LIFTING DEVICE

DEVICE NAME: E815 SHIELDING CAVE STEEL BLOCK LIFTING FIXTURE FOR TOP STEEL BLOCKS

ENGINEERING NOTE NUMBER: 84

DRAWING NUMBER: 9210.300-MD-328130

APPLICABLE STANDARD: AISC, ASME B30.20

RATED LOAD: 8000 #

TEST LOAD: 10000 #

TEST LOAD PERCENT: 125

LAST LOAD TEST DATE: 12/8/95

COLOR: YELLOW

STRESS CALCULATIONS:

Done by: R J Woods

Date: 11/29/95

Reviewed by: [illegible]

Date: 12-8-95

REMARKS:

INITIAL LOAD TEST PERFORMED BY DAVE ERICKSON ON 12/8/95 AT THE MELON ASSEMBLY BUILDING. THIS TEST WAS WITNESSED BY ERNIE VILLEGAS AND BOB WOODS

E.M.U.

IDENTIFICATION:

Engineering Note Number & Rated Load Must be Clearly Marked On a Conspicuous Surface.

DESIGN LIFTING FIXTURE FOR SAME BLOCKS AS FIRST LIFTING FIXTURE WITH A MAXIMUM HEIGHT OF 7"

FROM ORIGINAL CALCULATIONS, SHEET 2:

S_x REQ'D FOR A SAFETY FACTOR OF 3 = $\underline{8.89 \text{ IN}^3}$

USING 2 - C6 X 10.5 CHANNELS

$S_x = 2(5.06 \text{ IN}^3)$

$= 10.12 \text{ IN}^3 > 8.89 \text{ IN}^3$ $\underline{\text{OK}}$

CHECKING AISC CODE REQUIREMENTS:

$$F_b = \frac{12 \times 10^3 C_b}{Ld/A_f} = \frac{12 \times 10^3 (1.0)}{53.333(8.59)}$$

$= 26.2 \text{ KSI} > 0.6 F_y \ (21.6 \text{ KSI})$

$\therefore$ 21.6 KSI IS MAX. F_b

$21.6^{\text{KSI}} > 12.0 \text{ KSI}$ (ALLOWABLE FOR 3X SAFETY FACTOR)

$\therefore$ AISC CODE DOES NOT CONTROL.

ALLOWABLE SHEAR = 36.0/3 (3X SAFETY FACTOR)

= 12.0 KSI

OR $F_v = 0.40 F_y$ (AISC CODE)

$= 0.40(36)$

$= 14.4$ KSI

USE 12.0 KSI

$\therefore$ MAX LOAD = AREA OF 2 CHANNELS X2 X 12.0

$= 3.09(2)(12)$

$= 74.2^{\text{K}}$

$= 74{,}200^{\#} > 8000^{\#}$ $\underline{\text{OK}}$

NOTE: ALL OTHER MEMBERS WILL BE THE SAME AS ORIGINAL LIFTING FIXTURE. DESIGN OF THESE MEMBERS HAS BEEN CHECKED AND APPROVED.

BLOCK SIZES:

	WT
96 × 36 × 8	7840#
80 × 36 × 8	6520#
78 × 36 × 8	6360#

LIFTING FIXTURE FACTOR OF SAFETY = 3.0

DESIGN LOAD = 8000#

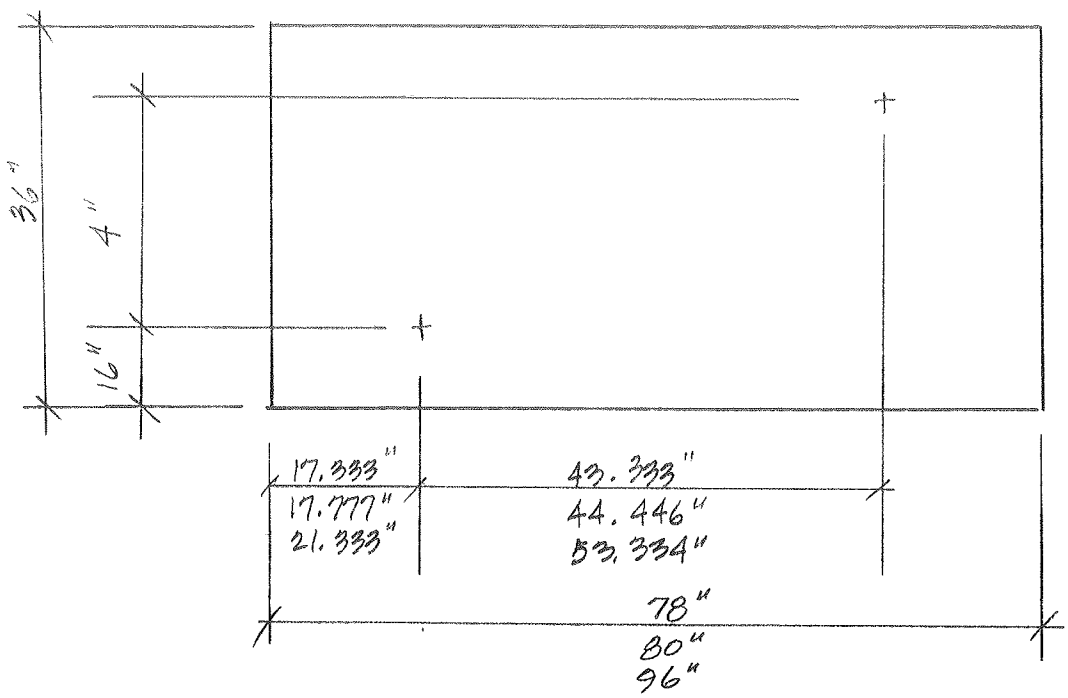
A) CHECK BOLTS:

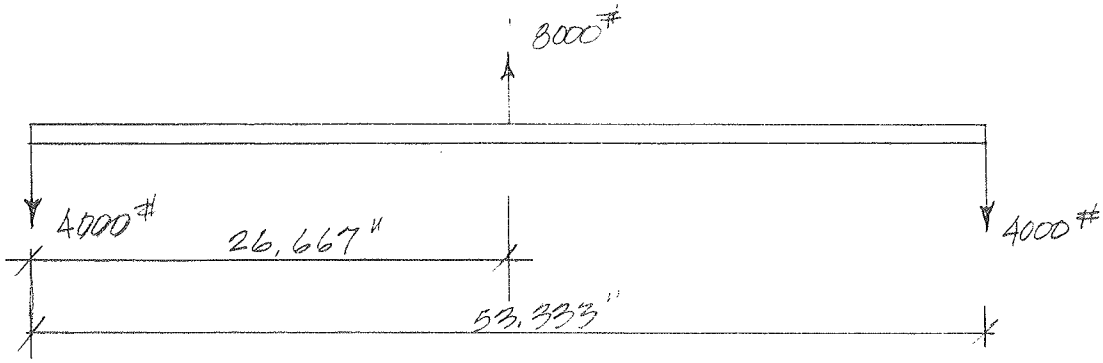
BOLT LOAD = 8000(3)/2 BOLTS
= 12,000#/BOLT

FROM AISC MANUAL EIGTH EDITION P. 4-3
TABLE 1-A

FOR 3/4" ϕ A325 BOLT, ALLOW. TENSION = 19.4K
= 19,400#

19,400# > 12,000# OK





$M = 8000(53.333)/4$
$= 106,666$ #-IN

CASE 1 - SAFETY FACTOR OF 3

$F_b = F_y/3$
$= 36000/3 = 12,000$ PSI

$S_{REQ'D} = 106,666/12,000$
$= \underline{\underline{8.89 \text{ IN}^3}}$

CASE 2 - AISC DESIGN
TRY C8 x 13.75 :
$l = 53.333''$ $\quad d/A_f = 8.75 \quad S_x = 9.03$

$F_b = \dfrac{12 \times 10^3 C_b}{ld/A_f} = \dfrac{12 \times 10^3 \times (1.0)}{53.333(8.75)} \leq 0.6F_y$
$= 25.7$ KSI $\quad$ $\underline{\underline{\text{USE } 0.6(36) = 21.6 \text{ KSI}}}$

$S_{x\,REQ'D} = 106\,666/21,600$
$= \underline{\underline{4.94 \text{ IN}^3}} < 9.03 \text{ IN}^3$ PROVIDED $\underline{\underline{\text{ok}}}$

TRY C10 x 30

$F_b = \dfrac{12 \times 10^3 \times (1.0)}{53.333(7.55)} = 29.8 \text{ KSI} \leq 0.6 F_y$

$\underline{\underline{\text{USE } 0.6(36) = 21.6 \text{ KSI}}}$

$S_{x\,REQ'D} = 106,666/21,600$
$= 4.94 \text{ IN}^3 < 27.0 \text{ IN}^3$ PROVIDED $\underline{\underline{\text{ok}}}$

PIN DESIGN:

FOR 10" LENGTH:

LOAD = 8000#

SHEAR = 8000/2 = 4000# PER END

ASSUME 1¼" ϕ PIN $A = 1.25^2\pi/4$
$= 1.227 \text{ IN}^2$

$f_v = 4000/1.227$
$= 3{,}260$ PSI

USING 3.0 SAFETY FACTOR

$F_v = 36{,}000/3.0$
$= 12{,}000$ PSI > 3260 PSI OK

USING AISC DESIGN

$F_v = 0.4 F_y$
$= 0.4(36000)$
$= 14{,}400$ PSI > 3260 PSI OK

BENDING:

$M = 8000(10)/4$
$= 20{,}000$ #-IN

$S = \pi d^3/32$
$= \pi(1.25)^3/32$
$= 0.1918 \text{ IN}^3$

$f_b = 20{,}000/0.1918$
$= 104{,}304$ PSI

$F_b = 36000/3 = 12{,}000$ PSI < 104304 N.G.

FIND MAXIMUM SPAN FOR 1¼" PIN:

MAXIMUM MOMENT = 0.1918(12,000)
= 2302 #-IN

$Pl/4 = 2302$

$8000l/4 = 2302$

$l = 1.15''$

REQ'D PIN SIZE FOR 3" SPAN:

$$M = 8000(3.0)/4$$
$$= 6000 \text{ \#-IN}$$

$$S_{REQ'D} = 6000/12000 \qquad (F_y = 36{,}000 \text{ PSI})$$
$$= 0.5 \text{ IN}^3$$

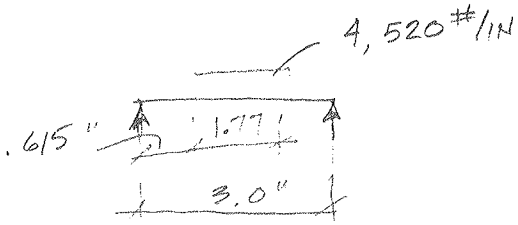
$$0.5 = \pi d^3/32$$

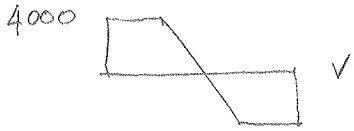
$$16 = \pi d^3$$
$$1.72'' = d \quad > \text{dia. OF hook} = 1.575''$$

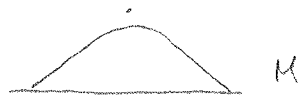
N.G.

WIDTH OF HOOK = 1.77"

$$8000/1.77 = 4{,}520 \text{ \#/IN}$$







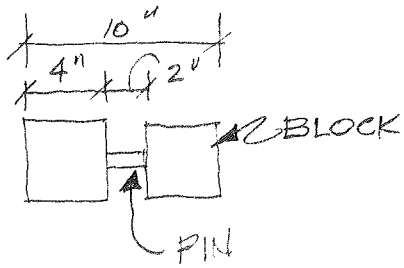
$$M = .615(4000) + \tfrac{1}{2}(4000(.885))$$
$$= 4230 \text{ \#-IN}$$

$$S_{REQ'D} = 4320/12000$$
$$= 0.3525 \text{ IN}^3$$

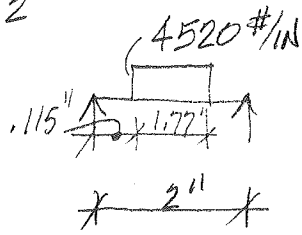
$$0.3525 = \pi d^3/32$$
$$11.28 = \pi d^3$$

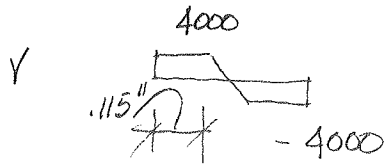
$$1.531 = d$$

STILL TOO LARGE — TRY PLATES TO SHORTEN SPAN



PIN SPAN = 2"





$$M = 0.115(4000) + \tfrac{1}{2}(4000)(.885)$$
$$= 2330 \text{ \#-IN}$$

$$S_{REQ'D} = 2330/12{,}000$$
$$= 0.1858 \text{ IN}^3$$

MIN. PIN DIAMETER

$$0.1858 = \pi d^3/32$$
$$1.237" = d \approx 1\tfrac{1}{4}" \quad \underline{\text{USE } 1\tfrac{1}{4}\text{" PIN.}}$$

WELD REQ'D FOR BLOCK - CHANNEL CONNECTION:

VERT. LOAD = 4000# ELECTRODE = E70XX

ALLOWABLE LOAD PER INCH FOR 1/16" WELD:

SHEAR:

AISC: $0.30(70^{KSI})(.707)(1/16) = 0.928^{K}/IN$ ← USE

3X SAFETY FACTOR $(70/3)(.707)(1/16) = 1.03^{K}/IN$

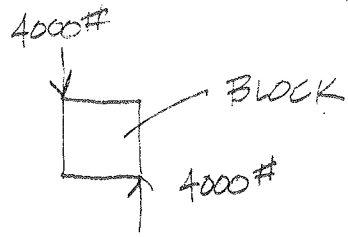
TENSION

AISC: $36(.707)(1/16) = 1.59^{K}/IN$

3X SAFETY FACTOR $(36/3)(.707)(1/16) = 0.530^{K}/IN$ ← USE

FOR 1/4" WELD:

SHEAR = 4(.928) = 3.71 K/IN
TENSION = 4(.530) = 2.12 K/IN



M = 4000(4) = 16000 #-IN

TENSION @ TOP DUE TO MOMENT = 16,000/4
= 4000 #

FOR 1/4" WELD ALL AROUND:

ALLOW SHEAR = 3.71(4") (4 SIDES) = 59.36 K
ALLOW TENSION = 2.12(4") (1 SIDE) = 8.48 K

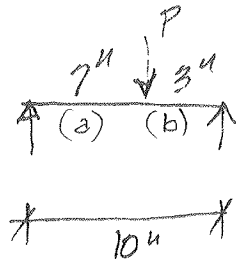
FOR COMBINED LOADING:

$4000/59360 + 4000/8480 \overset{?}{\leq} 1$

= 0.067 + 0.472
= 0.539 < 1.0 <u>OK</u> USE 1/4" WELD ALL AROUND.

TOP PLATE BENDING:

SPAN = 10" P = 4000#



$M_{MAX} = Pab/\ell$
$= 4000(7)(3)/10$
$= 8400$ #-IN

$S_{REQ'D} = 8400/12000$ PSI
$= 0.700$ IN^3

ASSUME 10" WIDTH OF PL EFFT

$0.70 = 10(t)^2/6$
$0.64 = t$ USE 3/4" PLATE

CHECK DEFLECTION:

$$I = 10(0.75)^3/12$$
$$= 0.3516 \text{ IN}^4$$

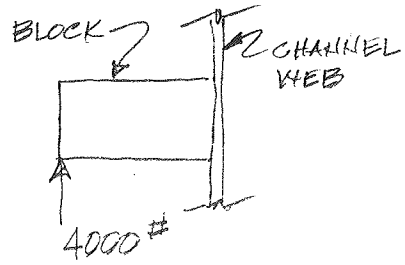
$E = 29{,}000{,}000$ PSI

$$\Delta_{MAX} = \frac{4000(3)(7)(7+2(3))\sqrt{(3(7))(7+2(3))}}{27(29{,}000{,}000)(0.3516)}$$

$$= 0.066''$$

<u>USE 3/4" PLATE</u>

TRY 3" x 3" x 4" LONG BLOCK



$M = 4(4000) = 16000$ #-IN

TENSION @ TOP DUE TO MOMENT $= 16000/3$
$= 5333$#

USE 5/16" WELD:

SHEAR $= 5(.928) = 4.64$ K/FT
TENSION $= 5(.530) = 2.65$ K/FT

ALLOWABLE TENSION @ TOP $= 2.65 \times 3"$
$= 7.95$ K
$= 7950$#

ALLOWABLE SHEAR $= 4 \times 3" \times 4.64$
$= 55.68$ K
$= 55{,}680$#

FOR COMBINED LOADING:

$$5333/7950 + 4000/55680 \overset{?}{\leq} 1.0$$

$= 0.671 + 0.072$
$= 0.743$ ok

MOMENT ON BLOCK $= 16000$ #-IN

ALLOW. BENDING $= 36{,}000/3$
$= 12{,}000$ PSI

$S_{REQ'D} = 16000/12000$
$= 1.33$ IN^3

3×3 BLOCK $= 3(3)^2/6 - \pi(1.3125)^3/32$
$= 4.28$ IN$^3 > 1.33$ IN^3 ok

CHANNEL WEB BENDING:

$M = 16{,}000$ PSI

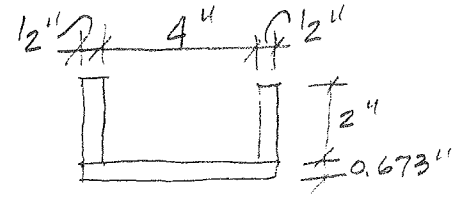
$S_{REQ'D} = 16{,}000/12000$ PSI
$= 1.33$ IN^3

WEB THICKNESS $= 0.673"$

$S_x = 3(0.673)^2/6$
$= 0.226$ IN^3
< 1.33 IN^3 NG

STIFFENERS REQ'D.

TRY 2 - ½" PLATES x 2"



PART	A	y	Ay	Ay^2	I_o	Ay^2+I_o
1	1.0	1.673	1.673	2.7989	1.3333	4.1322
2	1.0	1.673	1.673	2.7989	1.3333	4.1322
3	3.365	0.3365	1.1323	0.3810	0.1270	0.5080
	5.365		4.4783			8.7724
						−3.7380
					$I_x =$	5.0344

$$\bar{y} = \frac{4.4783}{5.365}$$

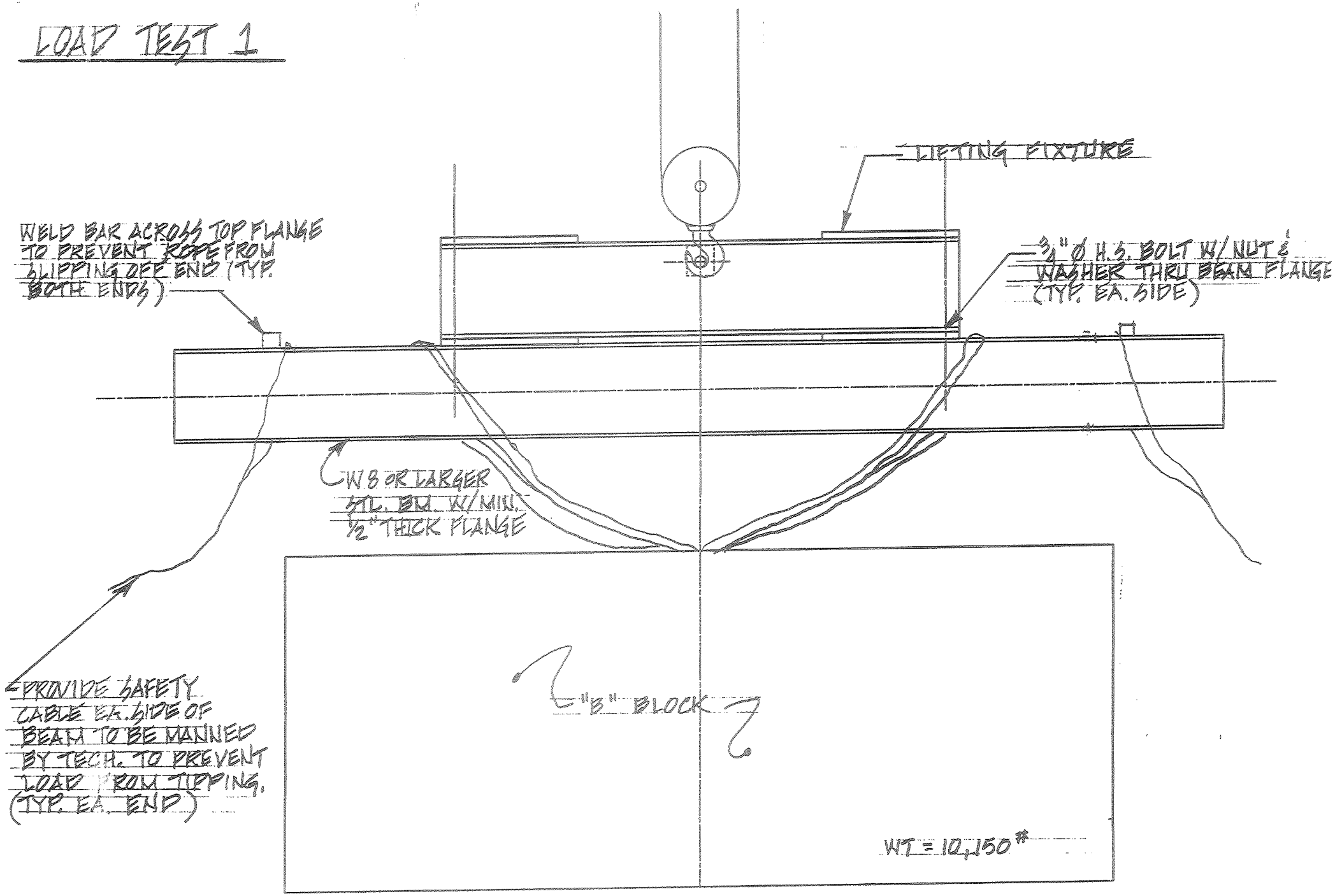
$$= 0.8347''$$

$$A\bar{y}^2 = 4.4783(0.8347)$$
$$= 3.7380$$

$$S = I/c \qquad c = 2.673 - 0.8347$$
$$= 1.8383$$
$$= 5.0344 / 1.8383$$
$$= 2.7386 \text{ IN}^3 > 1.33 \text{ IN}^3 \quad \underline{\text{ok}}$$

<u>USE 2 - ½" x 2" PL'S</u>

LOAD TEST 1



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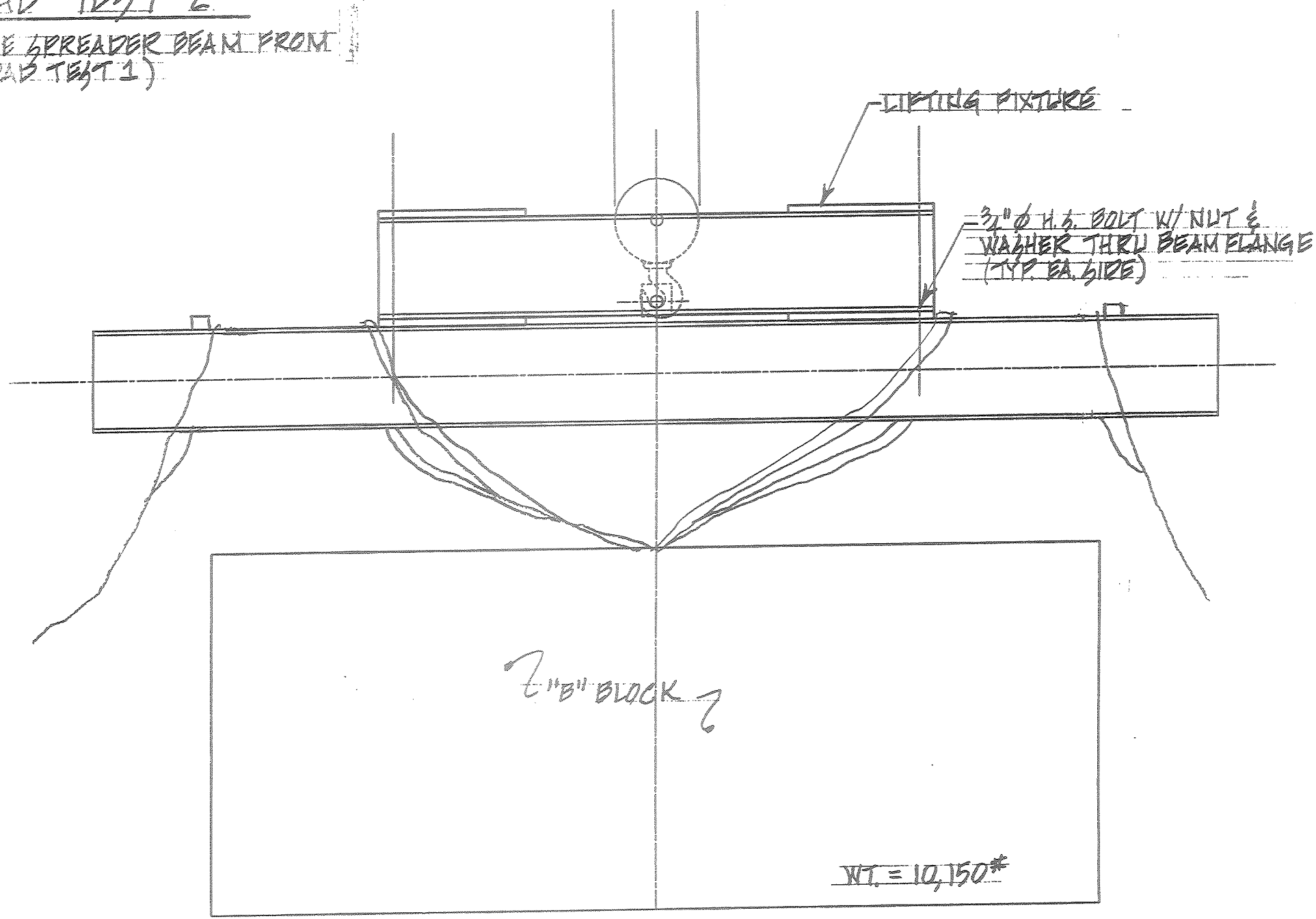
LOAD TEST 2

(USE SPREADER BEAM FROM LOAD TEST 1)



Plotted Fri Nov 17 11:09:14 CST 1995 by rjwoods

DESIGN LIFTING FIXTURE FOR SAME BLOCKS AS FIRST LIFTING FIXTURE WITH A MAXIMUM HEIGHT OF 7"

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S_x REQ'D FOR A SAFETY FACTOR OF 3 = $\underline{8.89 \text{ IN}^3}$

USING 2 - C6 X 10.5 CHANNELS

$S_x = 2(5.06 \text{ IN}^3)$
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CHECKING AISC CODE REQUIREMENTS:

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$= 26.2 \text{ KSI} > 0.6 F_y \ (21.6^{\text{KSI}})$

$\therefore$ 21.6^{KSI} IS MAX. F_b

$21.6^{\text{KSI}} > 12.0^{\text{KSI}}$ (ALLOWABLE FOR 3X SAFETY FACTOR)

$\therefore$ AISC CODE DOES NOT CONTROL.

ALLOWABLE SHEAR $= 36.0/3$ (3X SAFETY FACTOR)
$= 12.0 \text{ KSI}$

OR $F_v = 0.40 F_y$ (AISC CODE)
$= 0.40(36)$
$= 14.4 \text{ KSI}$

USE 12.0^{KSI}

$\therefore$ MAX LOAD = AREA OF 2 CHANNELS X2 X 12.0
$= 3.09 (2)(12)$
$= 74.2^{\text{K}}$
$= 74{,}200^{\#} > 8000^{\#}$ $\underline{\text{ok}}$

NOTE: ALL OTHER MEMBERS WILL BE THE SAME AS ORIGINAL LIFTING FIXTURE. DESIGN OF THESE MEMBERS HAS BEEN CHECKED AND APPROVED.