D0 ENGINEERING NOTE
3823.000-EN-533

7/7/00

**LIFTING FIXTURE
ENGINEERING NOTES
FOR
CFT AND A,B,C LAYER OCTANTS**

Fixture Numbers: 115 & 116

John Krider
&
Brent Anderson

FNAL Site No.: _____
if applicable

Div. Specific No.: _____
if applicable

Asset No. _____
if applicable

ASME B30.20 Group:
(check one)

Group I	Structural and Mechanical Lifting Devices
Group II	Vacuum Lifting Devices
Group III	Magnets, Close Proximity Operated
Group IV	Magnets, Remote Operated

Device Name or Description: DP CFT lifting fixture

Device was: Purchased from a Commercial Lifting Device Manufacturer
mfg. name:

(check all applicable)

~~L~~Designed and Built at Fermilab

Designed by Fermilab and Built by a Vendor

Assy drawing number:

Provided by a User or Other Laboratory

Other. Describe:

Engineering Note Prepared by: John Krider - JCK Date: 6/19/00

Engineering Note Reviewed by: Brent Anderson Date: 7/13/00

Lifting Device Data:

Capacity: 700 lb

Fixture Weight: 340 lb

Service: normal heavy severe (refer to B30.20 for definitions)

Duty Cycle: 8, 16 or 24 hour rating (applicable to groups III, and IV)

Inspections Frequency: Before each use

Rated Load Test by FNAL (if applicable): Date: 6/16/00 Load: 916 lb

Check if Load Test was by Vendor and attach the certificate.

Satisfactory Load Test Witnessed by: John Krider

Signature (of Load Test Witness): John C. Krill

Notes or Special Information:

Use a spreader bar with slings positioned to lift perpendicular to the top surface of the main beam. Avoid side loading of the channel brackets attached to the beam.

J. Krider
6-20-00

All components are structural steel.

$$\text{total weight} = \text{fixture} + \text{load} = 340 + 700 = 1040 \text{ lb}$$

Stress in lifting channel (C4x13.8)

$$\sigma = \frac{1040 \text{ lb}/2}{2.5 \text{ in}^2} = \boxed{208 \text{ lb/in}^2}$$

Stress in weld at base of channel ($\frac{1}{4}$ " fillet x 12" long)

$$\sigma = \frac{1040/2}{3 \text{ in}^2} = \boxed{173 \text{ lb/in}^2}$$

Stress in bolts and nuts in tension (two $\frac{1}{2}$ -13 bolts equally share approx 80% of load on each channel)

$$\sigma = \frac{\text{load/bolt}}{\text{effective cross section}} = \frac{(1040/4) \times 0.8}{0.142 \text{ in}^2} = \frac{208 \text{ lb}}{0.142 \text{ in}^2} = \boxed{1460 \text{ lb/in}^2}$$

Stress in main beam:

$$\begin{aligned} \sigma &= \text{stress due to its own weight} + \text{stress due to CFT} \\ &= \frac{(310 \text{ lb})(120 \text{ in})}{8 (27 \text{ in}^2)} + \frac{(1040 \text{ lb})(3 \text{ in})}{27 \text{ in}^2} = 172 + 116 = \boxed{288 \text{ lb/in}^2} \end{aligned}$$

All peak stresses are less than 10% of the allowable stresses for lifting fixtures.

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D ϕ CFT installation

Lift bracket weldment

NAME

J. Krider

DATE

6/9/00

REVISION DATE

Materials: C4 column 18 1/2" long - structural steel, any weight
1/2 x 6 x 6 base plate

1/4 x 4 x 8 gusset (1/4 x 2 1/2 flat)

→ 13.8 lb/ft actually used

2 assemblies

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Lift bracket base plate

NAME

J. Krider

DATE

6/9/00

REVISION DATE

$\frac{1}{2} \times 6 \times 6$ steel plate
2 pieces

Date: Mon, 10 Jul 2000 15:59:41 -0500 (CDT)
From: John Krider <krider@fnal.gov>
To: banderso@fnal.gov
Cc: krempetz@fnal.gov
Subject: Correction to CFT lifting fixture weld stress calculation

E t,

The actual weld area at the base plate of the CFT lifting bracket column and gusset plate, as built with heavier gauge materials than originally requested, is:

$$\begin{aligned} & (4+4+2.5+2+2.5+2 \text{ in}) \times (0.25 \text{ in}) \times (\cos 45 \text{ deg}) + (6.1 \text{ in}) \times (0.188 \\ & \text{ in}) \times (\cos 45 \text{ deg}) \\ & = 3.82 \text{ sqin} \end{aligned}$$

So the average stress in the weld is:

$$\begin{aligned} & (520 \text{ lb}) / (3.82 \text{ sqin}) \\ & = 136 \text{ lb/sqin} \end{aligned}$$

Because of the geometry of the lifting fixture, the stress is not uniform at all points in the weld. The peak weld stress occurs along the web of the channel and is probably on the order of 20% higher than the average stress. Therefore, the peak stress is estimated to be 163 lb/sqin, still slightly less than the originally calculated value, and vastly below allowable weld stresses.

If you still have the original copy of the engineering note, you could just attach a copy of this email message amending it. Otherwise, let me know and I will send you the same documents by lab mail.

John

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NAME

Brent Anderson

DATE

6/27/00

REVISION DATE

DØ Octant Lifting Fixture

Top Eye Bolt Lifting Assembly
rated for 5000 lbs.

$$I_{\text{rect. bar}} = 3.87 \text{ in}^4 \quad A = 2.02 \text{ in}^2 \quad (\text{pg. 103 AISC})$$

$$I_{\text{fin}} = \frac{1}{12} (I_c + A_i d_i^2)$$

$$I_{\text{fin}} = 2 \left[\frac{2 \text{ in} (.5 \text{ in})^3}{12} \right] + 2 \left[1 \text{ in}^2 (2.25 \text{ in})^2 \right] + 3.87 \text{ in}^4 = 14.03 \text{ in}^4$$

Bending Stress In Beam

$$\sigma_B = \frac{My}{I} = \frac{2500 \text{ lbs} (18 \text{ in}) (2.5 \text{ in})}{14.03 \text{ in}^4} = 8020 \text{ psi}$$

$$F_a = \frac{1}{3} F_y = \frac{1}{3} (36 \text{ ksi}) = 12 \text{ ksi}$$

$$\sigma_B < F_a \quad \text{O.K.}$$

Stress In Welds

.16" total length of welds $\frac{1}{4}"$ wide on each side

$$A_w = (.16" \times .177") 2 = 5.66 \text{ in}^2$$

$$\sigma_w = \frac{P}{A} = \frac{5000 \text{ lb}}{5.66 \text{ in}^2} = 883 \text{ psi} < F_a \quad \text{O.K.}$$

Stress In Bolts Grade 8 $\frac{1}{2}$ - 13 (4-5 AISC 8th ed. & FNAI TM-1662 Western & Johns)

$$F_a = \frac{1}{3} F_y = \frac{1}{3} (130 \text{ ksi}) = 43.3 \text{ ksi}$$

$$\sigma_b = \frac{P}{A} = \frac{2500 \text{ lb}}{.1419 \text{ in}^2} = 17,620 \text{ psi} < F_a \quad \text{O.K.}$$

$$F_v = 0.17 F_u = 0.17 (150 \text{ ksi}) = 25.5 \text{ ksi}$$

$$\tau_{\text{max}} = \sigma_b = 17,620 \text{ psi} < F_v \quad \text{O.K.}$$

$$\text{Lifting Capacity } 5000 \text{ lbs} - W_{\text{fixture}} = 5000 \text{ lbs} - 40 \text{ lbs} = \boxed{4960 \text{ lbs}}$$