Fermilab

Particle Physics Division

Mechanical Department Engineering Note

Number: MD-ENG-230 _____ Date: _____ 03/04/2010

Project: _____ NOvA

Project Internal Reference: _

Title: _____ MUON CATCHER BLK TRANSPTNG FIXTURE

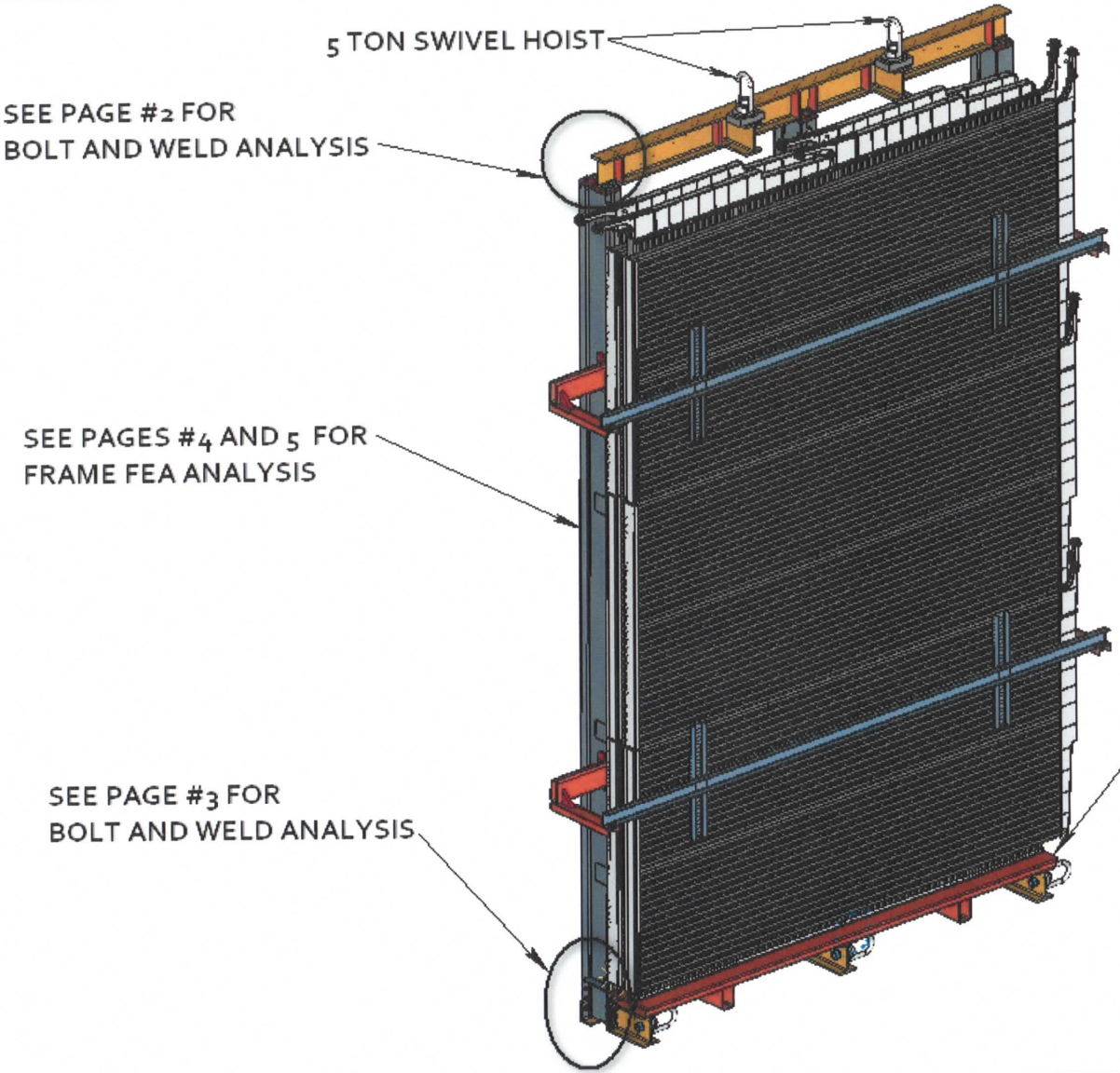
Author(s): _____ E.M.VILLEGAS

Reviewer(s): _____ 3/17/2010

Key Words: _____

Abstract/Summary: _____ THE FIXTURE IS USE TO TRANSPORT THE GLUED 4-PLANE MUON CATCHER BLOCK FROM ARGONNE TO FERMILAB. AT FERMI, THE FIXTURE WILL BE USE TO TRANSFER THE BLOCK FROM THE FIXTURE TO THE ALREADY MOUNTED 2" THICK PLATE.

Applicable Codes: _____ AISC "MANUAL OF STEEL CONSTRUCTION"



MUON CATCHER BLOCK
TRANSPORTING FIXTURE ASSY

FERMILAB
ENGINEERING NOTE

SECTION	PROJECT	SERIAL-CATEGORY	PAGE
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SUBJECT: 4-PLANE BLK TOP SUPT WLDNT
3/4-10 BOLTS & WELD LOADS

NAME: E.M. Collins
DATE: 03/02/10
REVISION DATE:

MAT'L: ASTM A36 STEEL

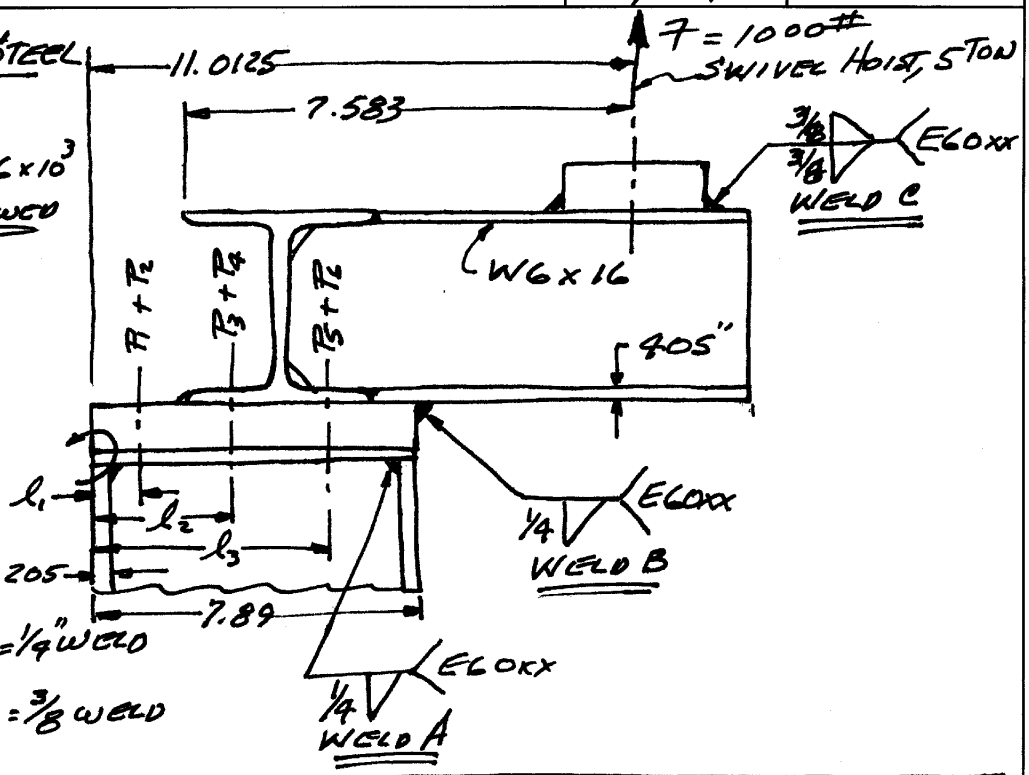
$F_Y = 36 \times 10^3$ psi

$F_{ALLOWED} = 0.6 \times 36 \times 10^3 = 21.6 \times 10^3$ ALLOWED

WELD ELECTRODE
E60XX

$F_V = 62 \times 10^3 \times 0.3$
$= 18.6 \times 10^3$ psi
ALLOWED

$F_W = \sin 45° \, w \, F_V$
$= 3{,}288$ #/IN @ w = 1/4" WELD
$= 4{,}932$ #/IN @ w = 3/8 WELD



LOAD ON 3" LG WELD A

$11.0125 \times 1000 = (7.89 - .205)3A$

$A = 479$ #/IN $< F_W = 3288$ #/IN

LOAD ON 4" LG WELD B

$11.0125 \times 1000 = 7.89 \times 4 \times B$

$B = 349$ #/IN $< F_W$

LOAD ON TWO, 4" LG WELDS C

$C = \frac{1000}{2 \times 4}$
$= 125$ #/IN $< F_W = 4932$ #/IN

USE 3/4-10, GRADE 8 BOLTS (6)

$P_{MAX\,ALLOWED} = .75 \times 130 \times 10^3 \times .334 = 3256$ # (USING 75% OF YIELD STRESS)

$P_{MIN} = 574$ (DESIGN LOAD)

$$11.0125 \times 1000 = \frac{2 l_1^2 P_6}{l_3} + \frac{2 l_2^2 P_6}{l_3} + 2 l_3 (P_6)$$
$$= .4789(P_6) + 5.4482(P_6) + 13.26(P_6)$$
$$= 19.1876(P_6)$$
$$P_6 = 574\# = P_{MIN}$$

D = BOLT DIA (.750)

K = .25 COEFFICIENT OF FRICTION (VERY DIRTY)

$T_{MIN} = P_{MIN} K D = 574 \times .25 \times .75$
$= 108$ IN-LB $\Rightarrow 9$ FT-LB

$T_{MAX} = 3256 \times .25 \times .75$
$= 610$ IN-LB $\Rightarrow$ 50 FT-LB

FERMILAB
ENGINEERING NOTE

SECTION	PROJECT	SERIAL-CATEGORY	PAGE
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SUBJECT: 4-PLANE BLOCK BOTT SUPT W/LDNT
3/4-10 BOLT & WELD LOADS

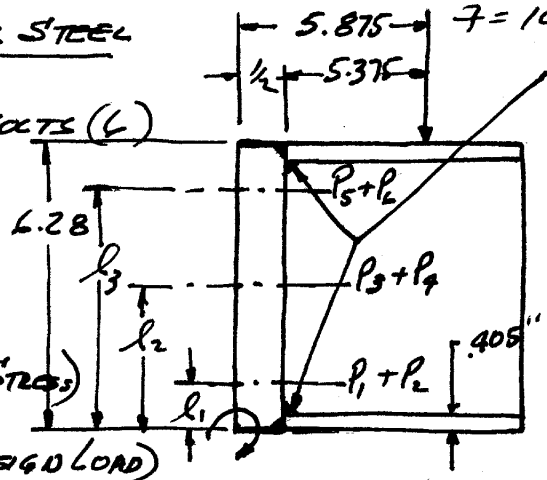
NAME: E.M. Allen
DATE: 03/02/10
REVISION DATE:

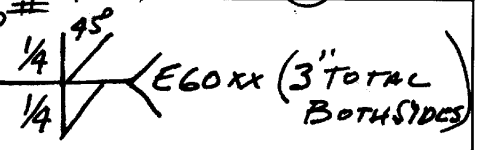
MAT'L.: ASTM A36 STEEL

3/4-10, GRADE 8 BOLTS (6)

P_{MAX} ALLOWED $= .75 \times 130 \times 10^3 \times .334$
$= 325^{\#}$
(75% OF YIELD STRESS)

$P_{MIN} = 185^{\#}$ (DESIGN LOAD)





MIN. GROOVED WELD SIZE REQ'D

$t_w = \sqrt{\frac{.405}{6}}$
$= .259$ say 1/4"

USE WELD ELECTRODE
E-60xx

$F_v = 62 \times 10^3 \times 0.3$
$= 18.6 \times 10^3$ psi

FOR A 1/4 FILLET

$F_w = \sin 45 \times .25 \times F_v$
$= 3288^{\#}$/IN ALLOWED

$$\frac{P_1}{l_1} = \frac{P_2}{l_2} = \frac{P_6}{l_3}$$

where $l_1 = 1.312$, $l_2 = 3.062$, $l_3 = 4.812$

$$P_1 = P_2 = \frac{l_1 P_6}{l_3}$$

$$P_3 = P_4 = \frac{l_2 T_6}{l_3}$$

$$M = l_1(P_1+P_2) + l_2(P_3+P_4) + l_3(P_5+P_6)$$
$$= 2l_1(P_1) + 2l_2(P_4) + 2l_3(P_6)$$
$$= 2l_1\left(\frac{l_1 P_6}{l_3}\right) + 2l_2\left(\frac{l_2 P_6}{l_3}\right) + 2l_3(P_6)$$
$$= \frac{2l_1^2(P_6)}{l_3} + \frac{2l_2^2(P_6)}{l_3} + 2l_3(P_6)$$
$$= 2 \times 1.312^2(P_6) + 2 \times 3.062^2(P_6) + 2 \times 4.812(P_6)$$
$$= 3.442(P_6) + 18.752(P_6) + 9.624(P_6)$$
$$M = 31.818(P_6) = 5.875 \times 1000$$
$$P_6 = 185^{\#}$$

WELDS IN BENDING

$f_w = \frac{M}{2S_w}$ where $M = 5.375 \times 1000$, $S_w = 4.03 \times 6.28$
$= 106^{\#}$/IN (DESIGN)

WELDS IN SHEAR

$f_w = \frac{1000}{2 \times 3}$
$= 167^{\#}$/IN

WELD SIZE REQ'D

$w = \frac{f_w}{F_w} = \frac{167}{3288}$
$= .051$" LEG SIZE

WE ARE GOOD WITH 1/4 WELDS

$K = .25$ COEFFICIENT OF FRICTION

$D = .75$ (BOLT DIA.)

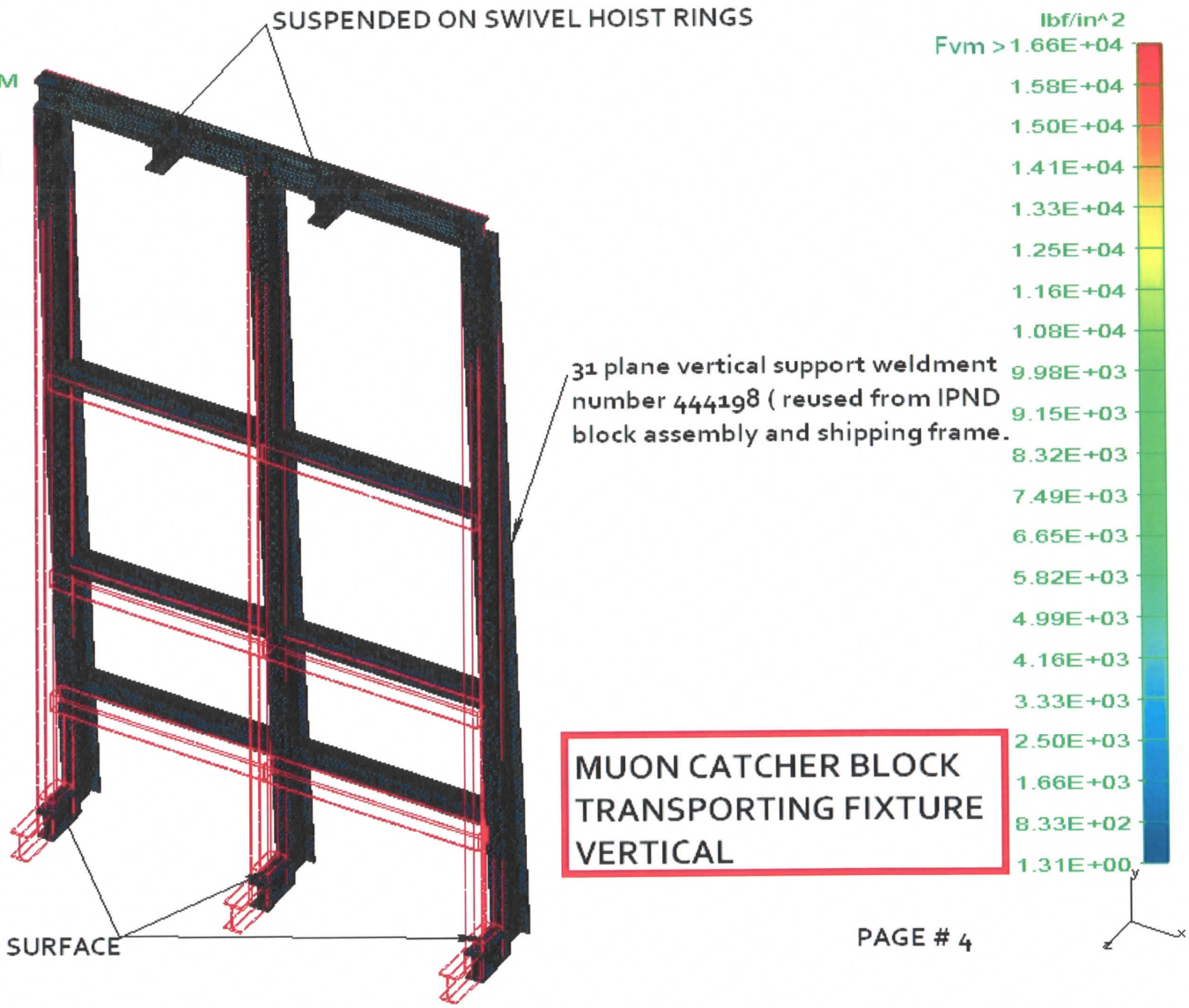
$T_{MIN} = P_{MIN} K D = 185 \times .25 \times .75$
$= 35$ IN-LB (MIN. TORQUE)

$T_{MAX} = P_{MAX} \times .25 \times .75$
$= 610$ IN-LB $\Rightarrow$ 50 FT-LB

I-DEAS 12 NX Series m2: I-DEAS Visualizer

4-PLANE_VERT_BLOCK_TRNSPG_FIXT_FEM
2000LB_LOAD-BLK_VERTICAL
STRESS Von Mises Averaged Top shell
Min: 1.31E+00 lbf/in^2 Max: 1.66E+04 lbf/in^2
B.C. 1,DISPLACEMENT_1,LOAD SET 1
DISPLACEMENT XYZ Magnitude
Min: 0.00E+00 in Max: 8.70E-01 in

MATERIAL: ASTM A36
Fvm = 0.6 x 36,000 = 21,600 psi (allowed)



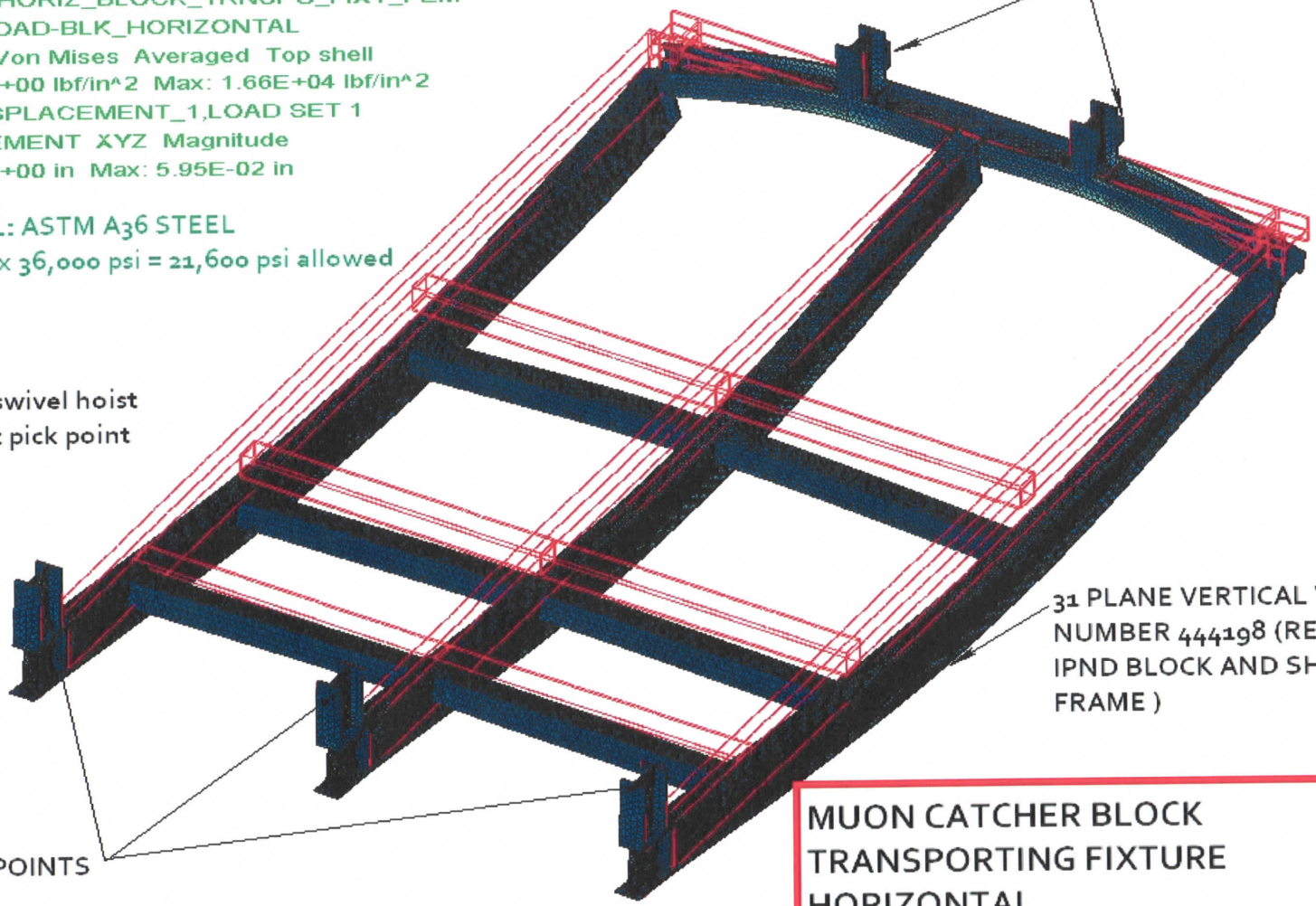
MUON CATCHER BLOCK TRANSPORTING FIXTURE VERTICAL

I-DEAS 12 NX Series m2: I-DEAS Visualizer

4-PLANE_HORIZ_BLOCK_TRNSPG_FIXT_FEM
2000LB_LOAD-BLK_HORIZONTAL
STRESS Von Mises Averaged Top shell
Min: 2.22E+00 lbf/in^2 Max: 1.66E+04 lbf/in^2
B.C. 1,DISPLACEMENT_1,LOAD SET 1
DISPLACEMENT XYZ Magnitude
Min: 0.00E+00 in Max: 5.95E-02 in

MATERIAL: ASTM A36 STEEL
Fvm = 0.6 x 36,000 psi = 21,600 psi allowed

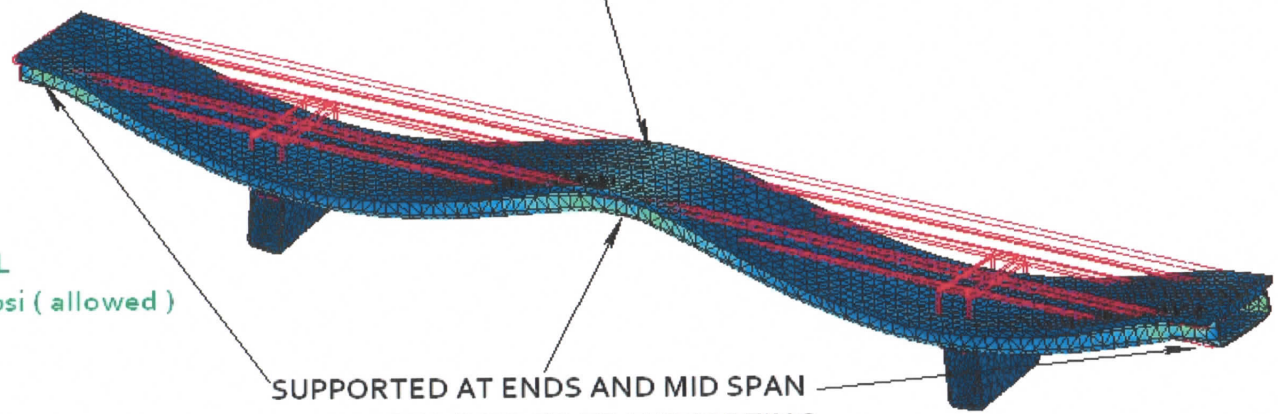
note:
Use 5 ton swivel hoist rings on at pick point locations



MUON CATCHER BLOCK TRANSPORTING FIXTURE HORIZONTAL

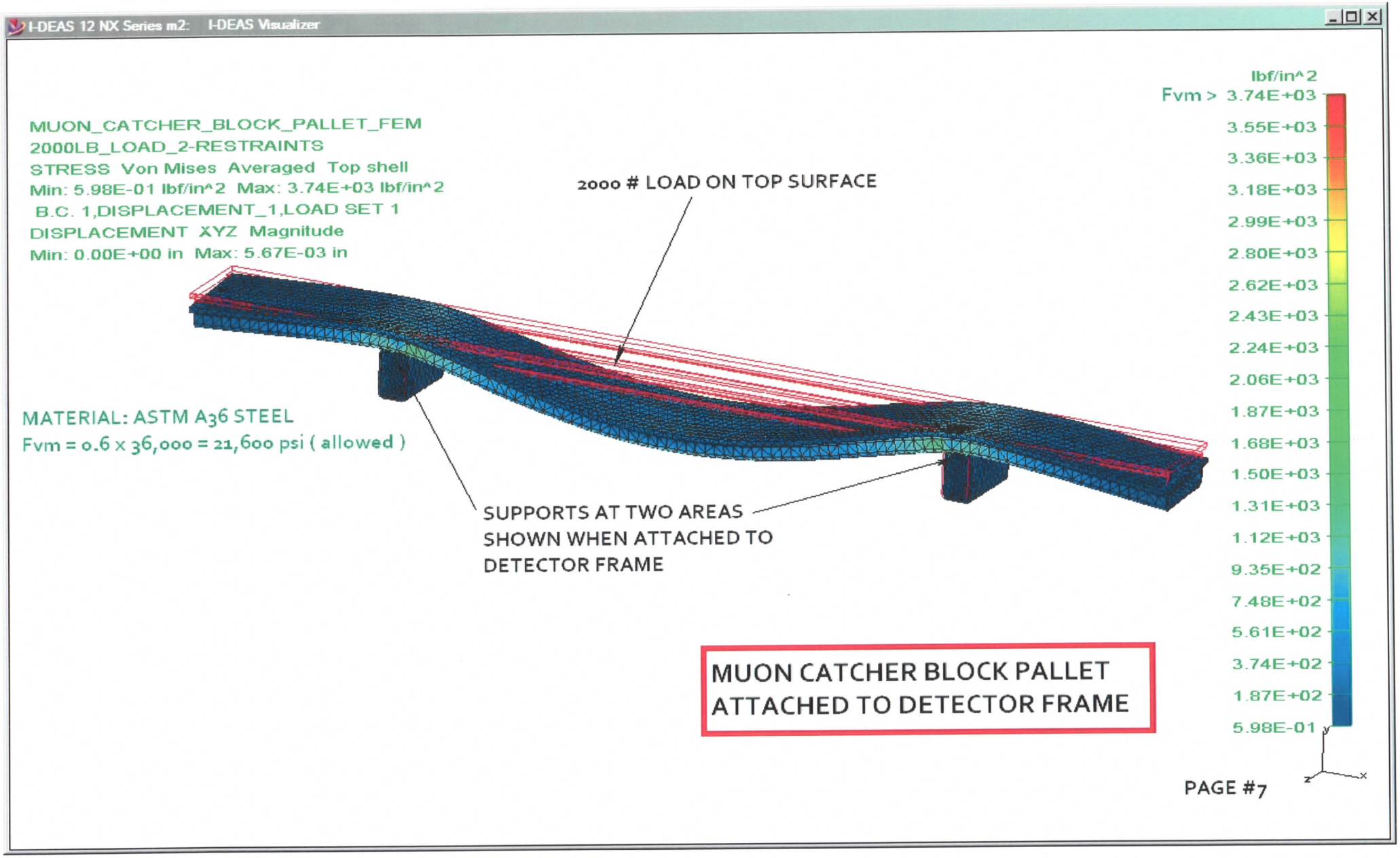
I-DEAS 12 NX Series m2: I-DEAS Visualizer

MUON_CATCHER_BLOCK_PALLET_FEM
2000LB_LOAD_3-RESTRAINTS
STRESS Von Mises Averaged Top shell
Min: 1.25E-03 lbf/in^2 Max: 3.19E+03 lbf/in^2
B.C. 1,DISPLACEMENT_1,LOAD SET 1
DISPLACEMENT XYZ Magnitude
Min: 0.00E+00 in Max: 3.04E-03 in



MATERIAL: ASTM A36 STEEL
Fvm = 0.6 x 36,000 = 21,600 psi (allowed)

MUON CATCHER BLOCK PALLET ATTACHED TO TRANPORT FIXT.


I-DEAS 12 NX Series m2: I-DEAS Visualizer
MUON_CATCHER_BLOCK_PALLET_FEM
2000LB_LOAD_2-RESTRAINTS
STRESS Von Mises Averaged Top shell
Min: 5.98E-01 lbf/in^2 Max: 3.74E+03 lbf/in^2
B.C. 1,DISPLACEMENT_1,LOAD SET 1
DISPLACEMENT XYZ Magnitude
Min: 0.00E+00 in Max: 5.67E-03 in
2000 # LOAD ON TOP SURFACE
MATERIAL: ASTM A36 STEEL
Fvm = 0.6 x 36,000 = 21,600 psi (allowed)
SUPPORTS AT TWO AREAS
SHOWN WHEN ATTACHED TO
DETECTOR FRAME
lbf/in^2
Fvm > 3.74E+03
3.55E+03
3.36E+03
3.18E+03
2.99E+03
2.80E+03
2.62E+03
2.43E+03
2.24E+03
2.06E+03
1.87E+03
1.68E+03
1.50E+03
1.31E+03
1.12E+03
9.35E+02
7.48E+02
5.61E+02
3.74E+02
1.87E+02
5.98E-01
MUON CATCHER BLOCK PALLET
ATTACHED TO DETECTOR FRAME