CYGNA
ENERGY SERVICES
101 California Street, Suite 1000, San Francisco, CA 94111-5894 415 397-5600

(8)

50-445, 446

July 31, 1984
84056.012

Mrs. Juanita Ellis
President, CASE
1426 S. Polk
Dallas, Texas 75224

Subject: Telecon Transmittal #8
Comanche Peak Steam Electric Station
Independent Assessment Program - Phase 4
Texas Utilities Generating Company
Job. No. 84056

Dear Mrs. Ellis:

Enclosed please find telecons associated with the Phase 4 Independent Assessment Program.

If you have any questions or desire to discuss any of these documents, please do not hesitate to call either me or Donna Oldag.

Very truly yours,

N. H. Williams

N. H. Williams
Project Manager

Attachments

cc: Mr. D. Wade (TUEC) w/attachments
Mr. S. Treby (USNRC) w/attachments
Mr. G. Grace (TUEC) w/attachments
Mr. D. Pigott (Orrick, Herrington & Sutcliffe) w/o
Mr. S. Burwell (USNRC) w/attachments

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/15/84
Subject:	Electrical Review	Time:	1:30 p.m.
	Conduit Sizing	Place:	G&H Offices
Participants:	P. N. Lalaji	of	G&H
	T. R. Martin		Cygna

Item	Comments	Required Action By
	Paul informed me that conduit sizing was performed in accordance with the Gibbs & Hill Design Guide. The specific section relating to conduit sizing was in the Electrical Design Guide E-Q, section XI, drawing number E-Q-202. Cygna will review this guide for technical adequacy.	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No.	84056
		Date:	6/15/84
Subject:	Electrical Review	Time:	1:30 p.m.
	Documentation Request	Place:	G&H Offices
Participants:	D. K. Ghosu	of	G&H
	T. R. Martin		G&H

Item	Comments	Required Action By
	Requested documentation related to the removal of radiation monitor (Re-4509) interlocks from the control circuit of the surge tank relief valve (RV-4508).	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	7/5/84
Subject:	Conduit Support Document Request	Time:	1:30 p.m.
		Place:	Comanche Peak
Participants:	Steve Ellis (x611)	of	DCTG
	Desmond Stevens (x226)		Cygna

Item	Comments	Required Action By
	Please supply Cygna with a historical listing of all CMC's and DCA's against conduit support 2323-S-0910, Sheet one IN-CSM-15a.	P.M. 7/5/84

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Communications Report

Company: Texas Utilities ☐ Telecon ☒ Conference Report

Project: Comanche Peak Steam Electric Station
Independent Assessment Program - Phase 4

Job No: 84056

Date: 6/25/84

Subject: Conduit Supports - Inspection Reports

Time: 10:00 a.m.

Place: CPSES

Participants:	of
D. C. Vaults	TUSI
Desmond Stevens (x 226)	Cygna

Item	Comments	Required Action By
	Please supply Cygna with a copy of the Inspection Reports for Conduit Line numbers: C13G03528 C12G05124 C13013677	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station	Job No.	84056
	Independent Assessment Program - Phase 4	Date	6/25/84
Subject:	Conduit Support (#910 Sheet CST-3)	Time	1:50 p.m.
		Place	CPSES
Participants:	Tom Keiss (x 487)	of	TUGCO
	Desmond Stevens (x 226)		Cygna

Item	Comments	Required Action By
1.	Calculations requested earlier for Conduit Support Detail #910 Sheet CST-3 were not complete. Please supply Cygna with a copy of the following calculations: 910 SCS-102C Set 2, R.1, Sheet 72-108 910 SCS-102C Set 5, R.1, Sheet 1-43	
2.	Please supply copy of: Calculation 910 SCS-1017 Set 1, Sheet 1-30, 70	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/25/84
Subject:	Conduit Supports - Calculations	Time:	10:30 a.m.
		Place:	CPSES
Participants:	Tom Keiss (x 487)	of	TUGCO
	Desmond Stevens (x 226)		Cygna

Item	Comments	Required Action By
	Please supply Cygna with all calcs pertinent to the design of the following conduit supports (up to and including the Rev. shown):	

Support #s	Rev.
CA-11	9
CSD-16	3

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/25/84
Subject:	Conduit Supports - Drawings, CMCs, DCAs	Time:	10:00 a.m.
		Place:	CPSES
Participants:	Diane Bleeker (DCC)	of	DCC
	Desmond Stevens (x 226)		Cygna

Item	Comments	Required Action By
	Please supply Cygna with a copy of the following:	
1.	Drawing 910 Sheet CSD-16, Rev. 3	
2.	CMC # 62932, Rev. 0	
3.	CMC # 33556, Rev. 0, 1, 2, 3, 4	
4.	DCA # 6588, Rev. 0, 1, 2	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/26/84
Subject:	Conduit Supports - CMCs	Time:	9:00 a.m.
		Place:	CPSES
Participants:	Diane Bleeker	of	DCC
	Desmond Stevens (x 226)		Cygna

Item	Comments	Required Action By
	Please supply Cygna with: 1. All Revisions (except Rev. 0) of CMC # 62932. 2. CMC 33556 Rev. 4, Sheet 1 of 2 and 2 of 2 (second sheet missing from prior request).	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase	Job No.	84056
		Date:	6/26/84
Subject:	Conduit Supports - Design Calculations	Time:	2:00 pm
		Place:	CPSES
Participants:	Tom Keiss (x 487)	of	TUGCO
	Desmond Stevens (x 226)		Cygna

Item	Comments	Required Action By
	Please furnish Cygna with a copy of: Calculation SCS-175C, Sheet 1/2, Rev.1	P.M. 6/26/84

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No.:	84056
		Date:	6/26/84
Subject:	Conduit Supports - Calculations	Time:	8:00 a.m.
		Place:	CPSES
Participants:	Desmond Stevens (x 226)	of	Cygna
	Tom Keiss (x 487)		TUGCO

Item	Comments	Required Action By
	Please supply all the design calculations for Conduit Support # 910 CSD-1.	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/27/84
Subject:	Conduit - Fire Protection	Time:	9:30 a.m.
		Place:	CPSES
Participants:	T. Keiss (x 487)	of	TUGCO
	D. Stevens (x 226)		Cygna

Item	Comments	Required Action By

Please identify which, if any, of the following conduit lines have fire protection coatings and supply the calculations for those identified.

	Location
C-120 02934	Safeguards Building 799'
C-120 00990	Auxiliary Building 799'
C-120 04700	Auxiliary Building 822'
C-120 02936	Safeguards Building 799'
C-120 02937	Safeguards Building 799'
C-120 02938	Safeguards Building 799'
C-110 03394	Safeguards Building 811'

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Communications Report

Company: Texas Utilities ☐ Telecon ☒ Conference Report

Project: Comanche Peak Steam Electric Station
Independent Assessment Program - Phase 4

Job No: 84056

Date: 6/27/84

Subject: Conduit Supports - Design Dwgs & CMCs, DCAs

Time: CPSES

Place: 11:10 a.m.

Participants		of
	Diane Bleeker	DCC
	Desmond Stevens (x 226)	Cygna

Item	Comments	Required Action By
1.	Please supply Cygna with a copy of Drawing 910 Sheet CA-11, Rev. 9	P.M. 6/27/84
2.	Please supply a listing of all DCAs and CMCs against Drawing 910 Sheet CA-11a, including all previous revisions.	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/27/84
Subject:	Conduit Supports - Design Calculations	Time:	11:00 a.m.
		Place:	CPSES
Participants:	Tom Keiss (x 487)	of	TUGCO
	Desmond Stevens (x 226)		Cygna

Item	Comments	Required Action By
	Please supply Cygna with a copy of calculation SCS-153C, Set 1, Sheet 92 which is part of the detail 910 design Sheet CA-11. This was missing from one of TUSI's earlier transmittals.	P.M. 6/27/84

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Communications Report

Company	Texas Utilities	☐ Telecon	☒ Conference Report
Project	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No.	84056
		Date	6/27/84
Subject	Conduit Supports - Design Calculations	Time	3:00 p.m.
		Place	CPSES (Civil Res. Group)

Participants		of
	Desmond Stevens (x 226)	Cygna
	Randy Hooton (Project Civil Engineer)	TUGCO
	Tom Keiss	TUGCO

Item	Comments	Required Action By
	From 6/18/84 to date, it has become evident that TUSI's response to Cygna's request for all the calculations for any given conduit support are often incomplete. With Mr. Keiss's assistance, Cygna was able to determine that the probable cause for these omissions is incomplete entries in the master log indexes for the support. Typically, the master log may list one calculation number only for a support, however, that calculation may in turn reference other relevant analysis in another calculation. To expedite Cygna's access to the necessary information, Messrs. Hooton and Keiss have permitted Cygna personnel to freely review calculation and master log binders, and to obtain copies. Cygna's understanding is that the calculation binders in the civil resident group's work area constitute a complete and final, design-reviewed set of calculations for conduit supports.	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/27/84
Subject:	Conduit Supports - Calculations	Time:	5:00 p.m.
		Place:	CPSES
Participants:	Diane Bleeker	of	DCC
	Desmond Stevens (x 226)		Cygna

Item	Comments	Required Action By
	Please supply Cygna with a copy of all revisions of the following DCAs: 3962 4031	A.M. 6/28/84

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Communications Report

Company: Texas Utilities	☐ Telecon	☒ Conference Report	
Project: Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4		Job No: 84056 Date: 6/21/84	
Subject: Conduit Supports - Calculations		Time: 11:36 a.m. Place: CPSES	
Participants: Tom Keiss		of: TUEC	
Desmond Stevens (x226)		Cygna	

Item	Comments	Required Action By
	Following a Communications Report Request to Tom Keiss for all calculations for conduit supports numbers as follows: (Each number is preceeded by "910 SH.") CA-1a, CA-2a, CA-5a, CA-15, CSM-6b, CSM-15a, CSM-18c, CSM-18d, CSM-18f, CSM-42, CST-3 and CST-17, a phone call was received from Q. A. vaults at Comanche Peak, requesting calulations numbers. The most recent conversation with Mr. Keiss, documented herein, was for the purpose of explaining that the previous communication reports constituted Cygna's formal request for all calculations pertaining to the design of these conduit supports to enable Cygna personnel to have all the relevant information at their disposal for review purposes. Cygna expects TUSI to research and furnish all calculation numbers, since they are the appropriate party to have familiarity with their archives. Cygna will appreciate expeditious execution of this request.	

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Page 1 of 1

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/22/84
Subject:	Cable Tray Supports	Time:	11:30 a.m.
	Document Request	Place:	G&H, N.Y.
Participants:	Peter Huang	of	G&H
	John Russ		Cygna

Item	Comments	Required Action By
	Cygna requested and received copies of the following calculations: SCS-101C, Set 5, Sheets 21-35 SCS-109C, Set 1, Sheets 133-163	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No.	84056
		Date	6/22/84
Subject:	Cable Tray Support Reviews	Time	
	Document Request	Place	G&H, N.Y.
Participants:	Ed Bezkor	of	G&H
	John Russ		Cygna

Item	Comments	Required Action By
	Cygna received the following documents: SRB-123c, Set 1 SRB-123c, Set 5, Rev. 0 GTN-69135 GTT-10395 GTT-10395	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/19/84
Subject:	Structural Review	Time:	11:20 a.m.
	Document Request	Place:	G&H, N.Y.
Participants:	Peter Huang	of	G&H
	John Russ		Cygna

Item	Comments	Required Action By
	Cygna requested the following items from Mr. Huang: 1. All calculations on the effects of vertical loads on beam members of regular cable tray supports. 2. Calculations on design of connections for attaching cable trays to supports. Mr. Huang provided a copy of sheets 28-33 from binder SCS-111C, Set 8 in response to item 1. In response to item 2, Mr. Huang stated that the calculations appear on sheet 42 of binder SCS-101C, Set 2.	

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Communications Report

Company: Texas Utilities ☐ Telecon ☒ Conference Report

Project: Comanche Peak Steam Electric Station
Independent Assessment Program - Phase 4

Job No: 84056

Date: 6/20/84

Subject: Conduit Support Calculations

Time: 7:30 a.m.

Place: CPSES

Participants		of
	Tom Keiss	TUEC
	Desmond Stevens	Cygna
	Bob Hess	Cygna

Item	Comments	Required Action By
	Please supply copies of following calculations for conduit supports, as follows:	A.M. 6/20/8
	Support 910 SH. CSM-18f	
1)	Calculation 910 SCS-205C Set 1 (SH. 1/51-1/81)	
	Support 910 SH. CA-1a	
2)	Calculation 910 SCS-153C Set 1 (SH. 1/4-1/29)	
3)	Calculation 910 SCS-102C Set 1 (SH. 1/1-1/29)	
	Support 910 SH. CSM-15a	
4)	Calculation 910 SCS-201C Set 1 (SH. 1/7-1/10)	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No.	84056
		Date:	6/20/84
Subject:	Conduit Supports	Time:	8:00 a.m.
		Place:	CPSES
Participants:	Tom Keiss	of:	TUEC
	Desmond Stevens		Cygna

Item	Comments	Required Action By
	D. Stevens asked T. Keiss about the existence of any generic calculations concerning fire protection loadings on conduit supports. T. Keiss explained that fire protected conduit lines have been documented on the "910 INFP" drawings, and the supports on these lines have been designed for the additional loads in associated calculation packages. Cygna will review these calculations if fire protection material is encountered on the conduit lines to be reviewed during the Phase 4 walkdowns.	N/A

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No.:	84056
		Date:	6/20/84
Subject:	Mechanical Systems Review	Time:	10:30 a.m.
	Westinghouse Data - Reactor Coolant Pumps	Place:	CPSES
Participants:	John Meyer	of	Westinghouse
	R. Hess		Cygna

Item	Comments	Required Action By
1)	Asked John to provide information on cooling water requirements to the reactor coolant pump thermal barrier per the "Westinghouse Instruction and Operation Book for Reactor Coolant Pump Model Westinghouse 11010-A1 (93-AS)" Book No. 5710-100-09. The requirements are:	

	Minimum	Normal	Maximum
Flow	35 GPM	40 GPM	60 GPM
Temperature	60° F	80° F	105° F
Pressure	N/A	150 PSIG	200 PSIG

There must be cooling water flow to the thermal barrier at all times when the reactor coolant temperature is 200° F or greater. The cooling water temperature can be allowed to reach 130° F if the reactor coolant temperature is less than 400° F.

2) John did not know of any variance paperwork between Westinghouse and G&H on isolation methods for thermal barrier leakage or maximum CCW system temperature.

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No.	84056
		Date:	6/22/84
Subject:	Structural Review	Time:	10:30 a.m.
	Document Request	Place:	G&H, N.Y.
Participants:	Ed Bezkor	of	G&H
	John Russ		Cygna

Item	Comments	Required Action By
	Cygna requested the following documents from Mr. Bezkor: SRB-123C, Set 1 SRB-123C, Set 5, Rev 0 These documents are in regard to 9 and 12 bolt clusters of civil anchors. I also asked Mr. Bezkor if design change authorizations (DCA's) were used to authorize global changes in design documents, e.g., specifications, drawings, etc. Mr. Bezkor replied that the structural group generally used DCA's for this type of design change.	

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Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/25/84
Subject:	Structural Review - Document Request	Time:	8:15 a.m.
		Place:	CPSES
Participants:	Tom Keiss	of	TUEC
	John Russ		Cygna
	Desmond Stevens		Cygna

Item	Comments	Required Action By
	Cygna received the documents as described below: Sheets A-1, A-2: Copies of the cable tray FSE support drawings (note that all drawings listed on these sheets were not received) Sheet B-1: QC Inspection Reports Sheet C-1: Conduit Support Attachments D (19 sheets) and E (22 sheets): CPE listing of cable tray support FSE number versus applicable CMC's for drawings 2323-E1-0601-01-S and 2323-E1-0700-01-S, respectively. Cygna also received a copy of drawing FSE-00176, Rev. 13.	

Signed: DLdag for NHW /ms Page 1 of 1

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ATTN: J. MINICHIELLO
X 226
TRAILOR BT-219

Calculation Sheet

SHT A-1

Project: TEXAS UTILITIES - CPSES IAP PHASE 4 | Prepared By: [signature] | Date: 19 June '84

Subject: SUPPORT NUMBERS | Checked By: | Date:

System: CABLE TRAYS | Job No: 84056 | File No:

Analysis No: | Rev No: 0 | Sheet No: 1/2

SUPPORT FSE NUMBER	FSE MAP NUMBER	SUPPORT FSE NUMBER	FSE MAP NUMBER
735	FSE-00176	793	FSE-00176
734	"	13080	"
714	"	2602*	"
624	"	2607	"
710	"	657	"
620	"	656	"
587	"	655	"
588	"	654	"
733	"	648	"
5616	"	649	"
731	"	593	"
730	"	592	"
728	"	5807	"
726	"	591	"
724	"	590	"
723	"	589	"
722	"	605	"
2606	"	720	"
2602*	"	638	"
758	"	5450	"
763	"	627	"
764	"	629	"
765	"	631	"
766	"	2608	"
767	"		
790	"	* NOT RECEIVED	
791	"		
7129	"		
792	"		

6-19-84

1006 20

CYGNA

Calculation Sheet SHT A-2

Project: TEXAS UTILITIES - CPSES IAP PHASE 4 | Prepared By: [signature] | Date: 14 Feb 89

Subject: SUPPORT NUMBERS | Checked By: | Date:

System: CABLE TRAYS | Job No: 8405L | File No:

Analysis No: | Rev. No: 0 | Sheet No: 2/2

SUPPORT FSE NUMBER	FSE MAP NUMBER	SUPPORT FSE NUMBER	FSE MAP NUMBER
3501	FSE-00185	455	FSE-00174
2920	"	202	"
3112	"	360	"
3034	"	481	"
3022	"	290	"
3026 *	"	367	"
3009	"	299	"
3504	"	480	"
2953	"	479	"
2990	"	101	"
2995	"	118	"
3023	"	119	"
3026	"	13127	"
2986	"	1483	"
2998	"	1484	"
2923	"	408	"
3028	"	100	"
3025	"	116	"
2994	"	117	"
2993	"	97	"
2992	"	112	"
3005	"	113	"
3019 *	"	95	"
6654 *	"	124	"
3017	"	331	"
3021	"		
3111	"		
2861 *	"		
3134	"		
3136	"		

* NOT RECEIVED

1006.00

QC INSPECTION REPORTS

IR	ME	20142F
"	"	1-0018379
"	"	1-0021299
"	"	1-0007997
"	"	20465
"	"	1-0044410
"	"	15747F
"	"	1-0036219
"	"	1-0030728
"	"	1-0021344
"	"	1-0018379
"	"	36980
"	"	38342F
"	"	17398F

SHEET OF DRAWING 2323-S-0910	APPLICABLE CALCULATIONS
IN-FP-212, REV. 1	(C-12G05088) SHTS 1-9, REV. 1
	(C-12Φ05093) SHTS 1-17, REV. 1
IN-FP-213a, REV. 0	SHTS 1-34, REV. 0
IN-FP-213b, REV. 0	" " "
IN-FP-214, REV. 0	(C-13Φ05080) SHTS 1-13, REV. 0
IN-FP-216, REV. 0	(C-12Φ04695) SHTS 1-14, REV. 0
CA-1a	SCS-153C, SET 1, SHTS 4-126
CSM-18a	SCS-209C, SET 1, SHTS 16-43
CSM-42	SCS-209C, SET 1, SHTS 16-43
CSM-15a	SCS-201C, SET 1, SHTS 7-10
CSM-18c, d, f	SCS-205C, SET 1, SHTS 51-81, 120
CSM-18c	SCS-208C, SET 1, SHTS 3-18
CST-3	SCS-157C, SET 1, SHTS 7-10
CST-17	SCS-121C, SET 2, SHTS 28-5:

ATTACHMENT D

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO
	1-J 7901-6"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
583	58270 9-9-81; 58270 R-1 4-15-82; 58270 R-2 4-30-82 CM04 R-1 9-24-81 88270 R-3 9/13/82	Cont.	58270 R-4 9/13/82; 58270 R-5 11/1/83
584	58270 9-9-81; 58270 R-1 4-15-82; 58270 R-2 4-30-82 58270 R-3 9/13/82; 58270 R-4 9/12/83	Cont.	58270 R-5 11/1/83
585	58270 9-9-81; 58270 R-1 4-15-82; 58270 R-2 4-30-82 58270 R-3 9/13/82; 58270 R-4 9/12/83	Cont.	58270 R-5 11/1/83
586	58270 9-9-81; 58270 R-1 4-15-82; 58270 R-2 4-30-82 58270 R-3 9/13/82; 88240 3/24/83	Cont	58270 R-4 9/13/82; 58270 R-5 11/1/83 88240 R-2 7/[illegible]/84 88240 R-3 4/[illegible]/84
587			
588	58215 9-10-81		
589	88240 4/[illegible]/83		
590			
591	[illegible] 7/[illegible]/83		
592			
593			
594	88240 7/[illegible]/83 88240 R-1 11/3/83 88240 R-2 [illegible]/[illegible]/83 88240 R-3 5/23/83		3626 R-4 6/9/83 88240 R-4 11/[illegible]/84
596			
597	88569 10/5/83 88569 R-1 7/[illegible]/83 88569 R-3 11/[illegible]/83		
598			
599	43244 11-10-82; 43244 R-1 1-30-81 43244 R-2 7/[illegible]/83		
600	79609 7/5/83 79609 R-1 1/[illegible]/84		

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7-7-82

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-1 790'-6"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
601	66803R 1 7/12/82 [illegible]		
602	93611 7/6/83 2058 9/28		
603	93610 7/6/83 93610 R-1 10/11/83 93610 R2 1/26/84		
604			
605			
606	36543 6-19-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	36543 R-4 2/13/84
607	36543 6-19-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
608	36543 3-16-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
609	36543 3-16-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
610	36543 3-16-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
611	36543 6-19-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
612	36543 6-19-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
613	36543 6-19-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
614	36543 6-19-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
615	36543 6-19-80 36543 R-1 3/18/83 36543 4/15/83 R 2 36543 R3 5/11/83	Cont	
616	36543 6-19-80 36543 R-1 3/18/83 36543 R 2 4/15/83 36543 R3 5/11/83	Cont	
617	54803 6-25-81		

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7-7-82

3/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-) 790'-6"	E1-0601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
618	56476 6-25-81		
619	34099 5-5-80 34099 R-1 7/7/82		
620	74945 6-3-82; 74945 R-1 6-14-82 74945 R-2 8/4/82; 74945 R-3 4/1/84		
621	74945 R-1 6-14-82 74945 R-3 2/3/84		
622	56276 9-10-81; 56276 R-1 5-26-82; 56276 R-2 4/24/84		
623	56276 9-10-81; 56276 R-1 5-26-82; 56276 R-2 4/24/84		
624	56315 8-17-81, 56315 R-1 12-9-81		
625	56315 8-17-81		
626			
627			
628			
629	64341 1-8-82		
630	76090 7/21/81		
631	48 8-17		
632	48844 3-6-81; 48844 R-1 6-19-81; 48844 R-3 9-22-81; 48844 R-5 7/20/81 48844 R-6 5/15/81	Cont.	48844 R-7 5/24/84
633			
634	46811 1-19-81		

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7-7-82

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
635	97690 3/16/84		
636			
637			
638			
639			
640	4PB525-2-E1, 4PE52R1-5-E1		
641			
642			
643	6847 1132E1, 1139 4-19-78 6847R1 1"/2483		
644	58239 9481		
645	58246 99E1; 58246 R1 3 A E2		
646			
647			
648			
649			
650			
651			

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5/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
652	80259 8/31/82 [illegible] 80259 R-2 3/12/84 80259 R-3 4/2/84	Cont.	80259 R-4 4/25/84
653	34110 R-2 6-7 EI; 34110 R-1 1-19 EI 34110 R-4 2/6/84 34110 R-5 2/15/84 34110 R-6 2/22/84		
654			
655			
656			
657			
660	69186 3-19-82 69186 R-1 11/11/83		
661			
662			
663	48844 3-6 EI; 48844 R-1 6-19 EI; 48844 R-2 7-14 EI 48844 R-3 9-22 EI 48844 R-5 2/26/84	Cont.	48844 R-6 5/18/84 48844 R-7 5/24/84
664			
665			
666			
667			
668			
670	66665 11-3 EI 66665 R-1 4/5/84		
671			

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7-7-82

4/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-10"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
672			
673	8470 4 3 E1		
674	4463 0 1-13 E1; 4463 0 R-1 1-11 E1; 4463 0 R-2 4-22 E1		
675	4463 0 1-13 E1; 4463 0 R-1 1-19 E1; 4463 0 R-2 4-22 E1		
676	8524 R-2 7/8/83		
677			
678	8504 R-1 7-22 E1 8524 R-2 7/8/83		
679	8524 R-2 7/8/83		
680			
681			
682	48E55 3-12 E1		
683			
684			
685			
686			
687			
688			

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7-7-82

7/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	I-J 790'-6"	E1-0601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
688	91589 9:22 E1		
690	EE331 7/23/83 88339 R-1 3/21/83 88339 R-3 6/16/83 88339 R-3 2/2/84		
691			
692	28032 R-1 11/23/82 · 996 R-1 11/23/82 ·		
693	3746 R-1 5/23/83		
694			
695	EE3410 3/23/83		
696	93530 6/21/83 93530 R-1 10/6/83		
697			
698			
699			
701			
701			
702	M2E R-2 3-11 E1; M2B R-3 6-2 E0; 8524 R-1 7-20 81 8524 R-2 7/8/83		
703	47013 2-17 81		
704	34110 R-1 1-19 81; 34110 R-2 E-2 81 34110 R-3 9/12/83 34110 R-4 2/8/84	Cont.	34110 R-5 2/21/84 34110 R-5 2/23/84
705	30461 6-10 E0; 48845 3-9-81; 48845 R-1 6-3-80		

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7-7-82

8/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
706			
707	37476 R-1 5/20/83		
708	58268 9-10-81		
709	58268 9-10-81		
710	30285 2-11-80; 30285 R-1 3-13-80; 30285 R-2 4-7-81 30285 R-4 6-14-82; 30285 R-3 2/8/84		
711	30285 2-11-80; 30285 R-1 3-13-80; 30285 R-2 4-7-81 30285 R-4 6-14-82 30285 R-3 2/8/84		
712	0168 R-1 12-5-80		
713			
714	68386 3-16-82 68386 R-1 8/3/82		
715	0168 R-1 12-5-80		
716			
717			
718			
719			
720			
722	44509 12-9-80		
723	0185 R-1 12-3-80		

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7-7-82

9/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
724	75587 7-7-82		
725	58358 9-21-81		
726	61806 11-20-81; 61806 R-1 5-16-82 61806 R3 4/6/84		
727			
728	52114; 61805 11-20-81		
729	53783 6-29-81		
730			
731	61804 11-19-81		
732			
733	8528 R-1; 8528 R-2 4-27-82		
734	0164 R-2 9-10-81 0164 R-3 9/28/83; 88240 3/24/83 0164 R-4 4/4/84		88240 R-2 4/4/84 88240 R-3 4/4/84
735	88240 3/24/83		
736	88240 3/24/83		
739	2656 R-1 5-15-81, 2656 R-2 9-10-81 2656 R3 6/6/83; 2656 R-4 9/1/83 2656 R-5 1/31/84		
740	2656 R-1 5-15-81, 2656 R-2 9-10-81 2656 R3 6/6/83, 2656 R-4 9/1/83, 2656 R-5 1/31/84		
741	2656 R-1 5-15-81, 2656 R-2 9-10-81 2656 R3 6/6/83, 2656 R-4 9/1/83, 2656 R-5 1/31/84		
742	2656 R-1 5-15-81, 2656 R-2 9-10-81 2656 R3 6/6/83, 2656 R-4 9/1/83, 2656 R-5 1/31/84		

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7-7-82

10/11

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	I-2 790'-6"	E1-0601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
777			
778	46833 7/30/82		
779	00154 9/9/78 00154 R-1 10/24/83 00154 R-2 12/21/83		
780	46885 1-21-80 46885 R-1 3/24/83		
781			
782			
783			
784			
785			
786			
787			
788			
789			
790			
791			
792			
793			

Dwn By TP
7-7-82

11/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
743	58238 9-4-81		
744	61846 11-22-81; 61846 R-1 3-16-82 61846 R-2 7/21/82		
745	61846 11-22-81; 61846 R-1 3-16-82		
746	58337 9-14-81		
747	58337 9-14-81		
748	58337 9-14-81		
749	58337 9-14-81		
750			
751			
752			
753			
754	6122, 6122 R-1 11/1/83 6122 R-2 11/7/83 6122 R-3 4/26/84		
755	6122, 6122 R-1 11/1/83, 6122 R-2 11/7/83 6122 R-3 4/26/84		
756	80294 10/18/82		
REPLACED BY 5807 (757)	CMC 30878 R-5		
758	12107 2-20-80; 12107 R-2 10-3-80; 12107 R-3 9-9-81 12107 R-4 9-25-81		
759			

Dwn By TP
7-7-82

12/19

BUILDING	CUBE/ELEVATION 1-J 790'-6"	DRAWING NO. E1-0601-01-S	MAP DRAWING NO. FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
760	12109 2-20-80; 12109 R-2 10-3-80; 12109 R-3 9-9-81 12109 R-4 9-23-81; 34110 5-7-80; 34110 R-1 1-19-81	760 cont	34110 R-2 8-7-81 34110 R-3 9/13/82 34110 R-4 2/8/84 34110 R-5 2/21/84 34110 R-6 2/23/84
761			
762	2649 R-1 10-21-80; 2649 R-2 9-9-81		
763			
764	53785 7-1-81		
765	32548 4-7-80; 2663 R-1 9-14-81 80282 9/8/82" 2663 R-3 10/7/82" 2663 R-4 12/9/83		
766	13179 2-8-80; 2663 R-1 9-14-81 80283 9/8/82" 2663 R-3 10/7/82" 2663 R-4 12/9/83		
767	43249 11-21-80; 2663 R-1 9-14-81 80284 9/8/82" 2663 10/7/82" 43248 R-1 12/13/82"	Cont	2663 R-4 12/9/83
768			
769	58272 9-9-81, 58272 R-1 3/7/83 58272 R-2 3/20/83		
770			
771	88444 3/2/83		
772	43245 11-12-80; 43245 R-1 3-4-81, 975 9/10/82 43245 R-2 12/21/82" 88410 3/21/83		
773	975 9/14/82		
774	975 9/10/82		
775	975 9/10/82		
776	2007 11/18/83		

Dwn By T.P.
7-7-82

13/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
794			
795			
796			
797			
798	44631 1-19-81		
799	44631 1-19-81		
800	94062 11/22/83		
801			
801a			
801b			
802			
803			
804			
805	116590 2/2/84		
806	77825 4/13/84		
807	77825 4/13/84		
808			

Dwn By TP
7-7-82

14/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-S	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
E10	32461 6-11-80; 32461 R-1 3-9-81; 32461 R-2 9-20-81		
E11	43207 11-4-80; 43207 R-1 1-19-81; 43207 R-2 1-24-81; 43207 R-3 3-6-81; 52575 6-5-81; 43207 R-4 4-19-83	Cont.	43207 R-5 4/4/83
E12	48841 3-6-81 48841 R-1 1/3/83		
E13	48854 3-10-81		
E14	85803 1/4/83 85803 R-1 1/26/84		
E15			
E16			
E17			
E18			
E19			
E20	32449 R-1 10-31-80; 32449 R-2 9-9-81		
E21			
E91			
1091			
1322	37574 9-21-81		
3142			
3403	32513 4-4-80; 35537 5-27-80; 35537 R-1 9-9-80; 35537 R-2 3-4-81; 85537 R-3 5-20-80		35537 7/4/83 4183 R-1 5/6/83 32513 R-1 5/31/83 - 32 5/13 R-2 8/8/83

Cont [illegible]

Dwn By T.P. 7-7-82

15/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-1 770'-6"	E1-0601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
3603	[illegible]		
3604	[illegible] 95395 [illegible]/83		
3605	[illegible] 95395 [illegible]/83		
3606			
3607			
3608	85846 [illegible]/83 85846 R-1 [illegible]/13/83 85846 R-2 [illegible] [illegible]		
3610			
3611			
3612			
3613			
3183			
3318	71248 [illegible] 71248 R-1 [illegible]/8/83 71248 R-2 5/[illegible]/83 71248 R-3 5/19/83	Cont	71248 R-4 [illegible]/83
3301			
3302	85715 [illegible] 85715 R 1 [illegible] 85715 R 2 [illegible]/83 85715 R 3 [illegible]/83	Cont	85715-R-4 [illegible]/83
3132	[illegible] R3 [illegible]/83		
3946	[illegible] R1 [illegible] 8524 R-2 7/[illegible]/83		
5375	[illegible]		

Dwn By TR 7-7-82

16/19

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-S	E-SE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
5276	62823 12-9-81		
5362	77897 8/18/82		
5363	78377 9/9/82 77899 R-1 11/18/83		
5423			
5449			
5450	61183 3-26-79		
5610			
5616			
5617	8530 R-1 6/28/83		
5622	8232 R-5 5/20/83		
5632			
5557			
5623	8232 R-1 5/20/83		
5807	80274 10/18/82		
6655			
7128	61418 9-19-79; 52406 5-5-81; 68386 3-16-82; 52406 R-1 7/26/82; 68386 R-1 9/13/82	Cont.	52406 R-2 3/22/84
7130	[illegible] 11/7/83		

Dwn By T.P. 7-7-82

17/A

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	1-J 790'-6"	E1-0601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
12268	43207 R-1 1-19-81; 43207 R-2 1-27-81; 43207 R-3 3-6-81 43207 R-4 4-13-82 43207 R-5 1/4/83		
12412	48842 3-6-81, 48842 R-1 4-13-82		
12413	48842 3-6-81; 48843 R-1 3-17-82		
12414	36461 R-1 3-9-81; 36461 R-2 7-22-81		
12415	36461 R-1 3-9-81; 36461 R-2 7-22-81		
12416	48850 3-12-80; 48850 R-1 6-22-81		
12437	52405 5-1-81		
12456	48844 R-2 7-14-81; 48844 R-3 9-22-81 48844 R-2 1/2 1/84 48844 R-6 5/16/84	Cont.	48844 R-7 5/24/84
12457	48844 R-2 7-14-81; 48844 R-3 9-22-81 48844 R-3 1/2 1/84 48844 R-6 5/16/84	Cont.	48844 R-7 5/24/84
12468	36461 R-2 7-22-81		
12474	58273 9-10-81; 58273 10-16-81		
12478	58358 9-21-81		
12568	60275 10-29-81; 60275 R-1 11-9-81; 60275 R-2 11-23-81 60275 R-3 1/21/84		
12592	65766 1-27-82; 65766 R-1 2-15-82; 65766 3-16-82		
12691	42898 Released		
1075	3424 R-1 Released, 3424 R-2 11/3/83		
1106	3424 R-1 Released; 3424 R-2 11/3/83		

Dwn By T.P.
7-7-82

BUILDING	CUBE/ELEVATION 990'-6"	DRAWING NO. E1-601-01-S	MAP DRAWING NO. FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
1098	3424 R-1 8/18/82, 3424 R-2 1/13/83,		
13077	85725 10/7/82		
~~1118~~	~~[illegible]~~ R-1 12/29/82		
13080	80720 3/2/83, 80720 R-2 4/5/83 85720 R-3 5/23/83 [illegible]		
595	01854 R-1 3/17/83 01854 R-2 4/15/83 01854 R-3 2/21/84		
13145	8532 R3 5/9/83 8532 R-4 5/11/83 8532 R5 5/20/83		
13146	8532 R3 5/9/83		
13144	8532 R4 5/11/83 8533 R5 5/20/83		
13148	91713 5/13/83		
13163	93469 6/22/83		
13165	93599 7/5/83		
13169	93601 7/19/83, 93601 R-1, 8/1/83 93601 R-2 9/12/83		
13170	93602 7/21/83, 93602 R-1 9/1/83; 93602 R-2 9/[illegible]/83		
2609	32273 R-3 10/4/83		
13192	95394 10/[illegible]/83 95394 R-1 11/7/83		
659	65156 R-1 11/2/83		
5557	96034 11/30/83		

Dwn By T.P.
7-7-82

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
	790'-6"	E1-601-01-5	FSE-00176

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
13201	960168 12/1/83 960168R-1 WED 9/21/84		
809	17836 4/6/84		
13221	17887 4/24/84		

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Received 25 June 84 J.P.L.

ATTACHMENT E

1/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	700'-6"	E1-700-01-5	FSE-0XX74

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
35			
85	8501" Water		
86			
93			
94			
95			
96			
97			
10			
101			
102	5102" Water		
103	5103" Water		
104			
106			
107	5107" Water		
108			
109	6"SP16 Water 6"SP16-R 1"&3/4" 6"SP16-R 3"&3/4" 6"SP16-R 3"&3/4"	Cont.	6"SP16-R 4-3/4"&1/8" 2091 R-1 1/2"&3

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2/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
110			
111			
112			
113			
116			
117			
118			
119			
120			
121			
122			
123			
124			
125	[illegible]		
126	[illegible]		
127			
[illegible]			

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3/22

BUILDING		CUBE/ELEVATION	DRAWING NO.		MAP DRAWING NO.
Auxiliary		790'-6"	E1-700-01-5		ESE-00174
HANGER NUMBER	REMARKS		HANGER NUMBER	REMARKS	
129					
130					
131					
132					
133	2093 R1 5/23/83 2093 R-3 2/6/84 2093 R-4 2/6/84				
134					
135					
136	8224 [illegible] 8224 R-1 [illegible] 8224 R-2 [illegible] 8224 R-4 [illegible] 8224 R-5 3/20/84 8224 R-6 [illegible]		Cont	8224 R-7 4/27/84	
138	15344 [illegible]				
140	15344 [illegible]				
143	15160 [illegible] 41160 [illegible] 41160 R-1 [illegible]				
144	16085 [illegible]				
145					
146					
147					
189	1141 R-1 [illegible] 1141 R-2 [illegible] 1141 R-3 10/3/83				
190					

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7-7-82

4/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	790'-6"	C1-700-01-5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
191			
192			
193			
194			
195			
197	31184 7/7/81" 31184 R-1 3/2/81" 48933 4/[illegible] 48933 R-1 4/7/81" 48933 R-2 4/13/82"		
201	36452 6/2/81" 36452 R-1 1/4/81" 36452 R-2 8/4/81" 36452 R-3 3/6/83		
202	4500 3/4/79" 4500 R-1 6/4/81" 4500 R-2 6/4/81"		
288	5075 4/21/81"		
289			
290	36282 4/14/81" 36282 R-1 4/14/82"		
291			
292	6915 7/3/79" 1815 R-1 7/4/81" 1815 R-2 8/26/80 1815 R-3 3/4/81" 1815 R-4 7/2/83 1815 R-5 4/3/83	Cont.	1815 R-6 4/21/83 1815 R-7 3/4/83 1815 R-8 7/5/83 6915 R-1 7/5/83 (cont'd)
293			
294			
295			
296			

(cont)

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7-7-82

5/22

BUILDING		CUBE/ELEVATION	DRAWING NO.		MAP DRAWING NO.
Auxiliary					

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
297	1808 R-1 7/26/83		
298			
299			
300	97794 4/18/84 97794 R-1 5/15/84 97794 R-2 5/22/84		
301	2961 R-1 4/18/84 97794 4/18/84 97794 R-1 5/15/84 7784 R-2 5/22/84		
302	3024 R-2 [illegible] 3024 R-1 [illegible] 3024 R-3 [illegible] 3024 R-4 [illegible]	Cont.	3034 R-5 4/17/84 97794 4/18/84 97794 R-1 5/15/84 3034 R-6 5/22/84 97794 R-2 5/22/84
303			
304	1828 R-1 7/26/83		
305			
306			
307			
308			
309			
311			
312			
313			
314			

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7-7-82

6/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	790'-6"	E1-700-01-5	FSE-00174.

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
315			
316			
317			
318			
319	1815 9/21/78" 331624 1/21/80" 312200 3/11/80" 1815R-1 3/11/80" 1815R-2 8/26/80" 1815R-3 3/11/81"	Cont.	331624R-3 3/11/82" 1815R-4 7/12/83 1815R-5 4/13/83 1815R-6 4/21/83
320			
321			
322	324160 3/11/81"		
323			
324			
325	812417 9/21/82"		
326			
327			
328			
331			
332			
333	769397 1/26/84		

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7-7-82

7/22

BUILDING		CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary		790'-6"	E1-700-01-5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
338	18322 3/16/81" 17727 5/16/81" 17787 ?/16/81"		
355	9987R 1 1/21/81" 9987 4/20/81" 9987R 2 ?/[illegible]		
356			
357	50723 4/20/81"		
358	48931 3/27/81" 48731R-1 4/20/81" 34058 R-1 [illegible] 48913 R-4 [illegible] 48931R5 7/6/81 30416 3/19/80"		
360			
361			
362			
363	17792 4/16/81		
364	28346 9/3/81" 28324 9/20/81" 58:360R-1 4/18/80" 96968 2/2/81		
365			
366			
367			
369			
370			
371	[illegible]		
372	19902 R-1 3/23/81"		

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7-7-82

8/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	1710'-6"	E1-710-D1-5	ESE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
102			
103			
111	[illegible]		
108	[illegible]		
109			
110			
111			
122	[illegible]		
123	[illegible]		
124			
125			
127			
128			
129			
130	[illegible]		
131	[illegible]		
310	[illegible]		

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9/22

BUILDING: Auxiliary	CUBE/ELEVATION: 790'-6"	DRAWING NO.: E1-700-01-5	MAP DRAWING NO.: ESE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
043			
198			
197			
310			
334	36467 6/3/81		
335	60017 2/11/82		
336			
337			
339	80718 12/16/82		
340	70837 8/16/82 70837 R1 9/16/82 (VOID)		
341			
342	95163 R-1 [illegible] 95163 R-2 4/5/84		
343	C464 R-1 9/3/81		
344			
345	97115 9/24/81 97115 R1 9/16/82 97115 R2 4/8/81 97115 R3 2/4/81 97115 R4 3/16/82 97115 R5 4/1/83		
346	80280 9/1/82 80280 R1 6/1/83		
347	95353 4/15/82 95353 R-1 2/1/84 95353 R-2 3/1/84 95353 R-3 3/13/84 95353 R-4 4/11/84		

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7-7-82

10/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	470'-6"	E1-NO-01-5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
348	3607R-1 [illegible] 3607 [illegible] 3607R-3 [illegible] 3607R-2 [illegible] 3607R-4 [illegible] 1852R-1 [illegible] 1852R-2 [illegible] 1852R-3 [illegible]	Cont.	3607R-5 7/15/83 3607R-6 10/3/83 3607R-7 10/28/83
349			
350			
351			
352	[illegible]		
353	[illegible]		
359			
373			
374			
375			
376			
377			
378	[illegible]		
379			
380	1862R-3 [illegible] 1862R-2 [illegible] 8291 [illegible] 8291R-1		
381			
382			

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11/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Hewlett			

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
383			
384			
385			
386	[illegible]		
387	[illegible]		
388	[illegible]		
389	[illegible]		
390	[illegible]		
391	[illegible]		
392	[illegible]		
394			
395	[illegible]		
396	[illegible]		
397	[illegible]		
398	[illegible]	cont.	[illegible]
399	[illegible]		
400	[illegible]		

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7-7-82

12/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
[illegible]	790'-6"	E1-700-01-S	

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
401	[illegible]		
403	[illegible]		
405	[illegible]		
313	[illegible]		
432	[illegible]		
433			
434	[illegible]		
435	[illegible]		
439			
455	[illegible]		
475			
476			
477			
478	[illegible]		
479			
480			
481	[illegible]		

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7-7-82

13/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	770'-6"	E1-700-01-5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
482	4533 [illegible] 4533R-1 [illegible] 4533R-3 [illegible]		
483	5231 [illegible]		
484			
485	[illegible] 8840R-2 [illegible]		
486	[illegible] R-1 [illegible] R-2 [illegible] R-3 [illegible]		
487	[illegible]		
488			
489	[illegible] R-1 [illegible]		
490	6182 [illegible] 6182R-1 [illegible] 6182R-2 [illegible] 6182R-3 [illegible] 6182R-4 [illegible]		
491	[illegible]		
492	[illegible]		
511			
[illegible]	[illegible] R-1 [illegible]		
[illegible]	[illegible] R-1 [illegible]		
[illegible]	3 [illegible]		
[illegible]	31 [illegible]		
[illegible]			

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7-7-82

14/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary			

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
C111	[illegible]		
C112	[illegible]		
C113			
C114	[illegible]		
C115	[illegible]		
C116	[illegible]		
C132			
C131			
C136			
C135			
C138	[illegible]		
C140			
C141	EE336 3/22/83		
C142	EE337 3/22/83		
C143	EE338 3/22/83		
C144			
C145	[illegible]		
C146	[illegible]		

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7-7-82

BUILDING		CUBE/ELEVATION	DRAWING NO.		MAP DRAWING NO.
Auxiliary		490'-6"	E1-1700-01-5		FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
447	44233 [illegible]		
448	77852 [illegible] 77852 R1 6/1/83		
449	77853 [illegible] 77853 R1 6/1/83 1921 9/28/78		
450	77854 [illegible] 77854 R1 6/1/83 1921 9/28/78		
451	58241 [illegible] 58241 R-3 [illegible] 58241 R-4 [illegible] 58241 R-5 [illegible] 58241 R-6 [illegible]	Cont.	58241 R-7 [illegible] 58241 R/9 5/30/84
452			
453	95388 10/17/83, 95388 R-1 [illegible]/1/83 95388 R-2 [illegible]		
456			
5305	853 R-1 [illegible] 853 R-2 [illegible]		
5542			
5545	95340 [illegible] 95341 [illegible]/83, 95341 R-1 [illegible] 95341 R-2 [illegible] 95341 R-3 [illegible]		
5514			
9117	52389 [illegible] 52389 R-1 [illegible]		
491			
5609	58241 R-? [illegible]		
3421	19320 [illegible]		
1591	15331 [illegible]		

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7-7-82

16/22

16/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxillary	790'-6"	E1-1700-01-5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
12275	44978 5/2/82, 44978 R-1 3/3/83		
12276	44979 5/2/82		
12467	57221 8/3/82, 57221 R-1 12/20/82, 57711 R-2 4/7/83		
12077	57227 8/6/82		
12472	110771 R-2 9/1/82, 110771 R-3 6/2/82		
12473	110771 R-2 9/9/82, 110771 R-3 6/2/82		
12638	111071 4/7/82, 111071 R-1 5/7/82, 111071 R-2 6/3/82		
12641	71132 9/28/82, 71132 R-1 7/16/82, 71132 R-2 7/16/82, 71132 R-3 3/10/83, 71132 R-4 3/16/83	Cont.	71132 R-5 3/30/83, 71132 R-10 2/6/84
12642	71133 4/28/82, 71133 R-1 7/17/82		
12448	11397 5/24/82, 11397 R-1 12/6/82, 11397 R-2 7/16/82		
457	95163 - 8-22-83;		
458			
459			
460			
461			
462			
463	77851 8/13/82, 77851 R1 6/1/83		

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7-7-82

17/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	790'-6"	E1-700-01-5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
4164	1063R 1 [illegible]/82 1063R-2 [illegible]/82 1063R-3 3/[illegible]/82 1063R-4 [illegible]/82		
4165	[illegible] 2 [illegible]/82		
4166			
4167			
4168			
4169	4532 3/[illegible] 4532R-1 2/3/84 4533R-2 5/14/81		
4170	80258 6/30/82		
4172	[illegible] 58241 [illegible] 58241R-2 [illegible]/82 58241R-3 [illegible]/82 58241R-4 [illegible]/83 58241R-5 11/3/83	Cont.	58241R-6 [illegible]/83 58241R-7 3/28/84 58241R 9 5/30/84
4173			
1883			
1885	58286 [illegible]/82		
1901			
1902	[illegible]		
2771			
3138			
3531			
5237			

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7-7-82

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	1700'-6"	E1-700-01-5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
1483	73333 4 1/2 153		
1484	73333 4 1/2 153		
6003	illegible		
6004	illegible		
3158			
1113			
5645			
5601			
3775	illegible		
3754			
3755			
3756	illegible		
3736			
3737			
3736			
3739			
3737	illegible		

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7-7-82

19/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	790'-6"	E1-100-01:5	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
3365			
1466			
1112			
4117			
3531			
2833			
1590			
1591			
1118			
4111			
950			
951			
373			
368			
1526			
1321			
333			

Dwn By T.P.
7-7-82

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	770'-6"	E1-700-01-5	FSE-001-X1

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
354			
454	[illegible] 80281 R1 6/1/83		
2774			
2701			
2775			
5514			
5288	[illegible]		
5289	[illegible]		
5291	[illegible]	Cont	[illegible]
5300			
5301			
5303	[illegible]	Cont	
5270			
5339			
[illegible]	[illegible]		
3531	[illegible]		
[illegible]	[illegible]	Cont	[illegible]

Dwn By T.P.
7-7-82

BUILDING	CUBE/ELEVATION	DRAWING NO. E1-700-01-S	MAP DRAWING NO.

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
13064	83005 R-1 3/4 83005 R-1 3/4 83005 R-2 12 1/2		
13083	85785 12		
13124	88465 R-3 88465 R-4 88465 R-5	cont.	88465 R-7 88465 R-8
13125	88508 R-1		
13127			
13130			
13131			
319			
13152	91799 91799 R-1		
13153	91800 91800 R-1 5 91800 R-3		
12641	7113 AG 7113		
312			
13180	85287		
13181	85287		
13182	85288		
13143			
13158			

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7-7-82

22/22

BUILDING	CUBE/ELEVATION	DRAWING NO.	MAP DRAWING NO.
Auxiliary	790'-6"	E1-700-01-S	FSE-00174

HANGER NUMBER	REMARKS	HANGER NUMBER	REMARKS
7117	4533R1 7/26/ 4533R23 14/61		

Dwn By T.P.
7-7-82

CYGNA

Communications Report

Company:	Texas Utilities	☐ Telecon	☒ Conference Report
Project:	Comanche Peak Steam Electric Station Independent Assessment Program - Phase 4	Job No:	84056
		Date:	6/19/84
Subject:	Thermal Loads on Conduit and Cable Tray Supports	Time:	9:30 a.m.
		Place:	G&H, N.Y.
Participants:	Peter Huang	of	G&H
	John Russ		Cygna

Item	Comments	Required Action By
	Reference: Conference Report, dated June 5, 1984, P. T. Huang, B. Hess, and J. Russ participating. In response to the request for Gibbs & Hill's evaluation of thermal loads on conduit and cable tray supports in the referenced conference report, Mr. Huang provided Cygna with the attached response.	

Signed: Doldag for NHW /ms Page 1 of 1

Distribution: N. Williams, D. Wade, G. Grace, R. Hess, J. Russ, S. Treby, J. Ellis, S. Burwell, Project File

1020.01a

RECEIVED: 19 June '84
9:30 AM

June 13, 1984

CYGNA's Question

Provide calculations or documentations on the acceptability of excluding thermal effects in the design of cable tray and conduit supports.

Response

FSAR Section 3.8.4.3.3 states in part, that under factored load conditions (including SSE loads), thermal loads are neglected when they are secondary and self-limiting in nature. Thermal loads, if proved to be secondary, generate secondary stresses. ASME NF-3213.8 states that secondary stress is a normal stress or a shear stress developed by the constraint of adjacent material or by self-constraint of the structure. The basic characteristic of a secondary stress is that it is self-limiting.

In the same section of the FSAR, under service load conditions (including OBE loads), if thermal stresses due to To (Thermal loads during normal operating conditions), are present and are secondary and self-limiting in nature, the allowable stress is increased by 50% (1.5S). This increased allowable is more than adequate to compensate for the stress increase due to thermal load.

In response to an earlier ASLB question on thermal effects on pipe supports, a report titled, "Evaluation of LOCA Temperature Effects on Pipe Supports" was issued on August 26, 1982. The findings of this report are applicable to cable tray and conduit supports due to the similarities in support materials and support configurations. The report concluded that the thermal stresses are secondary and self-limiting and that the increase in stress due to thermal load Ta (Thermal loads generated by the postulated break) is small. Note that under service load conditions, To is used in the load combination in lieu of Ta in the factored load combination and To is much smaller than Ta, thus the thermal effects from To is even smaller.

In summary, since the thermal stresses are secondary stresses and are self-limiting, and the increase in stresses due to thermal load To is small, we properly exclude the thermal effects in the design of the cable tray and conduit supports.

ELB/PTH:gw

Applicant's Exhibit 14-V

Report

Comanche Peak Steam Electric Station

Evaluation of

LOCA Temperature Effects on Pipe Supports

August 26, 1982 (Revised)

Contents

M.A. Vivirito
P.C. Charoglu

LOCA TEMPERATURE EFFECTS ON PIPE SUPPORTS

A pipe support structural steel frame of any configuration, subject to a sudden environmental temperature rise, would expand freely, in a stressless state, except for the fact that it is anchored at several locations, to relatively cold concrete members. The magnitude of the stresses in the structural frame, and the resultant thermal loads in the anchors, is a function of the flexibility of the frame between anchors and the flexibility of the anchors; the more flexible the frame, the lower the stress and the lower the resultant loads on the anchors. This is analagous to a piping system subject to a change in temperature; the greater the number of loops, the lower the stresses and the lower the resultant load on the end anchors.

In reviewing the various pipe supports inside the containment, the most severely stressed structural element therefore would be a straight structural member restrained by anchors at each end; such a configuration would tend to produce, under a LOCA temperature increase, the highest stresses in the structural member, and the greatest loads on the end anchors. In such a frame configuration (straight members anchored at each end) the thermal effects on the member and the anchors will be governed by the following factors:

1. The cross sectional area of the structural member
2. The length of the structural member
3. The "slip" vs. load characteristics of the anchors
4. The deformation vs. load characteristics of any welding at the anchor plate if an anchor plate is used to fasten the structural steel member to the anchors embedded in the concrete supporting structure.

In reviewing the various pipe support details inside containment, we have analyzed three (3) representative supports (for LOCA temperature effects) which are typical upper limit "composites" of various support elements as follows:

Case 1: Structural Member - TS 6" x 6" x 3/8"
Length of Structural Member: 6'0"
Anchors: Four (4) 3/4" diameter expansion bolts
Weld: 28" of ¼" fillet weld

Case 2: Structural Member - TS 6" x 6" x 3/8"
Length of Structural Member: 6'-0"
Anchors: Two (2) 1¼" diameter Richmond Anchors
Weld: None

Case 3: Structural Member - TS 6" x 6" x 3/8"
Length of Structural Member: 6'-0"
Anchors: Two (2) 3/4" diameter Nelson Studs
Weld: 12" of 3/16" fillet weld

The preceding three (3) cases constitute an "envelope" of the typical upper limit case supports considering the size and length of structural members, three (3) types of anchors and minimum and maximum welds (or no weld). Attachment No. 1, sheets 1 to 5, show the results of the thermal analysis assuming a 210°F increase in temperature for these three (3) cases, by graphic representation.

The method of performing this "graphic" analysis is as follows:

For Case 2 (no weld) -

Step 1 - A graph is established with "load" in the "y" direction and "displacement" in the "x" direction.

Step 2 - For the structural member, the zero elongation load or "fully restrained" load P_R is calculated:

$$P_R = \alpha \times 210°F \times E \times A$$

Where:

α = coefficient of thermal expansion = 6.5×10^{-6} inches/inch
E = modulus of elasticity of steel = 29×10^6 psi
A = cross-sectional area of structural member, sq. inches

Step 3 - For the structural member the zero load or "free thermal expansion" at each end is calculated:

$$= \alpha \times 210°F \times \frac{\text{length}}{2}$$

Step 4 - The straight line between points determined in Steps 2 and 3 above represents the relationship between the thermal elongation of the member and the residual thermal load in the member.

Step 5 - On the same scale, the load vs. slippage curve for the anchors are plotted (based on test data; see Attachments A through C).

Step 6 - The equations of equilibrium for the structural member and the anchors are:

(1) Load in the structural member = load in the anchors, and

(2) Elongation at one end of the structural member = slippage in the anchors at one end

Therefore, the point where the two (2) curves intersect (structural member and anchors, load vs. displacement curves) represents the magnitude of the resultant load and elongation of the structural member and the slippage of the anchors.

For Cases 1 and 3 - (Intermediate weld between member and anchors)

Steps 1 to 4 - Same as Case 2 above.

Step 5 - Plot load vs. slippage curve for anchors

Step 6 - Plot load vs. deformation curve for welds

Step 7 - The equations of equilibrium for the structural member, the anchors and the welds are as follows:

(1) Load in structural members = load in anchors = load in weld.

(2) Elongation in structural member = slippage in anchors plus deformation in welds.

Based on above, the resultant load, elongation, anchor slippage and weld deformation is graphically determined.

The above solutions (Attachment No. 1) clearly illustrate, in a graphic manner, the self-limiting nature of thermal expansion effects. For instance, in each case, the "fully restrained" load in the structural member is 319 kips. This magnitude of load would be the resultant load that would appear in the output of a computerized analysis (such as STRUDL) that does not consider the "relief" mechanism that exists via slippage of the anchors. As can be seen by the results of the analysis of the three (3) cases, the actual maximum load in the structural member is 39 kips, only 12% of the "fully restrained" load. This results in a maximum stress in the member of less than 5 ksi. A very small "slip" in the anchor of about .043 inches reduces the thermal stress from a theoretical fully restrained stress of about 40 ksi to less than 5 ksi.

Another aspect of the self-limiting nature of the temperature increase is to consider the maximum "free expansion" of the end of the structural member, equal to only .049 inches at each end of a symmetric system. This is the upper bound displacement that it can apply to any anchor, regardless of the size of the member, or the number and size of anchors. Since the ultimate slippage of the typical anchors used on

the project (see Attachments A to C) is much higher than .049 inches, thermal expansion of the structural members shown, due to a 210°F temperature rise, can never fail the anchors (or the welds; see Attachment D).

The results of the attached analyses also illustrate in this case the gross error in treating a self-limiting thermal load is if it were a constantly applied mechanical type load. For instance, if the 319^k fully restrained thermal load that would result from a computer analysis were used to design the end anchors, the following design would ensue:

If 1½" diameter Richmond inserts were to be used, with an allowable shear load of 25^k each, 13 inserts would be indicated as a design requirement. Actually, the residual load in the member is only 21^k, not 319^k, due to the relief caused by slight displacement of the anchors. In any event, since the maximum free elongation of the member at each support is only .049" and the ultimate displacement (at failure) of the Richmond is about 0.40", the thermal load in the structural member could never fail even a single anchor. A review of Attachments "A" to "D" indicates that this would be true of any size or type of anchor, or any size or length of weld; the maximum possible elongation of .049" is much less than the ultimate displacement of any of these anchors or welds.

To attempt to defend a "brute" approach of designing for the full 319^k fully restrained thermal load, on the basis of conservatism, without considering the self-relieving mechanisms that are present, would be absurd; it would merely indicate a complete lack of understanding of the self-limiting nature of thermal effects that is recognized in various sections of the ASME Code (i.e., NF3213.8, NF3231.1).

In Attachment No. 2, factors of safety of the anchors and welds are calculated, including the effects of temperature increase plus other normal loads that could act concurrently. Since the thermal effects are strain limited, the factors of safety are appropriately based on strain rather than stress. The minimum factor of safety is 3.0, which is more than adequate for this load combination.

On page 2, paragraph 4 of the supplementary testimony by Mark Walsh, the statement is made "where in any design criteria is an engineer allowed to yield on steel?" The answer is that the ASME Code allows all secondary stresses to go beyond yield (for definition of secondary stress see ASME NF 3213.8).

On the same page of Mr. Walsh's statement, paragraph 5, he states "when steel heats up, it will expand, and if it is fastened at both ends it will either buckle in the middle or shear off at the ends." There are obviously other possibilities that Mr. Walsh has not considered; the analysis in Attachment 1 shows that the residual stresses in the members are low, and the anchors will not fail. In regard to buckling criteria, any buckling that may be induced by restrained thermal expansion would tend to relieve the thermal stress in the member and the deformation would be self limited.

On the other hand, buckling caused by a mechanical load that is constantly applied is not self-relieving and the degree of buckling could be very high, leading ultimately to failure; this would not happen due to thermal effects. Again, the basic error is in considering a thermal load to behave the same as a mechanical load.

List of Attachments:

Attachment No. 1:	Thermal Analysis of Cases 1, 2 and 3 (5 sheets)
Attachment No. 2:	Factors of Safety-Results of Analysis
Attachment A:	Shear Load vs. Slippage - Nelson Studs
Attachment B:	Shear Load vs. Slippage - Expansion Bolts
Attachment C:	Shear Load vs. Slippage - Richmond Anchors
Attachment D:	Shear Load vs. Deformation - Fillet Welds

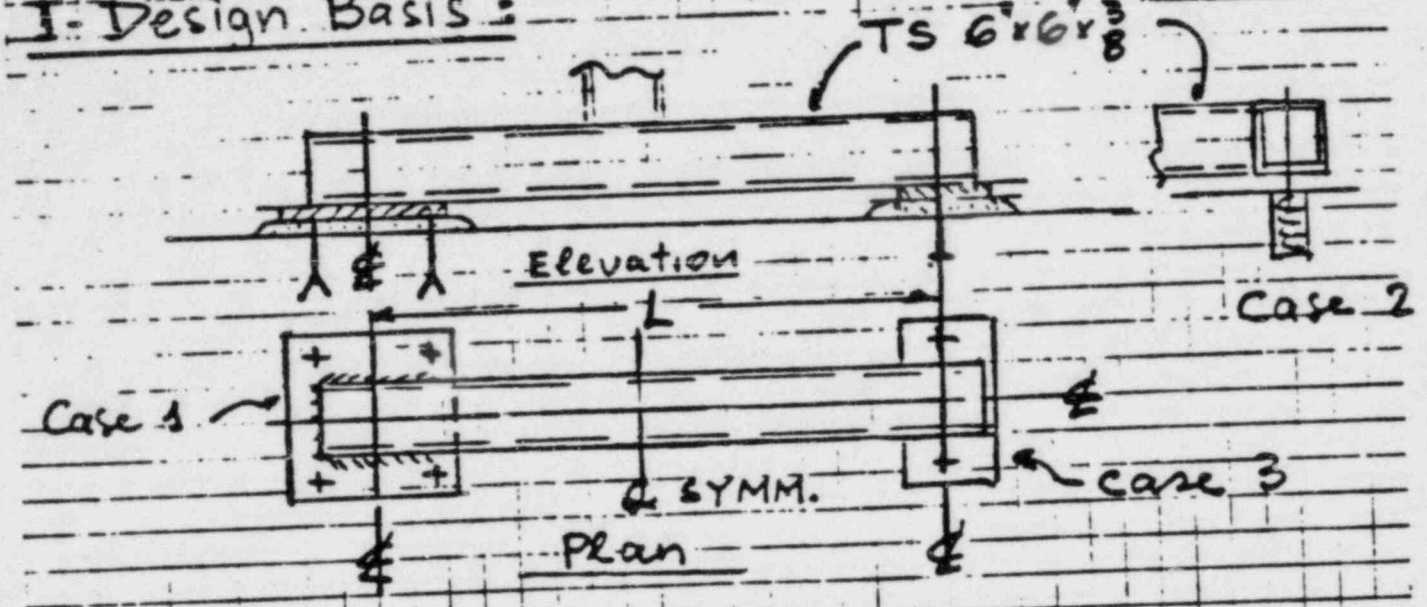
Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject Attachment 1 - Design Basis

Calculation Number Sheet No. 1 of F 5

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
Originator	1									
Preparer	PRCH	8/17/82								
Checker	DMC	8/25/82								

I- Design Basis :



All cases : $L = 6'-0$, TS $6 \times 6 \times \frac{3}{8}$ (Area = 8.08 in²) *
$E = 29 \times 10^6$ psi, $\Delta T = 210°$

Case 1 : Embedded items : 4 - $\frac{3}{4}$" ϕ Expansion Bolts (Hil
Weld : 20' of $\frac{1}{4}$" weld.

Case 2 : Embedded items : 2 - $1\frac{1}{2}$" ϕ Richmond anchors
No welds

Case 3 : 2 - $\frac{3}{4}$" ϕ Nelson studs
Weld 12' - $\frac{3}{16}$ weld

* {Hypothetical worst case support system consisting of a combination of most stringent elements.

F-166, 7-8

Checking Method # 1 Line-by-line checking
2 Alternate calculation. Results compared
3 Simplified calculation. Results compared
4 Compare inputs and results of computer with corresponding inputs and results of similar cases

Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject Attachment "1 - General procedure

Calculation Number Sheet No. 2 OF 5

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
Checker's Method	1											
Preparer	Pcdy	8/17/82										
Checker	DMC	8/25/82										

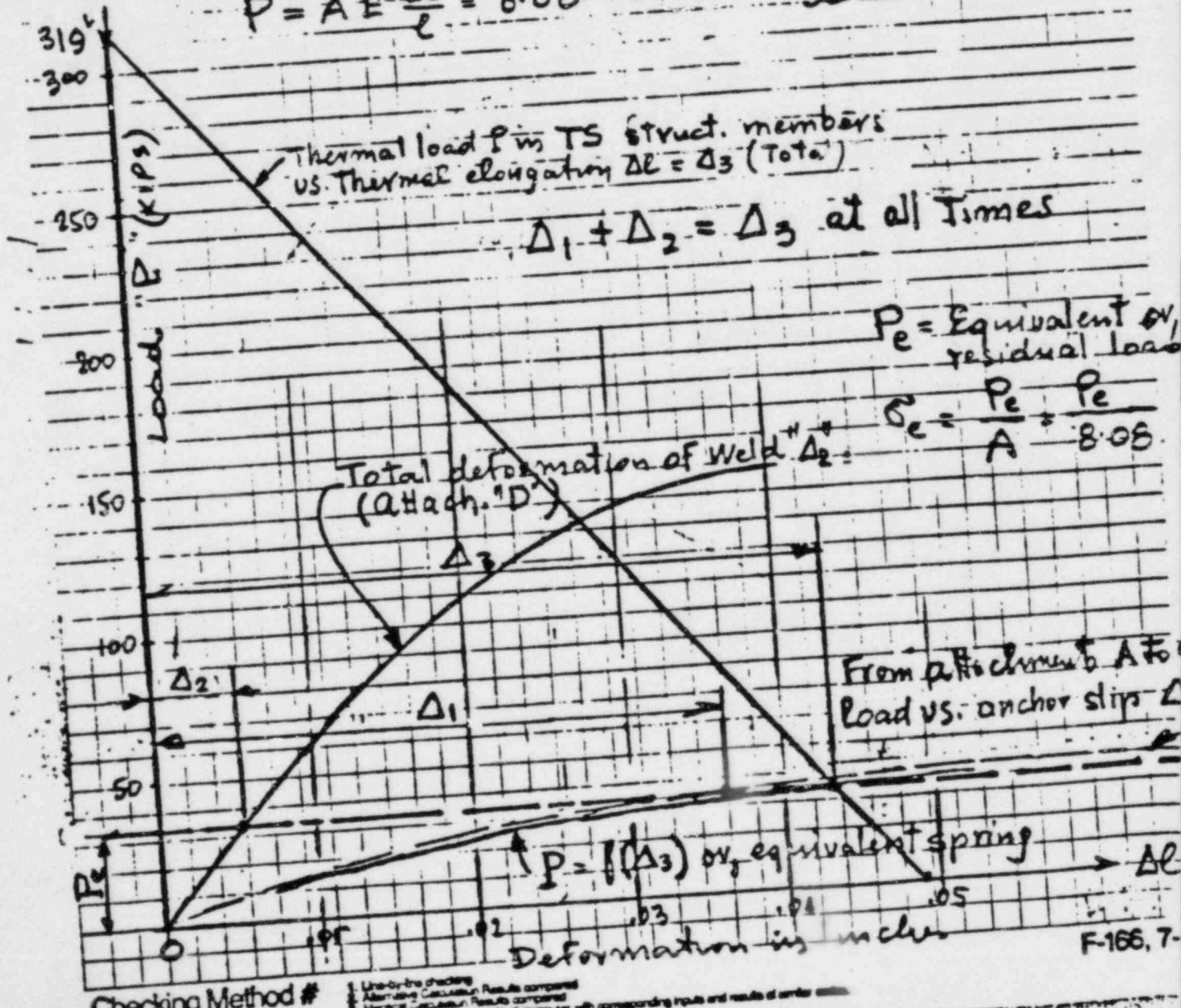
II - General procedure:

- Thermal free displacement of TS 6"x6"x3/8" (Load P=0)

$\Delta l = \alpha \Delta T \frac{l}{2} = 65 \times 10^{-7} \times 210^{\circ} \times \frac{72'}{2} = .049" \pm$

- Fully restrained thermal Load in member = AEE

$P = AE\frac{\Delta l}{l} = 8.08 \times 29 \times 10^{6} \times \frac{.049"}{36} = 319$ kips



$\Delta_1 + \Delta_2 = \Delta_3$ at all Times

P_e = Equivalent or residual load

$\sigma_e = \frac{P_e}{A} = \frac{P_e}{8.08}$

From attachments A to ... load vs. anchor slip Δ...

F-166, 7-

Checking Method #

1 Hand-by-hand checking
2 Alternate calculation results compared
3 Identical calculation results compared
4 Computer inputs and results of computer with corresponding inputs and results of similar

Gibbs & Hill, Inc. Job No. 2323 Client TVSI

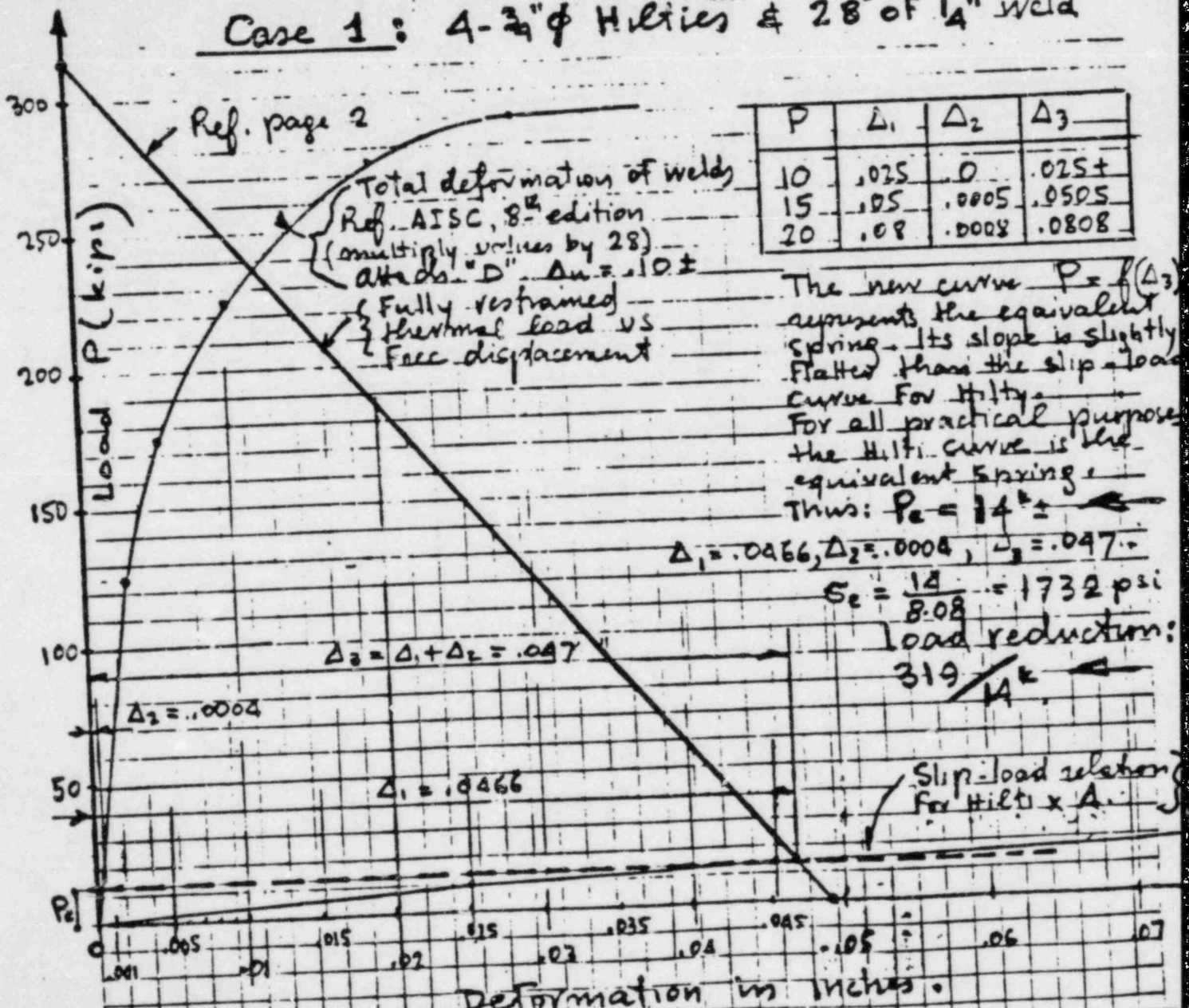
Subject Attachment 1 - Specific examples - Case 1

Calculation Number Sheet No. 3 of 5

Revision		Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date	
Drawing Sheet	1										
Preparer	Vcch	8/17/82									
Checker	DMC	8/25/82									

III - Specific examples:

Case 1: 4-3/4" ϕ Hilties & 28" of 1/4" weld



P	Δ1	Δ2	Δ3
10	.025	0	.025±
15	.05	.0005	.0505
20	.08	.0008	.0808

The new curve P = f(Δ3) represents the equivalent spring. Its slope is slightly flatter than the slip-load curve for Hilty. For all practical purposes the Hilti curve is the equivalent spring.

Thus: $P_e = 14^k \pm$ ←

$\Delta_1 = .0466, \Delta_2 = .0004, \Delta_3 = .047$

$\sigma_e = \frac{14}{8.08} = 1732$ psi

load reduction: 319/14 ←

Slip-load relation for Hilti x Δ

* From attachment B

(approx $\Delta_u > 1"\pm$)

Checking Method #

F-166, 7-8

Preliminary

Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject Attachment 1 – Specific examples – Case: 2

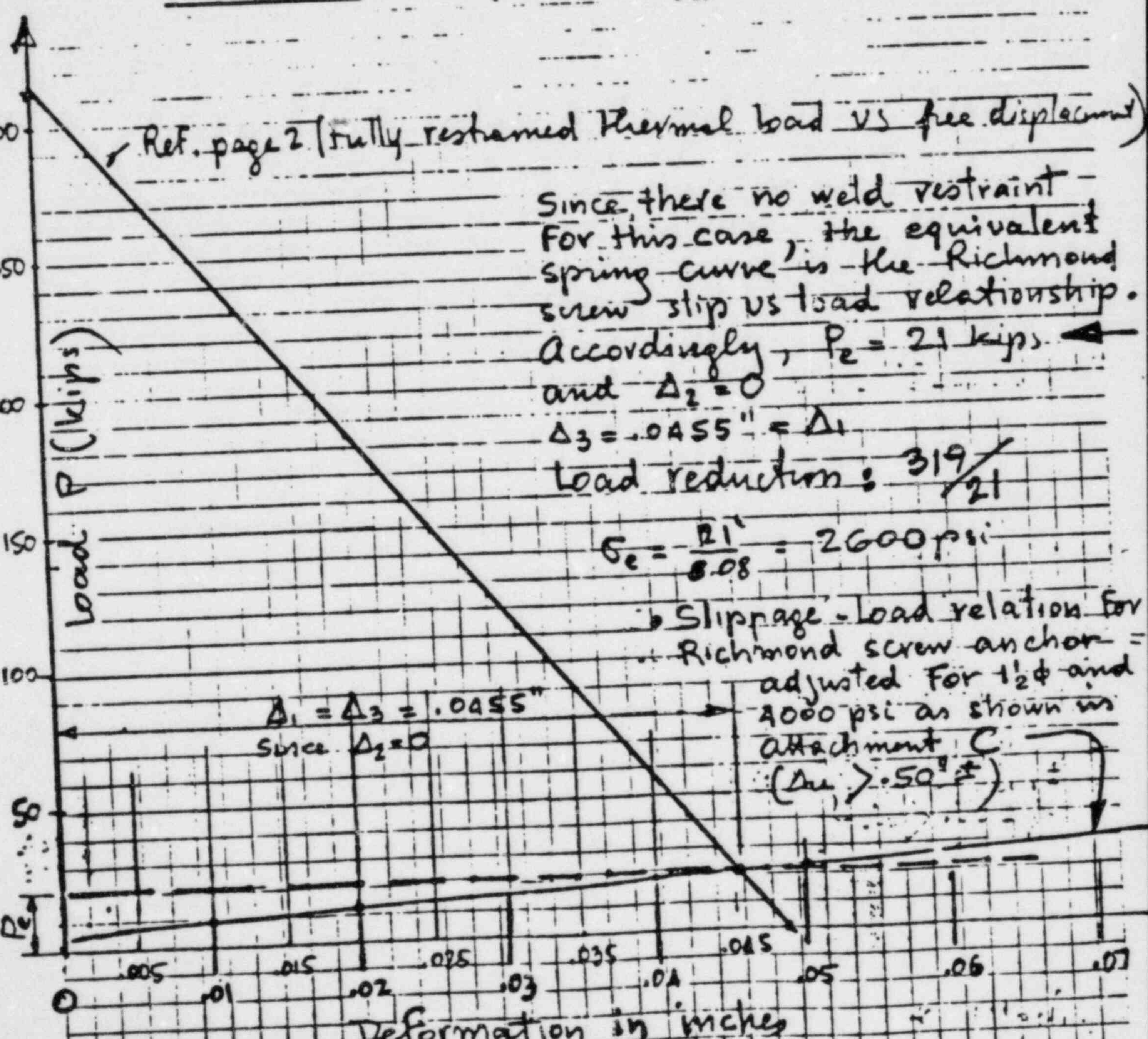
Sheet No. 4 of 5

Calculation Number

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date
Checking Method #	1	X		X		X		X		X
Preparer	RCCL	8/17/82								
Checker	DMC	8/25/82								

III - Specific Examples:

Case 2 : 2-1½"φ Richmond anchors



Checking Method #
1. Line-by-line checking
2. Alternate Calculation Results compared
3. Manual Calculator Results compared
4. Compare inputs and results of computer with corresponding inputs and results of similar studies.

Gibbs & Hill, Inc. Job No. 2323 Client TUSI

Subject Attachment 1 - Specific example - Case 3

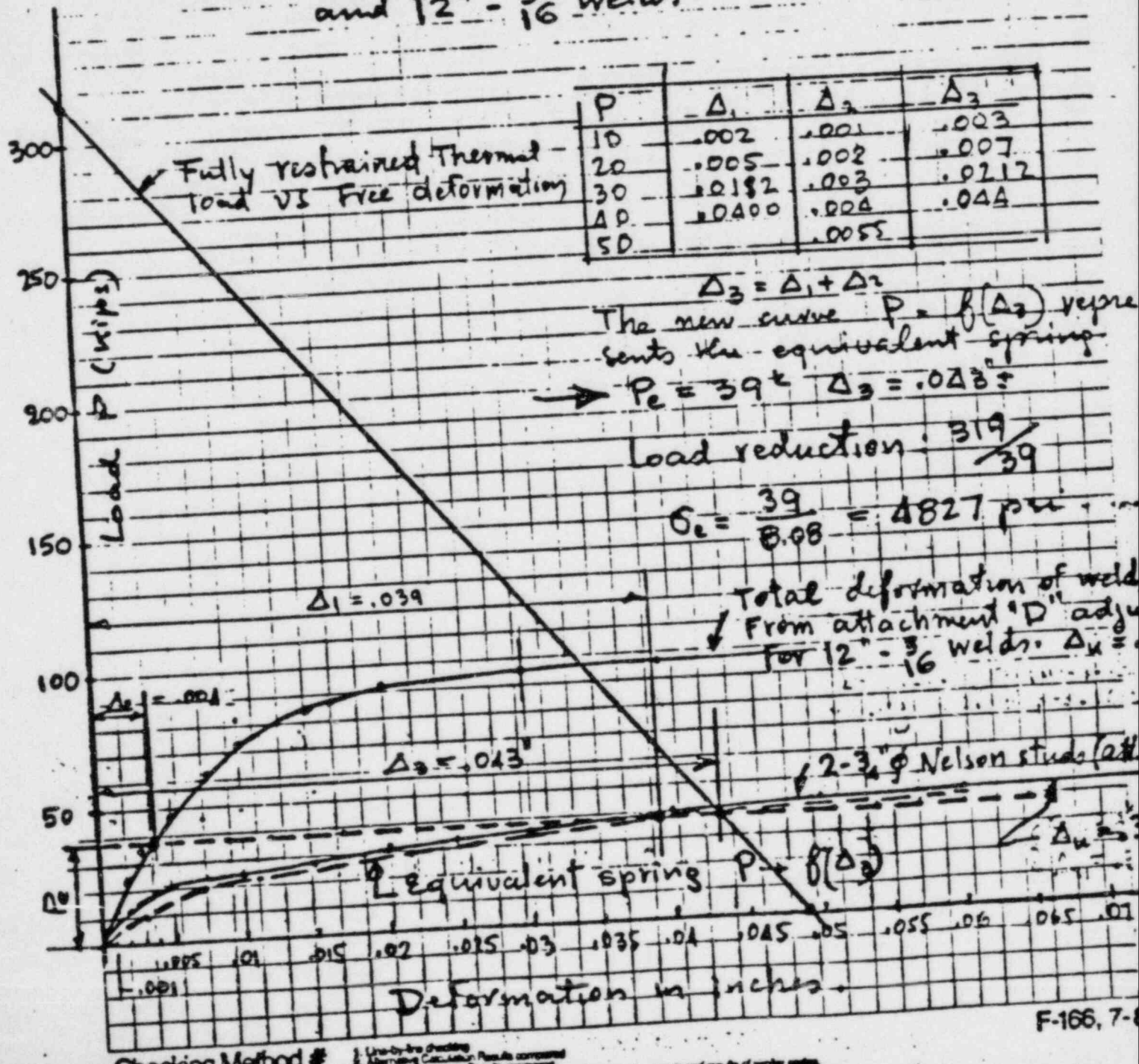
Calculation Number Sheet No. 5 of 5

Revision	Original Issue	Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date	
Preparer	PCM	R 11 82									
Checker	DMC	R 11 82									

III - Specific examples:

Case 3: 2-3/4" ϕ Nelson studs and 12" - 3/16 welds:

P	Δ_1	Δ_2	Δ_3
10	.002	.001	.003
20	.005	.002	.007
30	.0182	.003	.0212
40	.0400	.004	.044
50		.0055	



$\Delta_3 = \Delta_1 + \Delta_2$

The new curve P = f(Δ3) represents the equivalent spring

→ P_e = 39k Δ_3 = .043"

Load reduction: 319/39

$\sigma_e = \frac{39}{8.08} = 4827$ psi

Total deformation of weld
From attachment "D" adju
For 12" - 3/16 welds. Δ_u =

F-166, 7-

Checking Method #

Gibbs & Hill, Inc. Job No. 11-2323-001 Client TUSI - CPSES

Subject EVALUATION - THERMAL EFFECTS ON PIPE SUPPORTS

Calculation Number ATTACHMENT # 2 Sheet No.

Revision		Date	Rev.	Date	Rev.	Date	Rev.	Date	Rev.	Date	
Preparer	PCCH	8/25/82									
Checker	DMC	8/25/82									

REFERENCE :- ANALYSIS RESULTS PER ANALYSIS OF ATTACHMENT #1.

FACTORS OF SAFETY

CONSIDER THERMAL EFFECTS (ATTACHMENT #1) PLUS OTHER NORMAL LOADS THAT COULD ACT CONCURRENTLY. SINCE THE THERMAL EFFECTS ARE STRAIN LIMITED, THE FACTORS OF SAFETY ARE BASED ON STRAIN RATHER THAN STRESS. THE EFFECTS OF "OTHER LOADS" WILL BE CONSERVATIVELY CONSIDERED IN THAT THEY WILL BE ASSUMED TO RESULT IN MAXIMUM ALLOWABLE STRESSES AND CORRESPONDING STRAINS.

COMPONENT	A DEFORM. DUE TO THERMAL (ATT #1)	B DEFORM. DUE TO OTHER LOADS	C TOTAL DEFORM A+B	D ULT. DEF. ATT. A OR Δu	E FACT. OF SAFETY D/C	REMARKS
3/4 Φ NELSON STUD	0.039" (0₁)	0.010"*	0.049"	0.30"	6.1	Δu FROM ATT 'A'
3/4" Φ HILTI BOLTS	.047" ± (0₄)	0.050"*	0.097"	1.00"	10.0 +	Δu FROM ATT 'B'
1½" Φ RICHMOND ANCHOR	.045" ± (0₁)	0.12"*	0.165"	0.50"	3.0	Δu FROM ATT 'C'
1/4" FILLET WELD	0.0004" (0₇)	.001" ±	.0014"	0.10"	71	Δu FROM ATT 'B'
3/16" FILLET WELD	0.004" (0₇)	.001" ±	.005"	0.10"	20	Δu FROM ATT 'D'

* FOR DEFORMATION DUE TO OTHER LOADS THE FOLLOWING ALLOWABLE SHEAR LOADS ARE USED:

3/4" Φ NELSON STUD = 11.65 K/STUD

3/4 Φ HILTI EXP. BOLT = 3.7 K/BOLT

1½ Φ RICHMOND ANCHOR = 25 K/ANCHOR

Checking Method #

F-166, 4-81

REFERENCE : FA

FROM "DESIGN DATA NELSON CONCRETE ANCHOR STUDS" FOR SECURING STEEL TO CONCRETE.

Basic Data for Attachment "A"

Behavior and Strength in Shear

When an anchor is subjected to shear loading, it exerts pressure on the surrounding concrete and deflects. The deflection results in slip between the contact surfaces of the concrete and the steel member. Load-slip curves for three push-out specimens are shown in Fig. 13. The dimensions of the corresponding stud connectors are given in Table 9 along with pertinent strength data.

The load-slip curves are nonlinear and indicate substantial slips at failure. In comparison to the load displacement characteristics under tensile loading, shown in Fig. 13 as dashed lines, the load-slip curves exhibit a more gradual change in slope. At loads in excess of about 50 percent of the ultimate, the slips are larger than the displacements. Conversely, at low loads and at the ultimate, the displacements exceed the slips.

The type of failure that was observed in all nine specimens is illustrated in Fig. 14, which is a picture of the concrete slab. The studs sheared off next to the weld or partly through it. Some evidence of surface crushing of concrete was usually found just ahead of the connectors and a clear space was noted behind the connectors.

DESIGN DATA

CONCRETE ANCHORS

The failure loads are listed in Table IX. For all nine specimens, the loads are very close to the loads P'_u required for tension failure of the bare bar. Thus, the ultimate shear load for headed anchors may be computed in the same manner as the ultimate load for tension loading (Eq. A).

Table IX includes also loads causing a slip of 0.1". These loads were always smaller than the corresponding ultimate strengths, the difference being particularly large for the studs of larger diameters. On average the loads were equal to 0.87 P'_u, (for simplicity, 0.85 P'_u).

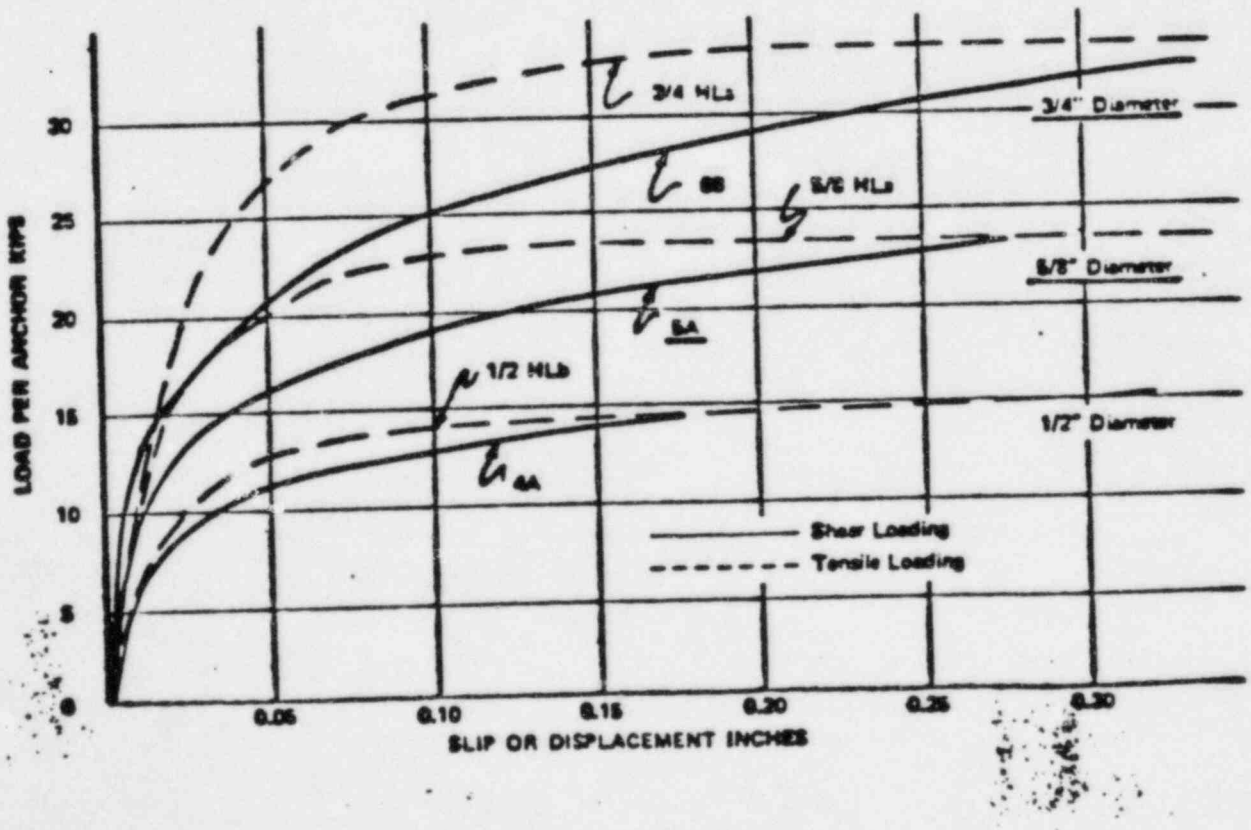
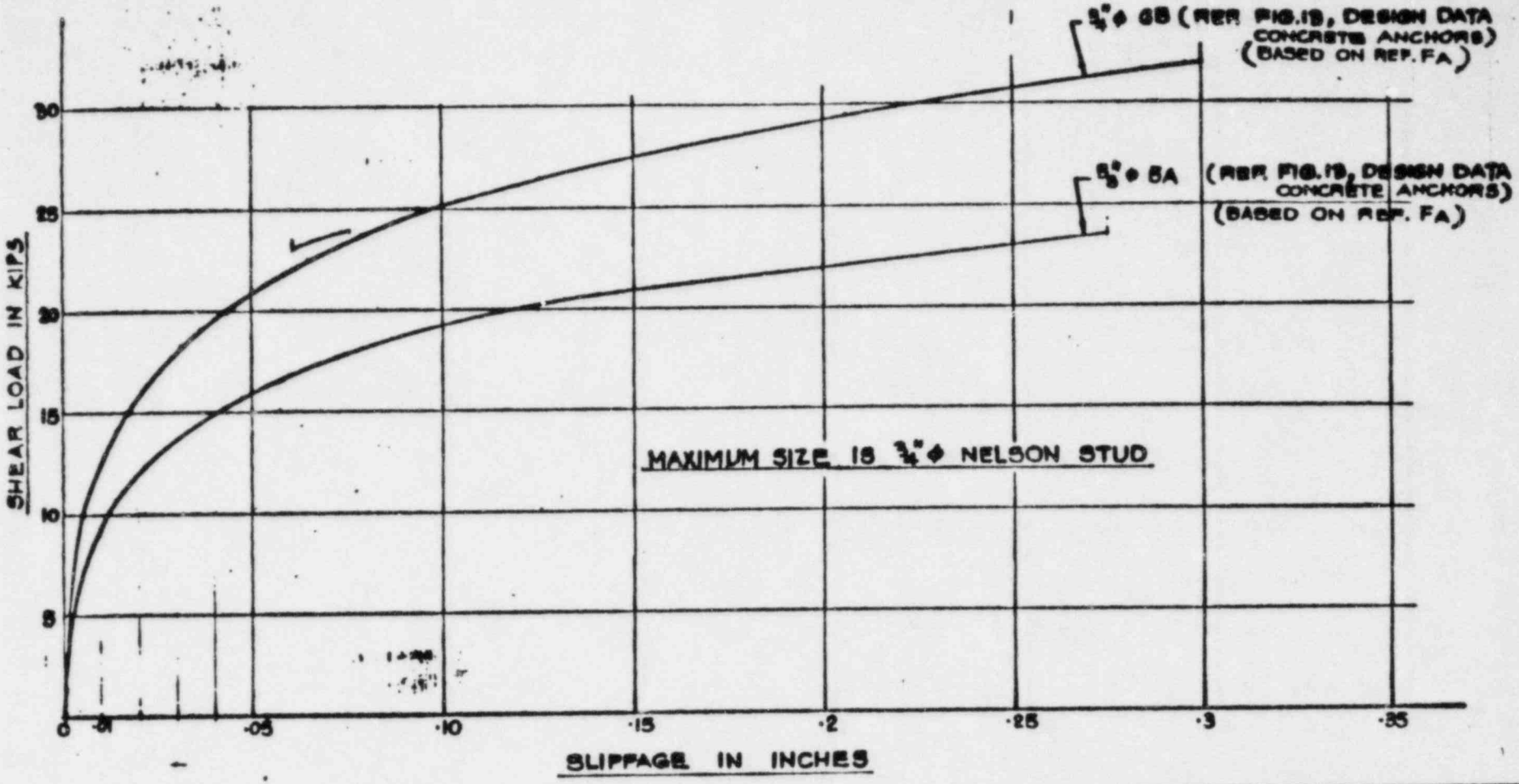


FIG. 13 LOAD-SLIP vs. LOAD DISPLACEMENT CURVES FOR HEADED STUDS

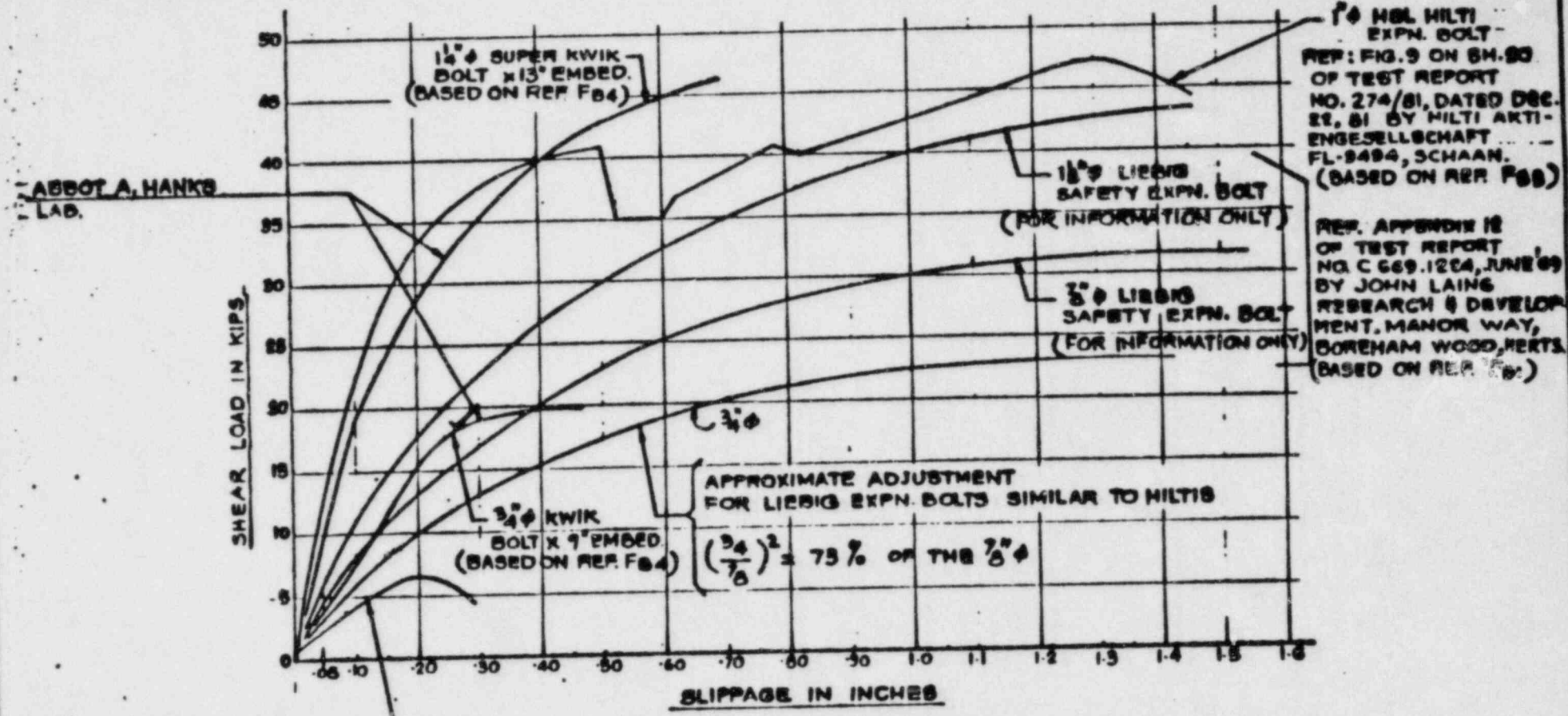
BASED ON TEST PROGRAMS PERFORMED BY THE ENGINEERING DIVISION OF NELSON STUD CO.



TUSI COMANCHE PEAK	
TEST RESULTS FOR SHEAR LOAD VERSUS SLIPPAGE FOR NELSON STUD TYPES	
Gibbs & Hill, Inc.	SCALE- N.T.S.
JOB NO 2323	ATTACHMENT-"A"

APPROVALS

ISSUED FOR



NOTE: EXPANSION BOLTS RANGE FROM ½"ϕ TO 1¼"ϕ.

TUSI
COMANCHE PEAK

TEST RESULTS FOR LOAD VERSUS SLIPPAGE FOR EXPANSION BOLT TYPES

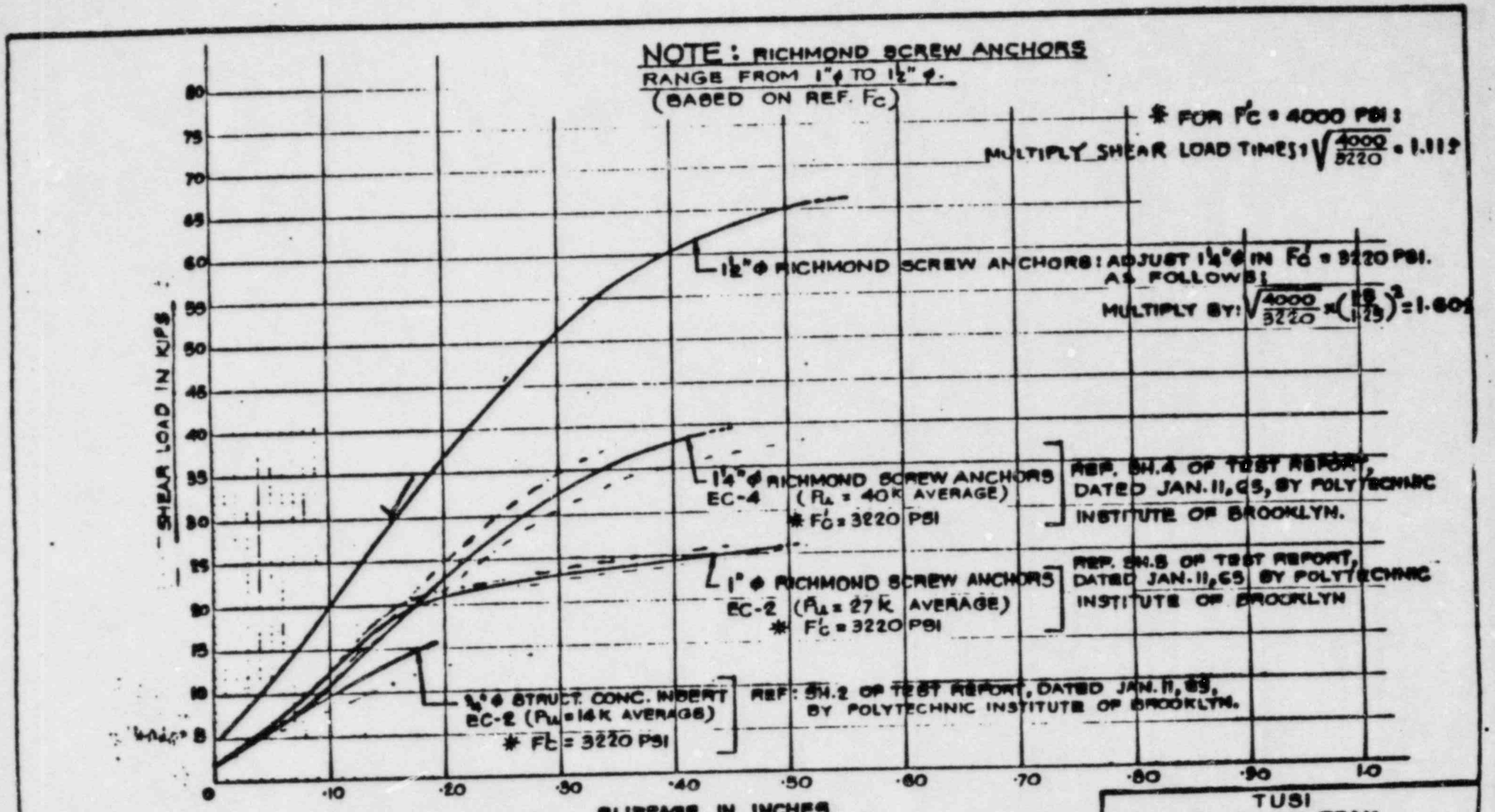
SCALE - N.T.S.

2323

ATTACHMENT - "B"

APPROVALS

ISSUED FOR



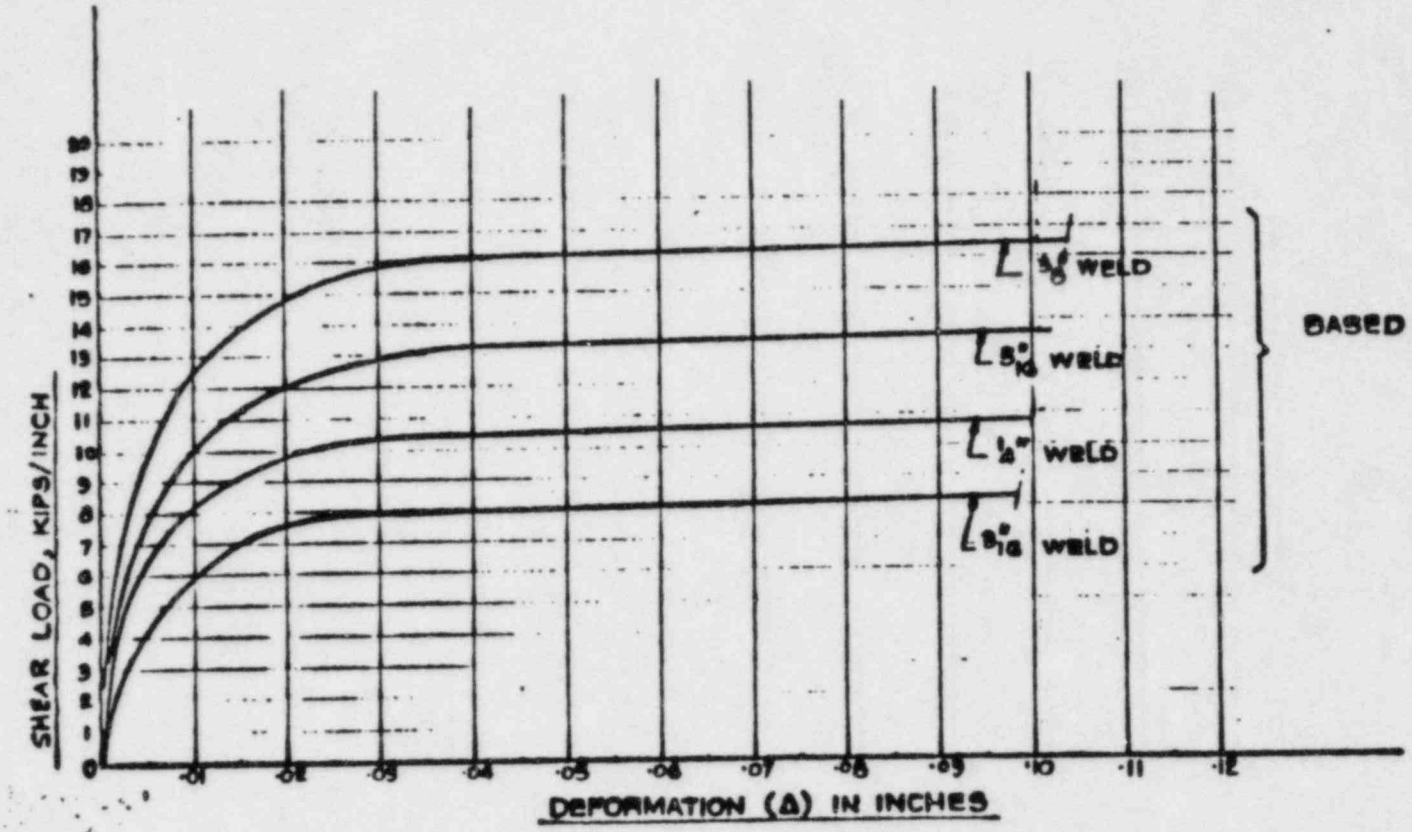
TUSI
COMANCHE PEAK

TEST RESULTS FOR SHEAR LOAD VERSUS SLIPPAGE FOR RICHMOND SCREW ANCHOR TYPES

SCALE - N.T.S.

JOB NO. 2323

ATTACHMENT - 'C'



REFERENCE: AISC MANUAL, 8TH EDITION, PAGES 4-72 & 4-73.
(SEE REF. FD)

TUSI COMANCHE PEAK	
SHEAR ON FILLET WELDS -LOAD VERSUS DEFORMATION-	
GIBBS & HILL, INC.	SCALE - N.T.S.
JOB NO 2323	ATTACHMENT - "D"

APPROVALS

ISSUED FOR

Summary of pull out and shear tests carried out by John Laing Research and Development, Manor Way, Boreham Wood, Herts.

Report No. C 669.1224, June 1969

Type of test: Pull out, single bolts, shear, single bolts

Size of test block:

length	2.50 m
width	1.50 m
depth	0.20 m

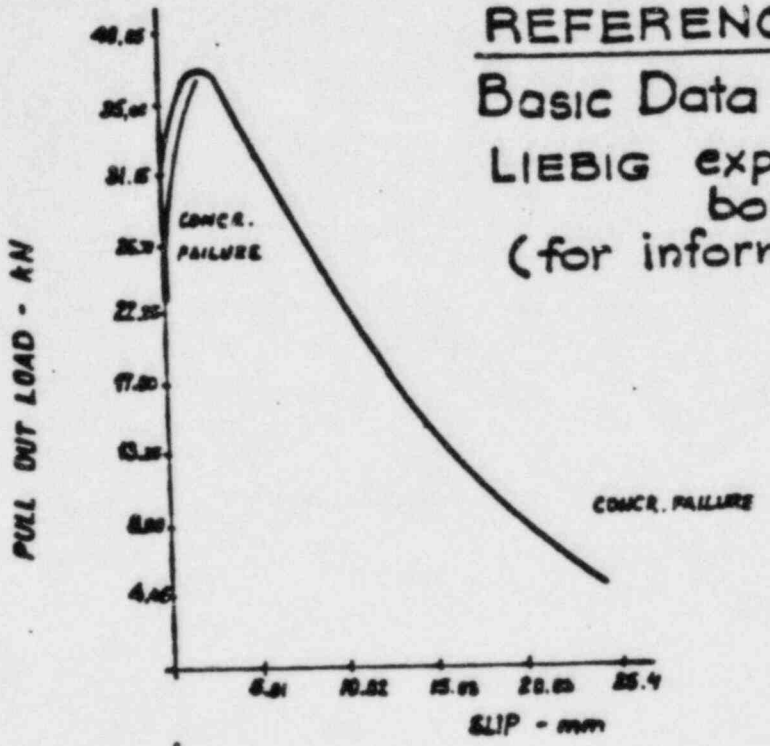
Compressive strength of concrete: 32 N/mm^2 (4.500 lbf/sq in), unreinforced

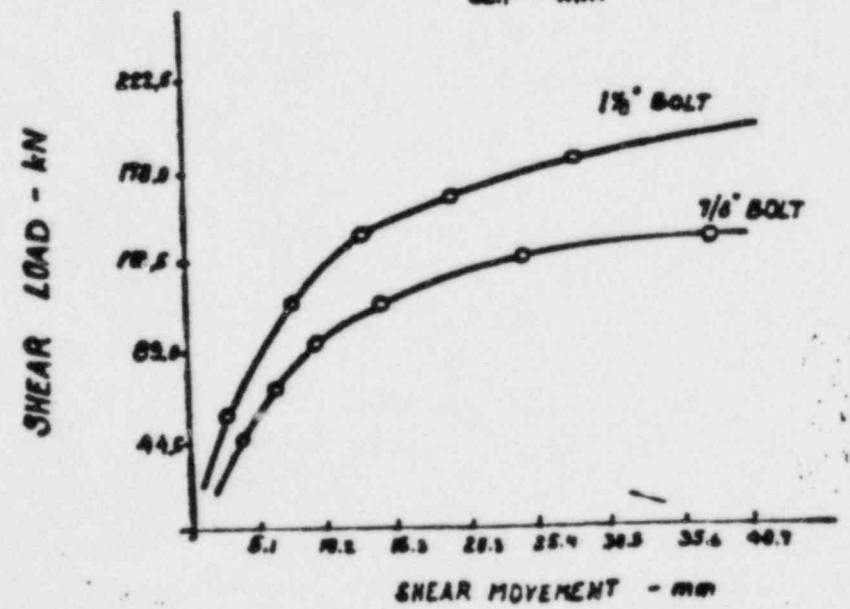
REFERENCE : FBL

Basic Data for Attachment "B"

LIEBIG expansion safety bolts

(for information only)





REFERENCE : F82

Basic Data for Attachment "B"

Fig. 9 shows a typical load-movement graph plotted from results from the short-time test carried out with the 1/2" anchor after it had been subjected to the dynamic testing program.

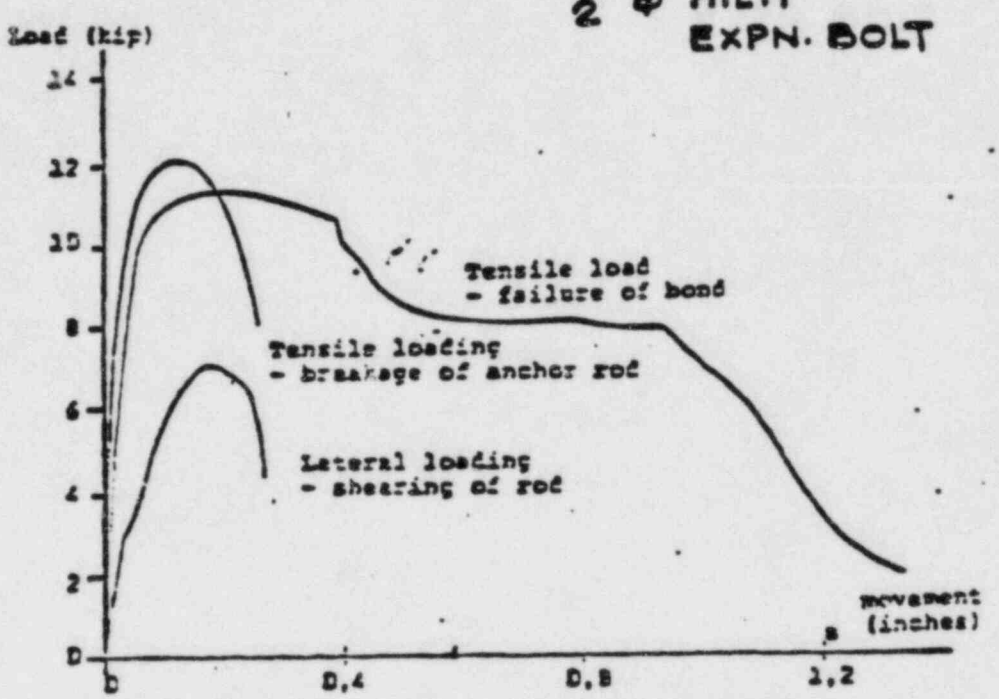


Fig. 9: Anchor movement during short-time test.

The measurements of the movement taken during the dynamic test are summarized in table 5.

TEST REPORT NO. 5/82 DATED JAN. 28, '82, BY HILTI AKTIENGESELLSCHAFT. FL-9494, SCHAAN.

REFERENCE : FB3

Basic Data for Attachment "B"

A typical load-movement graph for a 1" dynamically prestressed anchor subjected to a short-time test is shown by fig. 9.

1" ⌀ HILTI EXPN. BOLT.

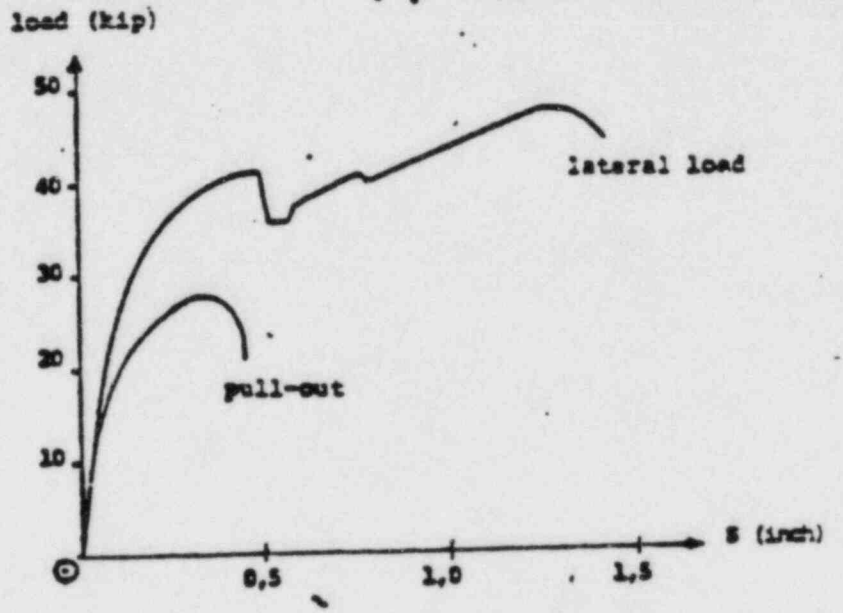


Fig. 9: Anchor movement, short-time test

The readings of movement which were taken during dynamic loading, have been summarized in table 8.

TEST REPORT NO. 274/81, DATED DEC. 22, 81, BY HILTI AKTIENGESELLSCHAFT, FL-9494, SCHAAN.

REFERENCE: F84

Basic Data for Attachment B

ABBOT A. HANKS

ESTABLISHED 1866

1115 INDIANA STREET, P. O. BOX 77265
SAN FRANCISCO, CA 94107
(415) 282-8600

File No. H2189-S1
Report No. 8785

January 30, 1974

HILTI FASTENING SYSTEMS, INC.
360 Fairfield Avenue
Stamford, Connecticut 06904

SUBJECT: KWIK-BOLT TESTING PROGRAM - LOAD VS. DISPLACEMENT GRAPHS

At your request, we have conducted a comprehensive program of testing of the seven different diameters of Kwik-Bolts (1/4" through 1 1/4") to determine their performance characteristics in 2,000, 4,000 and 6,000 psi concrete. The results obtained from this program are as noted on the attached graphs.

Anchors, drills and drill bits were furnished by HILTI from regular production runs and are considered to be indicative of that material normally used for installations of this type.

Concrete was supplied by a local batch plant and placed under Abbot A. Hanks supervision by a general contractor. Non reinforced slabs were used for testing. The concrete mix for the test slabs used limestone aggregate in accordance with ASTM C-33 (3/4" maximum) and Type II cement. The concrete was placed in typical construction manner and finished with a bull-float. Test slabs were designed for 28 day strengths of 2,000, 4,000 and 6,000 psi. Compressive strengths were verified from standard 6 x 12 inch cylinders from each slab prepared in accordance with ASTM C-31 and tested in accordance with ASTM C-39.

Tensile and shear testing was performed using a hollow-core hydraulic jack equipped with a calibrated pressure gauge. For tensile testing the testing equipment was supported by a three legged reaction tripod which distributed the loading outside a 24" diameter circle for anchors 3/4" diameter or less and outside a 30" diameter circle for 1" and 1 1/4" diameter anchors.

For shear testing, all anchors were at least 30" away from the reaction point of the hydraulic testing equipment. The load was applied as close to the surface as possible to minimize the effects of bending. In addition, several washers were placed between the shear plate and concrete surface to minimize friction between the two surfaces.

REFERENCE: F84

Basic Data for Attachment "B"

It is our opinion that the results of this test program are indicative of the performance of Kwik-Bolts when used in concrete of strengths as noted in this report.

ABBOT A. HANKS
TESTING LABORATORIES

Richard L. Rascice

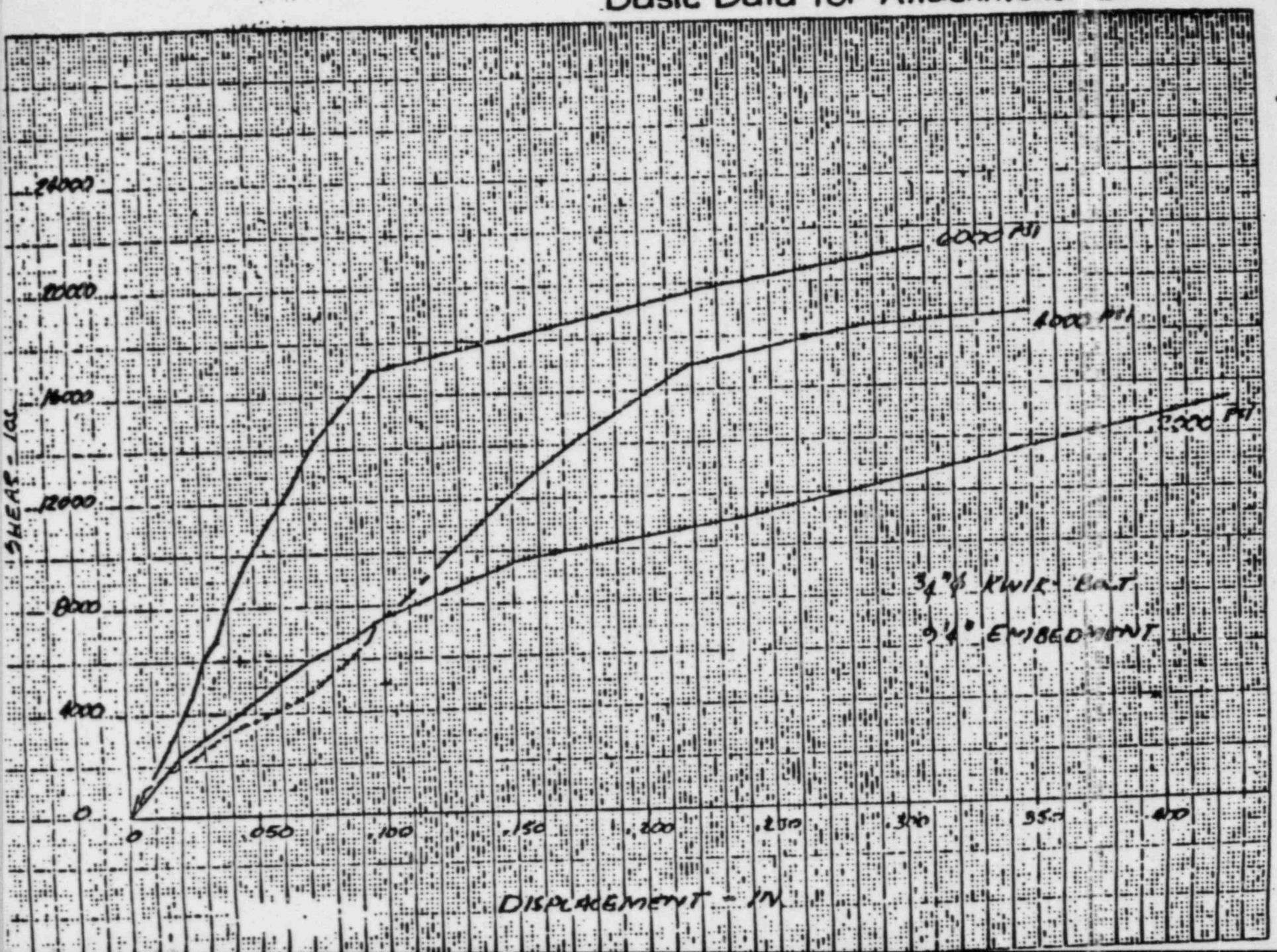
RICHARD L. RASCICE, CHIEF ENGINEER

Attachments

K-E

REFERENCE: FB4

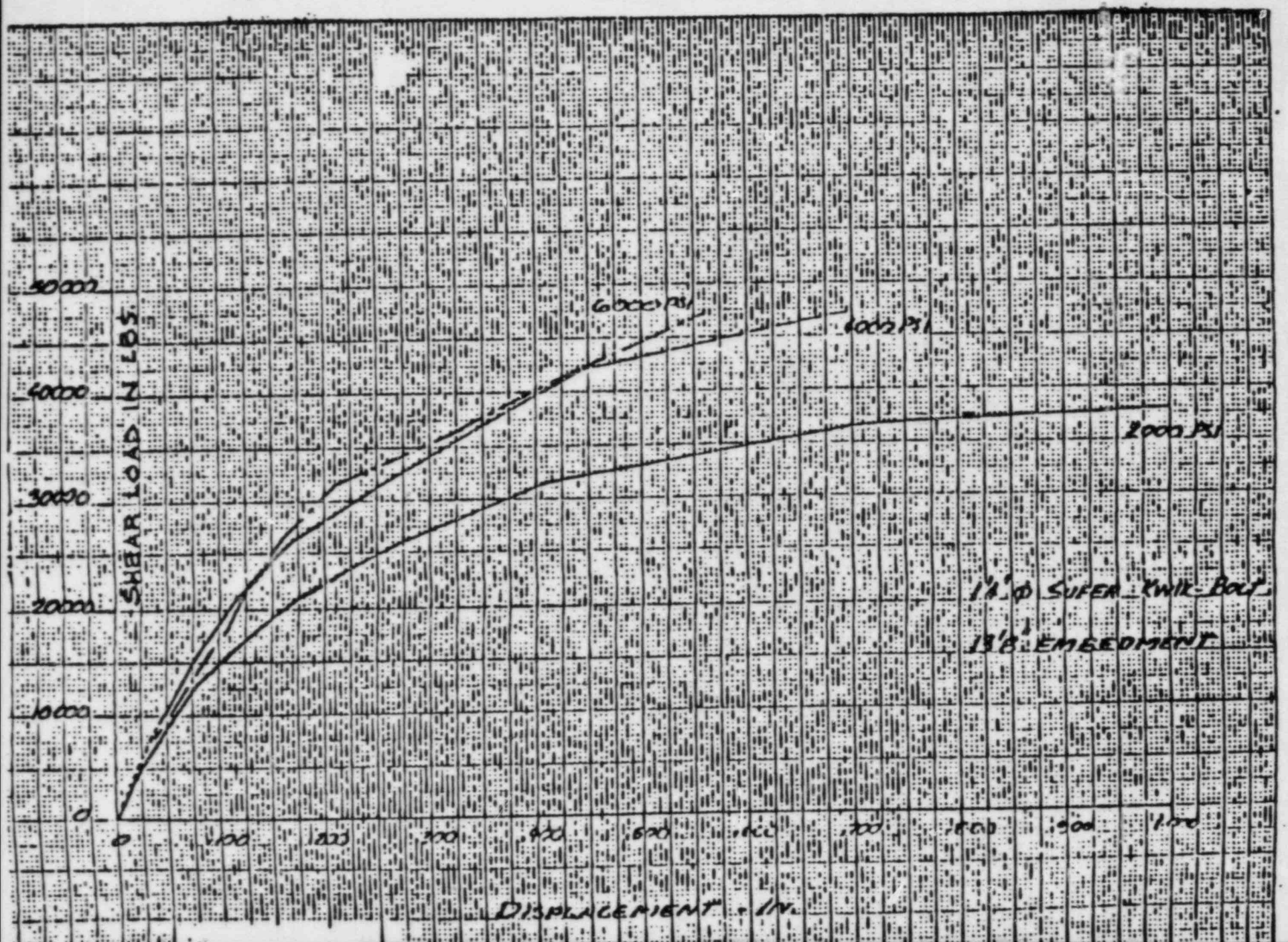
Basic Data for Attachment "B"



K-E

REFERENCE : FB4

Basic Data for Attachment "B"



RICHMOND Screw Anchor Co., Inc.

Over 65 Years of Progress in Quality Products for Concrete Construction

August 5, 1982

REFERENCE: Fc

Basic Data for Attachment "C"

Gibbs & Hill
9th Floor Structural Dept.
393 7th Avenue
New York, New York 10001

Attn: Peter Sharoglu

Re: EC Type Inserts Shear
Test Reports

Dear Mr. Sharoglu:

Per your conversation with Harry Lancelot on August 5, 1982, I am enclosing Shear Test Reports for 3/4" ø, 1" ø and 1¼" ø EC Type Inserts.

Please let us know if we can be of further service.

Sincerely,

RICHMOND SCREW ANCHOR CO., INC.

James L. Caldwell
Technical Services Engineer

JLC:nb
Enclosure
cc: H. Lancelot
J. Panagos

7214 BURNS STREET, RICHLAND HILLS ● FORT WORTH, TEXAS 76118 ● PHONE 817/284-4981

TWX No. 910 893 4071

POLYTECHNIC INSTITUTE OF BROOKLYN

DEPARTMENT

BY L.P. DATE SUBJECT Test Report SHEET NO. 2 OF

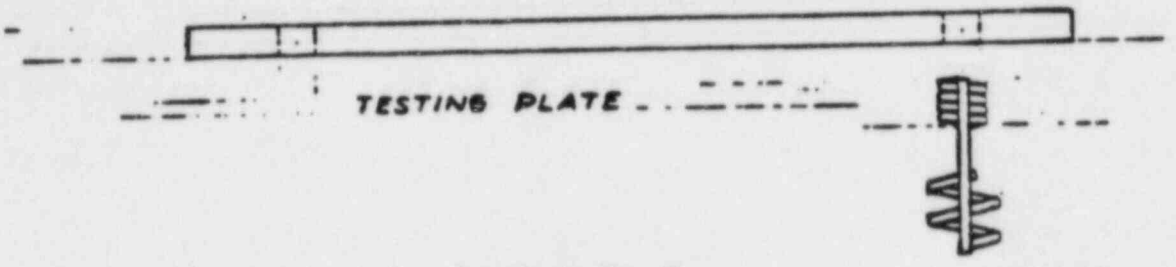
TEST DATE 01/11/65 for JOB NO.

Richmond Screw Anchor Co., Inc.

Product: Richmond 3/4" diameter E.C.-2 Structural Concrete Insert sheared from 18" x 18" x 8" concrete block by means of a testing plate: 45" long, 3 1/2" wide, 1 1/4" thick. The block was clamped on top of the testing machine with two 4" x 4" x 3/4" bracing angles. The insert was placed at the center of the 18" x 18" face and installed flush with the surface of the concrete. The concrete block was reinforced with a .440 wire mat, 6" x 6" center opening, located at mid-depth of the block. The strength of the concrete was 3220 psi, and the slip dial indicator was zeroed in at a load of 2000 lbs. The testing bolt was snugly tightened using a 12" monkey wrench. The shear load was applied perpendicular to the plane of the struts.

Failure occurred in both specimens due to a shear failure of the testing bolt at the face of the block. The concrete spalled in a 2" radius, semi-circular patch below the insert, and there was no further cracking of concrete.

Detail:



Specimen No. 1

Load, kips	Slip, in.
2	0
3	0.016
4	0.027
5	0.042
6	0.059
7	0.077
8	0.097
9	0.117
10	0.138
11	0.155
12	0.175
13	0.202
14	0.275

Ultimate Load = 11,200 lbs.

Specimen No. 2

Load, kips	Slip, in.
2	0
3	0.020
4	0.038
5	0.050
6	0.060
7	0.070
8	0.079
9	0.088
10	0.095
11	0.104
12	0.110
13	0.117
14	0.125
15	0.132
16	0.144

Ultimate Load = 17,200 lbs.

3/4" ϕ

Signed: Louis J. Pignataro

Louis J. Pignataro
Asst. Professor of Civil Engineering

REFERENCE : Fc

Basic Data for Attachment "C"

POLYTECHNIC INSTITUTE OF BROOKLYN

DEPARTMENT

BY L.P. DATE SUBJECT Test Report SHEET NO. 5 OF

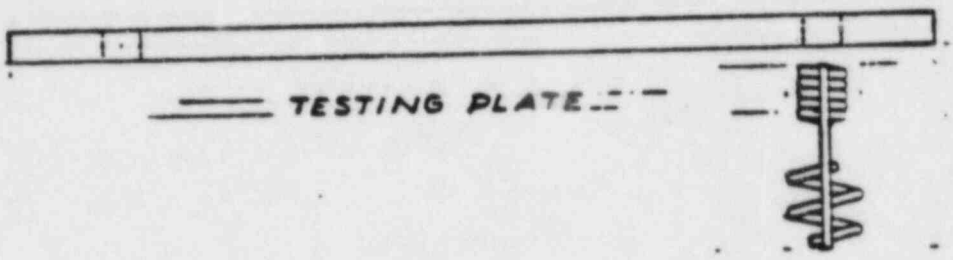
TEST DATE 01/11/65 for JOB NO.

Richmond Screw Anchor Co., Inc.

Product: Richmond 1" diameter E.C.-2 Structural Concrete Insert sheared from 18" x 18" x 12" concrete block by means of a testing plate: 45" long, 3 1/2" wide, 1 1/4" thick. The block was clamped on top of the testing machine with two 4" x 4" x 3/4" bracing angles. The insert was placed at the center of the 18" x 18" face and installed flush with the surface of the concrete. The concrete block was reinforced with a .440 wire mat, 6" x 6" center opening, located at mid-depth of the block. The strength of the concrete was 3220 psi, and the slip dial indicator was zeroed in at a load of 2000 lbs. The testing bolt was snugly tightened using a 12" monkey wrench. The shear load was applied perpendicular to the plane of the struts.

Failure occurred in both specimens due to a shear failure of the testing bolt at the face of the block. The concrete spalled in a 3" radius, semi-circular patch below the insert, and there was no further cracking of concrete.

Detail:



Specimen No. 1

Load, kips	Slip, in.
2	0
4	0.027
6	0.050
8	0.070
10	0.082
12	0.097
14	0.110
16	0.123
18	0.140
20	0.161
22	0.214
24	0.315
26	0.445

Ultimate Load = 26,800 lbs.

Specimen No. 2

Load, kips	Slip, in.
2	0
4	0.022
6	0.043
8	0.063
10	0.081
12	0.100
14	0.120
16	0.140
18	0.162
20	0.192
22	0.265
24	0.400
26	0.515

Ultimate Load = 27,200 lbs.

1" ϕ

Signed: Louis J. Pignataro

Louis J. Pignataro
Asst. Professor of Civil Engineering

REFERENCE: Fc

Basic Data for Attachment "C"

POLYTECHNIC INSTITUTE OF BROOKLYN

DEPARTMENT

BY L.P. DATE _____ SUBJECT Test Report SHEET NO. 4 OF _____

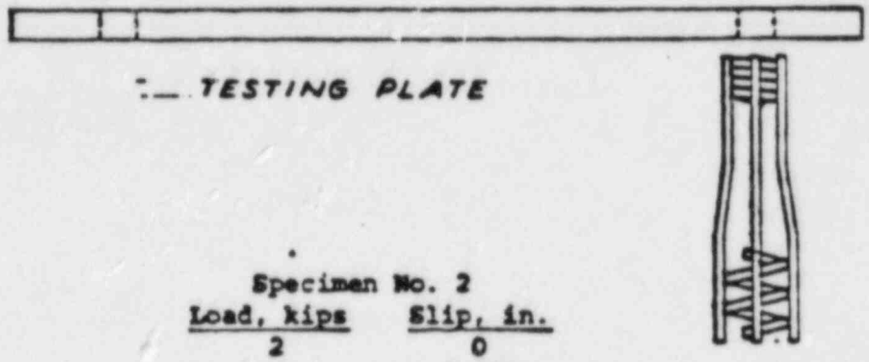
TEST DATE 01/11/65 for JOB NO. _____

Richmond Screw Anchor Co., Inc.

Product: Richmond 1 1/4" diameter E.C. - 4 Structural Concrete Insert sheared from 18" x 18" x 12" concrete block by means of a testing plate: 45" long, 3 1/2" wide, 1 1/4" thick. The block was clamped on top of the testing machine with two 4" x 4" x 3/4" bracing angles. The insert was placed at the center of the 18" x 18" face and installed flush with the surface of the concrete. The concrete block was reinforced with a .440 wire mat, 6" x 6" center opening, located at mid-depth of the block. The strength of the concrete was 3220 psi, and the slip dial indicator was zeroed in at a load of 2000 lbs. The testing bolt was snugly tightened using a 12" monkey wrench.

Failure in both specimens was caused by a crushing of the testing bolt on the testing plate. This crushing caused the bolt to deform about 3/32". The concrete spalled in a 4" radius, semicircular patch below the insert, and there was no further cracking of concrete.

Detail:



Specimen No. 1		Specimen No. 2	
Load, kips	Slip, in.	Load, kips	Slip, in.
2	0	2	0
4	0.028	4	0.030
6	0.055	6	0.052
8	0.075	8	0.076
10	0.092	10	0.096
12	0.107	12	0.115
14	0.120	14	0.132
18	0.148	18	0.168
22	0.177	22	0.204
26	0.210	26	0.243
30	0.247	30	0.292
34	0.291	34	0.357
38	0.350	38	0.513

Ultimate Load = 41,600 lbs.

Ultimate Load = 38,200 lbs.

REFERENCE: Fc

Basic Data for Attachment "C"

Signed: Louis J. Pignataro

Louis J. Pignataro
Asst. Professor of Civil Engineering

f_2 = Vertical stress on weld at B due to moment

$$= \frac{Pal(kl - xl)}{I_p} = \frac{Pal^2(k - x)}{I_p}$$

f_3 = Horizontal stress on weld at B due to moment

$$= \frac{Pal(l/2)}{I_p} = \frac{Pal^2}{2I_p}$$

f_R = Resultant of stresses on weld at B

$$= \sqrt{(f_1 + f_2)^2 + (f_3)^2}$$

$= 0.928D$ (for E70XX electrodes)

ULTIMATE STRENGTH METHOD*

When weld groups are loaded in shear by an external load that does not act through the center of gravity of the group, the load is eccentric and will tend to cause a relative rotation and translation between the parts connected by the weld. The point about which rotation tends to take place is called the *instantaneous center of rotation*. Its location is dependent upon the eccentricity, geometry of the weld group, and deformation of the weld at different angles of the resultant elemental force relative to the weld axis.

The individual resistance force of each unit weld element can then be assumed to act on a line perpendicular to a ray passing through the instantaneous center and that element's location. (See Fig. 2.)

The ultimate shear strength of weld groups can be obtained from the load deformation relationship of a single unit weld element which is expressed as:

$$R = R_{ult}(1 - e^{-\mu\Delta})^{\lambda} = R_u(1 - e^{-.75\Delta})^{.40}$$

where

R = Shear force in a single element at any given deformation

R_{ult} = Ultimate shear load of a single element

μ, λ = Regression coefficients

Δ = Deformation of a weld element

e = Base of natural logarithm = 2.718

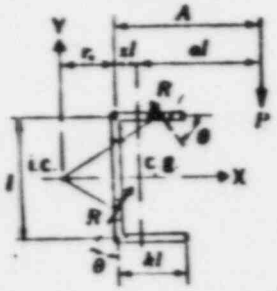


Fig. 2

Reference F_D page 4-72 AISC manual - 8th edition (Basic data for att. "D") - adjusted for $\theta = 0°$ - ...

* Butler, Pal and Kulak, *Eccentrically Loaded Weld Connections*, Journal of the Structural Div., ASCE, Vol. 98, No. ST5, May 1972, pp. 989-1005.

Unlike the load-deformation relationship for bolts, strength and deformation performance in welds are dependent on the angle θ that the resultant elemental force makes with the axis of the weld element. (See Fig. 2.)

The critical weld element is usually (but not always) the weld element furthest from the instantaneous center. The critical deformation can be calculated as:

$$\Delta_{max} = 0.225\,(\theta + 5)^{-0.47}, \quad \text{where } \theta \text{ is expressed in degrees} = .225^{5.47}$$

The deformation of other weld elements can then be calculated as:

$$\Delta = \frac{r}{r_{max}}\,\Delta_{max}$$

The values of R_{ult}, μ and λ depend on the value of the angle θ and can be obtained from the following relations:

For $\theta = 0$

$$R_{ult} = \frac{10 + \theta}{0.92 + 0.0603\theta} = \frac{10}{.92} = 10.87$$

$$\mu = 75\,e^{0.011408\theta} = 75$$

$$\lambda = 0.4\,e^{0.011408\theta} = .40$$

$$\Delta_u = \frac{.225}{5^{.47}} = .105''$$

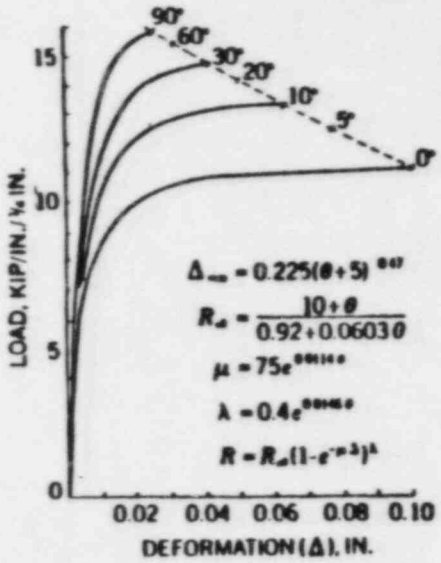


Fig. 3

The total resistance of all the weld elements combine to resist the eccentric ultimate load, and if the correct location of the instantaneous center has been selected, the three equations of statics will be satisfied. General performance curves for values of $\theta = 0°$, 10°, 30° and 90° are shown in Fig. 3.

Applicant's Exhibit 14-V

Report

Comanche Peak Steam Electric Station

Evaluation of

LOCA Temperature Effects on Pipe Supports

August 26, 1982 (Revised)

Contents

Vivirito
Charoglu