Job: 25-240 11041 SW 77th Ave.

LOCATION: 11041 SW 77th Ave. Pinecrest FL 33156

STRUCTURAL CALCULATIONS

DESIGN CRITERIA:

Calculations based on:

1. 2023 Florida Building Code
2. Minimum Design Loads for Buildings and Other Structures ASCE 7-22
3. Building Code Requirements for Structural Concrete ACI 318-19
4. American Institute of Steel Construction AISC-15 Ed
5. Specifications for the Design of Cold-Formed Stainless Steel Structural Members SEI/ASCE8-02
6. 2025 Aluminum Design Manual

CALCULATION INDEX:

I	Cover page	1
II	Steel Stair Design & Analysis	2-58

CALCULATION STATEMENT:

To the best of my knowledge, ability, belief and professional judgment, I hereby attest that the manual calculations and computer generated calculations are in compliance with the existing governing codes.

ALAYM AGUILAR LICENSE No. 92154 STATE OF FLORIDA PROFESSIONAL ENGINEER

Alaym Aguilar

Digitally signed by Alaym Aguilar
Date: 2025.11.05 09:48:02 -05'00'

Alaym Aguilar, State of Florida, Professional Engineer, License No. 92154. This item has been digitally signed and sealed by Alaym Aguilar, PE, on the date provided on the signature. Printed copies of this document are not considered signed and sealed and the signature must be verified on any copies.

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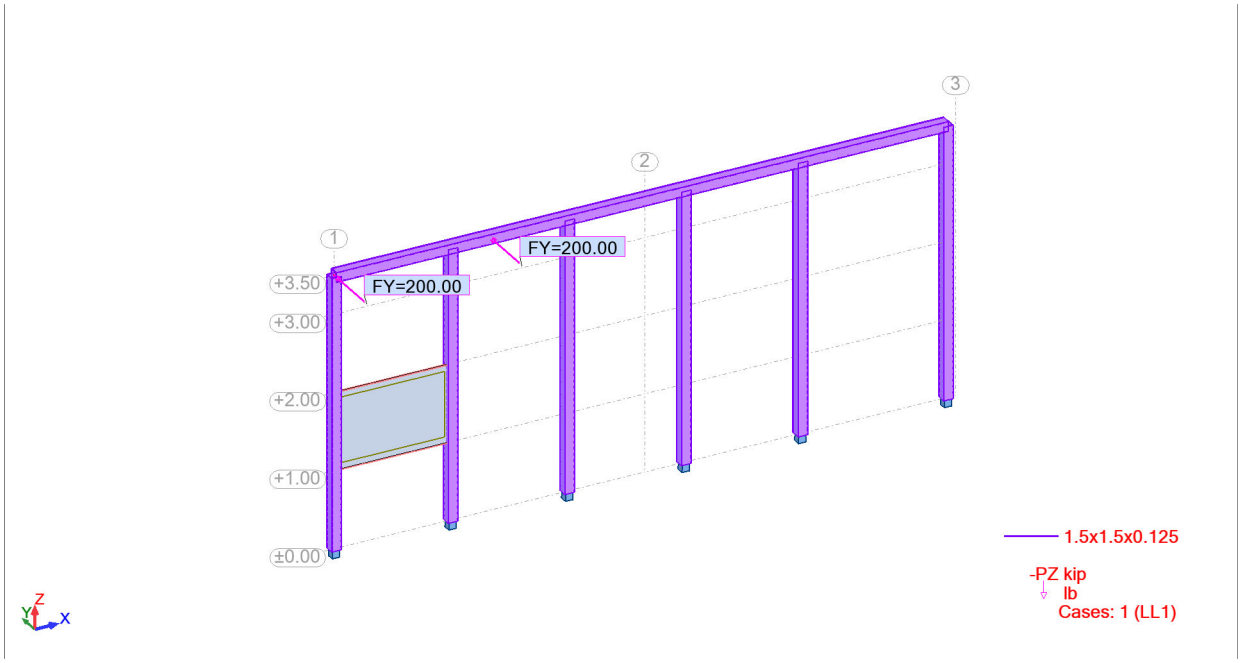
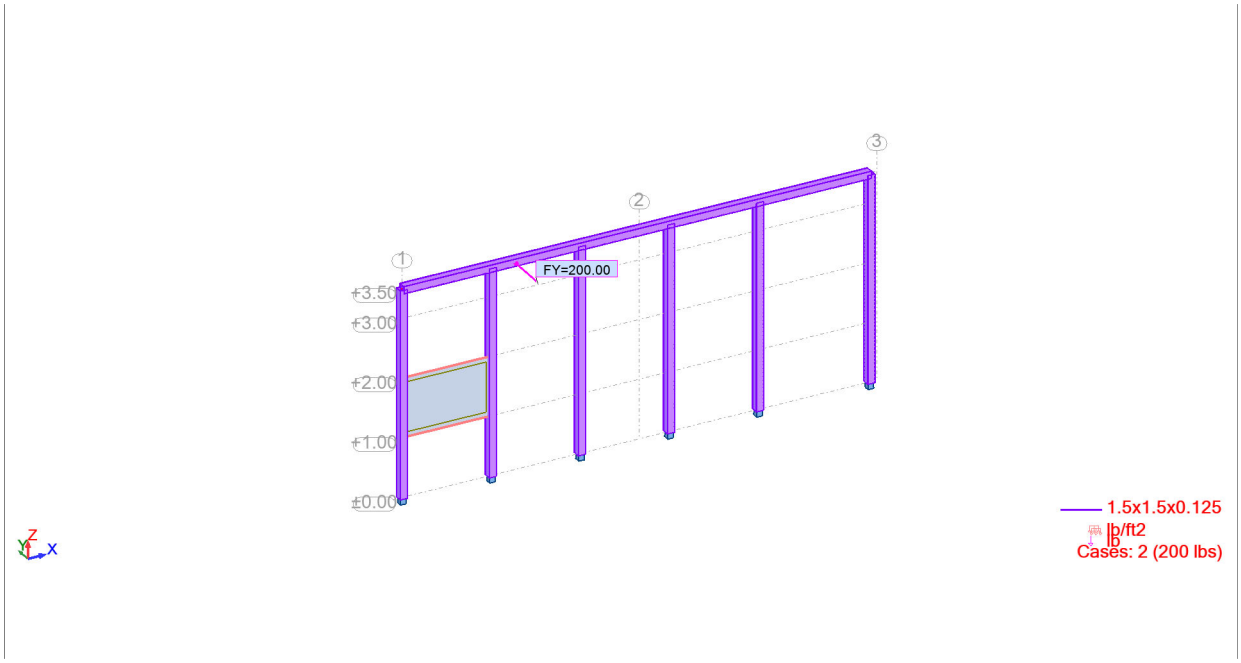
Alaym Aguilar, P.E
Lic. No. 92154

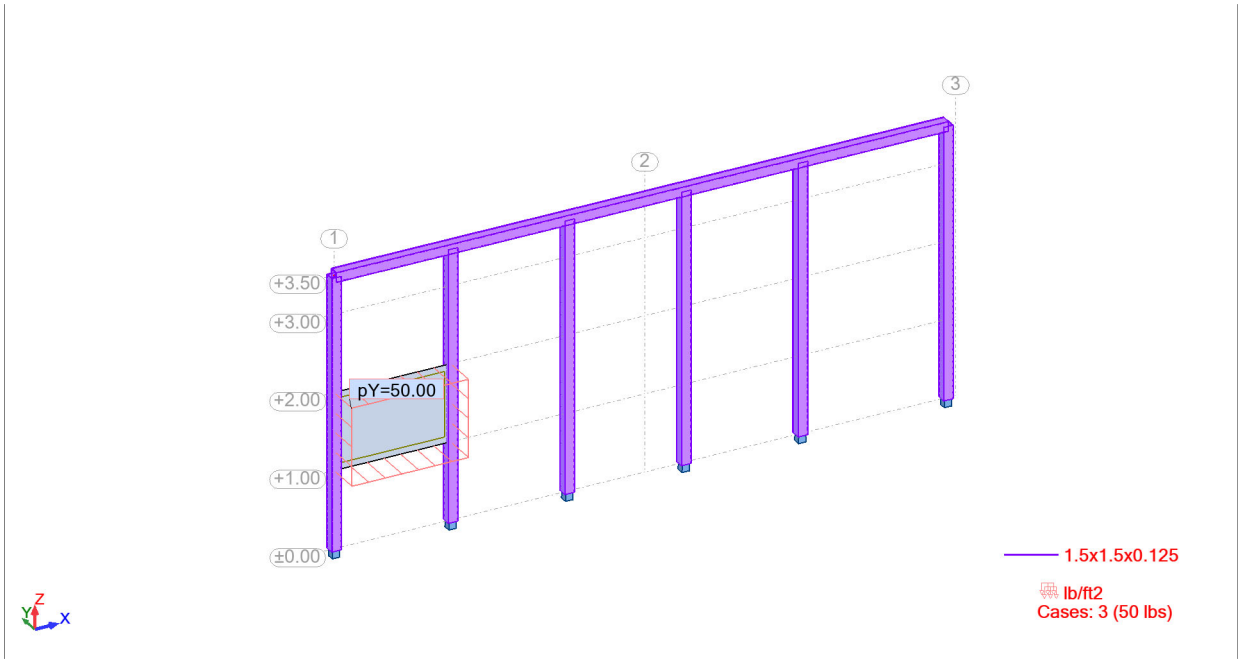
View - Cases: 1 (LL1)



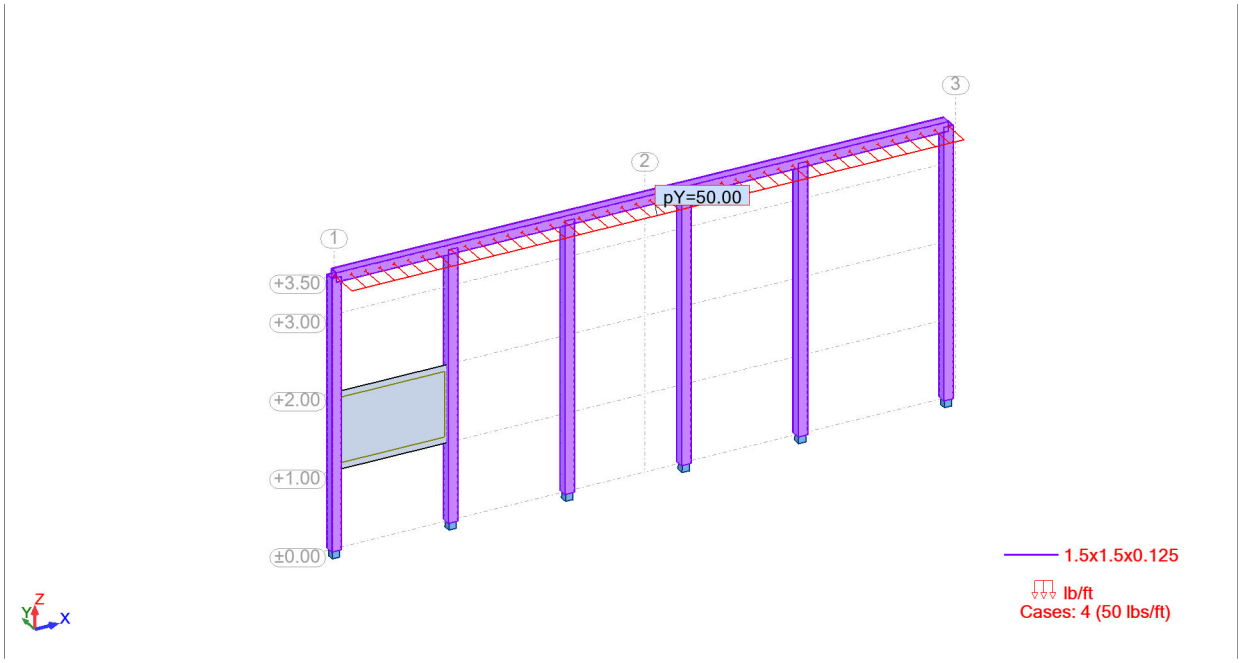
View - Cases: 2 (200 lbs)



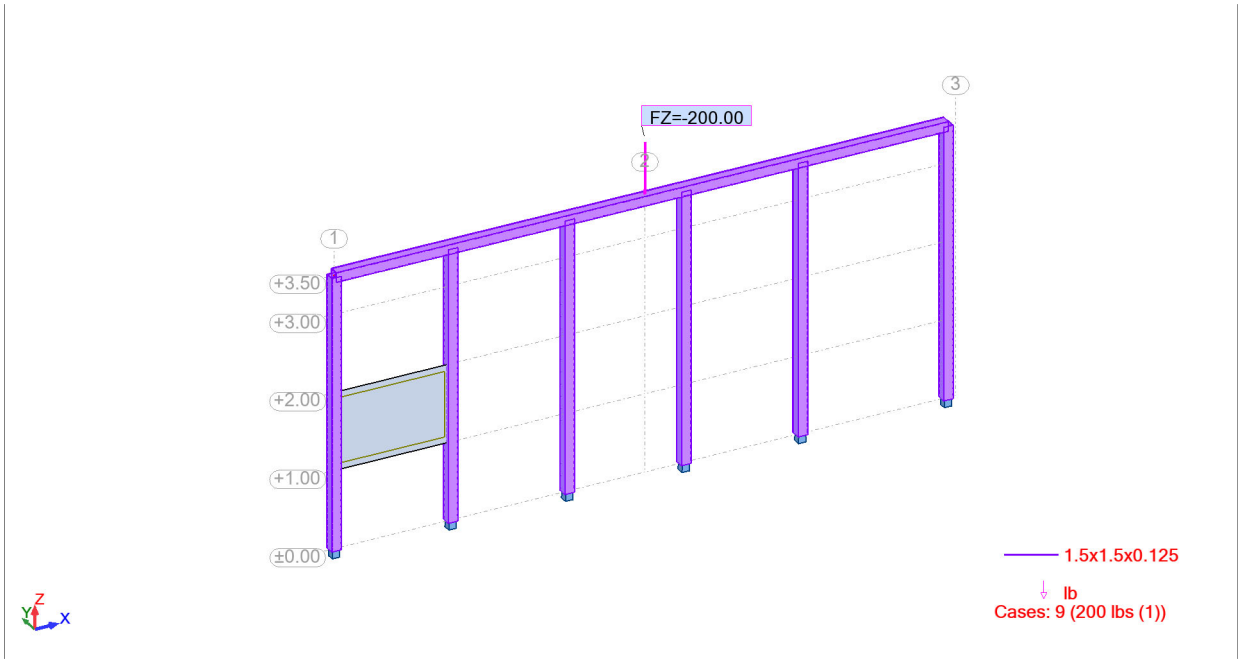
View - Cases: 3 (50 lbs)



View - Cases: 4 (50 lbs/ft)



View - Cases: 9 (200 lbs (1))



Analysis Railing

Robot Structural Analysis Professional 2025

Date: 01/04/25

Characteristics of analysis example:

Structure type: Space frame

Structure geometrical center coordinates:
X = 3.938 *(ft)*
Y = 0.000 *(ft)*
Z = 1.500 *(ft)*

Structure gravity center coordinates:
X = 3.937 *(ft)*
Y = 0.000 *(ft)*
Z = 1.827 *(ft)*
Central moments of inertia of a structure:
Ix = 67.160 *(lb*ft2)*
Iy = 550.136 *(lb*ft2)*
Iz = 483.017 *(lb*ft2)*
Mass = 69.198 *(lb)*

Structure description

Number of nodes:	53
Number of members:	23
Member finite elements:	52
Planar finite elements:	0
Volumetric finite elements:	0
Rigid links:	0
Releases:	0
Unidirectional releases:	0
Non-linear releases:	0
Compatibilities:	0
Elastic compatibilities:	0
Non-linear compatibilities:	0
Supports:	22
Elastic supports:	0
Unidirectional supports:	0
Non-linear supports:	0
Non-linear hinges:	0
Cases:	10
Combinations:	5

Calculation summary

Solution method - SKYLINE

No of static degr. of freedom:	186

Bandwidth

before/after optimization:	288 30

Time info [sec]

Max time of aggreg. + decomp.:	0
Max time of subspace iterat.:	0
Max time of nonlinear iterat.:	0
Total time:	1

Disk and core usage [B]

Total disk space:	75768
For solver TMP files:	0
For subspace iter. TMP files:	0
Memory:	172812

Stiffness matrix diagonal elements

Min/Max after decomposition:	9.642679e+02 1.904650e+09
Precision:	9

Table of load cases / analysis types

Case 1 : LL1
Analysis type: Static - Linear

Potential energy : 3.57372e+00 (lb*ft)

Precision : 1.87071e-12

Case 2 : 200 lbs
Analysis type: Static - Linear

Potential energy : 4.15076e+00 (lb*ft)
Precision : 2.41627e-12

Case 3 : 50 lbs
Analysis type: Static - Linear

Potential energy : 1.46164e-01 (lb*ft)
Precision : 2.20114e-12

Case 4 : 50 lbs/ft
Analysis type: Static - Linear

Potential energy : 1.13238e+01 (lb*ft)
Precision : 1.11434e-11

Case 5 : 1.6 LL
Analysis type: Linear combination

Case 6 : 1.6 (50)
Analysis type: Linear combination

Case 7 : 1.6 (50 lb/ft)
Analysis type: Linear combination

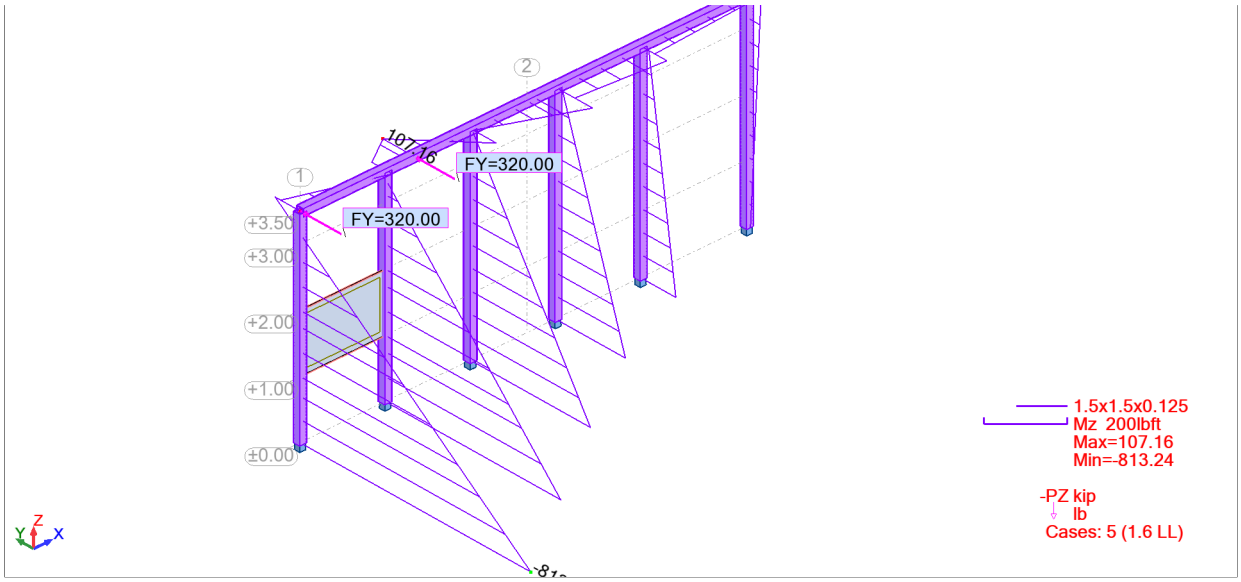
Case 8 : 1.6 (200 lbs)
Analysis type: Linear combination

Case 9 : 200 lbs (1)
Analysis type: Static - Linear

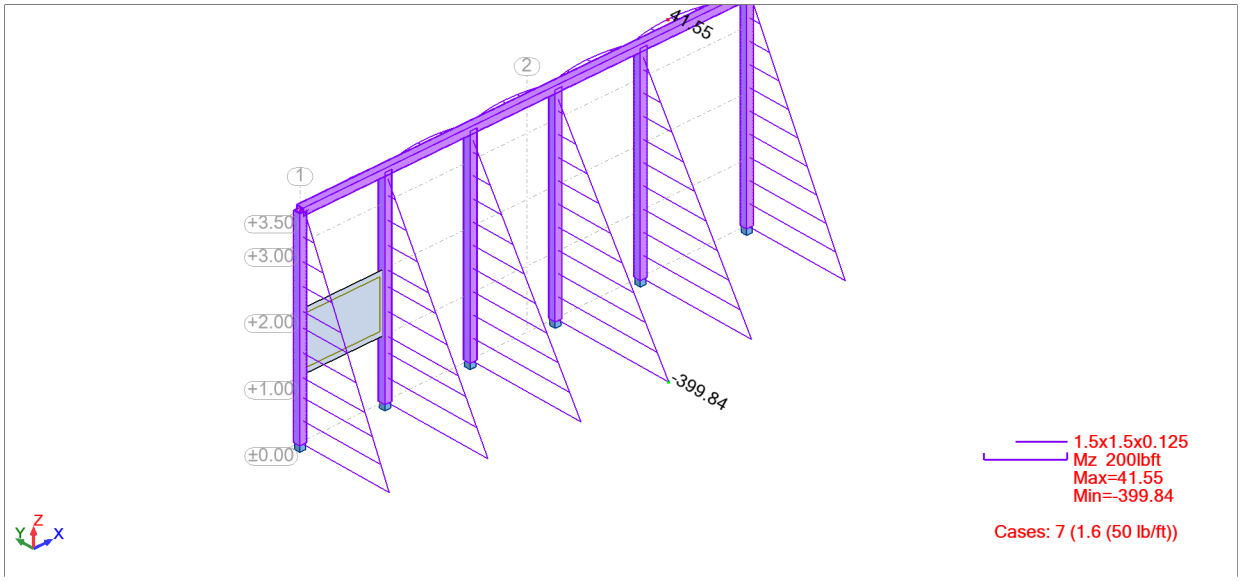
Potential energy : 1.42340e-02 (lb*ft)
Precision : 5.91101e-16

Case 10 : 1.6 (200 lbs)(1)
Analysis type: Linear combination

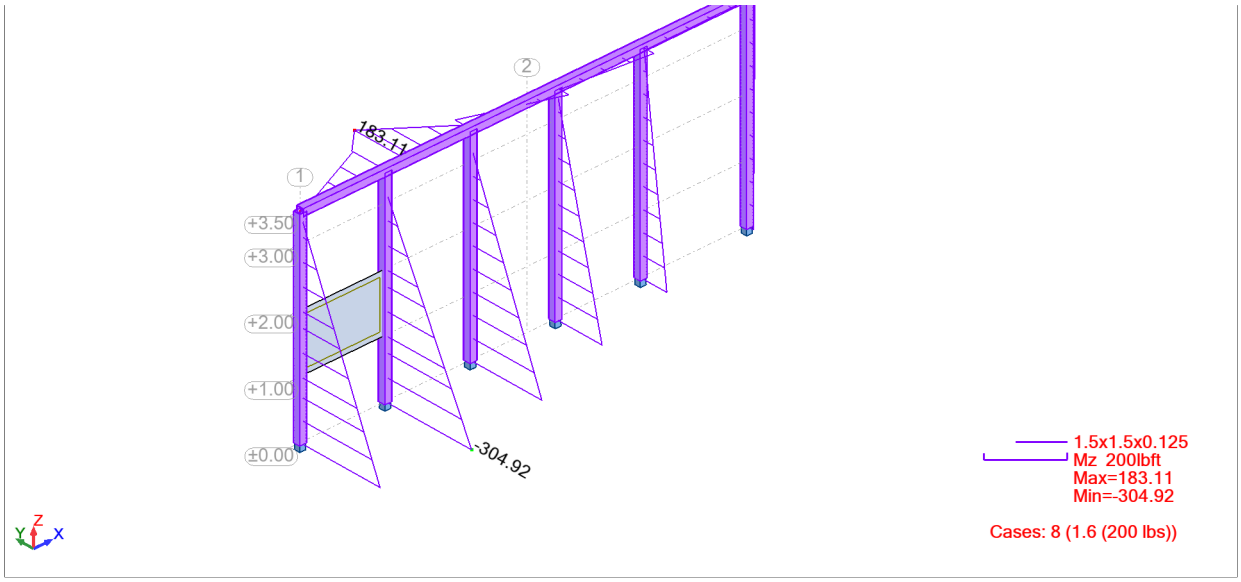
View - MZ, Cases: 5 (1.6 LL)



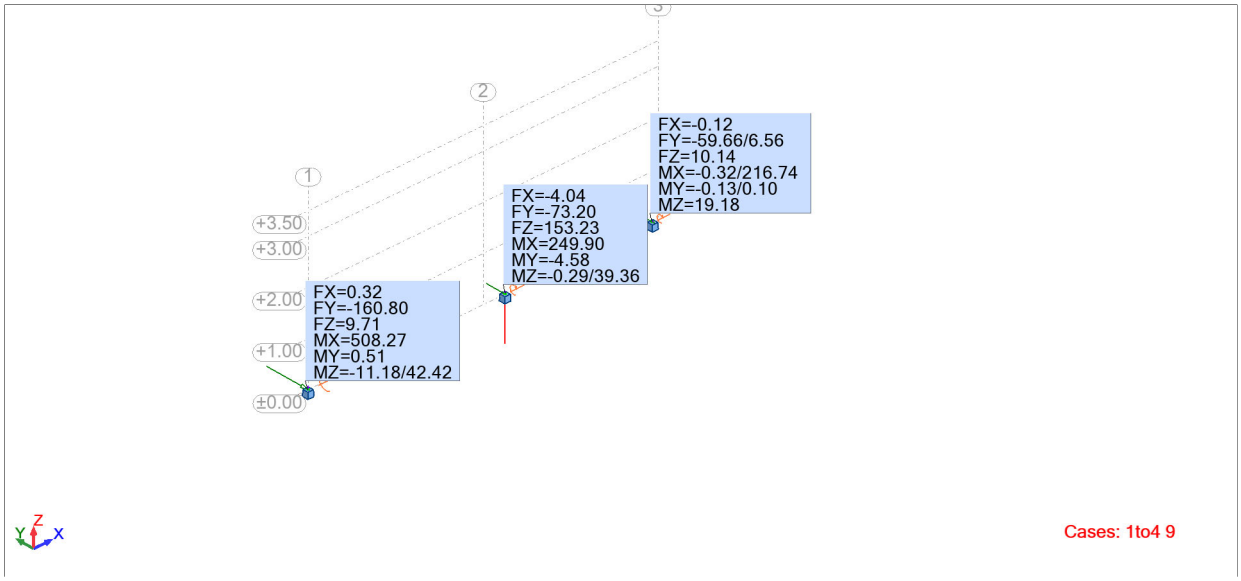
View - MZ, Cases: 7 (1.6 (50 lb/ft))



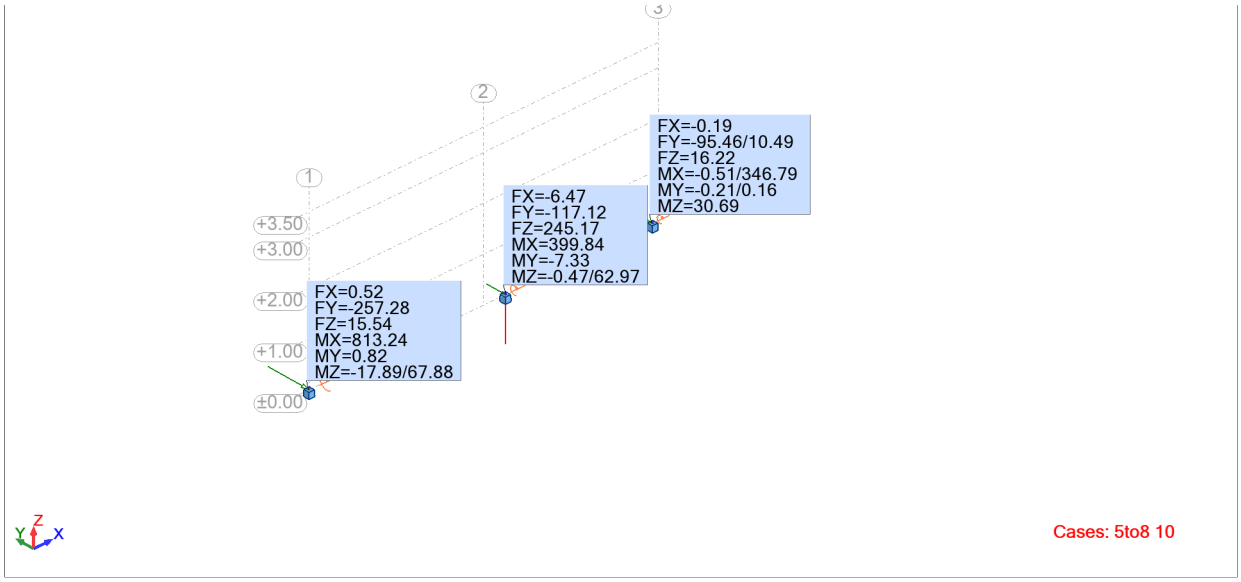
View - MZ, Cases: 8 (1.6 (200 lbs))



View:1 - Reaction forces(lb,lb/ft),Reaction moments(lb*ft,lb*ft/ft), Cases: 1to4 9



View:1 - Reaction forces(lb,lb/ft),Reaction moments(lb*ft,lb*ft/ft), Cases: 5to8 10



STEEL DESIGN

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 1 Simple member_1 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 5 1.6 LL 1*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: 1.5x1.5x0.125

d=1.50 in	Ay=0.281 in2	Az=0.281 in2	Ax=0.688 in2
bf=1.50 in	Iy=0.218 in4	Iz=0.218 in4	J=0.325 in4
tw=0.13 in	Sy=0.291 in3	Sz=0.291 in3	
tf=0.13 in	Zy=0.355 in3	Zz=0.355 in3	

MEMBER PARAMETERS:

Ly = 3.50 ft	Lz = 3.50 ft
Lcy = 3.50 ft	Lcz = 3.50 ft
Lcy/ry = 74.51	Lcz/rz = 74.51

INTERNAL FORCES:
Tr = 67.88 lb*ft

DESIGN STRENGTHS
FiT*Tn = 753.48 lb*ft

Pr = 15.54 lb
Fic*Pn = 16629.35 lb
Mry = 0.14 lb*ft
Vry = -257.28 lb
Fib*Mny = 959.77 lb*ft
Fiv*Vny = 5467.50 lb
Mrz = -813.24 lb*ft
Vrz = -0.11 lb
Fib*Mnz = 959.77 lb*ft
Fiv*Vnz = 5467.50 lb

SAFETY FACTORS
Fib = 0.90
Fic = 0.90
Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact
Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.85 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.05 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 74.51 < (Lc/r),max = 200.00 Lcz/rz = 74.51 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 2 Simple member_2 **POINT:** 3 **COORDINATE:** x = 0.24 L = 1.87 ft

---

LOADS:
Governing Load Case: 8 1.6 (200 lbs) 2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: 1.5x1.5x0.125

d=1.50 in	Ay=0.281 in2	Az=0.281 in2	Ax=0.688 in2
bf=1.50 in	Iy=0.218 in4	Iz=0.218 in4	J=0.325 in4
tw=0.13 in	Sy=0.291 in3	Sz=0.291 in3	
tf=0.13 in	Zy=0.355 in3	Zz=0.355 in3	

MEMBER PARAMETERS:

Ly = 7.87 ft
Lz = 7.87 ft
Lcy = 7.87 ft
Lcz = 7.87 ft
Lcy/ry = 167.66
Lcz/rz = 167.66

INTERNAL FORCES:
Tr = -28.35 lb*ft
DESIGN STRENGTHS
FiT*Tn = 753.48 lb*ft
Vry = -175.76 lb
Fiv*Vny = 5467.50 lb
Mrz = 183.11 lb*ft
Fib*Mnz = 959.77 lb*ft
Fiv*Vnz = 5467.50 lb

SAFETY FACTORS
Fib = 0.90
Fiv = 0.90

SECTION ELEMENTS:

Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Mrz/(Fib*Mnz) = 0.19 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.03 < 1.00 LRFD (G) Verified

Section OK !!!

Weld Design For Tube

MATERIALS:

Electrodes:
E 70 XX ----Fu= 70 Ksi

Weld and Section Data:

$F_u := 70.00$ Ultimate Tensile Strength (ksi)

$b := 2.0$ Width of Tube Steel (in)

$d := 1.0$ Depth of Tube Steel (in)

Load Data:

$M_{weld} := 0.5$ Moment (Kips-ft)

$V_{weld} := 0.1$ Shear (Kips)

$P_{weld} := 0.0$ Tension or Compression (Kips)

$T_{weld} := 0.0$ Torsional Moment (kips-ft)

Check Weld Section :

$F_v := 0.3 \cdot F_u$ $F_v = 21.00$ ksi

$$t_e := \left| \begin{array}{l} x \leftarrow 0.00001 \\ \text{while } \sqrt{\left[\frac{P_{weld}}{2(b+d)\cdot x} + \frac{M_{weld}\cdot 12}{\left(b\cdot d + \frac{d^2}{3}\right)\cdot x}\right]^2 + \left[\frac{1.5V_{weld}}{2(b+d)\cdot x} + \frac{T_{weld}\cdot 12\cdot\sqrt{\left(\frac{b}{2}\right)^2+\left(\frac{d}{2}\right)^2}}{\frac{(b+d)^3}{6}\cdot x}\right]^2} \geq F_v \\ x \leftarrow x + 0.01 \end{array} \right.$$

$t_e = 0.13$ in

$S_{weld} := \left(b\cdot d + \frac{d^2}{3}\right)\cdot t_e$ $S_{weld} = 0.30$ in^3

$A_{weld} := 2\cdot(d+b)\cdot t_e$ $A_{weld} = 0.78$ in^2

$J_{weld} := \frac{(b+d)^3}{6}\cdot t_e$ $J_{weld} = 0.59$ in^3

Check Bending Stress :

$f_b := \frac{M_{weld}\cdot(12)}{S_{weld}}$ $f_b = 19.78$ ksi

Check Shear Stress :

$$f_v := \frac{1.5V_{weld}}{A_{weld}} + \frac{T_{weld} \cdot 12 \cdot \sqrt{\left(\frac{b}{2}\right)^2 + \left(\frac{d}{2}\right)^2}}{J_{weld}} \qquad f_v = 0.19 \quad \text{ksi}$$

Check Tension Stress :

$$f_a := \frac{P_{weld}}{A_{weld}} \qquad f_a = 0.00 \quad \text{Ksi}$$

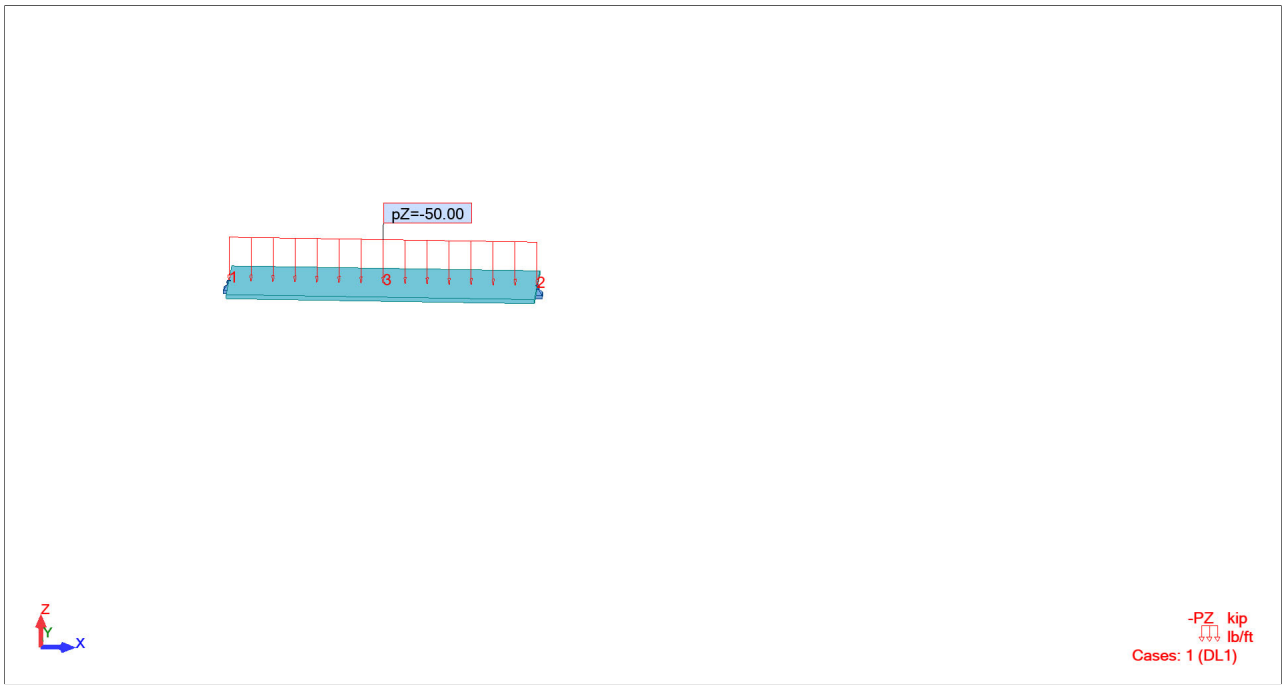
Check Combined Stress :

$$f_{weld} := \sqrt{\left(f_b + f_a\right)^2 + f_v^{\,2}} \qquad f_{weld} = 19.78 \quad \text{ksi}$$

$$STRESS := \begin{cases} \text{"N.G."} \\ \text{"OK"} \quad \text{if } F_v \geq f_{weld} \end{cases} \qquad STRESS = \text{"OK"}$$

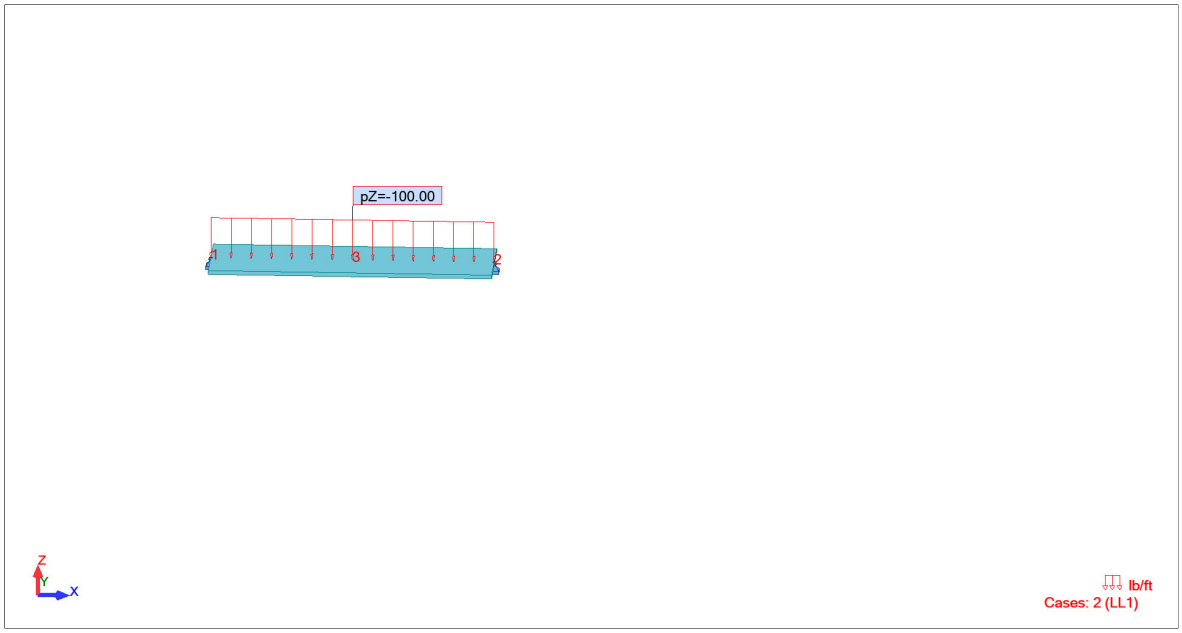
$$W_{weld} := \begin{cases} \text{"3/16"} \quad \text{if } \frac{t_e}{0.707} \leq 0.1875 \\ \text{" 1/4"} \quad \text{if } 0.1875 < \frac{t_e}{0.707} \leq 0.25 \\ \text{"3/8"} \quad \text{if } 0.25 < \frac{t_e}{0.707} \leq 0.375 \\ \text{"1/2"} \quad \text{if } 0.375 < \frac{t_e}{0.707} \leq 0.50 \\ \text{"5/8"} \quad \text{if } 0.50 < \frac{t_e}{0.707} \leq 0.625 \\ \text{"3/4"} \quad \text{if } 0.625 < \frac{t_e}{0.707} \leq 0.750 \\ \text{"1"} \quad \text{if } 0.75 < \frac{t_e}{0.707} \leq 1.00 \end{cases} \qquad W_{weld} = \text{"3/16"}$$

View - Cases: 1 (DL1)



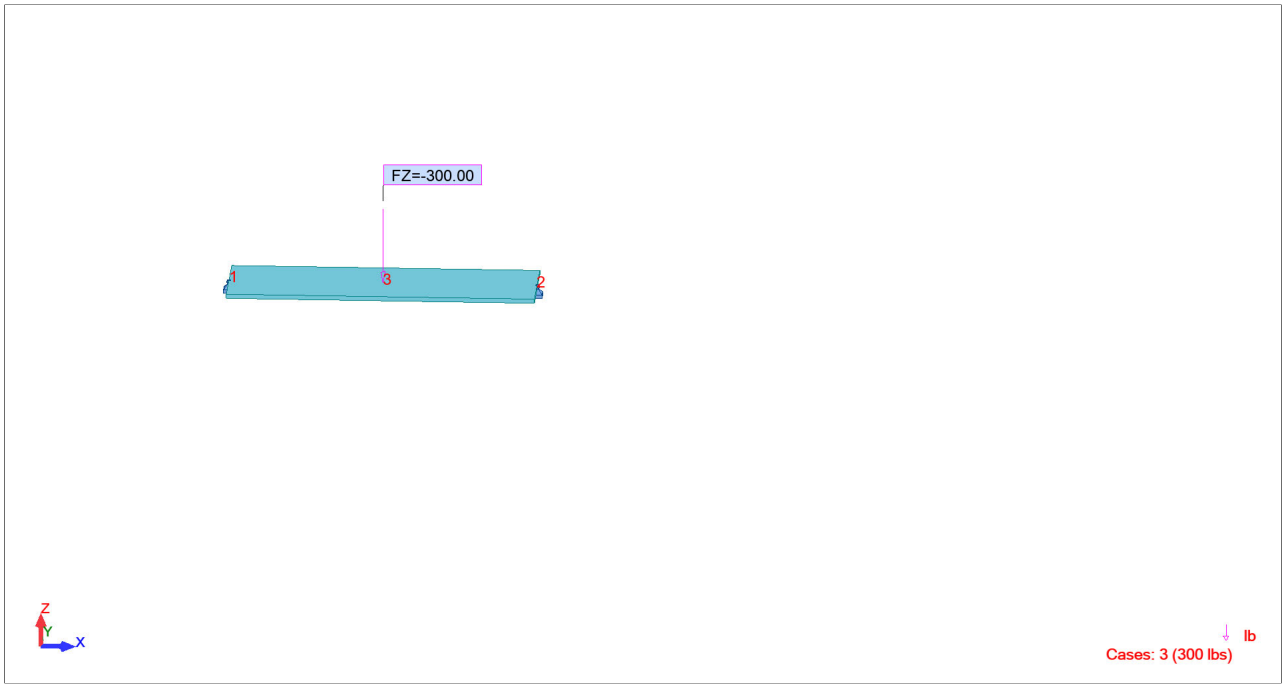
19/12/23 13:57

View - Cases: 2 (LL1)



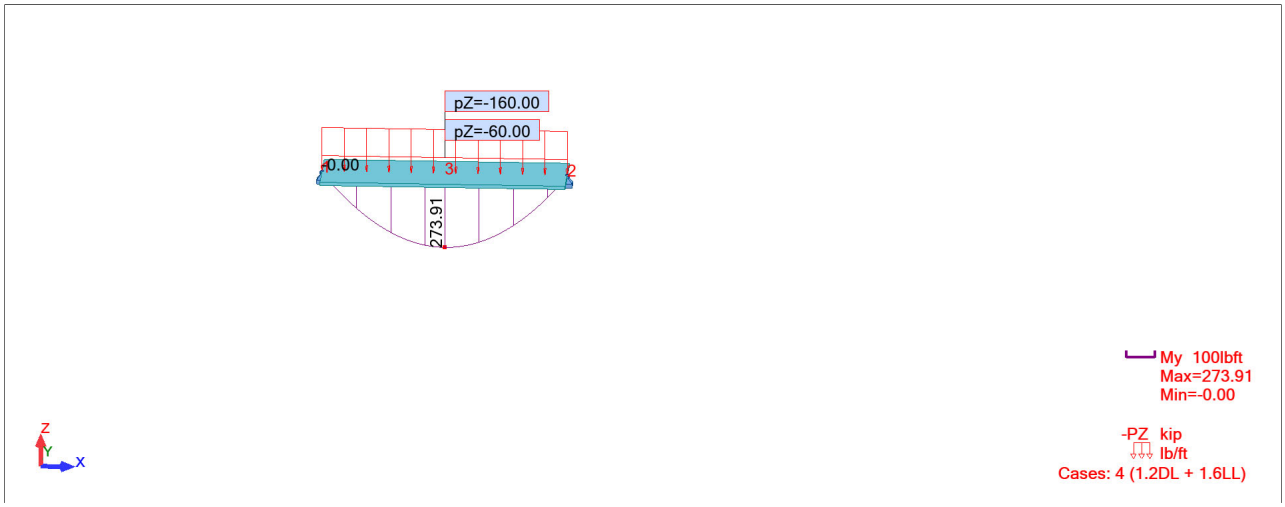
19/12/23 13:57

View - Cases: 3 (300 lbs)



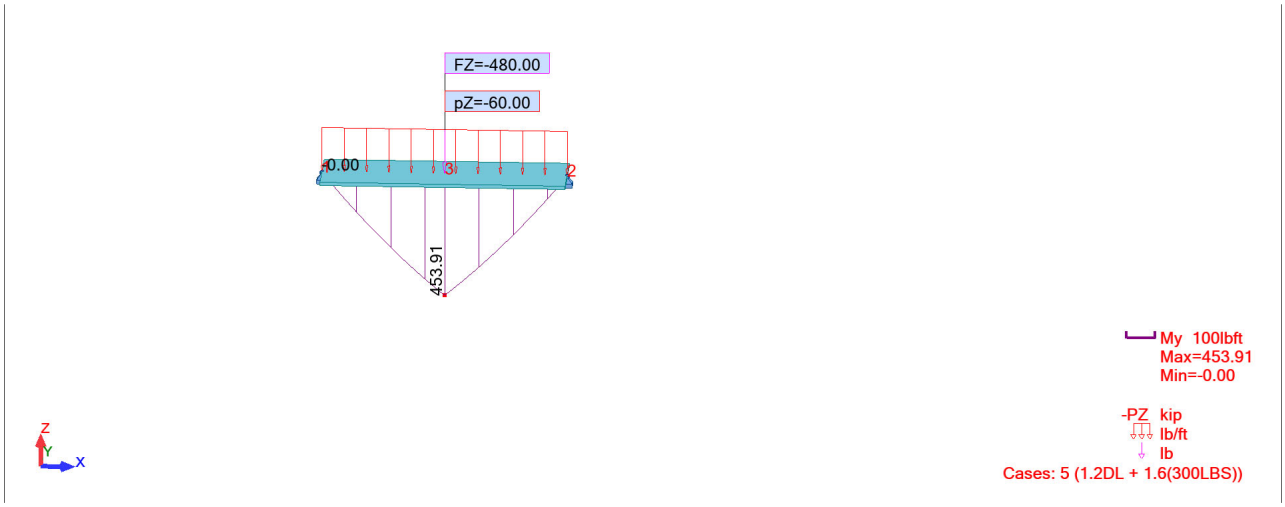
19/12/23 13:57

View - MY, Cases: 4 (1.2DL + 1.6LL)



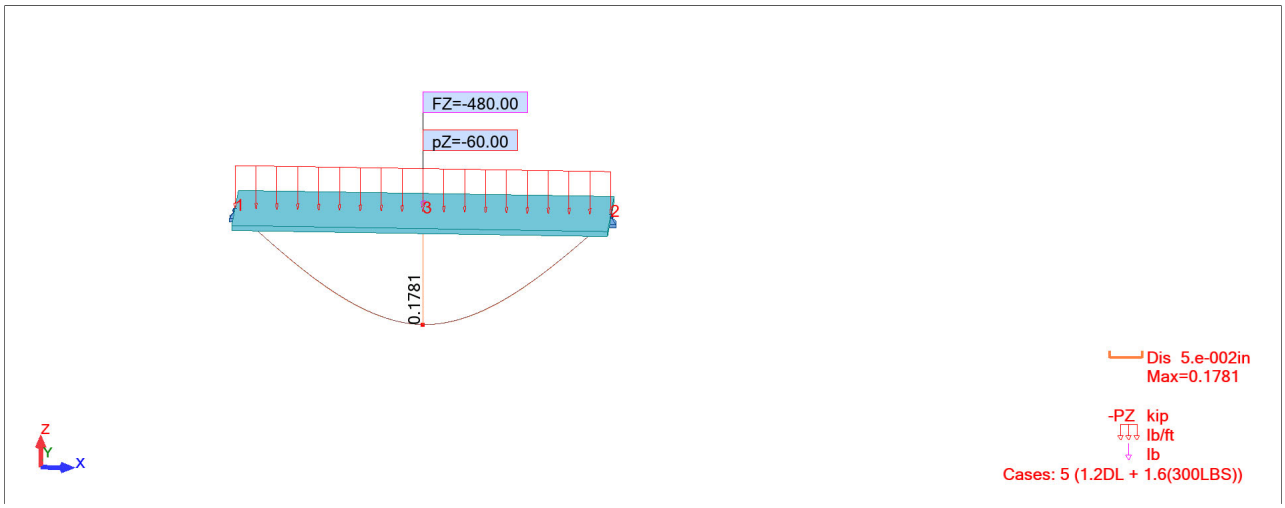
19/12/23 13:57

View - MY, Cases: 5 (1.2DL + 1.6(300LBS))



19/12/23 13:57

View - Deformation,Exact deformation(s), Cases: 5 (1.2DL + 1.6(300LBS))



19/12/23 13:57

Analysis

Autodesk Robot Structural Analysis Professional 2022

Date: 19/12/23

Project properties: **Structure**

File Name::
Folder:
Created:
Modified:
Size:

Author:
Office:
Address:

Characteristics of analysis example:

Structure type: Space frame

Structure geometrical center coordinates:
X = 1.500 *(ft)*
Y = 0.000 *(ft)*
Z = 0.000 *(ft)*

Structure gravity center coordinates:
X = 1.500 *(ft)*
Y = 0.000 *(ft)*
Z = 0.000 *(ft)*
Central moments of inertia of a structure:
Ix = 0.034 *(lb*ft2)*
Iy = 48.516 *(lb*ft2)*
Iz = 44.032 *(lb*ft2)*
Mass = 58.698 *(lb)*

Structure description

Number of nodes:	3
Number of members:	1
Member finite elements:	2
Planar finite elements:	0
Volumetric finite elements:	0
Rigid links:	0
Releases:	0
Unidirectional releases:	0
Non-linear releases:	0
Compatibilities:	0
Elastic compatibilities:	0
Non-linear compatibilities:	0
Supports:	2
Elastic supports:	0
Unidirectional supports:	0
Non-linear supports:	0
Non-linear hinges:	0
Cases:	5
Combinations:	2

Calculation summary

Solution method - SKYLINE

No of static degr. of freedom:	12	

Bandwidth

before/after optimization:	12	12

Time info [sec]

Max time of aggreg. + decomp.:	3
Max time of subspace iterat.:	0
Max time of nonlinear iterat.:	0
Total time:	3

Disk and core usage [B]

Total disk space:	2856
For solver TMP files:	0
For subspace iter. TMP files:	0
Memory:	118060

Stiffness matrix diagonal elements
Min/Max after decomposition: 1.000000e+00 3.244711e+09
Precision: 6

Table of load cases / analysis types

Case 1 : DL1
Analysis type: Static - Linear

Potential energy : 2.00992e-01 (lb*ft)
Precision : 4.49307e-16

Case 2 : LL1
Analysis type: Static - Linear

Potential energy : 4.15322e-01 (lb*ft)
Precision : 1.48110e-16

Case 3 : 300 lbs
Analysis type: Static - Linear

Potential energy : 1.04924e+00 (lb*ft)
Precision : 1.80721e-16

Case 4 : 1.2DL + 1.6LL
Analysis type: Linear combination

Case 5 : 1.2DL + 1.6(300LBS)
Analysis type: Linear combination

STEEL DESIGN

STEEL DESIGN

CODE: *ANSI/AISC 360-16 An American National Standard, July 7, 2016*
ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 1 Simple member_1 **POINT:** 1 **COORDINATE:** x = 0.50 L = 1.50 ft

---

LOADS:
Governing Load Case: 5 1.2DL + 1.6(300LBS) 1*1.20+3*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: FB 11.5x0.5

d=0.50 in	Ay=5.750 in2	Az=5.750 in2	Ax=5.750 in2
bf=11.50 in	Iy=0.120 in4	Iz=63.370 in4	J=0.479 in4
tw=0.25 in	Sy=0.479 in3	Sz=11.021 in3	
tf=0.25 in	Zy=0.719 in3	Zz=16.531 in3	

MEMBER PARAMETERS:

Ly = 3.00 ft	Lz = 3.00 ft	
Lcy = 3.00 ft	Lcz = 3.00 ft	Lb = 3.00 ft
Lcy/ry = 249.42	Lcz/rz = 10.84	Cb = 1.00

INTERNAL FORCES: **DESIGN STRENGTHS**

Mry = 453.91 lb*ft		Fib*Mny = 1940.63 lb*ft
	Vrz = -240.00 lb	Fiv*Vnz = 111780.00 lb

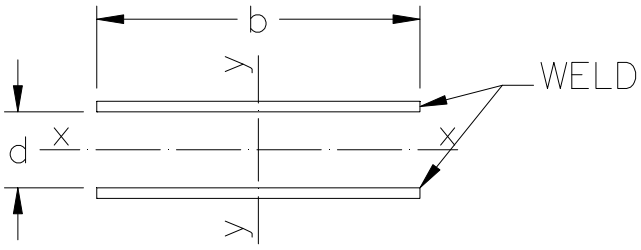
SAFETY FACTORS
Fib = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Mry/(Fib*Mny) = 0.23 < 1.00 LRFD (H1-1b) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified

Section OK !!!

Weld Design For Steel Plate



MATERIALS:

Electrodes:

E 70 XX ----Fu= 70 Ksi
E 60 XX ----Fu= 60 Ksi

Weld and Section Data:

$F_u := 70.00$ Ultimate Tensile Strength (ksi)

$b := 4.0$ Width of Steel Plate (in)

$d := 0.5$ Depth of Steel Plate (in)

Load Data:

$M_{weld} := 0.45$ Moment (Kips-ft)

$V_{weld} := 0.3$ Shear (Kips)

$P_{weld} := 0.0$ Tension or Compression (Kips)

Check Weld Section :

$F_v := 0.3 \cdot F_u$ $F_v = 21.00$ ksi

$t_e :=$ $x \leftarrow 0.00001$

while $\sqrt{\left[\frac{P_{weld}}{2(b)\cdot x} + \frac{M_{weld}\cdot 12}{(b\cdot d)\cdot x}\right]^2 + \left(\frac{V_{weld}}{2b\cdot x}\right)^2} \geq F_v$

$x \leftarrow x + 0.03125$

$t_e = 0.16$ in

$S_{weld} := (b\cdot d)\cdot t_e$ $S_{weld} = 0.31$ in^3

$A_{weld} := 2\cdot(b)\cdot t_e$ $A_{weld} = 1.25$ in^2

Check Bending Stress :

$$f_b := \frac{M_{weld} \cdot (12)}{S_{weld}}$$

$f_b = 17.28$ ksi

Check Shear Stress :

$$f_v := \frac{1.5 V_{weld}}{A_{weld}}$$

$f_v = 0.36$ ksi

Check Tension Stress :

$$f_a := \frac{P_{weld}}{A_{weld}}$$

$f_a = 0.00$ Ksi

Check Combined Stress :

$$f_{weld} := \sqrt{(f_b + f_a)^2 + f_v^2}$$

$f_{weld} = 17.28$ ksi

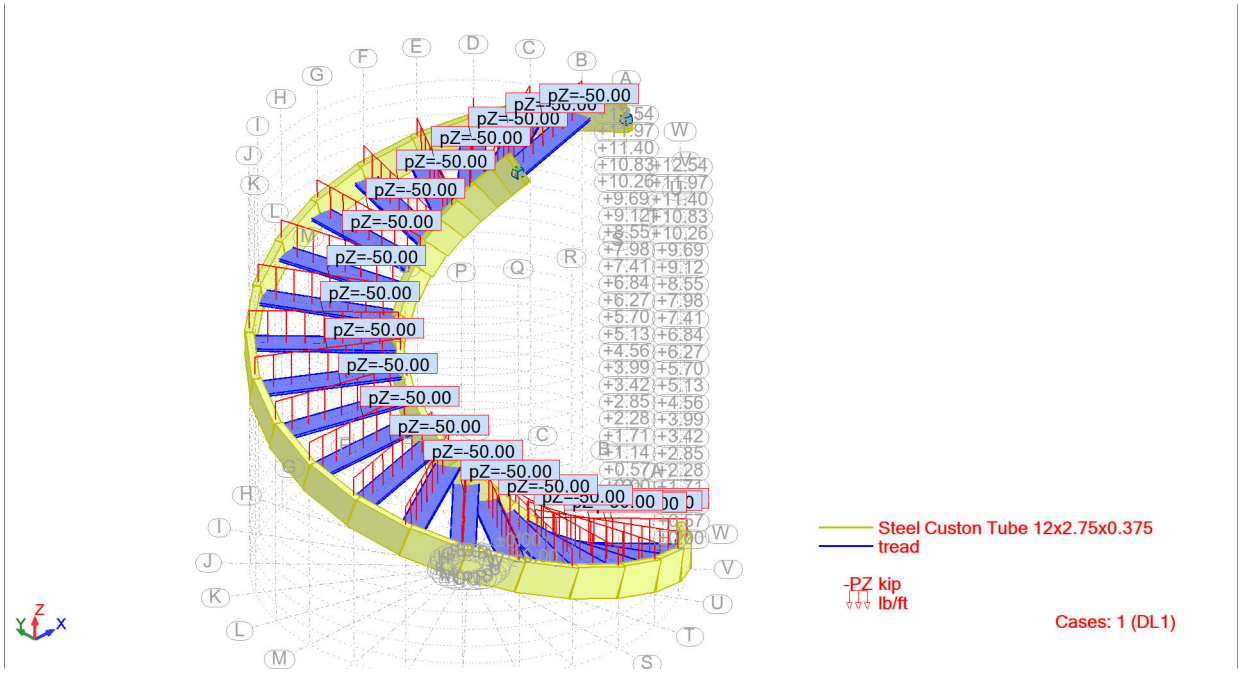
$$STRESS := \begin{cases} \text{"N.G."} \\ \text{"OK"} \quad \text{if } F_v \geq f_{weld} \end{cases}$$

STRESS = "OK"

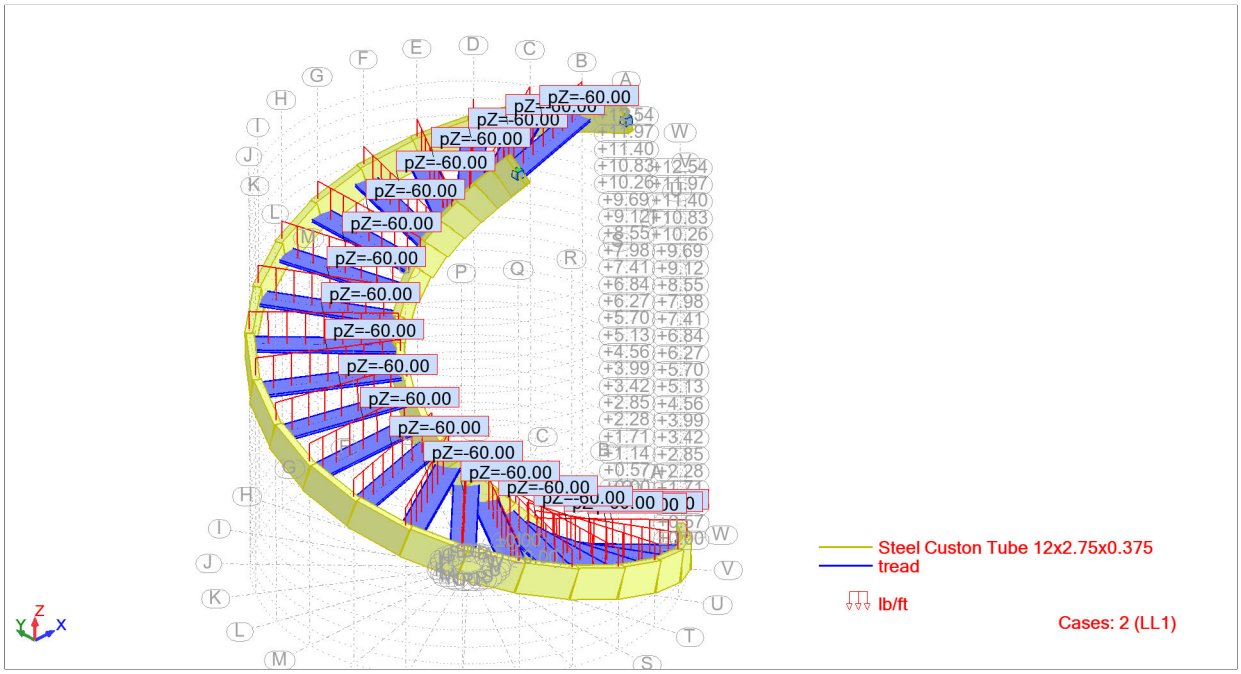
$$W_{weld} := \begin{cases} \text{"3/16"} \quad \text{if } \frac{t_e}{0.707} \leq 0.1875 \\ \text{" 1/4"} \quad \text{if } 0.1875 < \frac{t_e}{0.707} \leq 0.25 \\ \text{"3/8"} \quad \text{if } 0.25 < \frac{t_e}{0.707} \leq 0.375 \\ \text{"1/2"} \quad \text{if } 0.375 < \frac{t_e}{0.707} \leq 0.50 \\ \text{"5/8"} \quad \text{if } 0.50 < \frac{t_e}{0.707} \leq 0.625 \\ \text{"3/4"} \quad \text{if } 0.625 < \frac{t_e}{0.707} \leq 0.750 \\ \text{"1"} \quad \text{if } 0.75 < \frac{t_e}{0.707} \leq 1.00 \end{cases}$$

$W_{weld} =$ " 1/4"

View - Cases: 1 (DL1)



View - Cases: 2 (LL1)



Analysis

Robot Structural Analysis Professional 2025

Date: 01/05/25

Characteristics of analysis example:

Structure type: Shell

Structure geometrical center coordinates:
X = 0.000 *(ft)*
Y = 0.000 *(ft)*
Z = 6.270 *(ft)*

Structure gravity center coordinates:
X = -0.465 *(ft)*
Y = 0.125 *(ft)*
Z = 6.270 *(ft)*
Central moments of inertia of a structure:
Ix = 72844.372 *(lb*ft2)*
Iy = 66424.021 *(lb*ft2)*
Iz = 69701.935 *(lb*ft2)*
Mass = 2724.753 *(lb)*

Structure description

Number of nodes:	46
Number of members:	65
Member finite elements:	65
Planar finite elements:	0
Volumetric finite elements:	0
Rigid links:	0
Releases:	0
Unidirectional releases:	0
Non-linear releases:	0
Compatibilities:	0
Elastic compatibilities:	0
Non-linear compatibilities:	0
Supports:	4
Elastic supports:	0
Unidirectional supports:	0
Non-linear supports:	0
Non-linear hinges:	0
Cases:	4
Combinations:	2

Calculation summary

Solution method - SKYLINE
No of static degr. of freedom: 252

Bandwidth
before/after optimization: 138 24

Time info [sec]

Max time of aggreg. + decomp.:	0
Max time of subspace iterat.:	0
Max time of nonlinear iterat.:	0
Total time:	1

Disk and core usage [B]

Total disk space:	59856
For solver TMP files:	0
For subspace iter. TMP files:	0
Memory:	189896

Stiffness matrix diagonal elements

Min/Max after decomposition:	5.505780e+06 1.513005e+10
Precision:	12

Table of load cases / analysis types

Case 1 : DL1
Analysis type: Static - Linear

Potential energy :	2.14129e+01 (lb*ft)
Precision :	2.21155e-12

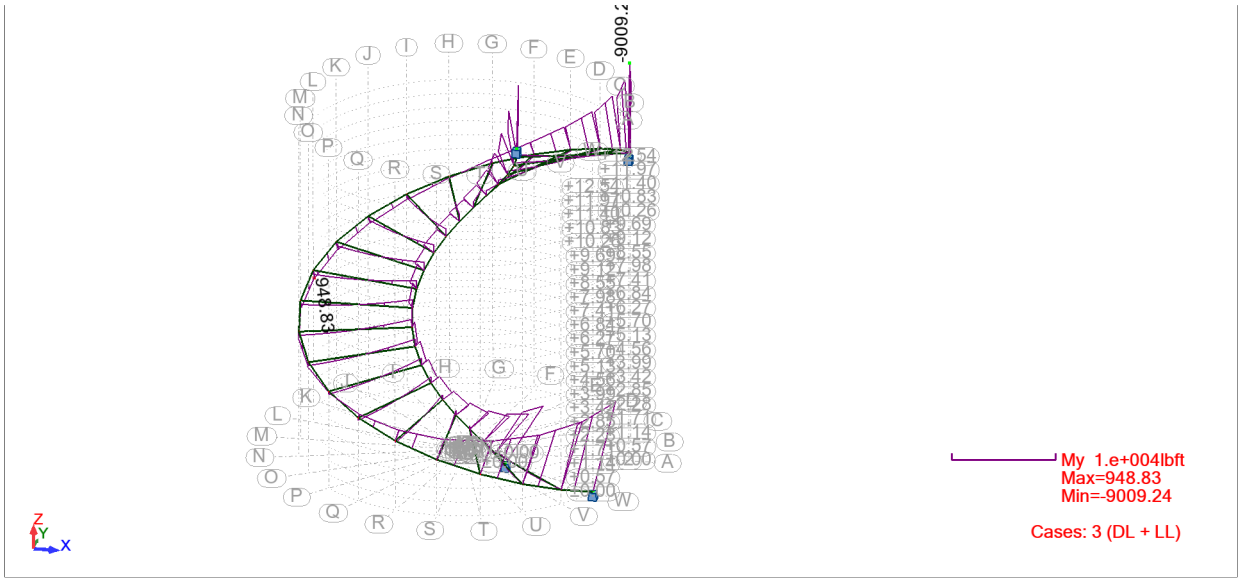
Case 2 : LL1
Analysis type: Static - Linear

Potential energy :	1.06125e+01 (lb*ft)
Precision :	1.93113e-12

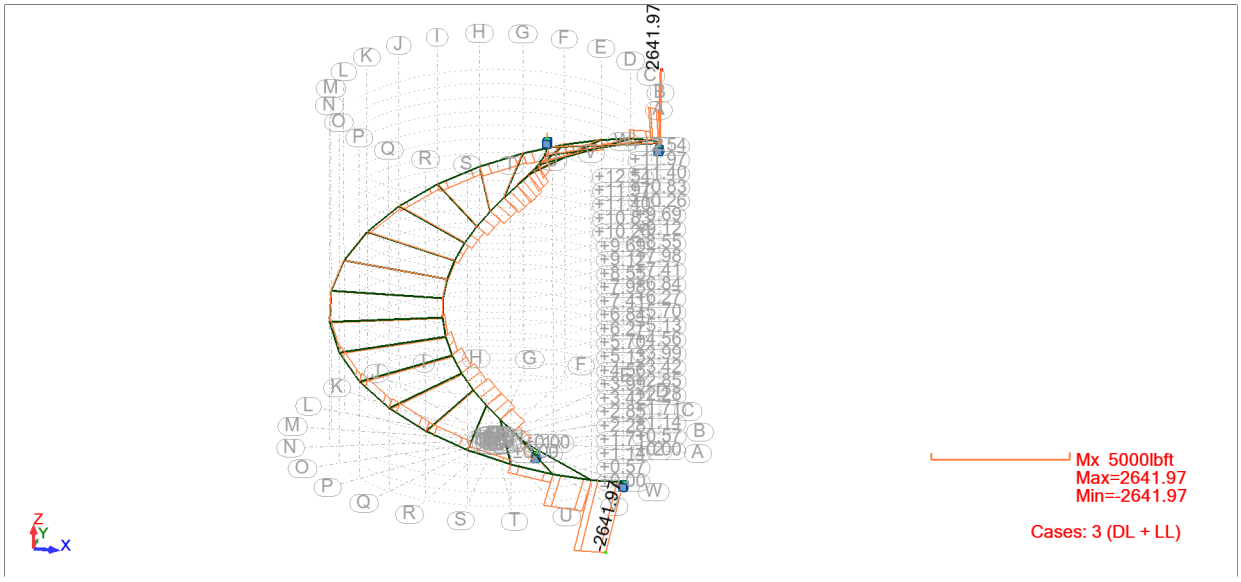
Case 3 : DL + LL
Analysis type: Linear combination

Case 4 : 1.2DL + 1.6 LL
Analysis type: Linear combination

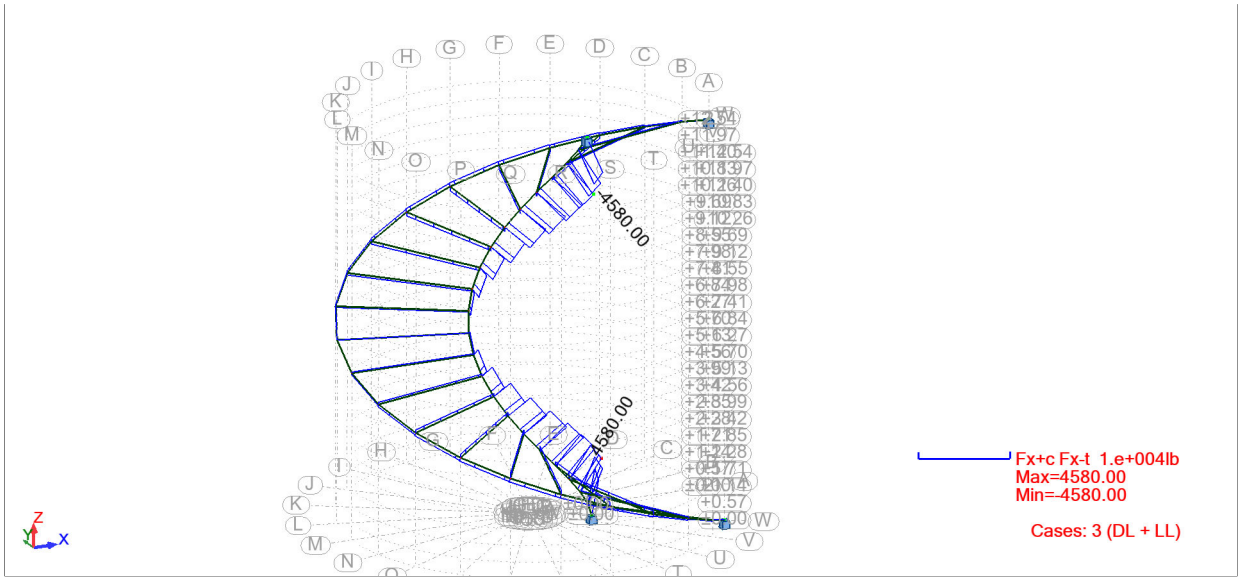
View - MY, Cases: 3 (DL + LL)



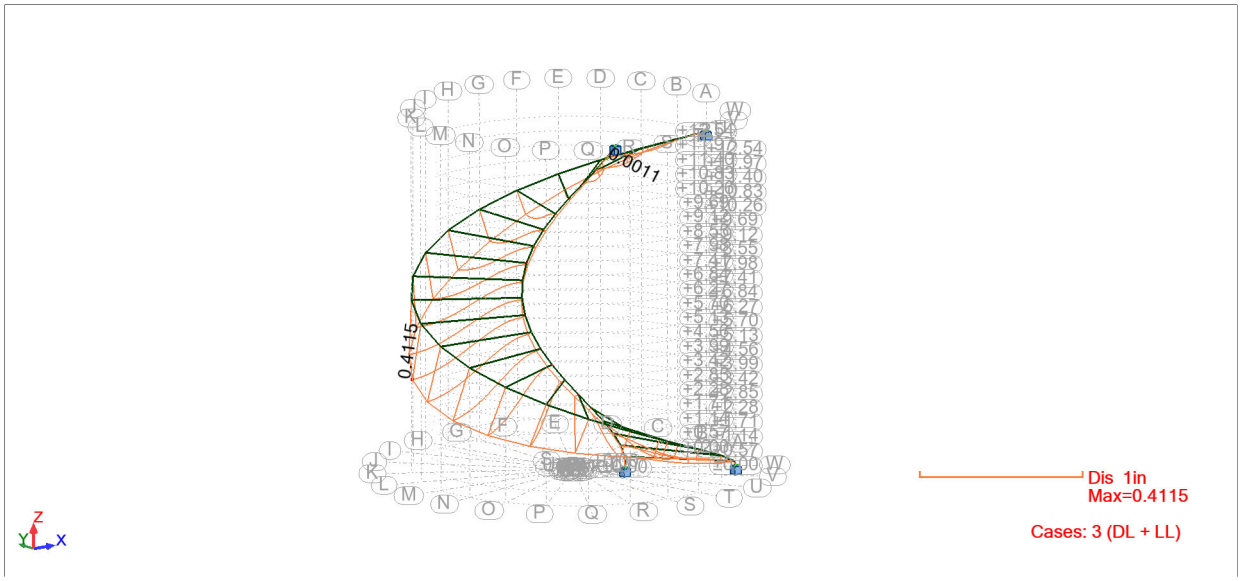
View - MX, Cases: 3 (DL + LL)



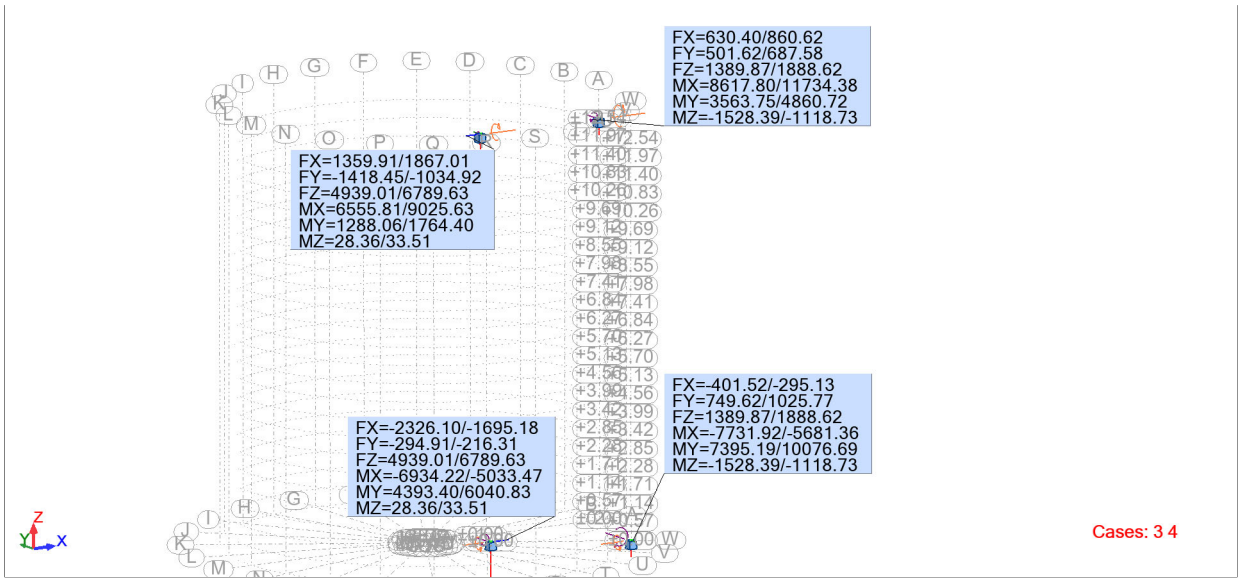
View - FX, Cases: 3 (DL + LL)



View - Exact deformation(s), Cases: 3 (DL + LL)



View:1 - Reaction forces(lb,lb/ft),Reaction moments(lb*ft,lb*ft/ft), Cases: 3 4



STEEL DESIGN

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 1 Simple member_1 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: **Steel Custon Tube 12x2.75x0.375**

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:
Tr = -3606.72 lb*ft

DESIGN STRENGTHS
FiT*Tn = 33215.39 lb*ft

Pr = 80.50 lb Fic*Pn = 334085.55 lb
Mry = -12268.44 lb*ft Vry = -943.00 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = -367.56 lb*ft Vrz = 1970.93 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fic = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.14 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.04 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 2 Simple member_2 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**
Tr = -1629.53 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = -91.70 lb Fity*Pnty = 340200.00 lb
Mry = -9592.57 lb*ft Vry = -1303.55 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = -690.89 lb*ft Vrz = 1645.78 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.12 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.06 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 3 Simple member_3 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**
Tr = -441.28 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = -296.60 lb Fity*Pnty = 340200.00 lb
Mry = -4808.52 lb*ft Vry = -1234.55 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = 1654.36 lb*ft Vrz = 1300.27 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.10 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.05 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 4 Simple member_4 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:		**DESIGN STRENGTHS**	
Tr = 210.88 lb*ft		FiT*Tn = 33215.39 lb*ft	
Pr = -443.21 lb		Fity*Pnty = 340200.00 lb	
Mry = -3073.91 lb*ft	Vry = -922.95 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = 1543.58 lb*ft	Vrz = 1052.50 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

SAFETY FACTORS

Fib = 0.90	Fity = 0.90	Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.08 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.04 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 5 Simple member_5 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = 507.51 lb*ft		FiT*Tn = 33215.39 lb*ft	
Pr = -540.91 lb		Fity*Pnty = 340200.00 lb	
Mry = -1647.56 lb*ft	Vry = -493.58 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = 1296.98 lb*ft	Vrz = 827.06 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

SAFETY FACTORS

Fib = 0.90	Fity = 0.90	Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.06 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.02 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*

ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 6 Simple member_6 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:
Tr = 580.74 lb*ft

DESIGN STRENGTHS
FiT*Tn = 33215.39 lb*ft

Pr = -560.24 lb
Fity*Pnty = 340200.00 lb

Mry = -1696.12 lb*ft	Vry = -15.57 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = 919.00 lb*ft	Vrz = 696.26 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.05 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.00 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 7 Simple member_7 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:

Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:

Tr = 527.76 lb*ft

Pr = -549.74 lb
Mry = -595.34 lb*ft Vry = 457.83 lb
Mrz = 1317.44 lb*ft Vrz = 522.00 lb

DESIGN STRENGTHS

FiT*Tn = 33215.39 lb*ft

Fity*Pnty = 340200.00 lb
Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

SAFETY FACTORS
Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.05 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.02 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 8 Simple member_8 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:

Tr = 416.43 lb*ft

Pr = -487.89 lb
Mry = 194.69 lb*ft
Vry = 884.33 lb
Mrz = 1592.04 lb*ft
Vrz = 375.96 lb

DESIGN STRENGTHS

FiT*Tn = 33215.39 lb*ft

Fity*Pnty = 340200.00 lb
Fib*Mny = 96440.62 lb*ft
Fiv*Vny = 23692.50 lb
Fib*Mnz = 30881.25 lb*ft
Fiv*Vnz = 158557.50 lb

SAFETY FACTORS

Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:

Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.05 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.04 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 10 Simple member_10 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:

Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:

STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4

tw=0.37 in Sy=26.449 in3 Sz=9.670 in3
tf=0.37 in Zy=35.719 in3 Zz=11.437 in3

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**
Tr = 289.09 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = -380.98 lb Fity*Pnty = 340200.00 lb
Mry = 729.25 lb*ft Vry = 1231.50 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = 1721.30 lb*ft Vrz = 256.40 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.06 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.05 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 11 Simple member_11 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in Ay=1.219 in2 Az=8.156 in2 Ax=10.500 in2
bf=2.75 in Iy=158.695 in4 Iz=13.297 in4 J=40.836 in4
tw=0.37 in Sy=26.449 in3 Sz=9.670 in3
tf=0.37 in Zy=35.719 in3 Zz=11.437 in3

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = 166.71 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = -238.77 lb Fity*Pnty = 340200.00 lb
Mry = 1065.80 lb*ft Vry = 1475.73 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = 1700.16 lb*ft Vrz = 158.47 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:

Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.07 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.06 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 12 Simple member_12 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:

Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:

STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = 54.10 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = -74.03 lb Fity*Pnty = 340200.00 lb

Mry = 1252.86 lb*ft Vry = 1601.64 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb

Mrz = 1537.00 lb*ft Vrz = 74.69 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:

Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.06 < 1.00 LRFD (H1-1b) Verified

Vry/(Fiv*Vny) = 0.07 < 1.00 LRFD (G) Verified

Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified

Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 13 Simple member_13 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:

Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:

STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft

Lcy = 1.74 ft Lcz = 1.74 ft

Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = -54.10 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = 98.47 lb Fic*Pn = 334085.55 lb

Mry = 1321.49 lb*ft Vry = 1601.64 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = 1250.83 lb*ft Vrz = -4.17 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fic = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.05 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.07 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 14 Simple member_14 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**
Tr = -166.71 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = 238.77 lb Fic*Pn = 334085.55 lb
Mry = 1065.80 lb*ft Vry = 1475.73 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = -1700.16 lb*ft Vrz = -158.47 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fic = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.07 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.06 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 15 Simple member_15 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**
Tr = -289.09 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = 380.98 lb Fic*Pn = 334085.55 lb
Mry = 729.25 lb*ft Vry = 1231.50 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = -1721.30 lb*ft Vrz = -256.40 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fic = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.06 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.05 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 17 Simple member_17 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:		**DESIGN STRENGTHS**	
Tr = -416.43 lb*ft		FiT*Tn = 33215.39 lb*ft	
Pr = 487.89 lb		Fic*Pn = 334085.55 lb	
Mry = 194.69 lb*ft	Vry = 884.33 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = -1592.04 lb*ft	Vrz = -375.96 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90	Fic = 0.90	Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.05 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.04 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 18 Simple member_18 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = -527.76 lb*ft		FiT*Tn = 33215.39 lb*ft	
Pr = 549.74 lb		Fic*Pn = 334085.55 lb	
Mry = -595.34 lb*ft	Vry = 457.83 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = -1317.44 lb*ft	Vrz = -522.00 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90	Fic = 0.90	Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.05 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.02 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 19 Simple member_19 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:		**DESIGN STRENGTHS**	
Tr = -580.74 lb*ft		FiT*Tn = 33215.39 lb*ft	
Pr = 560.24 lb		Fic*Pn = 334085.55 lb	
Mry = -1696.12 lb*ft	Vry = -15.57 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = -919.00 lb*ft	Vrz = -696.26 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90	Fic = 0.90	Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.05 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.00 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.00 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 20 Simple member_20 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = -507.51 lb*ft		FiT*Tn = 33215.39 lb*ft	
Pr = 540.91 lb		Fic*Pn = 334085.55 lb	
Mry = -1647.56 lb*ft	Vry = -493.58 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = -1296.98 lb*ft	Vrz = -827.06 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90	Fic = 0.90	Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.06 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.02 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 22 Simple member_22 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES:

Tr = -210.88 lb*ft

Pr = 443.21 lb
Mry = -3073.91 lb*ft Vry = -922.95 lb
Mrz = -1543.58 lb*ft Vrz = -1052.50 lb

DESIGN STRENGTHS

FiT*Tn = 33215.39 lb*ft

Fic*Pn = 334085.55 lb
Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

SAFETY FACTORS
Fib = 0.90 Fic = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.08 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.04 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 23 Simple member_23 **POINT:** 1 **COORDINATE:** x = 0.00 L = 0.00 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4
tw=0.37 in	Sy=26.449 in3	Sz=9.670 in3	
tf=0.37 in	Zy=35.719 in3	Zz=11.437 in3	

MEMBER PARAMETERS:

Ly = 1.74 ft	Lz = 1.74 ft
Lcy = 1.74 ft	Lcz = 1.74 ft
Lcy/ry = 5.37	Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = 441.28 lb*ft		FiT*Tn = 33215.39 lb*ft	
Pr = 296.60 lb		Fic*Pn = 334085.55 lb	
Mry = -4808.52 lb*ft	Vry = -1234.55 lb	Fib*Mny = 96440.62 lb*ft	Fiv*Vny = 23692.50 lb
Mrz = -1654.36 lb*ft	Vrz = -1300.27 lb	Fib*Mnz = 30881.25 lb*ft	Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90	Fic = 0.90	Fiv = 0.90

SECTION ELEMENTS:

Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.10 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.05 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 24 Simple member_24 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:

Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:

STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in	Ay=1.219 in2	Az=8.156 in2	Ax=10.500 in2
bf=2.75 in	Iy=158.695 in4	Iz=13.297 in4	J=40.836 in4

tw=0.37 in Sy=26.449 in3 Sz=9.670 in3
tf=0.37 in Zy=35.719 in3 Zz=11.437 in3

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**
Tr = 1629.53 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = 91.70 lb Fic*Pn = 334085.55 lb
Mry = -9592.57 lb*ft Vry = -1303.55 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = 690.89 lb*ft Vrz = -1645.78 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS
Fib = 0.90 Fic = 0.90 Fiv = 0.90

SECTION ELEMENTS:
Flange = Compact Web = Compact

VERIFICATION FORMULAS:
Pr/(2*Fic*Pn) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.12 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.06 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 200.00 Lcz/rz = 18.56 < (Lc/r),max = 200.00 STABLE

Section OK !!!

STEEL DESIGN

CODE: *ANSI/AISC 360-22 An American National Standard, August 1, 2022*
ANALYSIS TYPE: Member Verification

CODE GROUP:
MEMBER: 25 Simple member_25 **POINT:** 3 **COORDINATE:** x = 1.00 L = 1.74 ft

---

LOADS:
Governing Load Case: 4 1.2DL + 1.6 LL 1*1.20+2*1.60

MATERIAL:
STEEL A36 Fy = 36.00 ksi Fu = 58.00 ksi E = 29000.00 ksi

SECTION PARAMETERS: Steel Custon Tube 12x2.75x0.375

d=12.00 in Ay=1.219 in2 Az=8.156 in2 Ax=10.500 in2
bf=2.75 in Iy=158.695 in4 Iz=13.297 in4 J=40.836 in4
tw=0.37 in Sy=26.449 in3 Sz=9.670 in3
tf=0.37 in Zy=35.719 in3 Zz=11.437 in3

MEMBER PARAMETERS:

Ly = 1.74 ft Lz = 1.74 ft
Lcy = 1.74 ft Lcz = 1.74 ft
Lcy/ry = 5.37 Lcz/rz = 18.56

INTERNAL FORCES: **DESIGN STRENGTHS**

Tr = 3606.72 lb*ft FiT*Tn = 33215.39 lb*ft

Pr = -80.50 lb Fity*Pnty = 340200.00 lb
Mry = -12268.44 lb*ft Vry = -943.00 lb Fib*Mny = 96440.62 lb*ft Fiv*Vny = 23692.50 lb
Mrz = 367.56 lb*ft Vrz = -1970.93 lb Fib*Mnz = 30881.25 lb*ft Fiv*Vnz = 158557.50 lb

---

SAFETY FACTORS

Fib = 0.90 Fity = 0.90 Fiv = 0.90

SECTION ELEMENTS:

Flange = Compact Web = Compact

VERIFICATION FORMULAS:

Pr/(2*Fity*Pnty) + Mry/(Fib*Mny) + Mrz/(Fib*Mnz) = 0.14 < 1.00 LRFD (H1-1b) Verified
Vry/(Fiv*Vny) = 0.04 < 1.00 LRFD (G) Verified
Vrz/(Fiv*Vnz) = 0.01 < 1.00 LRFD (G) Verified
Lcy/ry = 5.37 < (Lc/r),max = 300.00 Lcz/rz = 18.56 < (Lc/r),max = 300.00 STABLE

Section OK !!!

Weld Design For Tube

MATERIALS:

Electrodes:
E 70 XX ----Fu= 70 Ksi

Weld and Section Data:

$F_u := 70.00$ Ultimate Tensile Strength (ksi)

$b := 2.75$ Width of Tube Steel (in)

$d := 12.0$ Depth of Tube Steel (in)

Load Data:

$M_{weld} := 9.1$ Moment (Kips-ft)

$V_{weld} := 4.6$ Shear (Kips)

$P_{weld} := 0.0$ Tension or Compression (Kips)

$T_{weld} := 2.7$ Torsional Moment (kips-ft)

Check Weld Section :

$F_v := 0.3 \cdot F_u$ $F_v = 21.00$ ksi

$$t_e := \left| \begin{array}{l} x \leftarrow 0.00001 \\ \text{while } \sqrt{\left[\frac{P_{weld}}{2(b+d)\cdot x} + \frac{M_{weld}\cdot 12}{\left(b\cdot d + \frac{d^2}{3}\right)\cdot x}\right]^2 + \left[\frac{1.5V_{weld}}{2(b+d)\cdot x} + \frac{T_{weld}\cdot 12\cdot\sqrt{\left(\frac{b}{2}\right)^2+\left(\frac{d}{2}\right)^2}}{\frac{(b+d)^3}{6}\cdot x}\right]^2} \geq F_v \\ x \leftarrow x + 0.01 \end{array} \right.$$

$t_e = 0.08$ in

$S_{weld} := \left(b\cdot d + \frac{d^2}{3}\right)\cdot t_e$ $S_{weld} = 6.48$ in^3

$A_{weld} := 2\cdot(d + b)\cdot t_e$ $A_{weld} = 2.36$ in^2

$J_{weld} := \frac{(b+d)^3}{6}\cdot t_e$ $J_{weld} = 42.79$ in^3

Check Bending Stress :

$f_b := \frac{M_{weld}\cdot(12)}{S_{weld}}$ $f_b = 16.85$ ksi

Check Shear Stress :

$$f_v := \frac{1.5V_{weld}}{A_{weld}} + \frac{T_{weld} \cdot 12 \cdot \sqrt{\left(\frac{b}{2}\right)^2 + \left(\frac{d}{2}\right)^2}}{J_{weld}} \qquad f_v = 7.58 \quad \text{ksi}$$

Check Tension Stress :

$$f_a := \frac{P_{weld}}{A_{weld}} \qquad f_a = 0.00 \quad \text{Ksi}$$

Check Combined Stress :

$$f_{weld} := \sqrt{\left(f_b + f_a\right)^2 + f_v^{\,2}} \qquad f_{weld} = 18.48 \quad \text{ksi}$$

$$STRESS := \begin{cases} \text{"N.G."} \\ \text{"OK"} \quad \text{if } F_v \geq f_{weld} \end{cases} \qquad STRESS = \text{"OK"}$$

$$W_{weld} := \begin{cases} \text{"3/16"} \quad \text{if } \frac{t_e}{0.707} \leq 0.1875 \\ \text{" 1/4"} \quad \text{if } 0.1875 < \frac{t_e}{0.707} \leq 0.25 \\ \text{"3/8"} \quad \text{if } 0.25 < \frac{t_e}{0.707} \leq 0.375 \\ \text{"1/2"} \quad \text{if } 0.375 < \frac{t_e}{0.707} \leq 0.50 \\ \text{"5/8"} \quad \text{if } 0.50 < \frac{t_e}{0.707} \leq 0.625 \\ \text{"3/4"} \quad \text{if } 0.625 < \frac{t_e}{0.707} \leq 0.750 \\ \text{"1"} \quad \text{if } 0.75 < \frac{t_e}{0.707} \leq 1.00 \end{cases} \qquad W_{weld} = \text{"3/16"}$$

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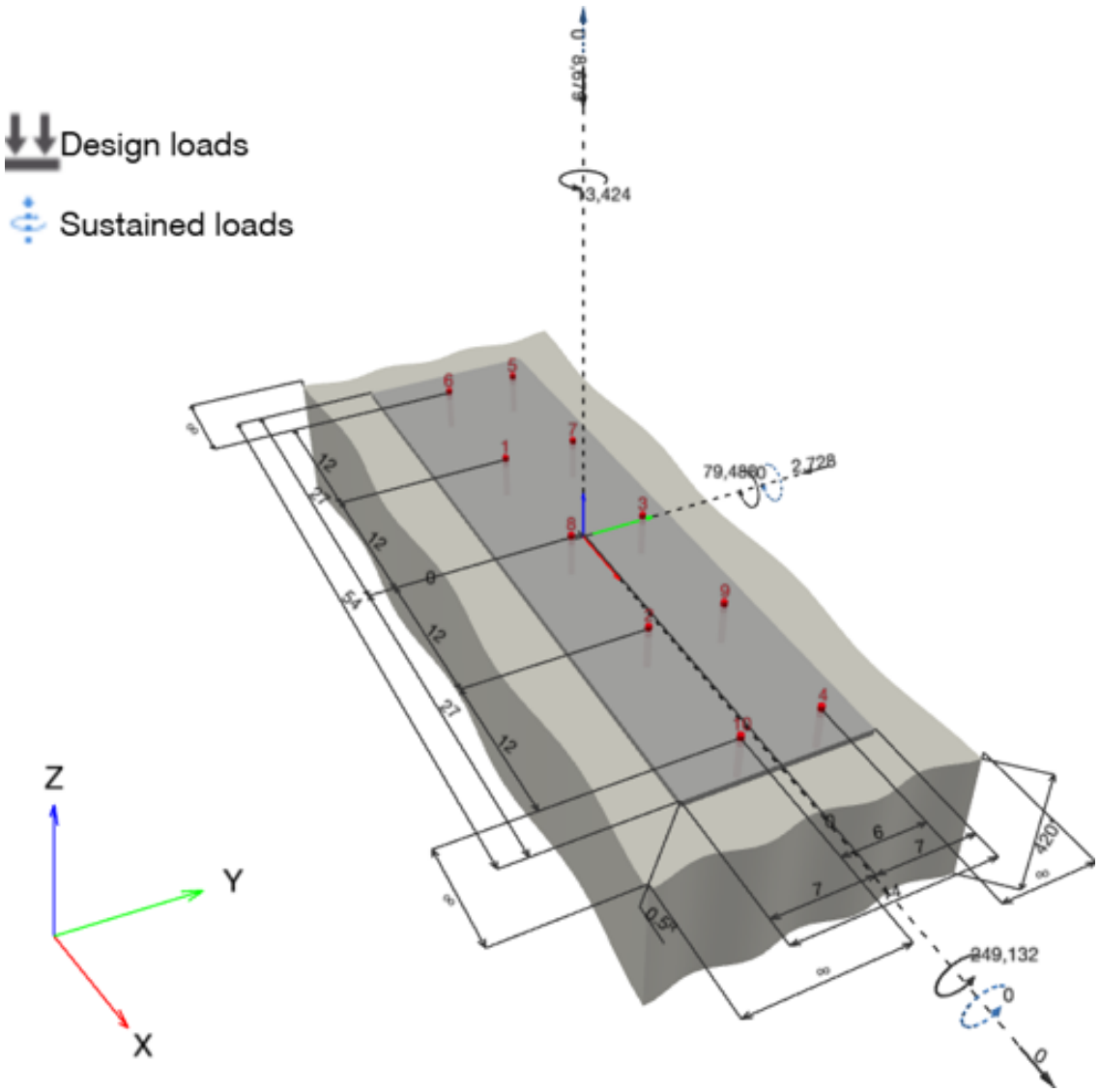
Specifier's comments:

1 Input data

R - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



Input data and results must be checked for conformity with the existing conditions and for plausibility!
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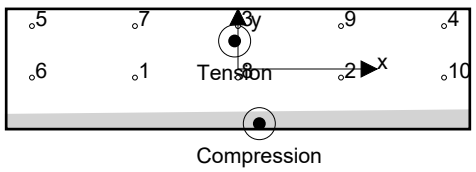
1.1 Design results

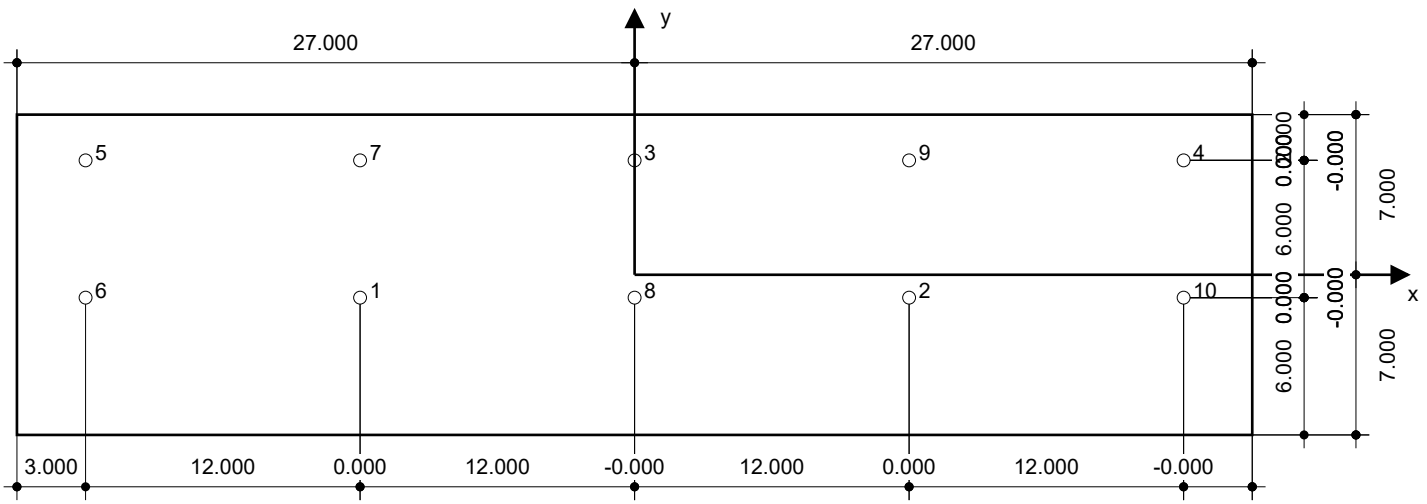
Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -8,679; V_x = 0; V_y = -2,728; M_x = 249,132; M_y = 79,488; M_z = 13,424;	no	67

2 Load case/Resulting anchor forces

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1,198	327	14	-327
2	1,132	219	14	-219
3	2,862	273	-14	-273
4	2,797	165	-14	-164
5	2,928	382	-14	-381
6	1,231	382	14	-381
7	2,895	327	-14	-327
8	1,165	273	14	-273
9	2,830	219	-14	-219
10	1,099	165	14	-164





Steel Bolts Threaded Tension & Shear Design 15th

Data:

$T_{bolt} := 3.0$ Tension in Anchor (kips)

$\Omega := 2.00$ ASD Factor=2.00

$V_{bolt} := 0.4$ Shear in Anchor (kips)

$F_{nv} := 54.00$ Nominal Shear Strength (ksi) Table J3.2 AISC 16.1-120 .....0.45*Fu

$F_{nt} := 90.00$ Nominal Tensile Strength (ksi) Table J3.2 AISC 16.1-120.....=0.75*Fu

$D := 0.5$ Screw Diameter (in)

$n := 13.0$ Threads per in..... (AISC-Table 7-17 page 7-81)

$$F_v := \frac{F_{nv}}{\Omega} \qquad F_v = 27.000 \text{ ksi}$$

$$F_t := \frac{F_{nt}}{\Omega} \qquad F_t = 45.000 \text{ ksi}$$

$$A_{bolt} := 0.7854\left(D - \frac{0.9743}{n}\right)^2 \qquad A_{bolt} = 0.142 \text{ in}^2$$

Check Shear

$$f_v := \frac{V_{bolt}}{A_{bolt}} \qquad f_v = 2.819 \text{ ksi}$$

$$V_{allow} := F_v \cdot A_{bolt} \qquad V_{allow} = 3.831 \text{ kips}$$

$$SHEAR := \text{if}\left(f_v \le F_v, \text{"OK"}, \text{"NG"}\right) \qquad SHEAR = \text{"OK"}$$

Check Tension

$$f_t := \frac{T_{bolt}}{A_{bolt}} \qquad f_t = 21.142 \text{ ksi}$$

$$F'_{nt} := \min\left(F_t, \max\left(0, 1.3F_t - \Omega \cdot \frac{F_t}{F_v} \cdot f_v\right)\right) \qquad F'_{nt} = 45.000 \text{ ksi}$$

$$T_{allow} := F'_{nt} \cdot A_{bolt} \qquad T_{allow} = 6.385 \text{ kips}$$

$$TENSION := \text{if}\left(T_{bolt} \le T_{allow}, \text{"OK"}, \text{"NG"}\right) \qquad TENSION = \text{"OK"}$$

Minimum Thread Length

$$TL_{min} := \frac{2 \cdot T_{bolt}}{F_v \cdot \pi \cdot \left(D - \frac{0.9743}{n}\right)} \qquad TL_{min} = 0.166 \text{ in}$$

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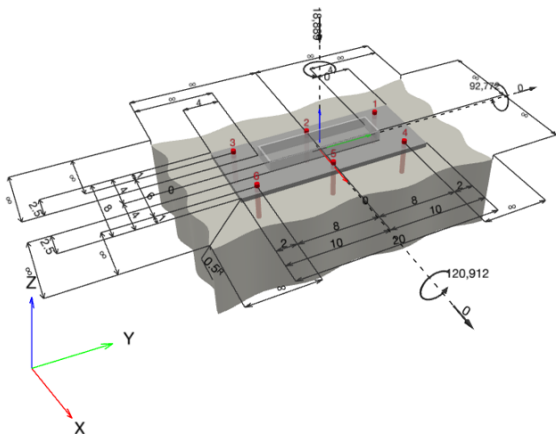
Specifier's comments:

1 Input data

Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ)-CRC (Corrosion-resistant Carbon Steel) 1/2 (4 1/4)**
Item number:	2221945 KH-EZ CRC 1/2"x5"
Specification text:	Hilti ∅ 1/2 in KWIK HUS-EZ (KH-EZ)-CRC (Corrosion-resistant Carbon Steel) with 4.25 in nominal embedment depth per ICC-ES ESR-3027 , Hammer drill bit installation per MPII,
Effective embedment depth:	$h_{ef,act}$ = 3.220 in., h_{nom} = 4.250 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	12/1/2023 | 12/1/2025
Proof:	Design Method ACI 318-19 / Mech
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate[R] :	l_x x l_y x t = 8.000 in. x 20.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	Rectangular HSS (AISC), HSS12X3X.1875; (L x W x T) = 12.000 in. x 3.000 in. x 0.188 in.
Base material:	cracked concrete, 3000, f_c' = 3,000 psi; h = 8.000 in.
Installation:	**Hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar

[R] - The anchor calculation is based on a rigid anchor plate assumption.

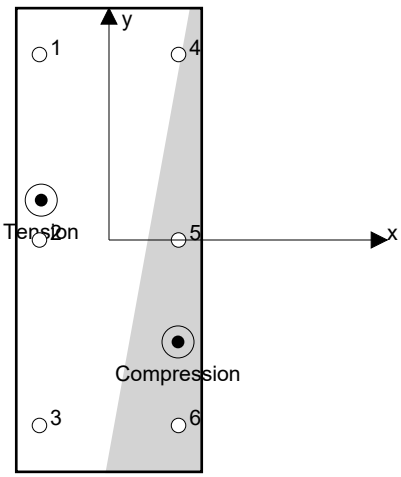
Geometry [in.] & Loading [lb, in.lb]



1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N = -18,889; V_x = 0; V_y = 0; M_x = 120,912; M_y = 92,772; M_z = 0;	no	75

2 Load case/Resulting anchor forces



Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2,663	0	0	0
2	2,037	0	0	0
3	1,412	0	0	0
4	79	0	0	0
5	0	0	0	0
6	0	0	0	0

Max. concrete compressive strain: 0.38 [‰]
Max. concrete compressive stress: 1,639 [psi]
Resulting tension force in (x/y)=(-2.923/1.719): 6,191 [lb]
Resulting compression force in (x/y)=(2.977/-4.397): 25,080 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	2,663	11,778	23	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	6,191	8,366	75	OK

* highest loaded anchor **anchor group (anchors in tension)

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-3027

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.16	112,540

Calculations

N_{sa} [lb]
18,120

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
18,120	0.650	11,778	2,663

3.2 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-19 Eq. (17.6.2.1b)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.220	1.423	0.281	∞	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
5.250	17	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
305.84	93.32	0.772	0.945	1.000	1.000	5,380

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
12,871	0.650	8,366	6,191

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (relevant anchors)

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (EN1992-4, AS5216, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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