

BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page

Lifting Device Numbers:

FNAL Site No.: _____ Div. Specific No.: 99 Asset No. _____
 if applicable if applicable if applicable

ASME B30.20 Group: Group I Structural and Mechanical Lifting Devices
 (check one) Group II Vacuum Lifting Devices
 Group III Magnets, Close Proximity Operated
 Group IV Magnets, Remote Operated

Device Name or Description: PAVEL LIFTING FIXTURE

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

(check all applicable) 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: Tony Levand Date: 10/12/99

Engineering Note Reviewed by: [Signature] Date: 12/13/99

Lifting Device Data:

Capacity: 315 lbs

Fixture Weight: 50 lbs

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

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

Inspections Frequency: _____

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:



SUBJECT

LIFTING FIXTURE ANALYSIS

NAME

LEVAUD

DATE

10/12/79

REVISION DATE

FIXTURE FOR OCTANT ASSEMBLY

THIS FIXTURE IS USED TO PICKUP AN ASSEMBLED ALUMINUM MDT FRAME AND MOVE IT TO STORAGE OR ASSEMBLY.

LOADS: WEIGHT OF THE PANEL PLUS MDTs.

$$\text{PANEL WEIGHT} = \left[1040 \times 109 \times \left(\frac{146 + 37}{2} \right) \right] 2 \cdot 101 = 32 \text{ lbs}$$

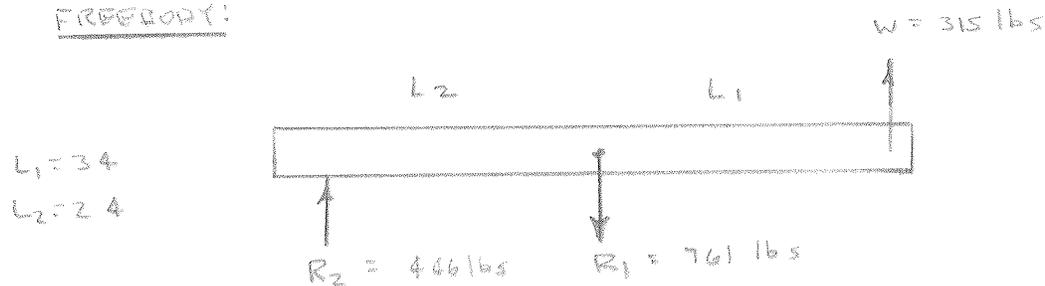
$$\text{MDT WEIGHT} = \left[1.5 \text{ lbs/foot} \times \left[\frac{146 + 37}{2} \right] \frac{32}{37.37} \right] 2 = 223 \text{ lbs}$$

$$\text{ASSEMBLED WEIGHT} = \underline{255 \text{ lbs}}$$

ADD 10 lbs misc weight (screws, channels, etc.)

USE 315 lbs as weight

FREEBODY:



$$R_2 = W \frac{L_1}{L_2} = 315 \frac{34}{24} = 446 \text{ lbs}$$

$$R_1 = W + R_2 = 761 \text{ lbs}$$



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FIXTURE FOR OCTANT ASSEMBLYMATERIAL ALLOWANCES ②

A500 GRADE B STEEL ①

$$F_t = \frac{F_{ty}}{3} = \frac{46}{3} = 15.3 \text{ KSI}$$

$$F_s = \frac{F_t}{2} = 7.65 \text{ KSI}$$

A-36 STEEL

$$F_t = \frac{F_{ty}}{3} = \frac{36}{3} = 12 \text{ KSI}$$

$$F_s = 6 \text{ KSI}$$

SECTION PROPERTIES

4x2x 1/8 WALL TUBING

$$I = \frac{4^{3.2} - 3.75^{3.2} \cdot 1.75}{12} = 2.98 \text{ in}^4$$

$$A = 1.44 \text{ in}^2$$

STRUCTURAL ANALYSISBENDING THROUGH R₁:

$$M = WL_1 = 315.34 = 10.7 \text{ in kip}$$

$$f_b = \frac{M c}{I} = \frac{10.7 \times 10^3 \times 2}{2.98} = 7.17 \text{ KSI} < 15 \text{ KSI}$$

SHEAR STRESS:

$$\frac{R_2}{A} = \frac{444}{1.44} = 307 \text{ PSI}$$

REFERENCES:

① STEEL CONSTRUCTION MANUAL P 5-118 NOTE 4

② ASTM B30-20-1993 P 19, PP 20-1.2.2



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LIFTING FIXTURE ANALYSIS

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FIXTURE FOR OCTANT ASSEMBLY

STRUCTURAL ANALYSIS (CONT.)

STRESS ON WELD:

$$\text{Weld Area} = A_{\text{weld}} = \frac{(6+1)^2 (.188)}{\sqrt{2}} = 1.86 \text{ in}^2$$

$$\sigma_{\text{weld}} = \frac{R_1}{A_{\text{weld}}} = \frac{761}{1.86} = 409 \text{ PSI}$$

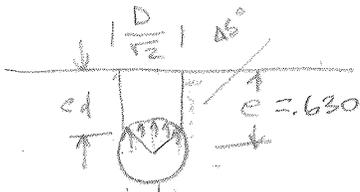
PIN SHEAR:

$$\tau_{\text{pin}} = \frac{R_1}{A_{\text{pin}}} = \frac{761}{\frac{\sqrt{2}\pi}{4} \times 2} = 1.94 \text{ KSI}$$

PIN BEARING:

$$f_{\text{pb}} = \frac{R_1}{A_{\text{b}}} = \frac{761}{2 \times .5 \times .188} = 4 \text{ KSI}$$

LUG ANALYSIS - SHEAR-BEARING FAILURE



$$e_d = .630 - \frac{.266}{\sqrt{2}} = .441$$

$$f_s = \frac{P}{A} = \frac{761}{.441 \times .25 \times 2} = 3.4 \text{ KSI} \quad \text{SHEAR-TERRORT} < 6 \text{ KSI Allowable}$$



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LIFTING FIXTURE ANALYSIS

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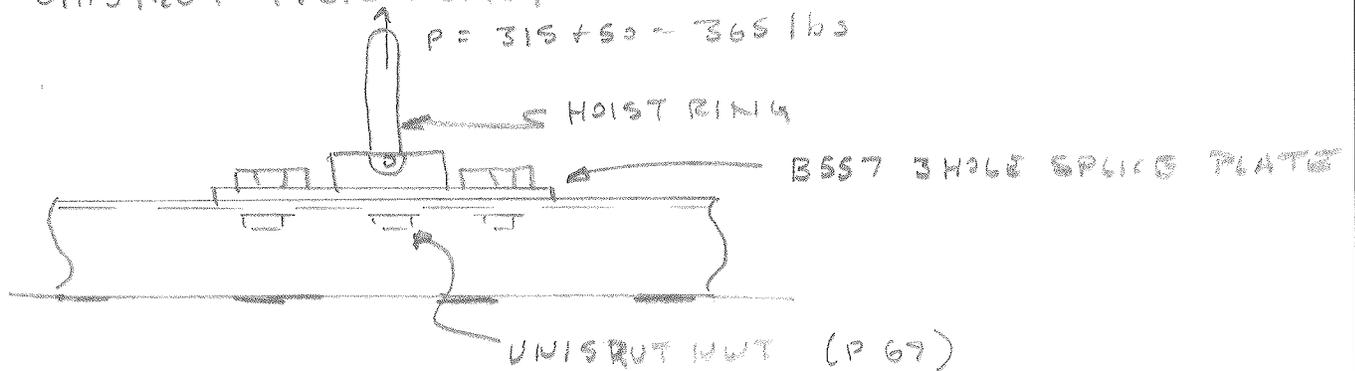
DATE

12/8/99

REVISION DATE

UNISTRUT PICK POINT

$$P = 315 + 50 = 365 \text{ lbs}$$



NUT PULL OUT = 2000 lbs (1/2-13)

$$\frac{2000}{365} \gg 1$$

Weld: 1/8" weld

$$\sigma = \frac{365}{4 \times \frac{.125}{\sqrt{2}}} = 1032 \text{ PSI}$$