BELOW-THE-HOOK LIFTING DEVICE
Engineering Note Cover Page

Lifting Device Numbers:

FNAL Site No.:_____ if applicable Div. Specific No.: 126 if applicable Asset No. _____ if applicable

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

Device Name or Description: MINOS FAR DETECTOR STRONGBACK

Device was: (check all applicable)
- ˇ Purchased from a Commercial Lifting Device Manufacturer
  mfg. name: _____
- ˇ Designed and Built at Fermilab
- ˇ Designed by Fermilab and Built by a Vendor
  Assy drawing number: _____
- ˇ Provided by a User or Other Laboratory
- ˇ Other. Describe: _____

Engineering Note Prepared by: R. L. WOOD Date: 1/10/01

Engineering Note Reviewed by: James R. Kilmer Date: 1/19/01

Lifting Device Data:

Capacity: 25,000 #

Fixture Weight: 12,500 #

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

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

Inspections Frequency: _____

Rated Load Test by FNAL (if applicable): Date: 26 Jan 2001 Load: 31,250 #

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

Satisfactory Load Test Witnessed by: T. J. SARLINA

Signature (of Load Test Witness): 4128

Notes or Special Information:

Fermilab

Revision 1.0

Particle Physics Division
Engineering and Technical Teams

1/21/1999

Mechanical Support Engineering Note

Number: MSG-E-990220 **Date: January 10, 2001**

Project: MINOS

Project Internal Reference:

Title: Far Detector Strongback

Author(s): Robert J. Woods

Reviewer(s): 1-24-2001

Key Words: MINOS, Strongback, Structural, Steel

Abstract/Summary:

The purpose of these calculations is to redesign the original Far Detector Strongback's connections to increase their moment capacity, as well as to provide

additional backwards tilt to the Plane and Strongback assembly while in the vertical position. In it's assembled form, this fixture measures over twenty-nine feet wide, which would be too wide to fit down the entry shaft of the Soudan mine. Thus, the Strongback will have to be assembled at the bottom of the mine from prefabricated parts lowered through the shaft. In order to facilitate the assembly, all connections will be bolted rather than welded. One additional change from the original Strongback was that the two vertical wide flange beam members were repositioned. These beams were brought approximately thirteen inches closer together to avoid an interference with the Plane-to-Plane connection bolts.

The first part of these calculations is a manual determination of the shears and moments of the structural members. These values were used to verify that the finite element analysis results were reasonable and the model used for the analysis was a good representation of the actual structure. The second part is the documentation of the finite element analysis of the Strongback. Included in this section is a brief explanation of the analysis and the results in both graphical and tabular form. The third part uses the results of the finite element analysis to design the new bolted connections and the fixtures, which have changed from the original Strongback. All stresses were below the allowable one third of yield stress, which, for A36 steel equals 12000 pounds per square inch and for the rectangular tube sections is 15300 pounds per square inch. The design of the roller support brackets and clamping fixtures are not included in these calculations since they have been previously designed and tested on the original Strongback.

Applicable Codes:

- *AISC Manual of Steel Construction, Allowable Stress Design, Ninth Edition*
- *ANSI/ASME B30.20-1993, Below the Hook Lifting Devices*
- *ANSI/AWS D1.1-98, Structural Welding Code - Steel*

Reference Books:

- *Steel Design Manual, by R.L. Brochenbrough*
- *Design of Welded Structures, by Blodgett*
- *Structural Steel Design, by Lynn S. Beedle*

REV.	DESCRIPTION	DRAWN / APPROVED	DATE
A	ITEM #20 WAS ITEM #35 ON SHEET 2 OF 2	VIC M	31OCT00
		C. NILA	10-31-00
B	ITEM #35 WAS MD-384884 AND ITEM #5 WAS MC-384857.	VIC M	13DEC00

NOTES:

1- TORQUE 3/4-10UNC BOLTS TO 200 LB-FT UNLESS NOTED OTHERWISE.

2- ALL STRUCTURAL STEEL SHALL PAINTED AS FOLLOWS:
EXCEPT FOR LABEL AND SURFACES WITHIN 2 INCHES OF ANY WELD, OPERATING PARTS, FINISHED SURFACES AND ALL OTHER NOT CONCEALED STEEL PARTS SHALL BE:
THOROUGHLY CLEANED OF ALL SCALE, RUST AND DIRT PER SPECIFICATIONS OF THE STEEL STRUCTURE PAINTING COUNCIL (SSPC) "SURFACE PREPARATION SPECIFICATION NO. 3,(SP-3) POWER TOOL CLEANING":
PRIMED WITH SYNTHETIC, QUICK DRYING, RUST-INHIBITING FERROUS METAL PRIMER GLIDDEN 5285 GLID-GUARD TANK AND STRUCTURAL PRIMER: PAINTED WITH TWO COATS OF INTERIOR, SEMI-GLOSS, ODORLESS, ALKYD ENAMEL GLIDDEN 4540 SPREAD ULTRA SEMI-GLOSS ENAMEL. COLOR SHALL BE "SAFETY YELLOW" INCLUDE 1 GALLON OF FINAL PAINT WITH SHIPMENT (FOR TOUCH-UP).

3- LABEL FURNISHED BY FERMILAB.

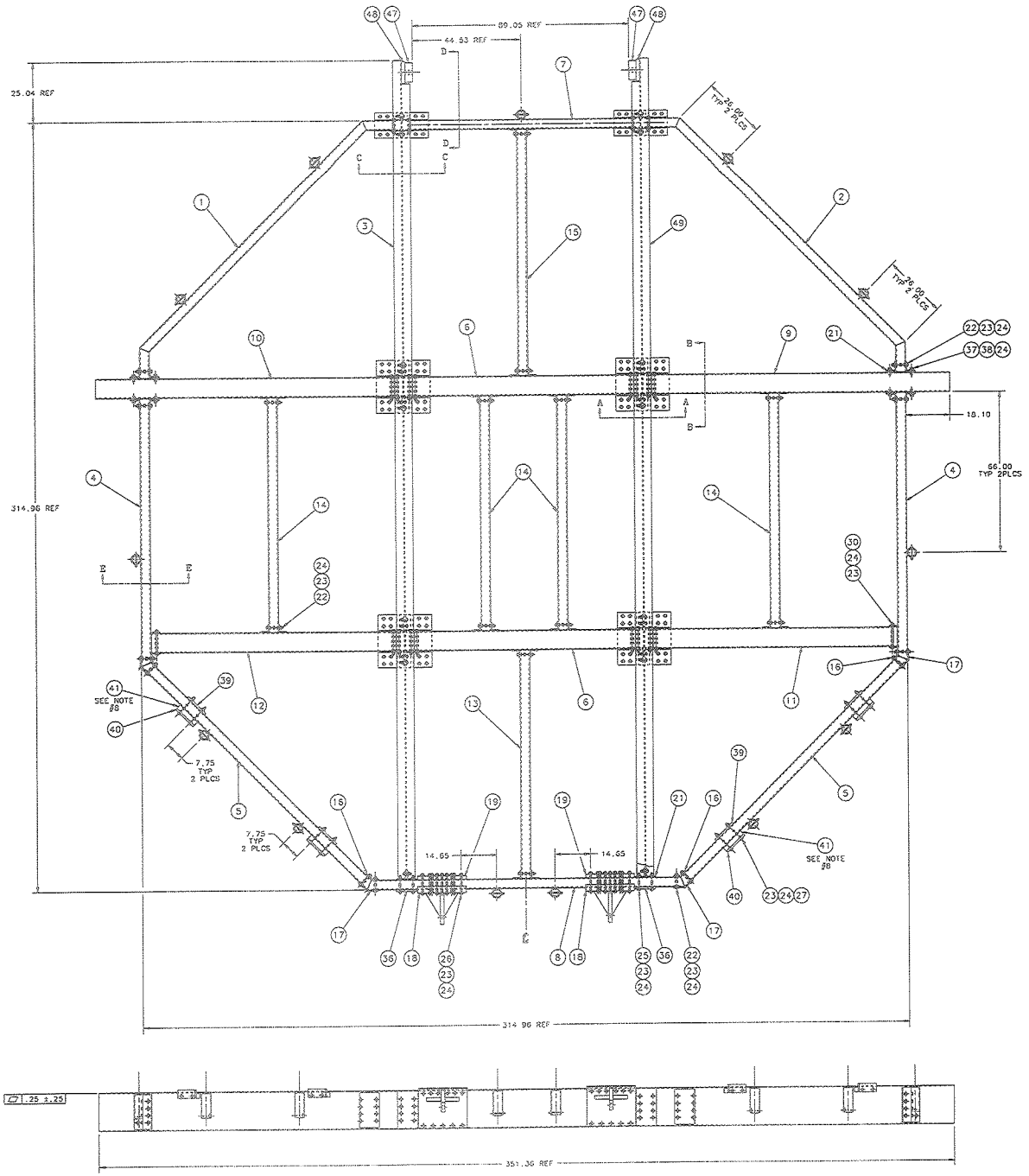
4- WELDING SHALL BE DONE USING THE ELECTRIC ARC PROCESS BY WELDERS HOLDING CURRENT WELDING CERTIFICATES FOR EACH REQUIRED PROCEDURE.

5- ALL WELDING SHALL BE DONE WITH E70XX ELECTRODES.

6- FABRICATION, ASSEMBLY AND ERECTION SHALL BE IN ACCORDANCE WITH AISC STANDARD PRACTICE. SPECIAL TOLERANCES SHOWN ON DRAWING SHALL BE FOLLOWED.

7- IT SHALL BE THE RESPONSIBILITY OF THE SUBCONTRACTOR TO VERIFY ALL PART DIMENSIONS TO INSURE THE EXACT OVERALL DIMENSIONS AND TOLERANCES OF THE FINAL ASSEMBLY AS SHOWN ON THE DRAWING.

8- FINAL THICKNESS OF PAD (ITEM #41) WILL BE DETERMINED AND MACHINED BY FERMILAB.



49	MC-397047	BEAM, WELDMENT R.H.	1
48	MD-397045	PAD, LIFTING LUG	2
47	MD-397044	LUG, LIFTING	2
46	COML	LOCKWASHER, 1/2 BOLT S.S.	13
45	COML	NUT, 1/2-13UNC-2B HX HD S.S.	13
44	COML	BOLT, 1/2-13UNC X 1 LONG HX HD S.S.	13
43			
42	MD-397040	PIPE, PIN HOLDER	13
41	MD-397037	PAD, OUTER	4
40	MD-397035	PLATE, OUTER	4
39	MD-397034	PLATE, INNER	4
38	COML	LOCK WASHER, HELICAL SPRING, 3/4 CARBON STEEL	32
37	COML	BOLT, 3/4-10UNC X 2 LONG HX HD ASTM A325 TYPE 1	32
36	MC-384867	PLATE, BOTTOM TUBE TO BEAM	2
35	MC-384884	ANGLE, BRACKET	16
34	MD-384883	ANGLE, 4" TUBE TO BEAM	8
33	MC-384882	PLATE, 4" TUBE X-OVER	8
32	MC-384881	PLATE, 6" TUBE X-OVER	16
31	MC-384874	PLATE, BEAM TO TUBE JOINT	16
30	COML	BOLT, 3/4-10UNC X 10 LONG HX HD ASTM A325 TYPE 1	40
29	COML	BOLT, 3/4-10UNC X 3 LONG HX HD ASTM A325 TYPE 1	160
28	COML	BOLT, 3/4-10UNC X 2 1/2 LONG HX HD ASTM A325 TYPE 1	48
27	COML	BOLT, 3/4-10UNC X 9 LONG HX HD ASTM A325 TYPE 1	8
26	COML	BOLT, 3/4-10UNC X 8 LONG HX HD ASTM A325 TYPE 1	30
25	COML	BOLT, 3/4-10UNC X 6 1/2 LONG HX HD ASTM A325 TYPE 1	16
24	COML	WASHER, FLAT, 3/4 BOLT ASTM F436 HARDENED	390
23	COML	NUT, 3/4-10UNC-2B HX HD ASTM A194 GRADE 2	358
22	COML	BOLT, 3/4-10UNC X 4 LONG HX HD ASTM A325 TYPE 1	80
21	MC-384885	ANGLE, 4"TUBE TO 6"TUBE JOINT	12
20	MC-384880	PLATE-6" TUBE TO BEAM CONN.	32
19	MC-384879	PLATE-ROLLER SUPPORT-HEAD	2
18	MD-384878	FRONT ROLLER SUB-ASSEMBLY	2
17	MC-384871	TUBE BRACKET-OUTER	4
16	MC-384870	TUBE BRACKET-INNER	4
15	MC-384875-3	TUBE, VERTICAL SUPPORT-UPPER	1
14	MC-384875-2	TUBE, VERTICAL SUPPORT-MIDDLE	4
13	MC-384875-1	TUBE, VERTICAL SUPPORT-LOWER	1
12	MD-384868	TUBE, LOWER R.H. WELDMENT	1
11	MD-384869	TUBE, LOWER L.H. WELDMENT	1
10	MD-384866	TUBE, UPPER L.H. WELDMENT	1
9	MD-384864	TUBE, UPPER R.H. WELDMENT	1
8	MD-384863	TUBE, BOTTOM WELDMENT	1
7	MC-384860	TUBE, TOP CENTER WELDMENT	1
6	MD-384858	TUBE, CTR UPPER & LOWER WELDMENT	2
5	MD-384857	TUBE, BOTTOM R.H. & L.H. WELDMENT	2
4	MC-384854	TUBE, R.H. & L.H. WELDMENT	2
3	MC-384852	BEAM WELDMENT	1
2	MC-384969	TUBE, TOP R.H. WELDMENT	1
1	MC-384968	TUBE, TOP L.H. WELDMENT	1
ITEM NO.	PART NO	DESCRIPTION OR SIZE	QTY. REQ.

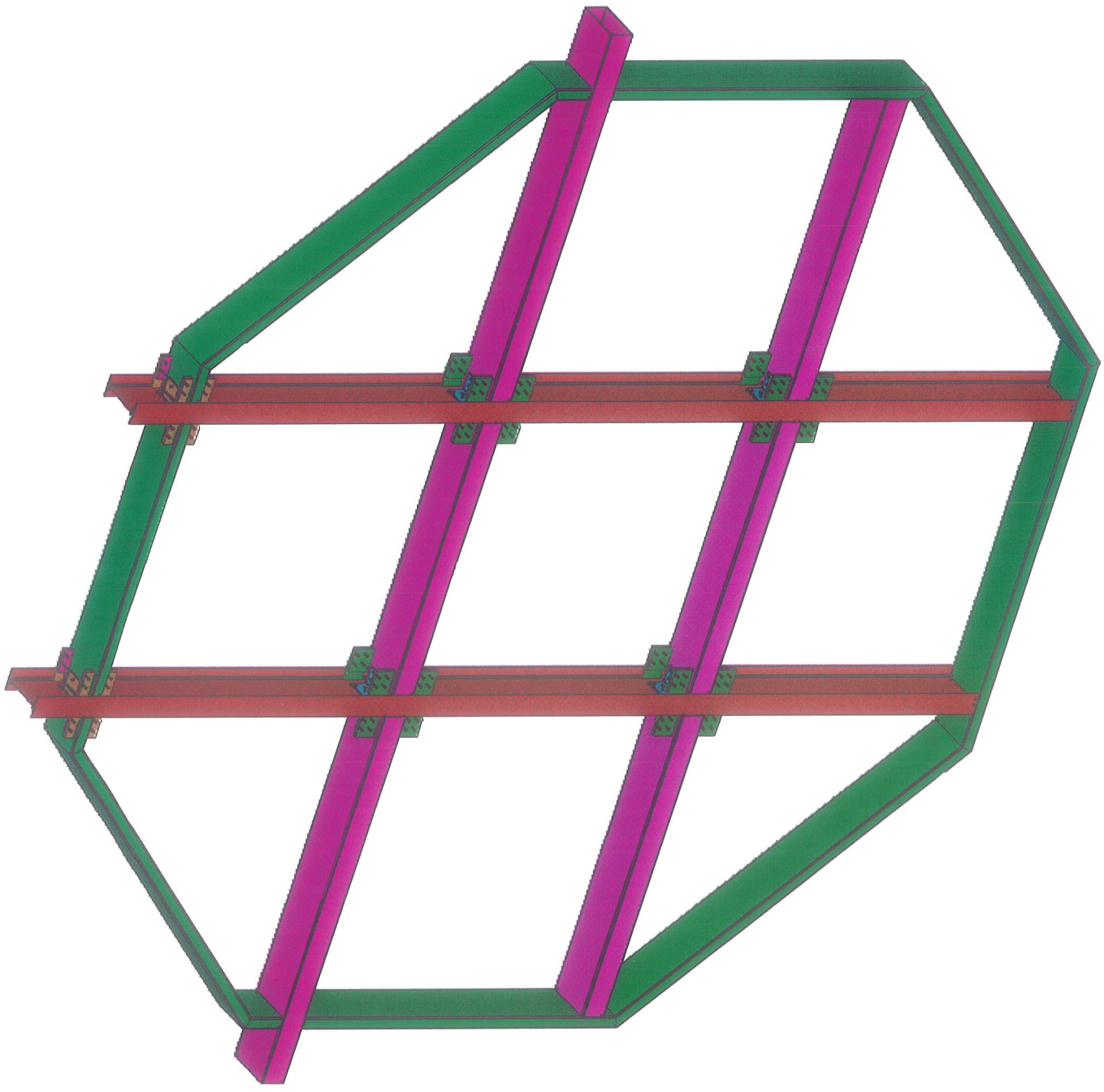
PARTS LIST

UNLESS OTHERWISE SPECIFIED		ORIGINATOR	R WOODS MA000
.XX ±	.XXX ±	ANGLES ±	DRAWN VIC MAJDANSKI 20MA000
			CHECKED C. NILA 7-25-00
1. BREAK ALL SHARP EDGES 0.01 MAX.			APPROVED JAMES R. KILMER 7-25-00
2. DO NOT SCALE DRWG. 3. DIMENSIONING IN ACCORD WITH ANSI Y14.5M-1982 STD.			USED ON
4. ALL DIMENSIONS ARE IN INCHES.			MATERIAL SEE PARTS LIST
MAX. ALL MACHINED SURFACES			

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

PPD/MECHANICAL SUPPORT
MINOS FAR DETECTOR
STRONGBACK FIXTURE WELDMENT

SCALE	DRAWING NUMBER	SHEET NO	REV
1/16 =1	9213.300-ME-384848	1 OF 2	B


X
Y
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