TVA 10697 (OE-4-85)

OE CALCULATIONS

TITLE: Comparison of [illegible]no Calculation Methods to Baseplate II Analysis	PLANT/UNIT: All Plants
PREPARING ORGANIZATION: CEB	KEY NOUNS (Consult RIMS DESCRIPTORS LIST): Baseplates, Anchors
BRANCH/PROJECT IDENTIFIERS: CSG-85-002	Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.
APPLICABLE DESIGN DOCUMENT(S): DS-C1.7.1	
SAR SECTION(S): NA / UNID SYSTEM(S): NA	

Rev	(for RIMS' use)	RIMS accession number
R0		B41 '850731 001
R__		
R__		
R__		

	Revision 0	R1	R2	R3
ECN No. (Indicate if Not Applicable)	NA			
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Reviewed	Marvin A. Covey			
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Date	7-31-85			
Use form TVA 10634 if more room required.	List all pages added by this revision.			
	List all pages deleted of this revision.			
	List all pages changed by this revision.			

Statement of Problem

Calculations were performed to justify the method prescribed in Section 5.0 of DS-C1.7.1 for determining anchor loads in flexible baseplates.

Abstract

The calculations show that the hand calculation method prescribed in Section 5.0 of DS-C1.7.1. produces anchor loads which equal or exceed anchor loads obtained from Baseplate II. Although conservative, the anchor loads are acceptable. The comparison between the hand calculation method and Baseplate II included analysis of baseplates with direct tension, uniaxial bending, bi-axial bending and combined tension and bi-axial bending loadings.

cc: RIMS, SL26 C-K

COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBR DATE 7/23/85

CHECKED LS DATE 7/30/85

PURPOSE: TO JUSTIFY THE HAND CALCULATION METHOD PRESCRIBED IN SECTION 5.0 OF DS-C1.7.1 FOR DETERMINING ANCHOR LOADS OF FLEXIBLE BASEPLATES.

ASSUMPTIONS: 1) 3/4-INCH DIAMETER SELF-DRILLING EXPANSION ANCHORS WERE USED FOR THE EVALUATION

2) TENSILE STIFFNESS OF 100 K/IN WAS USED FOR THE ANCHORS

DISCUSSION: TYPICALLY SIZED BASEPLATES WERE CHOSEN TO COMPARE BETWEEN HAND CALCULATION METHODS AND FINITE ELEMENT ANALYSIS. THE PLATES WERE SIZED TO REPRESENT RIGID AND FLEXIBLE CRITERIA. FOUR LOAD CASES WERE EVALUATED; AXIAL, UNIAXIAL BENDING, BIAXIAL BENDING AND COMBINED TENSION AND BIAXIAL BENDING.

CALCULATIONS: SEE ATTACHED SHEETS

CONCLUSIONS: FROM THE CALCULATIONS IT IS SHOWN THAT THE METHOD PRESCRIBED IN SECTION 5.0 OF DS-C1.7.1 IS CONSERVATIVE IN DETERMINING ANCHOR LOADS COMPARED TO FINITE ELEMENT ANALYSIS. FOR BOTH RIGID AND FLEXIBLE BASEPLATES.

COMPARISON OF HAND CALCULATION/ METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

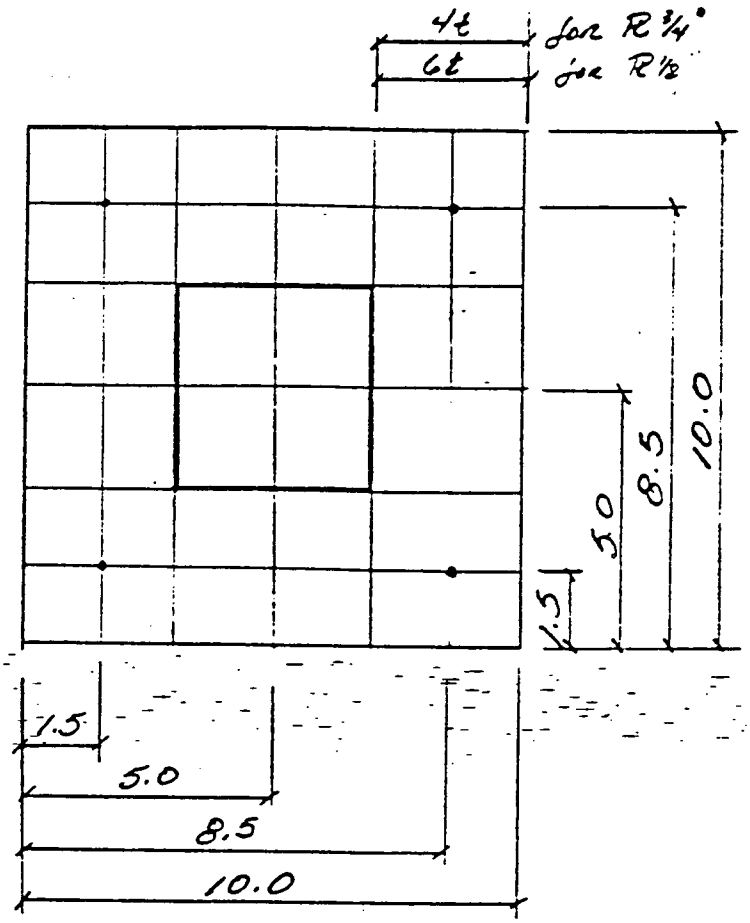
COMPUTED TBL DATE 7/13/85

CHECKED LS DATE 7-30-85

BASEPLATE E INPUT

R 1/2* X 10" X 0'-10" w/ 4 - 3/4" ϕ 350 ANC

```
3
OUT /
CON ,,,,3000 /
PLA 7,7,, 10,10,.5* /
APR ,,4,4,.5,.5 /
BPR ,,1,1E5,1E6 /
BOL 2,2,1,1.5,1.5 /
BOL 2,6,1,1.5,8.5 /
BOL 6,2,1,8.5,1.5 /
BOL 6,6,1,8.5,8.5 /
END /
TUS 4,4,1,5,5 /
END /
DOT 4,4 /
LOA ,,1,,,10000 /
LOA ,,2,,,10000 /
LOA ,,3,,,10000,10000 /
LOA ,,4,,,10000,10000,10000 /
END /
```



BASEPLATE MODEL

* PLATE THICKNESSES OF 1/2" AND 3/4" INCH USED FOR SIMPLE PLATE ANALYSIS { where R 1/2" → Flexible R
R 3/4" → Rigid R

LOAD CASE	LOAD DESCRIPTION
1	TENSION ONLY
2	UNIAXIAL BENDING
3	BI-AXIAL BENDING
4	COMBINED TENSION + BI-AXIAL BENDING

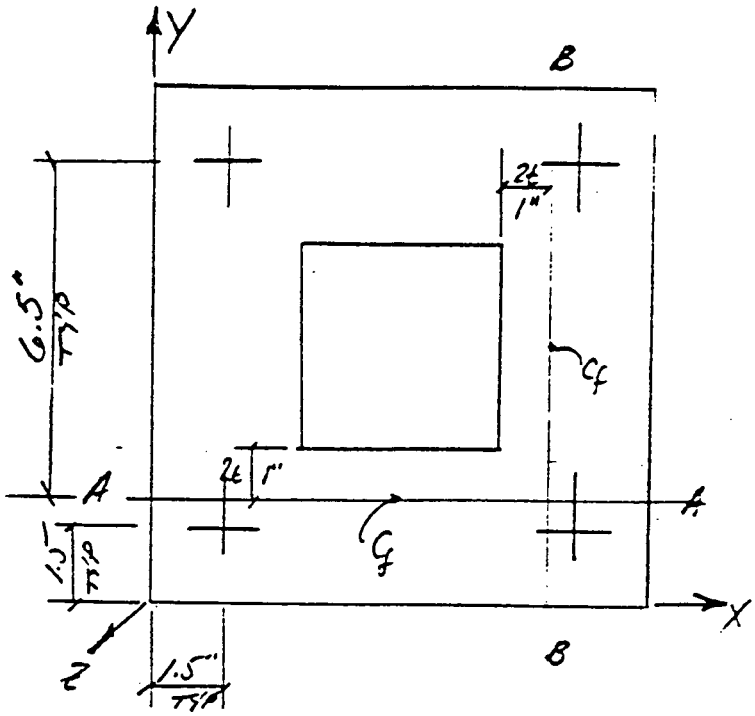
COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING END-OF LOADS

COMPUTED TSK DATE 9/13/85

CHECKED LS DATE 7-30-85

R 10X10X½ w/ 4-¾"Ø SSD ANCHORS

HAND CALCULATION METHOD



LOAD CASES

① $F_z = 10000^{lb}$

② $M_x = 10000^{in-lb}$

③ $M_y = M_y = 10000^{in-lb}$

④ $F_z = 10000^{lb}$, $M_x = M_y = 10000^{in-lb}$

ANCHOR LOADS

LOAD CASE ①

TENSION ONLY

$\Sigma F_z = 0$

$T = 10000/4 = 2500^{lb}$

LOAD CASE ②

UNIAXIAL BENDING, M_x

$\Sigma M_{A-A} = 0$

$T = \frac{10000}{2(6.5)} = 769^{lb}$

LOAD CASE ③

BIAXIAL BENDING $M_x + M_y$

$\Sigma M_{AA} = 0$

$T = \frac{10000}{2(6.5)} = 769^{lb}$

$\Sigma M_{B-B} = 0$

$T = \frac{10000}{2(6.5)} = 769^{lb}$

$T_{TOTAL} = 1538^{lb}$

LOAD CASE ④

BIAXIAL + TENSION

$\Sigma F_z = 0$

$T = 2500^{lb}$

$\Sigma M_{A-A} = 0$

$T = 769^{lb}$

$\Sigma M_{B-B} = 0$

$T = 769^{lb}$

$T_{TOTAL} = 4038^{lb}$

COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBL DATE 7/19/

CHECKED LS DATE 7-30-

PLATE
10 x 10 x 1/2 w/ 4 3/4" ø SSD ANCHORS

LOAD CASE	HAND CALCULATION	FINITE ELEMENT
1	2500	2500
2	769	643
3	1538	1138
4	4038	3921

NOTE IN ALL CASES THE ANCHOR LOADS OBTAINED THROUGH HAND CALCULATIONS IS EQUAL TO OR GREATER THAN THOSE OBTAINED FROM FINITE ELEMENT ANALYSIS

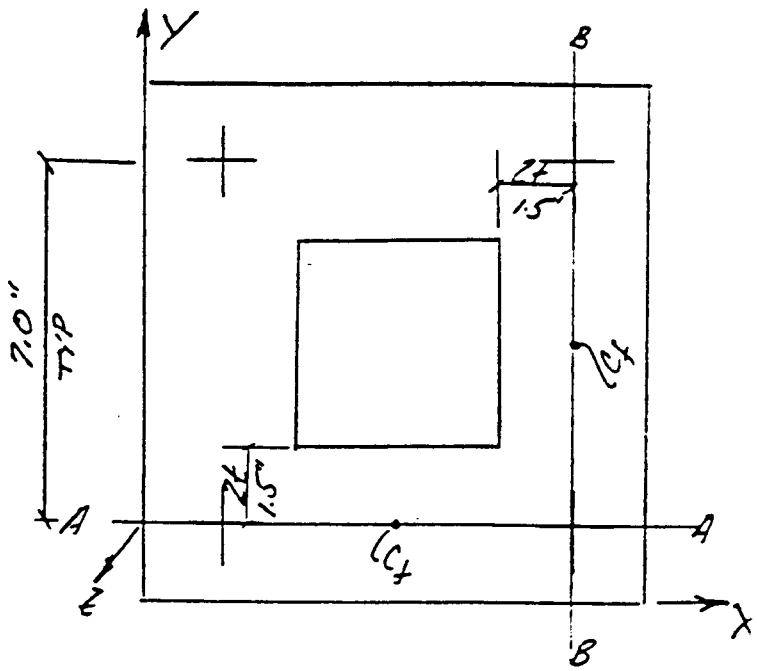
COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBR DATE 7/12/85

CHECKED LS DATE 7-30-85

10X10X 3/4 W/ 4 - 3/4 "Ø SSD ANCHORS

HAND CALCULATION METHOD



LOAD CASES

① $F_z = 10000^{lb}$

② $M_x = 10000^{"-lb}$

③ $M_x = M_y = 10000^{"-lb}$

④ $M_x = M_y = 10000$, $F_z = 10000^{lb}$

ANCHOR LOADS

LOAD CASE ①

TENSION ONLY

$\Sigma F_z = 0$

$T = 10000/4 = 2500^{lb}$

LOAD CASE ②

UNIAXIAL

$\Sigma M_{A-A} = 0$

$T = \frac{10000}{2(7)} = 714^{lb}$

LOAD CASE ③

BIAXIAL

$\Sigma M_{A-A} = 0$

$T = 714^{lb}$

$\Sigma M_{B-B} = 0$

$T = 714^{lb}$

$T_{TOTAL} = 1428^{lb}$

LOAD CASE ④

BIAXIAL + TENSION

$\Sigma F_z = 0$

$T = 2500^{lb}$

$\Sigma M_{AA} = 0$

$T = 714^{lb}$

$\Sigma M_{B-B} = 0$

$T = 714^{lb}$

$T_{TOTAL} = 3928^{lb}$ (MAX)

COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBC DATE 7/19/85

CHECKED LS DATE 7-30-85

R 10X10X3/4 w/ 4 3/4"Ø SSD ANCHORS

LOAD CASE	HAND CALCULATIONS	FINITE ELEMENT
1	2500	2500
2	714	585
3	1428	988
4	3928	3929

NOTE IN ALL CASES THE ANCHOR LOADS OBTAINED THROUGH HAND CALCULATION IS EQUAL TO OR GREATER THAN THOSE OBTAINED FROM FINITE ELEMENT ANALYSIS

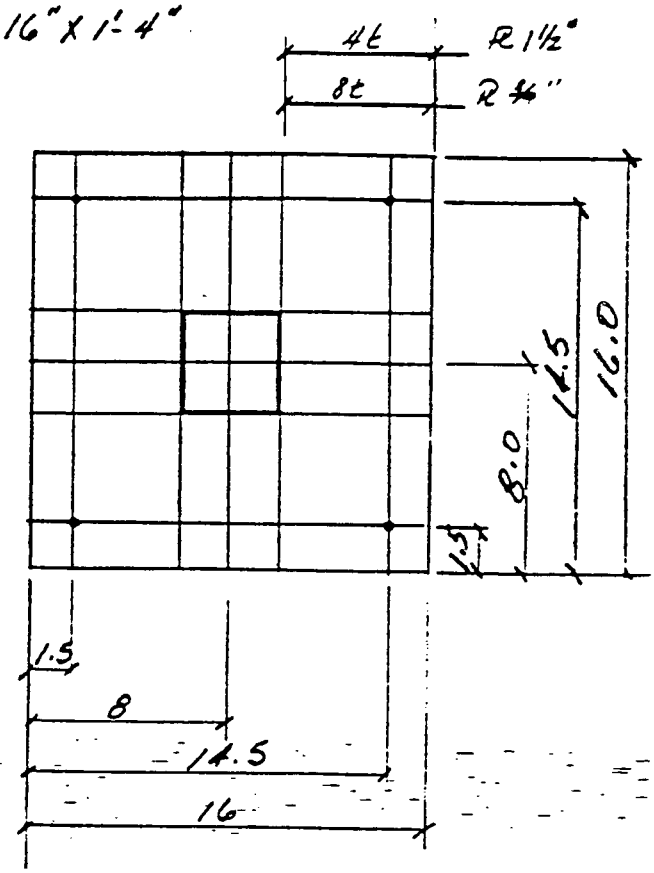
COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBR DATE 2/12/85
CHECKED LS DATE 7-30-85

BASEPLATE-II INPUT

3
OUT /
CON ,,,,3000 /
PLA 7,7,,16,16,.75*/
APR ,,1,4,4,.5,.5 /
BPR ,,1,165,165 /
BOL 2,2,1,1.5,1.5 /
BOL 2,6,1,1.5,14.5 /
BOL 6,2,1,14.5,1.5 /
BOL 6,6,1,14.5,14.5 /
END /
TUB 4,4,1,8,8 /
END /
POI 4,4 /
LOA ,,1,,,,10000 /
LOA ,,2,,,,10000 /
LOA ,,3,,,,10000,10000 /
LOA ,,4,,,,10000,10000,10000 /
END /

R 3/4" x 16" x 1'-4"



BASEPLATE MODEL

* PLATE THICKNESSES OF 3/4-INCH AND 1½ INCH WERE USED FOR SIMPLE PLATE ANALYSIS { 3/4" for Flexible ; 1½" for Rigid. }

LOAD CASE	LOAD DESCRIPTION
1	TENSION ONLY
2	UNIAXIAL BENDING
3	BI-AXIAL BENDING
4	COMBINED TENSION + BI-AXIAL BENDING

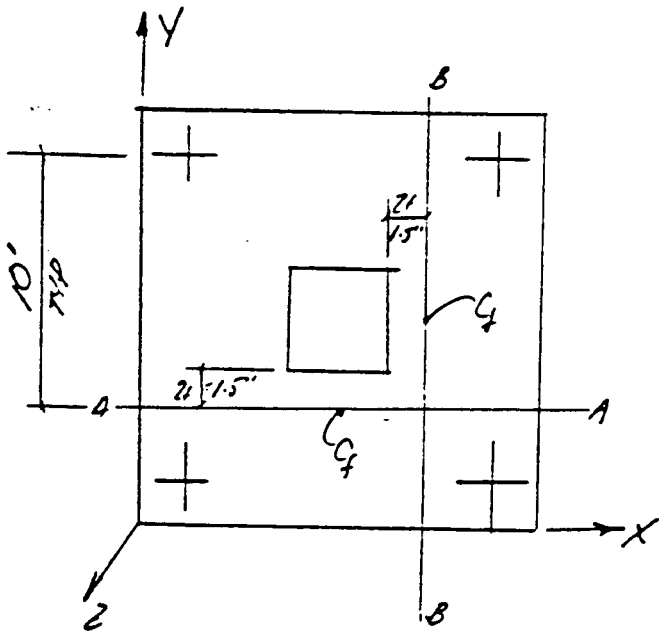
COMPARISON OF HAND APPLICATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBR DATE 7/19/85

CHECKED LS DATE 7-30-85

PL 16X16X 3/4 W/ 4-3/4"Ø 350 ANCHORS

HAND CALCULATION METHOD



LOAD CASES

① $F_z = 10000^{lb}$

② $M_x = 10000^{in\text{-}lb}$

③ $M_x = M_y = 10000^{in\text{-}lb}$

④ $F_z = 10000$, $M_x = M_y = 10000^{in\text{-}lb}$

ANCHOR LOADS

LOAD CASE ①

TENSION ONLY

$\Sigma F_z = 0$

$T = 10000/4 = 2500^{lb}$

LOAD CASE ②

UNIAXIAL

$\Sigma M_{A-A} = 0$

$T = \frac{10000}{2(10)} = 500^{lb}$

LOAD CASE ③

BIAXIAL

$\Sigma M_{A-A} = 0$

$T = 500^{lb}$

$\Sigma M_{B-B} = 0$

$T = 500^{lb}$

$T_{TOTAL} = 1000^{lb}$

LOAD CASE ④

TENSION + BIAXIAL

$\Sigma F_z = 0$

$T = 2500^{lb}$

$\Sigma M_{A-A} = 0$

$T = 500^{lb}$

$\Sigma M_{B-B} = 0$

$T = 500^{lb}$

$T_{TOTAL} = 3500^{lb}$

COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED BL DATE 7/17/85

CHECKED LS DATE 7-30-85

R16X16X3/4 w/ 4 3/4"Ø SSD ANCHORS

	Anchor Loads	
Load Case	Hand Calculations	Finite Elements
1	2500	2500
2	600	370
3	1000	684
4	3500	3270

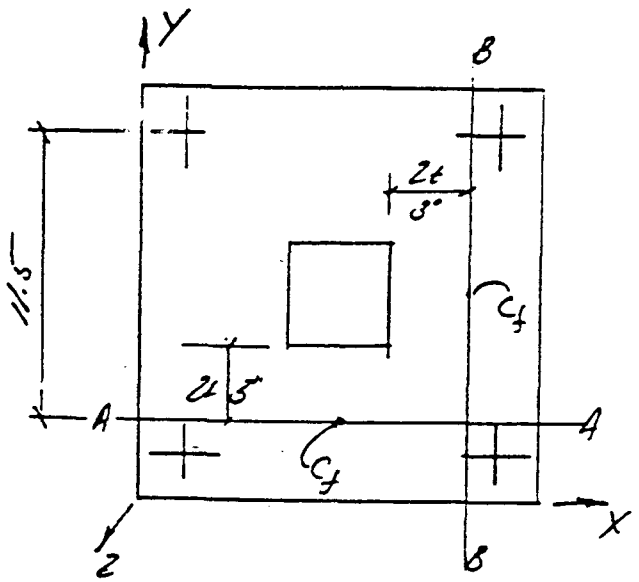
COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBL DATE 7/19/8[illegible]

CHECKED LS DATE 7-30-8[illegible]

PL 16X16X1 1/2" w/ 4-3/4"ø SSO ANCHORS

HAND CALCULATION METHOD



LOAD CASES

① $F_z = 10000^{lb}$

② $M_x = 10000^{in-lb}$

③ $M_x = M_y = 10000^{in-lb}$

④ $F_z = 10000^{lb}$, $M_x = M_y = 10000^{in-lb}$

ANCHOR LOADS

LOAD CASE ①

TENSION ONLY

$\Sigma F_z = 0$

$T = \frac{10000}{4} = 2500^{lb}$

LOAD CASE ②

UNIAXIAL

$\Sigma M_{A-A} = 0$

$T = \frac{10000}{2(11.5)} = 435^{lb}$

LOAD CASE ③

BIAXIAL

$\Sigma M_{AA} = 0$

$T = 435^{lb}$

$\Sigma M_{B-B} = 0$

$T = 435^{lb}$

$T_{TOTAL} = 870^{lb}$

LOAD CASE ④

TENSION + BIAXIAL

$\Sigma F_z = 0$

$T = 2500^{lb}$

$\Sigma M_{AA} = 0$

$T = 435^{lb}$

$\Sigma M_{B-B} = 0$

$T = 435^{lb}$

$T_{TOTAL} = 3370^{lb}$

COMPARISON OF HAND CALCULATION METHODS TO FINITE ELEMENT ANALYSIS IN DETERMINING ANCHOR LOADS

COMPUTED TBL DATE 2/19/85

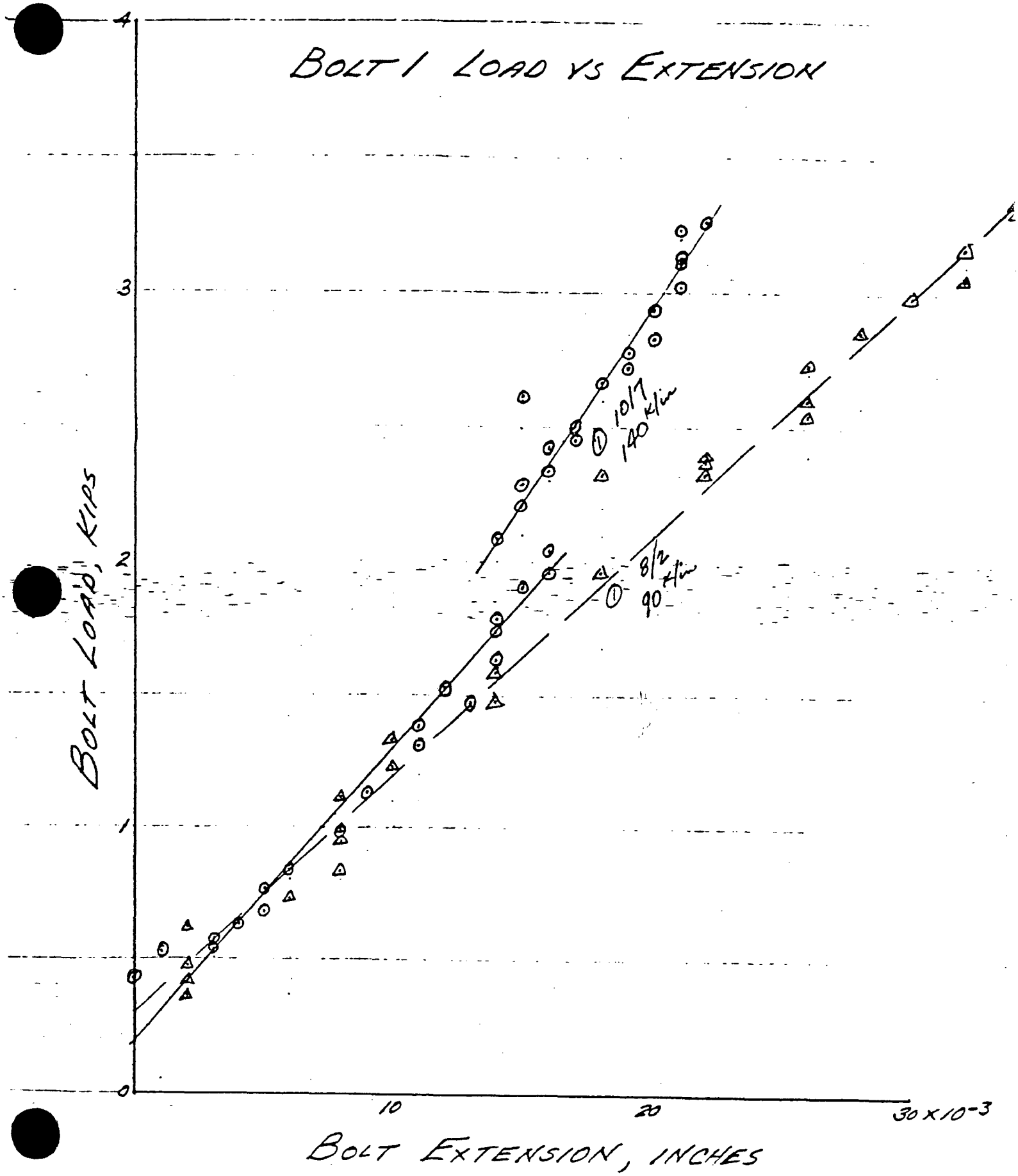
CHECKED LS DATE 7-30-85

PL6X16X1 1/2 W/ 4 3/4"Ø SSD ANCHORS

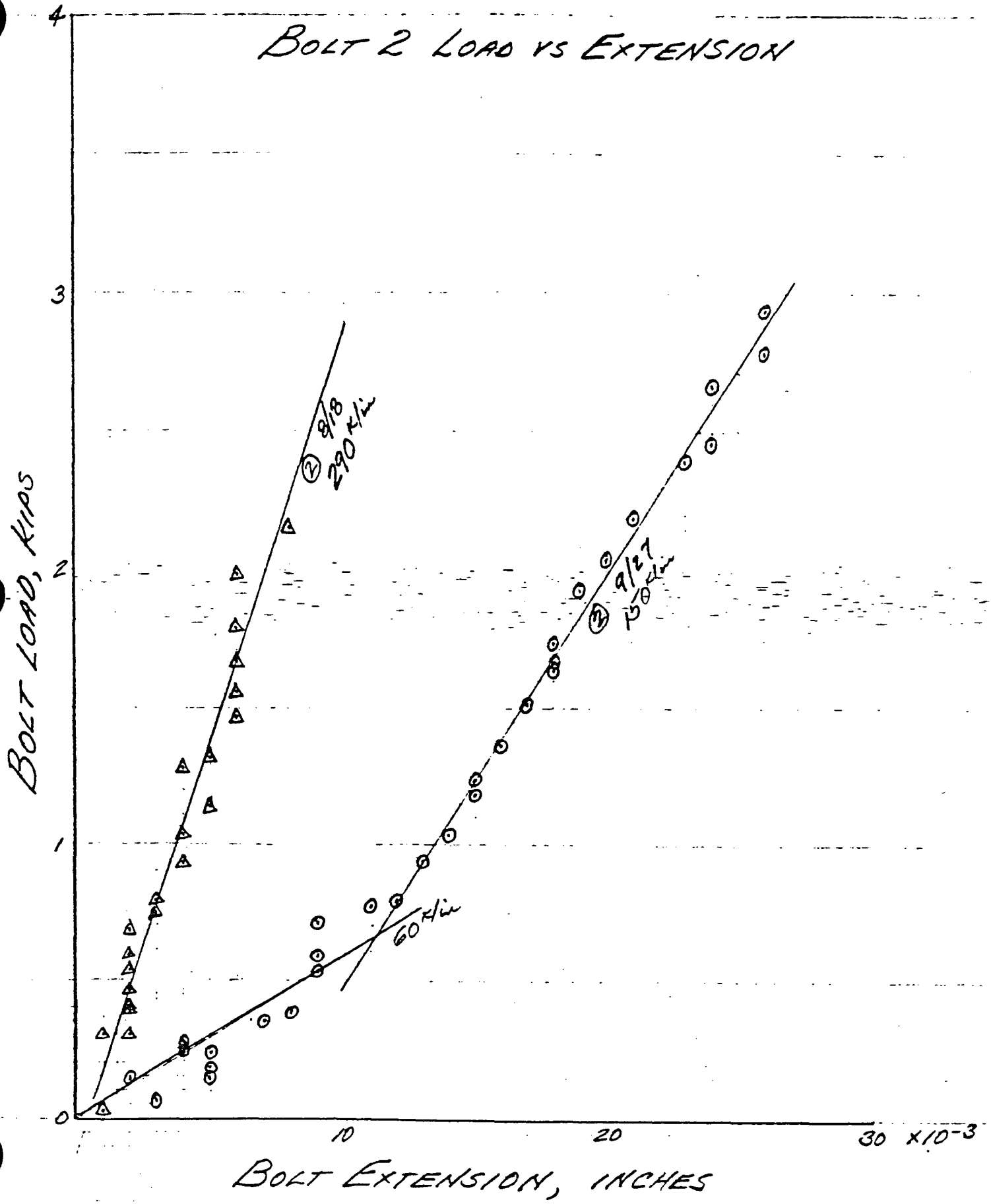
LOAD CASE	HAND CALCULATIONS	FINITE ELEMENT
1	2500	2500
2	435	344
3	870	546
4	3370	3269

ATTACHMENTS

2 & 3



ATTACHMENT 2



ATTACHMENT 3

ATTACHMENT

4