



**Particle Physics Division
Mechanical Department Engineering Note**

Number: MD-ENG-236

Date: 12 March 2010

Project Internal Reference: none

Project: NOvA Block Pivoter

Title: Upper Frame Rotate fixture # 1

Author(s): Dave Pushka

Reviewer(s):

Key Words: NOvA, Upper Frame Lift Fixture, Below-the-hook lifting device

Abstract Summary: Calculations to show conformance with ASME B30.20 for lifting fixtures used to move the upper frame of the NOvA block pivoter.

Applicable Codes: ASME B30.20

Givens:

Frame weight	34,000 pounds
Cylinder weight	8,000 pounds
Number of Lift Points	1
Design Load per lift pt.	42,000 pounds
Test Weight = 1.25 * Load =	52,500 pounds.

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BELOW-THE-HOOK LIFTING DEVICE

Engineering Note Cover Page

Lifting Device Numbers:

FNAL Site No/ _____ Div. Specific No. 177 Asset No. _____
If applicable If applicable If applicable

ASME B30.20 Group: [X] 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 NOvA-FHEP UPPER FRAME, LIFTING FIXTURE

Device was [] Purchased from a Commercial Lifting Device Manufacturer. Mfg Name _____
(check all [] Designed and Built at Fermilab _____
applicable) [X] Designed by Fermilab and Built by a Vendor. Assy drawing number 3929.000-MC-466741
[] Provided by a User or other Laboratory _____
[] Other: Describe _____

Engineering Note Prepared by Dave Pushka Date 12 March 2010

Engineering Note Reviewed by _____ Date _____

Lifting Device Data:

Capacity 42,000 pounds

Fixture Weight 850 pounds

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

Duty Cycle n/ a 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 6-1-2010 Load 52,500 pounds

[] Check if Load Test was by Vendor and attach the certificate

Satisfactory Load Test Witnessed by: Dave Pushka

Signature (of Load Test Witness) _____

Notes or Special Information: Use only for the upper weldment and the installed hydraulic cylinder or the bare upper weldment.

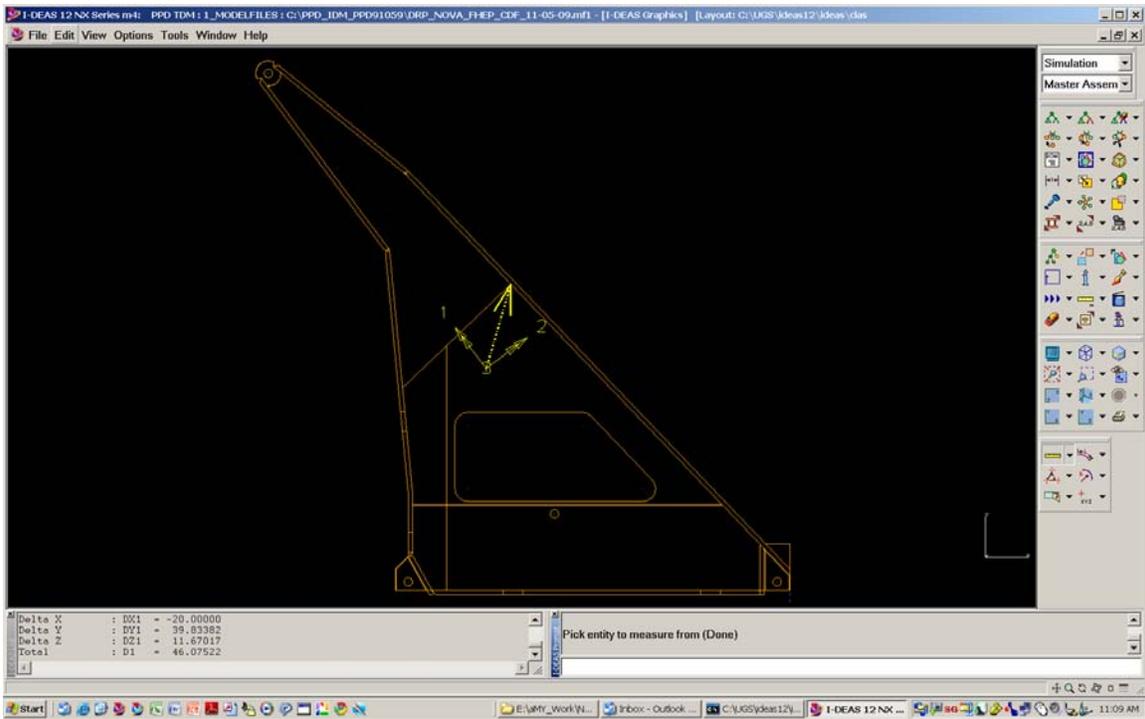


Image 1: Side view of the Upper frame for the NOvA blocks Pivoter.

Center of gravity is shown in yellow.

Holes at each corner are 4.0 inches in diameter.

Image 2: Assembly Drawing of the Rotate Fixture on Upper Frame:

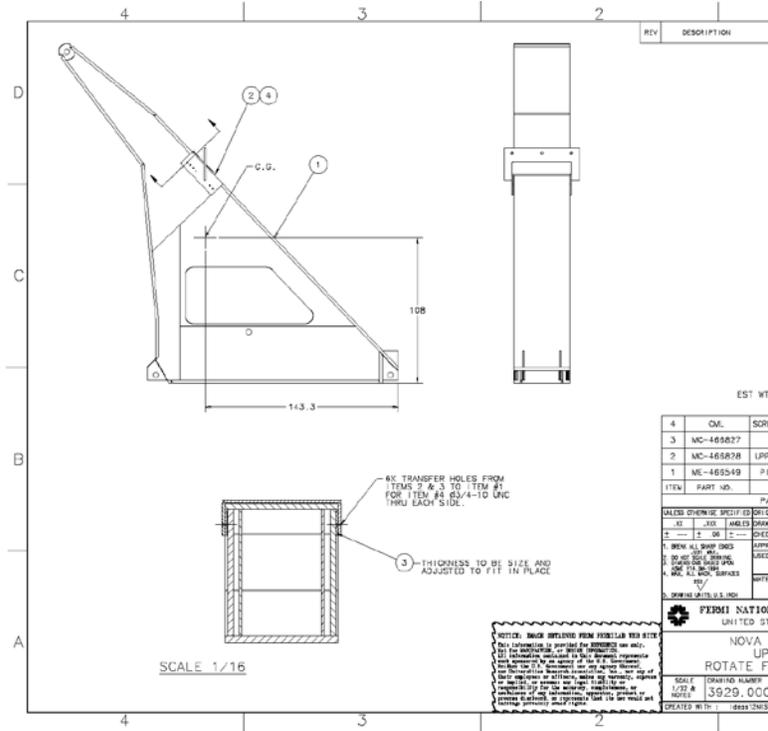
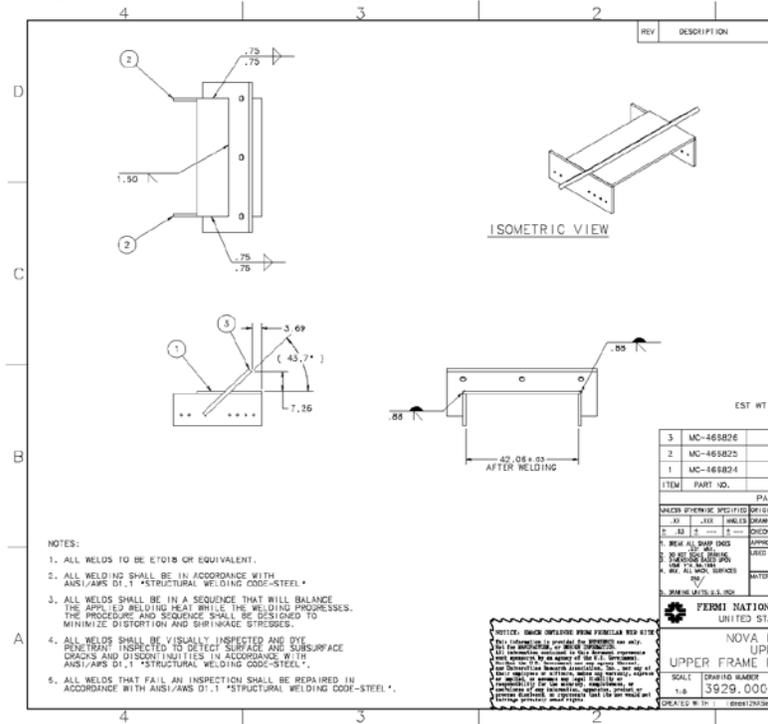


Image 3: Assembly Drawing of the Rotate Fixture:

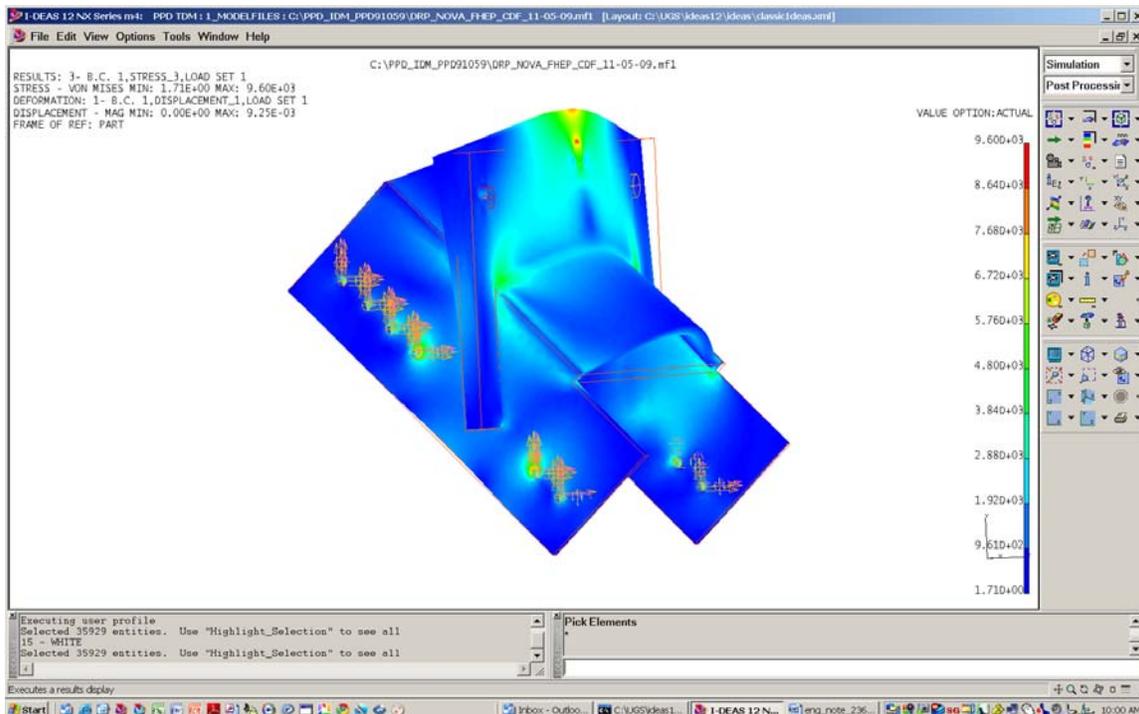


Discussion:

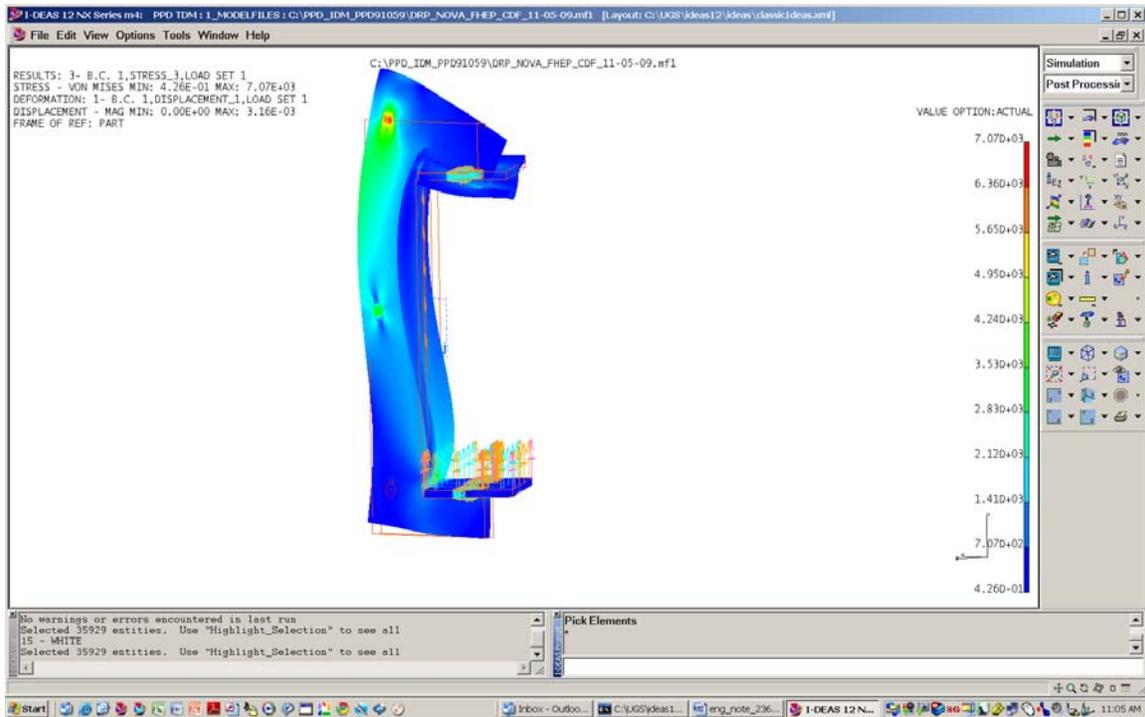
Upper frame weighs approximately 34,000 pounds. Cylinder that gets installed in the upper frame weighs approximately 8000 pounds. This rotate fixture will be used to rotate the upper frame from horizontal to vertical and to lift the combined upper frame and cylinder.

Design this fixture for 34,000 pounds, the weight of the upper frame plus the 8000 pound cylinder weight for a combined load of 42,000 pounds.

Material of construction for this weldment is all A-36 steel plate. Minimum yield strength is 36,000 psi. ASME B30.20 requires the working stress to be less than 1/3 of the yield stress. Therefore, the maximum allowable working stress for the material used on this weldment is 12,000 psi. This value is for the bulk material stress based on traditional hand calculations. Finite element calculations return local peak stresses that need to be averaged over a reasonable volume when comparing to the maximum allowable working stress. This is called stress averaging.



This image shows the maximum stress of 9600 psi during a vertical lift of the combined upper frame and cylinder.



This image shows the maximum stress of 7070 psi during a rotation lift of the upper frame.

In both loading conditions, the peak, local stress is less than the maximum allowable working stress per the ASME B30.20 code. Since even the peak stresses are below the allowable, no stress averaging is needed to show conformance with B30.20.