MAXIMUM REACH ENTERPRISES
1853 Wellington Court
Henderson, NV 89014
Ph: 702 547 1564
kent.goodman @ cox.net
www.maximumreach.com

01 June 2012

THE MILLSTONE II
STEAM GENERATOR REPLACEMENT PROJECT

WATERFORD, CONNECTICUT

Millstone Nuclear
Power Station

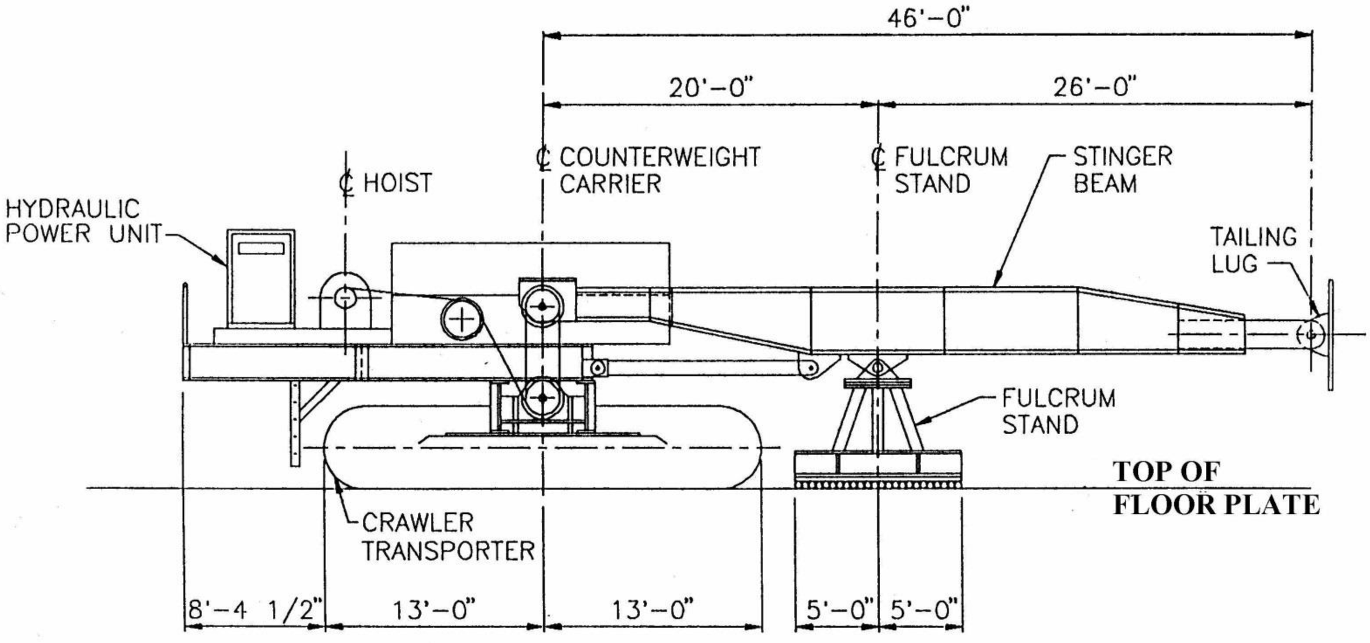
Unit 2 is the tall building just to the right of the stack

DESIGN OF THE STINGER BEAM FOR THE TAILING ASSEMBLY

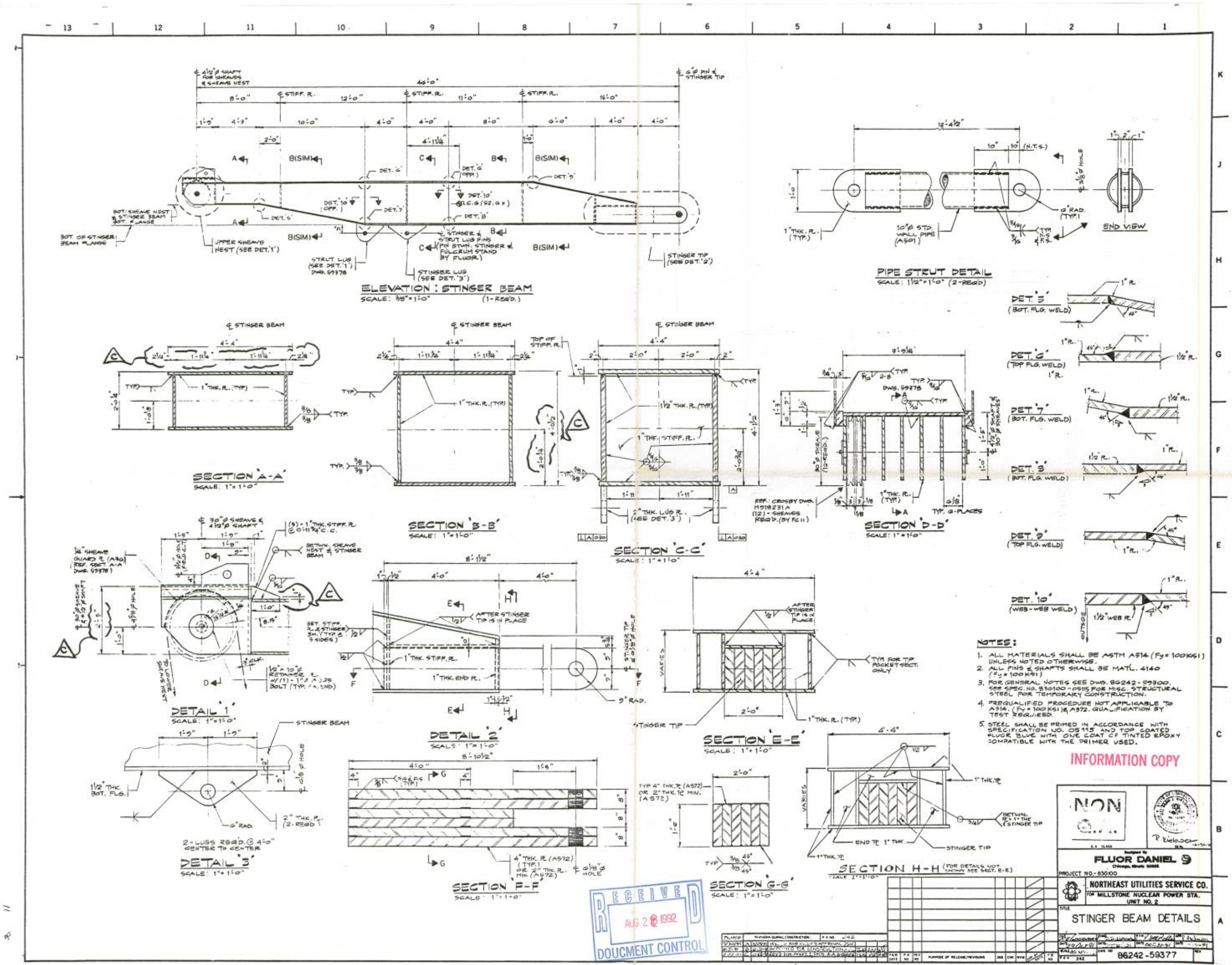
COMMENTS:

1. The 7 sheet check list is not included.
2. Presentation page 5 shows the calculation cover & signature sheet for the calculations.
3. Presentation page 6 shows the first sheet of 47 sheets of the actual calculations of the stinger beam.
4. These design calculations were listed as SC-048 on our design calculation log.
5. The 46’ length of the stinger beam was determined by the dimensions of the 600 ton transporter, the closest that the fulcrum stand could be located to the equipment hatch and the reach needed to position the flange lug under the centerline of the SGLA when it was as close to the containment wall as the H6 hoist could trolley it, ie, 11’ – 6”.   See calculation sheet 2.
6. Design references such as the AISC manual have not been included. If anyone wants to have any of the formulas explained, just let me know.
7. Presentation page 2 shows an overall drawing of the tailing assembly just to show how all of the components fit together.

8. Presentation page 3 shows the detail drawing of the stinger beam to give the reader an overall view of the design before going into the calculations.
9. To enlarge the drawing for better viewing, click on the **view** tab and change it to say 200 %.
10. Presentation page 4 contains the detail drawing of the counterweight carrier frame & the 600 ton transporter so the reader can see where a lot of the dimensions came from in the stinger beam design and how it connects to the stinger beam to form the tailing assembly.



TAILING ASSEMBLY



NOTES:

1. ALL MATERIALS SHALL BE ASTM A514 (Fy = 100KSI) UNLESS NOTED OTHERWISE.
2. ALL PINS & SHAFTS SHALL BE MAT'L. 4140 (Fy = 100KSI)
3. FOR GENERAL NOTES SEE DWG. 86242-59300. SEE SPEC. NO. 830100-05115 FOR MISC. STRUCTURAL STEEL FOR TEMPORARY CONSTRUCTION.
4. PREQUALIFIED PROCEDURE NOT APPLICABLE TO A514. (Fy = 100 KSI) & A572. QUALIFICATION BY TEST REQUIRED.
5. STEEL SHALL BE PRIMED IN ACCORDANCE WITH SPECIFICATION NO. 05115 AND TOP COATED FLUOR BLUE WITH ONE COAT OF TINTED EPOXY COMPATIBLE WITH THE PRIMER USED.

NON

Q.A. CLASS

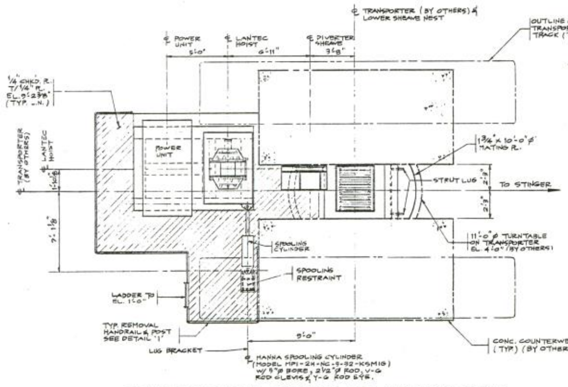
P. Kielawa

Designed By
FLUOR DANIEL
Chicago, Illinois 60606
PROJECT NO.- 830100

NORTHEAST UTILITIES SERVICE CO.
FOR MILLSTONE NUCLEAR POWER STA. UNIT NO. 2

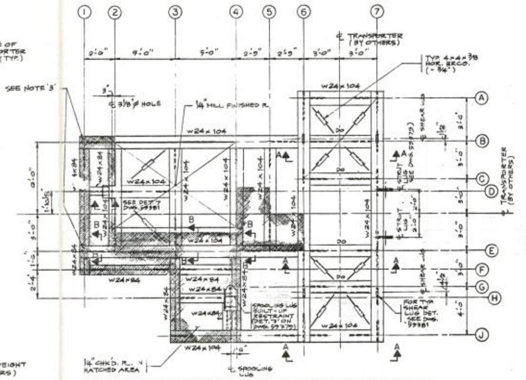
TITLE
STINGER BEAM DETAILS

SCALE AS NOTED
F.A.# 242
DWG NO 86242-59377



COUNTERWEIGHT CARRIER GEN. ARRANGEMENT

SCALE: 3/8" = 1'-0"



NOTE: ALL CONNECTIONS ARE TO BE BOLTED TYPE UNLESS NOTED OTHERWISE. ALL DECK PLATES ARE TO BE SHOP ERECTED & ACCESS AREAS TO BE PROVIDED FOR FIELD WELDED CONNECTIONS.

COUNTERWEIGHT CARRIER STL. FRMG. PLAN

SCALE: 3/8" = 1'-0"

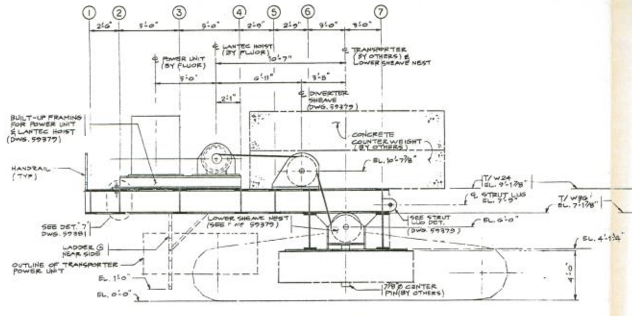
T.O.S. EL. 9'-1 3/8"

NOTES:

1. FOR GENERAL NOTES SEE DWG. 86242-59380. SEE SPEC. NO. 830100-05115 FOR MISC. STRUCTURAL STEEL FOR TEMPORARY CONSTRUCTION.
2. ALL PINS & SHAFTS SHALL BE MAT'L. 4140 (F_y = 100 KSI)
3. PROVIDE TEMPORARY SUPPORT UNDERNEATH BEAM PRIOR TO ATTACHMENT TO STEEL FRAMING ABOVE TRANSPORTER TURNTABLE.
4. PREQUALIFIED PROCEDURE NOT APPLICABLE TO A514 MATERIAL. QUALIFICATION BY TEST REQ'D.
5. GRADE EL. 0'-0" AS SHOWN IS EQUAL TO SITE EL. 14'-7".
6. WORK THIS DWG. WITH REF. DWGS. AS LISTED BELOW.
7. STEEL SHALL BE PRIMED IN ACCORDANCE WITH SPECIFICATION NO. 05115 AND TOP COATED FLUOR BLUE WITH ONE COAT OF TINTED EPOXY COMPATIBLE WITH THE PRIMER USED.

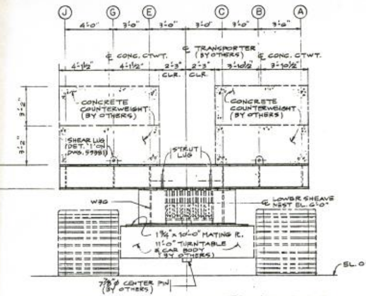
REFERENCE DWGS:

- FULCRUM STAND DETAILS ________ 86242-59376
- STINGER BEAM DETAILS ________ 86242-59377
- STINGER BEAM MISC. DETAILS ________ 86242-59378
- CTWT. CARRIER MISC. DETAILS ________ 86242-59379
- CTWT. CARRIER FRAME DETAILS ________ 86242-59381
- S/G LOWER ASS'Y. RIGGING HOOK-UP DETS. ________ 86242-59389



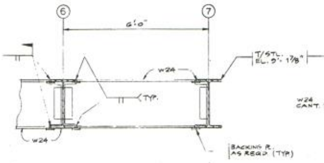
SECTION @ ℄ TRANSPORTER

SCALE: 3/8" = 1'-0"



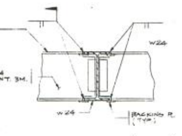
FRONTAL VIEW OF TRANSPORTER

SCALE: 3/8" = 1'-0"



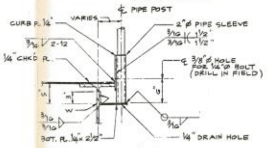
SECTION 'A-A'

SCALE: 3/4" = 1'-0"



SECTION 'B-B'

SCALE: 3/4" = 1'-0"



DETAIL '1'

SCALE: 1 1/2" = 1'-0"

RECEIVED
AUG 28 1992
DOUCMENT CONTROL

INFORMATION COPY

NON Q.A.

Q.A. CLASS

11-22-91

Designed by
FLUOR DANIEL
Chicago, Illinois 60606

PROJECT NO.- 830100

NORTHEAST UTILITIES SERVICE CO.
FOR MILLSTONE NUCLEAR POWER STA. UNIT NO. 2

TITLE
COUNTERWEIGHT CARRIER FRAME PLAN and SECTIONS

DR.	CHKD.	P.E. F. Del Toro	APP.
DATE 11-21-91	DATE	DATE 11-18-91	DATE 11-21-91
SCALE AS NOTED	DWG. NO. 86242-59375		REV.
P.A. 242			

FILM DATE	P.A. NO.	REV. NO.	PURPOSE OF RELEASE/REVISIONS	DES.	CHK.	P.E.	APP. BY DATE	P.E. NO.

FLUOR DANIEL

CALCULATION COVER SHEET

PROJECT: NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
CLIENT: S/G REPLACEMENT PROJECT

PROJECT NO:

ASSIGNMENT INFORMATION
Dept. Name STRUCTURAL
System No. SGR
Calc. No. SC-048 Work Item —
Revision 0 Date 1 JULY 91

Title: STINGER BEAM FOR STEAM GENERATOR REMOVAL & INSTALLATION (SHEME 3)

Content: 7 PAGE CHECK LIST N/A
47 PAGES OF CALCULATIONS & SKETCHES

NSR: ☐ YES ☑ NO

	NAME	INITIAL	DATE
Designed/Calculated By:	KENT GOODMAN	KEG	1 JULY 91
Checked By:		EDB	Sept. 3'91
Approved and Released By:		RAB	OCT 1, 91
Professional Engineer's Seal No.	16827	State of	CT.
Reviewed BY:			
QA Review:			

RECEIVED
OCT 1 1991
DOCUMENT CONTROL

Distribution:
Original to Project File
Copies To:

NOTE: This form must be legible and suitable for microfilming.

Form CC-630 Rev. (3) 2/22/89

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 1 JULY 91
CONT. NO. 830100
BY KE GOODMAN CHK'D EDE
SHEET NO. 1

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

1. PURPOSE & SCOPE

THE PURPOSE OF THIS SET OF CALCULATIONS IS TO DESIGN THE STINGER BEAM & PIN FOR USE IN DOWN/UP ENDING THE SGLA'S

2. REFERENCES & DESIGN INPUT

A. ANSI/ASME N45.2.15 1981 NUCLEAR RIGGING
B. ASME B30.5 1989 MOBILE & LOCOMOTIVE CRANES
C. AISC MANUAL FOR STEEL CONSTRUCTION 9TH ED
D. THE CROSBY PRODUCTS GENERAL CATALOG
E. FLUOR RIGGING DESIGN MANUAL
F. MACWHYTE CATALOG OF TABLES, ETC 6-17, 11TH ED
G. DESIGN OF WELDED STRUCTURES 7TH ED

3. SUMMARY OF RESULTS & CONCLUSIONS

THE STINGER CAN BE DESIGNED & FABRICATED TO SAFELY DOWN/UP END THE SGLA BY ADHERING TO THE DESIGN CODES & STANDARDS LISTED ABOVE.

4. CRITERIA & ASSUMPTIONS

A. SAFE WORKING LOAD (SWL) FOR DESIGN OF COMMERCIAL RIGGING GEAR = 5:1 S.F.
B. DUE TO THE CRITICAL APPLICATION, THE STINGER IMPACT FACTOR = 1.5
C. USE 0.5Fy FOR BEARING (NO IMPACT)
D. USE HOLE ϕ 1/8" OVER PIN ϕ

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.40
114	C_8	19.41
28	C_2=	9.64
42	C_3=	9.67

MISC

MW	gals/mol	
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

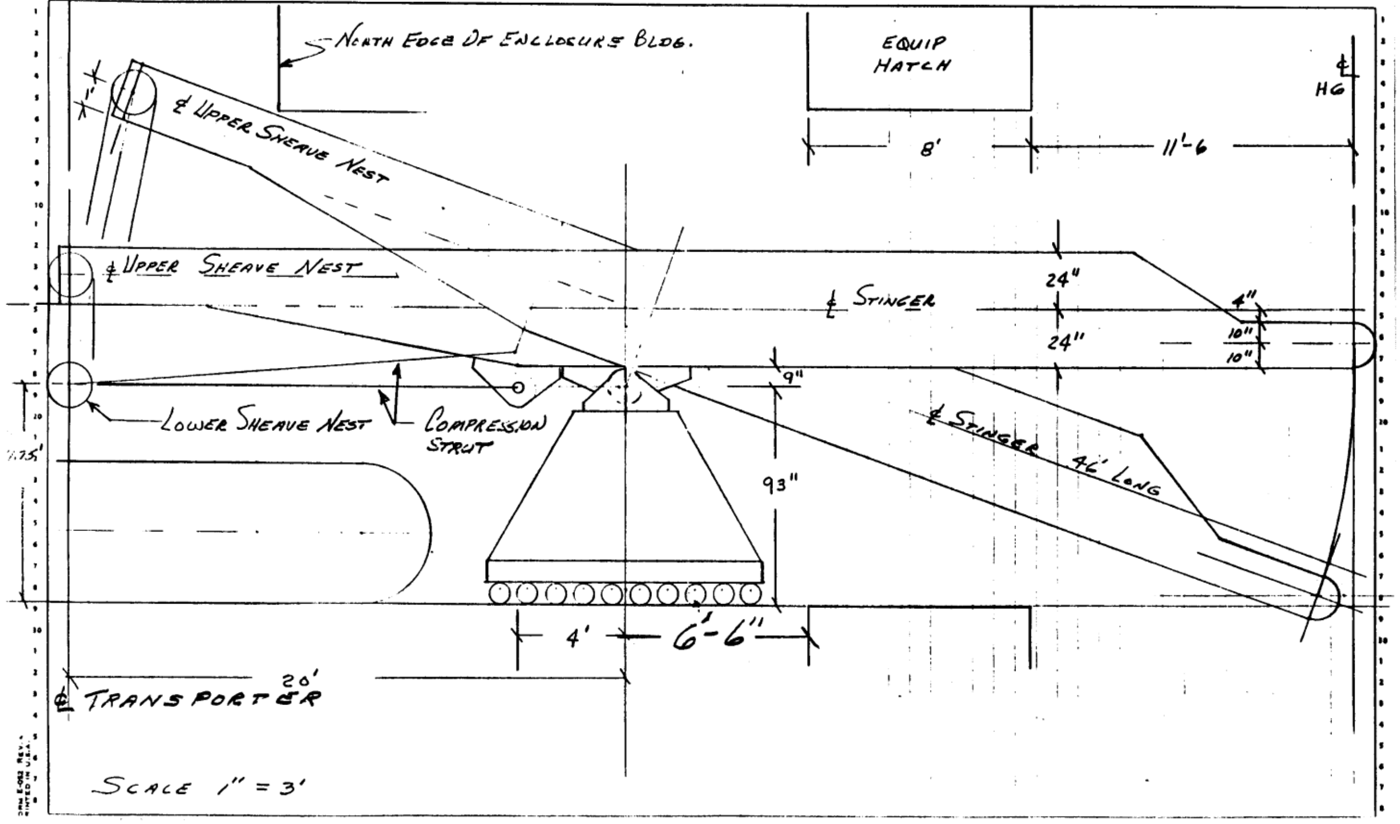
FORM E-050
PRINTED IN U.S.A.

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

FLUOR
CALCULATIONS and SKETCHES

SC-048

DATE 9 July 91
CONT. NO. B5D/DO
BY CHK'D
SHEET NO. 2



FORM E-052 REV. 4
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

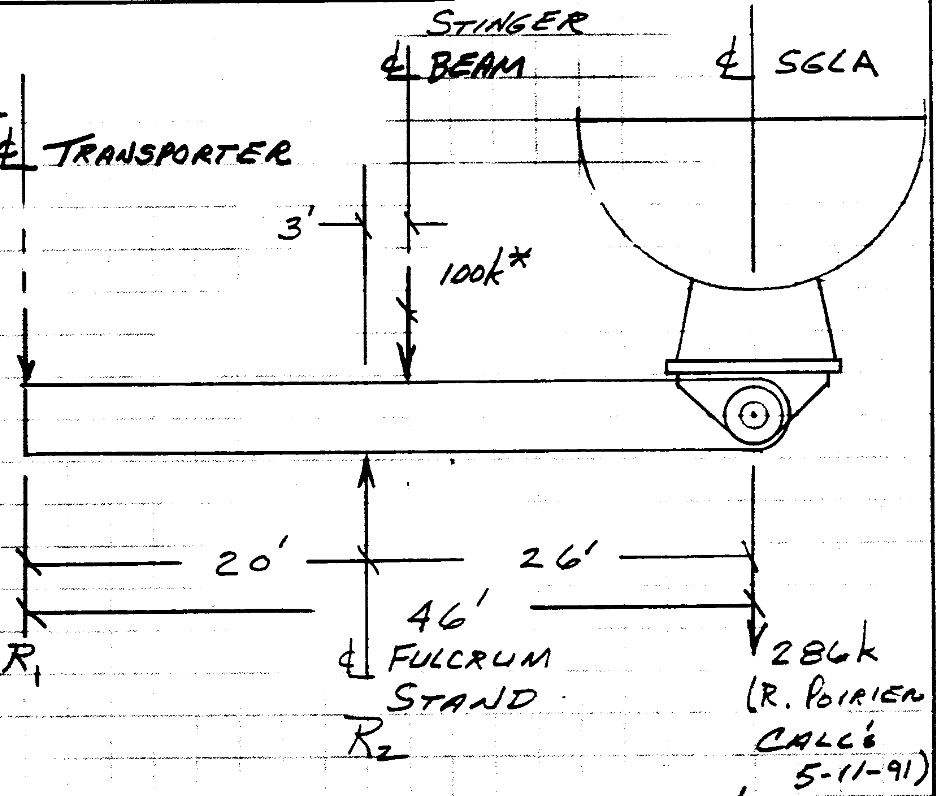
CALCULATIONS and SKETCHES

DATE 1 JULY 91
CONT. NO. 830/100
BY KE GOODMAN CHK'D
SHEET NO. 3

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

STINGER BEAM DESIGN

NOTE:
ALL HORIZONTAL DIMENSIONS WILL BE REF. FROM THE ℄ TRANSPORTER I.E. THE MOMENT AT THE FULCRUM STAND WOULD BE DESIGNATED $M_{20'}$



$\Sigma M_{R_1} (+\curvearrowright) = 0$

$$20\ R_2 = 23.0' * 100k + 46' * 286k$$

$$R_2 = 772.8\ k$$

$$\therefore\ R_1 = 386.8\ k$$

* ASSUMED

MW	gals/mol	
16	C_1	6.40
30	C_2	9.87
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.50
100	iC_7	17.2
100	C_7	17.40
114	C_8	19.41
28	$C_2{}^=$	9.64
42	$C_3{}^=$	9.67

MISC

MW	gals/mol	
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

SC-048

FLUOR DANIEL

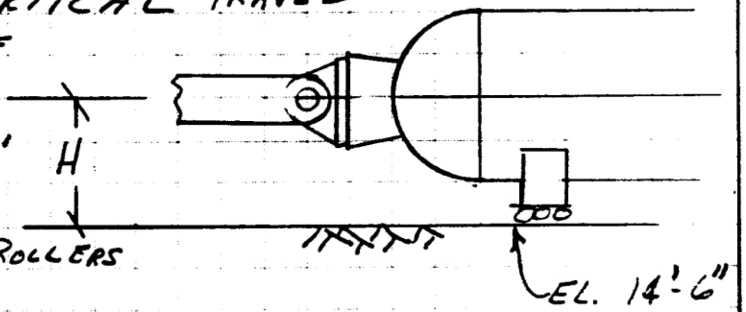
CALCULATIONS and SKETCHES

DATE 9 JULY 91
CONT. NO. 8301 00
BY K.E. GOODMAN CHK'D
SHEET NO. 4

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.85
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

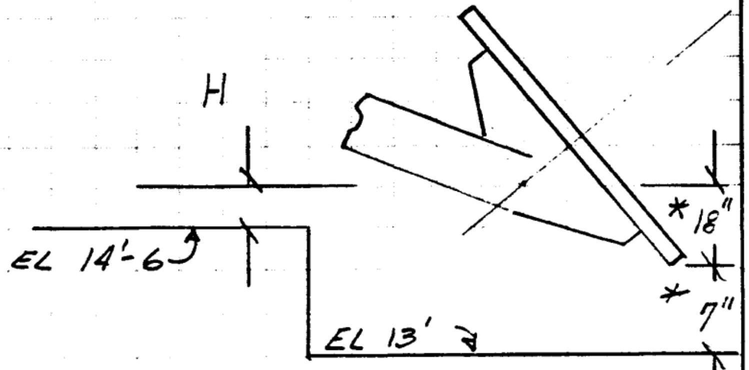
DETERMINE THE VERTICAL TRAVEL DISTANCE FOR THE STINGER TIP



$H_{MAX} = 13.75'/2 + 1.5' + .5'$

SG ⌀/2 · SADDLE · ROLLERS

$= 8.875'$



$H_{MIN} = 7"$

USE 5"

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

∴ MAX TRAVEL =

$8.875' - .42' = 8.46'$

*PER FDC CAD DWG

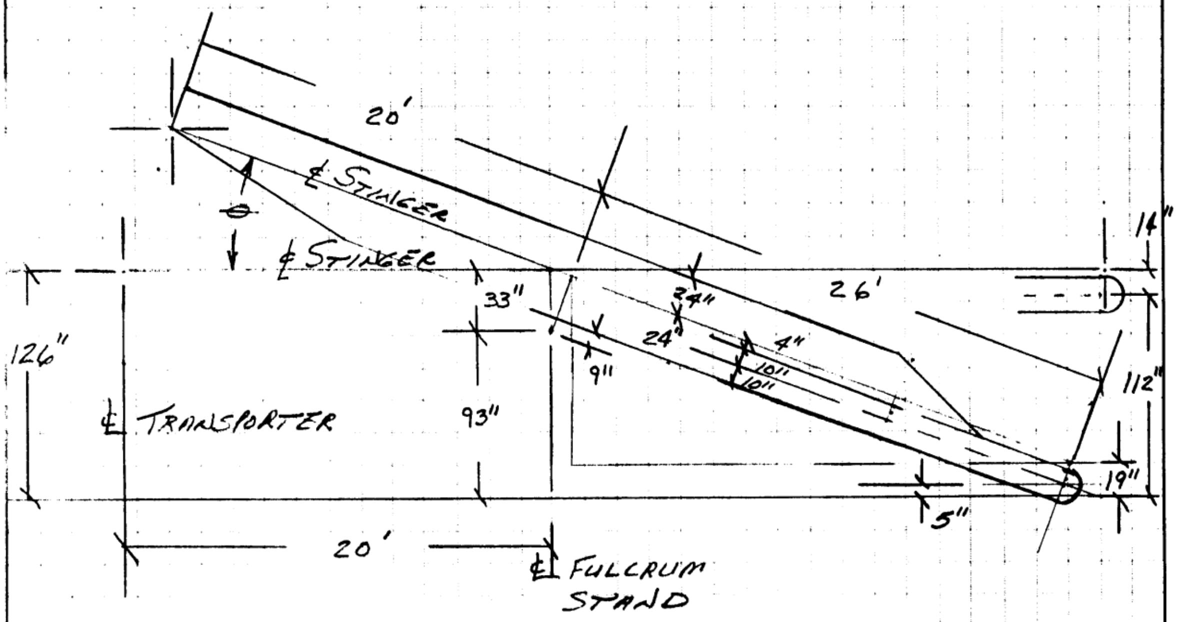
FORM E-050
PRINTED IN U.S.A.

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

FLUOR DANIEL
CALCULATIONS and SKETCHES

SC-048

DATE 9 JULY 91
CONT. NO. 830100
BY KEGOODMAN CHK'D
SHEET NO. 5



∴ Max. Tip Travel (Actual) 112" − 5" = 107" = 8.92'

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 9 JULY 91
CONT. NO. 830100
BY KEGOODMAN CHK'D
SHEET NO. 6

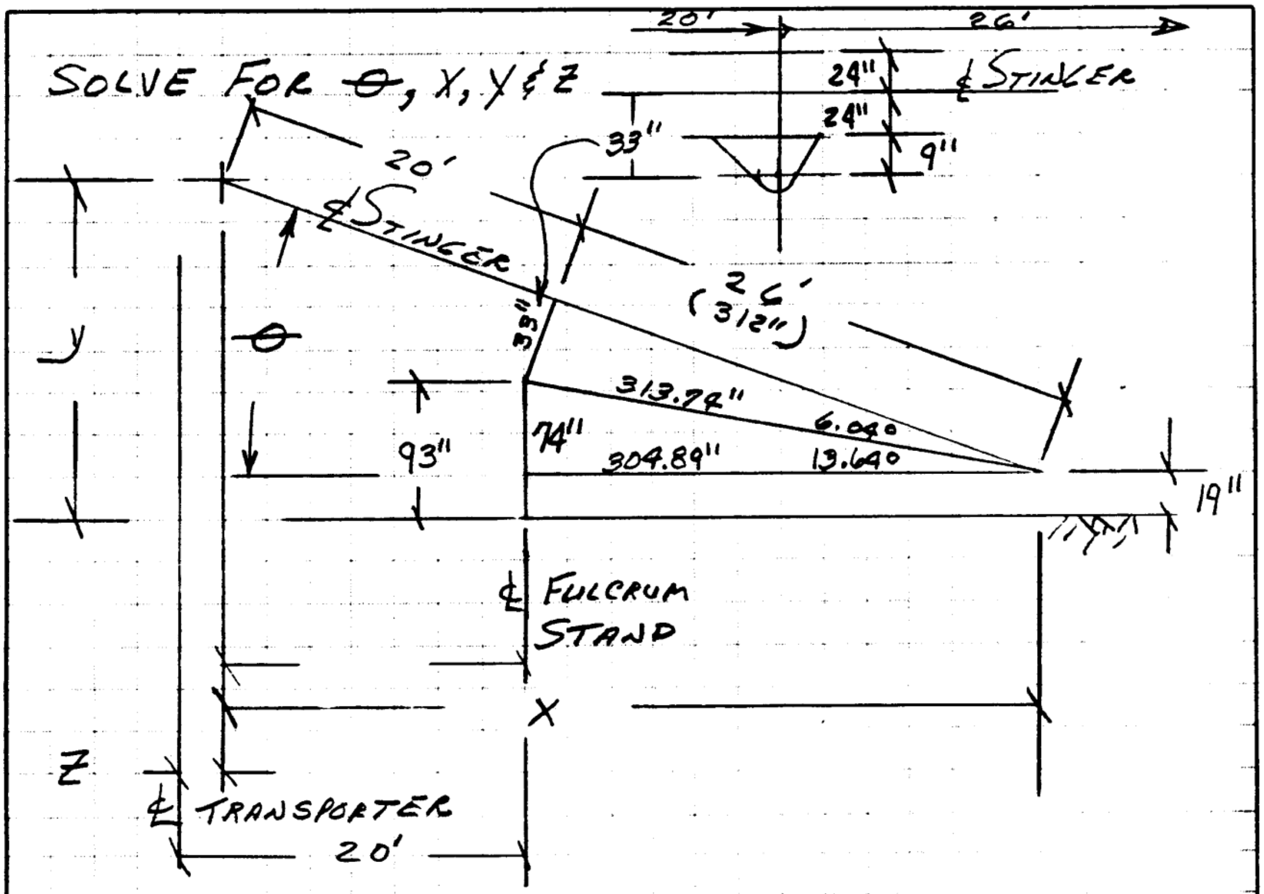
NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals./mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.88
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

SOLVE FOR θ, X, Y & Z



θ = 6.04° + 13.64° = 19.68°

Y = 17.1'

X = 43.31'

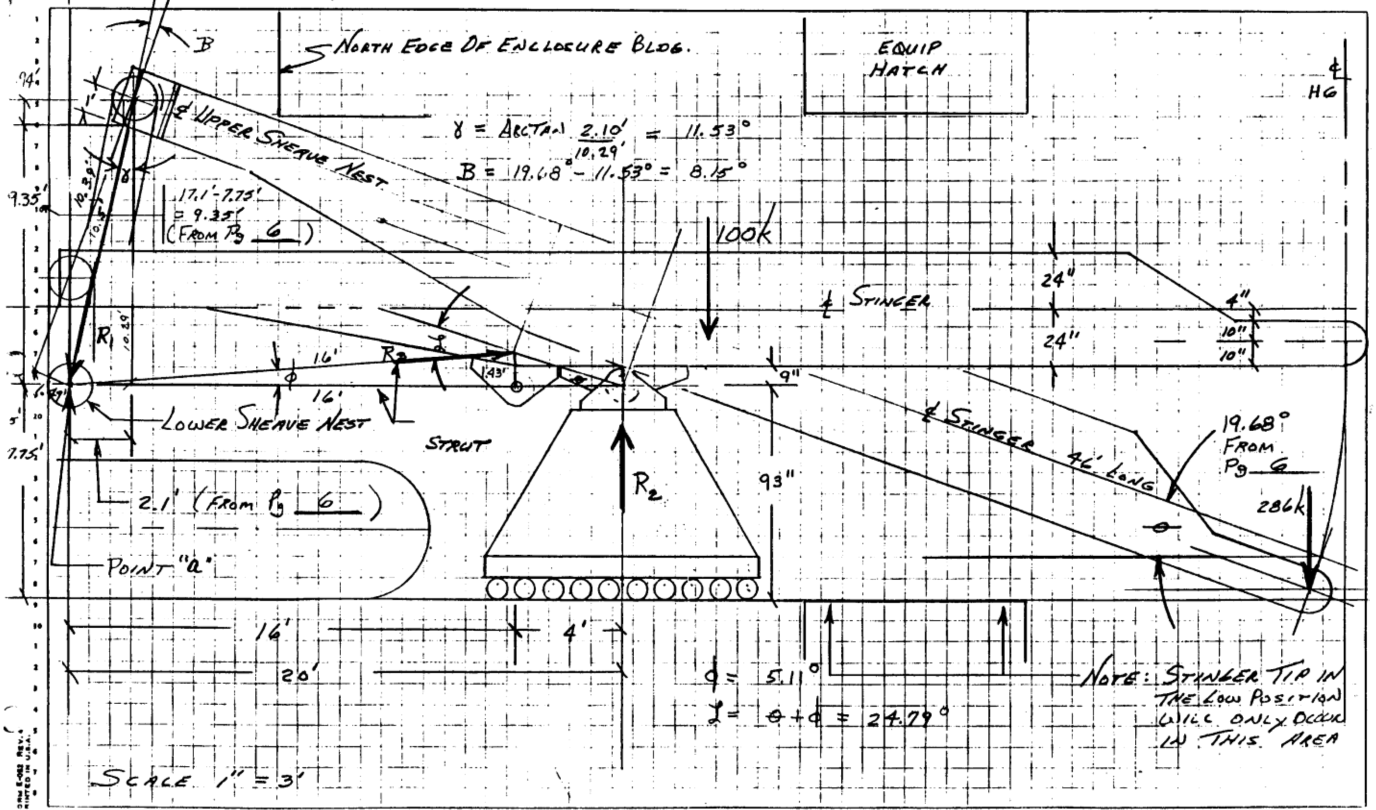
Z = 2.1'

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

FLUOR SC-048
CALCULATIONS and SKETCHES

DATE 9 JULY 91
CONT. NO. 830100
BY [illegible] CHK'D BOE
SHEET NO. 7

ANGLES & DIMENSIONS WHEN THE STINGER IS INCLINED AT 19.68°



γ = ARCTAN $\frac{2.10'}{10.29'}$ = 11.53°

B = 19.68° − 11.53° = 8.15°

ϕ = 5.11°

$\mathcal{L}$ = $\theta + \phi$ = 24.79°

NOTE: STINGER TIP IN THE LOW POSITION WILL ONLY OCCUR IN THIS AREA

SC-048

FLUOR DANIEL

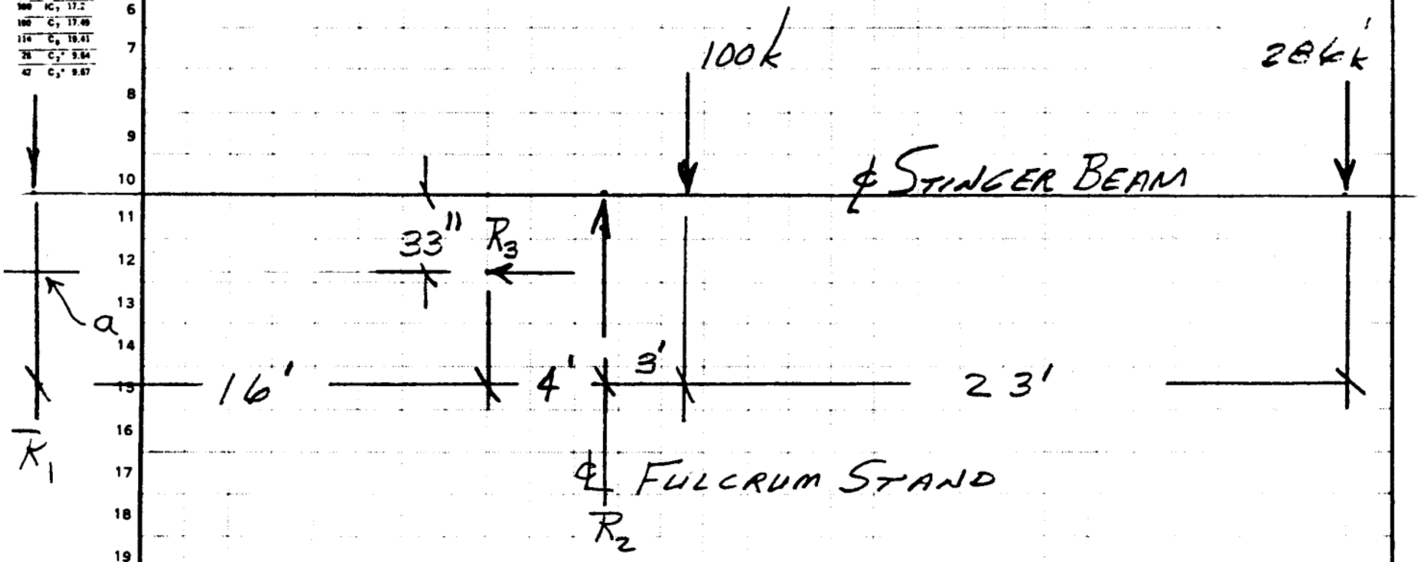
CALCULATIONS and SKETCHES

DATE 9 JULY 91
CONT. NO. 830100
BY KE GOODMAN CHK'D
SHEET NO. 8

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.96
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

SOLVE FOR THE FORCES IN THE STINGER BEAM (HORIZONTAL)



$\Sigma M_a +\!\!\circlearrowright = 0$

$-20' R_2 + 23' * 100k + 46' * 286k = 0$

$20 R_2 = 15,456 \text{ k-''}$

$R_2 = 772.8k$

$R_3 = 0.0$

$R_1 = 386.8k$

MISC

MW	gals/mol	
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

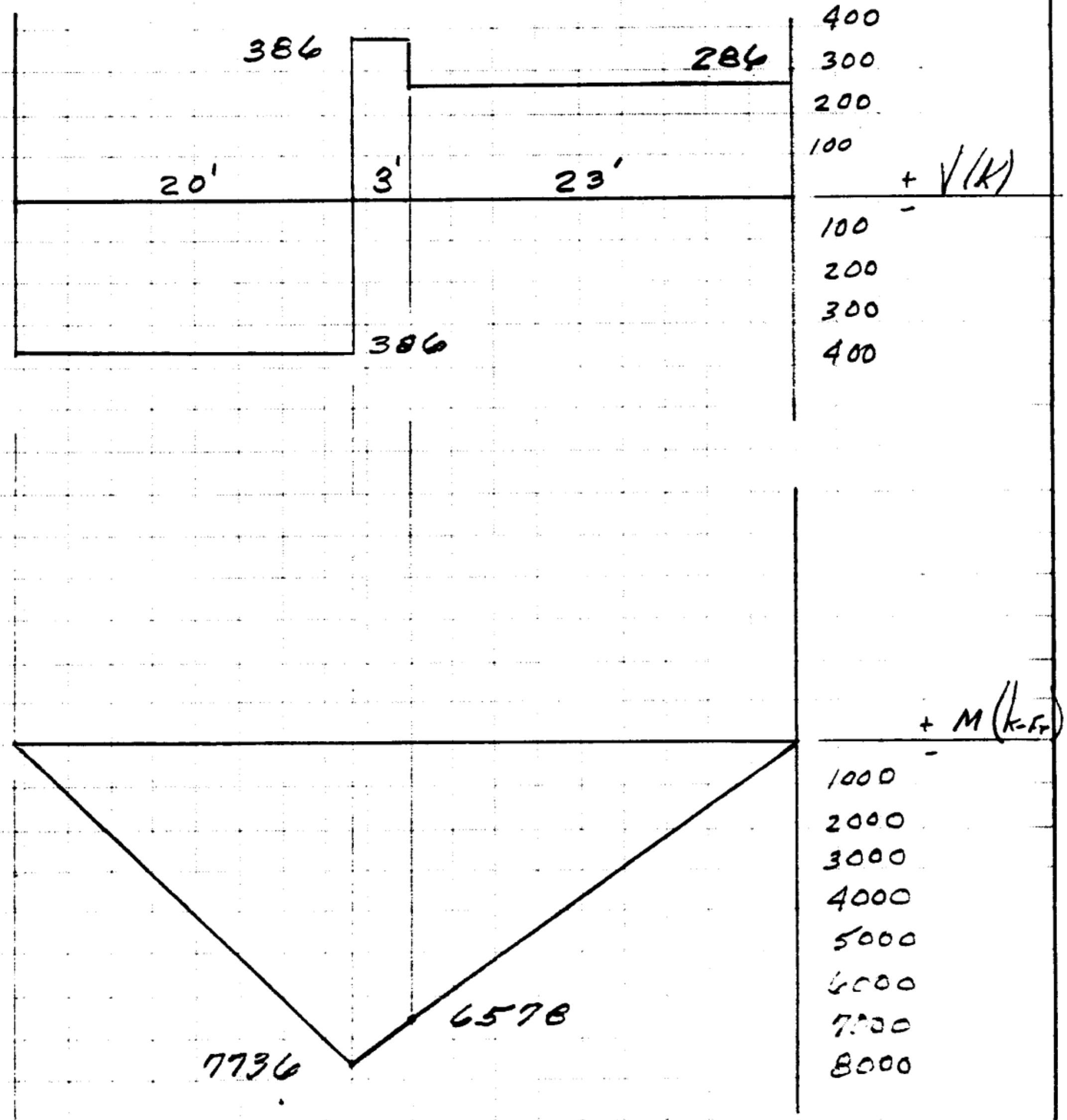
CALCULATIONS and SKETCHES

DATE 10 JULY 91
CONT. NO. 830100
BY K E GOODMAN CHK'D
SHEET NO. 9

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.96
72	IC_5	13.88
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	C_2°	9.64
42	C_3°	9.67

SHEAR & MOMENT DIAGRAMS
(WITH STINGER LEVEL)



MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

FORM E-050
PRINTED IN U.S.A.

SC-048

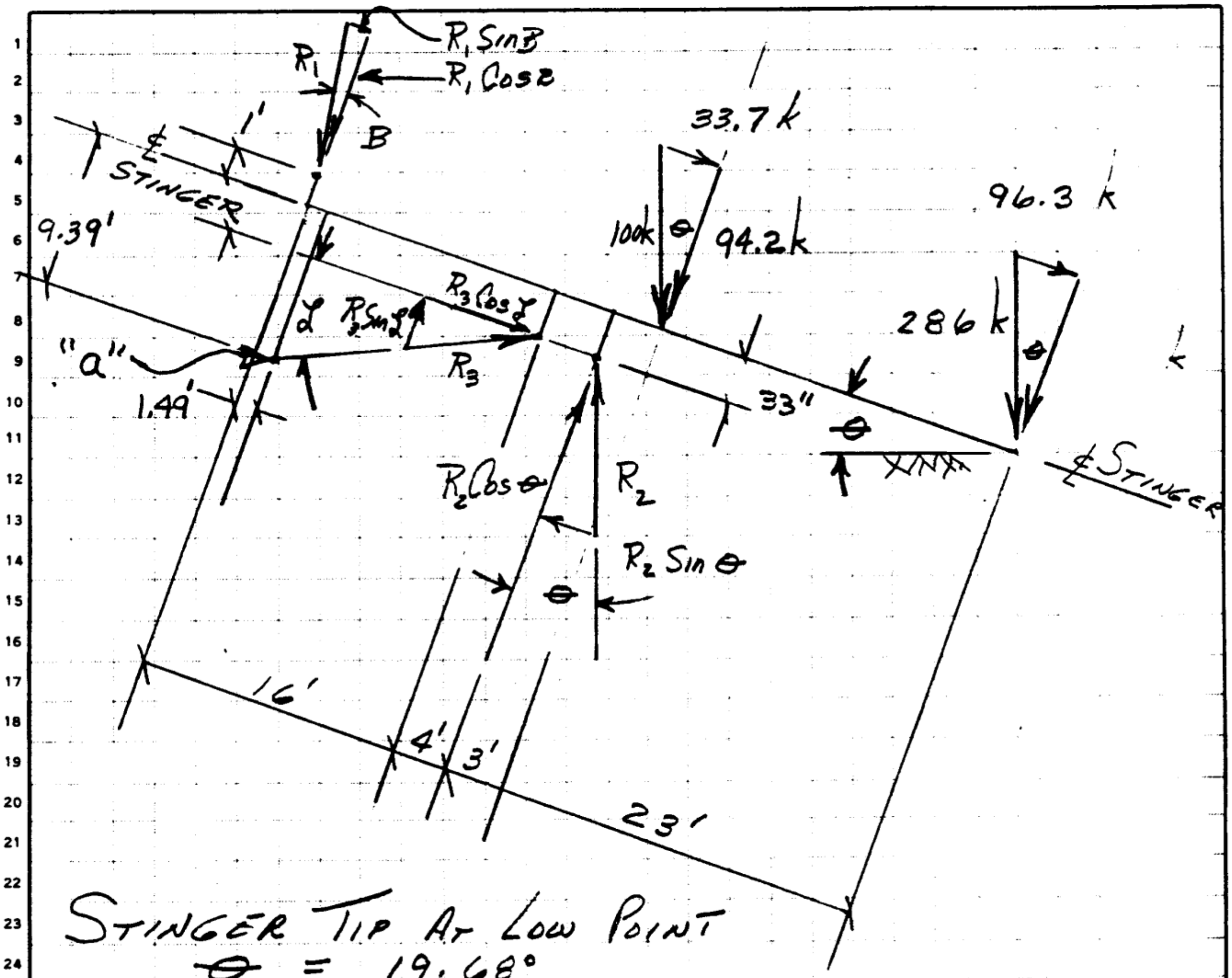
FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 11 JULY 91
CONT. NO. 830100
BY K E GOODMAN CHK'D
SHEET NO. 10

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.80
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67



STINGER TIP AT LOW POINT

$\theta = 19.68°$
$B = 8.15°$
$\mathcal{L} = 24.79°$

MISC

MW		gals/mol
4	CO_2	6.47
4	H_2S	5.18
8	N_2	4.16
2	H_2	3.38

POINT "a" IS AT THE INTERSECTION OF R_1 & R_3

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 11 JULY 91
CONT. NO. 860100
BY K E GOODMAN CHK'D EDE
SHEET NO. 11

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.88
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	C_2°	9.64
42	C_3°	9.67

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

SOLVE FOR R_1, R_2 & R_3

WHEN $\theta = 19.68°$

$\Sigma M_a +\circlearrowright = 0$

$$-\overbrace{(20'-1.49')*R_2}^{-17.43R_2}\cos\theta-\overbrace{(9.39'-2.75')*R_2}^{-2.24R_2}\sin\theta$$

$$+(46'-1.49')*269.3k \quad +9.39'*96.3k$$

$$+(23.0'-1.49')*94.2k \quad +9.39'*33.7k \quad = 0$$

$19.67R_2 = 15{,}009.3$

$R_2 = 763.1k$

$\Sigma F_y \uparrow + \theta = 0$

(1) $-R_1\cos B + R_3\sin\alpha + R_2\cos\theta - 94.2 - 264.6 = 0$

$-.99R_1 + .42R_3 = -359.7k$

$\Sigma F_x \rightarrow + = 0$

(2) $R_1\sin B + R_3\cos\alpha - R_2\sin\theta + 33.7k + 94.7k = 0$

$.14R_1 + .91R_3 = 128.6k$

MULTIPLY
(2) BY 7.07
& ADD TO
(1)

(2) $.99R_1 + 6.44R_3 = 909.4k$

$R_3 = 80.1k$

$R_1 = 397.7k$

SC-048

FLUOR DANIEL

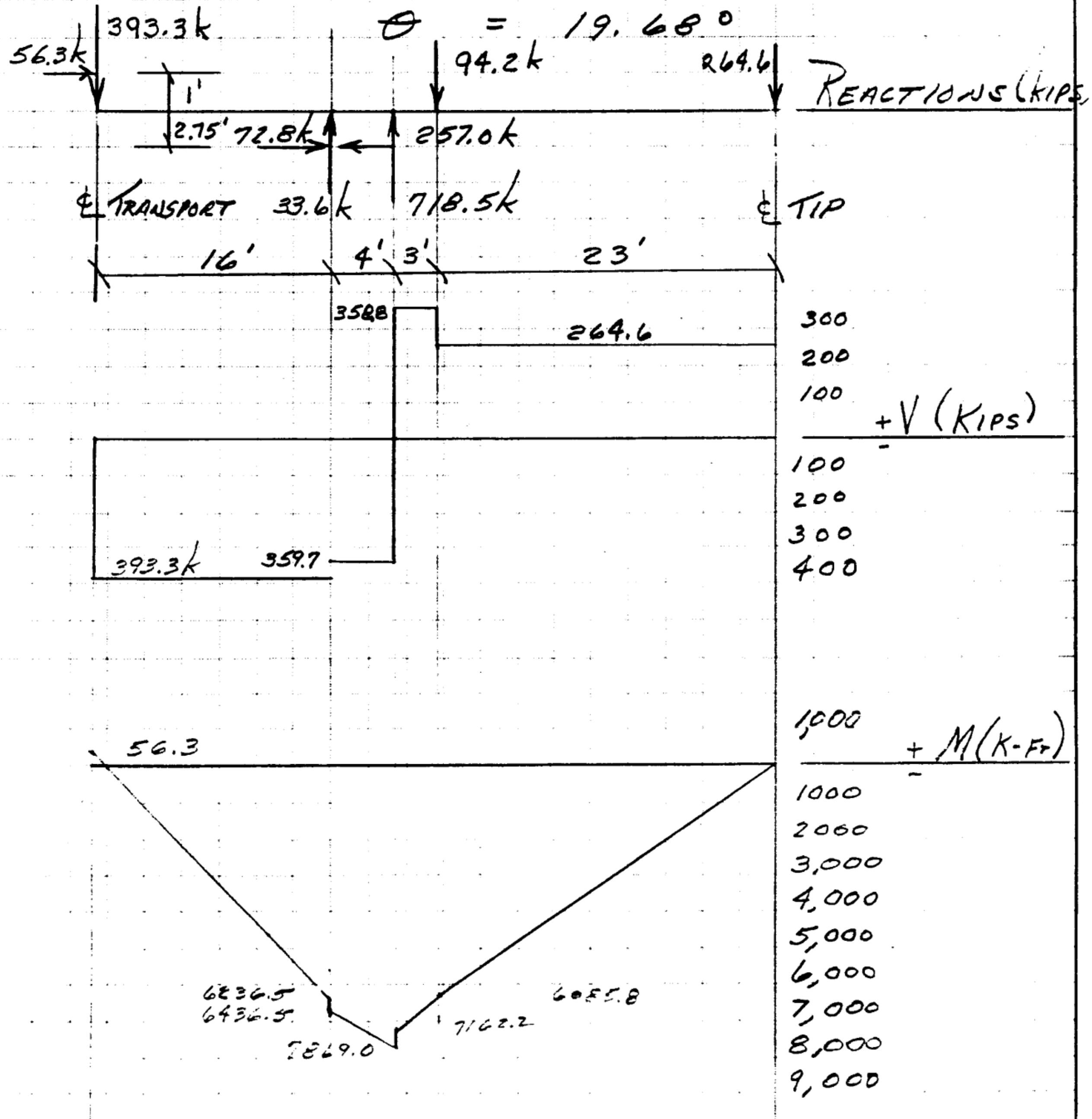
CALCULATIONS and SKETCHES

DATE 11 July 91
CONT. NO. 830100
BY KE GOODMAN CHK'D
SHEET NO. 12

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.86
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

SHEAR & MOMENT DIAGRAMS
STINGER TIP AT LOWER LEVEL



MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 12 JULY 91
CONT. NO. 830 100
BY KE GOODMAN CHK'D
SHEET NO. 13

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

SIZE THE STINGER BEAM

SECTION AT 20' FROM ℄ TRANSPORTER

MAX. MOMENT OCCURS AT ℄ OF THE FULCRUM STAND (REF SH 12)

= 7869 K-FT = 94,428 K-IN

USE 1.5 FOR IMPACT

USE A 514 F_y = 100 KSI MATL

∴ DESIGN MOMENT = 141,642 K-IN

TRY A BOX SECTION WITH
WEB DEPTH ≈ 46" t_w = 1½"
FLANGE WIDTH ≈ 50

AISC CHAPTER G $\frac{h}{t_w} = 15.3 < \frac{760}{\sqrt{60}} = 98$

∴ USE CHAPTER F FOR ALLOW. STRESSES

$\Longrightarrow$ NON-COMPACT SECTION

$F_b = .6F_y$ 60.0 KSI

$F_v = .4F_y$ = 40.0 KSI

CHECK SHEAR

$f_v = \frac{763k * 1.5}{2 * 1\frac{1}{2}'' * 46''}$ = 8.29 KSI OK.

CHECK FOR NEED OF INTERMEDIATE STIFFENERS

AISC F5 $\frac{h}{t_w} = 15.3 < 260$ No NEED

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.88
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2{}^=$	9.64
42	$C_3{}^=$	9.67

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 12 JULY 91
CONT. NO. 830100
BY K E GOODMAN CHK'D [illegible]
SHEET NO. 14

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

CHECK FLANGE AREA REQ (INITIAL TRY)

AISC 2-215

$$\underset{\left(\begin{smallmatrix}\text{ONE}\\ \text{FLANGE}\end{smallmatrix}\right)}{A} = \frac{M}{F_b * h} = \frac{141,642\ k\text{-in} * in^2}{60.0K * 46\ in} = 51\ in^2$$

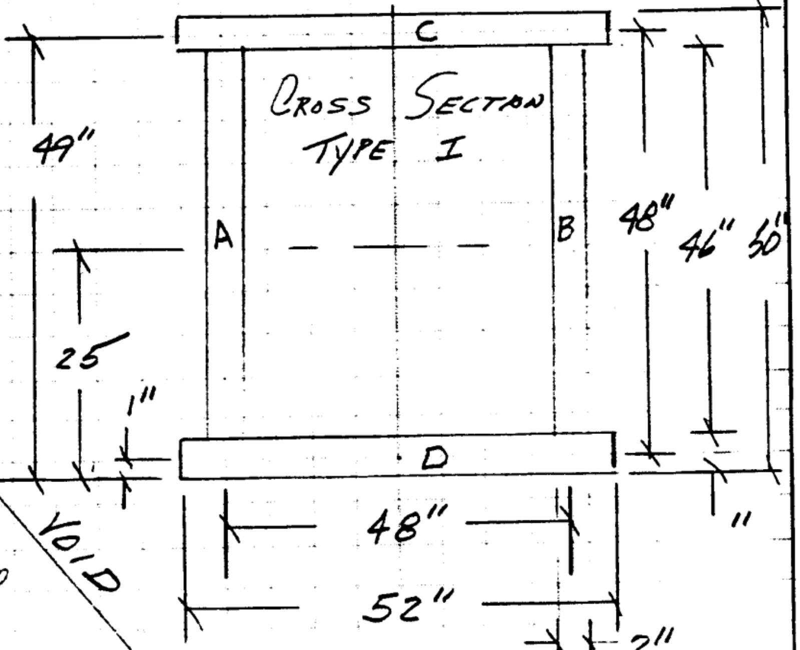
∴ TRY FLANGE : 1½" x 52" = 78.0 in² O.K.

REF SH 19

FLANGES
$b_1 = 2''$
$d_1 = 52''$

WEBS
$b_2 = 2''$
$d_2 = 46''$

REF LINE



VOID

MISC		
MW		gals/mol
4	CO_2	6.47
4	H_2S	5.18
[illegible]	N_2	4.16
2	H_2	3.38

REF DESIGN OF WELDED STRUCTURES
Pg 2.2-4

PLATE	SIZE (b x d) in	Y in	A (bxd) in²	M (AxY) in³	Iy MxY in⁴	Ig (bd³/12) in⁴
A	2 x 46	25	92	2,300	57,500	16,223
B	2 x 46	25	92	2,300	57,500	16,223
C	52 x 2	49	104	5,096	249,704	35
D	52 x 2	1	104	104	104	35
			392	9,800	364,808	32,516

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL
CALCULATIONS and SKETCHES

DATE 12 JULY 91
CONT. NO. 830100
BY KE GOODMAN CHK'D
SHEET NO. 15

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.86
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

MISC

MW		gals/mol
	CO_2	6.47
	H_2S	5.18
	N_2	4.16
	H_2	3.38

FROM SH 19

$$I_N = I_y + I_g - M^2/A$$

$$= 270{,}868 + 25{,}166 - 7{,}313^2/295.5 = 115{,}052\ in^4$$

$$\text{NEUT. AXIS CHECK} = \frac{7313}{295.5} = 25'' \qquad ok$$

$$f_b = \frac{141{,}642\ k\text{-}in * 25\ in}{115{,}073\ in^4} = 30.8\ ksi \qquad OK$$

$$f_V = \frac{763k * 1.5}{2 * 1\frac{1}{2}in * 46.5in * 1in^2} = 8.2\ ksi \qquad ok$$

LOCAL BUCKLING

AISC B5.1 & Pg 2-215

$$\frac{b_f}{2 * t_f} = \frac{52''}{2 * 1\frac{1}{2}''} = 17.4 < 238/\sqrt{Fy} = 23.8 \qquad O.K.$$

BEARING STIFFENERS

AISC K1.3 WEB YIELDING

$$\frac{R}{t_\omega (N + 5K)} = \frac{763 * 1.5}{2 * 1\frac{1}{2}(42 + 5 * .5)} = 8.8\ ksi\ o.k.$$

SEE SH 36 & ½" FILLET ASSUMED

K1.4 a WEB CRIPPLING

$$R = 67.5 * 1\frac{1}{2}^2 \left[1 + 3 \left(\frac{42}{50}\right) \left(\frac{1\frac{1}{2}}{1\frac{1}{2}}\right)^{1.5}\right] \sqrt{100 * 1\frac{1}{2} / 1\frac{1}{2}}$$

$$= 5346\ k > \frac{763.1k * 1.5}{2} = 572k$$

o.k.

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 12 JULY 91
CONT. NO. 830100
BY KEGOODMAN CHK'D
SHEET NO. 16

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.87
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.93
72	iC_5	13.85
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2{}^{=}$	9.64
42	$C_3{}^{=}$	9.67

FLANGE TO WEB (FILLET WELD)

HORIZONTAL SHEAR $v = \frac{VQ}{I}$

$V = \frac{281.0k * 1.5}{2} = 210.8\ k$

$Q = 78.0in^2 * 24\ in = 1872.0\ in^3$

1 FLANGE AREA M. ARM

$v = \frac{210.8\ k * 1,872.0in^3}{115,073\ in^4} = 3.4\ k/in$

WELD SIZE $= \frac{3.4k * 1\ in * in}{in * 2\ WELDS * 9.6k} = .18''$

LH60

∴ USE 3/8" FILLET BOTH SIDES OF THE WEBS

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

CHECK THE TORSIONIAL LOADING DUE TO THE WIRE ROPE
FROM SH 26 THE LEAD LINE PULL = 26.3k

THE DEADEND PULL $= \frac{393.3k}{24\ PARTS} = 16.4\ k$

FROM SH 28 THE DISTANCE FROM ℄ A OUT SIDE SHEAVE TO ℄ STINGER

$= \frac{51.25''}{2} - 1'' - 1/8'' - \frac{3.5''}{2} = 22.75''$

LOAD/SHEAVE AT LEAD LINE SIDE:

$= 2 * 26.3\ COS\ B = \quad 52.1k$

TO GET FORCE ⊥ TO STINGER ℄

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.88
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2{}^{=}$	9.64
42	$C_3{}^{=}$	9.67

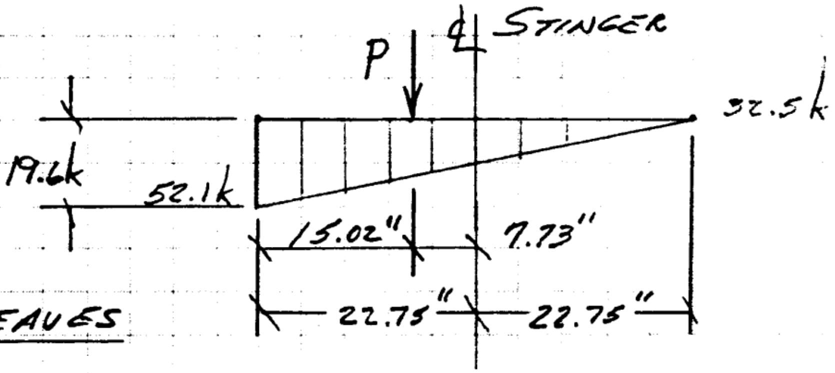
MISC

W	gals/mol	
4	CO_2	6.47
4	H_2S	5.18
8	N_2	4.16
2	H_2	3.38

LOAD/SHEAVE AT DEAD END

$= 2 * 16.4k * \cos B \quad = \quad 32.5k$

DIFFERENCE IN FORCES = 52.1 - 32.5 = 19.6 k



$$P = \frac{19.6k * 12 \text{ SHEAVES}}{2}$$

$$= 117.6 k$$

TORSIONAL MOMENT = 117.6 k * 7.73" = 909.0 in-k

FROM DESIGN OF WELDED STRUCTURES Pg 2.10-4

$$R = \frac{2 b_1^2 d_1^2}{\frac{b_1}{t_b} + \frac{d_1}{t_d}} = \frac{2 * 48^2 in^2 * 24^2 in^2}{\frac{48 in}{1\frac{1}{2} in} + \frac{24 in}{1\frac{1}{2} in}} = 55{,}296 \text{ in}^4$$

@ 1.75' FROM ℄ CRAWLER
TORSONIAL RESIST.

ANGULAR TWIST AT TIP OF STINGER Pg 8.2-1

$$\theta = \frac{TL}{E_{STEEL} R} = \frac{909.0 \text{ in-k} * 20 \text{ Ft} * 12 \text{ in} * \text{in}^2}{12{,}000 \text{ K} * 55{,}296 \text{ in}^4 * \text{FT}} = 0.00033 \text{ RAD}$$

$= .01°$

LOW!

O.K.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 13 JULY 91
CONT. NO. 830190
BY KE GOODMAN CHK'D EDE
SHEET NO. 18

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.88
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	C_2=	9.64
42	C_3=	9.67

TORSIONAL SHEAR STRESS

$$\tau = \frac{T}{2 A t_w} = \frac{909.0 \text{ in-k}}{2 * 48'' * 24'' * 1\tfrac{1}{2}''} = .26 \text{ ksi}$$

UNIT SHEAR FORCE FROM TORQUE

$$f_t = \tau t = \frac{.2 \text{ K} * 1\tfrac{1}{2}''}{\text{in}^2} = .3 \text{ k/in}$$

v FROM SH 16 = 3.4 K/in

TOTAL UNIT SHEAR FORCE (PER BEAM)

$$= .3 + 3.4 \qquad 3.7 \text{ K/in}$$

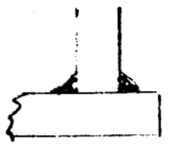
TOTAL SHEAR STRESS

$$\frac{3.7 \text{ k}}{\text{in} * 1\tfrac{1}{2} \text{ in}} = 2.5 \text{ KSI} \quad \text{O.K.}$$

RECHECK THE WELD SIZE AFTER ADDING THE TORQUE STRESS

$$w = \frac{\text{ACTUAL FORCE}}{2 * \text{ALLOWABLE FORCE}} = \frac{3.7 \text{ K/in}}{2 * 9.6 \text{ K/in}} = 0.19''$$

USE 3/8" WELD SIZE



∴ TORQUE DOESN'T HAVE MUCH EFFECT ON THE DESIGN.

MISC MW	gals/mol	
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 13 JULY 91
CONT. NO. B30100
BY KEGOODMAN CHK'D
SHEET NO. 19

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.94
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	C_2=	9.64
42	C_3=	9.67

MISC

MW		gals/mol
4	CO_2	6.47
[illegible]	H_2S	5.18
8	N_2	4.16
2	H_2	3.38

TYPE II CROSS SECTION

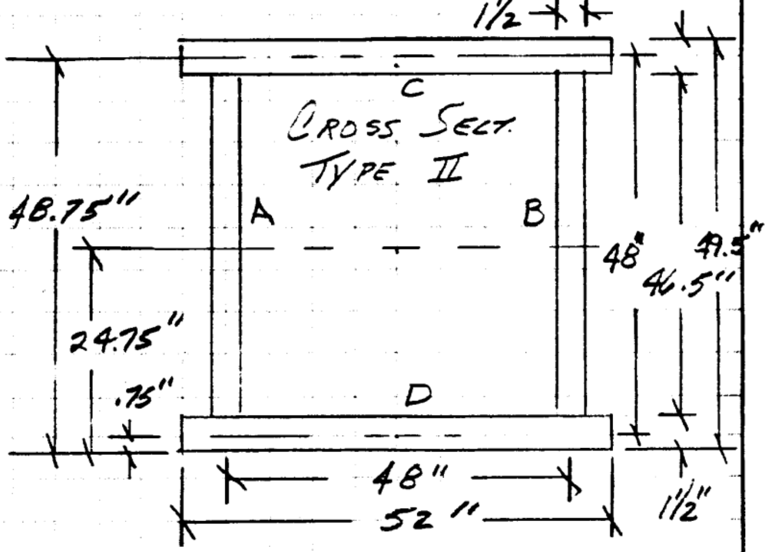


PLATE	SIZE (b x d) in	Y in	A (d*d) in²	M (A*Y) in³	IY (M*Y) in⁴	Ig (bd³/12) in⁴
A	1½ X 46.5	24.75	69.75	1,726	42,726	12,568
B	1½ X 46.5	24.75	69.75	1,726	42,726	12,566
C	52 X 1½	48.75	78.00	3,803	185,372	15
D	52 X 1½	.75	78.00	58	44	15
			295.5	7,313	270,868	25,166

NEUTRAL AXIS = M/A = 24.75"

I_N = 115,052 in⁴

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 13 JULY 91
CONT. NO. 830100
BY K E GOODMAN CHK'D EOB
SHEET NO. 20

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

TYPE III CROSS-SECTION

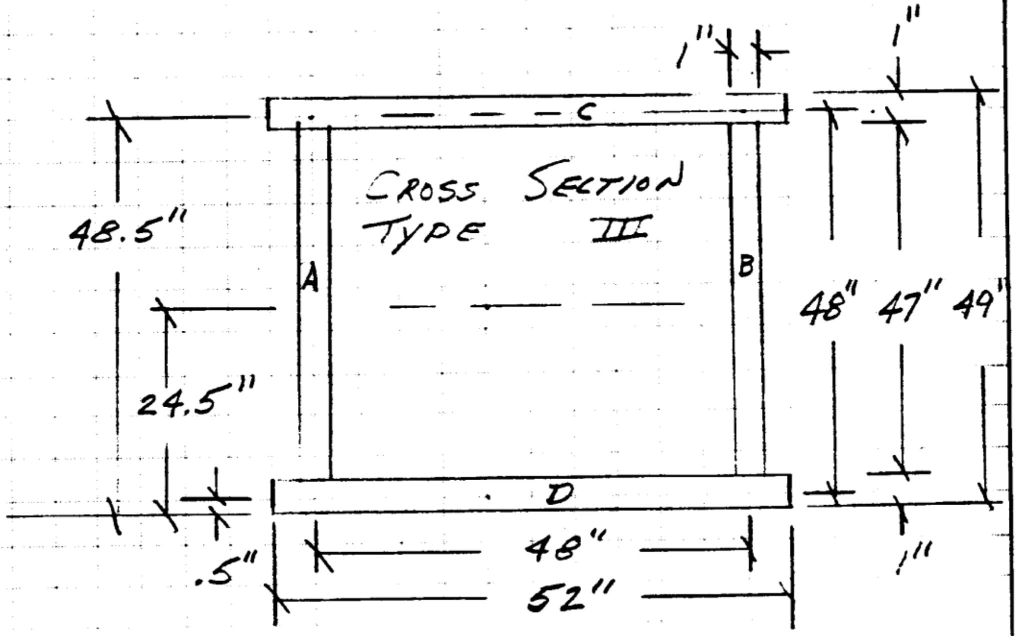


PLATE	SIZE (b x d) in	Y in	A (b*d) in^2	M (A*Y) in^3	IY (M*Y) in^4	Ig $(b*d^3/12)$ in^4
A	1 X 47	24.5	47	1,152	28,212	8,652
B	1 X 47	24.5	47	1,152	28,212	8,652
C	52 X 1	48.5	52	2,522	122,317	4
D	52 X 1	.5	52	26	13	4
			198	4,852	178,754	17,312

IN = 77,167 in^4 N/A = 24.5"

	gals/mol
C1	6.40
C2	9.87
C3	10.44
IC4	12.40
C4	11.95
IC5	13.88
C5	13.74
IC6	15.5
C6	15.99
IC7	17.2
C7	17.48
C8	19.41
C2°	9.64
C3°	9.67

MISC

	gals/mol
CO2	6.47
H2S	5.18
N2	4.16
H2	3.38

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 13 JULY 91
CONT. NO. 830100
BY K E GOODMAN CHK'D
SHEET NO. 21

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.93
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	C_2=	9.64
42	C_3=	9.67

MISC

MW	gals/mol	
	CO_2	6.47
	H_2S	5.18
	N_2	4.16
	H_2	3.38

TYPE IV CROSS SECTION

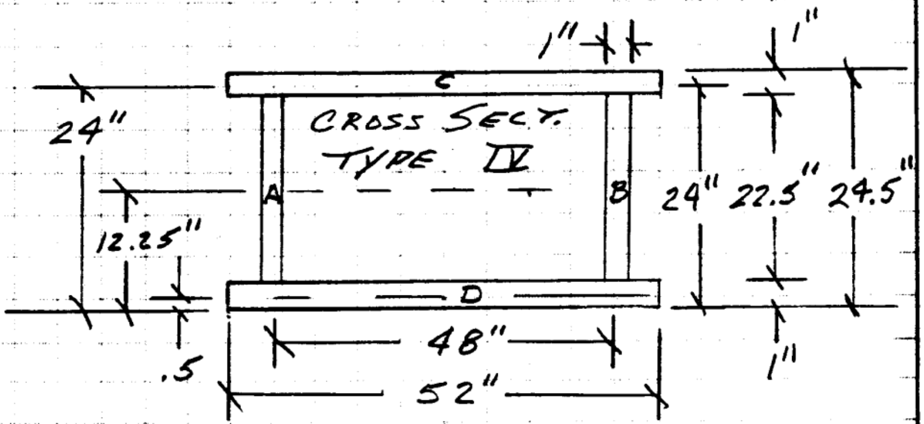


PLATE	SIZE (b×d) in	Y in	A (b×d) in²	M (A×Y) in³	I_Y (M×Y) in⁴	I_g ($bd^3/12$) in⁴
A	1 X 22.5	12.25	22.5	276	3,376	949
B	1 X 22.5	12.25	22.5	276	3,376	949
C	52 X 1	24.00	52.0	1,248	29,952	4
D	52 X 1	.50	52.0	26	13	4
			149	1,826	36,717	1,906

$$I_N = 36{,}717 + 1906 - 1826^2/149 = 16{,}245 \text{ in}^4$$

$$\text{NEUTRAL AXIS} = \frac{M}{A} = \frac{1826 \text{ in}^3}{149 \text{ in}^2} = 12.25 \text{ in}$$

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 13 JULY 91
CONT. NO. 830100
BY K.E. GOODMAN CHK'D EOE
SHEET NO. 22

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.93
72	iC_5	13.85
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.50
100	iC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

STINGER BEAM DESIGN CONT.

SECTION AT 1.75' FROM ℄ TRANSPORTER

REF: SH 12

$M_{1.75'} = (393.3k * 1.75' - 56.3k) * 1.5$

$= 947.9$ k-FT $= 11,375.6$ k-IN

TRY TYPE IV CROSS SECTION

$f_b = \frac{11,375.6 \text{ in-k} * 12.25 \text{ in}}{16,245} = 8.6$ ksi O.K.

SECTION AT 6' FROM ℄ TRANS, TRY TYPE IV

$M_{6'} = (393.3k * 6' - 56.3k) * 1.5$

$= 3,455.3$ FT-k $= 41,463$ in-k

$f_b = \frac{41,463 * 12.25}{16,245} = 31.3$ ksi OK

SECTION AT 16' FROM ℄ TRANS.

TRY TYPE III CROSS-SECTION

$M_{16'} = 6436.5$ Ft-k $= 77,238$ in-k

$f_b = \frac{77,238 * 24.5 *}{77,167}$ 24.6 ksi Ok

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 13 JULY 91
CONT. NO. 830100
BY KEGOODMAN CHK'D
SHEET NO. 23

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.86
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.50
100	IC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

SECTION AT 20' FROM ℄ TRANSP.

ALL READY SIZED ON SHEETS 13 - 18

SECTION AT 24' FROM ℄ TRANSP.
REF: SH 9
TRY TYPE III CROSS-SECTION

$M_{24'} = 281k * 22' * 12 = 74,184 \text{ in-k}$

$f_b = \frac{74,184 * 24.5}{77,167} * 1.5$ 35.4 ksi O.K.

SECTION AT 32' TRY TYPE III

$M_{32'} = 281k * 14' * 12 = 47,208 \text{ in-k}$

$f_b = \frac{47,208 \;\; 24.5}{77,167} * 1.5 = 22.5 \text{ ksi}$

TRY TYPE IV SECTION

$f_b = \frac{47,208 * 12.25}{16,245} * 1.5 = 53.4$
N.G

∴ USE TYPE III CROSS-SECTION

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 13 JULY 91
CONT. NO. 830100
BY K.E.GOODMAN CHK'D
SHEET NO. 24

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.93
72	iC_5	13.85
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

SECTION AT 42' FROM ℄ TRANSP.

$M_{42'} = 281k * 4' * 1.5 * 12in = 20,232\ in\text{-}k$

TRY TYPE IV CROSS-SECTION

$f_b = \dfrac{20,232 * 12.25}{16,245} = 15.3ksi$ O.K.

FORM E-050
PRINTED IN U.S.A.

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

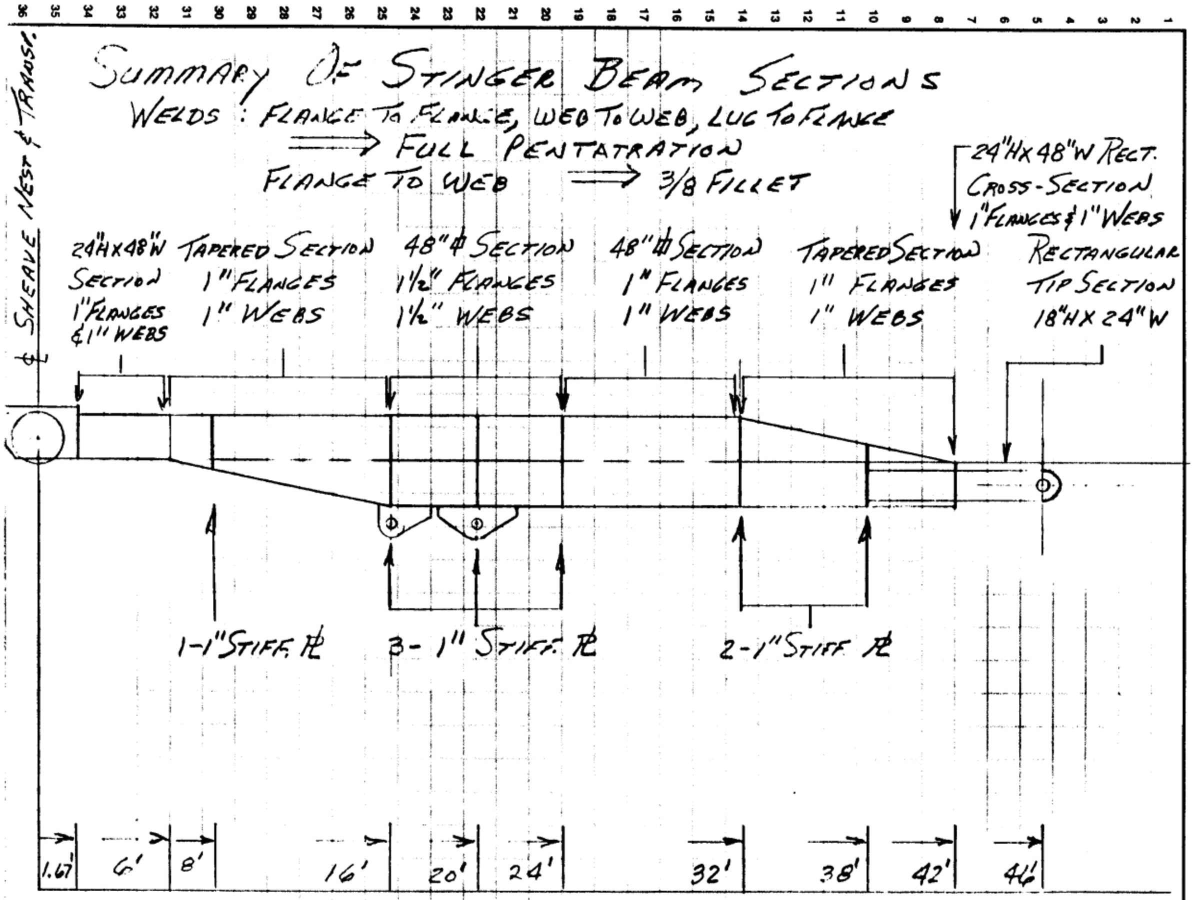
FLUOR DANIEL
CALCULATIONS and SKETCHES

SC-048

DATE 16 JULY 91
CONT. NO. 830100
BY KELOOMAN CHK'D
SHEET NO. 25

SUMMARY OF STINGER BEAM SECTIONS

WELDS : FLANGE TO FLANGE, WEB TO WEB, LUG TO FLANGE
⟹ FULL PENTATRATION
FLANGE TO WEB ⟹ 3/8 FILLET



SCALE 1" = 6'

FLUOR DANIEL SC-048

CALCULATIONS and SKETCHES

DATE 7-15-91
CONT. NO. 830100
BY K E GOODMAN CHK'D
SHEET NO. 26

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

UPPER SHEAVE NEST DESIGN

FIGURE PARTS OF LINE REQ.
& MAX. LEAD LINE PULL

MAX. LOAD IN THE STINGER REEVING
AT THE ℄ OF THE TRANSPORTER

= 397.7k SEE SH. 11 (R_1)

TRY 1 1/8" ϕ HOIST LINE, EIPS, IWRC
BREAKING STRENGTH = 130.0 k

$$SWL = \frac{130.0k * .925}{3.5}$$

.925 ← TERMINATION EFF. FACTOR FOR MECH. SPLICE

3.5 ← 3.5:1 FOR HOIST LINES

= 34.4 K

REF MACWHYTE Pg 150

$$E = \frac{(K^N - 1)}{K^S N(K-1)}$$

N = 24 No. PARTS
S = 25 No. SHEAVES
K = 1.04 ROLLER BRGS

$$= \frac{\overset{2.56}{1.04^{24}} - 1}{\underset{2.67}{1.04^{25}}\, 24(1.04 - 1)}$$

$$= \frac{1.56}{2.56} = .61$$

$$LEADLINE\ PULL = \frac{397.7}{24 * .61} = 27.2k < 34.4k$$

O.K

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.86
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.48
114	C_8	19.41
28	C_2*	9.64
42	C_3*	9.87

MISC

W		gals/mol
4	CO_2	6.47
4	H_2S	5.18
8	N_2	4.16
2	H_2	3.38

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL
CALCULATIONS and SKETCHES

DATE 15 JULY 91
CONT. NO. 830100
BY KELOGGMAN CHK'D
SHEET NO. 27

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.84
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.48
114	C_8	19.41
28	$C_2{}^=$	9.64
42	$C_3{}^=$	9.67

FIGURE SLP OF THE LANTEC HOIST AT MIN. TWO BLOCK & LENGTH OF WIRE REQ.

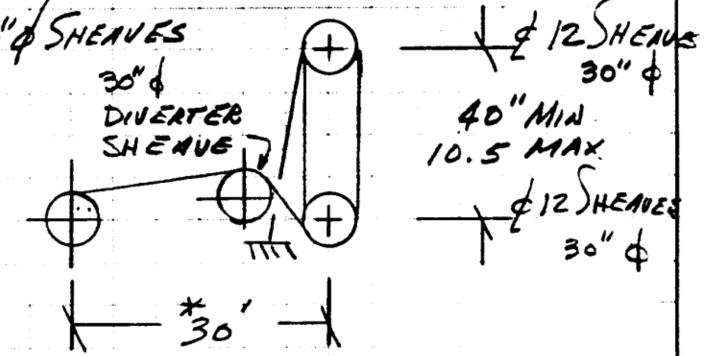
LENGTH OF $1\frac{1}{8}\phi$ WIRE REQUIRED:

REF: SH 7

CROSBY FAX ON 30"φ SHEAVES
LANTEC M#540

SHEAVE O.D. = 30"
SHEAVE TREAD φ = 26.62"
PITCH φ = 27.75"

πD = 87.16"



WIRE IN CONTACT WITH THE SHEAVES

$$= \frac{24 \text{ SHEAVES} * 87.2''}{12 * 2} = 87.2'$$

WIRE BETWEEN SHEAVES

= 10.5' * 24 PARTS = 252.0'

MISC

		gals/mol
	CO_2	6.47
	H_2S	5.18
	N_2	4.16
	H_2	3.38

WIRE BETWEEN DRUM &

SHEAVES = 30' (ASSUMED)

5 WRAPS ON DRUM

$5 * \pi * 14''$ = 18.3'

TOTAL LENGTH = 387.5' USE 450'

TOTAL WIRE TO SPOOL = 183' + (10.5' - 3.33') * 24 = 190.4'

∴ SLP (FULL DRUM) = 40.6k > 27.2k

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 15 JULY 91
CONT. NO. 830100
BY KE Goodman CHK'D
SHEET NO. 28

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

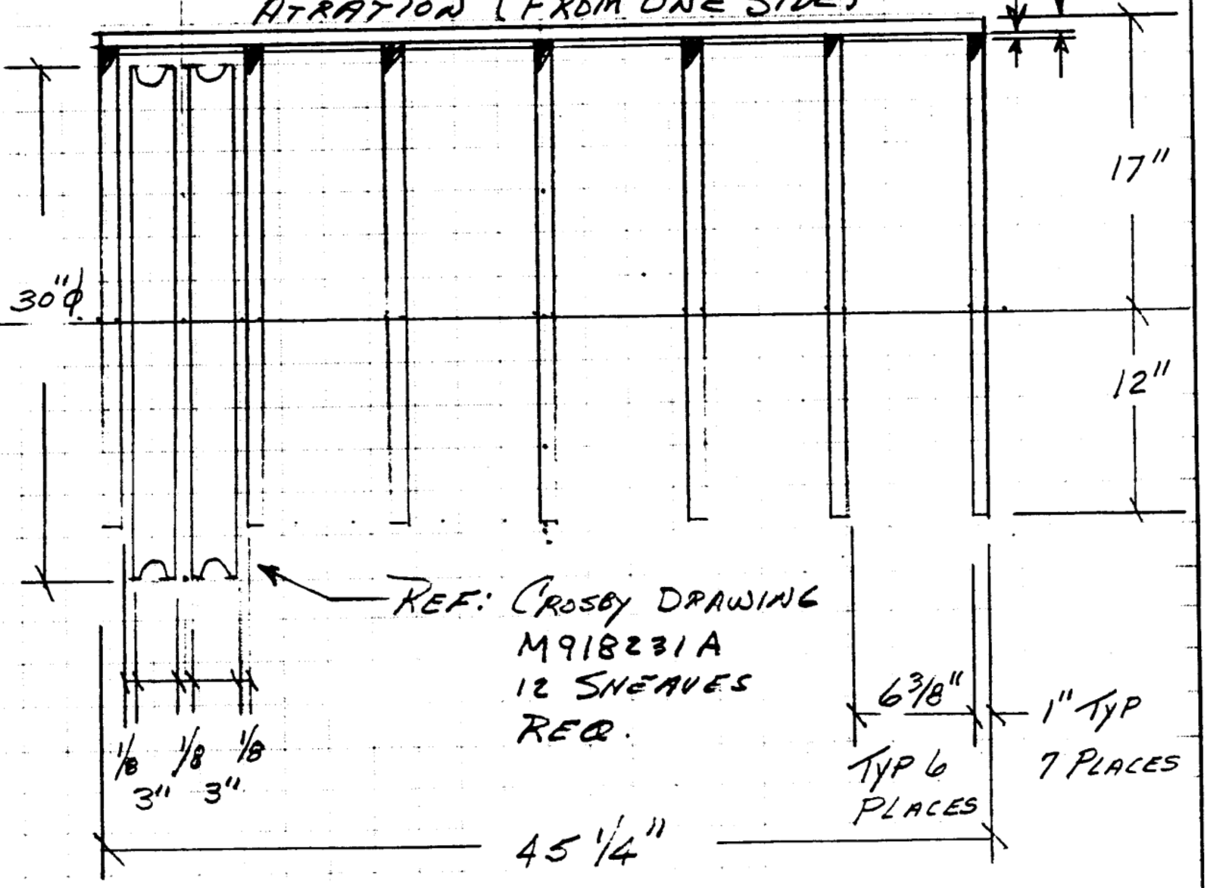
MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.88
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.48
114	C_8	19.41
28	$C_2{}^=$	9.64
42	$C_3{}^=$	9.67

MISC

MW		gals/mol
[illegible]	CO_2	6.47
[illegible]	H_2S	5.18
[illegible]	N_2	4.16
2	H_2	3.38

UPPER SHEAVE NEST DESIGN

NOTES: 1. ALL PLATE IS 1" A514 EXCEPT THE 1/4" A36 SHEAVE GUARD PLATE
2. ALL WELDS ARE FULL PENATRATION (FROM ONE SIDE)



SECTION AT ℄ OF SHEAVE NEST

SEE NEXT SH. FOR SIDE VIEW

SCALE 1" = 10"

FORM E-050
PRINTED IN U.S.A.

FLUOR DANIEL SC-048

CALCULATIONS and SKETCHES

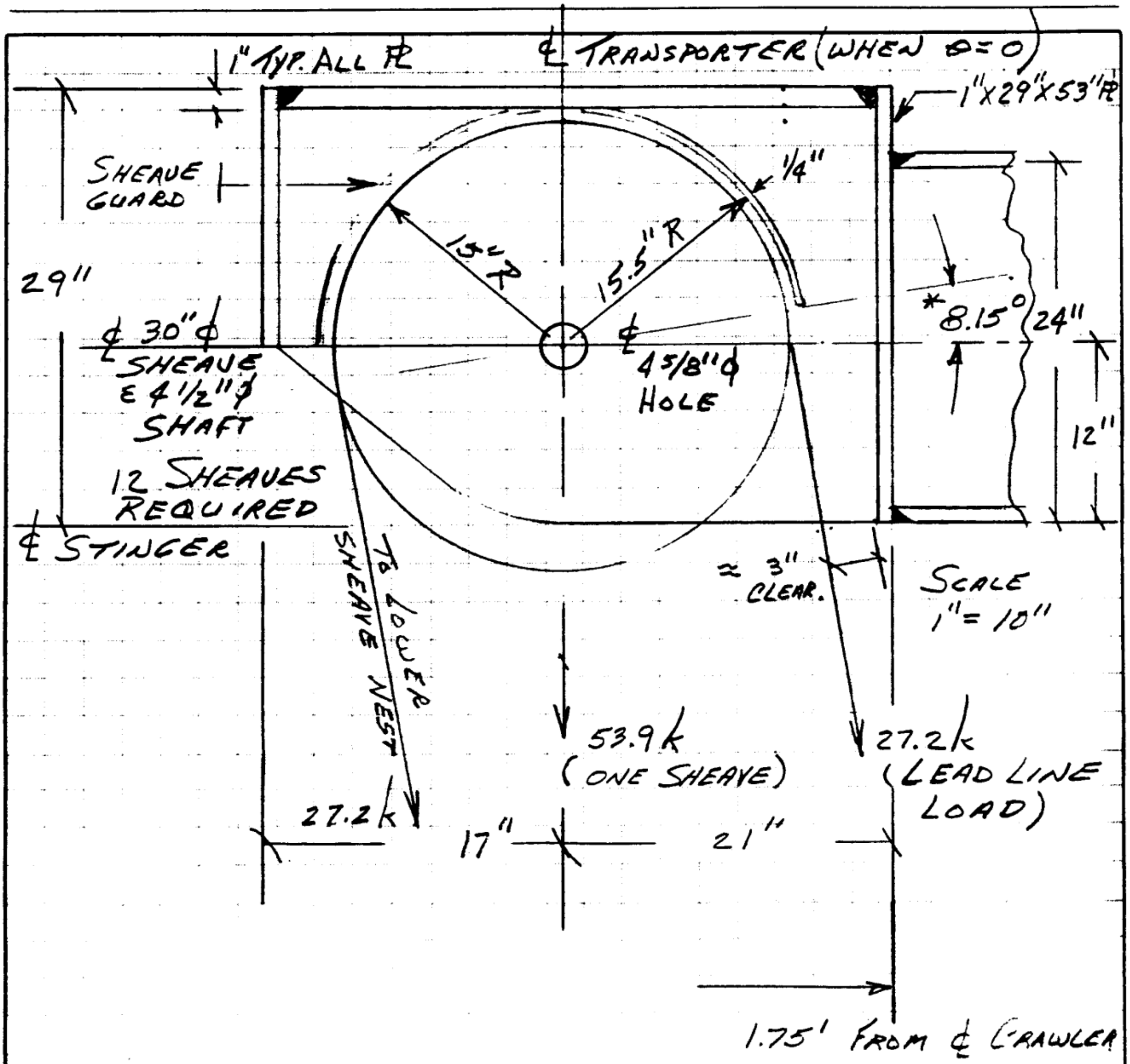
DATE 15 JULY 91
CONT. NO. 830160
BY KEGOODMAN CHK'D
SHEET NO. 29

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

MISC

	gals/mol
CO_2	6.47
H_2S	5.18
N_2	4.16
H_2	3.38



*THE 8.15° ANGLE OCCURS WHEN THE STINGER TIP IS AT IT'S LOWEST POINT (θ = 19.68°) & THE LOADS TO THE STINGER BEAM ARE THE GREATEST BETWEEN 0' & 20'

FLUOR DANIEL SC-048

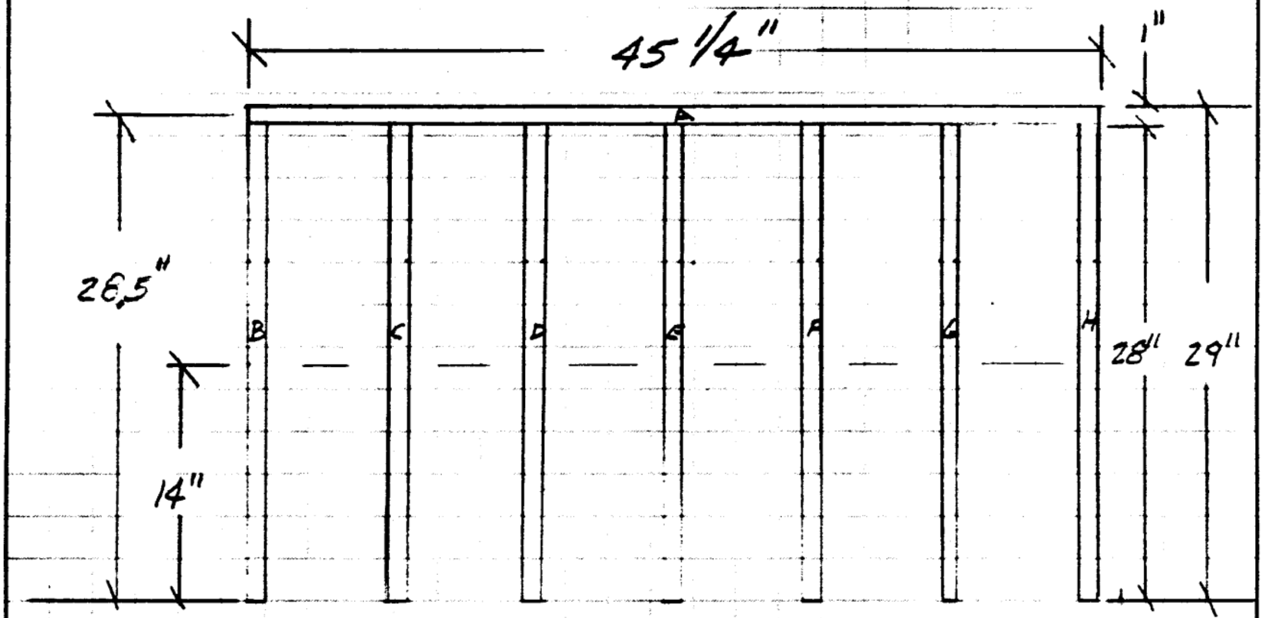
CALCULATIONS and SKETCHES

DATE 16 JULY 91
CONT. NO. 830100
BY FEGOODMAN CHK'D
SHEET NO. 30

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.38
58	C_4	11.93
72	iC_5	13.85
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2{}^=$	9.64
42	$C_3{}^=$	9.67

SECTION AT 1.67' FROM TRANPORTER ℄



MISC

MW	gals/mol	
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

PLATE	SIZE (b×d) in	Y in	A (b×d) in²	M (A×Y) in³	Iy (M×Y) in⁴	Ig (b×d³/12) in⁴
A	45.25 × 1	28.5	45.25	1290	36,754	4
B–H	1 × 28	14.0	196.0	2,744	38,416	1,829
			241.3	4,034	75,170	1833

I_N = 9,563 in⁴

NEUT AXIS = 4,034/241.3 = 16.7" = C

$M_{1.67'}$ = (393.3 k * 1.67' * − 56.3 k-Ft) * 12 in * 1.5 = 10,809 in·k

f_b = 10,809 in-k * 16.7" / 9,563 in⁴ = 18.8 ksi ok.

FORM E-050
PRINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 16 JULY 91
CONT. NO. 830100
BY KE GOOD/YA CHK'D
SHEET NO. 31

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.96
72	IC_5	13.80
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	C_2^*	9.64
42	C_3^*	9.67

MISC

W		gals/mol
4	CO_2	6.47
4	H_2S	5.18
8	N_2	4.16
2	H_2	3.38

$M_{20''}$ FOR 2 SHEAVES SUPPORTED BY 1-1" PLATE

WORST CASE LOAD $= 53.9\,k * 2 = 107.8k$

$M_{20''} = 107.8\,k * 20'' * 1.5 = 3{,}234.0\,k\text{-}in$

$$S = \frac{bd^2}{6} = \frac{1'' * 28.0^2\,in^2}{6}$$

$$= 130.7\ in^3$$

$$f_b = \frac{3234.0\,k\text{-}in}{130.7\ in^3} = 24.7\,ksi < .5Fy = 50\,ksi$$

CHECK BEARING (SHAFT)

$$t = \frac{107.8\ k * in^2}{50k * 4\tfrac{1}{2}''\phi} = .48 \quad \text{USE } 1''$$

$$\text{END AREA REQ} = \frac{.66 * 107.8k * 1.5}{45ksi} = 2.4\ in^2$$

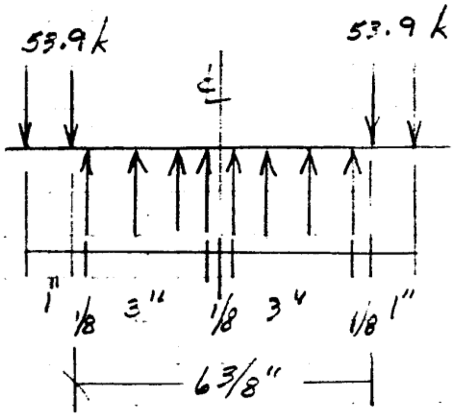
$$\text{AREA ACT} = 1'' * (12 - 4\tfrac{1}{2}''\phi/2) = 9.75\ in^2$$

CHECK BENDING IN SHAFT

$\Sigma M_{\text{℄}}(+\circlearrowleft) = 0$

$$M = 53.9k * \left(\frac{6\tfrac{3}{8}}{2} + \frac{1''}{2}\right) - 53.9 * \frac{6\tfrac{3}{8}}{4}$$

$$= 198.9k\text{-}in - 86.0k\text{-}in = 113.0k\text{-}in$$



FORM E-050
PRINTED IN U.S.A.

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.88
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.87

MISC

W		gals/mol
	CO_2	6.47
	H_2S	5.18
	N_2	4.16
	H_2	3.38

SHAFT CHECK CONT. ...

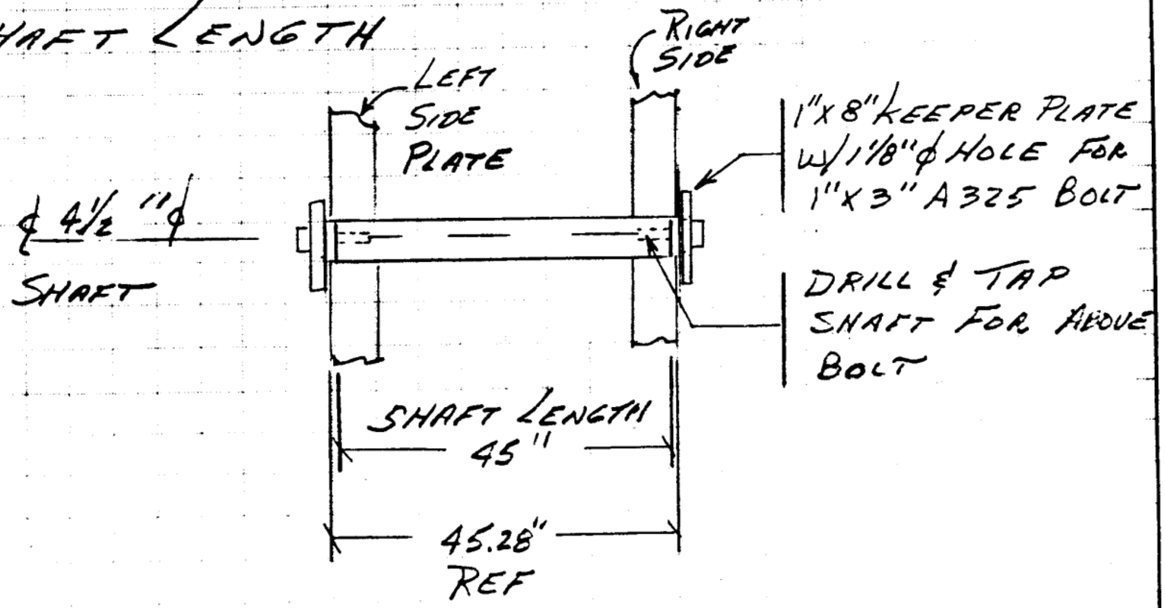
$S = .098175\,d^3 = .098175 \times 4.50^3\,in^3 = 8.95\,in^3$

$f_b = \dfrac{113.0\,k\text{-}in * 1.5}{8.95\,in^3} = 19.0$ KSI

USE SHAFT MAT'L 4140 $F_y = 100$ KSI

$F_b = .5\,F_y = 50$ KSI O.K.

SHAFT LENGTH



FLUOR DANIEL SC-048

CALCULATIONS and SKETCHES

DATE 7-15-91
CONT. NO. 830100
BY KELGOOMA CHK'D
SHEET NO. 33

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.88
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.40
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

MISC

MW		gals/mol
4	CO_2	6.47
4	H_2S	5.18
8	N_2	4.16
2	H_2	3.38

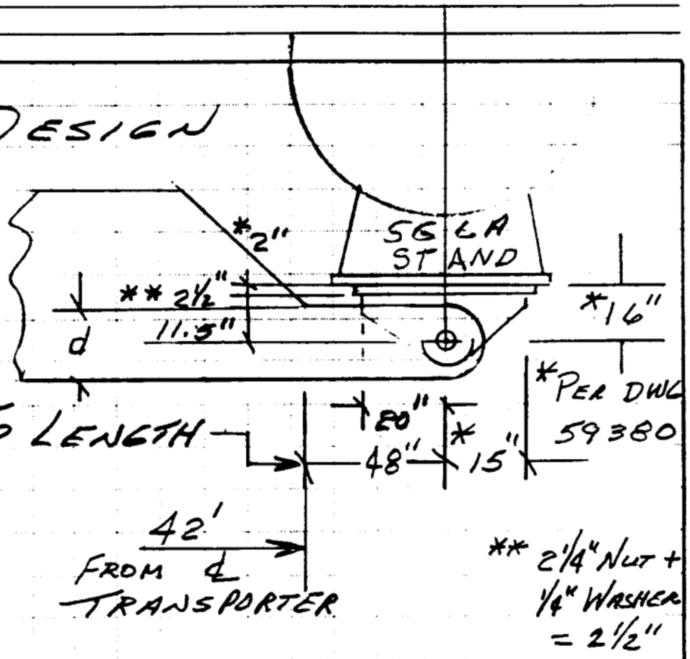
STINGER TIP DESIGN

SGLA STAND

$\phi = 82.25''$

$\frac{\phi}{2} = 41.125''$

USE 48" FOR TIP LENGTH



MAX. MOMENT

$M_{42'} = 48'' * 281.0k * 1.5$

$= 20,232.0\ k\text{-}in$

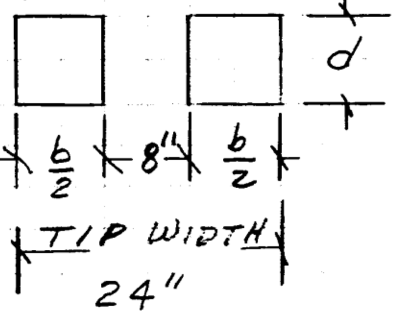
USE $d = 18''$

$$S_{REQ} = \frac{20,232.0\ k\text{-}in * in^2}{21\ \overset{k}{}} = 963.4 in^3$$

.5Fy(A572 PL)

$$= \frac{b d^2}{6}$$

$$b = \frac{S * 6}{d^2} = 17.8''$$



USE $b/2 = 8''$

THE ACTUAL CROSS-SECTION AT 42' WILL BE 18"H x 24"W SOLID STEEL.

FOR WELD DESIGN BETWEEN STINGER TIP & STINGER BEAM POCKET SEE SH 46

RM E-050
INTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

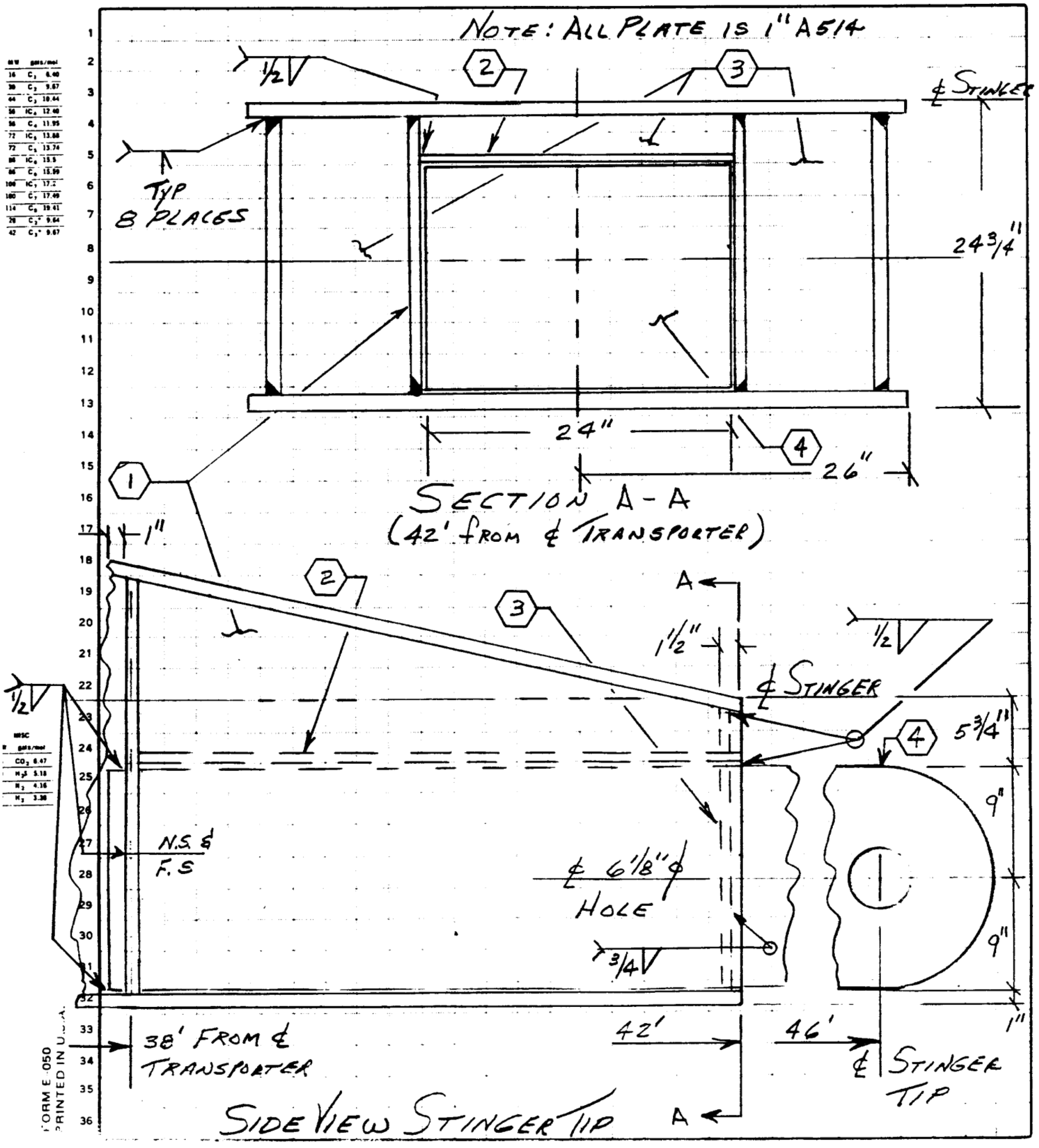
DATE 15 JULY 91
CONT. NO. 830100
BY KEGGOOANA CHK'D EOB
SHEET NO. 34

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.88
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^{=}$	9.64
42	$C_3^{=}$	9.67

MISC

	gals/mol
CO_2	6.47
H_2S	5.18
N_2	4.16
H_2	3.38



ORM E-050
RINTED IN U.S.A.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 15 July 91
CONT. NO. 830100
BY K E Goodman CHK'D EDB
SHEET NO. 35

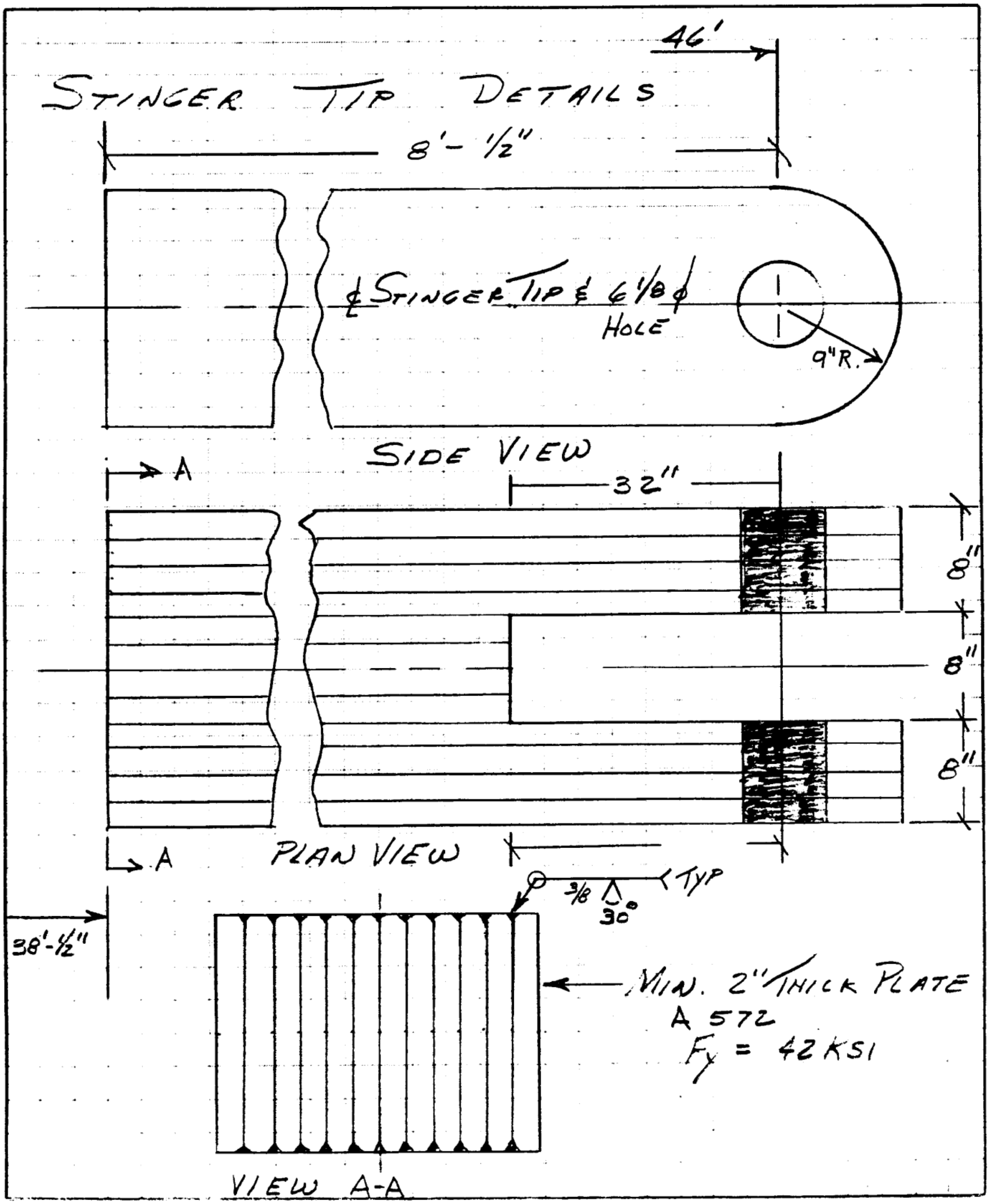
NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.86
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

STINGER TIP DETAILS



FORM E-050
PRINTED IN U.S.A.

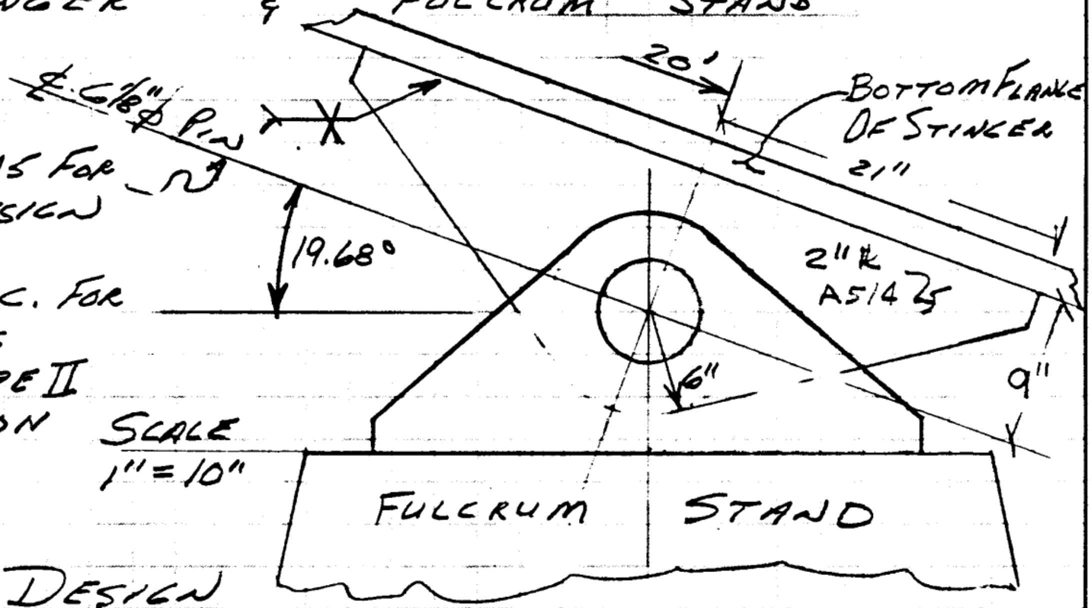
NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

DATE 17 JULY 91
CONT. NO. 836100
BY KE GOODIAAR CHK'D EJE
SHEET NO. 36

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.95
72	IC_5	13.86
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.59
100	IC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

FULCRUM STAND TO STINGER BEAM LUGS (2 LUGS REQ)

CHECK INTERFERENCE BETWEEN STINGER & FULCRUM STAND



SEE SH 45 FOR PIN DESIGN

48" C.C. FOR LUGS

SEE TYPE II SECTION SH. 19

LUG DESIGN

$$\text{LOAD} = 761.3^k * 1.5 = 1142.0^k$$

REF SH 3

$$\text{LOAD/LUG} = 571.0^k$$

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

$$t_{REQ} = \frac{571.0}{6"\phi * \underset{\uparrow .5F_y}{50\,KSI}} = 1.9" \quad \text{USE } 2"$$

$$\text{AREA REQ} = \frac{.66 * 571}{45\,KSI} = 8.4\,in^2$$

$$\text{AREA ACTUAL} = 2" * (9" - 6.125"/2) = 11.9\,in^2$$

USE FULL PENT. WELDS

SEE ADDITIONAL CALC'S ON SH 47

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

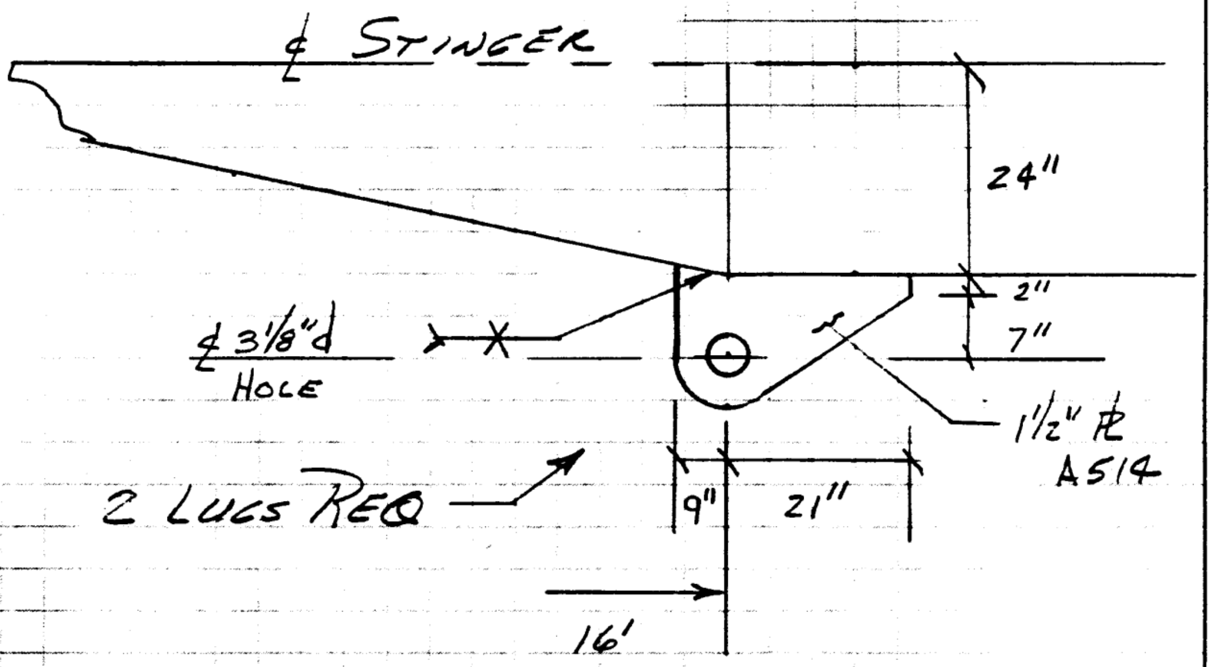
DATE 17 JULY 91
CONT. NO. 830100
BY KELOGOMAN CHK'D

SHEET NO. 37

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	IC_4	12.40
58	C_4	11.96
72	IC_5	13.86
72	C_5	13.74
86	IC_6	15.5
86	C_6	15.50
100	IC_7	17.2
100	C_7	17.40
114	C_8	19.41
28	C_2*	9.64
42	C_3*	9.67

LUG FOR COMPRESSION STRUTS



BY LOAD COMPARISON W/ FORCES @ R_2, THE ABOVE LUG DIMENSIONS ARE ADEQUATE FOR THE DESIGN LOADS ON SH 10 & 11.

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 17 JULY 91
CONT. NO. 830100
BY KEGoodman CHK'D
SHEET NO. 38

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.96
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.40
114	C_8	19.41
28	$C_2^{=}$	9.64
42	$C_3^{=}$	9.67

MISC

	gals/mol
CO_2	6.47
H_2S	5.18
N_2	4.16
H_2	3.38

COMPRESSION STRUT DESIGN

REF: SH 11 R_2 = 80.1k COMPRESSION

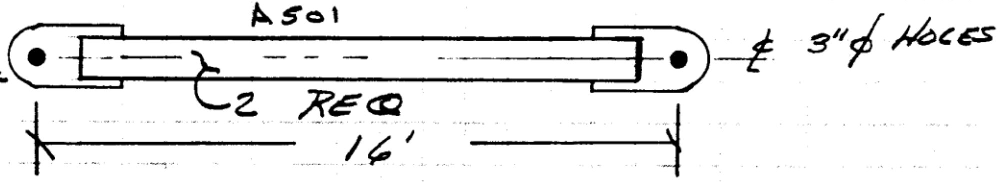
LOAD/STRUT = (80.1k + 800k SGLA WT * .05)/2

↖ DYNAMIC LOAD

= 60k

DESIGN LOAD = 60 * 1.5 = 90k

TRY 10"φ STD WALL PIPE



DEAD LOAD OF PIPE = 40.5 lb/FT * 16 = .7k

$$M_{℄} = \frac{Pl}{4} = \frac{.7k \times 192''}{4} = 33.6 \text{ in-k}$$

$$\text{DEFLECTION} = \frac{Pl^3}{48EI} = \frac{.7k * 192 in^3 * in^2}{48 * 29000k * 160.7 in^4}$$

$$= .022 \text{ in}$$

∴ NEGLECT BENDING & CONSIDER ONLY AXIAL STRESS

$$Kl/r = \frac{192}{3.67} = 52.3$$

$$F_A = 18.08 \text{ ksi}$$

$$f_A = \frac{90.1}{11.91} = 7.6 \text{ ksi} \quad OK$$

FORM E-050 I
PRINTED IN U.S.A.

DATE 17 JULY 91
CONT. NO. 830100
BY KG Goodman CHK'D EDE
SHEET NO. 39

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.96
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.48
114	C_8	19.41
28	$C_2{}^{=}$	9.64
42	$C_3{}^{=}$	9.67

CHECK 3"φ PIN φ

$\Sigma M_{℄}\ (+\circlearrowright) = 0$

$M = 45k * (1" + 1/4" + 1")$

$- 45k * .5"$

$= 78.75 \text{ in-k}$

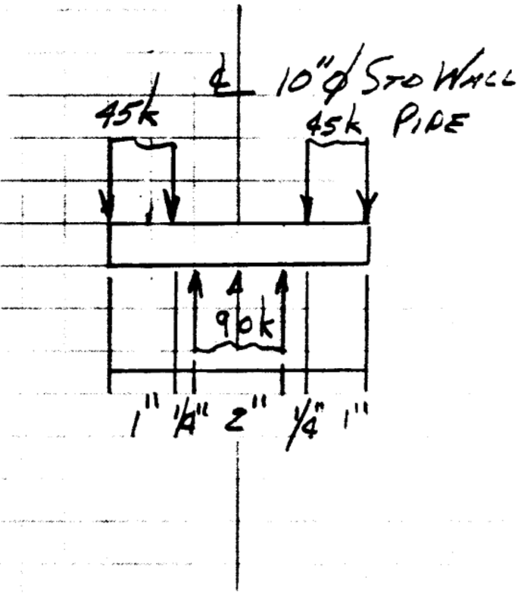
$S = .098175\, d^3$

$= 2.65 \text{ in}^3$

$f_b = \frac{M}{S} = \frac{78.75 \text{ in-k} \times 1.5}{2.65 \text{ in}^3} = 44.6 \text{ ksi}$

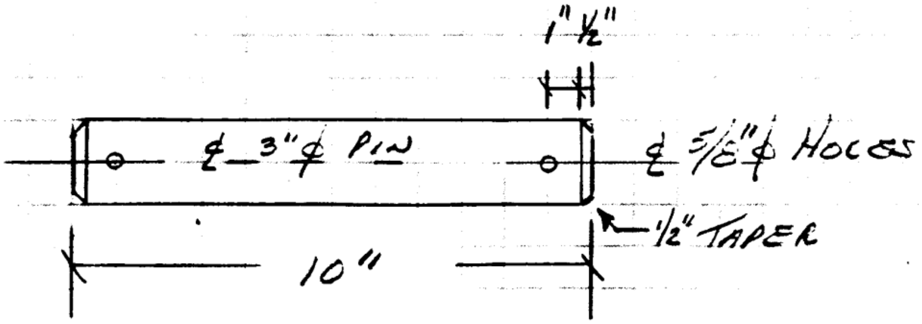
∴ USE A 4140 SHAFTING $F_y = 100$

$F_b = .5 * 100 = 50 \text{ KSI}$



MISC		
MW	gals/mol	
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

DRILL 5/8"φ HOLES FOR 1/2" x 8" COTTER PINS



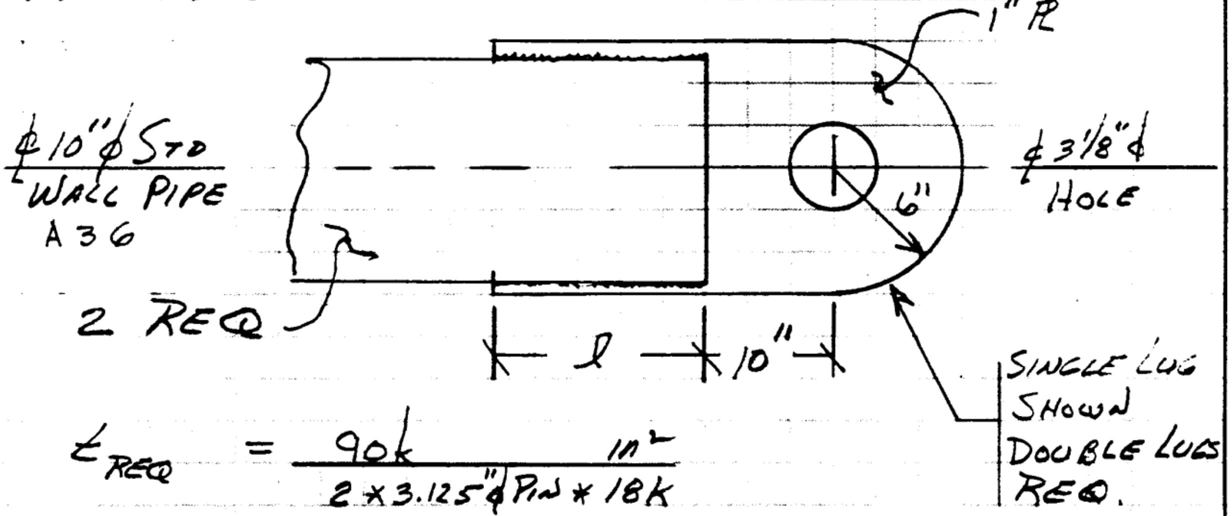
2 REQ

FORM E-050
PRINTED IN U.S.A.

DATE 17 JULY 91
CONT. NO. 830100
BY KEGoodman CHK'D EDE
SHEET NO. 40

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

DESIGN STRUTS AS TENSION-COMPRESSION MEMBERS



$t_{REQ} = \dfrac{90k \quad in^2}{2 \times 3.125'' \phi \, PIN * 18K}$

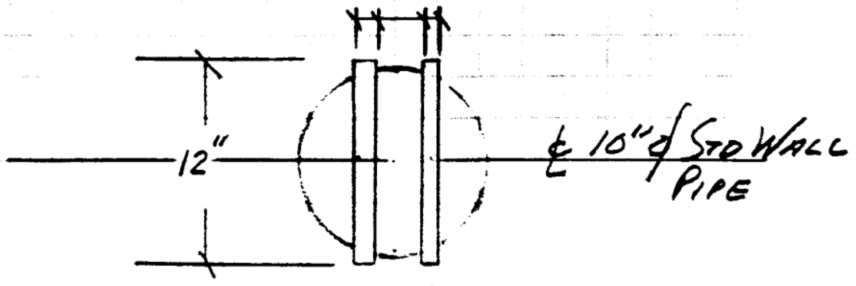
$= .8''$ USE 2-1" LUGS

AREA REQ $= \dfrac{.66 * 90k}{16.2 \, KSI} = 3.67 \, in^2$

AREA ACT $= 2 * (6'' - 3.125''/2) = 8.88 \, in^2$

WELD LENGTH l REQUIRED USE 5/16" WELD

$l = \dfrac{90k * in}{9.6K * .25 * 8 \, WELDS} = 5''$ USE $\underline{\underline{10''}}$



END VIEW

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.96
72	iC_5	13.88
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.50
100	iC_7	17.2
100	C_7	17.40
114	C_8	19.41
28	$C_2^{=}$	9.64
42	$C_3^{=}$	9.87

MISC

MW	gals/mol	
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

FORM E-050
PRINTED IN U.S.A.

SC-048

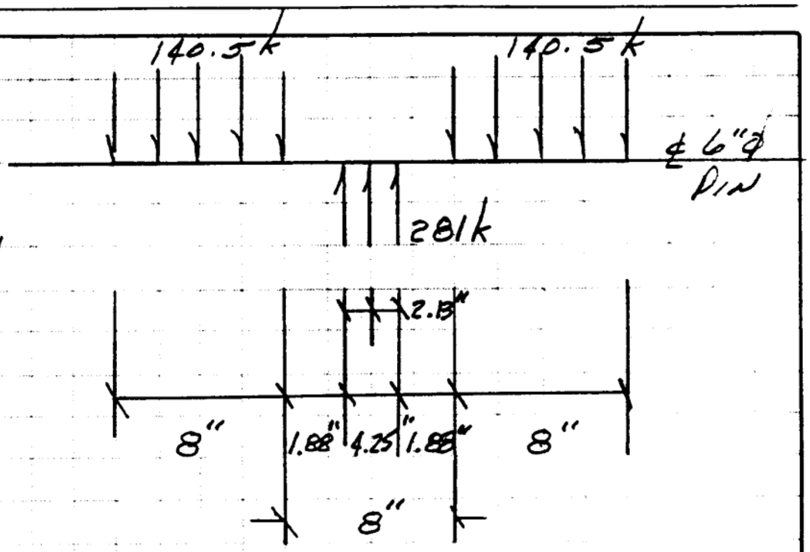
FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 8 JULY 91
CONT. NO. 830100
BY KE GOODMAN CHK'D EDB
SHEET NO. 41

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

6"φ PIN FOR STINGER TIP



TAIL LOAD = 281k

$F_{y\,PIN} = 100\,ksi$

$S = .098175\,\phi^3$

$= 21.2\ in^3$

$M_{℄} = 140.5^k * (4" + 1.88" + 2.13") - 140.5^k * 2.13"/2$

$= 1125.4\ k\text{-}in \qquad - 149.63\ k\text{-}in$

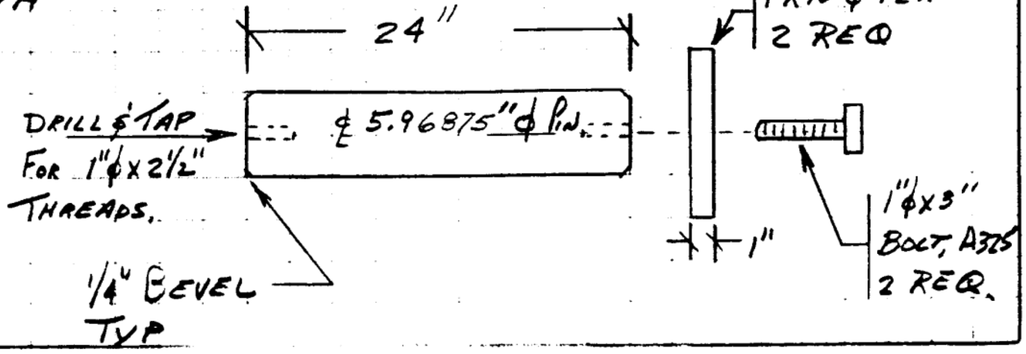
$= 975.8\ k\text{-}in$

$F_b = .6 * 100\,KSI \quad = 60\,ksi$

$$f_b = \frac{M}{S} = \frac{975.8\ k\text{-}in * 1.25}{21.2\ in^3}$$

$= 57.5\,Ksi < 60\,ksi \quad OK$

PIN LENGTH



FORM E-050 PRINTED IN U.S.A.

FLUOR DANIEL SC-048

CALCULATIONS and SKETCHES

DATE 16 JULY 91
CONT. NO. 830100
BY KE GOODMAN CHK'D EDE
SHEET NO. 42

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

STINGER WT TAKE-OFF

0'-1.75'	1-1"X16.5"X52"	858 in^3
	SHAFT 4 1/8" ϕ X 52" LONG $= \pi * \left(\frac{4\frac{1}{8}}{2}\right)^2 * 52''$ =	695 in^3
	7-1"X38"X28" PLATES	7,448 in^3
	1-1"X38"X51.25" "	1,948 in^3
	1-1"X29"X52" "	1,508 in^3
		12,457 in^3
	.289 FACTOR $WT = 12{,}457\,in^3 * \frac{500\,lb/CF * FT^3}{1728\,in^3}$	3604 lb.
	12-SHEAVES 200 lb * 12	2400
		6004
1.75'-6'	24"H x 48"W 1" PL	
	$149\,in^2 * 51'' * .289$	2,196 lb.
6-16'	TAPERED SECTION 1" PL	
	$(149.0\,in^2 + 198.0\,in^2) * 120'' * .289/2$	6,017
	1-1"*48"W*29"H*.289 STIFF AT 8'	402
		6,419
16'-24'	48"X48" SECTION 1½" PL	
	$295.5\,in^2 * 96'' * .289$	8198
	3-1½"X46"X46*.289 STIFF AT 16', 20', 24'	2,752
		10,950
24'-32'	48"X48" SECTION 1" PL	
	$198.0\,in^2 * 96'' * .289$	5,494
	1-1"X46"X46"*.289 STIFF AT 32'	612
		6,106
32'-42'	TAPERED SECTION 1" PL	
	$\frac{(198\,in^2 + 149\,in^2) * 120'' * .289}{2}$	6,017
	1-1"*46"W*34"H*.289 STIFF AT 38'	452
	1-1"*24"W*48"L*.289 POCKET FOR TIP	333
	$2 - 1'' * \frac{(34''H + 24''H)}{2} * 48''L * .289$ "	805

FORM E-050 PRINTED IN U.S.A.

SC-048

FLUOR DANIEL
CALCULATIONS and SKETCHES

DATE 16 JULY
CONT. NO. 830100
BY KEGOODMAN CHK'D EDE
SHEET NO. 43

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.[illegible]
100	C_7	17.40
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

2 – 1" * 24"H * 12"W * .289	POCKET FOR TIP	167
1 – 1" * 6"H * 24"W * .289	" " "	42
		7,816
42' - 46' 1 – 18"H * 24"W * 105"L * .289	TIP	13,109
		52,600 lbs

LOCATE THE CG

$\Sigma M_{0}, +) = 0$

$52{,}600\, R_4 = .88' * 6004k + 3.88' * 2{,}196k$

$+ 12.7' * 6419k + 20' * 10{,}950$

$+ 28' * 6{,}106k + 35.3' * 7{,}816k$

$+ 42' * 13{,}109k$

$R_4 = 24.94'$ FROM LEFT SIDE.

MW	MISC	gals/mol
44	CO_2	6.47
34	H_2S	5.10
28	N_2	4.16
2	H_2	3.38

CONCLUSION

LEAVE THE ESTIMATED WEIGHT OF 100k AS IS BECAUSE IT IS CONSERVATIVE IN THAT IT INCREASES THE MOMENT AT THE FULCRUM STAND & ADDS COUNTERWEIGHT TO THE TRANSPORTER.

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 5 AUG 91
CONT. NO. 830100
BY K E GOODMAN CHK'D EDE
SHEET NO. 44

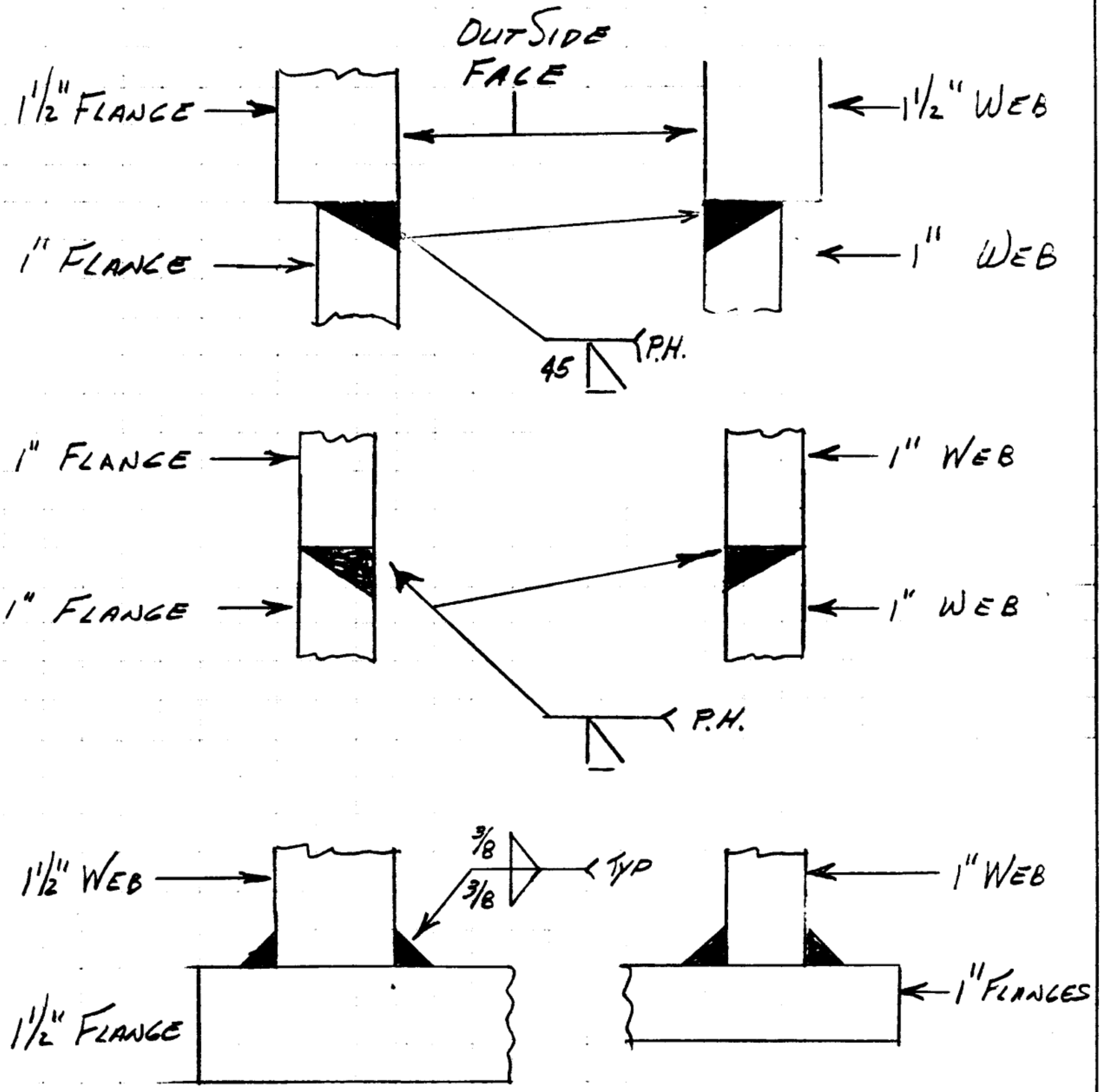
NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.88
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.61
28	$C_2^=$	9.64
42	$C_3^=$	9.67

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

STINGER BEAM WELD DETAILS



FORM E-050
PRINTED IN U.S.A.

SC-048

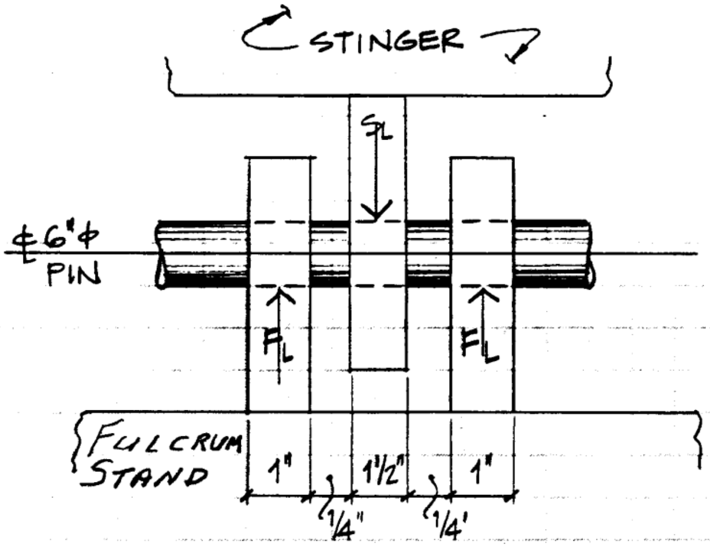
FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 25 JULY 91
CONT. NO. 330100
BY K.E. GOODMAN CHK'D
SHEET NO. 45

NUSCO-MILLSTONE 2
NUCLEAR POWER STATION
S/G REPLACEMENT PROJECT
6"ϕ PIN FOR FULCRUM/STINGER LUGS

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.96
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.46
114	C_8	19.41
28	$C_2^{=}$	9.64
42	$C_3^{=}$	9.67



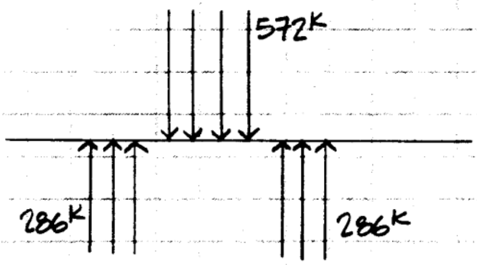
STINGER LOAD (SIDE) =

$762^{K}(1.5) \div 2 = 571.5^{K}$

$S_L = 572^{K}$

$F_L = 286^{K}/EA.$

PIN S = 21.2 IN³



$M = 286^{K}(.5''+.25''+.75'') - 286^{K}(.375'')$

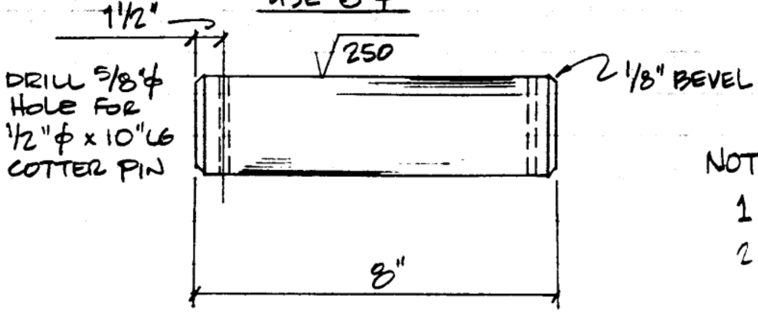
$= 321.75''^{K}$

TRY 4140 $(> 100^{KSI}\ F_y)$

$F_b = .6F_y = 60^{KSI}$

$f_b = \frac{M}{S} = \frac{321.75''^{K}}{21.2\ IN^3} = 15.18^{KSI} < 60^{KSI}$ OK

USE 6"ϕ



NOTES:
1. USE 100KSI MAT'L
2. TWO(2) PINS REQ'D.

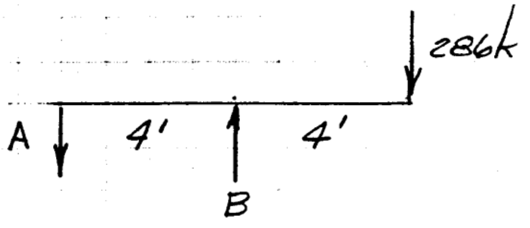
	gals/mol
CO_2	6.47
H_2S	5.18
N_2	4.16
H_2	3.38

RM E-050 1
INTED IN U.S.A.

MW	gals/mol	
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.95
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.49
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

WELD DETAILS
STINGER TIP TO STINGER POCKET

$R_A = \frac{286k * 4'}{4'} = 286k$



$R_B = \frac{286k * 8'}{4.0'} = 572k$

CHECK WELD CAP @ "B"

WELD LENGTH = 2*(24"+18") = 84"

$\delta w = \frac{572k * 1.5}{84} = 10.2$ K/in

TRY 11/16" WELD SIZE

$F_w = \frac{21 * .707 * 11}{16}$

= 10.21 K/n = 10.21

∴ USE 3/4" WELD

MISC

MW	gals/mol	
44	CO_2	6.47
[illegible]	H_2S	5.18
[illegible]	N_2	4.16
2	H_2	3.38

CHECK WELD CAP @ "A"

WELD LENGTH = 24" + 2*18" = 60"

$\delta w = 286k * 1.5 / 60" = 7.2$ K/in

TRY 1/2" FILLET

$F_w = \frac{21 * .707 * 8}{16} = 7.42$ O.K. USE 1/2" WELD

SC-048

FLUOR DANIEL

CALCULATIONS and SKETCHES

DATE 21 AUG 91
CONT. NO. EE0100
BY K E GOODMAN CHK'D
SHEET NO. 47

MW		gals/mol
16	C_1	6.40
30	C_2	9.67
44	C_3	10.44
58	iC_4	12.40
58	C_4	11.93
72	iC_5	13.86
72	C_5	13.74
86	iC_6	15.5
86	C_6	15.59
100	iC_7	17.2
100	C_7	17.48
114	C_8	19.41
28	$C_2^=$	9.64
42	$C_3^=$	9.67

MISC

MW		gals/mol
44	CO_2	6.47
34	H_2S	5.18
28	N_2	4.16
2	H_2	3.38

LUG DESIGN CHECK FOR COMBINED STRESS

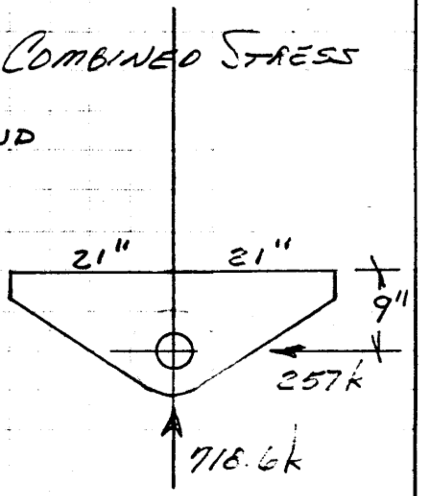
STINGER TO FULCRUM STAND
REF SH 12

$M = 1.5 * 257k * 9''$
$= 3470 \text{ in-k}$

$A = 2'' * 42'' = 84 \text{ in}^2$

$I_y = \frac{42*2^3}{12} = 28 \text{ in}^4$

$S = \frac{2*42^2}{6} = 588 \text{ in}^3$



$r = \sqrt{\frac{28}{84}} = .58$

$kl/r = 9''/.58'' = 15.52$

$C_c = \sqrt{\frac{2(\pi^2 E)}{F_Y}} = \sqrt{\frac{2*3.14^2*2900}{100}} = 76$

$KL/R < C_c$

$$F_A = \frac{\left(1-\frac{15.52^2}{2*76^2}\right)100}{\frac{5}{3}+\frac{3*15.52}{8*76}-\frac{15.52^3}{8*76^3}} = 56.2 \text{ KSI}$$

$\frac{f_A}{F_A} + \frac{f_b}{F_B} < 1.0$

$\frac{718.5/84}{56.2} + \frac{3470/588}{.6*100} = .25 < 1.0$ O.K.

FORM E-05C
PRINTED IN U.S.A.

THE END