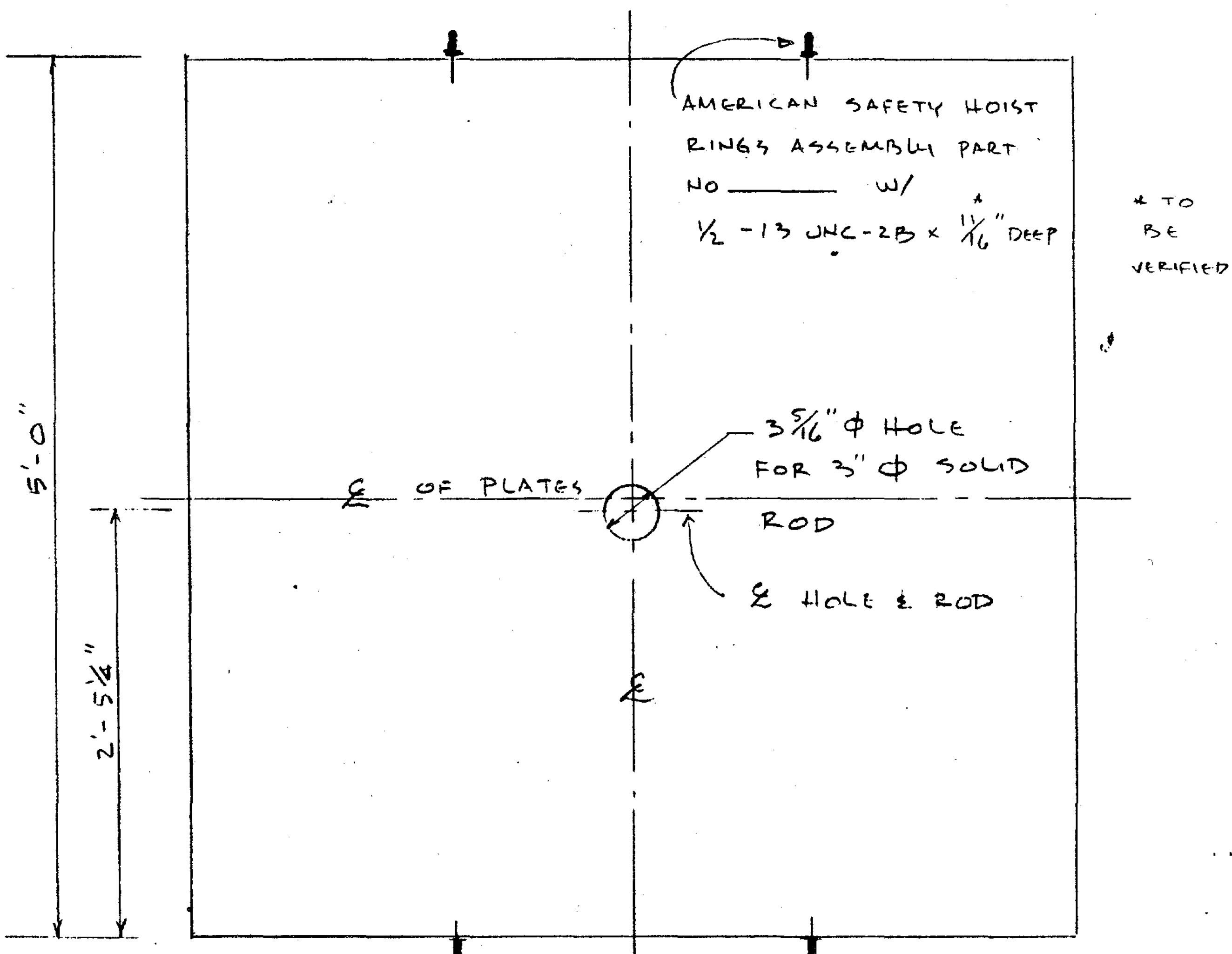
PAGE A-121

Advanced Engineering Consultants

Sheet No. 6-11
Job/Calc. No. CA 4001-02-1
Rev. No. 0
By MCM Date 6/6/94
Chk'd WKAW Date 6/6/94

Subject TEMP. PUMP 2 - CONTAINER TEST WEIGHTS

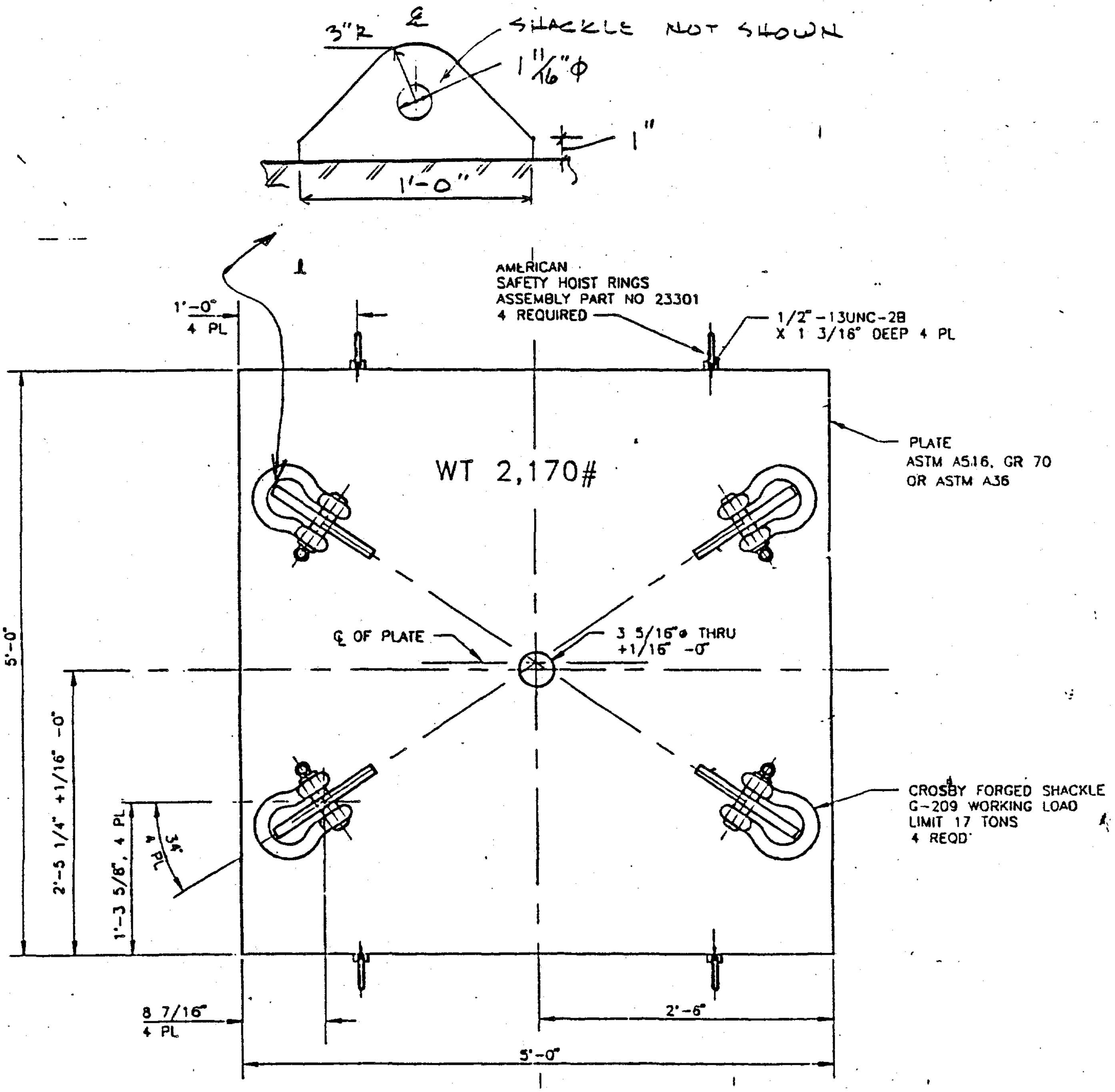




DETAIL 3
6-7

A-121

Subject TEMP. 1 CONTAINER TEST WEIGHTS



SECTION A / 6-11

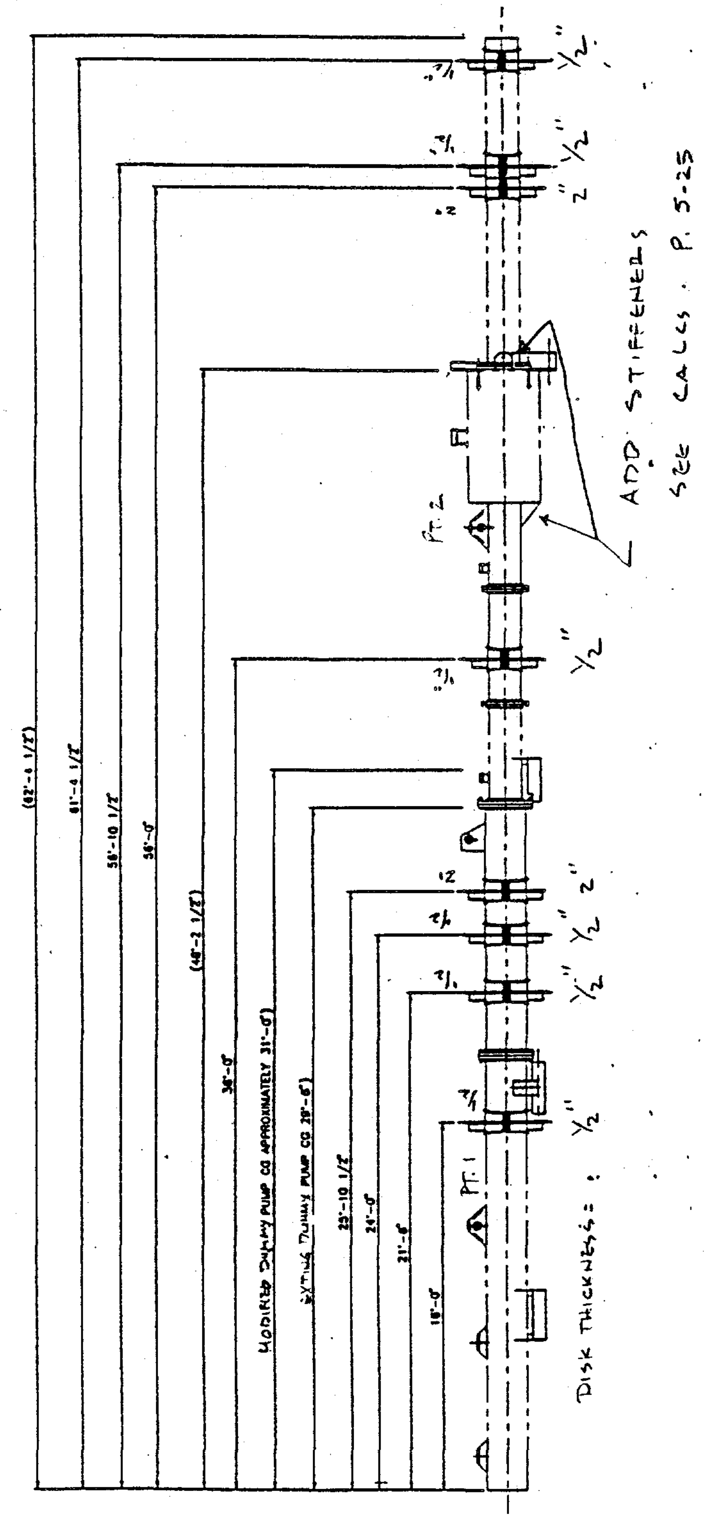
NTS

Advanced Engineering Consultants

Sheet No. 6-13
Job/Calc. No. CA 4001-02-1
Rev. No. 0

Subject: TEMP. PUMP 2 - DUMMY PUMP

By: [illegible] Date: 6/8/94
Chk'd: W Kan Date: 6/8/94



ELEVATION
SCALE 1/8" = 1'-0"

NOTE: 1. REMOVABLE DISKS
SEE CALC. P. 5-12 & 5-16
FOR SKETCHES
2. DUMMY PUMP IN HORIZONTAL POSITION, IT MUST BE LIFTED AT LEAST AT TWO POINTS, (PT. 1 & PT. 2)
3. LOCATIONS OF DISKS CAN BE ADJUSTED AS LONG AS LOCATION OF CG IS MAINTAINED, WHEN INTERFERENCE WITH ATTACHMENTS ON THE EXISTING DUMMY PUMP OCCURS.

Advanced Engineering Consultants

MEMORANDUM

6.5 CORRESPONDENCE & TELECONS

DATE: May 9, 1994

6-14

WHC-SD-WM-DA-168
REV. 0

PAGE A- 124

TO: Randy Jorissen (WHC)

FROM: Lincoln E. Malik LEM

SUBJECT: Tank 241 SY101 Mixer Pump Removal and Installation Project
BOA MJB-SMV-322666-002R, AEC Job No. 4001-02

6.5.1

Dear Randy:

This memo summarizes the data and clarifications AEC needs to proceed with the subject project:

Task 1 - Lifting Beam:

1. The design loads for each of the two lifting beams is not clear for us. The scope of work calls for a canister plus pump design weight of 150 Kips. However the load chart we received from you adds up to approximately 70 Kips, which is supposed to include an impact factor of 1.25. 100 kips

The loads are not uniformly distributed in the canister (the pump head is more heavy than the shaft). Design of the lifting beams requires that we have the maximum load on either lift beam. We can do this by having a load distribution of the canister and internals, as is given in the load chart, or a maximum lift load per lift beam defined by WHC.

In this regard, AEC also has a concern as to whether the design of the lift beams will be consistent with the design of the lifting lugs on the sides of the canister. The plates and welds now shown on the drawings may not be sufficient for the design load of the pin that will go in them. Also, will WHC or AEC take the responsibility for checking bearing and other associated loads on the canister lug plates. It does not make good sense to size a large pin for the design loads and factor of safety of 3, if the lug plates are designed for lower loads. Joint effort

NO 2. Should lift beam design loads include strongback, or will the strongback be left on the trailer?

3. AEC needs the size of hook used with the lift beams to size the hole in the beam lug plate. Alternatively, we can design

Determine clevis

DISTRIBUTION: AEC/4001-02, LEM RTY

a pin to accommodate the hook. This might be a better overall detail both from a design and operations point of view.

4. Lift beam will be designed per AISC working stress design with allowable stresses per design criteria for C-106.

Task 2 - Saddles:

Our design to-date assumes the following. Please advise if this is to be different.

will get loads tomorrow

1. Saddles will be designed for load distribution shown on the load chart. Design will be based on AISC working stress design approach for gravity loads only. Seismic ~~and wind~~ loads have been eliminated from consideration by WHC (per phone conversation of 5/6/94). Include wind.

2. Saddles will be placed on grout (for leveling) and the coefficient of friction used will be 0.2 (steel to concrete). Friction must still be used to resist initial lateral loads from laying the canister on the saddles at 15° with horizontal. 10°

3 ~~4~~. The saddles will be designed to be placed on the 8" slab-on-grade with soil bearing pressure of 2600 psf (ref. Dwg. STRL FDN PlAN & DETS).

4 ~~5~~. Height at low point of saddle is assumed to be 4-3/4" (from t.o. base plate to b.o. radius plate). OK

5 ~~6~~. AEC assumes that the container is designed to span the length between the two lifting lugs. Once the saddles are placed, WHC will check the container to span between the saddles, if necessary.

Higher Bearing during lay down.

WHC-SD-WM-DA-168
REV. 0

PAGE A- 125

Mackey
509-373-5262 FAX

6-16

WHC Response to AEC FAX (dated 5/9/94)
241SY101 Mixer Pump Project

6.5.2

Respondent: Randy Jorissen

Lincoln Malik,

This correspondence is a follow-up to our conversation on May 10, 1994, regarding the answers to your questions on the lifting beam and support saddles designs.

Response to Task 1 Questions/Comments - Lifting Beam

1. The 101SY load chart shows approximately 70 kip total load because it does not include the weight of the lead shot used for shielding, which will add an additional 66 kips. The lead shot must be included in the lifting beam design. As a design load, use 100 kips for each lifting beam (this includes an impact factor of 1.25).

   AEC and WHC must jointly determine the size of the pin at the container/lifting beam interface. It is WHC's responsibility to determine structural adequacy of the container's lug plates; however, if AEC feels that the container lugs or welds are inadequate, AEC must discuss their concerns with WHC until all parties are satisfied that a workable solution has been reached.

2. Do not include strongback in lifting beam design loads: the strongback will be left on the trailer.

3. AEC will determine pin (or clevis) size for the lift beam lug plate. Provide WHC with the clevis/lug geometry and WHC will provide required lifting interface.

4. Correct.

Response to Task 2 Questions/Comments - Saddles

1. Do not design saddles for load distribution on load chart, as the loads do not include the lead shot used for shielding. WHC will FAX an updated load chart to AEC on 5/11/94 for use in saddle design. Do not design for seismic loads; however, the saddles must be designed for wind (with the weight of the container, wind loads should have minimal effect on saddle design). Use AISC working stress approach and AISC allowable stresses for saddles.

2. Per our conversation, your plan is to use 2 saddles, one located at each end of the container under the ribs that attach to the lifting lugs. WHC will check the container for the interface loads on the assumption that the saddles support the container over a 1/4 circle. This design will preclude the necessity of leveling multiple saddles. However, if

the container cannot withstand the interface loads with 2 saddles, you must go to a multi-saddle design. A steel/concrete friction coefficient of 0.2 is acceptable. I understand your concern that a 15 degree tilt angle from horizontal will put high loads in one saddle when the container first contacts the saddle - per our conversation, WHC will limit the horizontal tilt angle to 10 degrees. When the container first contacts a single saddle, the soil capacity allowable of 2600 psf may be exceeded - this is acceptable because it is a transient load and bearing capacity allowables are generally based on settlement. Provide conceptual design to WHC ASAP for checking interface loads.

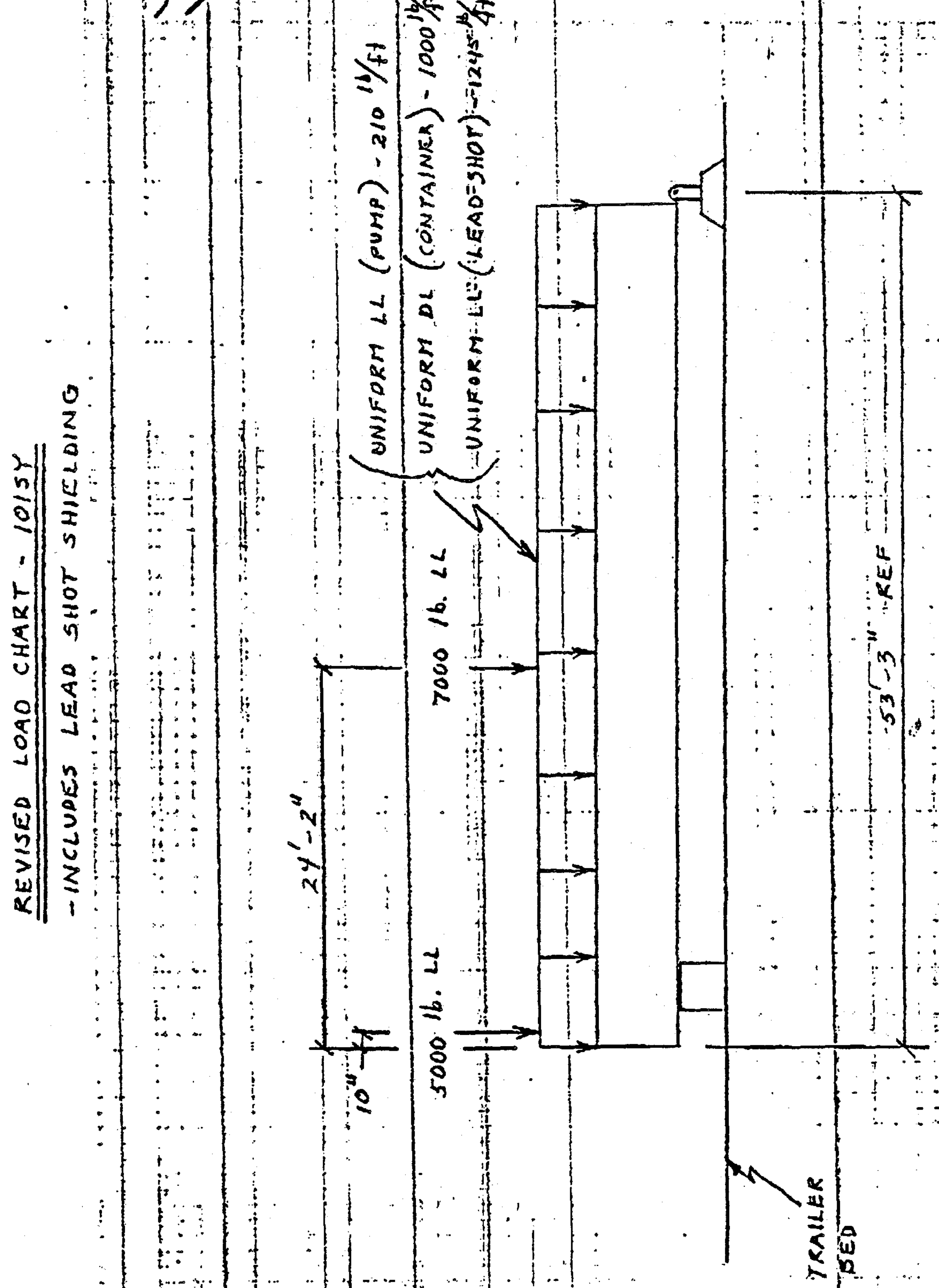
4. Correct

5. Correct (this is the same as C-106).

6. Correct

ANALYTICAL CALCULATIC

Subject: 101-SY CONTAINER/PUMP/LEAD SHOT LOAD DISTRIBUTION
Originator: CALCS. FOR INDEPENDENT REVIEW   Date: 5/10/94
Checker: Randy Jonsen   Date:

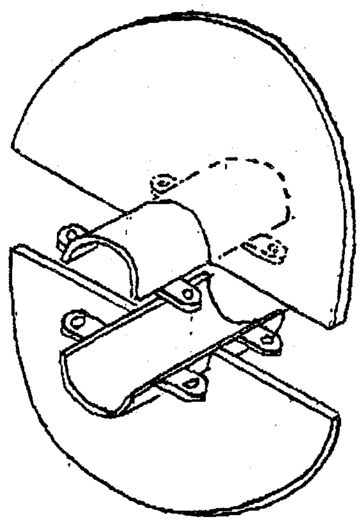


BD-6400-060.1 (07/93)

FROM RANDY JORISSEN

DUMMY PUMP

CONCEPT FOR ADDING REMOVABLE WEIGHTS



NOTE -

1.) CONCEPT SHOWN USES BOLTED CONNECTIONS
   - FRICTION REQUIRED TO HOLD WEIGHT ON SHAFT OF DUMMY PUMP
      - MUST BE SLIGHT GAP BETWEEN TUBE SECTIONS TO ALLOW FOR CLAMPING ACTION
      - LUGS MUST BE SIZED FOR HIGH BOLT TORQUE

2.) MAX. DIAMETER = 41 in.

3.) PLATE MUST BE CHECKED FOR BUCKLING/BENDING WHEN PUMP TRANSITIONS FROM VERTICAL TO HORIZONTAL POSITION

Advanced Engineering Consultants

6-20

RECORD OF

MEETING ☐
TELECON ☒

6.5.3

DATE: 6/2/94

WHC-SD-WM-DA-168
REV. 0
PAGE A- 130

AEC PARTICIPANTS: Mike C.S. Chiao MCM

OTHER PARTICIPANTS: Randy Jorissen (WHC)

PROJECT/SUBJECT: WHC Temporary Pump 2/Dummy Pump & Saddles
P.O. MJB-SWV-322666, Task 322666-002, AEC Job 4001-02

DISCUSSION NOTES:

Dummy Pump:

1. After Randy meets with Tom to discuss the subject matter tomorrow, he will then respond to AEC's previous request whether the dummy pump shown on Dwg. SK-2-24086, Rev. "0" reflects the as-built condition.

2. AEC is instructed to use the total length and limit a maximum cross sectional dimension of 36" as shown on Dwg. SK-2-24086 for designing and modifying the dummy pump.

3. Existing dummy pump weighs 19,435 lbs. per WHC calcs. on 11/28/92 by D.E. Ryman; new dummy pump after modifying will weigh 25,095 lbs. and the center of gravity to match that shown on 101SY load chart.

4. Randy did not object to AEC's proposal of increasing the new pump weights by filling the pipe sections with water.

Saddles:

WHC is still checking the canister rings for structural adequacy; however, he instructed AEC to go ahead to finalize the design AEC submitted earlier.

DISTRIBUTION: AEC/4001-02, LEM, SB, MCC, R. Jorissen (WHC)

Advanced Engineering Consultants

RECORD
MEETING
TELECON [X]

DATE: 6/3/94

AEC PARTICIPANTS: Lincoln Malik, Mike C.S. Chiao

OTHER PARTICIPANTS: Randy Jorissen (WHC)

PROJECT/SUBJECT: WHC Temporary Pump 2/Dummy Pump

DISCUSSION NOTES:

Dummy Pump:

1. Randy will provide AEC a dimension - distance between the pump end and pivot point as shown on 101SY load chart.

2. AEC will locate center of gravity from the left end of the dummy pump that will match the end location of the actual pump on the cradle when tested; see SK-2-24086, Rev. 0 for dummy pump orientation.

3. Randy will provide actual weight of the concrete-filled pipe segments of the dummy pump to AEC.

4. AEC will check structural integrity of the dummy pump that will be supported by series of 41" O.D. disks when the pump lays inside the canister; AEC will detail the disks.

5. WHC decided using concrete instead of water to fill in the pipes for adding weights to the pump.

DISTRIBUTION: AEC/4001-02, LEM, SB, MCC, R. Jorissen (WHC)

Advanced Engineering Consultants

RECO
MEETING
TELECON [X]

DATE: 5/26/94

AEC PARTICIPANTS: Mike C.S. Chiao

OTHER PARTICIPANTS: Randy Jorissen (WHC)

PROJECT/SUBJECT: WHC Temporary Pump 2/Lifting Beams, Saddles
P.O. MJB-SWV-322666, Task 322666-002, AEC Job 4001-02

DISCUSSION NOTES:

Lifting Beams: Randy received lifting beam sketches AEC faxed to him yesterday; agreed to single-plate (1-3/4" thick) extension to the underside of top flange of the beam; approved 12" clearance between the bottom of the beam and top of canister rings; AEC requested WHC to verify this dimension on the sketch.

Saddles: Randy asked how much of the container being supported in the AEC design; responded that the support is over a 1/4 circle.

Test Weights: Test weights include the weight of the holder; design two lifting lugs on the holder - one vertical, other horizontal; the center of the vertical lug is lined up with center of gravity of the holder itself, the horizontal lug is lined up with center of gravity of the holder plus all the weights. However, the vertical lug is still designed for full weights.

Dummy Pump: Randy will verify if the dummy pump shown on WHC sketch reflects as-built condition; WHC calcs. showed a conflicting dimension; use dimensions & load shown on 101SY load chart to check and modify the dummy pump.

DISTRIBUTION: AEC/4001-02, LEM, SB, MCC, R. Jorissen (WHC)

Advanced
Engineering
Consultants
180 Montgomery Street, Suite 850 San Francisco, CA 94104
Telephone: (415) 291-9600 Fax: (415) 291-9696

August 17, 1994

FAXED 8/17/94

Ms. Theresa Peterson
Westinghouse Hanford Company
P.O. Box 1970, H5-53
Richland, WA 99352

Subject: Hydrogen Mitigation in Tank SY101 - Dummy Pump Weights

Dear Ms. Peterson;

This letter is to confirm our telephone conversation earlier this afternoon. We understand that WHC wishes to replace the ⅜in 16 UNC2A x ¾in, A354 Grade BD Hex Cap Screws for the MPA Dummy Pump Removable Discs, shown in drawing H-2-834749, Sh. 1, with Same screws made of A307 Grade material. AEC finds this replacement to be acceptable for this case.

Please call me if you have any questions.

Very truly yours,

Lincoln E. Malik

Lincoln E. Malik
President

LEM:rm

Appendix B

Additional Analysis of Container Test Weight for Tank 241SY101

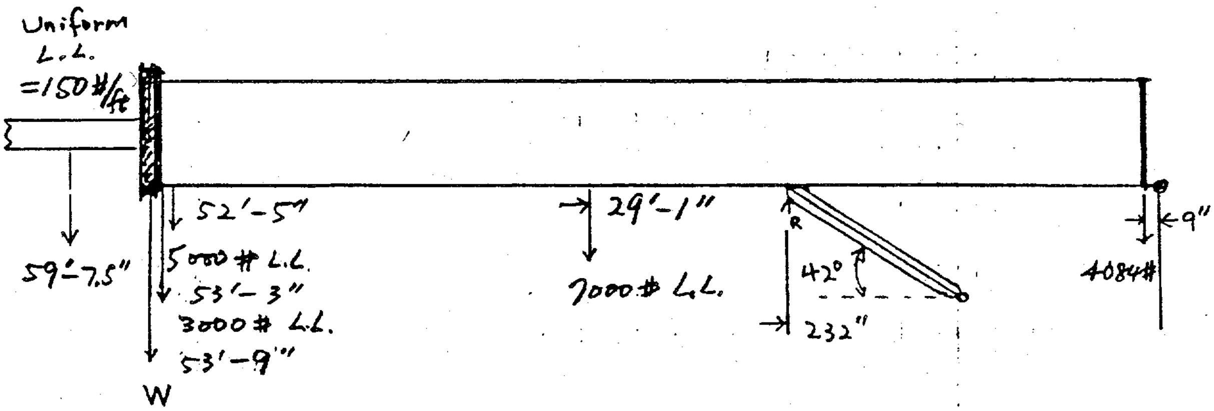
DESIGN CALCULATION

(1) Drawing H-2-83943, Rev. 0 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject Test weight for 101 SY container
(8) Originator FH Huang Date 7-7-94
(9) Checker B.M. Koe Date 7-11-94

(10)

WEIGHT OF TEST WEIGHT for 101 SY CONTAINER

* Uniform dead load = 92.8 lb/ft of CONTAINER
Uniform live load = 210 lb/ft of pump



purpose: Determine the weight of test weight assembly that simulate the pump. Also check the reactions of the hydraulic system.

Total wt. of pump (Live loads)

$$= 7000 + 5000 + 3000 + 210 \times 53.25 + 150 \times (12 \times 12 + 9)/12$$

$$= 28096 \text{ lb.}$$

calculate the weight of test weight assembly (W_t)

$$W_t\,(53 \times 12 + 9) = 210 \times 53.25 \times (53 \times 12 + 3)/2 + 7000 \times (29 \times 12 + 1) + 5000 \times (52 \times 12 + 5) + 3000 \times (53 \times 12 + 3) + 150 \times \frac{(12 \times 12 + 9)}{12} \times (59 \times 12 + 7.5)$$

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83743, Rev. 0 (2) Doc. No. ________
(4) Building ________ (5) Rev. ________
(7) Subject Test weight for 101 SY Container
(8) Originator FH Huang Date 7-11-94
(9) Checker B.M. K[illegible] Date 7-11-94

(10)

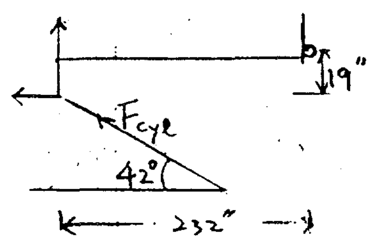
$$645 W_t = 3,495,929 + 2,443,000 + 3,145,000 + 1,917,000 + 1,368,394$$

$$W_t = \underline{19,296 \text{ lb.}}$$

Vertical Reaction at Jack joint

$$F_c(232 \sin 42° + 19.44 \cos 42°) = 19296 \times 645 + 1000 \times 53.25 \times \frac{(53 \times 12 + 3)}{2} + 4084 \times 9 + 30,000 \times 15 \times 12$$

$$= 34,896,060 \text{ lb-in}$$



$$F_c = \frac{34,896,060}{169.68}$$

$$\doteq 205.6 \text{ Kips}$$

1% within computer cals.

Use $F_{cye} = 203.6$ kips; $W_u = 928$ lb/ft to calculate the weight of Test Weight Assembly (W_T):

$$203614 \times 169.68 \doteq W_T \times 645 + 928 \times 53.25 \times 319.5 + 4084 \times 9 + 30,000 \times 15 \times 12$$

$$645 W_T = 13,324,055$$

$$W_T = \underline{20657} \text{ lb.}$$

Test weight increase is

$$20657 - 16770 = 3887 \text{ lb}$$

BD-6400-060.1 (12/87)

ANALYTICAL CALCULATIONS

Subject: H-2-83743, Rev. 0. Test Weight
Originator: F H Huang Date: 7-11-94
Checker: I. M. Koo Date: 7-11-94

Changes for test weight design:

(1) 6 filler plates (5'x 5'x 2")
→ 4 filler plates with a thickness of 3".

Total weight of new filler plates

$(5\times12)(5\times12)\,2\times0.284\times6+3887$

$=12268.8+3887=16156$ lb.

Weight of each new plate

$W=16156/4=4039$ lb.

The length of 5'x 3" plate

$=\dfrac{4039}{0.284\times3\times60}=79''$ or 6'-7".

Size of each new filler plate

6'-7" x 5' x 3"
Weight: 4039 lb

Hoist ring (part 23301, rate 4000 lb each)
4 rings on each plate, 2 each side O.K.

(2) or USE 8 filler plates of 5'x 5'x 2"

Total weight of Test Weight Assembly

$W_T=16770+60\times60\times2\times0.284\times2$

$=20{,}860$ lb.

Within 1% of 20657 lb. O.K.

BD-6400-060.1 (07/93)

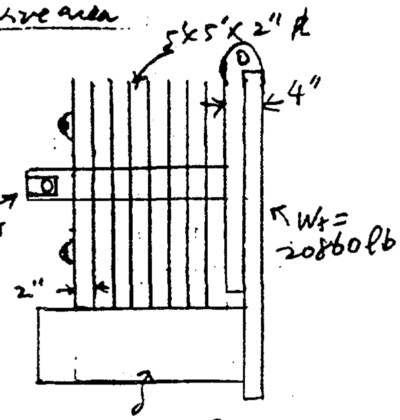
(1) Drawing H-2-83743, Rev0 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject Test weight for 101 SY Container
(8) Originator FH Huang Date 7-11-94.
(9) Checker JS Berg... Date 7/20/94

(10) Check W8x28 CANTILEVER BEAM

Design Criteria : Bending and tension stress = 12 ksi
weld : 7.2 ksi on effective area

Max Moment . (8 Filler plates of 5'x 5'x 2",
7 each weights 2045 lb, one 2175 lbs)

$M = 2045(5+7+9+11+13+15+17)$
$+ 2175(19)$
$= 198{,}790$ in-lb



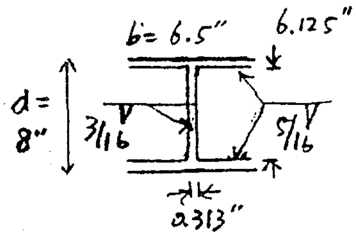
Bending stress :

$\sigma = \dfrac{198790}{2 \times 24.3} = 4090$ psi

With impact add 25% load

$\sigma = 4090 \times 1.25 = 5{,}113$ psi
$< 12{,}000$ psi OK

WELD STRENGTH , $b = 6.5''$; $d = 8''$



$S_w = 2bd + \dfrac{d^3}{3} = 125.33 \text{ in}^2$

$f_b = \dfrac{M}{S_w} = \dfrac{198790 \times 1.25}{2 \times 125.33}$

$= 991.3$ lb/in

$A_w = [4(6.5) - 2(0.313) + 2(6.125)]$

$= 37.624$ in

Shear

$V = (2045 \times 7 + 2175) \times 1.25/2$

$= 10306$ lb

$f_v = \dfrac{10306}{37.624} = 274$ lb/in

$f_r = \sqrt{991.3^2 + 274^2} = 1028.5$ lb/in

weld size $= \dfrac{1028.5}{7200} = 0.143$ in $< 3/16$ in O.K.

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83743, Rev. 0 (2) Doc. No. ________

(4) Building ________ (5) Rev. ________

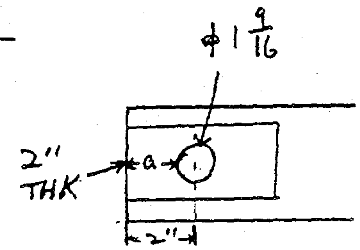
(7) Subject Test weight for 101 SY Container

(8) Originator EH Huang Date 7-12-94

(9) Checker [signature] Date 7/20/94

(10)

HORIZONTAL LIFTING LUG



Total weight of Test Weight $= 20860$ lb

Tearing strength

$a = 2 - (1\,{}^9\!/_{16})/2 = 1.219''$

$\text{Area} = at = 1.219 \times 2 = 2.438\ \text{in}^2$

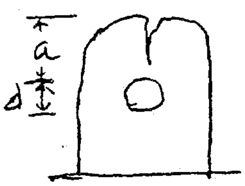
$$\sigma = \frac{20860}{2.438} = 8{,}558\ \text{psi} < 12{,}000\ \text{psi}$$

also check,

Allowable load for tear-out based on the Equation derived by D.T. Ricker, Eng. Journal of AISC

The allowable load is

$$P = \frac{1.67\, F_b\, t\, a^2}{d}$$



where

t is lug plate thickness

F_b allowable bending stress of lug

$F_b = 12$ ksi design criteria

d is hole diameter

a is edge distance

$$P = \frac{1.67(12000)(2)\left(2 - \frac{25}{16 \times 2}\right)^2}{25/16}$$

$= 38{,}100$ lb $> 20{,}860$ lb o.k.

tear-out allowable load is larger than the weight of Test Weight Assembly.

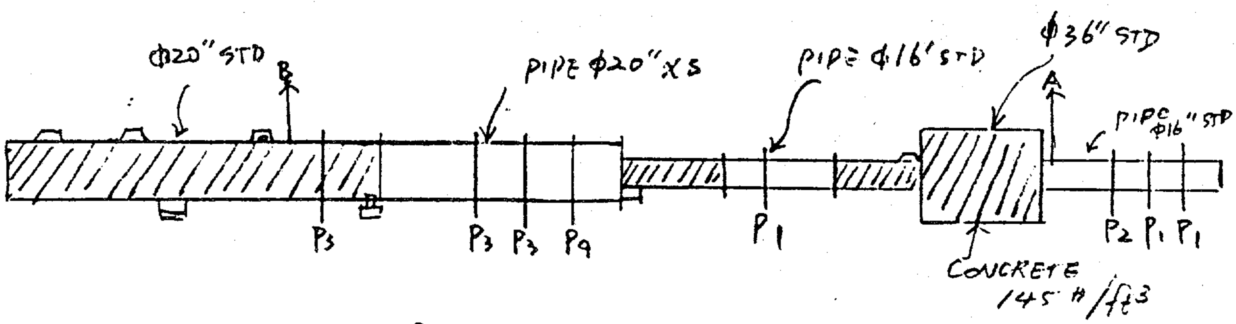
Appendix C

Additional Analysis of Mock-up Pump Modification for Tank 241SY101

(1) Drawing H-2-83749, Rev. 0 (2) Doc. No. ______
(4) Building SK-2-240886, Rev 0 (5) Rev. ______ (6. ______
(7) Subject SY101 Mock up pump Assembly
(8) Originator FH Hsieng Date 7-19-94
(9) Checker J. V. Egger Date 7/22/94

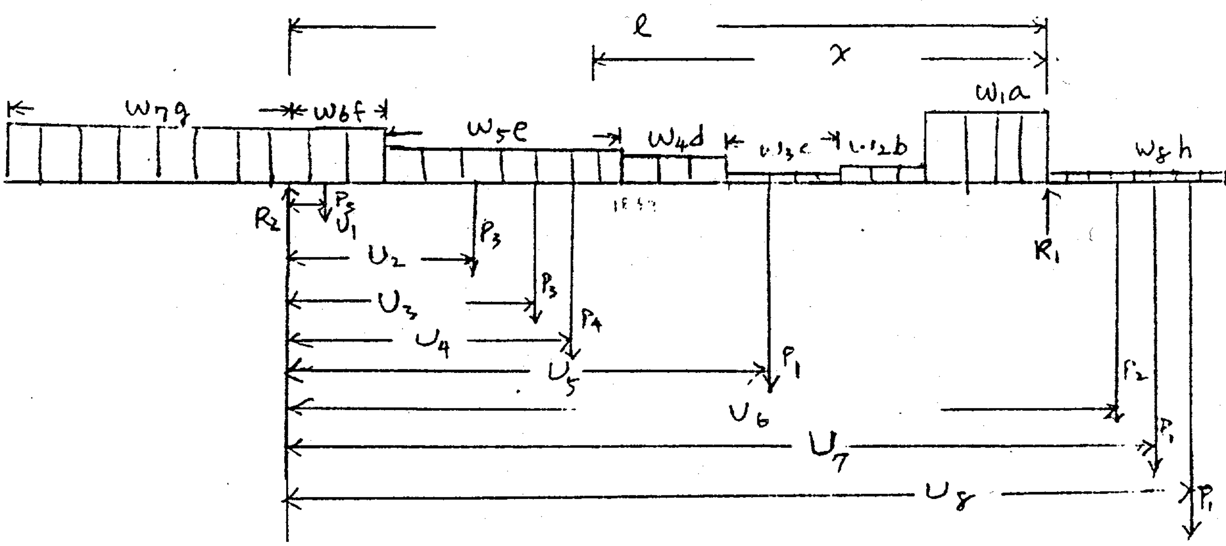
(10)

BENDING OF MOCK-UP pump



WEIGHT for PIPES
Φ36": 142.68 #/ft STD
Φ20": 78.64/ft STD; 104.13 #/ft XS
Φ16": 62.58 # STD from CRANE, CO

REACTIONS + MOMENTS FROM UNIFORM + POINT LOADS
(W's) (P's)



BD-6400-060 1 (12/87)

(1) Drawing H-2-83749, Rev. 0 (2) Doc. No. ____________

(4) Building ____________ (5) Rev. ____________

(7) Subject SY 101 Mockup pump Assembly

(8) Originator FH Huang Date 7-19-94

(9) Checker J. V. Egger Date 7/22/94

(10)

Section length and weight

$a = 5.667'$

$w_1 = [142.68 \times 5.667 + \frac{\pi}{4}(3)^2(5.667)145]/5.667$

$= 6617/5.667 = 1167.6$ #/ft

$b = 3.667'$

Wt of Bumper plate

$= [(4.625+24)\,9.75/2 \times \frac{1}{2} + 6 \times 6 \times 3/4 \times 2$

$+ \frac{\pi(4)^2}{4} \times 4 + \frac{2}{2}(1.25)(6+6+5.875)] \times 0.284$

$= 55.8$ #

$W_2 = [62.58 \times 3.667 + \frac{\pi}{4}(1.333)^2(3.667)145 +$

$55.8 + 106]/3.667$

$= 1133.3/3.667$

$= 309.05$ #/ft

* Flange wt:
106 # for 150 # Slip on.
Ladish Catalog 55.

$c = 4.958'$

Two Flanges wt $= (106)(2) = 212$ #

$W_3 = (62.58 \times 4.958 + 212)/4.958$

$= 522.27/4.958 = 105.34$ #/ft

$d = 4.333'$; Two Flanges: 106 # + 185 #

Saddle wt $= 1.833 \times 28.57 \times 2$

$= 105$ #

$W_4 = (62.58 \times 4.333 + \frac{\pi}{3}(1.333)^2(4.333) \times 145 +$

$106 + 185 + 105)/4.333$

$= 1544/4.333 = 356.3$ #/ft

(1) Drawing H-2-83749, Rev. 0 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject SY101 Mock up pump Assembly
(8) Originator FH Huang Date 7-19-94
(9) Checker J. Y. Eggen Date 7/22/94

(10)

$e = 10.833'$

Two Flange wt = 296#

$W_5 = (104.13 \times 10.833 + 296)/10.883$

$= 1424/10.833 = 131.5\ \#/ft$

Locate Lifting point at 4'-9" From ϕ20" STD Joint with ϕ20" XS pipe

$f = 4.75'$ filled with concrete, ϕ20" STD pipe

one Flange wt = 148#

Saddle wt = 105#

$W_6 = \{[78.6 + \frac{\pi}{4}(\frac{20}{12})^2 \times 145] \times 4.75 + 148 + 105\}/4.75$

$= 2129/4.75 = 448.2\ \#/ft$

Length of ϕ20" STD pipe Field Measured as 18'-9",

$g = 14'$ filled with concrete

Saddle wt $28.7 \times \frac{22}{12} \times 1.05 = 55\#$ add 5%

Bumper plate: $(10+18)(5\frac{5}{16}) \times \frac{1}{2} \times \frac{1}{2} \times 2$

$\times 0.284 \times 1.05 = 22\#$

$W_7 = \{[78.6 + \frac{\pi}{4}(\frac{20}{12})^2 \times 145] \times 14 + 55 + 22\}/14$

$= 5606.2/14 = 400.5\ \#/ft$

$h = 14.167'$, one flange: 106#; 3/8" plate: 21#

$W_8 = (62.58 \times 14.167 + 106 + 21)/14.167 = 71.58\ \#/ft$

Calculate R_1 at A

$$R_1 l = W_1 a(2l-a)/2 + W_2 b[2(l-a)-b]/2 + W_3 c[2(l-a-b)-c]/2$$
$$+ W_4 d[2(l-a-b-c)-d]/2 + W_5 e[2(e+f)-e]/2 + W_6 f^2/2$$
$$- W_7 g^2/2 + W_8 h(l+h+l)/2 + P_3(U_1+U_2+U_3)$$
$$+ P_4 U_4 + P_2 U_6 + P_1(U_5+U_7+U_8)$$

BD-6400-060 1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83749, Rev 0 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject SY101 Mockup pump assembly
(8) Originator FH Huang Date 7-19-94
(9) Checker J. Y. Eggen Date 7-22-94

(10)

where

$\ell = a+b+c+d+e+f = 34.21'$

disk weight

$\phi 16''$, $1/2''$ thick

$P_1 = \{\pi(20.5^2 - 8^2)\frac{1}{2} - 4 \times 12.5 \times 2 \times \frac{1}{2} +$
$\frac{1}{2} \times 8 \times 8 \times 4 + \frac{1}{2} \times 4 \times 8 \times 2 + \frac{\pi}{4}(16^2 - 15.25^2) \times 10\}$
$\times 0.284 = 242.5\#$

$\phi 16''$, $2''$ thick

$P_2 = \{\pi(20.5^2 - 8^2) \times 2 - 5 \times 12.5 \times 2 \times 2 +$
$1 \times 8 \times 8 \times 4 + 1 \times 4 \times 8 \times 2 +$
$\frac{\pi}{4}(16^2 - 14.75^2) \times 10\} \times 0.284 = 741.3\#$

$\phi 20''$, $\frac{1}{2}''$ thick

$P_3 = \{\pi(20.5^2 - 10^2)\frac{1}{2} - 10.5 \times 4 \times \frac{1}{2} \times 2 +$
$\frac{1}{2} \times 8 \times 8 \times 4 + \frac{1}{2} \times 4 \times 8 \times 2 +$
$\frac{\pi}{4}(20^2 - 19.25^2) \times 10\} \times 0.284 = 242\#$

$\phi 20''$, $2''$ thick

$P_4 = \{\pi(20.5^2 - 10^2)2 - 10.5 \times 5 \times 2 \times 2 +$
$1 \times 8 \times 8 \times 4 + 1 \times 4 \times 8 \times 2 + \frac{\pi}{4}(20^2 - 18.75^2) \times 10\}$
$\times 0.284 = 710.8\#$

(1) Drawing H-2-83749, Rev. 0 (2) Doc. No. ______________
(4) Building ______________ (5) Rev. ______________ (6, ...
(7) Subject SY 101 Mockup pump Assembly
(8) Originator EH Huang Date 7-19-94
(9) Checker J.D. [illegible] Date 7/25/94

(10)

point load distances

$U_1 = 2'$; $U_2 = 7.5'$; $U_3 = 10'$; $U_4 = 11.875'$

$U_5 = 22$; $U_6 = 42$; $U_7 = 42.875'$; $U_8 = 47.375'$

$$R_1(34.21) = 661.7(2\times 34.21 - 5.667)/2 + 1133.3[2(34.21-5.667) - 3.667]/2 + 522.27[2(34.21-5.667-3.667) - 4.958]/2 + 1544[2(34.21-5.667-3.667-4.958) - 4.333]/2 + 1424[2(10.833+4.75) - 10.83]/2 + 448.2(4.75)^2/2 - 400.5(14)^2/2 + 71.58\times 14.167(34.21\times 2 + 14.167)/2 + 242(2+7.5+10) + 710.8(11.875) + 741.3\times 42 + 242.5(42.875+47.375+22)$$

$$= 207{,}618.3 + 30269.9 + 11697.3 + 27{,}408.3 + 14477 + 5056.3 - 39249 + 41875 + 72231$$

$$R_1 = \frac{37140}{34.21} = 10856\ \#$$

Total weight of Mockup Pump

$$= 661.7 + 1133.3 + 522.27 + 1544 + 1424 + 2129 + 5606.2 + 71.58\times 14.167 + 242\times 3 + 710.8 + 741.3 + 242.5\times 3$$

$$= 22895\ \#$$

$$R_2 = 22895 - 10856 = 12039\ \#$$

DESIGN CALCULATION

(1) Drawing H-2-83749, Rev. 0 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) Job ______
(7) Subject SY101 Mock up pump Assembly
(8) Originator E H Huang Date 7-21-94
(9) Checker [illegible] Date 7/25/94

(10)

Determine the maxium moment, assuming X is in the section "d".

$$M_x = R_1 x - w_1 a(2x-a)/2 - w_2 b[2(x-a)-b]/2 - w_3 c[2(x-a-b)-c]/2 - w_4 (x-a-b-c)^2/2 - P_2(42-34.21+x) - P_1[(47.37-34.21+x) + (42.875-34.21+x) + (x-(34.21-22))]$$

$$\frac{\partial M_x}{\partial x} = 0 \Rightarrow$$

$$x = [R_1 - w_1 a - w_2 b - w_3 c + w_4(a+b+c) - P_2 - 3P_1]/w_4$$

$$= \{10856 - 6617 - 1133.3 - 522.3 + 356.3(5.667+3.667+4.958) - 741.3 - 727.5\}/356.3$$

$$= 17.42'$$

Max Moment at $x = 17.42'$ in Sect. d

$$M_{max} = 10856(17.42) - 6617(2\times 17.42 - 5.667)/2 - 1133.3[2(17.42-5.667)-3.667)]/2 - 522.3[2(17.42-5.667-3.667)-4.958]/2 - 356.3(17.42-5.667-3.667-4.958)^2/2 - 741.3(42-34.21+17.42) - 242.5[(47.37-34.21+17.42) + (42.875-34.21+17.42) + (17.42-(34.21-22))]$$

(1) Drawing H-2-83749, Rev. 0 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

(7) Subject SY101 Mock up pump Assembly

(8) Originator FH Huang Date 7-21-94

(9) Checker J.V. Elgin Date 7/25/94

(10)

$$M_{max} = 189111.5 - 96518.9 - 11241.8 - 2928.5 - 1743.1 - 18688.2 - 15004.7$$

$$= 42986 \text{ ft-lb}$$

$S = 70.3 \text{ in}^3$ for $\phi 16''$ STD pipe

Bending stress

$$\sigma_b = \frac{42986 \times 12}{70.3}$$

$$= 7337 \text{ psi}$$

With impact

$$M = 42986 \times 1.25 = 53,732 \text{ ft-lb}$$

$$\sigma_b = \frac{53732 \times 12}{70.3}$$

$$= 9,172 \text{ psi} < 12,000 \text{ psi} \quad \text{O.K.}$$

BD-6400-060.1 (12/87)

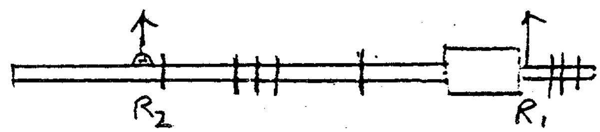
(1) Drawing H-2-83749, Rev. 2 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6)
(7) Subject Lifting Lug for Mock up pump
(8) Originator F.H. Zhang Date 7-21-94
(9) Checker J.V. Egger Date 7/21/94

(10)

Lifting Lug For mock up pump used in two load cases:

Load case 1:

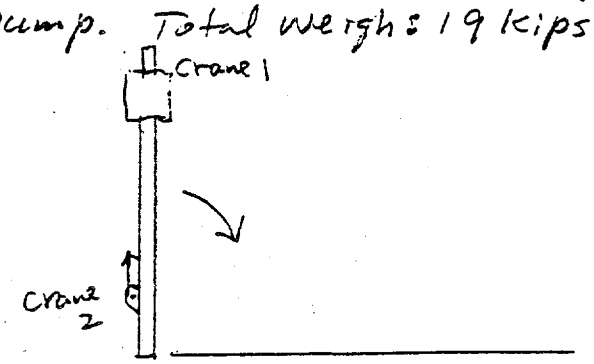
Eight disks of test weight are attached to the mock up pump. The assembly is lifted horizontally for load testing cradle.



Total weight is about 23 kips; reaction $R_2 \sim 13$ kips

Load case 2:

The mock up pump is in the vertical position for container and bag system testing. One crane hold the upper lug, the 2nd crane lift the pump through the lower lug. The Test Weight Disks are taken off from the pump. Total weigh: 19 kips



BD-6400-060.1 (12/87)

(1) Drawing H-2-83749, Rev. 2 (2) Doc. No. ____________

(4) Building ____________ (5) Rev. ____________

(7) Subject Lifting Lug for Mock-up Pump

(8) Originator FH Huang Date 7-21-94

(9) Checker J. V Eager Date 7/21/94

(10) Load Case 1:

Horizontal Lift:

$P = 13{,}000$ lb.

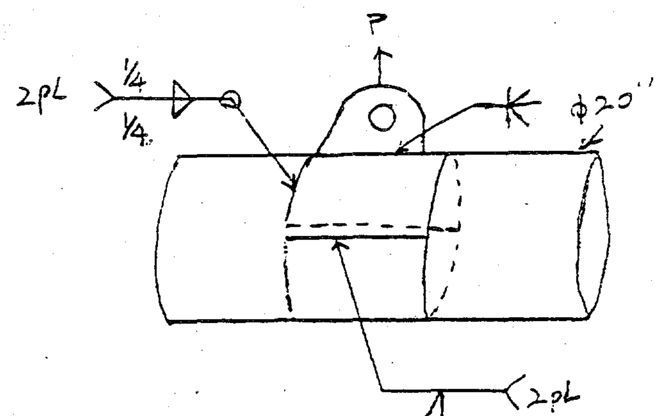
with a S.F of 1.25

$P = 13{,}000 \times 1.25$

$= 16.3$ kips

~~Assume~~

$P = 17$ kips



Tension tear-out strength.

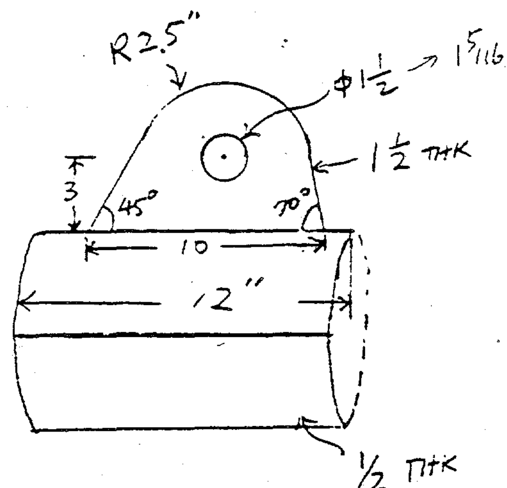
$A = t\,a = 1.5(2.5 - \frac{1.5}{2})$

$= 2.625\ in^2$

$\sigma_t = \frac{17}{2.625}$

$= 6.5$ ksi < 12 ksi

o.K.



The allowable load based on DT Rickersey.

$$P = \frac{1.67(12)(1.5)(2.5 - 1.5/2)^2}{1.5}$$

$= 61$ kips > 17 kips ok.

BD-6400-060.1 (12/87)

(1) Drawing H-2-83749, Rev. 0 (2) Doc. No. ____________
(4) Building ____________ (5) Rev. ____________ (6 ____________
(7) Subject Lifting Lug for Mock up pump
(8) Originator F.H. Huang Date 7-21-94
(9) Checker J. V. Elsen Date 7/21/94

(10)

Check weld strength

* Lug lifts 17,000 lb;
  design criteria: 7200 psi

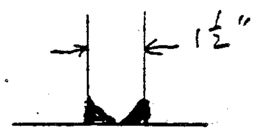
(1) Weld at the root of the lug

minimum weld size:

$$t = \frac{17{,}000}{10 \times 2 \times 7200}$$

$$= 0.12'' < 0.75''$$

ok.



Full penetration

(2) Weld at the ends of the sleeve

$$t = \frac{17{,}000}{20\pi \times 2 \times 7200}$$

$$= 0.019'' < 1/4''$$

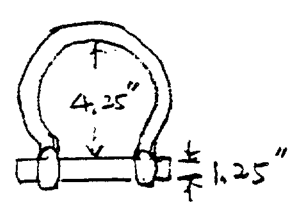
OK

(3) Weld at the joints of the two half cylinders.

$$t = \frac{17{,}000}{2 \times 12 \times 7200} = 0.10'' < 1/2''$$

OK

* use Crosby Forged Shackle 9 1/2 ton



BD-6400-060.1 (12/87)

(1) Drawing H-2-83749, Rev.0 (2) Doc. No. ____________

(4) Building ____________ (5) Rev. ____________

(7) Subject Lifting Lug for Mock up pump

(8) Originator E/L Huang Date 7-21-94

(9) Checker J.V. Eager Date 7/21/94

(10)

Load case 2:

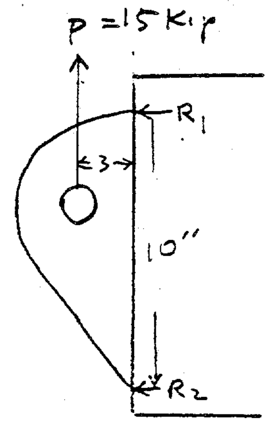
Vertical Lifting

Assume the lower lug carries one half of the total weight:

$P = \frac{23}{2} = 11.5$ kips

with impact

$P = 11.5 \times 1.25 \sim 15$ kips



Bending stress:

Moment

$M = 15 \times 3 = 45$ kip-in

$S = (1.5 \times 10^2)/6 = 25\ in^3$

$\sigma_b = \frac{45}{25} = 1.8$ ksi < 12 ksi O.K.

Compressive stress on concrete inside pipe

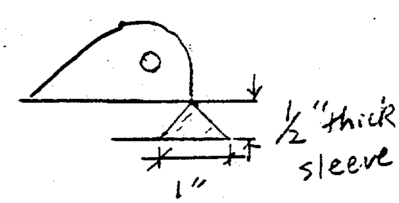
Reaction

$R_1 = \frac{15 \times 3}{10} = 4.5$ Kip

Compression area

$A = (\frac{1}{2} + \frac{1}{2})(1\frac{1}{2} + \frac{1}{2} + \frac{1}{2})$

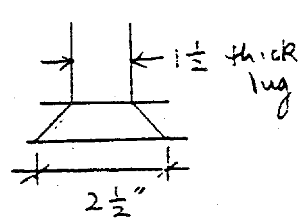
$= 2.5\ in^2$



$\sigma_c = \frac{4.5}{2.5} = 1800$ psi

< 2000 psi for Concrete

O.K.



BD-6400-060.1 (12/87)

Appendix D

Analysis of Removable Support for the Transport Assembly

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator J. V. EGGER Date 11/30/94
(9) Checker James A Tuck Date 5 DEC. 94

(10) OBJECTIVE

DESIGN TEMPORARY SUPPORT FOR CONTAINER ON 101SY TRAILER. SUPPORT WILL ELEVATE THE OPEN END OF THE CONTAINER DURING REMOVEAL OF THE TOP END OF THE 101SY PUMP. CONTAINER IS BEING ELEVATED TO PREVENT FLUIDS, WHICH MAY DRAIN THE PUMP, FROM DRAINING FROM THE CONTAINER

REFERENCES

1. MANUAL OF STEEL CONSTRUCTION ALLOWABLE STRESS DESIGN NINTH EDITION. (AISC)
2 MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES (ANSI/ASCE ~~7~~-88)

BD-6400-060.1 (12.87)

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No. ______

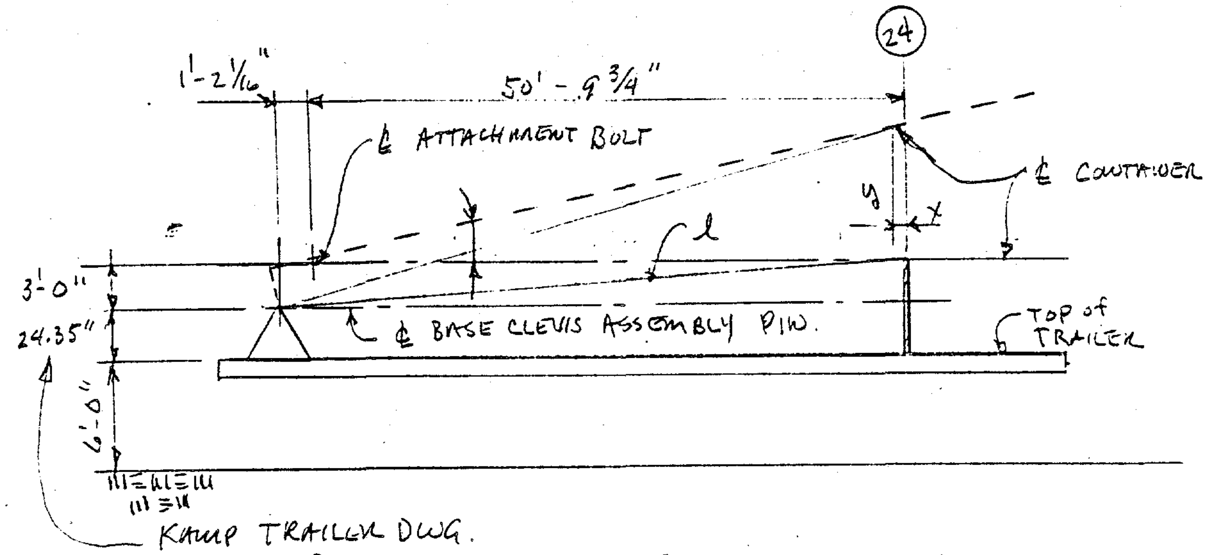
(4) Building ______ (5) Rev. ______

(7) Subject TRANSPORT ASSEMBLY REMOVABLE SUPPORT

(8) Originator J.V. EGGER Date 9/28/94

(9) Checker James A Tuck Date 5 Dec. 94

(10)



REF. DWG. H-2-83736 STRONGBACK

H-2-83734 CONTAINER

$$l = \sqrt{(623.813)^2 + 36^2} = 624.85 \text{ IN}$$

$$\tan^{-1}\left(36/623.813\right) = 3.303^\circ$$

MAXIMUM GRADE OF ROAD - 4%

MINIMUM SLOPE TO PREVENT DRAINAGE - 1/4" / FT

SLOPE ℄ OF CONTAINER $\frac{4}{100} + \frac{1/4}{12} = 0.06083$

$$\frac{36}{623.813} + 0.06083 = 0.119$$

(1) Drawing H-2-83755 (2) Doc. No.
(4) Building (5) Rev.
(7) Subject TRANSPORT ASSEMBLY REMOVABLE SUPPORT
(8) Originator J. V. EIGER Date 9/28/94
(9) Checker James A Tuck Date 6 Dec. 94

(10)

ROTATION of ℄ OF CONTAINER @ COL. LINE 24 AROUND ASSEMBLY PIN.

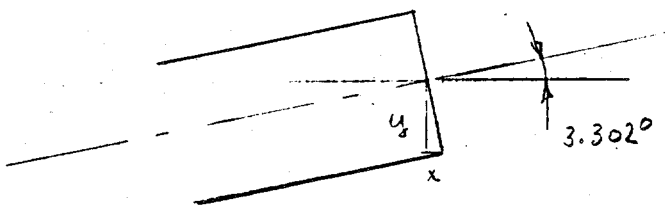
$$\tan^{-1}(0.119) = 6.76^\circ$$

Vertical offset of ℄ OF CONTAINER

$$y = 623.813 \tan(6.76^\circ) - 36 = 37.95''$$

HORIZONTAL offset of ℄ OF CONTAINER

$$y = 624.85(\cos 6.76^\circ) - 623.813 = -3.307''$$



ROTATION OF CONTAINER RING @ COL. LINE 24
5'- 11 5/8" DIA OF CONTAINER RING

$$y = 35.8125(\cos 3.302^\circ) = 35.753''$$

$$x = 35.8125(\sin 3.302^\circ) = 2.062''$$

LOCATION OF SUPPORT POINT FROM TOP OF TRAILER

$$\text{VERTICAL} = 24.35 + 36 + 37.95 - 35.753$$
$$= 62.547''$$
$$\text{HORIZONTAL} = -3.307 + 2.062$$
$$= -1.245''$$

BD-6400-060.1 (12/87)

DESIGN CALCULATION

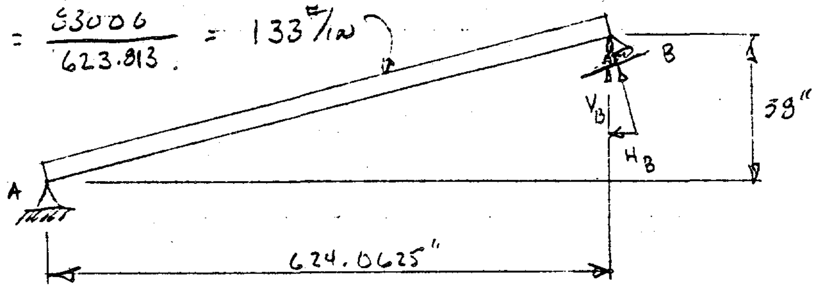
(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) J
(7) Subject TRANSPORT ASSEMBLY REMOVABLE SUPPORT
(8) Originator J. V. EGGER Date 9/28/94
(9) Checker James A Tuck Date 5 Dec. '94

(10)

WEIGHT OF CONTAINER AND PUMP 66400#

ASSUME 25% INCREASE FOR IMPACT W = 83,000#

$$w = \frac{83006}{623.813} = 133^{\#}/in$$



$$\Sigma V = V_A + V_B - 83000^{\#}$$

$$\Sigma H = H_A + H_B = 0$$

$$\Sigma M_A = V_B(623.813) + H_B(38) - 83000\left(\frac{623.813}{2}\right) = 0$$

ASSUME REACTION AT B IS NORMAL TO ℄ OF CONTAINER

$$\frac{H_B}{V_B} = \frac{38}{623.813}$$

$$H_B = \frac{38}{623.813} V_B$$

$$V_B(623.813) + \left(\frac{38}{623.813} V_B\right)(38) = 83000\left(\frac{623.813}{2}\right) = 0$$

$$V_B = \frac{83000\left(\frac{623.813}{2}\right)}{623.813 + \frac{38^2}{623.813}}$$

$$= 41347^{\#}$$

$$H_B = \frac{38}{623.813}(41347) = 2518^{\#}$$

(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject TRANSPORT ASSEMBLY REMOVABLE SUPPORT
(8) Originator J. V. EGGER Date 9/16/94
(9) Checker James A Tuck Date 5 Dec. 94

(10) WIND LOAD. (ANSI/ASCE 7-88)

$$q_z = 0.00256\ K_z\ (I\ V)^2$$

$V = 70\ {}^{MI}/_{HR}.$

$I = 1.07$ CATEGORY III

$K_z = 0.87$ EXPOSURE C $z = 20$ FT

$$q_z = 0.00256\ (0.87)\left[(1.07)(70)\right]^2$$

$$= 12.5\ \#/FT^2$$

$$F = q_z\ G_z\ C_f\ A_f$$

$G_z = 1.29$ TABLE 8 $z = 20$ FT

$M = 11$ FT $N = 11$ FT

$$M/N = \frac{11}{11} = 1.00 \leq 6$$

$C_f = 1.2$

$$F/A_f = 12.5(1.29)(1.2) = 19.35\ \#/FT^2$$

$$F = 19.35\ (11)(11) = 2341.35\ \#$$

DESIGN CALCULATION

(1) Drawing H-2-93755 (2) Doc. No.
(4) Building (5) Rev. (6.
(7) Subject TRANSPORT ASSEMBLY REMOVABLE SUPPORT
(8) Originator J. V. EGGER Date 9/23/94
(9) Checker James A Tuck Date 5 Dec 94

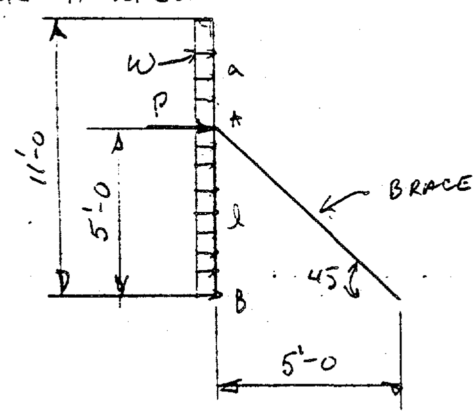
(10)

REQ'D BEARING AREA ON SHIELDING PLATE

$$A = \frac{P}{F_b} = \frac{\sqrt{41347^2 + 2518^2}}{12{,}000 \ \#/\text{IN}^2}$$

$$= 3.45 \ \text{IN}^2$$

CHECK HORIZONTAL BRACE.



$P = 4150\#$
$W = 19.35(11)$
$= 212.85 \ \#/\text{FT}$

REACTION AT A DUE TO W

$$R_A = \frac{w}{2\ell}(\ell + a)^2 \quad (\text{AISC pg. 2-304})$$

$$R_A = \frac{212.85}{2(5)}(5+6)^2$$

$$= 2575.5 \ \#$$

TOTAL AXIAL LOAD IN BRACE

$$P = \frac{(2575.5 + 2518)}{\cos 45°} = 7203 \ \#$$

BD-6400-060.1 (12/87)

(1) Drawing H-2-93755 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT

(8) Originator L. V. EGGER Date 9/29/94

(9) Checker VA Tuck Date 5 Dec. 94

(10)

CHECK L 3×3× 5/16"

$A = 1.78\ \mathrm{in}^2 \qquad r_z = 0.589\ \mathrm{in}$

$$\frac{Kl}{r} = \frac{(1)(5/\cos 45)(12)}{0.589} = 144$$

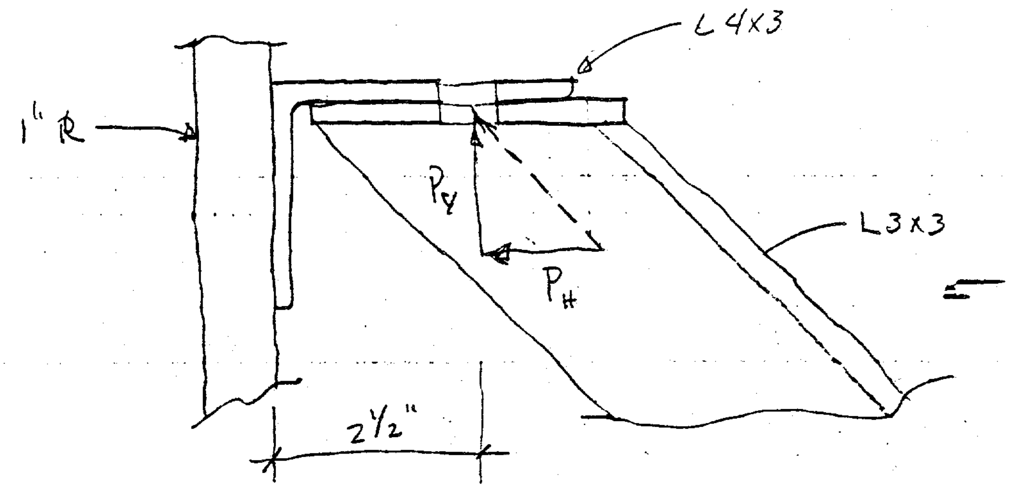
FOR A36 STEEL $F_y = 36$ (AISC E.2)

$C_c = 126.1$ (AISC pg 5-120)

$F_A = 7.2\ \mathrm{K/in}^2$ (AISC pg 5-122)

$$f_a = \frac{7203}{1.78} = 4047\ \#/\mathrm{in}^2 \le 7200\ \#/\mathrm{in}^2\ \mathrm{OK}$$

BOLT SIZE REQUIRED



$P_H = P_Y = 2575.5 + 2518 = 5094$

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator J. V. EGGER Date 9/29/94
(9) Checker James A Tuck Date 5 Dec. 94

(10)

CHECK 3/4" A325 BOLT $A = 0.4418 \text{ in}^2$

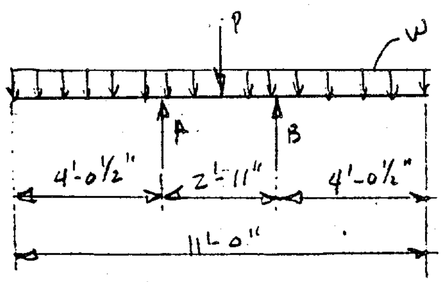
$$f_V = \frac{5.094}{0.4418} = 11.53 \text{ K/in}^2$$

$$F_T = \sqrt{(44)^2 - 4.39(11.53)^2}$$

$$= 36.78 \text{ K/in}^2$$

$$f_t = \frac{5.094}{0.4418} = 11.53 \text{ K/in}^2 < 30.36 \text{ K/in}^2 \text{ OK}$$

CHECK BENDING STRESS IN $L\, 4 \times 3 \times 5/16$



$w = \frac{2576}{11}$

$= 234.2 \text{ \#/FT}$

$P = 2518 \text{ \#}$

$$R_A = R_B = \frac{2518}{2} + \frac{234.2(11)}{2} = 2547 \text{ \#}$$

$$M_A = \frac{(234.2/12)(48.5)^2}{2} = 22{,}954 \text{ \#-IN}$$

MOMENT AT LOAD P

$$M = (234.2/12)\frac{(66)^2}{2} - 2547(17.5) = -2065 \text{ \#-IN}$$

SECTION PROPERTIES $L\, 4 \times 3 \times 5/16$ $A = 2.09 \text{ in}^2$

$I_x = 3.38 \text{ in}^4$ $\bar{y} = 1.26 \text{ in}$

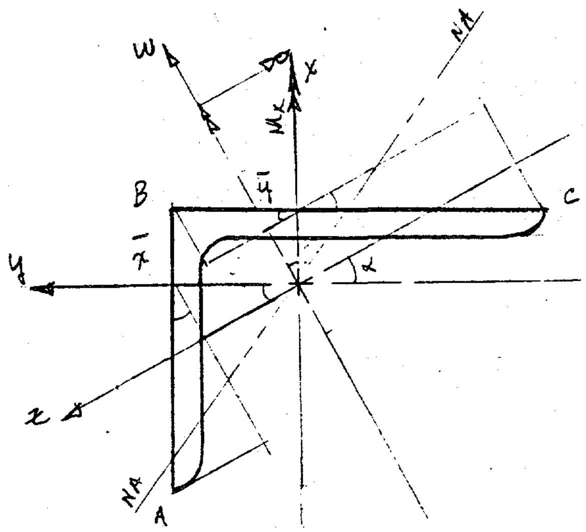
$I_y = 1.65 \text{ in}^4$ $\bar{x} = 0.759 \text{ in}$

$r_z = 0.647 \text{ in}$ $\tan\alpha = 0.554$

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator J.V EGGER Date 9/28/94
(9) Checker James A Tuck Date 5 Dec. 94

(10)



$\alpha = \tan^{-1}(0.554)$
$= 28.987°$

$I_z = Ar^2 = 2.09(0.647)^2 = 0.875 \text{ in}^4$

$I_w = I_x + I_y - I_z = 3.38 + 1.65 - 0.875 = 4.16 \text{ in}^4$

$z_A = (3 - \bar{x}) \sin\alpha + \bar{y} \cos\alpha$
$= (3 - 0.759)(\sin 28.987) + 1.26 (\cos 28.987)$
$= 2.188 \text{ in}$

$w_A = (3 - \bar{x}) \cos\alpha - 1.26 \sin\alpha$
$= 1.350 \text{ in}$

$z_B = \bar{y} \cos\alpha - \bar{x} \sin\alpha$
$= 0.734 \text{ in}$

$w_B = \bar{y} \sin\alpha + \bar{x} \cos\alpha$
$= 1.275 \text{ in}$

$z_C = (4 - \bar{y}) \cos\alpha + \bar{x} \sin\alpha$
$= 2.765$

$w_C = (4 - \bar{y}) \sin\alpha - \bar{x} \cos\alpha$
$= 0.664 \text{ in}$

(1) Drawing H-2-83755 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

(7) Subject TRANSPORT ASSEMBLY REMOVABLE SUPPORT

(8) Originator J.V. ELGER Date 9/29/94

(9) Checker [signature] Date 5 Dec. 94

(10)

$$M_w = 22954 \cos\alpha$$
$$= 20080 \text{ \#-in}$$
$$M_z = 22954 \sin\alpha$$
$$= 11120 \text{ \#-in}$$

STRESS AT A

$$f_{bA} = \frac{20080(2.133)}{4.16} - \frac{11120(1.35)}{0.875}$$
$$= -6595 \text{ \#/in}^2$$

STRESS AT B

$$f_{bB} = \frac{20080(0.734)}{4.16} + \frac{11120(1.275)}{0.875}$$
$$= 19{,}750 \text{ \#/in}^2$$

$$f_{bC} = \frac{-20080(2.765)}{4.16} - \frac{11120(0.664)}{0.875}$$
$$= -21780 \text{ \#/in}^2$$

$$b/t = 4/(5/16) = 12.8 \qquad 76/\sqrt{F_y} = 12.7$$

$$b/t \nless 76/\sqrt{F_y} \quad \text{(AISC TABLE B5.1)}$$

OK LESS THAN 1% $\left(\frac{12.8}{12.7} = 1.008\right)$

LATERALLY UNBRACED LENGTH 48.5"

$$l_b < \frac{76\, b_f}{\sqrt{F_y}} \quad \text{(AISC F1.2)}$$

$$48.5 < 50.7 \quad \text{OK} \quad F_b = 0.6F_y = 21.6\ \text{k/in} \ \text{OK.}$$

(1) Drawing H-2-83755 (2) Doc. No. ____
(4) Building ____ (5) Rev. ____
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator J.V. EGGER Date 9/20/94
(9) Checker James A Tucker Date 5 Dec. 94

(10)

CHECK BENDING STRESS IN 4" LEG OF L 4x3x5/16

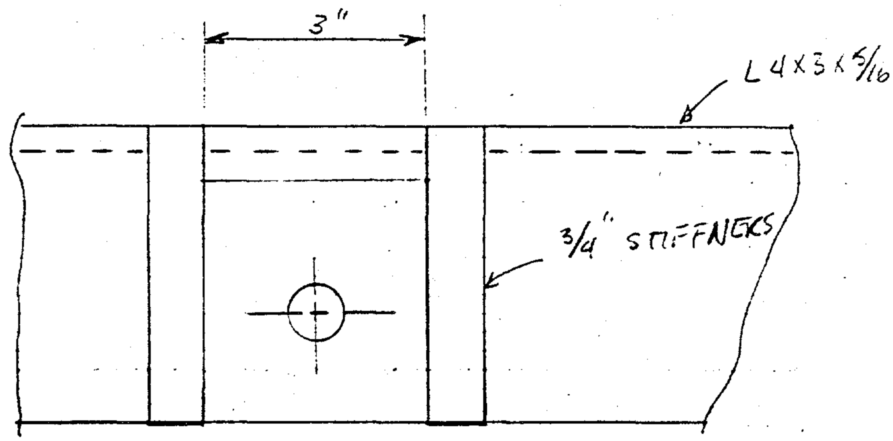
$$M = 6726(2.5 - 3/4) = 11770 \ \#\text{-in}$$

ASSUME 5" WIDTH OF LEG.

$$S = \frac{bd^2}{6} = \frac{5(5/16)^2}{6} = 0.0814 \ \text{in}^3$$

$$f_b = \frac{11770}{0.0814} = 144635 \ \#/\text{in}^2 \quad \text{N.G.}$$

ADD STIFFENERS ON EA. SIDE OF BOLT.



ASSUME UNIFORM LOAD ON PLATE WITH 3 EDGES FIXED AND 1 EDGE FREE (ROARK TABLE 26 CASE 10a, pg. 469)

$$q = \frac{6726}{(3)(4)} = 560 \ \#/\text{in}^2$$

$a = 3 \quad b = 4 \quad . \quad a/b = 0.75$

MAXIMUM STRESS $\beta_3 = 0.286$

$$\sigma = \frac{\beta_3 q b^2}{t^2} = \frac{0.286(560)(4)^2}{(5/16)^2} = 26240 \ \#/\text{in}^2$$

$F_b = 0.75 F_y \qquad F_b = 27{,}000 \ \#/\text{in}^2$ (AISC F2.1)

BD-6400-060.1 (12.87)

(1) Drawing H-2-93755 (2) Doc. No. ______

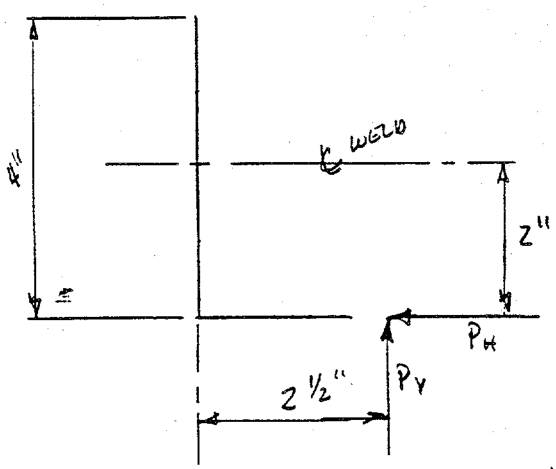
(4) Building ______ (5) Rev. ______

(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT

(8) Originator J. V. EGGEN Date 10/13/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10) DETERMINE SIZE OF WELD ON STIFFENER.



$$P_V = P_H = \frac{6726}{4} = 1682^{\#}$$

$$A_w = 4 \text{ IN}$$

$$S_w = \frac{d^2}{6} = \frac{4^2}{6} = 2.67 \text{ IN}^2$$

$$f_H = \frac{P_H}{4} + \frac{P_H(2)}{S_w} + \frac{P_V(2.5)}{S_w}$$

$$= \frac{1682}{4} + \frac{1682(2)}{2.67} + \frac{1682(2.5)}{2.67}$$

$$= 3255^{\#}/\text{IN}$$

$$f_V = \frac{P_V}{4} = \frac{1682}{4} = 421^{\#}/\text{IN}$$

$$f_w = \sqrt{3255^2 + 421^2} = 3282^{\#}/\text{IN}$$

$$w = \frac{f_w}{928^{\#}/\text{IN}/\tfrac{1}{16}} = \frac{3282}{928} = 3.5/16'' \text{ LEG}$$

USE 1/4" FILLET WELD

BD-6400-060.1 (12 87)

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No.
(4) Building (5) Rev.
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator L.V. EGGER Date 9/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

CHECK BENDING STRESS IN 1" PL

$$M = (19.35\ ^{\#}/_{FT^2})(6\ FT)(1\ FT) = 116.1\ ^{\#\text{-}FT}/_{FT}$$

$$S = \frac{bt^2}{6} = \frac{(12)(1)^2}{6} = 2.00\ IN^3/FT$$

$$f_b = \frac{116.1\ ^{\#\text{-}FT}/_{FT}\ (12\ ^{IN}/_{FT})}{2.00\ IN^3/FT} \quad 696.6\ ^{\#}/_{IN^2}$$

$$F_b = 0.75\ F_y = 27\ ^{K}/_{IN^2} > 0.697\ ^{K}/_{IN^2}\ OK.$$

WEIGHT OF 1" PLATE

$$(6\ FT)(11\ FT)(1/12\ FT)(490\ ^{\#}/_{FT^3}) = 4940^{\#}$$

CHECK CONNECTION TO EXISTING SUPPORT

$$V = 41347 + 4940$$
$$= 46287^{\#}$$

SHEAR PER BOLT

$$P_v = \frac{46287}{8} = 5786\ ^{\#}/BOLT$$

SINGLE SHEAR 1"ϕ A325 BOLTS

$$F_v = 16.5\ ^{K}/BOLT > 5.786\ ^{K}/BOLT\ OK$$

MINIMUM BOLT SPACING (AISC J3.3)

$$S_{MIN} = 3d = 3(1) = 3"$$

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator J. V. EGGER Date 9/22/94
(9) Checker James A Tuck Date 6 Dec. '94

(10)

MINIMUM BOLT SPACING (AISC J3.8)

$$s \nless \frac{2P}{F_u t} + \frac{d}{2}$$

$$s \nless \frac{2(5.752)}{(58)(1)} + \frac{(3/4)}{2}$$

$$\therefore s \nless 0.573''$$

MINIMUM EDGE DISTANCE

$$L_e = 1.5d = 1.5(3/4) = 1.125'' \text{ (AISC J3.9)}$$

$$L_e \nless \frac{2P}{F_u t}$$

$$L_e \nless \frac{2(5.752)}{58(1)}$$

$$L_e \nless 0.198''$$

BEARING STRESS

$$F_p = \frac{P}{dt} = \frac{5.752}{(1)(1)} = 5.752\ ^k/_{in^2}$$

$$1.0 F_u = 1.0(58) = 58\ ^k/_{in^2} \quad \text{OK}$$

BD-6400-060.1 (12/87)

(1) Drawing H-2-83755 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT

(8) Originator J. V. EGGER Date 9/28/94

(9) Checker [signature] Date 6 Dec. 1994

(10)

CHECK BEARING ON W30X191

$$\frac{R}{t_w(N+5k)} \leq 0.66 F_y \quad (\text{AISC K1.3})$$

$R = 46287^{\#}$

$t_w = 0.710$ IN

$N = 1$ IN

$k = 1\frac{15}{16}$ IN

$$\frac{46.287}{0.71(1+5(1\frac{15}{16}))} = 6.1\ ^{K}/_{IN^2} \leq 24\ ^{K}/_{IN^2} \text{ OK}$$

CHECK WEB CRIPPLING

$$R = 67.5\, t_w^2 \left[1+3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{F_{yw}\left(t_f/t_w\right)}$$

(AISC K1.4)

$t_w = 0.710$ IN

$t_f = 1.185$ IN

$d = 30.68$ IN

$F_{yw} = 36\ ^{K}/_{IN^2}$

$N = 1$ IN

$$R = 67.5(0.71)^2\left[1+3\left(\frac{1}{30.68}\right)\left(\frac{0.71}{1.185}\right)^{1.5}\right]\sqrt{36\left(\frac{1.185}{0.71}\right)}$$

$R = 275.72^{K} > 46.287$ OK.

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______ (6) ______

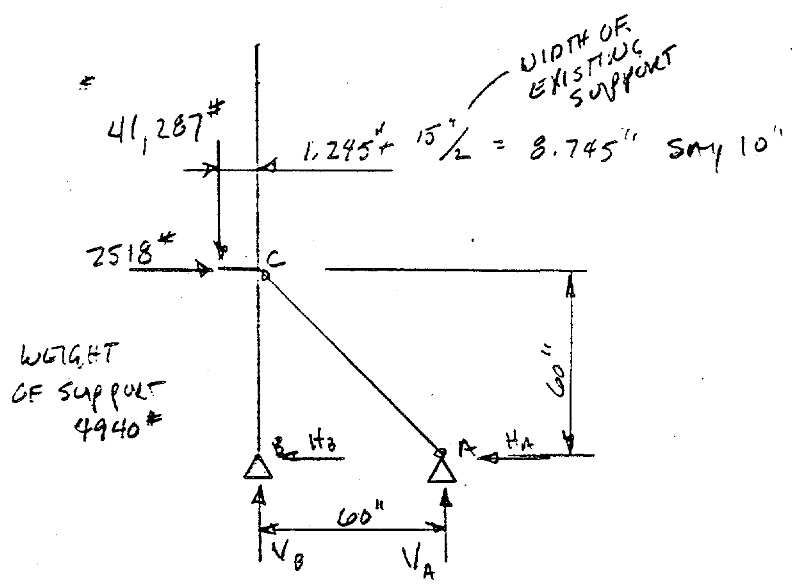
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT

(8) Originator J.V. EGGER Date 10/15/94

(9) Checker James A Tuck Date 6 Dec. 94

(10)

CHECK BENDING IN 1" PLATE DUE TO ECCENTRIC CONTAINER REACTIONS.



$$\Sigma M_B = 41287(10) - 2518(60) + V_A(60) = 0$$

$$V_A = \frac{261790}{60} = -4363^{\#}$$

MOMENT ON 1" PLATE

$$M = 41287(10) = 412,870 \ ^{\#}\text{-IN.}$$

$$F_b = 0.75 F_y = 24 \ ^{k}/_{in^2}$$

$$S = \frac{bd^2}{6}$$

$$\frac{M}{S} \leq F_b$$

BD-6400-060.1 (12/87)

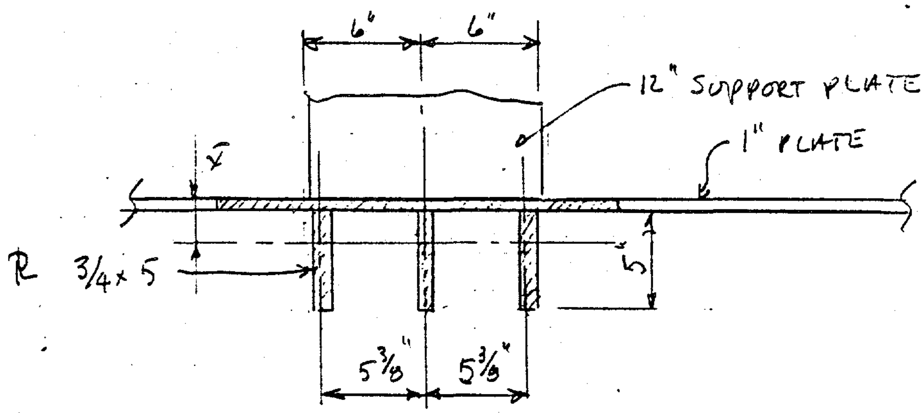
(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator J. V. EGGER Date 10/18/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$$\frac{412.87}{\frac{b(1)^2}{6}} \le 24$$

$$b \ge \frac{412.87(6)}{24(1)^2} = 103.22'' - 8'\,7''$$

8'-7" IS TOO WIDE TO ASSUME REASONABLE DISTRIBUTION OF THE LOADS ADD STIFFNERS TO REINFORCE PLATE



ASSUME ONLY 3 TEE 5 3/8" WIDE RESIST THE MOMENT.

$$\bar{x} = \frac{\Sigma A\bar{x}}{\Sigma A} = \frac{3(5\tfrac{3}{8})(1)(\tfrac{1}{2}) + 3(\tfrac{3}{4})(5)(1+\tfrac{5}{2})}{3(5\tfrac{3}{8})(1) + 3(\tfrac{3}{4})(5)}$$

$$= 1.733 \text{ IN}$$

$$I_{\bar{x}} = \Sigma(I_0 + A\bar{x}^2)$$

$$= \frac{3(5\tfrac{3}{8})(1)^3}{12} + 3(5\tfrac{3}{8})(1.733 - \tfrac{1}{2})^2 +$$

$$\frac{3(\tfrac{3}{4})(5)^3}{12} + 3(\tfrac{3}{4})(5)(1 + \tfrac{5}{2} - 1.733)^2$$

$$= 84.422 \text{ IN}^4$$

(1) Drawing H-2-83755 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______
(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT
(8) Originator J. W. EGGER Date 10/18/94
(9) Checker James A. Tuck Date 6 Dec. 1994

(10)

$$S_{x1} = \frac{I_x}{c_{x1}} = \frac{84.422}{1.733} = 48.718 \text{ in}^3$$

$$S_{x2} = \frac{I_x}{c_{x2}} = \frac{84.422}{(5+(-1.733))} = 19.784 \text{ in}^3$$

BENDING STRESS IN PLATE

$$f_b = \frac{412.87}{19.784} = 20.87 \text{ k/in}^2$$

$$d/t \le 127/\sqrt{F_y} \qquad \text{(AISC TABLE B5.1)}$$

$$d/t = 5/{3/4} = 6.67$$

$$127/\sqrt{36} = 21.17 \qquad \text{OK.}$$

$$F_b = 0.6 F_y \qquad \text{AISC SECTION F1.2}$$

$$F_b = 0.6(36) = 21.6 \text{ k/in}^2 > 20.87 \text{ k/in}^2 \text{ OK}$$

$$\Sigma V = V_A + V_B - 41.287^k = 0$$

$$-2.700 + V_B - 41.287 =$$

$$V_B = 43.987^k$$

AXIAL STRESS

$$f_a = \frac{43.987}{(3)(5\tfrac{3}{8})(1) + 3(\tfrac{3}{4})(5)} = \frac{43.987}{27.375} = 1.61 \text{ k/in}^2$$

$$r_x = \sqrt{I/A} = \sqrt{\frac{84.422}{27.375}} = 1.756 \text{ in}$$

$$\frac{k\ell}{r} = \frac{(1)(60)}{1.756} = 34.17$$

(1) Drawing H-2-33755 (2) Doc. No. ____

(4) Building ____ (5) Rev. ____

(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT

(8) Originator J. V. Egger Date 10/18/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$$\frac{\frac{Kl}{r}}{C_c} = \frac{34.17}{127.9} = 0.267$$

$$C_a = 0.547 \quad \text{(AISC TABLE 3)}$$

$$F_a = C_a F_y = 0.547(36) = 19.7\ ^{k}/_{in^2}$$

$$\frac{f_a}{F_a} = \frac{1.61}{19.7} = 0.082 \leq 0.15$$

COMBINED STRESS

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1 \quad \text{(AISC H1)}$$

$$0.082 + \frac{20.87}{21.6} = 1.05 \quad \text{OK}$$

LOAD DISTRIBUTED OVER A LARGER AREA OF THE 1" PLATE. AND WEIGHT OF CONTAINER USED

CHECK SHEAR STRESS

$$\Sigma H = H_A + H_B - 2.518^k = 0$$

$$H_A - V_A = -4.36^K$$

$$H_B = -1.85^K$$

$$f_v = \frac{-1.85}{3(5)(3/4)} = 0.164\ ^{k}/_{in^2} \leq 0.4F_y \quad \text{OK}$$

(AISC F4)

BD-6400-060 1 (12 87)

DESIGN CALCULATION

(1) Drawing H-2-83755 (2) Doc. No. ____________

(4) Building ____________ (5) Rev. ____________

(7) Subject TRANSPORT ASSEMBLY REMOVEABLE SUPPORT

(8) Originator J.V. EGGER Date 10/18/94

(9) Checker James A Tusk Date 6 Dec. 1994

(10)

CHECK WELD STRESS (HORIZONTAL SHEAR STRESS)

$$f_v = \frac{VQ}{I}$$

$V = 6.847^k$

$Q = 3(5\tfrac{3}{8})(1)(1.733 - \tfrac{1}{2})$

$= 19.882$

$I = 84.422$

$$f_v = \frac{6.847\,(19.882)}{84.422} = 1.613\ ^{K}/_{IN}$$

MINIMUM FILLET WELD – 1/4" (AISC TABLE J2.4)

ALLOWABLE WELD STRESS

$0.3\ F_T$ – $F_T = 70\ ^{k}/_{in^2}$

STRESS PER IN OF 1/4" FILLET

$$F_v = (\tfrac{1}{4})(\tfrac{1}{\sqrt{2}})(0.3)(70) = 3.712\ ^{K}/_{IN}$$

MAX SPACING FOR 2" OF WELD ON EACH SIDE

$$\frac{(2)\,2\,(3.712)}{1.613} = 9.205\ \text{IN.}$$

USE 1/4 2-6 / 1/4 2-6

BD-6400-060 (12 87)

Appendix E

Analysis of Saddle Modification for Air Pallets

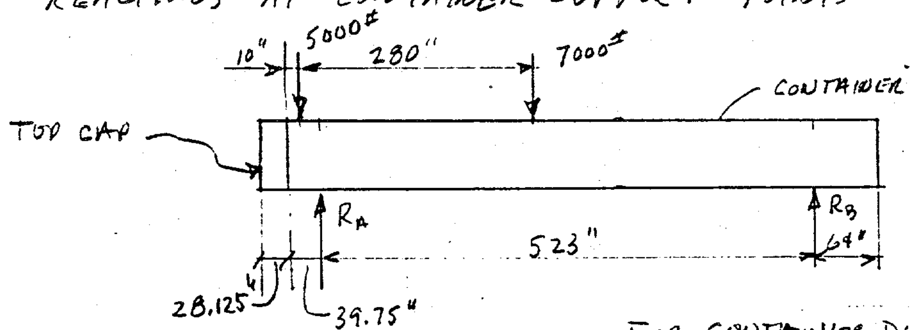
DESIGN CALCULATION

(1) Drawing H-2-93763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6)
(7) Subject SADDLE MODIFICATIONS FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10) MODIFICATION OF SADDLE DESIGN TO ALLOW AIR PALLETS TO BE INSTALLED FOR LIFTING AND MOVING CONTAINERS.

MAXIMUM ALLOWABLE SLAB LOADING LIMITED TO ALLOWABLE SOIL BEARING PRESSURE OF $\cong 2600\#/FT^2$. $(18.056\#/IN^2)$

REACTIONS AT CONTAINER SUPPORT POINTS



FOR CONTAINER DIMENSION SEE H-2-83734

FOR LOADS SEE LOAD CHART 10154

UNIFORM PUMP LOAD - 210#/FT
UNIFORM CONTAINER - 1000#/FT
UNIFORM SHIELDING - 1245#/FT

$$\Sigma Y = R_A + R_B - 5000 - 7000 - 210(654.875)/12$$
$$- 1000(654.875)/12 - 1245(623.75)/12 = 0$$

$$R_A + R_B = 142{,}747\#$$

$$\Sigma M_A = -5000(29.75) + 7000(250.25)$$
$$+ (210/12)(654.875)(654.875/2 - 67.875)$$
$$+ (1000/12)(654.875)(654.875/2 - 67.875)$$
$$+ (1245/12)(623.75)(623.75/2 - 39.75)$$
$$- R_B(523) = 0$$

BD-6400-060.1 (12/87)

(1) Drawing H-2-83763 (2) Doc. No. ____
(4) Building ____ (5) Rev. ____ (6) J
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J. V. EGGER Date 11/29/94
(9) Checker Vanessa A. Tuck Date 6 Dec. 1994

(10)

$$\Sigma M_A = -148{,}750 + 1{,}752{,}000 + 2{,}975{,}000 + 14{,}165{,}000 + 17{,}707{,}000 - R_B(523)$$

$$R_B = \frac{36{,}450{,}000}{523} = 69{,}694^{\#}$$

$$R_A = 142{,}747 - 69{,}694 = 73{,}053^{\#}$$

MINIMUM AREA OF AIR PALLET

$$A = \frac{73{,}053^{\#} + 8000^{\#}}{18.056^{\#}/\text{in}^2}$$

$$A = 4489 \text{ in}^2 \quad \text{TOTAL}$$

$$\frac{4489}{2} = 2245 \text{ in}^2/\text{pallet} \quad \text{FOR 2.}$$

BOB JEFFERS, WESTERN REGIONAL MANAGER OF AERO-GO (206) 293-6304
MODEL K60THD WITH 2700 in²/PALLET
SIZE 60" x 60" x 2 3/4"

USE 2 5'x5' AIR PALLETS UNDER EXISTING DESIGN. EXISTING DESIGN USED 4'x8' BASE. (AEC CALCULATION PG 3-4)

CHECK MAXIMUM MOMENT FOR 5'x10 BASE (AEC CALCULATION pg. 3-7)

$$M = \frac{77}{2}\left(\frac{5}{2}(12) - \frac{50.65}{2} \times \frac{1}{2}\right) = 667.5^{K\text{-}in}$$

BD-6400-060 1 (12 87)

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec 1994

(10)

DETERMINE MOMENT FOR 80^K LOAD AT CENTER OF 62" SPAN.

$$M = \frac{80(62)}{4} = 1240^{K-IN.}$$

ALLOWABLE BENDING STRESS

$$F_b = 12^{K}/IN^2$$

REQUIRED SECTION MODULUS

$$\frac{1240}{12} = 103 \text{ IN}^3$$

TRY 5 W 12 X 19 $S = 21.3 \text{ IN}^3$

$$5(21.3) = 106.5 \text{ IN}^2 \text{ OK.}$$

CHECK WEB CRIPPLING (AISC K1.4.a)

$$R = 67.5\, t_w^2 \left[1 + 3\left(\frac{N}{d}\right)\left(\frac{t_w}{t_f}\right)^{1.5}\right]\sqrt{F_{yw}\left(\frac{t_f}{t_w}\right)}$$

$R = 80/5 = 16^K$ $F_{yw} = 36^K/IN^2$

$t_w = 0.235$ $t_f = 0.350$ $d = 12.16$

$$16 = 67.5(0.235)^2\left[1 + 3\left(\frac{N}{12.16}\right)\left(\frac{0.235}{0.350}\right)^{1.5}\right]\sqrt{36\left(\frac{0.235}{0.350}\right)}$$

$$16 = 18.327\left[1 + 0.136\,N\right]$$

$$\left(\frac{16}{18.327} - 1\right)\left(\frac{1}{0.136}\right) = N$$

$N = -0.934 < 0$ WEB CRIPPLING OK

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______ (6) ______

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10)

CHECK LOCAL WEB YIELDING

LOAD AT ℄ OF W12x19 (AISC K1.3.a)

$$\frac{R}{t_w(N+5K)} \leq 0.66 F_y$$

$R = 16^K \quad t_w = 0.235 \quad K = 13/16 \quad F_y = 36$

$$\frac{16}{(0.235)(N+5(13/16))} \leq 0.66(36)$$

$$\frac{16}{0.235(0.66)(36)} \leq \left(N + 5\left(\frac{13}{16}\right)\right)$$

$$2.866 \leq N + 4.063$$

$N \geq -1.197 < 0$ LOCAL WEB YIELDING OK

LOAD AT END OF W12x19 (AISC K1.3.b)

$$\frac{R}{t_w(N+2.5K)} \leq 0.66 F_y$$

$$R = 16/2 = 8^K$$

$$\frac{8}{(0.235)(N+2.5(\frac{13}{16}))} \leq 0.66(36)$$

$$\frac{8}{0.235(0.66)(36)} \leq \left(N + 2.5\left(\frac{13}{16}\right)\right)$$

$$1.433 \leq N + 2.031$$

$N \geq -0.598 < 0$ LOCAL WEB YIELDING OK.

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J. V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10) CHECK SHEAR STRESS (AISC F4)

$$\frac{h}{t_w} \le \frac{380}{\sqrt{F_y}}$$

$$h = 12.16 - 2(0.35) = 11.46$$

$$h/t_w = 11.46/0.235 = 48.77$$

$$\frac{380}{\sqrt{36}} = 63.33 \ge 48.77 \quad \text{OK.}$$

$$F_v = 0.4\,F_y$$
$$= 0.4(36) = 14.4\ ^{k}/_{in^2}$$

$$f_v = \frac{8}{12.16(0.235)} = 2.8\ ^{k}/_{in^2} \le 14.4\ ^{k}/_{in^2} \text{ OK}$$

CHECK BENDING STRESS (AISC F1.3)

$$l/r_T = 62/1.00 = 62$$

$$\sqrt{\frac{102 \times 10^3 C_b}{36}} \le l/r_T \le \sqrt{\frac{510 \times 10^3 C_b}{F_y}}$$

$$53 C_b \le 62 \le 119 C_b$$

$$F_b = \left[\frac{2}{3} - \frac{F_y (l/r_T)^2}{1530 \times 10^3\, C_b}\right] F_y \le 0.6 F_y$$

$$= \left[\frac{2}{3} - \frac{36(62)^2}{1530 \times 10^3 (1)}\right] 36 = 20.74\ ^{k}/_{in^2}$$

$$f_b = \frac{1240/5}{21.3} = 11.64\ ^{k}/_{in^2} < 20.74\ ^{k}/_{in^2} \text{ OK.}$$

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ________

(4) Building ________ (5) Rev. ________ (6) ________

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10)

ALLOWABLE BEARING PRESSURE $2.6^{K}/FT^2$

BEAM REACTION LOAD $80^{K}/2 = 40^{K}$

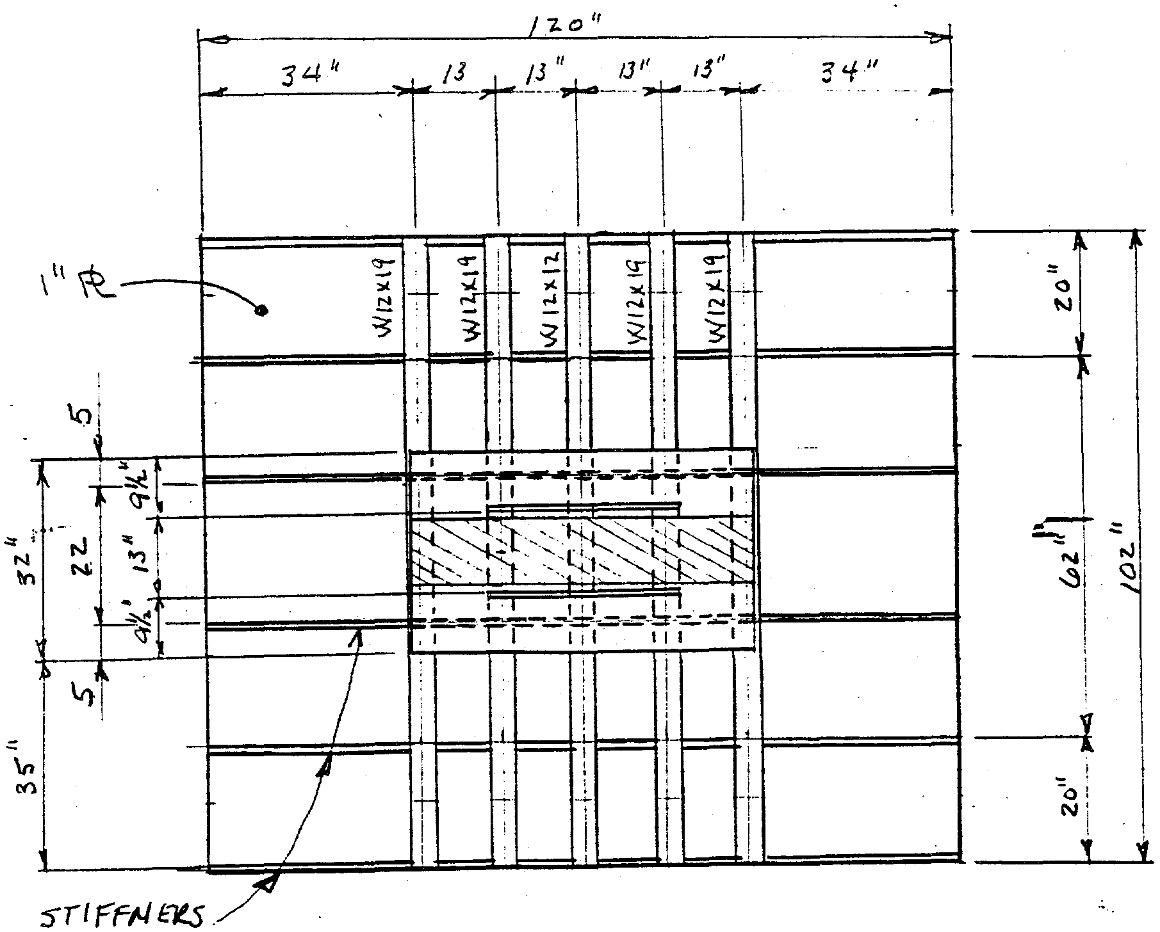
REQUIRED AREA $A = \frac{40}{2.6} = 15.39\ FT^2$

LENGTH OF PLATE – 10'

WIDTH REQ'D $= \frac{15.39}{10} = 1.539\ FT$

18.462 IN

USE 20"



PLAN VIEW

BD-6400-060.1 (12/87)

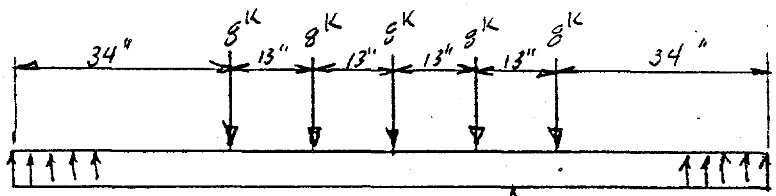
DESIGN CALCULATION

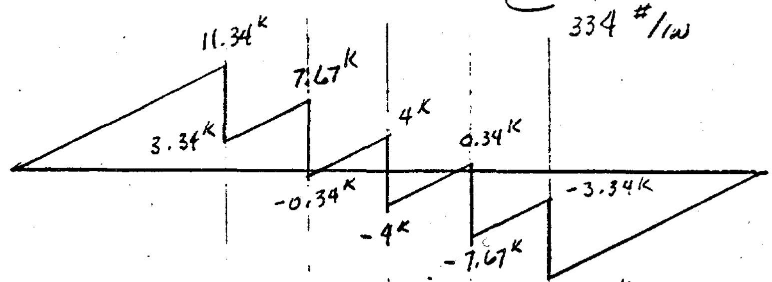
(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J. V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

UNIFORM PRESSURE UNDER PLATE

$$\frac{40{,}000}{20(120)} = 16.7\ \#/\text{in}^2$$





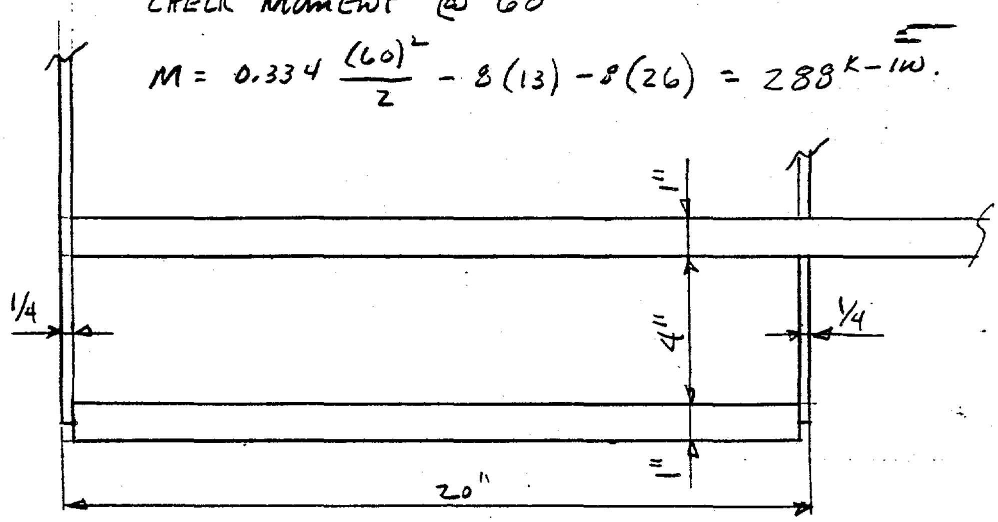
SHEAR DIAGRAM

CHECK MOMENT @ 47"

$$M = 0.334\frac{(47)^2}{2} - 8(13) = 264.2^{K-IN}$$

CHECK MOMENT @ 60"

$$M = 0.334\frac{(60)^2}{2} - 8(13) - 8(26) = 288^{K-IN}$$



DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

DETERMINE SECTION MODULUS. (ASSUME 20" WIDE TUBE

$$S = \frac{20(6)^2}{6} - \frac{19.5(4)^2}{6} = 68 \text{ IN}^3$$

$$f_b = \frac{288}{68} = 4.235 \text{ k/IN}^2$$

AISC TABLE B5.1

$$\frac{b}{t} \le \frac{190}{\sqrt{F_y}} \qquad \text{FLANGE}$$

$$\frac{b}{t} = \frac{20}{1} = 20 \qquad \frac{190}{\sqrt{36}} = 31.67 \quad \text{OK}$$

$$\frac{d}{t} \le \frac{640}{\sqrt{F_y}} \qquad \text{WEB}$$

$$\frac{d}{t} = \frac{6}{0.25} = 24 \qquad \frac{640}{\sqrt{36}} = 106.7 \quad \text{OK.}$$

CHECK HORIZONTAL SHEAR IN WEBS

$$f_v = \frac{VQ}{It}$$

$$Q = 1(20)(3 - 1/2) = 50 \text{ IN}^3$$

$$I = \frac{20(6)^3}{12} - \frac{19.5(4)^3}{12} = 256 \text{ IN}^4$$

$$V = 11.34^k \qquad t = (1/4")(2) = 0.5 \text{ IN}$$

$$f_v = \frac{50(11.34)}{256(0.5)} = 4.43 \text{ k/IN}^2 < 14.4 \text{ k/IN}^2 \text{ OK}$$

DESIGN CALCULATION

WHC-SD-WM-DA-168
REV. 0

PAGE E-10

(1) Drawing H-2-83763 (2) Doc. No. ____

(4) Building ____ (5) Rev. ____

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

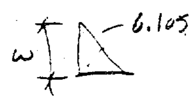
(10)

WELD REQ'D BETWEEN WEB & FLANGE.

$$f_v = 4.34\ ^{K}/_{IN^2}\,(0.5) = 2.215\ ^{K}/_{IN} \text{ OF WELD}$$

$$F_v = 0.3\,(70) = 21\ ^{K}/_{IN^2}$$

$$\text{EFFECTIVE THROAT} = \frac{2.215}{21} = 0.105 \text{ IN}$$



$$w = \sqrt{2}\,(0.105) = 0.149 \text{ IN}$$

USE 3/16 FILLET WELD

$$\frac{1/4}{0.149}\,(3) = 5.034$$

OR USE $\overline{1/4 \bigvee 3\text{-}5}$

BD-6400-060.1 (12/87)

DESIGN CALCULATION

WHC-SD-WM-DA-168
REV. 0

PAGE E-11

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

BENDING IN 1" PLATE

$$M = \frac{w l^2}{8}$$

$$w = 16.7 \#/in/in$$

$$l = 20 \text{ in}$$

$$M = \frac{16.7(20)^2}{8} = 835 \#\text{-in/in}$$

$$S = \frac{bd^2}{6} = \frac{1(1)^2}{6} = 0.167 \text{ in}^3$$

$$f_b = \frac{M}{S} = \frac{835}{0.167} = 5010 \#/in^2$$

ALLOWABLE STRESS

$$F_b = 0.75 F_y \quad (\text{AISC F2.1})$$

$$F_b = 0.75(36) = 27 \text{ k/in}^2 \text{ OK}$$

CHECK SHEAR STRESS IN 1" PLATE

$$V = \frac{wl}{2} = \frac{16.7(20)}{2} = 167 \#/in$$

$$f_v = \frac{167}{(1/4)(1)} = 668 \#/in^2$$

$$F_v = 0.4 F_y \quad (\text{AISC F4})$$

$$F_v = 0.4(36) = 14.4 \text{ k/in}^2 > 668 \#/in^2 \text{ OK.}$$

CHECK AXIAL LOAD IN 1/4" PLATE

$$f_a = \frac{167}{0.25(1)} = 668 \#/in$$

(1) Drawing H-2-83763 (2) Doc. No. ____________

(4) Building ____________ (5) Rev. ____________

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$$r = \frac{d}{\sqrt{12}} = \frac{(1/4)}{\sqrt{12}} = 0.072$$

$$\frac{Kl}{r} = \frac{2\,(5)}{0.072} \doteq 138.6$$

$$C_c = 126.1 \quad \text{(AISC TABLE 4)}$$

$$F_a = \frac{12\pi^2 E}{23\,(Kl/r)^2} \quad \text{(AISC E2)}$$

$$F_a = 7.73\ ^{K}/_{IN^2} > 668\ ^{\#}/_{IN^2} \quad OK$$

DESIGN CALCULATION

WHC-SD-WM-DA-168
REV. 0

PAGE E-13

(1) Drawing H-2-83763 (2) Doc. No. ____________

(4) Building ____________ (5) Rev. ____________ (6) ____________

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker [signature] Date 6 Dec. 1994

(10)

DETERMINE WEIGHT OF SUPPORT

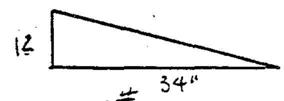
1" PLATE 120" X 102"

$$\frac{(120)(102)(1)}{1728}(490) = 3471^{\#}$$

24 ½" PLATE 13 X 12

$$(24)\frac{(13)(12)(\frac{1}{2})}{1728}(490) = 531^{\#}$$

12 ½" PLATE 34 X 12



$$(12)(\tfrac{1}{2})\frac{(34)(12)(\frac{1}{2})}{1728}(490) = 347^{\#}$$

5 W12X19 102" LONG

$$5(19)\left(\frac{102}{12}\right) = 808^{\#}$$

1" PLATE ROLLED TO 2'-11 5/8" RADIUS

$$\frac{\frac{\pi}{2}(35.625)(22)(1)}{1728}(490) = 349^{\#}$$

2 1" PLATES 120" X 20"

$$2\frac{(1)(120)(20)}{1728}(490) = 1361^{\#}$$

4 ½" PLATES 5" X 120

$$4\frac{(\frac{1}{2})(5)(120)}{1728}(490) = 340^{\#}$$

TOTAL = 7207#

SAY 8000#

BD-6400-060.1 (12/87)

DESIGN CALCULATION

WHC-SD-WM-DA-168
REV. 0

PAGE E-14

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

USE 3 1/4 TON SHACKLES AT 4 PLACES (3/4" ⌀ PIN)

$$\frac{8000}{2} = 4000^{\#}/\text{SHAKLE}$$

ASSUME 45° PULL ANGLE

$$P = \frac{4000}{\sin 45^\circ} = 5657^{\#} < 6{,}500^{\#} \text{ OK}$$

BEAR LOAD ON 1/2" PLATE

$$f_p = \frac{6500}{0.75(1/2)} = 17{,}330^{\#}/\text{in}^2$$

$$F_p = \frac{L_e F_u}{2d} \leq 1.2 F_u \quad (\text{AISC J3.7})$$

$$L_e = 1'' \quad F_u = 58^k/\text{in}^2 \quad d = 0.75''$$

REF 1 - DESIGN AND CONSTRUCTION OF LIFING BEAMS 4th QTR 1991 ENGINEERING JOURNAL AISC

$$F_p = \frac{1(58)}{2(0.75)} = 38.7^k/\text{in}^2 > 17{,}330^{\#}/\text{in}^2 \text{ OK}$$

$$P_u = 2at F_u \quad (\text{REF 1 pg. 151})$$

$$a = 4t \quad t = 1/2''$$

$$P_u = 2(4(1/2))(1/2)(58) = 116^k \quad 0.2P_u = 23.2^k > 6500^{\#} \text{ OK}$$

$$P_p = 0.9F_y t d \quad (\text{REF 1 pg. 152})$$

$$= 0.9(36)(1/2)(0.75) = 12.15^k > 6500^{\#} \text{ OK}$$

$$e_{min} = \sqrt{\frac{Pd}{1.67F_b t}} \quad (\text{REF 1 pg. 152})$$

$$P = 6500^{\#} \quad d = 0.75 \quad F_b = 0.6(36) = 21.6^k/\text{in}^2 \quad t = 1/2''$$

$$e_{min} = \sqrt{\frac{6.5(0.75)}{1.67(21.6)(1/2)}} = 0.52 \text{ IN.} < 0.625'' \text{ OK}$$

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6)
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$$P_u = 2(0.4)(F_y)\,e\,t \qquad (\text{REF 1 pg. 152})$$

$$P_u = 2(0.4)(36)(0.625)(1/2) = 9.0^K$$

$$0.2\,P_u = 1.8^K < 2830^{\#} \text{ N.G.}$$

INCREASE EDGE DISTANCE

$$e = \frac{2.83}{1.8}(0.625) = 0.983$$

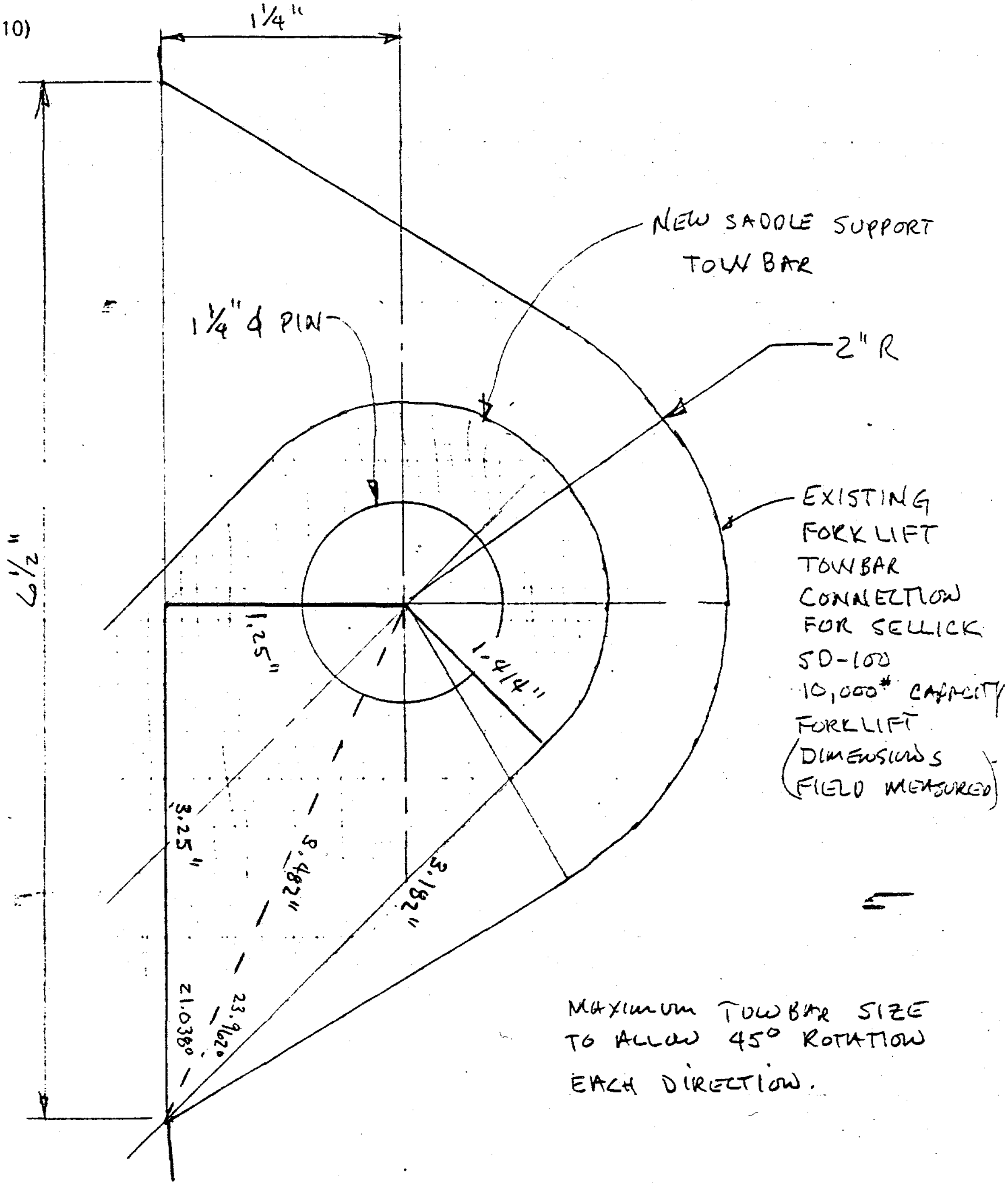
USE $1\frac{3}{8}''$

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No.
(4) Building (5) Rev.
(7) Subject SADDLE MODIFICATION FOR AIR PALLET
(8) Originator J. V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)



BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______ (6) ______

(7) Subject SADDLE MODIFICATION FOR AIR PALLET

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

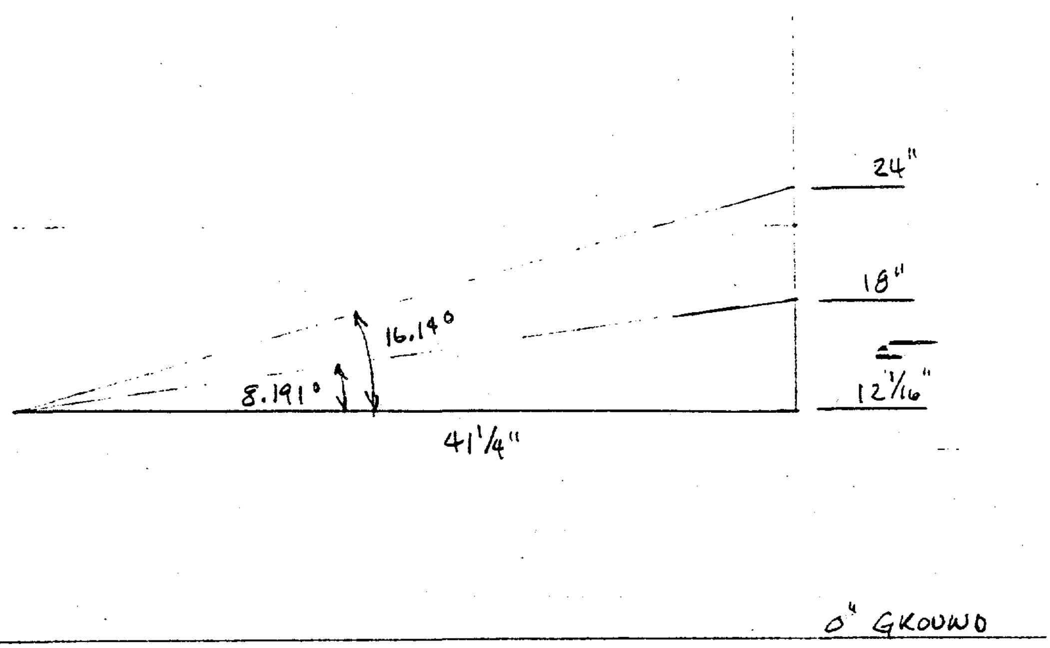
(10)

HEIGHT OF FORKLIFT CONNECT FROM GROUND IS BETWEEN 18" & 24"

HEIGHT OF TOWBAR PIN ON SADDLE SUPPORT FROM GROUND $5" + 1" + 12\frac{1}{8}"/2 = 12\frac{1}{16}"$

DISTANCE FROM FORK LIFT TO TOWBAR PIN.
$12\frac{3}{4}" - 3\frac{7}{8} + 13" + 13" + 6\frac{3}{8}" = 41\frac{1}{4}"$

ANGLE BETWEEN TOW BAR & GROUND.



DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______ (6) J

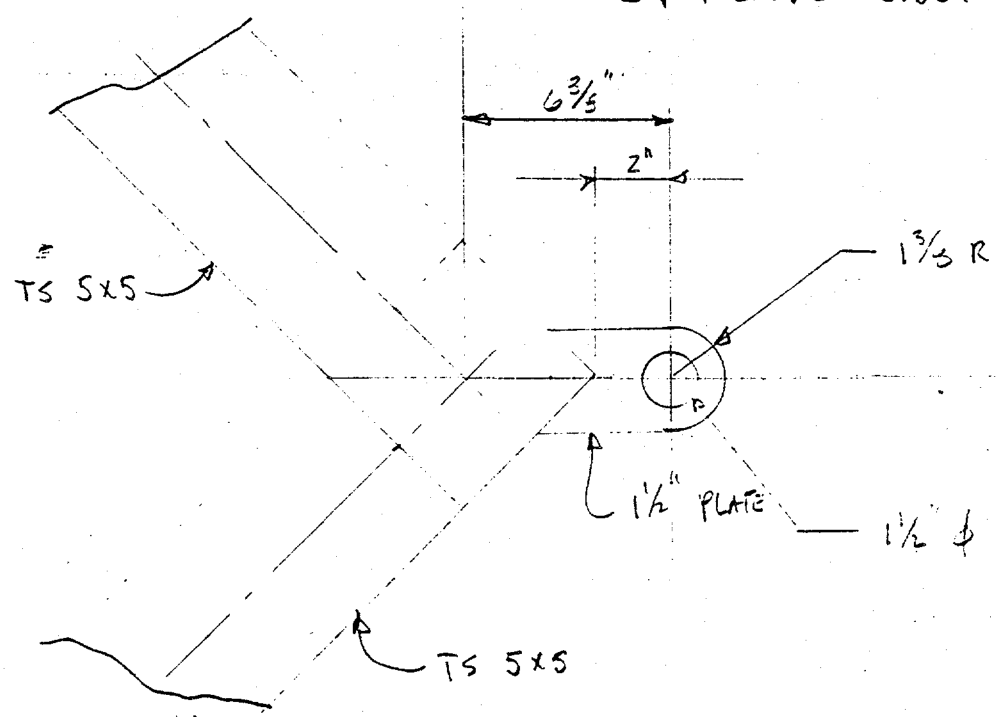
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

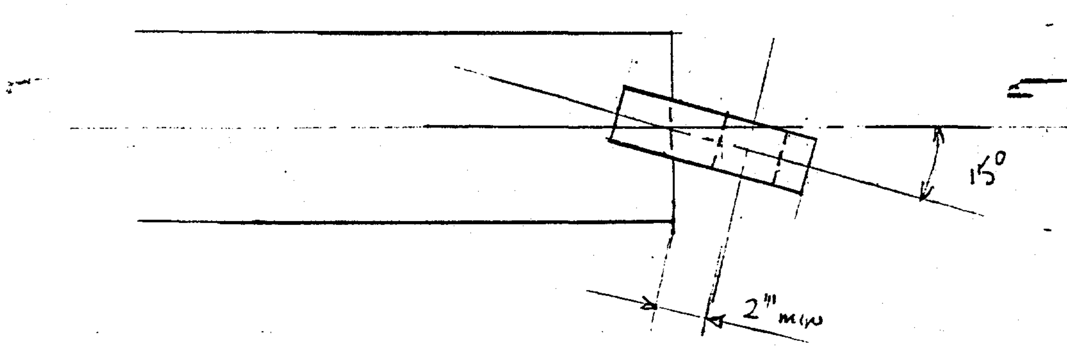
(8) Originator J.V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$2\sqrt{2} + 2.5\sqrt{2} = 6.364''$



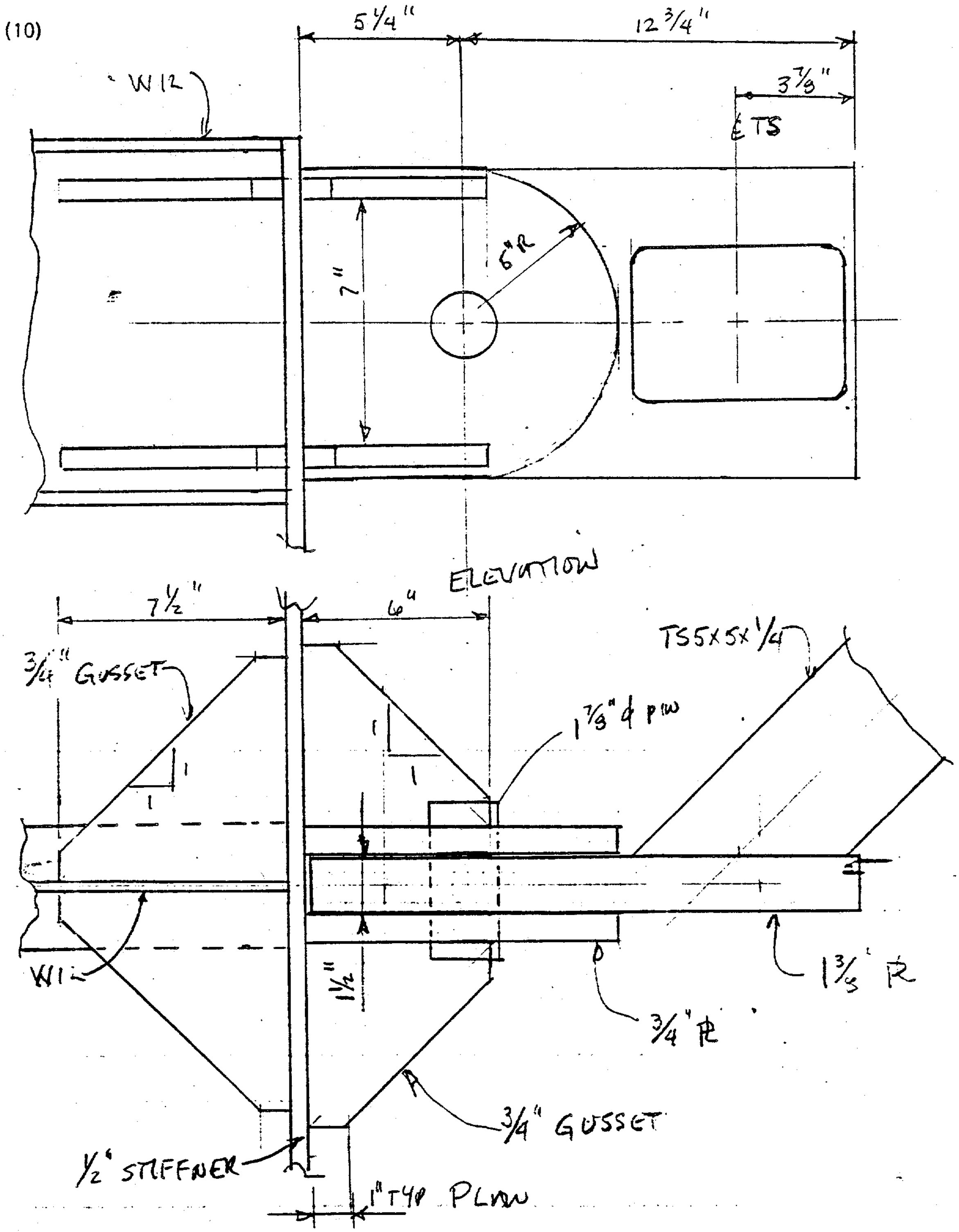


BD-6400-060.1 (12.87)

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ____
(4) Building ____ (5) Rev. ____ (6) J ____
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/90
(9) Checker James A Tuck Date 6 Dec. 1994

(10)



BD-6400-060 1 (12.87)

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6) ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J. V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

MAXIMUM LOAD ON TOWBAR EYE.

$t = 1\frac{1}{2}''$

$a = e = 1\frac{3}{8}'' - \frac{1}{2}(1\frac{1}{2}'') = 0.625''$

$d = 1\frac{1}{2}''$

$F_u = 58 \, ^k/_{in^2}$

$P_u = 2at\,F_u$

$= 2(0.625)(1.5)(58) = 108^k$

$P = 0.2\,P_u = (0.2)(108) = 21.75^k$

BEARING

$P_p = 0.9 F_y t d$

$= 0.9(36)(1.5)(1.5) = 72.9^k$

TENSION TEAR OUT

$$P = \frac{1.67 F_b t e^2}{d}$$

$$= \frac{1.67[(0.75)(36)](1.5)(0.625)^2}{1.5} = 17.6^k$$

SHEAR

$P_u = 2(0.4)(F_y)\,e\,t$

$= 2(0.4)(36)(0.625)(1.5) = 27^k$

MAXIMUM LOAD $= 17.6^k$

BD-6400-060.1 (12.87)

DESIGN CALCULATION

(1) Drawing H-2-53763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6. ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J.V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

ASSUME MAXIMUM FORCE IN TOW BAR IS 18^K

CHECK TS 5×5×1/4

LENGTH OF TS 5×5×1/4

$$(13+13)\sqrt{2} = 36.77 \text{ IN}$$

$$r = \sqrt{I/A} = \sqrt{\frac{16.9}{4.59}} = 1.92 \text{ IN}$$

$$\frac{K\ell}{r} = \frac{36.77}{1.92} = 19.15 \qquad C_c = 126.1 \ (\text{AISC TABLE 4})$$

$$\frac{K\ell/r}{C_c} = \frac{19.15}{126.1} = 0.152$$

$$C_a = 0.574$$

$$F_a = 0.574(36) = 20.66 \ {}^K/_{IN^2} \ (\text{AISC TABLE 3})$$

$$f_a = \frac{18}{4.59} = 3.922 \ {}^K/_{IN^2} < 20.66 \ {}^K/_{IN^2} \ \text{OK}$$

CHECK $1\frac{3}{8}$" × 10" PLATE

$$f_a = \frac{P}{A} = \frac{18^K \cos 45^\circ}{(1.375)(10)} = 0.926 \ {}^K/_{IN^2}$$

$$M = (18^K)(\sin 45^\circ)(7.375)$$
$$= 100.2^{K\text{-}IN}$$

$$f_b = \frac{M}{S} = \frac{100.2^{K\text{-}IN}}{\frac{10(1.375)^2}{6}} = 31.31 \ {}^K/_{IN^2} \ \text{N.G.}$$

BD-6400-060.1 (12/87)

DESIGN CALCULATION

(1) Drawing H-2-83763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (6 ______
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J. V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

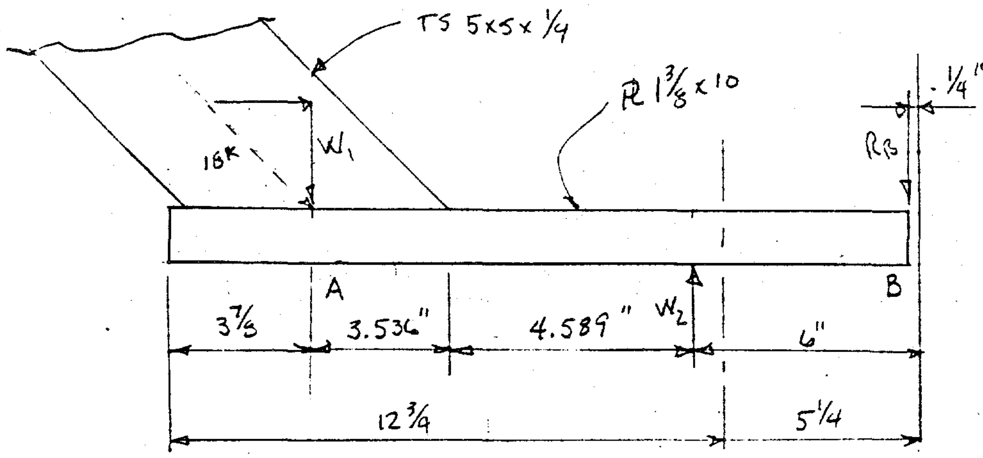
MOMENT OF INERTIA OF TS 5×5×1/4

$I = 16.9 \text{ IN}^4 \qquad I/\ell = 16.9/36.77 = 0.46$

MOMENT OF INERTIA OF 1 3/8 × 10" PLATE

$$I = \frac{10(1.375)^3}{12} = 2.166 \text{ IN}^4 \qquad I/\ell = 2.166/13.875 = 0.16$$

$$\ell = 3.536 + 4.589 + 6 - 1/4 = 13.875"$$



THE TS 5×5×1/4 IS 0.46/0.16 = 2.9 TIMES STIFFER THAN THE 1 3/8" PLATE. ASSUME THE TS 5×5×1/4 RESTRAINS THE ROTATION ~~OF~~ THE 1 3/8" PLATE (SEE ROARK TABLE 3 CASE 1F)

BD-6400-060.1 (12/87)

(1) Drawing H-2-93763 (2) Doc. No. ____

(4) Building ____ (5) Rev. ____ (6) ____

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10)

Roark's Formulas for Stress and Strain, Sixth Edition

Table 3

Notation:

$W := 18000 \cdot \cos\left(\frac{45}{180} \cdot \pi\right)$	W = load
$w := 0$	w = load per unit length
$M_o := 0$	M_o = applied couple
$\theta_o := 0$	q_o = angular displacement
$\Delta_o := 0$	Δ_o = lateral displacement
$T_1 := 0$	T_1 = temperature on top suface
$T_2 := 0$	T_2 = temperature on bottom surface
$R_a := 0$	R_a = left vertical reaction
$R_b := 0$	R_b = right vertical reaction
$M_a := 0$	M_a = left end moment
$M_b := 0$	M_b = right end moment
$V := 0$	V = shear
$E := 29000000$	E = modulus of elasticity
$I := \frac{10 \cdot 1.375^3}{12}$	I = moment of interia
$\gamma := 0$	γ = temperature coefficient of expansion
$l := 12.75 + 5.25 - .25 - 3.875$	l = length of beam
$x := l + .25 - 6$	x = lenght from left end of beam
$a := 0$	a = x distance from left end
	$\langle x-a \rangle^n = \Phi(x-a) \cdot (x-a)^n$

DESIGN CALCULATION

(1) Drawing H-2-53763 (2) Doc. No. ____

(4) Building ____ (5) Rev. ____

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$W_1 := 18000 \cdot \cos\left(\frac{45}{180} \cdot \pi\right)$ $\qquad a_1 := 0$

1.f Left end guided, right end simply supported

$R_{a1} := 0$ $\qquad M_{a1}(x) := W_1 \cdot (l - a_1)$ $\qquad \theta_{a1} := 0$

$$y_{a1}(x) := \frac{-W_1 \cdot (l - a_1)}{6 \cdot E \cdot I} \cdot \left(2 \cdot l^2 + 2 \cdot a_1 \cdot l - a_1^2\right)$$

$R_{b1}(x) := W_1$ $\qquad M_{b1} := 0$

$\theta_{b1}(x) := \frac{W_1}{2 \cdot E \cdot I} \cdot \left(l^2 - a_1^2\right)$ $\qquad y_{b1} := 0$

1. Concentrated load

Transverse Shear

$V_1(x) := R_{a1} - W_1 \cdot \Phi(x - a_1)$ $\qquad V_1(x) = -1.273 \cdot 10^4$

Bending Moment

$M_1(x) := M_{a1}(x) + R_{a1} \cdot x - W_1 \cdot \Phi(x - a_1) \cdot (x - a_1)$ $\qquad M_1(x) = 7.319 \cdot 10^4$

Slope

$$\theta_1(x) := \theta_{a1} + \frac{M_{a1}(x) \cdot x}{E \cdot I} + \frac{R_{a1} \cdot x^2}{2 \cdot E \cdot I} - \frac{W_1 \cdot \Phi(x - a_1) \cdot (x - a_1)^2}{2 \cdot E \cdot I}$$

$\theta_1(x) = 0.016$

Deflection

$$y_1(x) := y_{a1}(x) + \theta_{a1} \cdot x + \frac{M_{a1}(x) \cdot x^2}{2 \cdot E \cdot I} + \frac{R_{a1} \cdot x^3}{6 \cdot E \cdot I} - \frac{W_1 \cdot \Phi(x - a_1) \cdot (x - a_1)^3}{6 \cdot E \cdot I}$$

$y_1(x) = -0.106$

(1) Drawing H-2-53763 (2) Doc. No. ______
(4) Building ______ (5) Rev. ______ (
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS
(8) Originator J. V. EGGER Date 11/29/94
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$W_2 := -28050 \qquad a_2 := l + .25 - 6$

1.f Left end guided, right end simply supported

$R_{a2} := 0 \qquad M_{a2}(W_2) := W_2 \cdot (l - a_2) \qquad \theta_{a2} := 0$

$$y_{a2}(W_2) := \frac{-W_2 \cdot (l - a_2)}{6 \cdot E \cdot I} \cdot \left(2 \cdot l^2 + 2 \cdot a_2 \cdot l - a_2^2\right)$$

$R_{b2}(W_2) := W_2 \qquad M_{b2} := 0$

$\theta_{b2}(W_2) := \frac{W_2}{2 \cdot E \cdot I} \cdot \left(l^2 - a_2^2\right) \qquad y_{b2} := 0$

1. Concentrated load

Transverse Shear

$V_2(x, W_2) := R_{a2} - W_2 \cdot \Phi(x - a_2) \qquad V_2(x, W_2) = 2.805 \cdot 10^4$

Bending Moment

$M_2(x, W_2) := M_{a2}(W_2) + R_{a2} \cdot x - W_2 \cdot \Phi(x - a_2) \cdot (x - a_2)$

$M_2(x, W_2) = -1.613 \cdot 10^5$

Slope

$$\theta_2(x, W_2) := \theta_{a2} + \frac{M_{a2}(W_2) \cdot x}{E \cdot I} + \frac{R_{a2} \cdot x^2}{2 \cdot E \cdot I} - \frac{W_2 \cdot \Phi(x - a_2) \cdot (x - a_2)^2}{2 \cdot E \cdot I}$$

$\theta_2(x, W_2) = -0.021$

Deflection

$$y_2(x, W_2) := y_{a2}(W_2) + \theta_{a2} \cdot x + \frac{M_{a2}(W_2) \cdot x^2}{2 \cdot E \cdot I} + \frac{R_{a2} \cdot x^3}{6 \cdot E \cdot I} - \frac{W_2 \cdot \Phi(x - a_2) \cdot (x - a_2)^3}{6 \cdot E \cdot I}$$

$y_2(x, W_2) = 0.148$

DESIGN CALCULATIO

WHC-SD-WM-DA-168
REV. 0

PAGE E-26

(1) Drawing H-2-53763 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

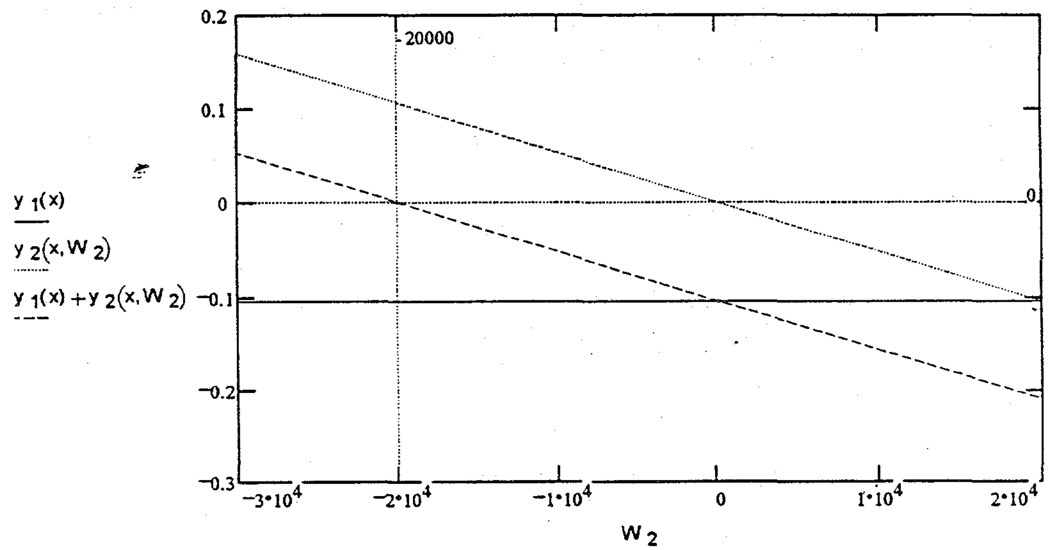
(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J.V. EGGER Date 11/29/94

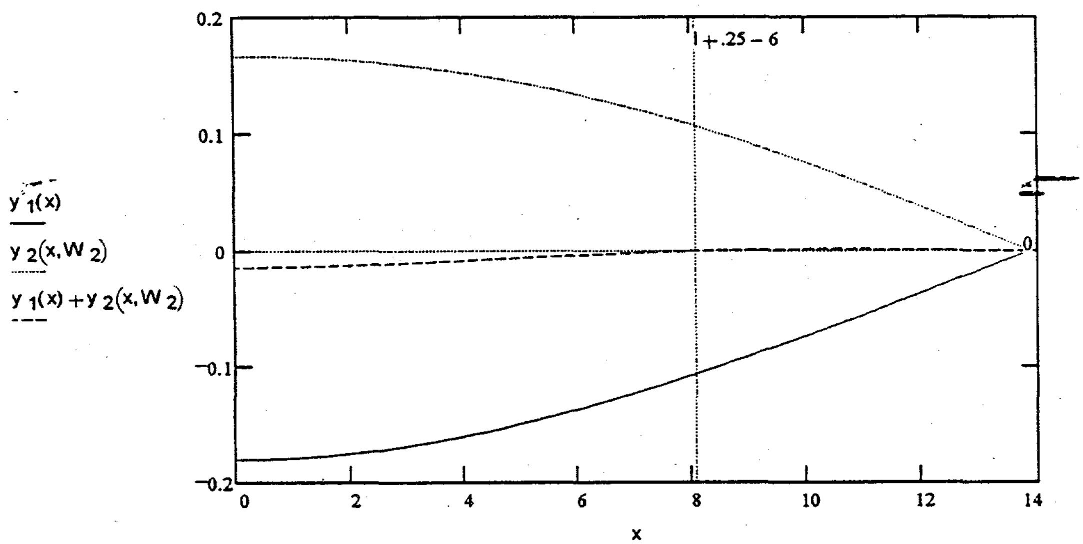
(9) Checker James A Tuck Date 6 Dec. 1994

(10)

$x := l + .25 - 6 \qquad W_2 := -30000, -29000 .. 20000$



$x := 0, .1 .. l \qquad W_2 := -20000$



DESIGN CALCULATIO

(1) Drawing H-2-83763 (2) Doc. No. ________

(4) Building ________ (5) Rev. ________

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

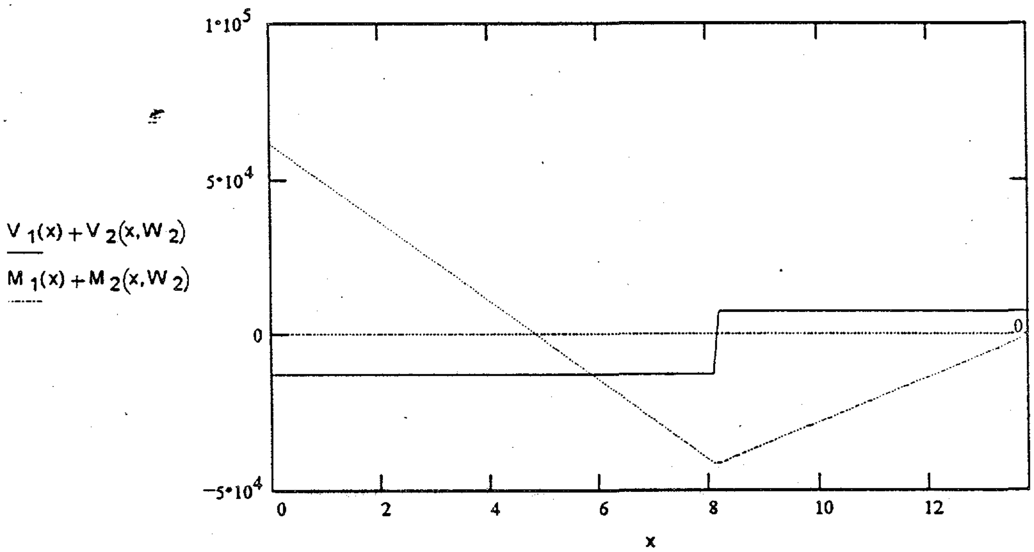
(8) Originator J.V. EGGER Date 11/29/94

(9) Checker [signature] Date 6 Dec. 1994

(10)

$V_1(l+.25-6)+V_2(l+.25-6,W_2)=7.272\cdot10^3$ $\quad V_1(0)+V_2(0,W_2)=-1.273\cdot10^4$

$M_1(l+.25-6)+M_2(l+.25-6,W_2)=-4.181\cdot10^4$ $\quad M_1(0)+M_2(0,W_2)=6.16\cdot10^4$



(1) Drawing H-2-83763 (2) Doc. No. ______

(4) Building ______ (5) Rev. ______

(7) Subject SADDLE MODIFICATION FOR AIR PALLETS

(8) Originator J. V. EGGER Date 11/29/94

(9) Checker James A Trick Date 6 Dec. 1994

(10)

MAXIMUM MOMENT IN PLATE 61.4^{k}-IN

$$f_b = \frac{61.4}{\frac{10(1.375)^2}{6}} = 19.5\ ^{k}/_{in^2}$$

$$F_b = 0.75\,F_Y \quad \text{(AISC F2.1)}$$

$$F_b = 0.75(36) = 27\ ^{k}/_{in^2}$$

COMBINED STRESS (AISC H1)

$$\frac{f_a}{F_a} = \frac{0.926}{20.66} = 0.045$$

$$r = \sqrt{I/A} = \sqrt{\frac{2.166}{13.75}} = 0.397$$

$$Kl/r = \frac{2(13.875)}{0.397} = 69.9$$

$$F_{ex} = 30.48$$

$$\frac{f_a}{F_a} + \frac{C_{mx}\,f_{bx}}{\left(1-\frac{f_a}{F_{ex}}\right)F_{bx}} = 0.045 + \frac{0.85\,(19.5)}{\left(1-\frac{0.926}{30.48}\right)27}$$

$$= 0.677 \le 1.0 \text{ OK}$$