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

Fixture Numbers: 115 & 116

John Krider
&
Brent Anderson
BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page

Lifting Device Numbers: 115
FNAL Site No.: Div. Specific No.: Asset No.
if applicable if applicable if applicable

ASME B30.20 Group:
(goal 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: DF CFI lifting fixture

Device was:
Purchased from a Commercial Lifting Device Manufacturer

mfg. name:
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 Date: 6/19/00
Engineering Note Reviewed by: Brent Anderson Date: 7/19/00

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. Krider

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.
All components are structural steel.

Total weight = fixture + load = 340 + 700 = 1040 lb

Stress in lifting channel (C4 x 13.8)

\[ \sigma = \frac{1040 \text{ lb}}{2.5 \text{ in}^2} = 416 \text{ lb/in}^2 \]

Stress in weld at base of channel (1/4" fillet x 12" long)

\[ \sigma = \frac{1040 \text{ lb}}{3 \text{ in}^2} = 347 \text{ lb/in}^2 \]

Stress in bolts and nuts in tension (two 1/2-13 bolts equally share approx 80% of load on each channel)

\[ \sigma = \frac{\text{load/bolt}}{\text{effective cross section}} = \frac{(1040/4) \times 0.8}{0.142 \text{ in}^2} = 347 \text{ lb/in}^2 \]

Stress in main beam:

\[ \sigma = \frac{310 \text{ lb}}{2 \text{ in}^2} + \frac{(1040 \text{ lb}) \times (3 \text{ in})}{27 \text{ in}^2} = 172 + 116 = 288 \text{ lb/in}^2 \]

All peak stresses are less than 10% of the allowable stresses for lifting fixtures.
Materials:
- C4 column 18½" long - structural steel, any weight
- ½ x 6 x 6 base plate
- ¼ x 4 x 8 gusset (¼ x 2½ flat)

2 assemblies

\[ 1\frac{1}{4} \]

\[ 6 \]
DΦ CFT installation
Lift bracket base plate

0.5 x 6 x 6 steel plate
2 pieces

4 x Φ 9/16 through

3/4
4 7/8
5/8
6

1/2
1 1/4
3/4
2 1/2
4 1/2
6
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:

\[(4+4+2.5+2+2.5+2\text{ in}) \times (0.25 \text{ in}) \times (\cos 45^{\circ}) + (6.1 \text{ in}) \times (0.188 \text{ in}) \times (\cos 45^{\circ})\]

\[= 3.82 \text{ sqin}\]

So the average stress in the weld is:

\[(520 \text{ lb}) / (3.82 \text{ sqin}) \]

\[= 136 \text{ lb/sqin}\]

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
## BELOW-THE-HOOK LIFTING DEVICE

### Engineering Note Cover Page

<table>
<thead>
<tr>
<th>Lifting Device Numbers: 116</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNAL Site No.</td>
</tr>
<tr>
<td>if applicable</td>
</tr>
</tbody>
</table>

**ASME B30.20 Group:**
- 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:**

**Device was:**
- Purchased from a Commercial Lifting Device Manufacturer
- Designed and Built at Fermilab
- Designed by Fermilab and Built by a Vendor
- Assy drawing number: ____________________
- Provided by a User or Other Laboratory
- Other: ____________________

**Engineering Note Prepared by:**

**Engineering Note Reviewed by:**

**Lifting Device Data:**

- **Capacity:** 4900 lbs
- **Fixture Weight:** 400 lbs
- **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: ____________________ Load: ____________________

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

**Satisfactory Load Test Witnessed by:**

**Signature (of Load Test Witness):**

**Notes or Special Information:**
Dφ Octant Lifting Fixture

Top Eye Bolt Lifting Assembly rated for 5000 lbs.

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

Bending Stress In Beam

\[ \sigma_B = \frac{M_y}{I} = \frac{2500 \text{lbs} \cdot \text{in} \cdot (2.5 \text{ in})}{14.03 \text{ in}^4} = 8020 \text{ psi} \]

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

\[ \sigma_B < F_a \quad \text{O.K.} \]

Stress In Welds

\[ \frac{\text{16" total length of welds} \quad \frac{1}{4} \text{" wide on each side}}{\text{16" total length of welds} \quad \frac{1}{4} \text{" wide on each side}} \]

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

Stress In Bolts

\[ \sigma_b = \frac{P}{A} = \frac{2500 \text{ lbs}}{14.19 \text{ in}^2} = 17,620 \text{ psi} < F_a \quad \text{O.K.} \]

\[ \tau_{\text{max}} = \frac{\sigma_b}{2} = 17,620 \text{ psi} < F_v \quad \text{O.K.} \]

Lifting Capacity

\[ 5000 \text{ lbs} - \text{Wire} = 5000 \text{ lbs} - 40 \text{ lbs} = 4960 \text{ lbs} \]