COMMONWEALTH EDISON COMPANY
CALCULATION TITLE PAGE

CALCULATION NO.: L-001337 PAGE N[illegible]

X SAFETY RELATED ☐ REGULATORY RELATED ☐ NON-SAFETY RELAT[illegible]

CALCULATION TITLE: Containment Liner Leak Chase Cha[illegible]el Assessment

STATION/UNIT: LaSalle County/ Unit 1 SYSTEM ABBREVIATION: NA

EQUIPMENT NO.: (IF APPL.) NA PROJECT NO.: (IF APPL.) 10248-012

REV: 0 STATUS: Approved QA SERIAL NO. OR CHRON NO. DATE:

PREPARED BY: A. C. Eberhardt/ A. C. Eberhardt DATE: 10/28/97

REVISION SUMMARY: Initial Issue

ELECTRONIC CALCULATION DATA FILES REVISED: NA
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DO ANY ASSUMPTIONS IN THIS CALCULATION REQUIRE LATER VERIFICATION YES ☐ NO X

REVIEWED BY: R. Namperumal/ R. Namperumal DATE: 10-30-97

REVIEW METHOD: Detailed COMMENTS (C, NC OR CI): CI

APPROVED BY: S. M. KAZMI S M Kazmi DATE: 11-3-97

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PDR ADOCK 05000373
P PDR

Exhibit C
NEP-12-02
Revision 4
Page 1 of 2

ComEd

LASALLE STATION

☒ Unit 1 ☐ Unit 2 ☐ Unit 0

CALCULATION NO: L-001337

DESCRIPTION CODE (C018): S02
DISCIPLINE CODE (C011): S
SYSTEM CODE (C011): NA
ELEVATION (C016): NA

Title: Containment Liner Leak Chase Channel Assessment

☒ Safety Related ☐ Regulatory Related ☐ Augmented Quality ☐ Non-Safety Related

REFERENCE NUMBERS: (C011 Panel)

Type	Number	Type	Number
AEDV	PD-SED	PIF	L1997-06237
CHRN			
PAL	3265		
PROG			
PROJ	10248-012		
SSYS			
RNID			

COMPONENT EPN: (C014 Panel)

EPN	Component Type

DOCUMENT NUMBERS: (C012 Panel)

Doc Type	Sub Type	Document Number	Assoc. Calc.
Calc	Eng	164	☒Yes ☐No
			☐Yes ☐No
			☐Yes ☐No
			☐Yes ☐No
			☐Yes ☐No

REMARKS:

REV. No.	REVISING ORGANIZATION	APPROVED (Print & Sign)	DATE
1	S040/SCL NPD	S. M. Kazmi [signature]	12-04-97
2	S040/SCL NPD	S. M. KAZMI [signature]	02-03-98

REVISION SUMMARIES

REV: 1

REVISION SUMMARY:

Incorporated Administrative Review Comments: Added Pgs 1.1, 1.2, & 25.2, Revised Pgs 2, 3, 25.1, REPLACED PAGE 25

Electronic Calculation Data Files:
(Program Name, Version, File name ext/size/date/hour/: min)
NA

	Print	Sign	Date
Prepared by:	A. C. Eberhardt	A. C. Eberhardt	12/2/97
Reviewed by:	R. Namperumal	R. Namperumal	12-4-97

Type of Review: ☒ Detailed ☐ Alternate ☐ Test

DO ANY ASSUMPTIONS IN THIS CALCULATION REQUIRE LATER VERIFICATION ☐ YES ☒ NO

Tracked by: NA

REV: 2

REVISION SUMMARY: ADDED EVALUATION OF LEAK CHASE FOR DOWNCOMER BRACING EMBED PLATES. REVISED PAGES 1.1, 1.2, 2, 3, 26, ADDED PGS. 27 - 32 AND ATTACHMENT E, PGS E1-E6

Electronic Calculation Data Files:
(Program Name, Version, File name ext/size/date/hour/: min)

	Print	Sign	Date
Prepared by:	A.C EBERHARDT	A. C. Eberhardt	1-26-98
Reviewed by:	R. NAMPERUMAL	R. Namperumal	1-27-98

Type of Review: ☒ Detailed✓ ☐ Alternate ☐ Test

DO ANY ASSUMPTIONS IN THIS CALCULATION REQUIRE LATER VERIFICATION ☐ YES ☒ NO

Tracked by: NA

COMMONWEALTH EDISON COMPANY
CALCULATION TABLE OF CONTENTS

	PROJECT NO. 10248-012	
CALCULATION NO. L-001337	REV. NO. 2	PAGE NO. 2

2

This Calculation has been prepared using Mathcad Plus 5, S&L Program Number 03.7.548-5.0

Purpose and Objective

To perform a design assessment of 2" and 3" containment liner leak chase channels in the suppression pool and drywell. Discrepancies between design material yield strength and specified minimum material yield strength are addressed. In addition, the margin between specified yield and ultimate tensile strength as determined from vendor supplied certified material test reports (CMTRs) will be verified. Results are given in terms of margin factor which is defined as the ratio of allowable stress divided by actual stress. This calculation is performed in response to PIF # L1997-06237. Rev. 1 provides an enhancement to the discussion of jet impingement loads in the containment drywell but has no impact on the summary or conclusion. See page 27 for Rev. 2. 2

Methodology and Acceptance Criteria

This calculation shall be performed in accordance with the applicable documents listed as Design Inputs below. The acceptance criteria used for this assessment is given in Subsection 4.3.2 of the LaSalle Design Assessment Report (DAR) (D.I. 32). Applicable load combinations are defined in Table 4.3-2 of the DAR. Allowable stresses for load combinations 1 through 3 are per the 1969 AISC Specification. However, it has been demonstrated in previous calculations (see D.I. 33) that the governing load combinations involve either hydro-dynamic loads or jet impingement loads. For these load combinations, the allowable stress is limited to 0.95 fy. As permitted in Ref. 3, Sect. III.2.a, a 10% increase in minimum specified yield strength will be used to account for strain rate effects associated with impact loads. The allowable stress used for weld assessment is 21 ksi for all load combinations.

Assumptions

There are no unverified or unconservative assumptions used in this calculation.

Design Inputs (Check where applicable "APP")

APP

1) X DC-SE-01-LS, Rev. 7, Structural Project Design Criteria
2) ___ AISC's Manual of Steel Construction, Eighth Edition
3) X AISC's Manual of Steel Construction, Seventh Edition
4a) ___ ACI-318 Building Code Requirements for Reinforced Concrete Structures, 1983
4b) ___ ACI-349 Building Code Requirements for NSR Concrete Structures, 1980
5) ___ AISI's Cold Formed Steel Design Manual, 1983
6) X DC-SE-02-LS, Rev. 0, Seismic Response Spectra
7) X DC-SE-03-LS through DC-SE-09-LS, All Rev. 0, Hydrodynamic Response Spectra
8) ___ Calculation 802-100.2, Rev. 0, Pages 25-37, Peak g-values for Pipe Supports
9) ___ Calculation 802-100.2, Rev. 8, Pages 41-44, Peak g-values for Pipe Supports in the Drywell
10) ___ Calculation 802-100.2, Rev. 8, Page 40, Peak g-values for Electrical Supports in the Drywell
11) ___ Calculation 795, Rev. 0, Pages 42-43, Peak g-values for Cable Trays and Conduits
12) ___ DIT No. LS-EPED-0077-01 and Calculation No. GDS-3.6.6, Rev. 1, Reduced Conduit Weights
13) ___ S&L's SD&D Report No. 78, Rev. 4, Concrete Masonry Wall Design
14) ___ S&L's SDS-E5.0, Rev. 1, Loads, Load Combinations, and Allowables
15) ___ S&L's SDS-E11.0, Rev. 2 Hilti Kwik Bolt Design
16) ___ S&L's SDS-E11.0, Rev. 3 Hilti Kwik Bolt II Design
17) ___ S&L's SDS-E30.0, Rev. 0 Cable Tray Design

18) ___ S&L's SDS-E31.0, Rev. 2 Cable Tray Support Design
19) ___ S&L's SDS-E33.0, Rev. 3 Conduit and Conduit Support Design
20) _X_ S&L's SDS-E37.0, Rev. 5 Pipe Support Design
21) ___ S&L's SDS-E41.0, Rev. 2 Weld Design
22) ___ S&L's SDS-E44.0, Rev. 0 Embedment Plate Design
23) ___ Calculation 802-104.4, Rev. 9, Pages 4-5, Design Equations for Embedment Plates
24) _X_ LaSalle County Station Updated Final Safety Report, Rev. 11
25) _X_ LaSalle County Station Drawing S-384, Rev. U
26) ___ S&L's GDS-3.6.3, Rev. 3
27) ___ S&L's Project Instruction LSNS-22, Rev. 3
28) _X_ NUREG \CR-2913, "Two Phase Jet Loads" Published Jan. 1983 by SANDIA National Laboratories
29) ___ S&L's Project Instruction LSNS-16, Appendix I, Rev. 0
30) _X_ CBI Shop Drawings (See specific references below for Revision nos.)
31) _X_ SRV & LOCA Loads on Downcomer Bracing and Gusset Plates, NSLD Calc. 3C7-1179-002)
32) _X_ LaSalle County Station Mark II Design Assessment Report, Rev. 10
33) _X_ LaSalle Calculation 164, "Suppression Pool Liner Assessment & Anchorage Assessment"
34) _X_ LaSalle Calculation 3C7-1075-001, "Loads due to Loss-of Coolant Accident in LaSalle Containment," Rev. 6
35) _X_ LaSalle Specification J-2534, "Primary Containment Steel Liner Work", Amd. 3, 9-14-81

References

1. PIF # L1997-06237
2. Staad-III Structural Analysis, S&L Program # 03.7.065-20.2)
3. USNRC Standard Review Plan 3.6.2, Rev. 1, July 1981

GLOBAL UNIT DEFINITIONS :

$kip \equiv 1000 \cdot lbf$ $psf \equiv \frac{lbf}{ft^2}$ $ksf \equiv \frac{kip}{ft^2}$ $ksi \equiv \frac{kip}{in^2}$ $ORIGIN \equiv 1$

$lbs \equiv 1 \cdot lbf$ $lb \equiv 1 \cdot lbf$

Calculations

General Description

A total of three cases are considered to cover all variations in configuration, material properties, and governing load combinations. These three cases are described below as part of the calculation index.

Calculation Index

The calculation is divided into three sections to consider the following cases:

Pages 5 to 11, 2"x1"x 3/16" stainless steel channel subject to all loads in the suppression pool.

Pages 12 to 17, 3x4.1 channel subjected to jet impingement loads in the drywell and hydro-dynamic LOCA and SRV loads in the suppression pool.

Pages 18 to 24, 3x4.1 channel with one leg shortened by 1/2" to accommodate a thickened embed plate. This configuration is analyzed for hydro-dynamic LOCA and SRV loads in the suppression pool.

Case 1: 2"x1"x 3/16" Stainless Steel Channel

Preparation of Input to Staad Computer Model

This model includes the 2" channel as well as the half coupling and test plug connection detail shown in Section D-D on CBI dwg. 34, Rev. 3. This model covers all 2" channels on the wall and basemat. Joint coordinates are center line coordinates. Additional joints are provided so that stresses can be determined at the end of the fillets at each corner of the channel. Member properties of the channel web and flanges are based on a thickness tw of 3/16" and an effective width of 3.0". This is based on the criteria given in D.I. 20, Fig. 37.6.6-4 where ba is the side dimension of a square with an area equivalent to that of the 1/4" half coupling which has a diameter of 7/8".

$d := \frac{7}{8} \cdot in$ $tw := \frac{3}{16} \cdot in$

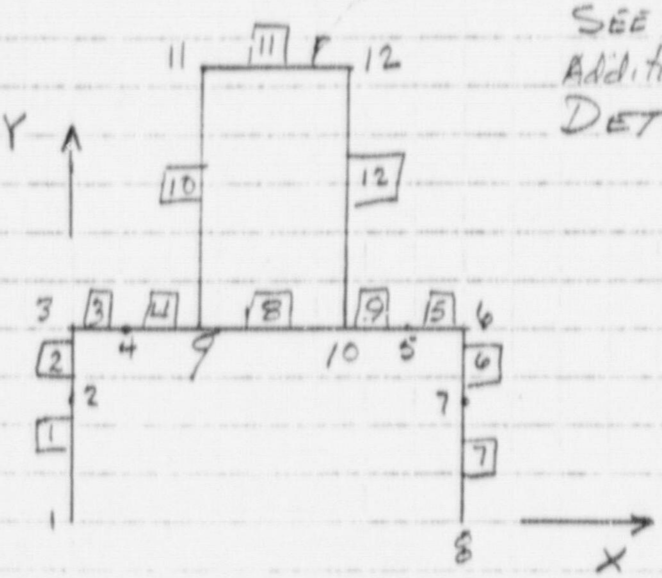
Equivalent square: $ba := \left(\pi \cdot \frac{d^2}{4}\right)^{.5}$ $ba = 0.78 \cdot in$

STAAD MODEL FOR CASE 1 - [2"x1"x 3/16"
WITH TEST COUPLING

Channel Properties
d = 2"
bf = 1"
tf = tw = 3/16"
k = 0.261" conservative

test coupling, see next page.

SEE NEXT 2 PAGES FOR ADDITIONAL MODEL DETAILS



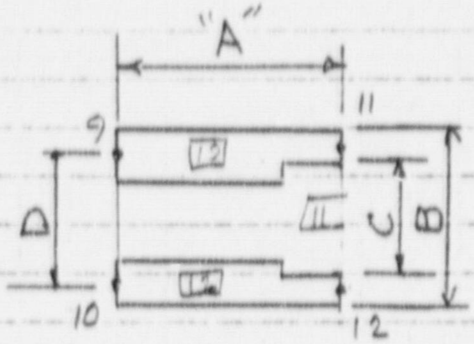
Joint	Coord.		Member	Incidences	
1	0	0	1	1	2
2	0	.7394	2	2	3
3	0	.9063	3	3	4
4	.1669	.9063	4	4	9
5	1.6456	.9063	5	5	6
6	1.8125	.9063	6	6	7
7	1.8125	.7394	7	7	8
8	1.8125	0	8	9	10
9	0.5475	.9063	9	10	5
10	1.264	.9063	10	9	11
11	0.5475	2.33	11	11	12
12	1.264	2.33	12	12	10

Sargent & Lundy	Calcs. For		Calc. No. L-001337	
			Rev. 0	Date
	Safety-Related	Non-Safety-Related	Page 5.2 of	

Client		Prepared by	Date
Project		Reviewed by	Date
Proj. No. 10248-012	Equip. No.	Approved by	Date

1/4"Φ 3,000 lb half coupling

A, B & C Dimensions From CATALOG W-6B
Bonney Forge
Allentown, PA



A = 1 1/8"
B = 7/8"
C = 0.555"

$D = B - \frac{B - C}{2}$

$= 7/8 - \frac{7/8 - .555}{2} = 0.715''$

$D/2 = 0.3575''$

DIM "A" including 1/4" PLUG

$= A + \frac{C}{2} = 1\,1/8 + \frac{0.555}{2} = 1.40$

USE 1.42"

Effective width $b = ba + 12 \cdot tw$

$b = 3.0 \cdot in$

C 2 x 1 x 3/16" Properties of Flange and Web

$b = 3.0 \cdot in$

$t = \frac{3}{16} \cdot in$

$AY = b \cdot t$

$IZ = \frac{b \cdot t^3}{12}$

$AY = 0.5625 \cdot in^2$

$IZ = 0.00165 \cdot in^4$

Note that Ax is calculated in the Staad program using the values of YD and ZD. Arbitrary values of IX, IY, and AZ are input to Staad but are not used in the analysis.

Member Properties of 1/4" Dia. 3000 lb. half coupling

From Catalog W-6B Bonney Forge, Allentown, PA

$A = 1.125 \cdot in$

$B = \frac{7}{8} \cdot in$

$C = .555 \cdot in$

Wall thickness $t = \frac{B - C}{2}$ $t = 0.16 \cdot in$

$b = B$

use $t = 0.17 \cdot in$

$b = 0.875 \cdot in$

$AY = b \cdot t$

$AY = 0.1488 \cdot in^2$

$IZ = \frac{b \cdot t^3}{12}$

$IZ = 0.0003582 \cdot in^4$

Note that Ax is calculated in the Staad program using the values of YD and ZD. Arbitrary values of IX, IY, and AZ are input to Staad but are not used in the analysis.

Loads:

The previous Calculation No. 164 (D.I. 33) identified the following critical loads: Maximum Accident Pressure = 45 psi (Ref. 32, Table 1.1-1) and LOCA Poolswell Impact.

As shown in Table 2 of D.I. 34, loads due to pool swell impact act on structures above the suppression pool located between El. 700'-2" (High water level in the suppression pool) and El. 718'-8" (Max. height of poolswell). The maximum value of pool swell impact pressure (= 643 psi) is used in this analysis.

Member Loads

Member loads due to poolswell act on members 1 and 2. The magnitude is equal to the pressure times the member width.

Uniform load, members 1 and 2: $GX := (643 + 45) \cdot 3.0 \cdot \frac{lbf}{in}$

$$GX = 2064 \cdot \frac{lbf}{in}$$

Poolswell impact pressure on circular half coupling and plug:

From D.I. 34, Table 3, the maximum value of pool swell impact pressure acting on circular pipe sections is 48.88 psi.

Uniform load, member 10: $GX := (48.88 + 45) \cdot 0.875 \cdot \frac{lbf}{in}$

$$GX = 82.14 \cdot \frac{lbf}{in}$$

Member loads on Members subjected to Accident Pressure = 45 psi

Uniform load, mems. 3 to 7 & 9: $GX1 := 45 \cdot 3.0 \cdot \frac{lbf}{in}$

$$GX1 = 135.0 \cdot \frac{lbf}{in}$$

Uniform load, members 11 & 12: $GX2 := 45 \cdot 0.875 \cdot \frac{lbf}{in}$

$$GX2 = 39.4 \cdot \frac{lbf}{in}$$

Uniform load, member 8:

Load on member 8 is equal to balance of load not acting on member 11.

$$GY := GX1 - GX2$$

$$GY = 95.6 \cdot \frac{lbf}{in}$$

Joint Loads

Member loads do not represent 100% of the pressure load acting on the channel because member length is based on center to center dimensions. Therefore, length times member width will not completely represent the total surface area subjected to pressure loads. For this reason, Joint loads are used to apply the additional load that acts on the missing surface area. Joint loads due to poolswell are applied to Joint 3. The magnitude is equal to the pressure times the missing surface area of the channel flange.

Flange length = 1" Length modeled in Staad = .9063"

Effective width = 3.0"

Missing surface area: $A := (1 - .9063) \cdot in \cdot 3.0 \cdot in$

$$A = 0.28 \cdot in^2$$

Pressure load = 688 psi

$$FX := 688 \cdot psi \cdot A$$

$$FX = 193.4 \cdot lbf$$

Evaluate joint force at Joints 3 & 6 due to LOCA Pressure = 45 psi

$FY := 45 \cdot psi \cdot A$

$FY = 12.65 \cdot lbf$

Thermal Load:

As stated in the previous Calculation No. 164 (D.I. 33) the channel is analyzed with and without the effects of temperature. The temperature change for the poolswell load condition is 76 deg. F.

Variations in Material Properties

Review of Vendor-supplied CMTRs shows that ASTM A276 Type 304 material has been supplied with two types of finishes. Hot-finished material has a yield of 30 ksi and an ultimate of 75 ksi, whereas cold-finished material has a yield of 45 ksi and an ultimate of 90 ksi. CMTRs are reviewed to determine the appropriate design yield strength for each channel configuration.

Material Yield Strength

The following documents related to Vendor Specification 2534 are provided in Attachment 4 of the calculations:

1. Stores and Metal Verification Summary & Supplement Sheets, File # 5.1 CCM
2. Material Heat Number Sheet, File No. 8.16-2, Document #18
3. Certified Material Test Reports, File No. 5.2

These documents identify the following material heats for 2x1x3/16" channels:

Heat No.	Min. Specified Yield Strength
23755	30,000 psi
F30188	30,000 psi
30660	45,000 psi
30706	45,000 psi
30844	45,000 psi
40523	30,000 psi
42379	30,000 psi

For the cases shown above, design yield strength is controlled by min. specified yield strength = 30 ksi. As permitted in Ref. 3, Section III.2.a, a 10% increase in min. specified design yield strength is used to account for strain rate effects associated with dynamic effects of LOCA loads such as jet impingement and poolswell impact loads

Therefore, the allowable stress is:

$$Fb := 0.95 \cdot 1.1 \cdot 30.0 \cdot ksi$$

$$Fb = 31.35 \cdot ksi$$

Results of Staad III Analysis:

Results of the analysis are shown in Attachment A.

Maximum member stress occurs in member 1 = 29.00 ksi. (See Page A7)

$$Mar11 := \frac{Fb}{29.00 \cdot ksi}$$

$$Mar11 = 1.08$$

Check weld based on reactions at Joints 1 and 8 (Max. reaction occurs at joint 1).

Weld force: $$fw := \frac{\left(1.434^2 + .4467^2\right)^{.5}}{3 \cdot in} \cdot kip$$

$$fw = 0.50 \cdot \frac{kip}{in}$$

Weld Allowable: $$Fw := 0.707 \cdot 21 \cdot ksi \cdot \frac{3}{16} \cdot in$$

$$Fw = 2.78 \cdot \frac{kip}{in}$$

$$Mar12 := \frac{Fw}{fw}$$

$$Mar12 = 5.56$$

<u>Check 3/16" weld between Channel and coupling for test plug:</u>

Diameter of circular weld = $B = 0.875 \cdot in$

Assume 1/2 of weld length is effective for Member no. 11 and 12, each.

Therefore, weld length = $L = 3.14159 \cdot \frac{B}{2}$

$L = 1.37 \cdot in$

Weld allowable = $Fw1 = Fw \cdot L$

$Fw1 = 3.83 \cdot kip$

Actual force in weld (Member 12 governs): $fw = \left(.0743^2 + .0499^2\right)^{.5} \cdot kip$

$fw = 0.09 \cdot kip$

$Mar13 = \frac{Fw1}{fw}$

$Mar13 = 42.75$

Inspection of this large margin shows that the half coupling and its attachment weld can easily resist the pool hydrodynamic loads.

Case 2: 3x4.1 Channel Subjected to Jet Impingement Loads

Preparation of Input to Staad Computer Model

This model covers the following two configurations:

1. Leak Test Assembly 39-EE located in the suppression pool (see CBI Dwg. No. 39, Rev. 5)
2. All 3" ASTM A36 leak chase channels in the drywell.

Joint coordinates are center line coordinates. Additional joints are provided so that stresses can be determined at the end of the fillets at each corner of the channel. Member properties of the channel web and flanges are based on an effective width of 1.00". Test couplings are not modeled for channels in the drywell because the design evaluation of the drywell channels is governed by jet impingement loads which are defined in D.I. #35, Sketch JF-1A on Page 2-2-7. The presence of a test coupling is not significant in the evaluation of "EE" assemblies because it is attached to a vertical channel which is not a highly loaded member in the assembly.

Member Properties

C3x4.1 Flange Properties (Members 1, 2, 6, 7)

$b := 1 \cdot in$ $t := 0.273 \cdot in$

$AY := b \cdot t$ $IZ := \frac{b \cdot t^3}{12}$

$IZ = 0.0016955 \cdot in^4$

$AY = 0.273 \cdot in^2$

Note that Ax is calculated in the Staad program using the values of YD and ZD. Arbitrary values of IX, IY, and AZ are input to Staad but are not used in the analysis.

C3x4.1 Web Properties (Members 3, 4, 5)

$b := 1 \cdot in$ $t := 0.170 \cdot in$

$A := b \cdot t$ $IZ := \frac{b \cdot t^3}{12}$

$IZ = 0.0004094 \cdot in^4$

$A = 0.1700 \cdot in^2$

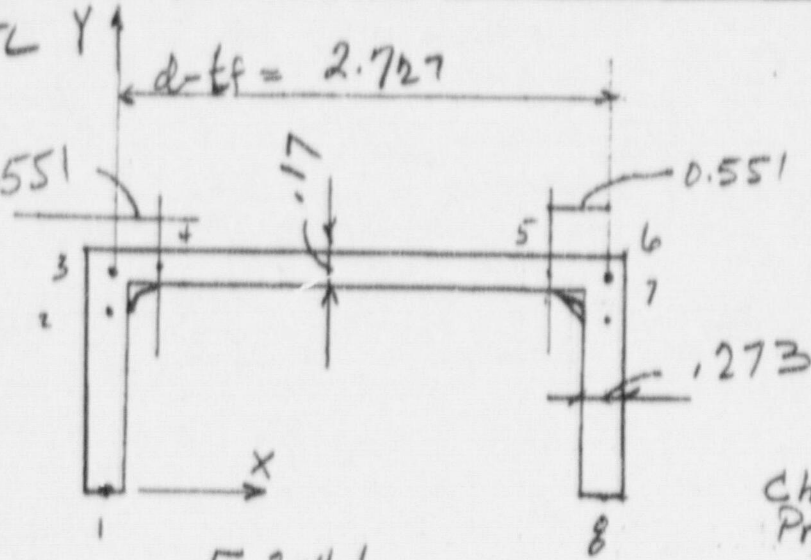
Note that Ax is calculated in the Staad program using the values of YD and ZD. Arbitrary values of IX, IY, and AZ are input to Staad but are not used in the analysis.

Sargent & Lundy

Calcs. For STAAD MODEL - CASE 2	Calc. No. L-001337
	Rev. 0 Date
Safety-Related / Non-Safety-Related	Page 12.1 of

Client	Prepared by / Date
Project	Reviewed by / Date
Proj. No. 10248-012 Equip. No.	Approved by / Date

STAAD MODEL



⊏ 3x4.1

Channel Properties
$d = 3''$
$bf = 1.41''$
$tf = 0.273$
$tw = 0.17$
$k = 11/16''$

JOINT COORDINATES

1	0	0
2	0	0.774
3	0	1.325
4	0.551	1.325
5	2.176	1.325
6	2.727	1.325
7	2.727	0.774
8	2.727	0

$(bf - \frac{t_w}{2})$

Member Incidences

1	1	2
2	2	3
3	3	4
4	4	5
5	5	6
6	6	7
7	7	8

Form GQ-3.08.1 Rev. 2

M3598.001 6-90

Loads:

Critical Assembly for C3x4.1 Evaluation

Review of CBI Dwgs. 32 Rev. 4 and 39 Rev. 5 indicates that all 3" leak test channels in the suppression pool have the inside leg of the channel shortened by 1/2" to accommodate attachment to the thickened liner embed plate. See Section A-A on Dwg. 32, Section D-D on Dwg. 39 and the related table which give the "C" dimension of 1/2". The only exception to this is Leak Test Ass'y EE on Dwg. 39 which has a "C" dimension of 0". This assembly is analyzed as a separate case since its specific configuration is more severe that those channels that have a C dimension = 1/2".

The previous Calculation No. 164 (D.I. 33) identified the following critical loads: Maximum Accident Pressure = 45 psi (Ref. 32, Table 1.1-1) and LOCA Poolswell Impact.

Review of CBI Dwgs. 34 through 37, Rev. 3, 7, 3, 6, respectively, shows that Ass'y EE is used at 8 locations: Four at El. 679'-0" and four at El. 726'-0". (Dwgs 1D through 1G, Revs. 8, 7, 4, 6, respectively.) These elevations will be used to reduce the poolswell impact loads on these critical channels.

As shown in Table 2 of D.I. 34, loads due to pool swell impact act on structures above the suppression pool located between El. 700'-2" (High water level in the suppression pool) and El. 718'-8" (Max. height of poolswell).

Based on Table 2, none of the "EE" assemblies lie in the zone subject to Poolswell Impact forces.

Other forces acting on the Ass'y EE leak test channels are tabulated in the load combination table given on page 26 of Calc. 164 (Ref. 33). After pool swell impact, the next most critical load combination is #8 which is jet impingement load. This load case governs the design of A36 channels in the drywell. Jet loads in the suppression pool are much smaller than in the drywell. The jet pressure on the basemat is a maximum of 33 psi and reduces to zero at El. 700'-2" (See Fig. 4 in D.I. 34). The related joint and member loads for the jet impingement load in the drywell are described below.

After pool swell impact, the next most critical load combination for channels in the suppression pool is Case #7 which applies a vertical pressure of 197.03 psi and horz. pressure of 161.13 psi.

Results of the Ass'y EE analysis for Load Combinations 7 are presented below. Results for the other 3" channels which have a "C" dimension = 1/2" and which are located in the poolswell impact zone are evaluated later using another Staad III model (See Case 3 below).

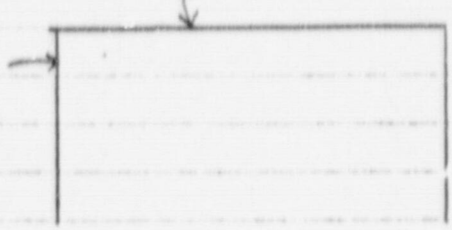
Review of CBI Dwgs. 288 through 291 and 294 through 297, Rev. 3, 3, 3, 4, 3, 3, 2, 3, respectively, shows that 3x4.1 channels (ASTM A36) have been used as leak chase channels in the drywell. Channels in the drywell are not subject to hydrodynamic impact loads, therefore the critical load for these channels is jet impingement. See load combination #8 in the load combination table given on page 26 of Calc. 164 (Ref. 33).

Sargent & Lundy	Calcs. For		Calc. No. L-001337
			Rev. 0 Date
	Safety-Related	Non-Safety-Related	Page 13.1 of

Client	Prepared by Date
Project	Reviewed by Date
Proj. No. 10248-012 Equip. No.	Approved by Date

STAAD ANALYSIS - LOAD CASE 1 - UNIFORM PRESSURE LOAD
(LOAD COMBINATION #7 in CALC #164, D.I. #33)
REVISED L.C. WHEN POOLSWELL
DOES NOT APPLY

D ESS LOCA SRV Pa
11.5 + 14.25 + 70.84 + 19.54 + 45 = 161.13 psi



D	11.5
ESS	4.36
LOCA	116.56
SRV	19.61
Pa	45.0
	197.03 psi

D	11.5
ESS	4.36
LOCA	45.00 } no drag load
SRV	17.94
Pa	45.0
	123.8 psi

Member Loads

Member loads due to Load Combination #7 applies a vertical pressure of 197.03 psi and horz. pressure of 161.13 psi.. The magnitude of the member load is equal to the pressure because the member width is 1". The vertical pressure is applied to members 1 & 2 and the horz. pressure is applied to Members 3 to 5.

The load on members 6 and 7 is the same as on members 1 and 2 minus the drag loads. From Calc. 164, Page 21, the LOCA drag load is 71.56 psi and the SRV drag load is 1.67 PSI.

Net Load on Members 6 & 7: $GX := (197.03 - 71.56 - 1.67) \cdot psi$

$GX = 123.80 \cdot psi$

Jet Impingement loads on Members 3, 4, and 5

As shown on Pages 26 and 27 of Calc. 164, Load Case 8 is the jet impingement pressure load of 467 lbs/in acting on members 3, 4, and 5 which represent the channel web.

Note: See Page 25 for further discussion of jet loads in the containment drywell area.

Joint Loads

Member loads do not represent 100% of the pressure load acting on the channel because member length is based on center to center dimensions. Therefore length times member width will not completely represent the total surface area subjected to pressure loads. For this reason, Joint loads are used to apply the additional load that acts on the missing surface area. Joint loads for Load Combination 7 are applied to Joints 3 and 6. The magnitude is equal to the pressure times the missing surface area of the channel flange and web.

Flange length = 1.41"
Length modeled in Staad = 1.325"

Web length = 3"
Length modeled in Staad = 2.727

Effective width = 1.0"

Missing surface area:

$Af := (1.41 - 1.325) \cdot in \cdot 1.0 \cdot in$

$Af = 0.0850 \cdot in^2$

$Aw := (3 - 2.727) \cdot 1 \cdot in^2$

Aw is distributed to joints 3 and 6, therefore:

$Aw := \frac{Aw}{2}$

$Aw = 0.14 \cdot in^2$

Pressure load for Jt. ? in X & Y directions = 197.03 psi & -161.13 psi, respectively

$FX := 197.03 \cdot psi \cdot Af$ $FY := -161.13 \cdot psi \cdot Aw$

$FX = 16.75 \cdot lbf$ $FY = -21.99 \cdot lbf$

Pressure load for Jt. 6 in X & Y directions = -123.8 psi & -161.13 psi, respectively

$FX := -123.8 \cdot psi \cdot Af$ $FY := -161.13 \cdot psi \cdot Aw$

$FX = -10.523 \cdot lbf$ $FY = -21.99 \cdot lbf$

Evaluate Joint Force at Joints 3 & 6 due to Jet Pressure = -467 psi

$FY := -467 \cdot psi \cdot Aw$

$FY = -63.75 \cdot lbf$

Thermal Load:

As stated in the previous Calculation No. 164 (D.I. 33) the channel is analyzed with and without the effects of temperature. The temperature change for the poolswell load condition is 76 deg. F, and the change for Jet Impingement Load is 30 deg. F. The 30 deg. change is accomplished by using a load factor of 0.4 in Load Combination 5.

Material Yield Strength

The following documents related to Vendor Specification 2534 are provided in Attachment 4 of the calculations:

1. Stores and Metal Verification Summary & Supplement Sheets, File # 5.1 CCM
2. Material Heat Number Sheet, File No. 8.16-2, Document #18
3. Certified Material Test Reports, File No. 5.2

These documents identify the following material heats for the 3x4.1 channels in Assembly 39-EE in the suppression pool:

Heat No.	Min. Specified Yield Strength	Actual Ultimate Strength Per CMTR
40079	30,000 psi	85,350
40489	45,000 psi	89,200

For the cases shown above, design yield strength is equal to the min. specified yield strength = 30 ksi. As permitted in Ref. 3, Section III.2.a, a 10% increase in the design yield strength is used to account for strain rate effects associated ... dynamic effects of LOCA loads such as jet impingement and poolswell impact loads. Therefore, the allowable stress for channels in the suppression pool is:

$$Fb1 := 0.95 \cdot 1.1 \cdot 30.0 \cdot ksi$$

$$Fb1 = 31.35 \cdot ksi$$

The CBI CMTR documents identify the following material heats for the ASTM A36 3x4.1 channels in drywell:

Heat No.	Min. Specified Yield Strength	Actual Tensile Strength Per CMTR
93063	36,000 psi	68,100 psi
94541	36,000 psi	72,300 psi

Design yield strength is equal to the min. specified yield strength = 36 ksi. In addition, a 10% increase in min. specified design yield strength is used as permitted to account for strain rate effects associated with jet impingement loads. Therefore, the allowable bending stress for channels in the drywell is:

$$Fb2 := 0.95 \cdot 1.1 \cdot 36.0 \cdot ksi$$

$$Fb2 = 37.62 \cdot ksi$$

Results of Staad III Analysis:

Results of the analysis are shown in Attachment B.

For the 3x4.1 channels in Assembly 39-EE in the suppression pool, the maximum member stress due to hydrodynamic load (L.C. #1) occurs in member 4 (12.57 ksi), and Fb1 is the allowable stress. For A36 channels in the drywell, the maximum member stress due to jet impingement occurs in member 4 (35.77 ksi), and Fb2 is the allowable stress.

Assembly 39-EE

$$Mar21 = \frac{Fb1}{12.57 \cdot ksi}$$

$$Mar21 = 2.49$$

ASTM A-36 Channels in Drywell

$$Mar21a = \frac{Fb2}{35.77 \cdot ksi}$$

$$Mar21a = 1.05$$

Check weld based on reactions at Joints 1 and 8 (Max. reaction occurs in L.C. #5).

Weld force: $fw = \left(.2038^2 + .7005^2\right)^{.5} \cdot kip$

$$fw = 0.73 \cdot kip$$

Weld Allowable: $Fw = 0.707 \cdot 21 \cdot ksi \cdot \frac{3}{16} \cdot in^2$

$$Fw = 2.78 \cdot kip$$

$$Mar22 = \frac{Fw}{fw}$$

$$Mar22 = 3.82$$

Case 3: 3x4.1 Channel With Short Leg

Preparation of Input to Staad Computer Model

This model covers all 3x4.1 channels billed on CBI Dwg. Nos. 32 (Rev. 4) and 39 (Rev. 5) other than those identified as Leak Test Assembly 39-EE (See Case 2). All Case 3 channels have one leg shortened by 1/2" as shown on Dwgs. 32 (Section A-A) and 39 (Section D-D).

Joint coordinates are center line coordinates. Additional joints are provided so that stresses can be determined at the end of the fillets at each corner of the channel. Member properties of the channel web and flanges are based on an effective width of 1.00". Test couplings are not modeled for this configuration because Ass'y A (Dwg. 32) and Detail E (Dwg. 39) show that test couplings on these assemblies are always mounted on a vertical leg of the assembly. The vertical leg is not the critical member for pool hydrodynamic loads because these impact loads primarily act in the vertical direction. Thus, the presence of a test coupling in the suppression pool is only significant when it is attached to a horizontal channel.

Member Properties

Member properties are the same as those used in the Case 2 model.

Material Yield Strength

The following documents related to Vendor Specification 2534 are provided in Attachment 4 of the calculations:

1. Stores and Metal Verification Summary & Supplement Sheets, File # 5.1 CCM
2. Material Heat Number Sheet, File No. 8.16-2, Document #18
3. Certified Material Test Reports, File No. 5.2

These documents identify the following material heats for the 3x4.1 channels billed on CBI Dwgs. 32 and 39:

Heat No.	Min. Specified Yield Strength	Actual Ultimate Strength per CMTR
30384	45,000 psi	91,400
40079	30,000 psi	85,350
40489	45,000 psi	89,200

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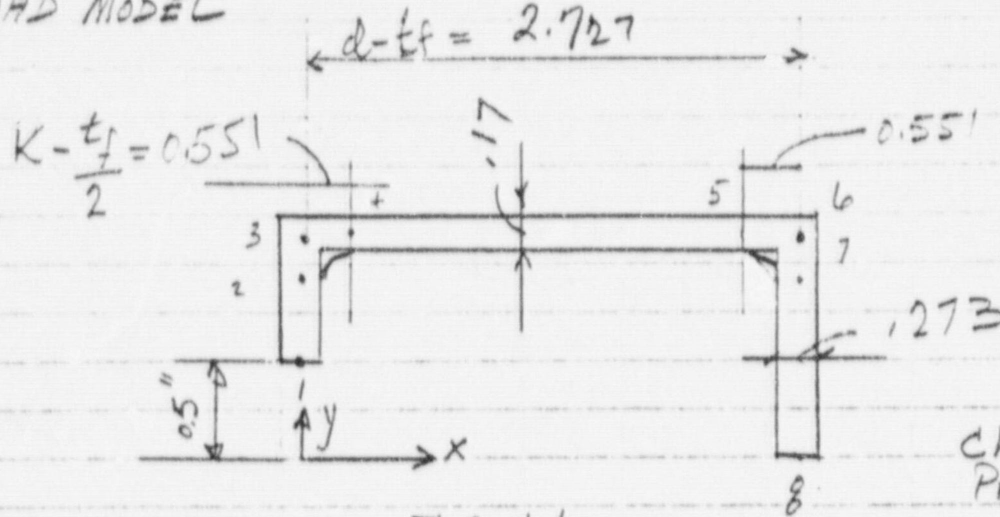
Calcs. For	STAAD MODEL – CASE 3		Calc. No.	L-001337
	Safety-Related	Non-Safety-Related	Rev. 0	Date
			Page 18.1	of

Client	
Project	
Proj. No. 10248-012	Equip. No.

	Date
Prepared by	
Reviewed by	
Approved by	

STAAD MODEL



⊏ 3x4.1

Channel Properties
$d = 3"$
$bf = 1.41"$
$tf = 0.273$
$tw = 0.17$
$k = 11/16"$

JOINT COORDINATES

1	0	0.5
2	0	0.774
3	0	1.325
4	0.551	1.325
5	2.176	1.325
6	2.727	1.325
7	2.727	0.774
8	2.727	0

$\left(bf - \frac{t_w}{2}\right)$

Member Incidences

1	1	2
2	2	3
3	3	4
4	4	5
5	5	6
6	6	7
7	7	8

Form GO-3.06.1 Rev. 2

Heat number 40079 has the lowest yield strength (Fy = 30 ksi, so the allowable stress is:

$$Fb1 = 0.95 \cdot 1.1 \cdot 30.0\ ksi$$

$$Fb1 = 31.35 \cdot ksi$$

Loads:

Critical Assembly for C3x4.1 Evaluation:

Review of the above specified CMTRs shows that channels from heat no. 40079 have a yield strength of 30 ksi. Based on previous calculations, it is necessary to reexamine the poolswell impact loads acting on the channels from heat no. 40079.

As shown in Table 2 of D.I. 34, loads due to pool swell impact act on structures above the suppression pool located between El. 700'-2" (High water level in the suppression pool) and El. 718'-8" (Max. height of poolswell). Therefore, CBI dwgs. 34 through 37 (Revision Nos. 3, 7, 3, 6, respectively) were reviewed to identify all '32'- and '39'-Series channel assemblies that fall within the poolswell zone. The following four assemblies were found to be subjected to significant poolswell impact loads: 39-A, 39-M, 39-N, 39-FF. Of these four, only Assembly 39-M had horizontal channels from heat no. 40079.

The center line elevation of 39-M is 703'-6" (See CBI dwgs. 1E and 1F, Revs. 7 & 4, respectively). Due to the poolswell phenomenon, the most critical load condition occurs when the lower flange of the bottom channel is impacted due to poolswell. This elevation corresponds to 702'-11 1/4". However, conservatively, poolswell for this case will be based on El. 704'-0". From Table 2 of D.I. 34, the poolswell impact at 704'-0" is 421.9 psi (A value of 422 psi will be used in this calculation. LOCA pressure is added to yield a total applied pressure of 422 + 45 = 467 psi.

Other forces acting on Ass'y 39-M are tabulated in the load combination table given on page 26 of Calc. 164 (Ref. 33). As stated earlier, jet impingement load is not a governing load in the suppression pool. Therefore, after pool swell impact, the next most critical load combination for channels in the suppression pool is Case #7 which applies a vertical pressure of 197.03 psi and horz. pressure of 161.13 psi.

The Staad model for this third configuration is analyzed for a total of nine load cases as described below:

Case 1. This case represents poolswell impact on the lower flange of the upper channel of Ass'y 39-FF.

Case 2. This case represents poolswell impact on the lower flange of the lower channel of Ass'y 39-FF. This case combined with thermal load produces the highest stresses and is used to qualify all channel assemblies built using heat numbers other than 40079.

Case 3. This case represents poolswell impact on the lower flange of the lower channel of Ass'y 39-M.

Case 4. This case represents Case #7 which applies a vertical pressure of 197.03 psi and horz. pressure of 161.13 psi..

Case 5. This case represents thermal effects due to accident temperature.

Cases 6, 7, 8, and 9 are the same as cases 1, 2, 3, and 4 combined with the appropriate thermal effects.

Member Loads

Load Case 1

Member loads due to poolswell + accident pressure acting on members 1 and 2. The magnitude is equal to the pressure times the member width.

Uniform load, Members 1 and 2: $GX = (643 + 45) \cdot 1.0 \cdot \frac{lbf}{in}$

$$GX = 688 \cdot \frac{lbf}{in}$$

Member loads on Members subjected to Accident Pressure = 45 psi

Uniform load, Members 3 to 7: $GX1 = 45 \cdot 1.00 \cdot \frac{lbf}{in}$

$$GX1 = 45.00 \cdot \frac{lbf}{in}$$

Joint Loads

Joint loads are applied to Joints 3 and 6 to account for the additional poolswell load or accident pressure that acts on surface area not represented by member length times width. The magnitude is equal to the pressure times the missing surface area of the channel flange and web.

Flange length = 1.41"
Length modeled in Staad = 1.325"

Web length = 3"
Length modeled in Staad = 2.727

Effective width = 1.0"

Missing surface area:

$Af := (1.41 - 1.325) \cdot in \cdot 1.0 \cdot in$

$Af = 0.0850 \cdot in^2$

$Aw := (3 - 2.727) \cdot 1 \cdot in^2$

Aw is distributed to joints 3 and 6, therefore:

$Aw := \frac{Aw}{2}$

$Aw = 0.14 \cdot in^2$

Pressure load for Jt. 3 in X & Y directions = 688 psi & - 45 psi, respectively

$FX := 688 \cdot psi \cdot Af$

$FX = 58.48 \cdot lbf$

$FY := -45 \cdot psi \cdot Aw$

$FY = -6.14 \cdot lbf$

Pressure load for Jt. 6 in X & Y directions = -45 psi

$FX := -45 \cdot psi \cdot Af$

$FX = -3.825 \cdot lbf$

$FY := -45 \cdot psi \cdot Aw$

$FY = -6.14 \cdot lbf$

Load Case 2

Load Case 2 is the same as Load case 1 except that poolswell impact pressure acts on Members 6 and 7 and Joint 6 instead of members 1 and 2 and Joint 3. Therefore, the loads for these members and joints are just the reverse case of Load Case 1.

Load Case 3

Load Case 3 represents poolswell impact on the lower flange of the lower channel of Ass'y 39-M. Member loads due to poolswell + accident pressure act on members 6 and 7. The magnitude is equal to the pressure times the member width. As stated earlier, the center line elevation of 39-M is 703'-6" (See CBI dwgs. 1E and 1F, Revs. 7 & 4, respectively). Due to the poolswell phenomenon, the most critical load condition occurs when the lower flange of the bottom channel is impacted due to poolswell. This elevation corresponds to 702'-11 1/4". However, conservatively, poolswell for this case will be based on El. 704'-0". From Table 2 of D.I. 34, the poolswell impact at 704'-0" is 421.9 psi (A value of 422 psi will be used in this calculation. LOCA pressure is added to yield a total applied pressure of 422 + 45 = 467 psi.

Uniform load, Members 6 and 7: $GX := (422 + 45) \cdot 1.0 \cdot \frac{lbf}{in}$

$GX = 467 \cdot \frac{lbf}{in}$

Member loads on members subjected to Accident Pressure = 45 psi

Uniform load, Members 1 to 5: $GX1 := 45 \cdot 1.00 \cdot \frac{lbf}{in}$

$GX1 = 45.00 \cdot \frac{lbf}{in}$

Joint Loads:

Joint loads are the same as for load case 2 except for 'oint 6. Pressure load for Jt. 3 in the -X direction = 467 psi:

$FX := 467 \cdot psi \cdot Af$

$FX = 39.69 \cdot lbf$

Load Case 4: Alternate Load Case 7 (Calculation 164)

As shown on Pages 26 of Calc. 164, there is an alternate Load Combination #7 which applies a vertical pressure of 197.03 psi and horz. pressure of 161.13 psi.. The magnitudes of the member loads and the joint loads are the same as Case 2 given on page 14 of this calculation except that the loads for these members and joints are just the reverse case, i.e., the maximum pressure load (197.03 psi) acts on Members 6 and 7 and Joint 6 instead of Members 1 and 2 and Joint 3.

Load Case 5: Thermal Load

As stated in the previous Calculation No. 164 (D.I. 33) the channel is analyzed with and without the effects of temperature. Since jet impingement load in the suppression pool is not a governing load condition, the temperature change corresponding to the poolswell load condition of 76 deg. F is used in the analysis.

Loads Cases 6, 7, 8 and 9:

These cases are the same as Cases 1, 2, 3, and 4 combined with thermal effects.

Results of Staad III Analysis:

Results of the analysis are shown in Attachment C. Review of member stresses shown on Page C7 shows that design of channels made from Heat No. 40079 is governed by Load Combination 8 (f8 = 26.17 ksi), and design of all other 3x4.1 channels covered in Case 3 is governed by Load Combination 7 (f7 = 39.04 ksi).

$f8 := 26.17 \cdot ksi$ $\qquad$ $f7 := 39.04 \cdot ksi$

Procedure for Adjusting Design Yield Stress

The CMTR for heat no. 40489 reports a yield of 51.6 ksi and an ultimate of 89.2 ksi. The yield meets the ASTM specified minimum of 45 ksi for cold-finished material, but the ultimate value is 0.8 ksi less than the minimum value of 90 ksi. In order to maintain the ASTM specified stress margin of 45 ksi between yield and ultimate, the design yield stress is adjusted to meet the following criteria:

$$Fy\ max \leq Fu - 45\ ksi.$$

Allowable Stress:

As stated previously, the 3x4.1 channel covered under this Case 3 analysis were manufactured from the following three heat numbers:

Heat No.	Min. Specified Yield Strength	Ultimate Strength from CMTR	
30384	45,000 psi	91,400	> 90,000 O.K.
40079	30,000 psi	85,350	> 75,000 O.K.
40489	45,000 psi	89,200	Revised Fy = 89,200 - 45,000 = 44,200

The heat number corresponding to Load Cases 3, 4, 8, and 9 is 40079, so Fy8 = 30.0 ksi.

Due to the adjusted design yield strength, Heat No. 40489 has the next lowest effective yield strength and controls for Load Case 7, so Fy7 = 44.2 ksi

The corresponding allowable stresses are:

$Fb8 := 0.95 \cdot 1.1 \cdot 30.0 \cdot ksi$

$Fb8 = 31.35 \cdot ksi$

$Fb7 := 0.95 \cdot 1.1 \cdot 44.2 \cdot ksi$

$Fb7 = 46.19 \cdot ksi$

The resulting design margins are:

$Mar31 := \frac{Fb8}{f8}$

$Mar31 = 1.20$

$Mar31a := \frac{Fb7}{f7}$

$Mar31a = 1.18$

Check weld based on reactions at Joints 1 and 8 (Max. reaction occurs in L.C. #2 at Jt. 8):

Weld force: $fw := \left(.5924^2 + .1064^2\right)^{.5} \cdot kip$

$fw = 0.60 \cdot kip$

Weld Allowable: $Fw := 0.707 \cdot 21 \cdot ksi \cdot \frac{3}{16} \cdot in^2$

$Fw = 2.78 \cdot kip$

$Mar32 := \frac{Fw}{fw}$

$Mar32 = 4.63$

Discussion of Jet Impingement Loads on Liner Leak Chase Channels Inside Containment Drywell

In the previous calculation (D.I. 33), the main purpose of the analysis was to analyze channels subject to hydrodynamic impact loads in the suppression pool. The jet impingement forces were not part of the governing load case in the suppression pool. This calculation includes qualification of ASTM A36 channels in the drywell, so a study is included here to document that jet loads act on the web of the leak chase channels and do not apply significant loading to the channel flanges.

The UFSAR (D.I. 24), Section 3.6, Table 3.6-8 provides a list of postulated pipe breaks inside the containment. Two types of breaks are postulated: Circumferential and Longitudinal. Circumferential breaks cause jets to develop parallel to the axis to the pipe, whereas Longitudinal breaks cause jets which act perpendicular to the axis of the pipe. Review of Figs. 3.6-1 through 3.6-15 shows that large bore high pressure piping inside the containment is close to the liner only at the containment wall penetration locations and these are always horizontal pipe runs. Thus, Circumferential breaks on these pipe runs govern the jet loads on the liner channel web while longitudinal breaks govern the load on the flanges of the channel. Vertical pipe runs are always away from the containment liner plate. Therefore, a jet force would apply a significant force to the channel flanges only if there is a postulated longitudinal pipe break at or very close to the containment wall pipe penetration.

Figs. 3.6-1 through 3.6-15 and Table 3.6-8 can be used to determine the approximate location of all longitudinal breaks inside the containment. Based on this information, the closest longitudinal breaks to the liner channels are the break numbers C214 and C214S shown in Figs. 3.6-3 and 3.6-6, respectively. Per Table 3.6-8, the pipewhip restraints which have been designed to restrain the pipe from whipping due to the postulated breaks at C214 and C214S are R-72 and R-88, respectively. These restraints are shown on LaSalle Dwg. S-384, Rev. U (D.I. 25). Using the dimensions shown on the plan view, the radial distance, D1, from the RPV center line to these restraints is obtained as:

$H1 := 27 \cdot ft + 7.125 \cdot in$ $H2 := 3 \cdot ft + 8 \cdot in$

$D1 := \left(H1^2 + H2^2\right)^{0.5}$ $A1 := acos\left(\frac{H2}{D1}\right)$

$D1 = 27.84 \cdot ft$

$A1 = 82.43 \cdot deg$

$\Gamma := 210 \cdot deg - A1$ $\Gamma = 127.57 \cdot deg$

The elbow at which the break occurs is located further from the liner than the restraint. Therefore, the location of the restraint conservatively can be used as the break location. From the sketch on Page 25.1, the distance, X, from the pipe break to the drywell liner is determined as shown on Page 25.2

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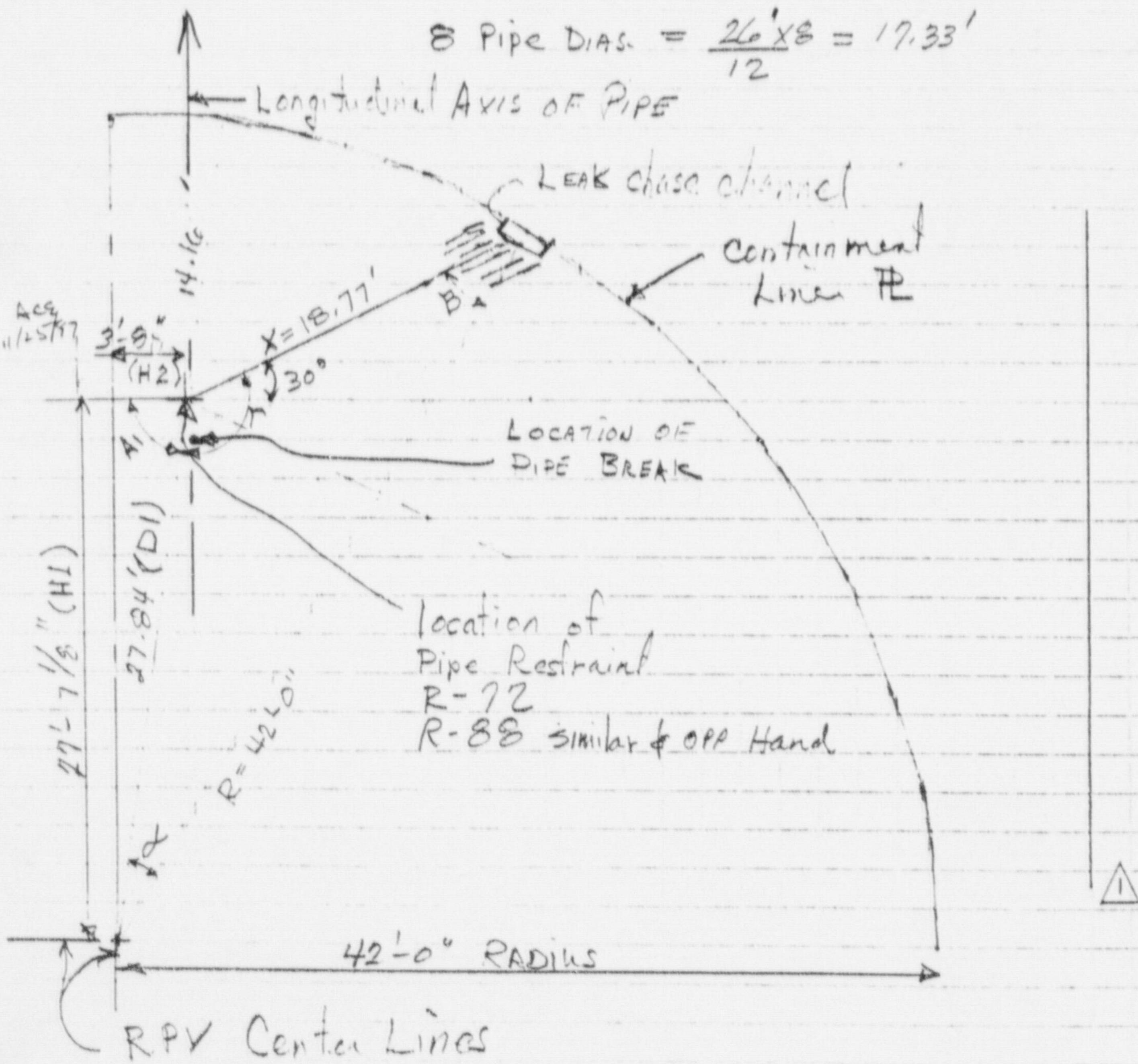
Calcs. For			
	Safety-Related		Non-Safety-Related

Calc. No. L-001337	
Rev. 01	Date
Page 25.1 of	

Client	
Project	
Proj. No. 10248-12	Equip. No.

Prepared by	Date
Reviewed by	Date
Approved by	Date

8 Pipe Dias. = $\frac{26'' \times 8}{12}$ = 17.33'



Radius to the drywell liner: $R := 42 \cdot ft$

Angle $B := asin\left(\frac{D1}{R} \cdot sin(\Gamma)\right)$

$B = 31.69 \cdot deg$

$\alpha := 180 \cdot deg - \Gamma - B$

$\alpha = 20.74 \cdot deg$

$X := R \cdot \frac{sin(\alpha)}{sin(\Gamma)}$

$X = 18.77 \cdot ft$

According to NUREG \CR-2913 (D.I. 28), it can be conservatively stated that pipe break forces are not significant at distances greater than 8 pipe diameters from the pipe break location. For the Main Steam line with a diameter of 26 in, this distance is:

$DIA := 26 \cdot in$

$D8 := 8 \cdot DIA$

$D8 = 17.33 \cdot ft$

The calculated distance to the liner is 18.77 ft which is greater than D8. Therefore, it can be concluded that none of the longitudinal breaks inside the containment will apply significant jet loads on the ASTM A36 liner leak chase channels in the containment drywell.

~~FINAL~~

SUMMARY AND CONCLUSIONS

In response to PIF # L1997-06237, three channel configurations have been evaluated in the suppression pool and the drywell. This assessment has been performed using minimum specified material yield strength as determined from vendor supplied certified material test reports (CMTRs). In addition, the design yield strength is reduced, if necessary, to maintain a minimum of 45 ksi between yield and ultimate. Results are given in terms of the margin factor which is defined as the ratio of allowable stress divided by actual stress.

All margin factors are greater than 1.0 thus demonstrating that all leak chase channels have been found to meet the acceptance criteria and are thus able to serve as part on the containment pressure boundary.

Margin factors are summarized below.

	Channel Section	Weld
Case 1:		
C 2 x 1 x 3/16	Mar11 = 1.08	Mar12 = 5.56
Case 2:		
Assembly 39-EE	Mar21 = 2.49	Mar22 = 3.82
Drywell Channels	Mar21a = 1.05	
Case 3:		
C3x4.1, Heat No. 40079	Mar31 = 1.20	Mar32 = 4.63
All other C3x4.1 in Suppression Pool	Mar31a = 1.18	

Purpose/Objective (Rev. 2)

To perform a design assessment of the containment liner leak chase system associated with the downcomer bracing embedment plates in the suppression pool. This assessment is required to support Licensing Event Report LER 97-030-00 which relates to the use of the liner leak chase system as part of the Containment pressure boundary.

Methodology and Acceptance Criteria

This calculation shall be performed in accordance with the applicable documents listed as Design Inputs listed on Pages 3, 4 and below. The acceptance criteria used for this assessment is given in Subsection 4.3.2 of the LaSalle Design Assessment Report (DAR) (D.I. 32). Applicable load combinations are defined in Table 4.3-2 of the DAR. Allowable stresses for load combinations 1 through 3 are per the 1969 AISC Specification. As explained in the previous revisions of this calculation, the governing load combinations for structural elements in the suppression pool are those which involve the various hydro-dynamic LOCA loads. For these load combinations, the allowable stress is limited to 0.95 Fy. As permitted in Ref. 3, Sect. III.2.a, a 10% increase in minimum specified yield strength will be used to account for strain rate effects associated with impact loads. The allowable stress used for weld assessment is 21 ksi for all load combinations.

Assumptions

There are no unverified or unconservative assumptions used in this calculation.

Design Input

See Pages 3 and 4 for D.I. 1 through D.I. 35.

36) X CBI Shop Drawing No. 107, Rev. 2, LaSalle Specification J-2990, "Downcomer Bracing Work"
37) X CBI Shop Drawing No. 108, Rev. 2, LaSalle Specification J-2990, "Downcomer Bracing Work"
38) X CBI Shop Drawing No. 111, Rev. 1, LaSalle Specification J-2990, "Downcomer Bracing Work"
39) X CBI Shop Drawing No. 114, Rev. 3, LaSalle Specification J-2990, "Downcomer Bracing Work"
40) X CBI Shop Drawing No. 123, Rev. 12, LaSalle Specification J-2990, "Downcomer Bracing Work"
41) X CBI Shop Drawing No. 124, Rev. 2, LaSalle Specification J-2990, "Downcomer Bracing Work"
42) X CBI Shop Drawing No. 129, Rev. 3, LaSalle Specification J-2990, "Downcomer Bracing Work"
43) X CBI Shop Drawing No. 137, Rev. 2, LaSalle Specification J-2990, "Downcomer Bracing Work"
44) X LaSalle Specification J-2990, "Downcomer Bracing Work," Amd. 2, 7-27-78.

References

See Page 4 for References 1 through 3.

CALCULATIONS

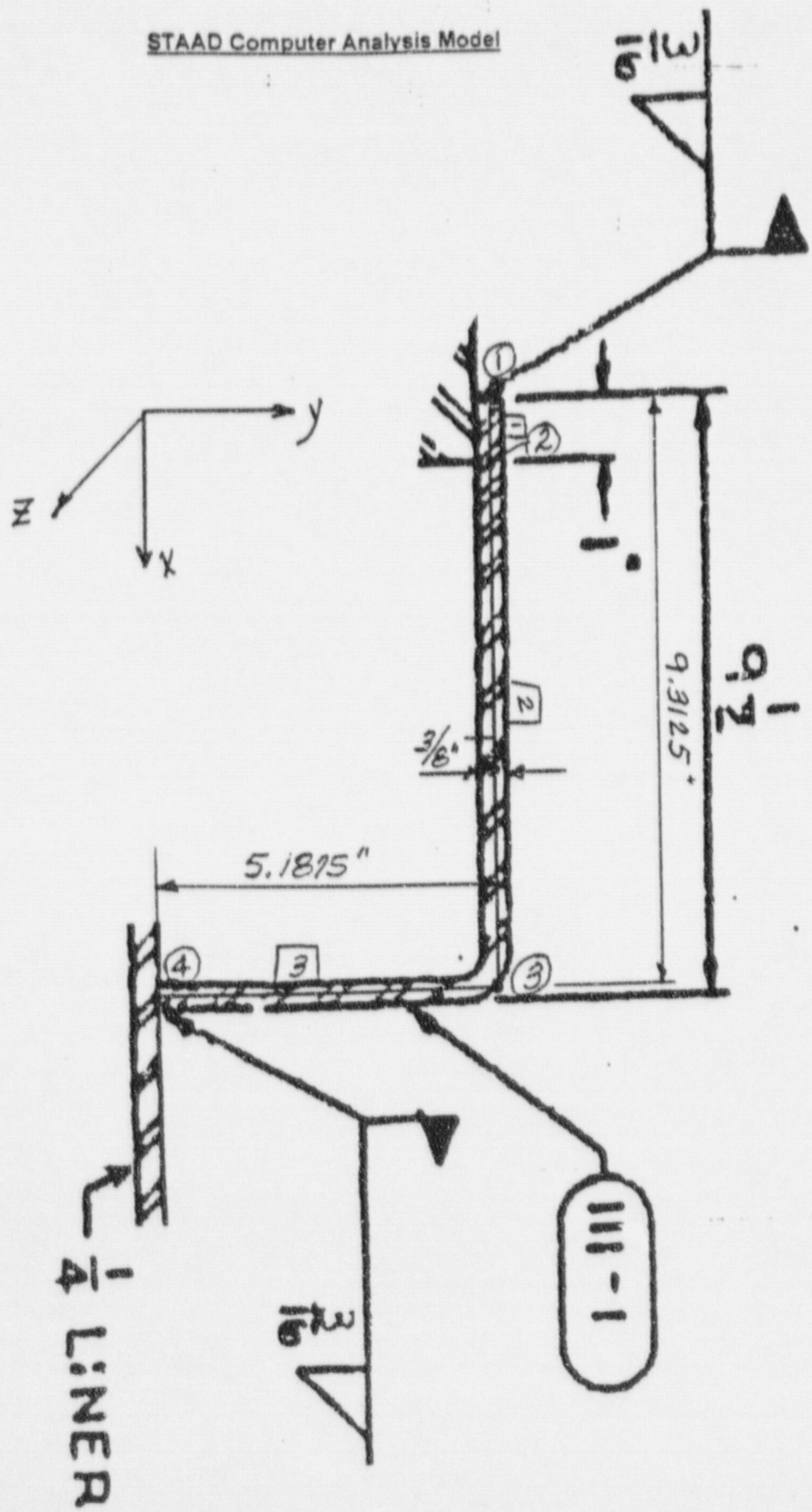
As stated above, the purpose of Rev. 2 of this calculation is to perform a design assessment of the containment liner leak chase system associated with the downcomer bracing embedment plates in the suppression pool. (See CBi drawings listed as D.I. Nos. 36 through 43.) The objective is to show that stresses under the critical load combinations meet the acceptance criteria so the plates and welds which form the leak chase can qualify to serve as part of the Containment Pressure Boundary. In those cases where the leak chase cannot be qualified, the air spaces must be unplugged so that the leak chase no longer serves as part of the containment pressure boundary.

The leak chase system consists of 3/8" Stainless Steel plates that form an air space which can be pressurized to test the weld between the containment liner plate and the downcomer bracing embed plates. As stated previously the controlling loads acting on the leak chase plates are the hydrodynamic LOCA loads which are defined in D.I. # 34.

As stated above under Methodology, acceptance of the leak chase system as part of the pressure boundary requires stresses to meet the allowable stress of 0.95 Fy under accident load combinations. This calculation will show that the leak chase for downcomer bracing embeds below El. 700' meets the acceptance criteria and are qualified to serve as part of the containment pressure boundary. On the other hand, hydrodynamic loads increase greatly above El. 700' such that the leak chase for downcomer bracing embed plates above El. 700' cannot be qualified for use as part of the pressure boundary. In this case, the plugs should be removed from the test couplings for the eighteen embed plates above El. 700' so that they no longer serve as part of the containment pressure boundary.

The following section describes the STAAD computer model which has been used to evaluate the hydrodynamic pressure load capacity of the leak chase for the downcomer bracing embed plates. The geometric properties of the STAAD model are based on the properties of the embed plates located most closely to the elevation where the pool swell impact load reaches its maximum value which is El. 709'-4". (See D. I. Nos. 34 and 36 to 43.)

STAAD Computer Analysis Model



Analysis of Peak Pressure Load Capacity

The purpose of the STAAD analysis is to determine the vertical pressure load which produces the maximum allowable stress of 0.95*1.1*Fy = 31.35 ksi where Fy = 30 ksi for SA 240 Type 304 per Spec. J-2990 (D.I. 44). The horizontal pressure for this analysis is set equal to the LOCA design basis accident pressure of 45 psi.

Results of STAAD Analysis

Through an iterative process, the allowable vertical pressure on the leak chase which meets the above stated acceptance criteria has been found to be 295 psi. This pressure produces a stress of 31.35 ksi in Member 3 of the STAAD model. (See page 6 of Attachment E). The maximum allowable hydrodynamic pool swell impact pressure is then found to be equal to 295 - 45 = 250 psi, where 45 psi is the LOCA design basis pressure.

The next step is to use the load data in Table 2 on Page 47 of D.I. 34 to determine the elevation where the pool swell impact pressure exceeds the allowable pressure of 250 psi. As shown in Table 2, the impact pressure exceeds 250 psi between Elevations 702'-3" and El. 717'-0". Review of D.I. Nos. 40 and 41 shows that there are 18 downcomer bracing embed plates that fall within this range.

Based on this analysis, it is concluded that the leak chase for these 18 embedment plates do not meet the acceptance criteria and thus do not qualify for use as part of the containment pressure boundary. For this reason, the plugs for these specific portions of the leak chase should be removed so that the leak chase no longer serves as part of the containment pressure boundary.

All remaining downcomer bracing embedment plates are below El. 700'. Therefore, the leak chase for these embedments are below the surface of the suppression pool and will be subjected to drag and lift loads as described in D.I. # 34.

Pool Swell Drag and Lift Loads on Leak Chase Plates Below El. 700'-0"

As stated in Section 3.5.3 of D.I. # 34, the standard drag pressure on plates, Ps, is determined from Fig 12 of D.I. # 34, and the acceleration drag load, Pv is determined from Fig. 14:

$$Ps\ max. = 15.4\ psi$$
$$Pv = Fv \cdot T = 0.57\ lbf/in^3 \cdot 3/8" = 0.214\ psi$$

where Fv is the acceleration drag load from Fig. 14 in lbf/in^3 and T is the plate thickness (in).

The total drag pressure is: $Pd = Ps + Pv = 15.4 + 0.2 = 15.6\ psi < 250\ psi$ O.K.

Drag Loads due to Fallback:

Per Section 3.5.7 of D.I. # 34, the standard drag pressure on plates, Ps, is determined from Fig. 28, and the acceleration drag is determined from Fig. 30 as follows:

Ps max. = 45.23 psi
Pv = Fv * T = 0.3226 lbf/in^3 * 3/8" = 0.121 psi

where Fv = Fa/V = 200 lbs/ 620 in^3 = 0.3226 lbf/in^3 (Fv is the acceleration drag load from Fig. 30 in lbf/in^3 and T is the plate thickness in inches.)

The total drag pressure Pd = Ps + Pv = 45.23 + 0.12 = 45.35 psi < 250 psi O.K.

On the basis of the large stress margin and the analyses performed earlier in this calculation, the leak chase welds are acceptable based on engineering judgment.

Therefore, it is concluded that the downcomer bracing embedment plate leak chase system located below El. 700'-0" in the suppression pool is subjected to hydrodynamic pressures that are less than the allowable of 250 psi. Therefore, the embedment plate leak chase below El. 700'-0" and the associated welds meet the stress acceptance criteria necessary to qualify for use as part of the containment pressure boundary.

Evaluation of Leak Chase for Bolt Cover Assembly (Ref. D.I. Nos. 39 and 42)

As shown in D.I. # 39, the leak chase for the bolt cover assembly is fabricated from 6" dia. seamless schedule 40 pipe, and the total length of the assembly, L, is 8". From D.I. # 44, the pipe material is SA-312, Type TP 304 which has a yield, Fy, of 30 ksi. The pipe section modulus, Sx, is 8.50 in^3 and the outside dia. (OD) is 6.625" (D.I. # 3). From Table 3 of D.I. #34, the maximum pool swell impact pressure, P, is found to be 48.88 psi.

Calculate Bending Stress, fb, due to Pool Swell Impact Load:

$P = 48.88\cdot psi$ $L = 8\cdot in$ $OD = 6.625\cdot in$ $Fy = 30\cdot ksi$

$Sx = 8.50\cdot in^3$ $Mx = OD\cdot P\cdot\frac{L^2}{2}$ $Mx = 1.036\cdot 10^4\ \cdot in\cdot lbs$

$fb = \frac{Mx}{Sx}$ $fb = 1.22\ \cdot ksi$ $IC = \frac{fb}{0.95\cdot 1.1\cdot Fy}$ $IC = 0.04$ < 1.0 O.K.

On the basis of this very low IC value, the leak chase welds are acceptable based on engineering judgment. Therefore, the leak chase for the downcomer bracing embedment plate bolt cover assemblies at all elevations within the wetwell and the associated welds meet the acceptance criteria.

Summary and Conclusion (Revision 2 only)

Revision 2 of this calculation covers the design assessment of the containment liner leak chase system associated with the downcomer bracing embedment plates in the suppression pool. The following conclusions can be drawn.

1. The containment liner leak chase system associated with the downcomer bracing embedment plates is located in the suppression pool between Elevations 681' and 710'. The leak chase located above El. 700' is subjected to pool swell impact pressures greater than the allowable of 250 psi. Therefore, this portion of the leak chase does not meet the established criteria and therefore cannot be considered to serve as part of the containment pressure boundary. The plugs for this portion of the leak chase should be permanently removed.

2. The leak chase located below El. 700' is subjected to pool swell drag and fallback pressures less than the allowable of 250 psi. As a result, this portion of the leak chase does meet the acceptance criterion, and therefore, this portion of the downcomer bracing embedment leak chase and the associated welds are considered acceptable for use as part of the containment pressure boundary.

3. The Leak Chase for the Bolt Cover Assembly has been evaluated for the maximum hydrodynamic pool swell impact pressure within the suppression pool and has been found to meet the acceptance criteria by a large margin. Therefore, the leak chase for Bolt Cover Assembly and the associated welds are considered acceptable for use as part of the containment pressure boundary.

This assessment has been performed to support Licensing Event Report LER 97-030-00 which relates to the use of the liner leak chase system as part of the Containment pressure boundary.

See Page 26 for the Summary and Conclusions relating to Revisions 0 and 1 of this calculation.

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**************************************************
*                                                *
*           S T A A D - III                      *
*           Revision 20.2                        *
*           Proprietary Program of               *
*           Research Engineers, Inc.             *
*           Date=    OCT 22, 1997                *
*           Time=       9: 5:13                  *
*                                                *
*      USER ID: SARGENT & LUNDY ENGRS            *
**************************************************
```

```
STAAD PLANE 2X1X3/16 CHANNEL & TEST PLUG
INPUT WIDTH 72
UNIT INCHES POUND
JOINT COORDINATES
1 0. 0.; 2 0. .7394; 3 0. .9063; 4 .1669 .9063; 5 1.6456 .9063
6 1.8125 .9063; 7 1.8125 .7394; 8 1.8125 0.
9 0.5475 .9093; 10 1.264 .9063; 11 .5475 2.33; 12 1.264 2.33
MEMBER INCIDENCES
1 1 2; 2 2 3; 3 3 4; 4 4 9; 5 5 6; 6 6 7; 7 7 8
8 9 10; 9 10 5; 10 9 11; 11 11 12; 12 10 12
MEMBER PROPERTY AMERICAN
1 TO 9 PRI IX .1 IY 8.E-4 IZ 1.65E-3 AY .5625 AZ .3 YD .1875 ZD 3.00
10 11 12 PRI IX .1 IY 4E-4 IZ 3.582E-4 AY .1488 AZ .1 YD .17 ZD .875
MEMBER RELEASE
10 12 START MZ
CONSTANTS
E STEEL ALL
POISSON STEEL ALL
DENSITY STEEL ALL
BETA 0. ALL
* STAINLESS STEEL
ALPHA 99E-7 ALL
SUPPORTS
1 8 PINNED
LOAD 1 LC 4,5,7
JOINT LOAD
3 FX 193.4 FY -12.65
6 FX -12.65 FY -12.65
MEMBER LOAD
1 2 UNI GX 2064.
3 4 5 9 UNI GY -135.
6 7 UNI GX -135.
8 UNI GY -95.6
10 UNI GX 82.14
11 UNI GY -39.4
12 UNI GX -39.4
LOAD 2 THERMAL
TEMP LOAD
3 4 5 8 9 11 TEMP 76.
LOAD COMB 3
1 1. 2 1.
```

```
42. LOAD LIST ALL
43. PERFORM ANALYSIS


      P R O B L E M   S T A T I S T I C S
      -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    12/   12/    2
  ORIGINAL/FINAL BAND-WIDTH =     5/    2
  TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =     32
  SIZE OF STIFFNESS MATRIX =      288 DOUBLE PREC. WORDS
  REQRD/AVAIL. DISK SPACE =  12.02/ 1069.5 MB,  EXMEM =  1.02 MB

++ PROCESSING ELEMENT STIFFNESS MATRIX.              9: 5:14
++ PROCESSING GLOBAL STIFFNESS MATRIX.               9: 5:14
++ PROCESSING TRIANGULAR FACTORIZATION.              9: 5:14
++ CALCULATING JOINT DISPLACEMENTS.                  9: 5:14
++ CALCULATING MEMBER  FORCES.                       9: 5:14

44. PRINT JOINT DISP LIST 3 6
```

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
3	1	0.00652	0.00002	0.00000	0.00000	0.00000	-0.00293
	2	-0.00068	.00000	0.00000	0.00000	0.00000	0.00056
	3	0.00585	0.00002	0.00000	0.00000	0.00000	-0.00237
6	1	0.00645	-0.00004	0.00000	0.00000	0.00000	-0.00358
	2	0.00068	0.00000	0.00000	0.00000	0.00000	-0.00056
	3	0.00713	-0.00004	0.00000	0.00000	0.00000	-0.00414

************** END OF LATEST ANALYSIS RESULT **************

45. PRINT MEMBER FORCES LIST 1 4 7 9 10 12

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- POUN INCH

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	-446.67	1434.44	0.00	0.00	0.00	0.00
		2	446.67	91.68	0.00	0.00	0.00	496.42
	2	1	0.00	-32.51	0.00	0.00	0.00	0.00
		2	0.00	32.51	0.00	0.00	0.00	-24.04
	3	1	-446.67	1401.93	0.00	0.00	0.00	0.00
		2	446.67	124.19	0.00	0.00	0.00	472.38
4	1	4	625.78	-486.80	0.00	0.00	0.00	-373.83
		9	-625.38	538.18	0.00	0.00	0.00	178.77
	2	4	32.51	-0.26	0.00	0.00	0.00	29.46
		9	-32.51	0.26	0.00	0.00	0.00	-29.56
	3	4	658.29	-487.06	0.00	0.00	0.00	-344.36
		9	-657.89	538.44	0.00	0.00	0.00	149.21
7	1	7	716.66	654.98	0.00	0.00	0.00	447.39
		8	-716.66	-555.17	0.00	0.00	0.00	0.00
	2	7	0.00	32.51	0.00	0.00	0.00	24.04
		8	0.00	-32.51	0.00	0.00	0.00	0.00
	3	7	716.66	687.50	0.00	0.00	0.00	471.43
		8	-716.66	-587.68	0.00	0.00	0.00	0.00
9	1	10	690.17	-629.97	0.00	0.00	0.00	192.75
		5	-690.17	681.48	0.00	0.00	0.00	-442.97
	2	10	32.51	0.00	0.00	0.00	0.00	29.46
		5	-32.51	0.00	0.00	0.00	0.00	-29.46
	3	10	722.68	-629.97	0.00	0.00	0.00	222.21
		5	-722.68	681.48	0.00	0.00	0.00	-472.43
10	1	9	-46.06	66.85	0.00	0.00	0.00	0.00
		11	46.06	49.85	0.00	0.00	0.00	12.08
	2	9	0.00	0.00	0.00	0.00	0.00	0.00
		11	0.00	0.00	0.00	0.00	0.00	-0.01
	3	9	-46.06	66.84	0.00	0.00	0.00	0.00
		11	46.06	49.85	0.00	0.00	0.00	12.07
12	1	10	74.29	-6.25	0.00	0.00	0.00	0.00
		12	-74.29	-49.85	0.00	0.00	0.00	31.04
	2	10	0.00	0.00	0.00	0.00	0.00	0.00
		12	0.00	0.00	0.00	0.00	0.00	0.01
	3	10	74.29	-6.24	0.00	0.00	0.00	0.00
		12	-74.29	-49.85	0.00	0.00	0.00	31.05

************** END OF LATEST ANALYSIS RESULT **************

46. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT POUN INCH STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-1434.44	-446.67	0.00	0.00	0.00	0.00
	2	32.51	0.00	0.00	0.00	0.00	0.00
	3	-1401.93	-446.67	0.00	0.00	0.00	0.00
8	1	-555.17	716.66	0.00	0.00	0.00	0.00
	2	-32.51	0.00	0.00	0.00	0.00	0.00
	3	-587.68	716.66	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

47. PRINT MEMBER STRESSES LIST 1 4 7 9

MEMBER STRESSES

ALL UNITS ARE POUN/SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
1	1	.0	794.1 T	0.0	0.0	794.1	2550.1	0.0
		1.00	794.1 T	0.0	28205.6	28999.7	163.0	0.0
	2	.0	0.0 T	0.0	0.0	0.0	57.8	0.0
		1.00	0.0 T	0.0	1365.8	1365.8	57.8	0.0
	3	.0	794.1 T	0.0	0.0	794.1	2492.3	0.0
		1.00	794.1 T	0.0	26839.8	27633.9	220.8	0.0
4	1	.0	1112.5 C	0.0	21240.2	22352.8	865.4	0.0
		1.00	1111.8 C	0.0	10157.3	11269.0	956.8	0.0
	2	.0	57.8 C	0.0	1674.1	1731.9	0.5	0.0
		1.00	57.8 C	0.0	1679.6	1737.4	0.5	0.0
	3	.0	1170.3 C	0.0	19566.2	20736.4	865.9	0.0
		1.00	1169.6 C	0.0	8477.6	9647.2	957.2	0.0
7	1	.0	1274.1 C	0.0	25420.0	26694.1	1164.4	0.0
		1.00	1274.1 C	0.0	0.0	1274.1	987.0	0.0
	2	.0	0.0 C	0.0	1365.8	1365.8	57.8	0.0
		1.00	0.0 C	0.0	0.0	0.0	57.8	0.0
	3	.0	1274.1 C	0.0	26785.8	28059.9	1222.2	0.0
		1.00	1274.1 C	0.0	0.0	1274.1	1044.8	0.0
9	1	.0	1227.0 C	0.0	10951.5	12178.4	1119.9	0.0
		1.00	1227.0 C	0.0	25168.7	26395.7	1211.5	0.0
	2	.0	57.8 C	0.0	1674.1	1731.9	0.0	0.0
		1.00	57.8 C	0.0	1674.1	1731.9	0.0	0.0
	3	.0	1284.8 C	0.0	12625.6	13910.3	1119.9	0.0
		1.00	1284.8 C	0.0	26842.8	28127.6	1211.5	0.0

************** END OF LATEST ANALYSIS RESULT **************

48. FINISH

*************** END OF STAAD-III ***************

**** DATE= OCT 22,1997 TIME= 9: 5:15 ****

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**************************************************
*                                                *
*           S T A A D - III                      *
*           Revision 20.2                        *
*           Proprietary Program of               *
*           Research Engineers, Inc.             *
*           Date=    SEP 30, 1997                *
*           Time=    10:42:16                    *
*                                                *
*      USER ID: SARGENT & LUNDY ENGRS            *
**************************************************

  1. STAAD PLANE 3X4.19 CHANNEL
  2. INPUT WIDTH 72
  3. UNIT INCHES POUND
  4. JOINT COORDINATES
  5. 1 0. 0.; 2 0. .774; 3 0. 1.325; 4 0.551 1.325; 5 2.176 1.325
  6. 6 2.727 1.325; 7 2.727 0.774; 8 2.727 0.
  7. MEMBER INCIDENCES
  8. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 5 6; 6 6 7; 7 7 8
  9. MEMBER PROPERTY AMERICAN
 10. 1 2 PRI IX .1 IY .0016955 IZ .0016955 AY .273 AZ .2 YD .273 ZD 1
 11. 3 4 5 PRI IX .1 IY .0004094 IZ .0004094 AY .170 AZ .2 YD .170 ZD 1
 12. 6 7 PRI IX .1 IY .0016955 IZ .0016955 AY .273 AZ .2 YD .273 ZD 1
 13. CONSTANTS
 14. E STEEL ALL
 15. POISSON STEEL ALL
 16. DENSITY STEEL ALL
 17. BETA 0. ALL
 18. * STAINLESS STEEL
 19. ALPHA 99E-7 ALL
 20. SUPPORTS
 21. 1 8 PINNED
 22. LOAD 1 LC 4,5,7
 23. JOINT LOAD
 24. 3 FX 16.75 FY -21.99
 25. 6 FX -10.523 FY -21.99
 26. MEMBER LOAD
 27. 1 2 UNI GX 197.03
 28. 3 4 5 UNI GY -161.13
 29. 6 7 UNI GX -123.8
 30. LOAD 2 JET IMPINGEMENT
 31. JOINT LOAD
 32. 3 FY -63.75
 33. 6 FY -63.75
 34. MEMBER LOAD
 35. 3 4 5 UNI GY -467.0
 36. LOAD 3 THERMAL
 37. TEMP LOAD
 38. 3 4 5 TEMP 76.
 39. LOAD COMB 4
 40. 1 1. 3 1.
 41. LOAD COMB 5 JET IMPINGEMT + THERMAL
```

```
42. 2 1. 3 0.40
43. LOAD LIST ALL
44. PERFORM ANALYSIS


      P R O B L E M   S T A T I S T I C S
      -----------------------------------

 NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =      8/     7/     2
 ORIGINAL/FINAL BAND-WIDTH =     1/     1
 TOTAL PRIMARY LOAD CASES  =     3, TOTAL DEGREES OF FREEDOM =     20
 SIZE OF STIFFNESS MATRIX =      120 DOUBLE PREC. WORDS
 REQRD/AVAIL. DISK SPACE =  12.01/ 1070.8 MB,  EXMEM =  1.02 MB

++ PROCESSING ELEMENT STIFFNESS MATRIX.          10:42:17
++ PROCESSING GLOBAL STIFFNESS MATRIX.           10:42:17
++ PROCESSING TRIANGULAR FACTORIZATION.          10:42:18
++ CALCULATING JOINT DISPLACEMENTS.              10:42:18
++ CALCULATING MEMBER  FORCES.                   10:42:18

45. PRINT JOINT DISP LIST 3 6
```

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
3	1	0.00245	-0.00004	0.00000	0.00000	0.00000	-0.00200
	2	0.00006	-0.00012	0.00000	0.00000	0.00000	-0.00251
	3	-0.00102	0.00000	0.00000	0.00000	0.00000	0.00072
	4	0.00143	-0.00004	0.00000	0.00000	0.00000	-0.00129
	5	-0.00035	-0.00012	0.00000	0.00000	0.00000	-0.00223
6	1	0.00235	-0.00004	0.00000	0.00000	0.00000	-0.00081
	2	-0.00006	-0.00012	0.00000	0.00000	0.00000	0.00251
	3	0.00102	0.00000	0.00000	0.00000	0.00000	-0.00072
	4	0.00337	-0.00004	0.00000	0.00000	0.00000	-0.00152
	5	0.00035	-0.00012	0.00000	0.00000	0.00000	0.00223

************** END OF LATEST ANALYSIS RESULT **************

46. PRINT MEMBER FORCES LIST 1 4 7

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- POUN INCH

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	215.09	86.47	0.00	0.00	0.00	0.00
		2	-215.09	66.03	0.00	0.00	0.00	7.91
	2	1	700.50	-201.91	0.00	0.00	0.00	0.00
		2	-700.50	201.91	0.00	0.00	0.00	-156.28
	3	1	0.00	-4.70	0.00	0.00	0.00	0.00
		2	0.00	4.70	0.00	0.00	0.00	-3.64
	4	1	215.09	81.76	0.00	0.00	0.00	0.00
		2	-215.09	70.74	0.00	0.00	0.00	4.27
	5	1	700.50	-203.79	0.00	0.00	0.00	0.00
		2	-700.50	203.79	0.00	0.00	0.00	-157.74
4	1	4	191.35	104.32	0.00	0.00	0.00	-23.55
		5	-191.35	157.52	0.00	0.00	0.00	-19.67
	2	4	201.91	379.44	0.00	0.00	0.00	-12.43
		5	-201.91	379.44	0.00	0.00	0.00	12.43
	3	4	4.70	0.00	0.00	0.00	0.00	6.23
		5	-4.70	0.00	0.00	0.00	0.00	-6.23
	4	4	196.05	104.32	0.00	0.00	0.00	-17.32
		5	-196.05	157.52	0.00	0.00	0.00	-25.90
	5	4	203.79	379.44	0.00	0.00	0.00	-9.93
		5	-203.79	379.44	0.00	0.00	0.00	9.93
7	1	7	268.29	112.61	0.00	0.00	0.00	50.08
		8	-268.29	-16.79	0.00	0.00	0.00	0.00
	2	7	700.50	201.91	0.00	0.00	0.00	156.28
		8	-700.50	-201.91	0.00	0.00	0.00	0.00
	3	7	0.00	4.70	0.00	0.00	0.00	3.64
		8	0.00	-4.70	0.00	0.00	0.00	0.00
	4	7	268.29	117.31	0.00	0.00	0.00	53.72
		8	-268.29	-21.49	0.00	0.00	0.00	0.00
	5	7	700.50	203.79	0.00	0.00	0.00	157.74
		8	-700.50	-203.79	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

47. SECTION 0. .5 1. MEMB 4
48. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT POUN INCH STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-86.47	215.09	0.00	0.00	0.00	0.00
	2	201.91	700.50	0.00	0.00	0.00	0.00
	3	4.70	0.00	0.00	0.00	0.00	0.00
	4	-81.76	215.09	0.00	0.00	0.00	0.00
	5	203.79	700.50	0.00	0.00	0.00	0.00
8	1	-16.79	268.29	0.00	0.00	0.00	0.00
	2	-201.91	700.50	0.00	0.00	0.00	0.00
	3	-4.70	0.00	0.00	0.00	0.00	0.00
	4	-21.49	268.29	0.00	0.00	0.00	0.00
	5	-203.79	700.50	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

49. * UNIT INCH KIP
50. PRINT MEMBER STRESSES LIST 1 4 7

MEMBER STRESSES

ALL UNITS ARE POUN/SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
1	1	.0	787.9 C	0.0	0.0	787.9	316.7	0.0
		1.00	787.9 C	0.0	636.7	1424.5	241.9	0.0
	2	.0	2565.9 C	0.0	0.0	2566.0	739.6	0.0
		1.00	2565.9 C	0.0	12581.7	15147.7	739.6	0.0
	3	.0	0.0 T	0.0	0.0	0.0	17.2	0.0
		1.00	0.0 T	0.0	293.1	293.1	17.2	0.0
	4	.0	787.9 C	0.0	0.0	787.9	299.5	0.0
		1.00	787.9 C	0.0	343.6	1131.4	259.1	0.0
	5	.0	2565.9 C	0.0	0.0	2566.0	746.5	0.0
		1.00	2565.9 C	0.0	12699.0	15264.9	746.5	0.0
4	1	.0	1125.6 C	0.0	4890.4	6015.9	613.6	0.0
		0.50	1125.6 C	0.0	11445.9	12571.5	156.5	0.0
		1.00	1125.6 C	0.0	4083.4	5209.0	926.6	0.0
	2	.0	1187.7 C	0.0	2579.8	3767.5	2232.0	0.0
		0.50	1187.7 C	0.0	34583.8	35771.6	0.0	0.0
		1.00	1187.7 C	0.0	2579.8	3767.5	2232.0	0.0
	3	.0	27.7 C	0.0	1294.0	1321.6	0.0	0.0
		0.50	27.7 C	0.0	1294.0	1321.6	0.0	0.0
		1.00	27.7 C	0.0	1294.0	1321.6	0.0	0.0
	4	.0	1153.2 C	0.0	3596.4	4749.6	613.6	0.0
		0.50	1153.2 C	0.0	10151.9	11305.2	156.5	0.0
		1.00	1153.2 C	0.0	5377.4	6530.6	926.6	0.0
	5	.0	1198.8 C	0.0	2062.2	3261.0	2232.0	0.0
		0.50	1198.8 C	0.0	34066.3	35265.1	0.0	0.0
		1.00	1198.8 C	0.0	2062.2	3261.0	2232.0	0.0
7	1	.0	982.7 C	0.0	4031.6	5014.3	412.5	0.0
		1.00	982.7 C	0.0	0.0	982.7	61.5	0.0
	2	.0	2566.0 C	0.0	12581.7	15147.7	739.6	0.0
		1.00	2566.0 C	0.0	0.0	2566.0	739.6	0.0
	3	.0	0.0 C	0.0	293.1	293.1	17.2	0.0
		1.00	0.0 C	0.0	0.0	0.0	17.2	0.0
	4	.0	982.7 C	0.0	4324.7	5307.4	429.7	0.0
		1.00	982.7 C	0.0	0.0	982.7	78.7	0.0
	5	.0	2566.0 C	0.0	12699.0	15264.9	746.5	0.0
		1.00	2566.0 C	0.0	0.0	2566.0	746.5	0.0

************** END OF LATEST ANALYSIS RESULT **************

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51. * PARAMETERS
52. * CODE AISC
53. * CHECK CODE 1 TO 12 14 TO 22
54. FINISH
```

*************** END OF STAAD-III ***************

FINAL

```
**** DATE= SEP 30,1997   TIME= 10:42:19 ****

************************************************************
*        For questions on  STAAD-III,   contact:           *
*              Research Engineers, Inc at                  *
*      Ph: (714) 974-2500   Fax:  (714) 921-2543           *
************************************************************
```

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**************************************************
*                                                *
*            S T A A D - III                     *
*            Revision 20.2                       *
*            Proprietary Program of              *
*            Research Engineers, Inc.            *
*            Date=    OCT 28, 1997               *
*            Time=    13:37: 2                   *
*                                                *
*       USER ID: SARGENT & LUNDY ENGRS           *
**************************************************

  1. STAAD PLANE 3X4.19 CHANNEL
  2. INPUT WIDTH 72
  3. UNIT INCHES POUND
  4. JOINT COORDINATES
  5. 1 0. .5; 2 0. .774; 3 0. 1.325; 4 0.551 1.325; 5 2.176 1.325
  6. 6 2.727 1.325; 7 2.727 0.774; 8 2.727 0.
  7. MEMBER INCIDENCES
  8. 1 1 2; 2 2 3; 3 3 4; 4 4 5; 5 5 6; 6 6 7; 7 7 8
  9. MEMBER PROPERTY AMERICAN
 10. 1 2 PRI IX .1 IY .0016955 IZ .0016955 AY .273 AZ .2 YD .273 ZD 1
 11. 3 4 5 PRI IX .1 IY .0004094 IZ .0004094 AY .170 AZ .2 YD .170 ZD 1
 12. 6 7 PRI IX .1 IY .0016955 IZ .0016955 AY .273 AZ .2 YD .273 ZD 1
 13. CONSTANTS
 14. E STEEL ALL
 15. POISSON STEEL ALL
 16. DENSITY STEEL ALL
 17. BETA 0. ALL
 18. * STAINLESS STEEL
 19. ALPHA 99E-7 ALL
 20. SUPPORTS
 21. 1 8 PINNED
 22. LOAD 1 LC 4,5,7 UPPER CHANNEL
 23. JOINT LOAD
 24. 3 FX 58.48 FY -6.1425
 25. 6 FX -3.825 FY -6.1425
 26. MEMBER LOAD
 27. 1 2 UNI GX 688.
 28. 3 4 5 UNI GY -45.
 29. 6 7 UNI GX -45
 30. LOAD 2 LC 4,5,7 LOWER CHANNEL
 31. JOINT LOAD
 32. 3 FX 3.825 FY -6.1425
 33. 6 FX -58.48 FY -6.1425
 34. MEMBER LOAD
 35. 1 2 UNI GX 45.
 36. 3 4 5 UNI GY -45.
 37. 6 7 UNI GX -688.
 38. LOAD 3 LC 4,5,7 CHANNEL AT EL. 703'-0"
 39. JOINT LOAD
 40. 3 FX 3.825 FY -6.1425
 41. 6 FX -39.69 FY -6.1425
```

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42. MEMBER LOAD
43. 1 2 UNI GX 45.
44. 3 4 5 UNI GY -45.
45. 6 7 UNI GX -467.
46. LOAD 4 LC 4,5,7 PRESSURE LOAD = 197.03 PSI
47. JOINT LOAD
48. 3 FX 10.523 FY -21.99
49. 6 FX -16.75 FY -21.99
50. MEMBER LOAD
51. 1 2 UNI GX 123.8
52. 3 4 5 UNI GY -161.13
53. 6 7 UNI GX -197.03
54. LOAD 5 THERMAL
55. TEMP LOAD
56. 1 TO 7 TEMP 76.
57. LOAD COMB 6
58. 1 1. 5 1.
59. LOAD COMB 7
60. 2 1. 5 1.
61. LOAD COMB 8 CHANNEL AT EL. 703'-0"
62. 3 1. 5 1
63. LOAD COMB 9 PRESSURE LOAD + THERMAL
64. 4 1. 5 1.0
65. LOAD LIST ALL
66. PERFORM ANALYSIS
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P R O B L E M   S T A T I S T I C S

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NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =     8/    7/    2
ORIGINAL/FINAL BAND-WIDTH =     1/    1
TOTAL PRIMARY LOAD CASES  =     5, TOTAL DEGREES OF FREEDOM =    20
SIZE OF STIFFNESS MATRIX =      120 DOUBLE PREC. WORDS
REQRD/AVAIL. DISK SPACE =  12.01/ 1069.0 MB,  EXMEM =  1.02 MB

++ PROCESSING ELEMENT STIFFNESS MATRIX.              13:37: 4
++ PROCESSING GLOBAL STIFFNESS MATRIX.               13:37: 4
++ PROCESSING TRIANGULAR FACTORIZATION.              13:37: 4
++ CALCULATING JOINT DISPLACEMENTS.                  13:37: 4
++ CALCULATING MEMBER  FORCES.                       13:37: 4

67. PRINT JOINT DISP LIST 3 6
```

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
3	1	0.00769	0.00001	0.00000	0.00000	0.00000	-0.00811
	2	-0.01168	-0.00003	0.00000	0.00000	0.00000	0.01242
	3	-0.00765	-0.00002	0.00000	0.00000	0.00000	0.00809
	4	-0.00095	-0.00003	0.00000	0 00000	0.00000	0.00050
	5	-0.00083	0.00062	0.00000	0.00000	0.00000	0.00097
	6	0.00687	0.00063	0.00000	0.00000	0.00000	-0.00714
	7	-0.01250	0.00060	0.00000	0.00000	0.00000	0.01339
	8	-0.00848	0.00060	0.00000	0.00000	0.00000	0.00905
	9	-0.00177	0.00059	0.00000	0.00000	0.00000	0.00147
6	1	0.00760	-0.00003	0.00000	0.00000	0.00000	-0.00425
	2	-0.01189	0.00002	0.00000	0.00000	0.00000	0.00594
	3	-0.00780	0.00001	0.00000	0.00000	0.00000	0.00395
	4	-0.00106	-0.00004	0.00000	0.00000	0.00000	0.00111
	5	0.00122	0.00100	0.00000	0.00000	0.00000	-0.00083
	6	0.00882	0.00097	0.00000	0.00000	0.00000	-0.00508
	7	-0.01067	0.00101	0.00000	0.00000	0.00000	0.00511
	8	-0.00658	0.00100	0.00000	0.00000	0.00000	0.00312
	9	0.00016	0.00096	0.00000	0.00000	0.00000	0.00028

************** END OF LATEST ANALYSIS RESULT **************

68. PRINT MEMBER FORCES LIST 1 4 7

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- POUN INCH

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	-49.48	463.69	0.00	0.00	0.00	0.00
		2	49.48	-275.18	0.00	0.00	0.00	101.22
	2	1	241.35	-336.75	0.00	0.00	0.00	0.00
		2	-241.35	349.08	0.00	0.00	0.00	-93.96
	3	1	181.49	-225.46	0.00	0.00	0.00	0.00
		2	-181.49	237.79	0.00	0.00	0.00	-63.46
	4	1	257.07	-92.13	0.00	0.00	0.00	0.00
		2	-257.07	126.06	0.00	0.00	0.00	-29.89
	5	1	-1.34	-7.29	0.00	0.00	0.00	0.00
		2	1.34	7.29	0.00	0.00	0.00	-2.00
	6	1	-50.82	456.40	0.00	0.00	0.00	0.00
		2	50.82	-267.89	0.00	0.00	0.00	99.23
	7	1	240.02	-344.03	0.00	0.00	0.00	0.00
		2	-240.02	356.36	0.00	0.00	0.00	-95.95
	8	1	180.16	-232.74	0.00	0.00	0.00	0.00
		2	-180.16	245.07	0.00	0.00	0.00	-65.46
	9	1	255.74	-99.42	0.00	0.00	0.00	0.00
		2	-255.74	133.34	0.00	0.00	0.00	-31.89
4	1	4	162.39	-80.42	0.00	0.00	0.00	-110.93
		5	-162.39	153.54	0.00	0.00	0.00	-79.17
	2	4	377.70	210.42	0.00	0.00	0.00	170.36
		5	-377.70	-137.29	0.00	0.00	0.00	112.15
	3	4	266.41	150.55	0.00	0.00	0.00	111.53
		5	-266.41	-77.43	0.00	0.00	0.00	73.71
	4	4	204.79	146.30	0.00	0.00	0.00	13.07
		5	-204.79	115.54	0.00	0.00	0.00	11.92
	5	4	7.29	-1.34	0.00	0.00	0.00	6.75
		5	-7.29	1.34	0.00	0.00	0.00	-8.92
	6	4	169.68	-81.75	0.00	0.00	0.00	-104.18
		5	-169.68	154.88	0.00	0.00	0.00	-88.08
	7	4	384.99	209.08	0.00	0.00	0.00	177.11
		5	-384.99	-135.96	0.00	0.00	0.00	103.24
	8	4	273.69	149.22	0.00	0.00	0.00	118.28
		5	-273.69	-76.09	0.00	0.00	0.00	64.79
	9	4	212.08	144.96	0.00	0.00	0.00	19.82
		5	-212.08	116.87	0.00	0.00	0.00	3.00
7	1	7	184.48	133.77	0.00	0.00	0.00	90.06
		8	-184.48	-98.94	0.00	0.00	0.00	0.00
	2	7	-106.35	-59.87	0.00	0.00	0.00	-252.42
		8	106.35	592.38	0.00	0.00	0.00	0.00
	3	7	-46.49	-30.60	0.00	0.00	0.00	-163.57
		8	46.49	392.06	0.00	0.00	0.00	0.00

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- POUN INCH

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
	4	7	226.31	79.48	0.00	0.00	0.00	2.50
		8	-226.31	73.02	0.00	0.00	0.00	0.00
	5	7	1.34	7.29	0.00	0.00	0.00	5.64
		8	-1.34	-7.29	0.00	0.00	0.00	0.00
	6	7	185.82	141.06	0.00	0.00	0.00	95.70
		8	-185.82	-106.23	0.00	0.00	0.00	0.00
	7	7	-105.02	-52.58	0.00	0.00	0.00	-246.78
		8	105.02	585.10	0.00	0.00	0.00	0.00
	8	7	-45.16	-23.32	0.00	0.00	0.00	-157.93
		8	45.16	384.77	0.00	0.00	0.00	0.00
	9	7	227.65	86.76	0.00	0.00	0.00	8.14
		8	-227.65	65.74	0.00	0.00	0.00	0.00

************/* END OF LATEST ANALYSIS RESULT **************

69. SECTION 0. .5 1. MEMB 4
70. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT POUN INCH STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-463.69	-49.48	0.00	0.00	0.00	0.00
	2	336.75	241.35	0.00	0.00	0.00	0.00
	3	225.46	181.49	0.00	0.00	0.00	0.00
	4	92.13	257.07	0.00	0.00	0.00	0.00
	5	7.29	-1.34	0.00	0.00	0.00	0.00
	6	-456.40	-50.82	0.00	0.00	0.00	0.00
	7	344.03	240.02	0.00	0.00	0.00	0.00
	8	232.74	180.16	0.00	0.00	0.00	0.00
	9	99.42	255.74	0.00	0.00	0.00	0.00
8	1	-98.94	184.48	0.00	0.00	0.00	0.00
	2	592.38	-106.35	0.00	0.00	0.00	0.00
	3	392.06	-46.49	0.00	0.00	0.00	0.00
	4	73.02	226.31	0.00	0.00	0.00	0.00
	5	-7.29	1.34	0.00	0.00	0.00	0.00
	6	-106.23	185.82	0.00	0.00	0.00	0.00
	7	585.10	-105.02	0.00	0.00	0.00	0.00
	8	384.77	-45.16	0.00	0.00	0.00	0.00
	9	65.74	227.65	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

71. PRINT MEMBER STRESSES LIST 1 4 7

MEMBER STRESSES

ALL UNITS ARE POUN/SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
1	1	.0	181.2 T	0.0	0.0	181.3	1698.5	0.0
		1.00	181.2 T	0.0	8149.3	8330.5	1008.0	0.0
	2	.0	884 1 C	0.0	0.0	884.1	1233.5	0.0
		1.00	884.1 C	0.0	7564.3	8448.4	1278.7	0.0
	3	.0	664.8 C	0.0	0.0	664.8	825.8	0.0
		1.00	664.8 C	0.0	5109.3	5774.1	871.0	0.0
	4	.0	941.7 C	0.0	0.0	941.7	337.5	0.0
		1.00	941.7 C	0.0	2406.5	3348.2	461.7	0.0
	5	.0	4.9 T	0.0	0.0	4.9	26.7	0.0
		1.00	4.9 T	0.0	160.7	165.6	26.7	0.0
	6	.0	186.1 T	0.0	0.0	186.2	1671.8	0.0
		1.00	186.1 T	0.0	7988.6	8174.7	981.3	0.0
	7	.0	879.2 C	0.0	0.0	879.2	1260.2	0.0
		1.00	879.2 C	0.0	7725.0	8604.2	1305.4	0.0
	8	.0	659.9 C	0.0	0.0	659.9	852.5	0.0
		1.00	659.9 C	0.0	5270.0	5929.9	897.7	0.0
	9	.0	936.8 C	0.0	0.0	936.8	364.2	0.0
		1.00	936.8 C	0.0	2567.2	3504.0	488.4	0.0
4	1	.0	955.3 C	0.0	23030.8	23986.0	473.1	0.0
		0.50	955.3 C	0.0	6380.9	7336.1	688.1	0.0
		1.00	955.3 C	0.0	16436.8	17392.1	903.2	0.0
	2	.0	2221.8 C	0.0	35370.3	37592.1	1237.7	0.0
		0.50	2221.8 C	0.0	2958.5	5180.3	1022.7	0.0
		1.00	2221.8 C	0.0	23285.5	25507.3	807.6	0.0
	3	.0	1567.1 C	0.0	23155.8	24722.8	885.6	0.0
		0.50	1567.1 C	0.0	842.4	2409.5	670.5	0.0
		1.00	1567.1 C	0.0	15303.2	16870.2	455.5	0.0
	4	.0	1204.7 C	0.0	2713.9	3918.6	860.6	0.0
		0.50	1204.7 C	0.0	10923.0	12127.6	90.5	0.0
		1.00	1204.7 C	0.0	2475.0	3679.7	679.6	0.0
	5	.0	42.9 C	0.0	1400.6	1443.5	7.9	0.0
		0.50	42.9 C	0.0	1626.0	1668.8	7.9	0.0
		1.00	42.9 C	0.0	1851.3	1894.2	7.9	0.0
	6	.0	998.1 C	0.0	21630.1	22628.3	480.9	0.0
		0.50	998.1 C	0.0	4754.9	5753.0	696.0	0.0
		1.00	998.1 C	0.0	18288.1	19286.2	911.1	0.0
	7	.0	2264.6 C	0.0	36771.0	39035.6	1229.9	0.0
		0.50	2264.6 C	0.0	4584.5	6849.1	1014.8	0.0
		1.00	2264.6 C	0.0	21434.2	23698.9	799.7	0.0
	8	.0	1609.9 C	0.0	24556.4	26166.3	877.8	0.0
		0.50	1609.9 C	0.0	2468.4	4078.3	662.7	0.0
		1.00	1609.9 C	0.0	13451.9	15061.8	447.6	0.0
	9	.0	1247.5 C	0.0	4114.6	5362.1	852.7	0.0
		0.50	1247.5 C	0.0	9297.0	10544.5	82.6	0.0
		1.00	1247.5 C	0.0	623.7	1871.2	687.5	0.0
7	1	.0	675.8 C	0.0	7250.6	7926.3	490.0	0.0
		1.00	675.8 C	0.0	0.0	675.8	362.4	0.0

MEMBER STRESSES

ALL UNITS ARE POUN/SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
2		.0	389.6 T	0.0	20321.7	20711.3	219.3	0.0
		1.00	389.6 T	0.0	0.0	389.6	2169.9	0.0
3		.0	170.3 T	0.0	13168.5	13338.8	112.1	0.0
		1.00	170.3 T	0.0	0.0	170.3	1436.1	0.0
4		.0	829.0 C	0.0	201.1	1030.1	291.1	0.0
		1.00	829.0 C	0.0	0.0	829.0	267.5	0.0
5		.0	4.9 C	0.0	454.0	458.8	26.7	0.0
		1.00	4.9 C	0.0	0.0	4.9	26.7	0.0
6		.0	680.6 C	0.0	7704.5	8385.2	516.7	0.0
		1.00	680.6 C	0.0	0.0	680.7	389.1	0.0
7		.0	384.7 T	0.0	19867.8	20252.5	192.6	0.0
		1.00	384.7 T	0.0	0.0	384.7	2143.2	0.0
8		.0	165.4 T	0.0	12714.6	12880.0	85.4	0.0
		1.00	165.4 T	0.0	0.0	165.4	1409.4	0.0
9		.0	833.9 C	0.0	655.1	1489.0	317.8	0.0
		1.00	833.9 C	0.0	0.0	833.9	240.8	0.0

************** END OF LATEST ANALYSIS RESULT **************

72. FINISH

*************** END OF STAAD-III ***************

**** DATE= OCT 28,1997 TIME= 13:37: 5 ****

```
**********************************************************
*        For questions on  STAAD-III,   contact:         *
*              Research Engineers, Inc at                *
*     Ph: (714) 974-2500   Fax:  (714) 921-2543          *
**********************************************************
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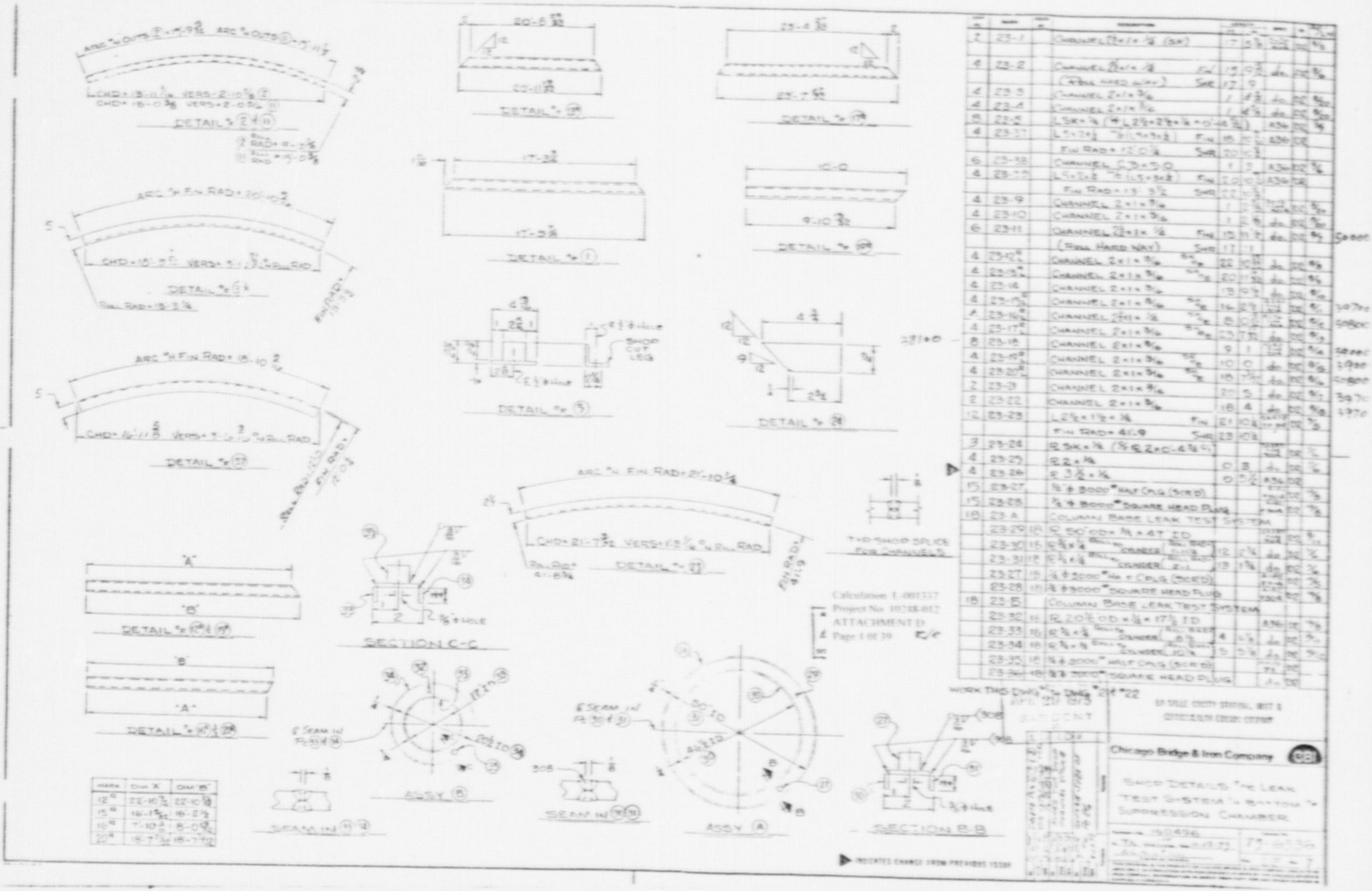


Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 1 of 39
Chicago Bridge & Iron Company
SHOP DETAILS THE LEAK TEST SYSTEM IN BOTTOM OF SUPPRESSION CHAMBER
WORK THIS DWG WITH DWG 21 & 22
APR 29 1975
DETAIL 1
DETAIL 5
DETAIL 24
DETAIL 23
SECTION C-C
SECTION B-B
ASSY A
ASSY B
TYP SHOP SPLICE FOR CHANNELS
COLUMN BASE LEAK TEST SYSTEM
INDICATES CHANGE FROM PREVIOUS ISSUE

1785 REV.

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 2 0f 39 R/0

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
23-3	4 Pcs		40161						
23-4	4 Pcs		40161						
23-5	8 Pcs		14592						
23-6	4 Pcs		74800						
23-8	4 Pcs		74800						
23-9	4 Pcs		40161						
23-10	4 Pcs		40161						
23-22	2 Pcs		23755						
23-21	2 Pcs		23755						
23-15	4 Pcs		23755						
23-18	2 Pcs		F30188						
23-18	6 Pcs		42379						
23-13	4 Pcs		40161						
23-19	4 Pcs		F30188						
23-17	4 Pcs		40161						
23-12	4 Pcs		40161						
23-23	12 Pcs.		68940						
23-2	4 Pcs		30844						
23-11	6 Pcs		30844						
23-1	2 Pcs		30844						
23-14	4 Pcs		30706						
23-20	4 Pcs		30706						
23-16	4 Pcs		30706						

Data taken from records in accordance with applicable CB&I QA Manual.

CBI Shop QA [signature] Date 10/8/74

REV | BY | CHKD | DATE

Reviewed (for material covered by code): N/A

9-1

Contract No. 74-1331

No. 23 Sh 1 of —

QUALITY ASSURANCE DOCUMENT INDEX

Specification 2534.24 ____ Page ______ of __

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 3 Of 39 R/0

File Number 5.3 Document Title CMTR's

Contractor Name CB&I

Document Listing:

CMTR's

Engineer Signoff ______________ Paper Count 53

REYNOLDS ALUMINUM SUPPLY COMPANY

METALS AND BUILDING PRODUCTS

4500 FIFTH AVENUE, S. · P. O. BOX 10785 · BIRMINGHAM, ALABAMA 35202 · 205/591-2341

September 31, 1974

Chicago Bridge
P. O. Box 774
Kankakee, Illinois 60901

Attention: Art Johnson

Please use this letter as authorization to mark material on P.O. # C73-6336-12A as follows:

6 pcs.	Ht. # F30188
22 pcs.	Ht. # 23755
39 pcs.	Ht. # 17797
7 pcs.	Ht. # 42379

Very truly yours,

REYNOLDS ALUMINUM SUPPLY CO.

Bob Littleton

Bob Littleton

BL:rf

cc: File

11
7

REYNOLD ALUMINUM SUPPLY DMPANY

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 5 0f 39 R/0

CERTIFICATE OF TEST
STAINLESS STEEL

Date 8-19-74

Customer Chicago Bridge
Customer Order No. 73-6336-12A

Address

Consignee
Consignee Order No.

Address

Invoice No. 07-07279
Date of Shipment 8-2-74

Specification ASTM-A-240
Grade 304

MATERIAL

ITEM	HEAT NUMBER	NUMBER OF PIECES	SIZE	CONDITION
1.	F 30188	6	2 X 1 X 3/16 X 120	23-18, 23-
2.	23755	11	2 X 1 X 3/16 X 120	23-21, 23-15, 23-2
3.	23755	11	2 X 1 X 3/16 X 120	
4.	17797	34	2 X 1 X 3/16 X 120	
5.	42379	7	2 X 1 X 3/16 X 120	23-18

CHEMICAL ANALYSES

ITEM	C	MN	P	S	SI	CR	NI	CU	TI	CB	MO		
1.	.046	1.62	021	.011	.56	18.18	8.79						
2.	.04	1.65	.026	.016	.70	18.30	8.60						
3.	.04	1.65	.026	.016	.70	18.30	8.60						
4.	.033	1.62	.025	.014	.25	18.15	9.10						
5.	.05	1.47	.019	.011	.51	18.22	8.60						

PHYSICAL PROPERTI

ITEM	TENSILE STRENGTH	YIELD STRENGTH	% ELONGATION	HARDNESS	REMARKS
1.	87,200	39,000	50	686	
2.	80,800	39,700	59.1	RB82	
3.	80.800	34,700	59.1	RB82	
4.	85,200	38,200	62	B78-79	
5.	86,700	38,100	56.5	RB 82	

We certify that the chemical analyses and physical test results applying on the above order nur er are correct and true to the best of our knowledge and belief.

Sworn and subscribed to before me

Reynolds Aluminum Supply Company

Diane Smith

NOTARY PUBLIC

11
7

ITT
ITT Harper Inc.
8200 Lehigh Avenue . Morton Grove Ill 60053
(312) 966-8000

CERTIFIED TEST REPORT

Date: 6/14/74
HMH Register No. 005439

Customer: METAL GOODS SERVICE CENTER
DIV ALCAN ALUM
11400 W. ADDISON STREET
FRANKLIN PARK, ILL. 60131

Address:

HMH Drawing No.

HMH Work Order No.

Purchase Order No. 24-91055

Description of Item

Weight and Pieces	Shape	Size	Length	Material
1090 LBS 13 PCS	CHANNEL	2½ x1 x 1/4"	18/24'	304 STAINLESS STEEL

* SPEC ASTM A276 23-11

YOUR P.O. # CBT C-73-6336
OUR NUMBER 24-91055
DATE SHIPPED 6-20-74
SPECIFICATIONS ASTM A27[illegible]
ITEM T304 SS Chan[illegible]
2½ x 1 x 1/4 18'/2[illegible]
S Brau[illegible] 7/23/7[illegible]

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN
30844	.064	.028	.021	.21	.29	18.65	9.91	.22	1.38

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	Elongation	R of A	Hardness
30844	88,300	50,000	49%	69	

QCIE

We hereby certify that the above figures are correct as contained in the records of this company.

Louis Paul Q C MGR.

11
4

ITT Harper Inc.
8200 Lehigh Avenue, Morton Grove, Ill. 60053
(312) 968-6000

CERTIFIED TEST REPORT

Date: 6/4/74

CHANGED ITEM

HMH Register No. 005090

tomer: METAL GOODS SERVICE
DIV ALCAN ALUM
P.O. BOX 427
ress: FRANKLIN PARK, ILL. 60131

HMH Drawing No.

HMH Work Order No.

chase Order No. 24-90807

Description of Item

ight and Pieces	Shape	Size.	Length	Material
8045 LBS 110 PCS	CHANNEL	2 x 1 x 1/4"	R/L	304 STAINLESS STEEL

Chicago Bridge & Iron
C 73-6337-55
OUR NUMBER 24-90985
DATE SHIPPED 6-7-74
SPECIFICATIONS ASTM A 236
ITEM T.304 S/S Channel 2 x 1 x 1/4
Cindy Zwicker 6-26-74

23-16
23-20

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN
30599	.080	.012	.022	.43	.25	18.38	9.65	.46	1.45
30706	.064	.021	.023	.31	.34	18.69	10.03	.24	1.43
30013	.049	.018	.023	.26	.28	18.68	9.90	.34	1.45

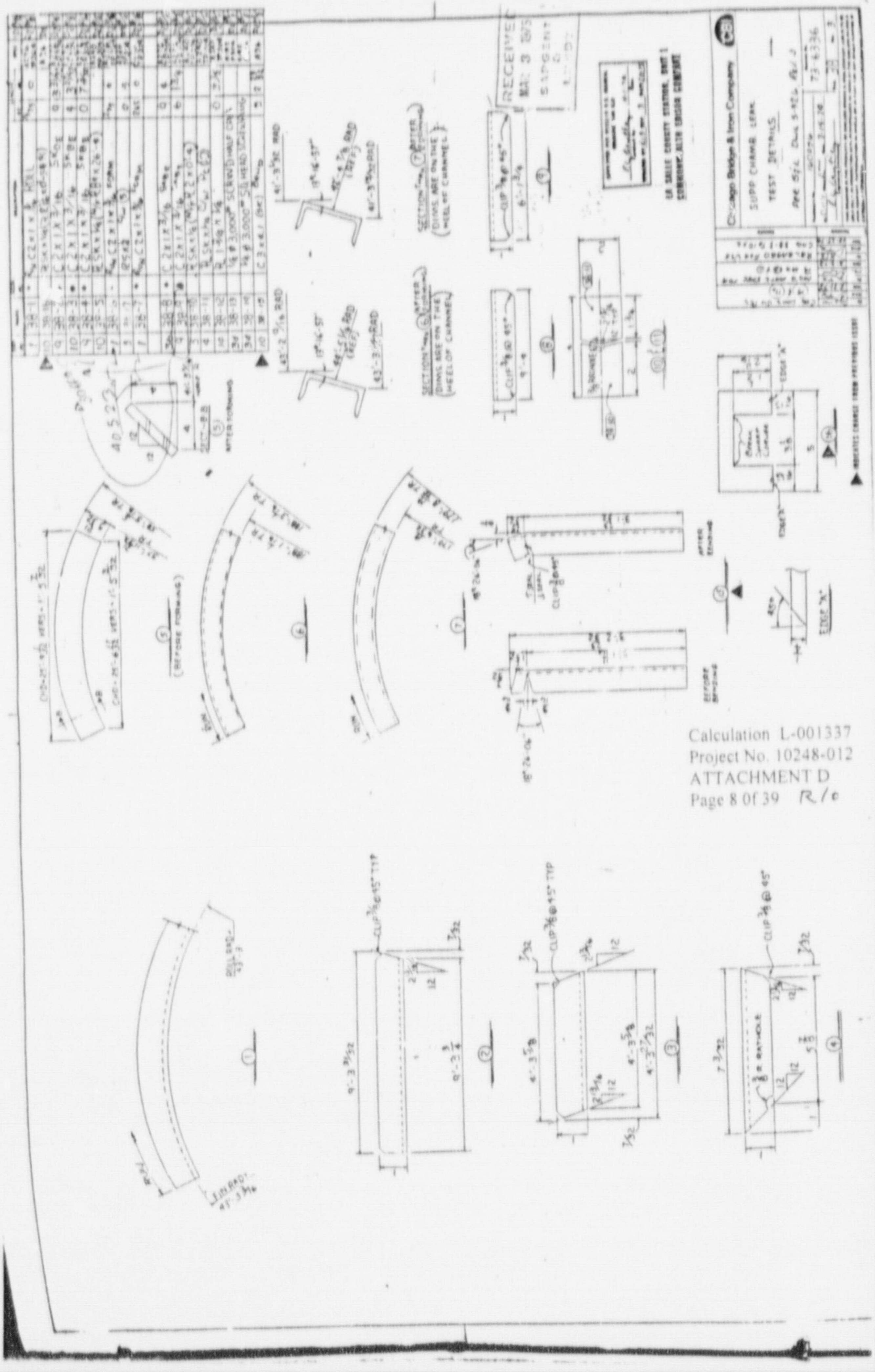
10/28/74

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	% Elongation	R of A	Hardness	PCS	LBS
30599	90,600	51,700	50	68		57	3890
30706	91,000	50,800	48	67		59	4020
30013	89,200	49,300	51	70		2	135

We hereby certify that the above figures are correct as contained in the records of this company.

13
10



Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 8 Of 39 R/0

O 785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
38-1	1 Pc.		40523						
38-6	1 Pc.		40523						
38-7	1 Pc.		40523						

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 9 of 39 R/0

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 1/8/75

REV		
BY		
CHKD		
DATE		

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date 17-1

Contract No. 73-6336

No. 38 Sh 1 of —

D 785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
38-2	9pcs		30660						
38-3	10pcs.		30660						
38-6	9pcs.		30660						
38-8	36pcs		30660						
38-15	10pcs.		30660						

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 10 0f 39 R/0

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 1/21/75

REV BY / CHKD / DATE

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date 17-7

Contract No. 73-6336

No. 38
Sh 3 of —

QO 785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
38-9	9Pcs.		30660					Calculation L-001337	
38-12	14Pcs.		3P5919					Project No. 10248-012	
38-17	3Pcs.		3P5919					ATTACHMENT D	
								Page 11 0f 39 R/0	

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 1/16/75

REV	BY		
	CHKD		
	DATE		

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date 17-1

Contract No. 73-6336

No. 38
Sh 2 of —

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 12 Of 39 R/0

[illegible] CO[illegible]
OUR P.O. NO. C73-6331-3
UR NUMBER 74-91653
DATE SHIPPED 11/20/74
SPECIFICATIONS ASTM A 276
ITEM T304 Channel
2 x 1 x 3/16 18/24 R/L
12 1367 [illegible]

[illegible]
[illegible]

CERTIFIED TEST REPORT

Date: 11/12/74
HMH Register No. 005727
HMH Drawing No. 8484
HMH Work Order No. AA 686

RS

50131

Description of Item

Weight and Pieces	Shape	Size	Length	Material
3610 LBS 64 PCS	CHANNEL	2x1x3/16	20' R/L	304 STAINLESS STEEL

64 B

SPEC: ASTM-A-276

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN		
40523	.073	.020	.023	.36	.20	18.60	10.02	.31	1.36		

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	Elongation	R of A.	Hardness	
40523	83,600	35,400	60.0	75.0		

We hereby certify that the above figures are correct as contained in the records of this company.

By John P. [illegible] Q.C. MANAGER
Name and Title

Form 74

AWS

18

OUR NUMBER 24-90675
DATE SHIPPED 3-5-74
SPECIFICATIONS ASTM-A-276
ITEM ① T304 SS Channel 2x1x3/16

ITT Harper Inc.
8200 Lehigh Avenue
(312) 966-6000

CERTIFIED TEST REPORT

Date: 3/4/74

HMH Register No. 00645

S Braun 4-5-74

Customer: METAL GOODS SERVICE CENTER
DIV. ALCAN ALUMINUM
11400 W. ADDISON STREET
Address: FRANKLIN PARK, ILLINOIS 60131

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 13 0f 39 R/0

HMH Drawing No.

HMH Work Order No.

Purchase Order No. 24-90675

Description of Item

Weight and Pieces	Shape	Size	Length	Material
3315 LBS 61 PCS	CHANNEL	2 x 1 x 3/16	19' R/L	304 STAINLESS STEEL
920 LBS 11 PCS	CHANNEL	3 x 1 3/8 x 3/16	15-24 R/L	304 STAINLESS STEEL

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN	LBS	PCS
30660	.066	.023	.023	.30	.29	18.84	[illegible]	.57	1.41	2730	51
30549	.52	.018	.025	.23	.27	18.96	8.90	.46	1.60	585	10
40079	.06	.014	.021	.20	.19	18.55	9.63	.53	1.83	22	11

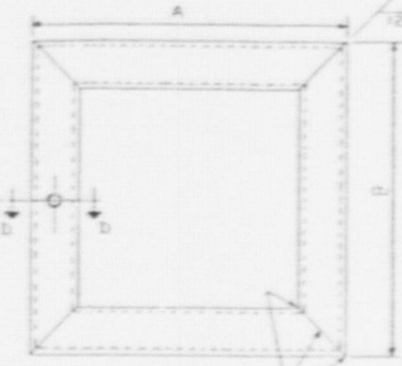
Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	Elongation	R of A	Hardness
30660	90,850	55,180	62	66.6	
30549	86,400	43,750	[illegible].8	69	
40079	85,350	40,200	52.5	71	

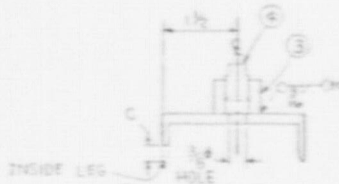
We hereby certify that the above figures are correct as contained in the records of this company.

By [signature]
Name and Title

Form 74



LEAK TEST ASSY
INSIDE ELEV VIEW



SECTION "D-D"

DETAIL "E"

SHOP NOTE! TWO WELD MUST BE LEAK TIGHT @ 4 CORNERS ON EACH ASSY

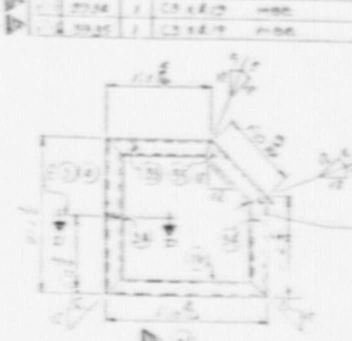
ASSY	TEST CP GRND	HORIZ A DIM	VERT FL DIM B	C	LEAK TEST FOR ASSY
A	YES	1'-1½	1'-1½	½	79-A
B	NO	1'-1½	1'-6¼	½	81-B
C	NO	1'-4 1/16	2'-10¼	½	82-A
D	NO	1'-1½	1'-4⅛	½	90-B
E	NO	1'-8½	2'-4½	½	84-A
F	NO	1'-1 3/16	2'-4⅛	½	91-B
G	NO	1'-10⅞	2'-1¼	½	88-A
H	NO	1'-1 13/16	2'-1½	½	85-A
J	NO	1'-11½	2'-1½	½	88-B
K	NO	1'-1½	1'-1¼	½	83A & 83B
M	YES	1'-10⅞	1'-1½	½	85-B
P	NO	1'-10 3/16	2'-1¼	½	89-A
R	NO	1'-3	1'-1½	½	81-A
S	NO	1'-1½	1'-7¼	½	87-B
T	NO	1'-1½	1'-9⅛	½	86-B
W	NO	1'-7⅛	2'-4¼	½	87-A
Y	NO	1'-10⅞	1'-1¼	½	84-A
AA	NO	1'-8⅝	1'-1½	½	82-B
BB	NO	1'-7⅞	2'-10½	½	92-A
CC	NO	1'-6 11/32	2'-4½	½	91-A
DD	YES	1'-2½	1'-2½	½	75-B
EE	YES	"	"	0	75-A
FF	NO	1'-5½	1'-11½	½	76-A

REQ'D	MARK	PCS	DESCRIPTION	FT	IN
32	39-A		LEAK TEST ASS'Y		
	39-1	32	C 3×4.1 w/HOLE M BE	1	1½
	39-2	96	C 3×4.1 M BE	1	1½
	39-3	32	½ # 3000 SCRWD HALF CPLG		
	39-4	32	½ # 3000 SQ HEAD SCRWD PLUG		
2	39-B		LEAK TEST ASS'Y		
	39-2	4	C 3×4.1 M BE	1	1½
	39-5	4	C 3×4.1 M BE	1	6¼
1	39-C		LEAK TEST ASS'Y		
	39-6	2	C 3×4.1 M BE	1	4 1/16
	39-7	2	C 3×4.1 M BE	2	10¼
4	39-D		LEAK TEST ASS'Y		
	39-2	8	C 3×4.1 M BE	1	1½
	39-8	8	C 3×4.1 M BE	1	4⅛
1	39-E		LEAK TEST ASS'Y		
	39-9	2	C 3×4.1 M BE	1	8½
	39-10	2	C 3×4.1 M BE	2	4½
	39-F		LEAK TEST ASS'Y		
	39-11	2	C 3×4.1 M BE	1	1 3/16
	39-12	2	C 3×4.1 M BE	2	4⅛
1	39-G		LEAK TEST ASS'Y		
	39-13	2	C 3×4.1 M BE	1	10⅞
	39-22	2	C 3×4.1 M BE	2	1¼
2	39-H		LEAK TEST ASS'Y		
	39-11	4	C 3×4.1 M BE	1	1 13/16
	39-14	4	C 3×4.1 M BE	2	1½
1	39-J		LEAK TEST ASS'Y		
	39-13	2	C 3×4.1 M BE	1	11½
	39-11	2	C 3×4.1 M BE	2	1½
7	39-K		LEAK TEST ASS'Y		
	39-2	14	C 3×4.1 M BE	1	1½
	39-15	14	C 3×4.1 M BE	1	1¼
	39-M		LEAK TEST ASS'Y		
	39-13	4	C 3×4.1 M BE	1	10⅞
	39-1	2	C 3×4.1 w/HOLE M BE	1	1½
	39-2	2	C 3×4.1 M BE	1	1½
	39-3	2	½ # 3000 SCRWD HALF CPLG		
	39-4	2	½ # 3000 SQ HEAD SCRWD PLUG		
1	39-N		LEAK TEST ASS'Y		
	39-16	1	C 3×4.1 M BE	1	10 3/16
	39-33	1	C 3×4.1 M BE	1	1 3/16
	39-17	1	C 3×4.1 w/HOLE M BE	2	1½
	39-3	1	½ # 3000 SCRWD HALF CPLG		
	39-4	1	½ # 3000 SQ HEAD SCRWD PLUG		
	39-34	1	C3×4.1 M BE	1	8⅝
	39-35	1	C3×4.1 M BE	1	0¾

REQ'D	MARK	PCS	DESCRIPTION	FT	IN
1	39-P		LEAK TEST ASS'Y		
	39-16	2	C 3×4.1 M BE	1	10 3/16
	39-12	2	C 3×4.1 M BE	2	1¼
1	39-R		LEAK TEST ASS'Y		
	39-18	2	C 3×4.1 M BE	1	3
	39-2	2	C 3×4.1 M BE	1	1½
3	39-S		LEAK TEST ASS'Y		
	39-2	6	C 3×4.1 M BE	1	1½
	39-19	6	C 3×4.1 M BE	1	7¼
2	39-T		LEAK TEST ASS'Y		
	39-2	4	C 3×4.1 M BE	1	1½
	39-20	4	C 3×4.1 M BE	1	9⅛
1	39-W		LEAK TEST ASS'Y		
	39-21	2	C 3×4.1 M BE	1	7⅛
	39-12	2	C 3×4.1 M BE	2	4⅛
3	39-Y		LEAK TEST ASS'Y		
	39-13	6	C 3×4.1 M BE	1	10⅞
	39-15	6	C 3×4.1 M BE	1	1¼
1	39-AA		LEAK TEST ASS'Y		
	39-23	2	C 3×4.1 M BE	1	8⅝
	39-2	2	C 3×4.1 M BE	1	1½
1	39-BB		LEAK TEST ASS'Y		
	39-24	2	C 3×4.1 M BE	1	7⅞
	39-25	2	C 3×4.1 M BE	2	10½
1	39-CC		LEAK TEST ASS'Y		
	39-26	2	C 3×4.1 M BE	1	6 11/32
	39-10	2	C 3×4.1 M BE	2	4½
18	39-DD		LEAK TEST ASS'Y		
	39-28	18	C 3×4.1 w/HOLE M BE		2½
	39-27	54	C 3×4.1 M BE	1	2½
	39-3	18	½ # 3000 SCRWD HALF CPLG		
	39-4	18	½ # 3000 SQ HEAD SCRWD PLUG		
8	39-EE		LEAK TEST ASS'Y		
	39-30	8	C 3×4.1 w/HOLE M BE	0	11
	39-29	24	C 3×4.1 M BE	0	11
	39-3	8	½ # 3000 SCRWD HALF CPLG		
	39-4	8	½ # 3000 SQ HEAD SCRWD PLUG		
30	39-FF		LEAK TEST ASS'Y		
	39-31	60	C 3×4.1 M BE	1	5½
	39-32	60	C 3×4.1 M BE	1	11½

RECEIVED
FEB 7 1975
SARGENT & LUNDY

GENERAL NOTES:
1. SEE DWG. #34 THRU #37 FOR FIELD LOCATION OF LEAK TEST ASSYS.
2. FOR NOTES ON LEAK TEST ASSYS SEE DWG. #34.



Calculation L-001337
Project No. 10238-012
ATTACHMENT D
Page 14 of 39

LA SALLE COUNTY STATION, UNIT 1
COMMONWEALTH EDISON COMPANY

Chicago Bridge & Iron Company (CBI)

SUPP CHAMB. LEAK TEST ASS'Y DETAILS

▲ INDICATES CHANGE FROM PREVIOUS ISSUE

GO 785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 15 0f 39 R/0

Piece-Mark	Serial No.		Material Heat No.	Matl. Type
39A	32 ASSY'S.		LEAK TEST ASSY	
✓ 39-1	32 PCS.		40489	
✓ 39-2	96 PCS.		40489	
✓ 39-3	32 PCS.		JR	
✓ 39-4	32 PCS.		KY	
39B	2 ASSY'S.		LEAK TEST ASSY	
✓ 39-2	4 PCS		40489	
✓ 39-5	4 PCS		40489	
39C	1 ASSY		LEAK TEST ASSY.	
✓ 39-6	2 PCS		40489	
✓ 39-7	2 PCS.		40489	
39D	4 ASSY'S.		LEAK TEST ASSY.	
✓ 39-2	8 PCS		40489	
39-8	8 PCS.		40489	
39E	1 ASSY.		LEAK TEST ASSY.	
✓ 39-9	2 PCS.		40489	
✓ 39-10	2 PCS.		40489	
39F-F	30 ASSY'S.		LEAK TEST ASSY.	
✓ 39-31	60 PCS.		40489	
✓ 39-32	60 PCS.		40489	

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 1/7/75

REV BY / CHKD / DATE

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date

18-1

Contract No. 73-6336

No. 39 Sh 2 of —

GO 785 REV 4-73

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 16 Of 39 P. / 7

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.	Material Heat No.	Matl. Type	Piece-Mark	Serial No.	Material Heat No.	Matl. Type
39F	1 ASSY.	LEAK TEST ASSY.		39R	1 ASSY	LEAK TEST ASSY	
✓39-11	2 Pcs	40079		• 39-18	2 PCS.	30384	
✓39-12	2 PCS	40079		✓ 39-2	2 PCS.	40079	
39G	1 ASSY.	LEAK TEST ASSY.		39S	3 ASSY'S.	LEAK TEST ASSY.	
✓39-13	2 PCS.	40079		✓39-2	6 PCS.	40079	
•39-22	2 PCS.	30384		• 39-19	6 PCS.	30384	
39H	2 ASSY'S.	LEAK TEST ASSY.		39T	2 ASSY'S.	LEAK TEST ASSY.	
✓39-11	4 Pcs.	40079		✓ 39-2	4 PCS.	40079	
✓39-14	4 PCS.	40079		• 39-20	4 PCS.	30384	
39J	1 ASSY	LEAK TEST ASSY.		39W	1 ASSY.	LEAK TEST ASSY.	
✓39-13	2 PCS	40079		• 39-21	2 PCS.	30384	
✓39-14	2 PCS	40079		✓ 39-12	2 PCS.	40079	
39K	7 ASSY'S.	LEAK TEST ASSY.		39Y	3 ASSY'S.	LEAK TEST ASSY.	
✓ 39-2	12 PCS. 2 PCS.	40489 40079		✓39-13	6 PCS.	40079	
✓ 39-15	14 PCS.	40079		✓39-15	6 PCS.	40079	
39P	1 ASSY	LEAK TEST ASSY		39A-A	1 ASSY.	LEAK TEST ASSY.	
• 39-16	2 PCS	30384		• 39-23	2 PCS.	30384	
•39-22	2 PCS	30384		✓39-2	2 PCS.	40079	
39M	2 ASSY'S.	LEAK TEST ASSY.		39B-B	1 ASSY.	LEAK TEST ASSY.	
✓39-13	4 PCS.	40079		• 39-24	2 PCS.	30[illegible]4	
✓39-2	2 PCS	40079		✓ 39-25	2 PCS.	40079	
✓39-1	2 PCS.	40489					
✓39-3	2 PCS	JR		39C-C	1 ASSY.	LEAK TEST ASSY.	
✓39-4	2 PCS.	KY		✓39-26	2 PCS.	40079	
				✓39-10	2 PCS.	40489	

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 1/30/75

REV: BY / CHKD / DATE

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date

18-1

Contract No. 73-6331 No. 39 Sh 3 of —

GO 785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl.
39N			LEAK TEST ASSY.					Calculation L-001337	
39-16			30394					Project No. 10248-012	
✓39-33			40489					ATTACHMENT D	
✓39-17			40079					Page 17 of 39 R/0	
✓39-3			JR						
✓39-4			KY						
✓39-34			40489						
✓39-35			40489						

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 2/21/75

REV: BY / CHKD / DATE

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date

18-1

Contract No. 73-6336

No. 39 Sh 4 of —

GC 123

SUPPLEMENTAL SUMMARY SHEET FOR MATERIAL VERIFICATION

CHICAGO BRIDGE & IRON COMPANY

CONTRACT NO. 73-6336 LOCATION CCM

ITEM ID	u.m. s.c	ENGINEERING PIECE MARK	SERIAL NO.	NO. PIECES FABRICATED
30384	13-5	39-16	1-4	4
		39-18	1-2	2
		39-19	1-6	6
		39-20	1-4	4
		39-21	1-2	2
		39-22	1-4	4
		39-23	1-2	2
		39-24	1-2	2
Y69494	um 20-8	417-5	1-2	2
		432-7	1-4	4
		433-7	1-4	4
	21-8	368-4		1
		371-4		1
		377-4		1
		378-4		1
		386-4		1
	54-8	502-4	1-2	2
		520-7	1-2	2
		438-5	1-2	2
	63-8	302-5	1-10	10
		302-4	1-10	10
	87-8	473-8	1-2	2
	21-10	399-4	1-4	4
		342-5	1-2	2
		456-4	1-2	2
	22-10	400-4 529-4		1 1
		424-4		1

CBI

SUPPLEMENTAL SUMMARY SHEET FOR MATERIAL VERIFICATION #13

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 19 0f 39 R/0

GO 823 REV 11-72

CONTRACT NO. 73-6336 LOCATION CCM

Heat #	ITEM ID Slab #	Item #	S.6 #	ENGINEERING PIECE MARK	SERIAL NO.	NO. PIECES FABRICATED
40079		38	19-3	39-2	121-148	28
				39-11	1-6	6
			20-3	39-25	1-2	2
				39-26	1-2	2
				39-27	1-54	54
				39-29	1-24	24
646111	#2	42.11	43-4	81-3	2	1
				82-3	1	1
				91-1	1	1
				86-3	1-2	2
				85-3	1-2	2
				89-1	1	1
				80-1	1	1
				84-3	1	1
				82-1	1	1
				88-3	1	1
				85-1	1-2	2
				88-1	1	1
				86-1	1-3	3
				91-3	1	1
				90-3	1-6	6

GO 781

MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
39-EE		4 pcs	LEAK TEST ASS'Y					Calculation L-001337	
39-30		1	40489 HT#	2				Project No. 10248-012	
39-30	2thru4	3	40079 "	2				ATTACHMENT D	
39-29	1thru12	12	40079 "	2				Page 20 0f 39 R/0	
39-3		4	1/4" ϕ 3000# SCREWD 1/2 Plug						
39-4		4	1/4" ϕ 3000# SQ HEAD Plug						

Data taken from records in accordance with applicable CB&I QA Program.

CB&I Shop QA George Fred Ponel Jr Date 1/27/75

Reviewed (for material covered by code): Authorized Inspector N/A Date

18-1

Contract No. 73-6336

No. 39 Sh 1 of 1

GO 785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl.
390-D	18 ASSY'S.		LEAK TEST ASSY.						
✓39-28	18 PCS.		40079						
✓39-27	54 PCS.		40079						
✓39-3	18 PCS.		JR						
✓39-4	18 PCS.		KY						
39E-E	8 ASSY'S.		LEAK TEST ASSY.						
✓39-30	8 AS.	1 PC. 7 PCS.	40084 40079						
✓39-29	24 PCS.		40079						
✓39-3	8 PCS.		JR						
✓39-4	8 PCS.		KY						

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 21 Of 39 R/0

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 11/30/75

REV | BY | CHKD | DATE

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date

18-1

Contract No. 2-4334 No. 39 Sh 3 of __

QUALITY ASSURANCE DOCUMENT INDEX

Specification 2534.24 Page ____ of ____

File Number 5.2 Document Title CMTR'S

Contractor Name CB&I

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 22 of 39 R/0

Document Listing:

CMTR'S

Engineer Signoff ____________ Paper Count 70

METAL GOODS

OUR P. O. # C13-6336-C123
OUR NUMBER 24-91097
DATE SHIPPED 10/24/74
SPECIFICATIONS ASTMA-276
ITEM T304 Channel
3X 1 3/8 X 3/16 X 20ft Rdm
10/31/74

H. M. Harper Inc.
8200 Lehigh Avenue, Morton Grove, Ill. 60053
(312) 966-6000

131

CERTIFIED TEST REPORT

Date: 10/21/74
HMH Register No. 005743
HMH Drawing No.
HMH Work Order No.

Description of Item

Weight and Pieces	Shape	Size	Length	Material
3,320 LBS 25 PCS	CHANNEL	3x1 3/8x3/16"	R/L	304 STAINLESS STEEL

SPEC: ASTM A 276

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN		
40489	.051	.021	.030	.24	.09	18.56	9.96	.56	1.55		

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	Elongation	R of A	Hardness	
40489	89,200	51,600	50.0	68.0		

0015

We hereby certify that the above figures are correct as contained in the records of this company.

By John D. Person Q.C. MANAGER
Name and Title

Form 74

17
10

YOUR P. O. #

OUR NUMBER 24-90675

DATE SHIPPED 3-5-74

SPECIFICATIONS ASTM-A-276

ITEM ① T304 SS Channel 2x1x3/16

Date: 3/4/74

ITT ITT Harper Inc.
8200 Lehigh Avenue Morton Grove, Illinois 60053
(312) 966-6000

CERTIFIED TEST REPORT

HMH Register No. 00430

S Brau 4-5-79

Customer: METAL GOODS SERVICE CENTER
DIV. ALCAN ALUMINUM
11400 W. ADDISON STREET
Address: FRANKLIN PARK, ILLINOIS 60131

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 24 Of 39 R/0

HMH Drawing No.

HMH Work Order No.

Purchase Order No. 24-90675

Description of Item

Weight and Pieces	Shape	Size	Length	Material
3315 LBS 61 PCS	CHANNEL	2 x 1 x 3/16	19' R/L	304 STAINLESS STEEL
920 LBS 11 PCS	CHANNEL	3 x 1 3/8 x 3/16	15-24 R/L	304 STAINLESS STEEL

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN	LBS	P[illegible]
30660	.066	.028	.023	.30	.29	18.84	9.79	.57	1.41	2730	
30549	.52	.018	.025	.23	.27	18.86	9.90	.46	1.60	585	
40079	.049	.014	.021	.20	.19	18.55	9.63	.53	1.39	22	

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	Elongation	R of A	Hardness	
30660	90,850	55,100	42	61.6		
30549	86,400	43,750	46.8	69		
40079	85,350	40,200	52.5	71		

We hereby certify that the above figures are correct as contained in the records of this company.

By [signature]
Name and Title

Form 74

(17)

0020

ITT Harper Inc.
8200 Lehigh Avenue, Morton Grove, Ill. 60053
(312) 966-5000

* CORRECTION 10/17/7

CERTIFIED TEST REPORT

Date: 8/8/73

HMH Register No. 002751-C

Customer: INDUSTRIAL SERVICE CENTER
255 BENT STREET
CAMBRIDGE, MASS. 02141

HMH Drawing No.

Address: (NOW: Metal Goods Service Centers)

HMH Work Order No.

Purchase Order No. S-15536-D

Description of Item

Weight and Pieces	Shape	Size	Length	Material
3170 LBS 34 PCS	CHANNEL	3 x 1-3/8 x 3/16"	18/24'	304 STAINLESS STEEL

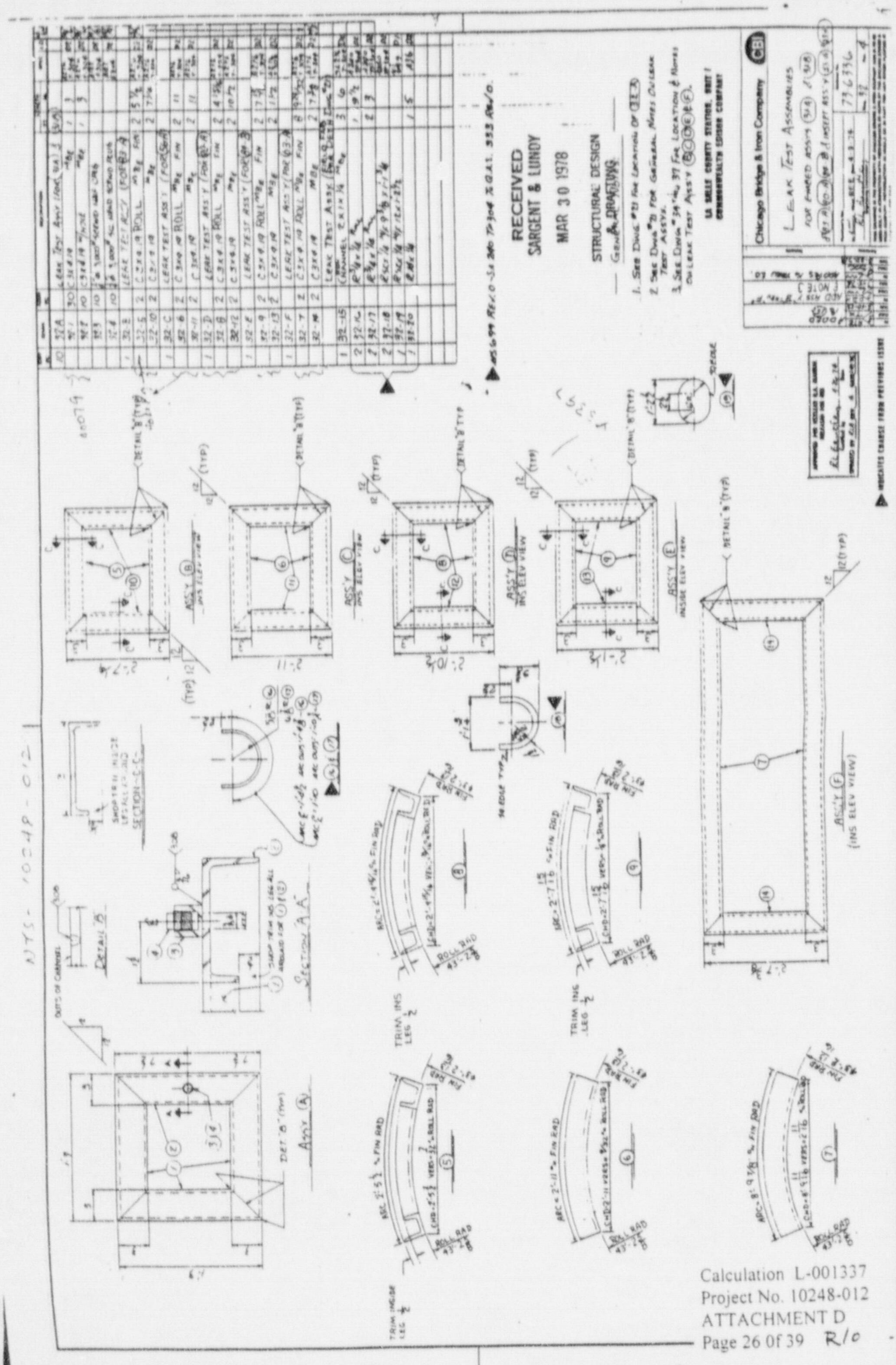
* SPEC ASME SA 479

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN	CO
30408	.065	.020	.022	.32	.35	18.73	10.43	.45	1.52	
30384	.067	.021	.023	.37	.31	18.22	10.27	.37	1.83	

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	% Elongation	R of A	Hardness	PCS	LBS
30408	92,000	52,200	50.8	71.5		20	185[illegible]
30304	91,400	51,500	51.3	71.7		14	13[illegible]



Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 26 0f 39 R/0

0785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
32A	10 ASSY'S.		LEAK TEST ASSY.					Calculation L-001337	
✓ 32-1	30 PCS.		40079					Project No. J0248-012	
✓ 32-2	10 PCS.		40079					ATTACHMENT D	
✓ 32-3	10 PCS		JR					Page 27 Of 39 R/0	
32-4	10 PCS.								

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 12/21/74

REV BY / CHKD / DATE

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date

16-7

Contract No. 73-6336

No. 32 Sh 1 of —

GO 785 REV 4-73

CBI **MATERIAL HEAT NUMBER SHEET**

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
32 B	1 ASSY.		LEAK TEST ASSY					Calculation L-001337	
✓ 32-5	2 PCS		40489					Project No. 10248-012	
✓ 32-10	2 PCS		40489					ATTACHMENT D	
								Page 28 0f 39 R/0	
32 C	1 ASSY.		LEAK TEST ASSY						
✓ 32-6	2 PCS.		40489						
✓ 32-11	2 PCS.		40489						
32 D	1 ASSY.		LEAK TEST ASSY						
✓ 32-8	2 PCS.		40489						
✓ 32-12	2 PCS		40489						
32 E	1 ASSY.		LEAK TEST ASSY						
✓ 32-9	2 PCS.		40489						
✓ 32-13	2 PCS		40489						

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 1/30/75

REV — BY / CHKD / DATE

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A D 16-1

Contract No. 73-6336

No. 32 Sh 2 of —

30785 REV 4-73

CBI MATERIAL HEAT NUMBER SHEET

Material Types:
1. Welded Assemblies
2. Non-Welded Code Matl.
3. Non Code Matl.

Piece-Mark	Serial No.		Material Heat No.	Matl. Type	Piece-Mark	Serial No.		Material Heat No.	Matl. Type
32 F			LEAK TEST ASSY						
✓ 32-7	2 PCS.		40489						
✓ 32-14	2 PCS		40489						

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 29 0f 39 R/o

Data taken from records in accordance with applicable CB&I QA Manual.
CBI Shop QA [signature] Date 2/21/75

REV	BY	
	CHKD	
	DATE	

Reviewed (for material covered by code):
Authorized Inspector (Shop) N/A Date

16-1

Contract No. 73-6336

No. 32
Sh 3 of ___

OUR NUMBER 24-90675
DATE SHIPPED 3-5-74
SPECIFICATIONS ASTM-A-276
ITEM ① T304 SS Channel 2x1x3/16

ITT Harper Inc.
8200 Lehigh Avenue ... 60053
(312) 966-6000

CERTIFIED TEST REPORT Date: 3/18/74

HMH Register No. 00430

S Brau 4-5-7

Customer: METAL GOODS SERVICE CENTER
DIV. ALCAN ALUMINUM
11400 W. ADDISON STREET
Address: FRANKLIN PARK, ILLINOIS 60131

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 30 0f 39 R10

HMH Drawing No.

HMH Work Order No.

Purchase Order No. 24-30675

Description of Item

Weight and Pieces	Shape	Size	Length	Material
3315 S 61	CHANNEL	2 x 1 x 3/16	19' R/L	304 STAINLESS STEEL
920 LBS 11 PCS	CHANNEL	3 x 1 3/8 x 3/16	15-24 R/L	304 STAINLESS STEEL

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN	LBS
30660	.066	.023	.023	.30	.29	18.84	9.74	.57	1.41	2730
30549	.52	.018	.025	.23	.27	18.86	9.90	.46	1.60	585
40079	.044	.014	.021	.20	.19	18.55	9.63	.53	1.89	22

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	Elongation	R of A	Hardness
30660	90,850	55,100	42	64.6	
30549	86,400	43,750	46.8	69	
40079	85,350	40,200	52.5	71	

We hereby certify that the above figures are correct as contained in the records of this company.

By [signature]
Name and Title

0018

METAL GOODS

)UR P. O. # C 13-L336-C123

JR NUMBER 24-91097

ATE SHIPPED 10/24/74

PECIFICATIONS ASTMA-276

EM T304 Channel 3 X 1 3/8 X 3/16 X 20ft Rdm

10/31/74

8200 Lehigh Avenue . Morton Grove, Ill. 60053
(312) 966-6000

CERTIFIED TEST REPORT

Date: 10/21/74

HMH Register No. 005743

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 31 Of 39 R/0

131

HMH Drawing No.

HMH Work Order No.

Description of Item

Weight and Pieces	Shape	Size	Length	Material
3,320 LBS 25 PCS	CHANNEL	3x1 3/8x3/16"	R/L	304 STAINLESS STEEL

SPEC: ASTM A 276

Chemical Analysis

Heat Number	C	S	P	CU	MO	CR	NI	SI	MN		
40489	.051	.021	.030	.24	.09	18.56	9.96	.56	1.55		

Mechanical Properties

Heat Number	Tensile Strength	Yield Strength	Elongation	R of A	Hardness	
40489	89,200	51,600	50.0	68.0		

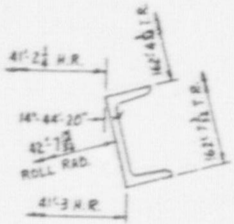
0018

We hereby certify that the above figures are correct as contained in the records of this company.

By John D. Ferrari Q.C. MANAGER
Name and Title

Form 74

17
10



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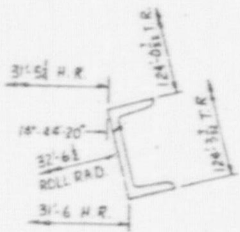

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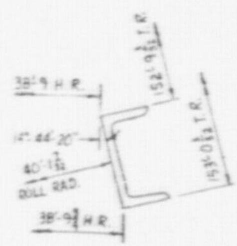

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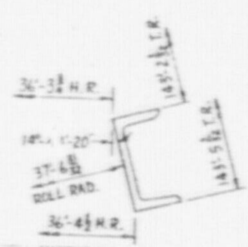

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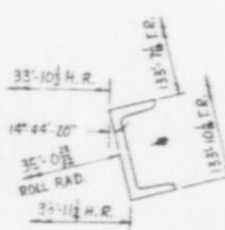

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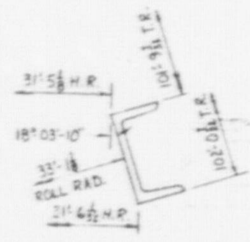
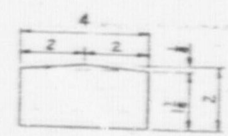


SECTION THRU PC ⑭



⑯

Qty	Piece Mark	Description	Ft	In	Material		
1	287-1	R_HH C3×4.1 (LENGTH ON 41'-2¾ H.R.)	130	0	A36	P₂	
1	287-5	R_HH C3×4.1 (LENGTH ON 31'-5¼ H.R.)	130	0	A36	P₂	
1	287-11	R_HH C3×4.1 (LENGTH ON 38'-9 H.R.)	645	0	A36	P₂	
1	287-12	R_HH C3×4.1 (LENGTH ON 36'-3⅜ H.R.)	705	0	A36	P₂	
1	287-13	R_HH C3×4.1 (LENGTH ON 33'-10½ H.R.)	500	0	A36	P₂	
1	287-14	R_HH C3×4.1 (LENGTH ON 31'-5⅜ H.R.)	225	0	A36	P₂	
1	287-15	R_HH C3×4.1	2730	0	A36	P₂	
6	287-16	PL 5K×⅛ (C.S. 21) (PL 2½×4⅝)			A36	P₂	
865	287-17	PL 2×⅛ (C.S. 21)	0	4	A36	P₂	
131	287-18	¼ø 3000# HALF CPLG (SCR'D)			A105	P₂	
131	287-19	¼ø 3000# SQ. HD. PLUG (SCR'D)			A105	P₂	

NOTE:

WORK THIS DWG. WITH DWGS #286, 288, 289, 290, & 291.

RECEIVED
MAR - 1 1976
SARGENT & LUNDY

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 32 of 39

LA SALLE COUNTY STATION, UNIT 1
COMMONWEALTH EDISON COMPANY

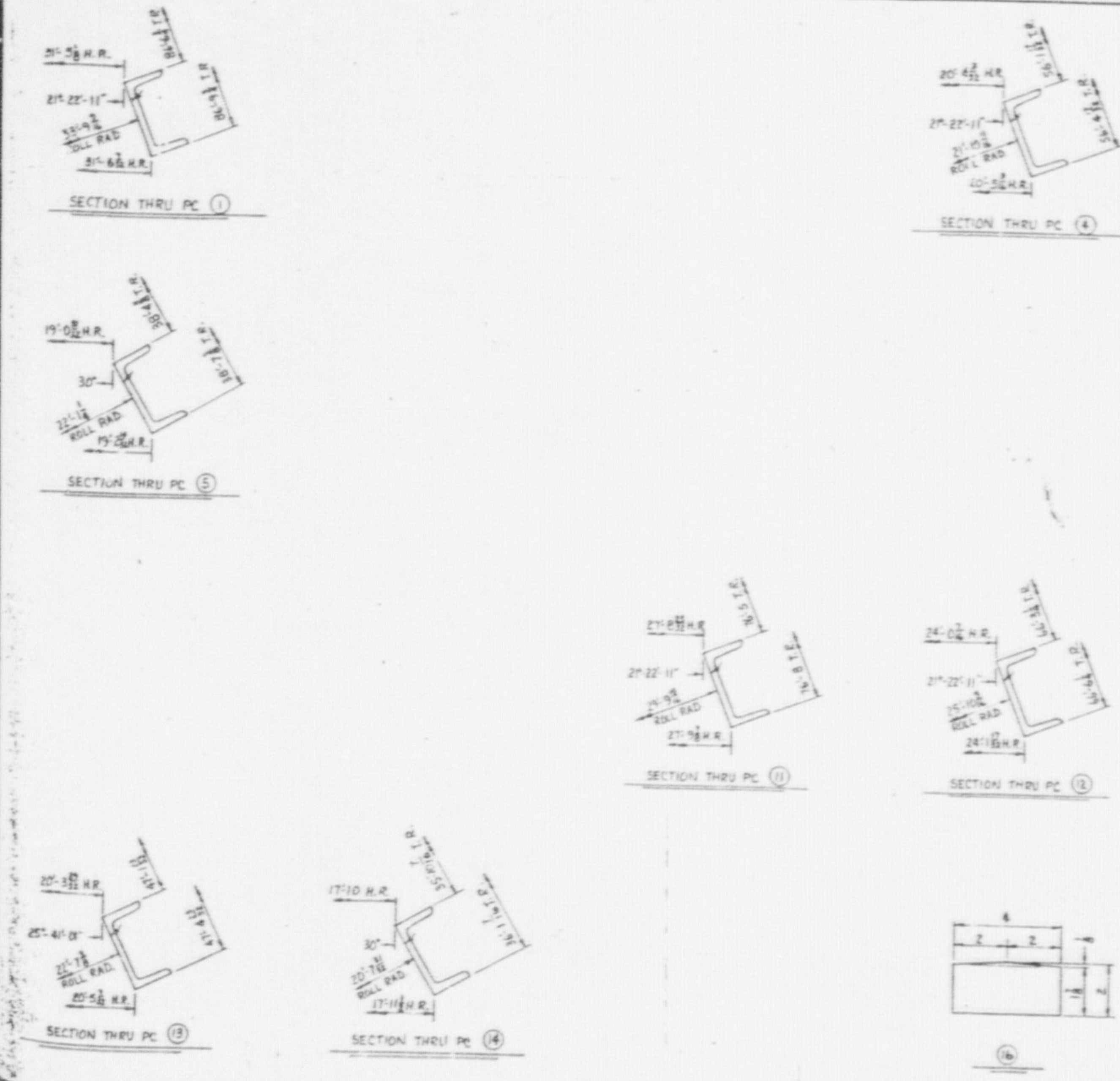
Chicago Bridge & Iron Company CBI

MISC DETAILS

FOR LOWER CONE LEAK TEST

73-6336
287 – 3

▶ INDICATES CHANGE FROM PREVIOUS ISSUE



Qty	Piece No.	Description	Length ft	Length in	Spec
1	293-1	RUN C3x4.1	95	0	A36
		(LENGTH ON 31'-5⅝ H.R.)			
1	293-4	RUN C3x4.1	115	0	A36
		(LENGTH ON 20'-4 H.R.)			
1	293-5	RUN C3x4.1	35	0	A36
		(LENGTH ON 19'-0 H.R.)			
1	293-11	RUN C3x4.1	455	0	A36
		(LENGTH ON 27'-8 H.R.)			
1	293-12	RUN C3x4.1	380	0	A36
		(LENGTH ON 24'-0 H.R.)			
1	293-13	RUN C3x4.1	125	0	A36
		(LENGTH ON 20'-3 H.R.)			
1	293-14	RUN C3x4.1	125	0	A36
		(LENGTH ON 17'-10 H.R.)			
1	293-15	RUN C3x4.1	975	0	A36
2	293-16	PL SK x ⅜ (Cut PL 2½ x ⅜ x 0'-4⅜)			A36
930	293-17	PL 2 x ⅛	0	2	A36
77	293-18	¾ ø 3000# HALF CPLG (SCREWED)			A105
77	293-19	¾ ø 3000# SQ. HD. PLUG (SCREWED)			A105

Calculation L-001337
Project No. 10248-012
ATTACHMENT C
Page 33 of 39 R/o

WORK THIS DWG. WITH DWGS #292 AND 294 THRU 297.

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MAR - 8 1976
SARGENT & LUNDY

LA SALLE COUNTY STATION, UNIT 1
COMMONWEALTH EDISON COMPANY

Chicago Bridge & Iron Company CBI

MISC. DETAILS
FOR LEAK TEST
RINGS #15 THRU #18

160496
JRS 7-28-75
73-6336
293 - 3

▶ INDICATES CHANGE FROM PREVIOUS ISSUE

CBI

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 34 0f 39 R/0

SUPPLEMENTAL SUMMARY SHEET FOR MATERIAL VERIFICATION

CONTRACT NO. 73-6336 LOCATION CCM

SUPPLIER'S ID NO.			ENGINEERING PIECE MARK	SERIAL NO.	NO. PIECES FABRICATED
D81784	100-6	2-12	603-2	1	1
			611-3	1-2	2
			611-4	1	1
			609-2	1-4	4
			609-3	1-2	2
M92565 ~~100-13~~	100-13	16-12	711-2		6
		16-12	715-4		2
		16-12	719-4		2
		16-12	723-4		2
94541	100-19	51-12	740-4	1-4	4
			731-4	1-3	3
			731-5		1
			741-4	1-4	4
KA4989	100-18	51-12	751-4		1
			753-4		1
			731-11	1-2	2
			740-10	1-2	2
			741-10	1-2	2
			692-7	1-2	2
94541	100-19	71-12	287-5	1	1
		74-12	673-20	1	1
		81-12	287-1		1
			287-5		1
			287-11		1
KA4989	100-18	82-12	455-5		1
94541	100-19	84-12	293-12		1
			293-13		1
			293-14		1
		110-12	283-2		1
			283-5		1

See Standard 607-3-1 for instructions on using this form.

GO 823 REV DEC 74

CBI

SUPPLEMENTAL SUMMARY SHEET
FOR MATERIAL VERIFICATION

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 35 Of 39 R/0

GO 823 REV 11-72

CONTRACT NO. 13-6336 LOCATION CCAT

ITEM ID			ENGINEERING PIECE MARK	SERIAL NO.	NO. PIECES FABRICATED
94541	100-19	142-10	283-6	1	1
			283-5	1	1
			283-4	1	1
		94-12	287-12		1
			287-13		1
			287-14		1
			293-1		1
			293-4		1
			293-5		1
			293-11		1
		111-12	596-3	1	1
			596-4	1	1
801S04750	100-12	115-12	712-2		48
			712-3		24
			716-1		16
			716-2		8
			720-1		16
			720-2		8
			724-1		16
			724-2		8
			717-3		6
			725-3		6

CBI

SUPPLEMENTAL SUMMARY SHEET FOR MATERIAL VERIFICATION

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 36 Of 39 R/0

GO 823 REV 11-72

CONTRACT NO. 73-6336 LOCATION CCN

ITEM ID		5-6	ENGINEERING PIECE MARK	SERIAL NO.	NO. PIECES FABRICATED
Y88170	71-2	43-8	345-3		8
			379-3		8
			404-5		1
			404-4		1
			345-2		1
			379-2		1
		48-8	404-5		7
		82-8	343-2		1
			343-3		8
		8-10	426-3		8
			426-2		1
Y88170	71-2	107-10	526-2		1
		107-10	527-2		1
		107-10	526-3		8
		107-10	527-3		8
93063	62-4	130-12	287-13		1 each
			293-11 ✓		"
			293-1 ✓		"
			293-1 ✓		"
			293-5 ✓		"
			287-5 ✓		"
			287-11 ✓		"
			293-15 ✓		"
			287-1 ✓		"
			287-15 ✓		"

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 37 0f 39 R/0

CBI

SUPPLEMENTAL SUMMARY SHEET #12 FOR MATERIAL VERIFICATION

GO 823 REV 11-72

CONTRACT NO. 73-6336 LOCATION CCM

ITEM ID Heat # Slab #	Item #	S.6 #	ENGINEERING PIECE MARK	SERIAL NO.	NO. PIECES FABRICATED
40489	67-3	10-3	39-1	1-36	36
	~~To Be Recut~~		~~39-30~~	~~1-8~~	~~8~~
			32-15	1-2	2
			32-13	1-2	2
			32-12	1-2	2
			32-11	1-2	2
			32-14	1-2	2
		15-3	39-31	1-60	60
			39-32	1-60	60
		19-3	39-2	1-120	120
			39-5	1-4	4
			39-6	1-2	2
			39-7	1-2	2
			39-8	1-12	12
			39-9	1-2	2
			39-10	1-4	4
		28-3	39-30	1	1
		55-3	32-5	1-2	2
			32-6	1-2	2
			32-7	1-2	2
			32-8	1-2	2
			32-9	1-2	2
		35-5	39-33	1	1
		35-5	39-35	1	1
		35-5	39-34	1	1
93063	67-4	12.14	293-15		30

INLAND STEEL COMPANY

REPORT OF CHEMICAL AND PHYSICAL TESTS • METALLURGICAL DEPARTMENT

65.
61
9/

INLAND

CONSIGNEE
CHICAGO BRIDGE & IRON CO.
P. O. BOX 774
KANKAKEE, ILL. 60901

DATE
2 25 1975

DESTINATION	VIA	MILL ORDER NO.	SHIPPING NO.	
INDIAN OAKS, IL	IC 97052	Z-43696	55380.4	5

SPECIFICATION & DESCRIPTION	PIECES	LENGTH FT.	LENGTH IN.	WEIGHT	CUSTOMER ORDER NO.	HEAT NO.	SLAB NO.	YIELD POINT LBS./SQ. IN.	TENSILE STRENGTH LBS./SQ. IN.	ELONGATION IN.	ELONGATION %	BEND
ASTM A-36-70 C3X4.1#	201	30		24723	C73-6336G-159	94541		52200	72300	8	27	OK

ITEm # 100-19

CHEMICAL ANALYSIS

HEAT NO.	C	Mn	P	S	Si	Cu	Ni	Mo	Cr	Cb	V	B	Al
94541	16	80	009	032									

Calculation L-001337
Project No. 10248-012
ATTACHMENT D
Page 38 Of 39 R/0

STATE OF INDIANA
COUNTY OF LAKE
SUBSCRIBED AND SWORN TO BEFORE ME THIS
DAY OF A.D., 19 NOTARY PUBLIC

Steel

WE HEREBY CERTIFY THAT THE ABOVE FIGURES ARE CORRECT AS CONTAINED IN THE RECORDS OF THE COMPANY.

RAYMOND L. GILSON

AS

JONES & LAUGHLIN STEEL SERVICE CENTER DIVISION

JONES & LAUGHLIN STEEL CORPORATION

CERTIFIED RECORD OF CHEMICAL AND MECHANICAL PROPERTIES

Member Steel Service Center Institute

PURCHASER

Chicago Bridge & Iron Company
POST OFFICE BOX 744
Kankakee, Illinois 60701
Attn: Art Johnson

DATE 9-19-74

YOUR ORDER NO. C73-6336E-115- C74-2270E10
C73-6336F-124

CORRECTED

OUR INVOICE NO. 41-16082

Calculation L-001337
Project No. 10248-012
ATTACHMENT D R/0
Page 39 Of 39/Final

ITEM	MANUFACTURER	MATERIAL AS DESCRIBED ON INVOICE		
1	N.W.	1 channel 3" x 4.1#	HR A 36	40'
2	N.W.	24 "	"	"
3	Inland	50 Chan "	"	60'

ITEM	HEAT NO.	CARBON	MANG.	PHOS.	SULPHUR	SILICON	CHROM.	NICKEL	MOLY.	COPPER	Ti or Cb-Ta
1	60930	.24	.64	.018	.47						
2	60930	.24	.64	.018	.47						
3	93063	.14	.67	.008	.020	.21					

ITEM	HEAT NO.	TENSILE PSI	YIELD PSI	ELONGATION IN 2 INCHES %	ELONGATION IN 8 INCHES %	REDUCTION OF AREA %	HARDNESS	BEND TEST	GRAIN TEST	EMB.	JOMINY HARDENABILITY
1	60930	66000	47300		25			ok			
2	60930	66000	47300		25			ok			
3	93063	68100	50400		27			ok			

SUBSCRIBED AND SWORN TO BEFORE ME THIS 19th DAY OF September, 19 74

R McCarville
NOTARY PUBLIC

MY COMMISSION EXPIRES 1-22, 19 75

WE CERTIFY THE ABOVE INFORMATION IS AN EXACT COPY OF CERTIFIED TEST CERTIFICATES FURNISHED BY THE ABOVE MANUFACTURERS AND KEPT IN OUR PERMANENT RECORD FILES.

JONES & LAUGHLIN STEEL SERVICE CENTER DIVISION

CHICAGO SERVICE CENTER

SIGNED [signature]
R. M. CARROLL

```
**************************************************
*                                                *
*           S T A A D - III                      *
*           Revision 20.2                        *
*           Proprietary Program of               *
*           Research Engineers, Inc.             *
*           Date=    JAN 16, 1998                *
*           Time=      9:59:40                   *
*                                                *
*      USER ID: SARGENT & LUNDY ENGRS            *
**************************************************
```

```
 1. STAAD PLANE DETAIL C-C, CBI DWG. 129 R3
 2. INPUT WIDTH 72
 3. UNIT INCHES POUND
 4. JOINT COORDINATES
 5. 1 0. 5.1875; 2 1. 5.1875; 3 9.3125 5.1875; 4 9.3125 0.
 6. MEMBER INCIDENCES
 7. 1 1 2; 2 2 3; 3 3 4
 8. MEMBER PROPERTY AMERICAN
 9. 1 TO 3 PRI IX .02 IY .00439 IZ .004395 AY .375 AZ .4 YD .375 ZD 1
10. CONSTANTS
11. E STEEL ALL
12. POISSON STEEL ALL
13. DENSITY STEEL ALL
14. BETA 0. ALL
15. * STAINLESS STEEL
16. ALPHA 99E-7 ALL
17. SUPPORTS
18. 1 4 PINNED
19. 2 FIXED BUT FX MZ
20. LOAD 1 PRESSURE LOAD = 295 PSI ON MEMB 3, 45 PSI ON 1&2
21. MEMBER LOAD
22. 1 2 UNI GY -45.
23. 3 UNI GX -295.
24. LOAD 2 THERMAL
25. TEMP LOAD
26. 1 TO 3 TEMP 76.
27. LOAD COMB 3
28. 1 1. 2 1.
29. LOAD LIST 1 3
30. PERFORM ANALYSIS
```

P R O B L E M   S T A T I S T I C S

```
NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =      4/     3/     3
ORIGINAL/FINAL BAND-WIDTH =      1/     1
TOTAL PRIMARY LOAD CASES  =      2, TOTAL DEGREES OF FREEDOM =      7
SIZE OF STIFFNESS MATRIX =        35 DOUBLE PREC. WORDS
REQRD/AVAIL. DISK SPACE =  12.01/ 1059.6 MB,  EXMEM =  1.02 MB
```

```
++ PROCESSING ELEMENT STIFFNESS MATRIX.          9:59:41
++ PROCESSING GLOBAL STIFFNESS MATRIX.           9:59:41
++ PROCESSING TRIANGULAR FACTORIZATION.          9:59:41
++ CALCULATING JOINT DISPLACEMENTS.              9:59:41
++ CALCULATING MEMBER  FORCES.                   9:59:42

  31. PRINT JOINT DISP LIST 3
```

JOINT DISPLACEMENT (INCH RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
3	1	-0.00075	-0.00012	0.00000	0.00000	0.00000	-0.00530
	3	0.00624	0.00378	0.00000	0.00000	0.00000	-0.00575

************** END OF LATEST ANALYSIS RESULT **************

32. PRINT MEMBER FORCES LIST 2 3

MEMBER END FORCES STRUCTURE TYPE = PLANE

ALL UNITS ARE -- POUN INCH

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
2	1	2	878.65	126.45	0.00	0.00	0.00	85.13
		3	-878.65	247.61	0.00	0.00	0.00	-588.73
	3	2	891.39	112.70	0.00	0.00	0.00	36.98
		3	-891.39	261.36	0.00	0.00	0.00	-654.85
3	1	3	247.61	878.65	0.00	0.00	0.00	588.73
		4	-247.61	651.67	0.00	0.00	0.00	0.00
	3	3	261.36	891.39	0.00	0.00	0.00	654.85
		4	-261.36	638.92	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

33. SECTION 0. .30129 .33805 1. MEMB 2
34. SECTION 0. .57416 .58249 1. MEMB 3
35. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT POUN INCH STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE Z	MOM-X	MOM-Y	MOM Z
1	1	878.65	-62.63	0.00	0.00	0.00	0.00
	3	891.39	-14.48	0.00	0.00	0.00	0.00
4	1	651.67	247.61	0.00	0.00	0.00	0.00
	3	638.92	261.36	0.00	0.00	0.00	0.00
2	1	0.00	234.08	0.00	0.00	0.00	0.00
	3	0.00	172.18	0.00	0.00	0.00	0.00

************** END OF LATEST ANALYSIS RESULT **************

36. PRINT MEMBER STRESSES LIST 2 3

MEMBER STRESSES

ALL UNITS ARE POUN/SQ INCH

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
2	1	.0	2343.1 C	0.0	3631.8	5974.8	337.2	0.0
		0.30	2343.1 C	0.0	3857.8	6200.9	36.7	0.0
		0.34	2343.1 C	0.0	3947.4	6290.5	0.0	0.0
		1.00	2343.1 C	0.0	25116.5	27459.5	660.3	0.0
	3	.0	2377.0 C	0.0	1577.7	3954.7	300.5	0.0
		0.30	2377.0 C	0.0	4443.2	6820.2	0.0	0.0
		0.34	2377.0 C	0.0	4353.6	6730.6	36.7	0.0
		1.00	2377.0 C	0.0	27937.2	30314.2	697.0	0.0
3	1	.0	660.3 C	0.0	25116.5	25776.8	2343.1	0.0
		0.57	660.3 C	0.0	30707.2	31367.5	0.0	0.0
		0.58	660.3 C	0.0	30695.5	31355.8	34.0	0.0
		1.00	660.3 C	0.0	0.0	660.3	1737.8	0.0
	3	.0	697.0 C	0.0	27937.2	28634.1	2377.0	0.0
		0.57	697.0 C	0.0	29506.1	30203.0	34.0	0.0
		0.58	697.0 C	0.0	29517.8	30214.8	0.0	0.0
		1.00	697.0 C	0.0	0.0	697.0	1703.8	0.0

************** END OF LATEST ANALYSIS RESULT **************

37. FINISH

*************** END OF STAAD-III ***************

**** DATE= JAN 16,1998 TIME= 9:59:42 ****

Attachment F

References

References

1. United States Nuclear Regulatory Commission (NRC) Inspection Report 50-373/78-33, dated January 19, 1979

2. L. O. DelGeorge [Commonwealth Edision Company (ComEd)] letter to A. Schwencer (NRC), "LaSalle County Station, Units 1 and 2, Containment Leak Chase Channels," dated August 10, 1981

3. L. O. DelGeorge (ComEd) letter to A. Schwencer (NRC), "LaSalle County Station, Units 1 and 2, Supplemental Information Concerning Containment Leak Chase Channels," dated September 1, 1981

4. L. O. DelGeorge (ComEd) letter to A. Schwencer (NRC), "LaSalle County Station, Units 1 and 2, Containment Leak Chase Channels," dated October 1, 1981

5. NRC Inspection Report 50-373/81-28, dated November 6, 1981

6. S. V. Athavale (NRC) letter to Donald F. Schnell (Union Electric Company), "Containment Liner Leak Chase Channel Venting Callaway Plant Unit No. 1 (TAC No. 72750)," dated March 14, 1990

7. Stephen P. Sands (NRC) letter to Thomas J. Kovach (ComEd), "Safety Evaluation of Containment Leak Chase Channels - Byron, Unit Nos. 1 and 2, Braidwood, Unit Nos. 1 and 2 (TAC Nos. 72569, 73570, 66476, and 66477)," dated May 17, 1990

8. Licensee Event Report (LER) 50-373/97-030-00, dated September 17, 1997

9. W. T. Subalusky (ComEd) letter to the NRC Document Control Desk, "Containment Leak Chase Channels," dated November 26, 1997