

LIFTING DEVICE

DEVICE NAME: KTEV MUON COUNTER STAGING SPREADER BAR

ENGINEERING NOTE NUMBER: 72

DRAWING NUMBER: 3832.273-MC-268256

APPLICABLE STANDARD: ASME B30.20-1993

AISC 9th EDITION ASD

RATED LOAD: 1500 LBS MAX. TOTAL LOAD, 750 LBS MAX. POINT LOAD

TEST LOAD: 2020 LBS TOTAL LOAD, 1010 LBS POINT LOAD

TEST LOAD PERCENT: 134%

LAST LOAD TEST DATE: 30 MARCH 1995

COLOR: YELLOW

STRESS CALCULATIONS:

Done by: DAVE PUSHKA

Date: 20 FEBRUARY 1995

Reviewed by: BOB WANDS

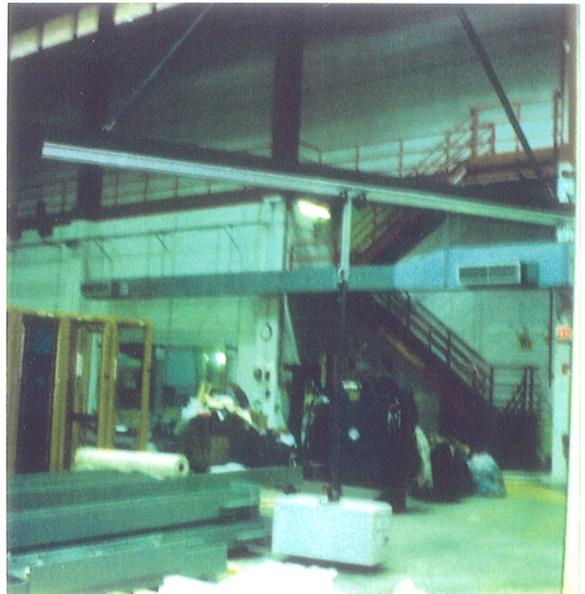
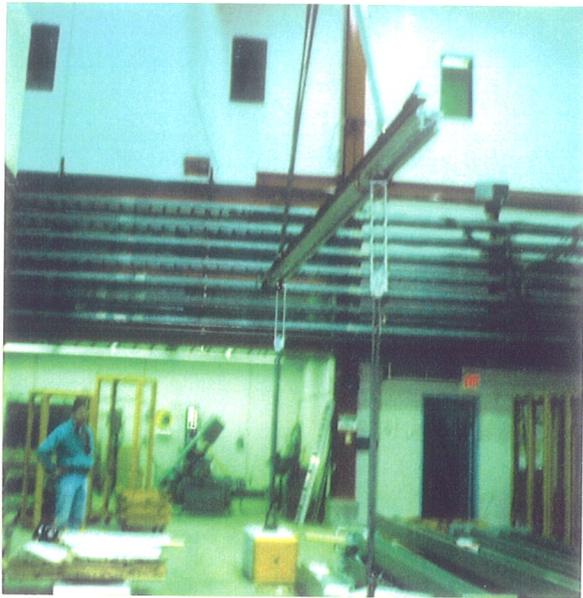
Date: FEBRUARY 1995

REMARKS: THIS NOTE WAS PREPARED TO ALLOW USE OF AN EXISTING FIXTURE FOR INSTALLING HANGING COUNTERS IN NMS. THIS BEAM SUPPORTS AN ALUMINUM EXTRUSION ON WHICH WHEELS ROLL. FUTURE USE OF THIS FIXTURE SHOULD NOT BE DONE WITHOUT AN ENGINEERING ANALYSIS.

IDENTIFICATION:

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





**MECHANICAL SUPPORT DEPARTMENT
ENGINEERING NOTE**

NUMBER: MSD EN-2.7.3 - KTeV
(WBS number items 2.7.3 - Staging)

DATE: 20 February 1995

TITLE: Design Note for the Lifting Fixture used for staging the Muon Counters in NMS

AUTHOR(s): Dave Pushka

REVIEWER: *Bob Wands* February 1995

KEY WORDS: Lifting Fixture, Muon Counter Staging, NMS, New Muon Laboratory

ABSTRACT/SUMMARY:

Previously in the New Muon Laboratory, a lifting fixture was used for installation of detectors on the extrusions mounted on the south end of CCM. This lifting fixture is a S6x12.5 by 24'-0 long beam with a section of the extrusion slipped over the lower flange. The detector to be installed would be attached to this lifting fixture and hoisted into position directly adjacent to and west of the permanently installed extrusion/S6x12.5 beams mounted on the south of CCM. The detector would then be rolled to the east, off the lifting fixture and onto the permanently installed extrusion/S6x12.5 beams. Apparently, this fixture was not documented.

Since this same fixture is going to be used for staging the KTeV muon counters, I have made the calculations to verify the S6x12.5 is sufficient.

This design note contains the calculations required to size member used for the lifting fixture. Allowable stresses are based on those calculated from AISC 9th edition and from ASME B30.20 'Under-the-Hook Lifting Fixtures'. The most conservative of the two values calculated from each Code was used.

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SUBJECT
MUON COOLER STAGING.

NAME
DAVE PUSKA

DATE
7 FEB '95

REVISION DATE

GIVEN THE EXISTING 6Gx12.5 x 24'-0" LG BEAM,
FIND THE MAX. ALLOW. MOMENT - IGNORE EXTENSION CONTRIBUTION.

6Gx12.5 - $A = 3.67 \text{ in}^2$

$d = 6.0 \text{ in}$

$b_f = 3.332 \text{ in}$

$t_f = 0.359 \text{ in}$

$t_w = 0.232 \text{ in}$

$d/A_f = 5.02 \text{ in}$

$I = 22.1 \text{ in}^4$

$\frac{d}{t} = \frac{23.332}{.359} = 64$

$\frac{65}{\sqrt{36}} = 10.83$

$\therefore \frac{d}{t} < \frac{65}{\sqrt{36}} \therefore$ COMPACT SECTION

$\therefore F_b = 0.66 F_y$

$L_c < \frac{76 b_f}{\sqrt{F_y}} \rightarrow L_c < \frac{(76)(3.332)}{\sqrt{36}} \quad L_c < 42 \text{ FEET}$

$L_c < \frac{20,000}{(d/A_f) F_y} \rightarrow L_c < \frac{20,000}{(5.02)(36)} = 110 \quad \therefore L_c < 110 \text{ FEET}$

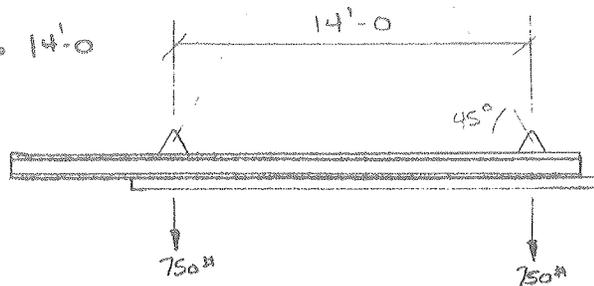
\therefore THE 24'-0" LONG SECTION IS COMPACT AND $L_c > L_{RETURN} \therefore F_b = 0.66 F_y$

$\sigma = \frac{M y}{I} \rightarrow \frac{(0.66)(36)(I)}{4} = M_{MAX} = 175 \text{ KIP-IN}$

FOR PT LOAD @ $l = 24'$ $M = \frac{Pl}{4} \rightarrow P_{MAX} = \frac{(175 \text{ KIP-IN})(4)}{(24' \times 12 \text{ in/ft})} = 2.4 \text{ KIPS}$

SINCE WT OF COOLER $< 2.4 \text{ K}$ THIS IS OKAY

ASSUME LARGEST MC IS 14'-0"
WIDE $\therefore M_{MAX}$ @
PT WHERE ONE
WHEEL IS @ $\frac{l}{2}$
OF SPAN



AXIAL COMP = $\frac{750}{.707} = 1060 \text{ #} \quad \therefore \sigma_{AXIAL} = 288 \text{ PSI}$



SUBJECT
MOON COUNTER STAGING

NAME
DAVE POSHKA

DATE
20 FEB '95

REVISION DATE

$F_a:$ $k=2.0$ $l=14'$, $r=0.705$

$$\frac{kl}{r} = \frac{28}{0.705} = 39.7$$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = \sqrt{\frac{(2\pi^2) 29000}{36}} = 39.8$$

$$\therefore \frac{kl}{r} < C_c \quad \& \quad F_a = \left[1 - \frac{\left(\frac{kl}{r}\right)^2}{2C_c^2} \right] F_y$$

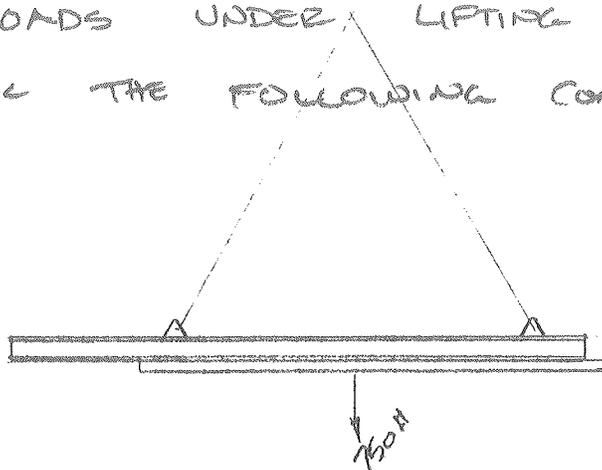
$$\frac{5}{3} + \frac{3}{8} \frac{kl/r}{C_c} - \frac{1}{8} \left(\frac{kl/r}{C_c}\right)^3$$

$$\frac{kl/r}{C_c} = 0.996$$

$$F_a = \frac{\left[1 - \frac{1}{2} (0.996)^2 \right] F_y}{\frac{5}{3} + \frac{3}{8} (0.996) - \frac{1}{8} (0.996)^3} = 0.263 F_y = 9.46 \text{ ksi}$$

SINCE $f_a = 0.288 \text{ ksi}$ & $F_a = 9.46 \text{ ksi}$ \therefore OK

\therefore THIS BEAM IS OKAY AS A SPREADER
W/ LOADS UNDER LIFTING LUGS -
CHECK THE FOLLOWING CONDITION:





SUBJECT
MOON COUNTER STAGING.

NAME
DANE PUSKA

DATE
ZOTER '95

REVISION DATE

MOMENT IS $\frac{PL}{4} = \frac{(750 \#)(14')}{4} = 2625 \text{ FT-LBS}$

$\sigma = \frac{M y}{I} = \frac{(2625 \text{ FT-LBS})(3)(12 \text{ IN/FT})}{22.1 \text{ IN}^4} = 4276 \text{ PSI}$

AXIAL COMP = $\frac{750}{2(707)} = 530 \#$ $\sigma_{\text{AXIAL}} = 144 \text{ PSI}$

COMBINED STRESS CASE

$f_a = 144 \text{ PSI}$ $f_b = 4276$ $\frac{f_a}{F_a} = 0.015 < 0.15$
 $F_a = 9460 \text{ PSI}$ $F_b = 21,600 \text{ PSI}$ \therefore USE EQN. H1-3

$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1.0$ $\frac{144}{9460} + \frac{4276}{21,600} = 0.21 < 1.0$

SUMMARY - BEAM IS SUITABLE FOR LIFTING FIXTURE.

WLG SIZE -

$A_T = (4-1)(3/4") = 2.25 \text{ IN}^2$
 $\sigma_T = \frac{750 \#}{2.25 \text{ IN}^2} = 333 \text{ PSI} \ll \frac{1}{3} F_y$

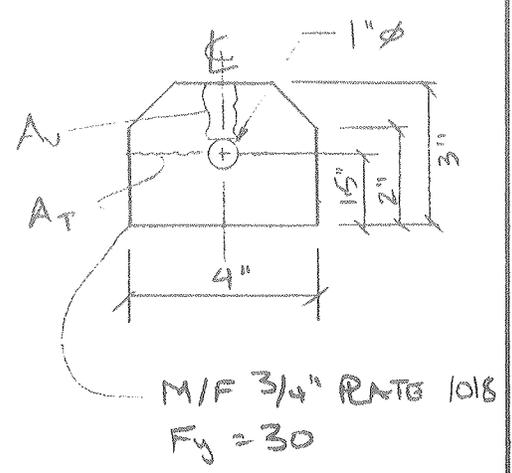
$A_U = (3-1/2-1/2)(.75)(2) = 1.5 \text{ IN}^2$

$\sigma = \frac{750 \#}{1.5 \text{ IN}^2} = 500 \text{ PSI} \ll \frac{1}{3} F_y$

Weld, $P = 0.928 \frac{\text{K}}{\text{IN-IN}} \rightarrow \frac{1.5 \text{ K}}{.928} = 1.6 \frac{\text{K}}{\text{IN}} @ 1" \text{ LONG REVD}$

\therefore USE 1/4" FILLET BOTH SIDES, $P_{\text{MAX}} = 30 \text{ K} \gg 1.5 \text{ K} \therefore \text{OK}$

SEE DWG 3832.233-MB-268106 FOR WLG DETAIL





SUBJECT
MUON COUNTER STAGING SPREADER BAR TESTING.

NAME
D. PESHKA

DATE
3/16/95

REVISION DATE

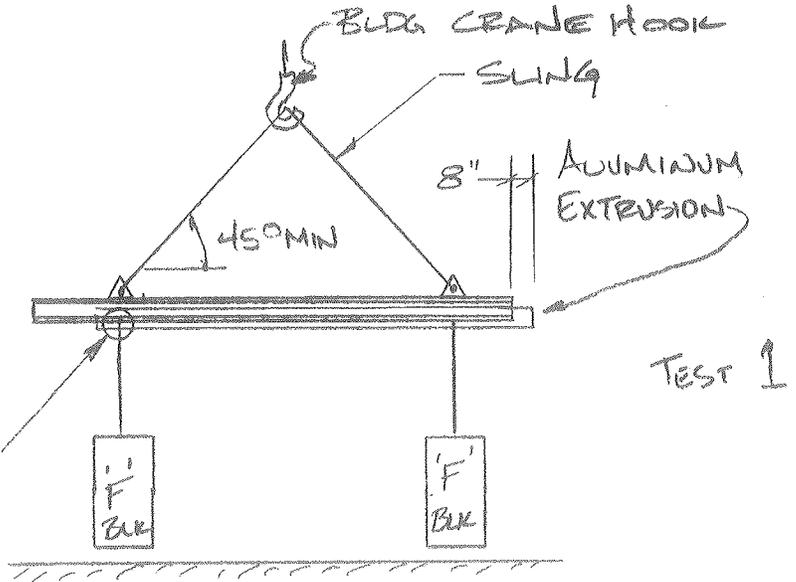
DESIGN FOR (2) 750# POINT
LOADS UNDER LUGS OR
ONE 750# POINT LOAD
@ CENTER OF SPAN

$$(1.25)(750) = 937 \#$$

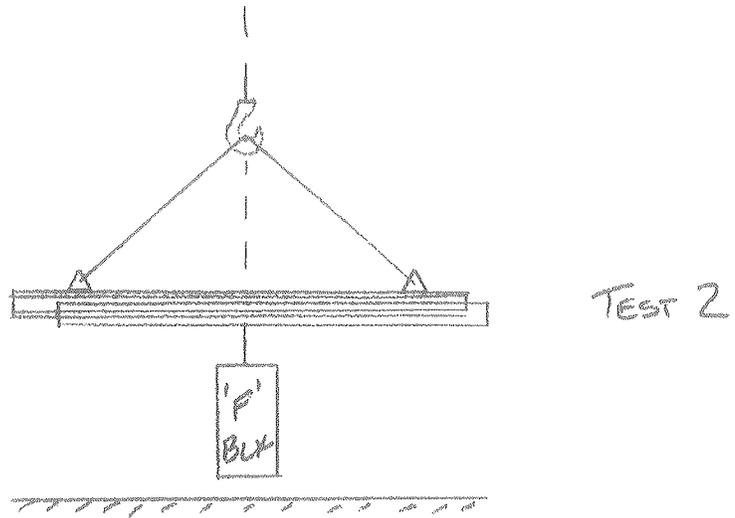
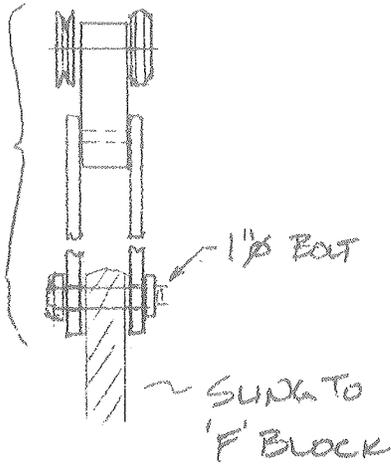
∴ USE AN 'F' BLOCK (1 KIP)

∴ 133% OVERLOAD

USE A BEAM TROLLEY
W/ A 1/2" Ø HOLE
(SEE Pg 6 OF MU3
STAGING CALCS)



MU3
ASSEM
FOR
TEST.



NOTE: CAPTURE TROLLEYS W/ A C-CLAMP ON EACH
SIDE TO PREVENT SHIFTING DURING TEST.