Calculations required to be provided by the Permittee on site for all Inspections

QUANTUM
CONSULTING ENGINEERS

February 22, 2024

STRUCTURAL CALCULATIONS
(Permit Submittal)

CENTERIS DATA CENTER VOLTAGE PARK CHILLER PIPE FRAMES
1023 39th Avenue SE
Puyallup, WA 98374

Quantum Job Number: 23444.01

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STATE OF WASHINGTON
36098
STRUCTURAL ENGINEER
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City of Puyallup
Building
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FOR
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03/22/2024
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City of Puyallup
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Building	Planning
Engineering	Public Works
Fire	Traffic

PRCTI20240275

QUANTUM | CONSULTING ENGINEERS

CENTERIS DATA CENTER
VOLTAGE PARK CHILLER PIPE FRAMES
1023 39TH AVENUE SE
PUYALLUP, WA 98374

QUANTUM JOB NUMBER: 23444.01

INDEX

Structural Design Criteria

Building Code: 2018 International Building Code
Building Department: City of Puyallup

Seismic Criteria

S_s:	1.26	I_e:	1.00
S_1:	0.43	Seismic Soil Site Class:	D
S_{ds}:	1.01	Seismic Design Category:	D
S_{d1}:	0.50		
R:	3.50	Steel Ordinary Moment Frames	
R:	3.25	Steel Ordinary Concentrically Braced Frames	
R:	1.25	Steel Ordinary Cantilever Column System	

Wind Criteria

Wind Speed:	98
Risk Category:	II
Wind Exposure:	B
Kzt:	1

Geotechnical Criteria

Allowable Bearing Pressure 2,000 PSF

Materials Criteria

Concrete (28 Day Strength):

Foundation/Slab on Grade F'c= 3,000 PSI

Reinforcing Steel:

Grade 60 Fy= 60,000 PSI

Structural Steel:

Wide-Flange Sections: A-992	Fy= 50,000 PSI
Miscellaneous Sections: A-36	Fy= 36,000 PSI
Tube Sections: A-500	Fy= 46,000 PSI
Pipe Sections: A-53	Fy= 35,000 PSI
Welding	Fy= 70,000 PSI

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

ATC Hazards by Location

Search Information

Address: 1015 39th Ave SE Puyallup, WA 98374

Coordinates: 47.1590004, -122.2794422

Elevation: 489 ft

Timestamp: 2023-12-01T15:14:56.409Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: III

Site Class: D-default

Basic Parameters

Name	Value	Description
S_S	1.257	MCE_R ground motion (period=0.2s)
S_1	0.433	MCE_R ground motion (period=1.0s)
S_{MS}	1.508	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	1.005	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.914	Coefficient of risk (0.2s)
CR_1	0.898	Coefficient of risk (1.0s)
PGA	0.5	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.6	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	1.257	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.375	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.433	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.483	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Seismic Base Shear for the Equivalent Lateral Force Procedure

Per IBC 2018 & ASCE 7-16 Chapter 15.4

Structure: **Pipe Steel Frame**
Address: **1015 39th Ave SE Puyallup, WA 98374**
Latitude: **47.1590** Longitude: **-122.2794**

Structure Classification

Risk Category : **II** per ASCE Table 1.5-1

Seismic Force-Resisting System: **Steel Ordinary Moment Frames** per ASCE 15.7.14

R:	**3 1/2**	per ASCE Table 15.4-2
W_o:	**3**	per ASCE Table 15.4-2
C_d:	**3**	per ASCE Table 15.4-2
h_n (ft):	**15.00**	height above the base to the highest level of the structure

Site Ground Motion

S_1 (g-sec): **0.43** S_S (g-sec): **1.26**
Site Class: **D** **Assumed Value** per ASCE 11.4.3

ASCE 11.4.8 Exception 2 Used

F_v **1.87** F_a **1.20**

1.2 Min Value where SC D Assumed

S_{M1} (g-sec): **0.81** S_{MS} (g-sec): **1.51** per ASCE 11.4.4
S_{D1} (g-sec): **0.54** S_{DS} (g-sec): **1.01** per ASCE 11.4.5

SDC: **D** per ASCE 11.6
I_E: **1.00** per ASCE Table 1.5-2

Fundamental Period per ASCE 12.8.2

Period Method: **Approximate Fundamental Period**
Structure Type: **Steel Moment Frame**

T_L (sec):	**6.00**	ASCE Figures 22-14 through 22-17
T_S:	0.54	
Ta (sec):	0.24	Ct * hnx per ASCE Eq. 12.8-7
T_{use} (sec):	**0.24**	- <= TL

Equivalent Lateral Force Procedure Design Base Shear per ASCE 12.8

C_s:	0.287	$= S_{DS} / (R/I_E)$ per ASCE Eq. 12.8-2
$C_{s\text{-}max}$:	0.630	$= S_{D1} / (T_a{*}R/I_E)$ for $T \le T_L$ per ASCE Eq. 12.8-3
$C_{s\text{-}max}$:	--	$= S_{D1}{*}T_L / (T_a^2{*}R/I_E)$ for $T > T_L$ per ASCE Eq. 12.8-4
$C_{s\text{-}min}$:	0.044	per ASCE Eq. 15.4-1
$C_{s\text{-}min}$:	--	$= 0.8S_1 / (R/I_E)$ for S_1 => 0.6g per ASCE Eq. 15.4-2
$C_{s\text{-}use}$:	0.287	

V : 0.287 W = $C_{S\text{-}use}$ * W per ASCE Eq. 12.8-1

Seismic Base Shear for the Equivalent Lateral Force Procedure

Per IBC 2018 & ASCE 7-16 Chapter 15.4

Structure: **Pipe Steel Frame**
Address: **1015 39th Ave SE Puyallup, WA 98374**
Latitude: **47.1590** Longitude: **-122.2794**

Structure Classification

Risk Category : **II** per ASCE Table 1.5-1

Seismic Force-Resisting System: **Steel Ordinary Concentrically Braced Frames** per ASCE 15.7.14

R: **3 1/4** per ASCE Table 15.4-2
W_o: **2** per ASCE Table 15.4-2
C_d: **3 1/4** per ASCE Table 15.4-2
h_n (ft): **15.00** height above the base to the highest level of the structure

Site Ground Motion

S_1 (g-sec): **0.43** S_S (g-sec): **1.26**
Site Class: **D** **Assumed Value** per ASCE 11.4.3

ASCE 11.4.8 Exception 2 Used

F_v **1.87** F_a **1.20**

1.2 Min Value where SC D Assumed

S_{M1} (g-sec): **0.81** S_{MS} (g-sec): **1.51** per ASCE 11.4.4
S_{D1} (g-sec): **0.54** S_{DS} (g-sec): **1.01** per ASCE 11.4.5
SDC: **D** per ASCE 11.6
I_E: **1.00** per ASCE Table 1.5-2

Fundamental Period per ASCE 12.8.2

Period Method: **Approximate Fundamental Period**
Structure Type: **All Other Structural Systems**
T_L (sec): **6.00** ASCE Figures 22-14 through 22-17
T_S: 0.54

Ta (sec): 0.15 Ct * hnx per ASCE Eq. 12.8-7

T_{use} (sec): **0.15** ˉ <= TL

Equivalent Lateral Force Procedure Design Base Shear per ASCE 12.8

C_s: 0.309 $= S_{DS} / (R/I_E)$ per ASCE Eq. 12.8-2
$C_{s\text{-max}}$: 1.088 $= S_{D1} / (T_a{*}R/I_E)$ for $T <= T_L$ per ASCE Eq. 12.8-3
$C_{s\text{-max}}$: -- $= S_{D1}{*}T_L / (T_a^2{*}R/I_E)$ for $T > T_L$ per ASCE Eq. 12.8-4
$C_{s\text{-min}}$: 0.044 per ASCE Eq. 15.4-1
$C_{s\text{-min}}$: -- $= 0.8S_1 / (R/I_E)$ for S_1 => 0.6g per ASCE Eq. 15.4-2
$C_{s\text{-use}}$: 0.309

V : 0.309 W = $C_{S\text{-use}}$ * W per ASCE Eq. 12.8-1

Seismic Base Shear for the Equivalent Lateral Force Procedure

Per IBC 2018 & ASCE 7-16 Chapter 15.4

Structure: **Pipe Steel Frame**
Address: **1015 39th Ave SE Puyallup, WA 98374**
Latitude: **47.1590** Longitude: **-122.2794**

Structure Classification

Risk Category : **II** per ASCE Table 1.5-1

Seismic Force-Resisting System: **Steel Ordinary Cantilever Columns** per ASCE 15.7.14

R:	**1 1/4**	per ASCE Table 15.4-2
W_o:	**1 1/4**	per ASCE Table 15.4-2
C_d:	**1 1/4**	per ASCE Table 15.4-2
h_n (ft):	**15.00**	height above the base to the highest level of the structure

Site Ground Motion

S_1 (g-sec): **0.43** S_S (g-sec): **1.26**
Site Class: **D** **Assumed Value** per ASCE 11.4.3
ASCE 11.4.8 Exception 2 Used

F_v **1.87** F_a **1.20**
1.2 Min Value where SC D Assumed

S_{M1} (g-sec): **0.81** S_{MS} (g-sec): **1.51** per ASCE 11.4.4
S_{D1} (g-sec): **0.54** S_{DS} (g-sec): **1.01** per ASCE 11.4.5

SDC: **D** per ASCE 11.6
I_E: **1.00** per ASCE Table 1.5-2

Fundamental Period per ASCE 12.8.2

Period Method: **Approximate Fundamental Period**
Structure Type: **All Other Structural Systems**
T_L (sec): **6.00** ASCE Figures 22-14 through 22-17
T_S: 0.54

Ta (sec): 0.15 Ct * hnx per ASCE Eq. 12.8-7

T_{use} (sec): **0.15** - <= TL

Equivalent Lateral Force Procedure Design Base Shear per ASCE 12.8

C_s:	0.804	$= S_{DS} / (R/I_E)$ per ASCE Eq. 12.8-2
$C_{s\text{-}max}$:	2.828	$= S_{D1} / (T_a{*}R/I_E)$ for $T \le T_L$ per ASCE Eq. 12.8-3
$C_{s\text{-}max}$:	--	$= S_{D1}{*}T_L / (T_a^2{*}R/I_E)$ for $T > T_L$ per ASCE Eq. 12.8-4
$C_{s\text{-}min}$:	0.044	per ASCE Eq. 15.4-1
$C_{s\text{-}min}$:	--	$= 0.8S_1 / (R/I_E)$ for $S_1 \Rightarrow 0.6g$ per ASCE Eq. 15.4-2
$C_{s\text{-}use}$:	0.804	

V : 0.804 W = $C_{S\text{-}use}$ * W per ASCE Eq. 12.8-1

This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

Search Information

Address:	1015 39th Ave SE Puyallup, WA 98374
Coordinates:	47.1590004, -122.2794422
Elevation:	489 ft
Timestamp:	2023-12-01T15:13:57.333Z
Hazard Type:	Wind

ASCE 7-16

MRI 10-Year	67 mph
MRI 25-Year	73 mph
MRI 50-Year	78 mph
MRI 100-Year	82 mph
Risk Category I	92 mph
Risk Category II	97 mph
Risk Category III	104 mph
Risk Category IV	108 mph

ASCE 7-10

MRI 10-Year	72 mph
MRI 25-Year	79 mph
MRI 50-Year	85 mph
MRI 100-Year	91 mph
Risk Category I	100 mph
Risk Category II	110 mph
Risk Category III-IV	115 mph

ASCE 7-05

ASCE 7-05 Wind Speed	85 mph

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Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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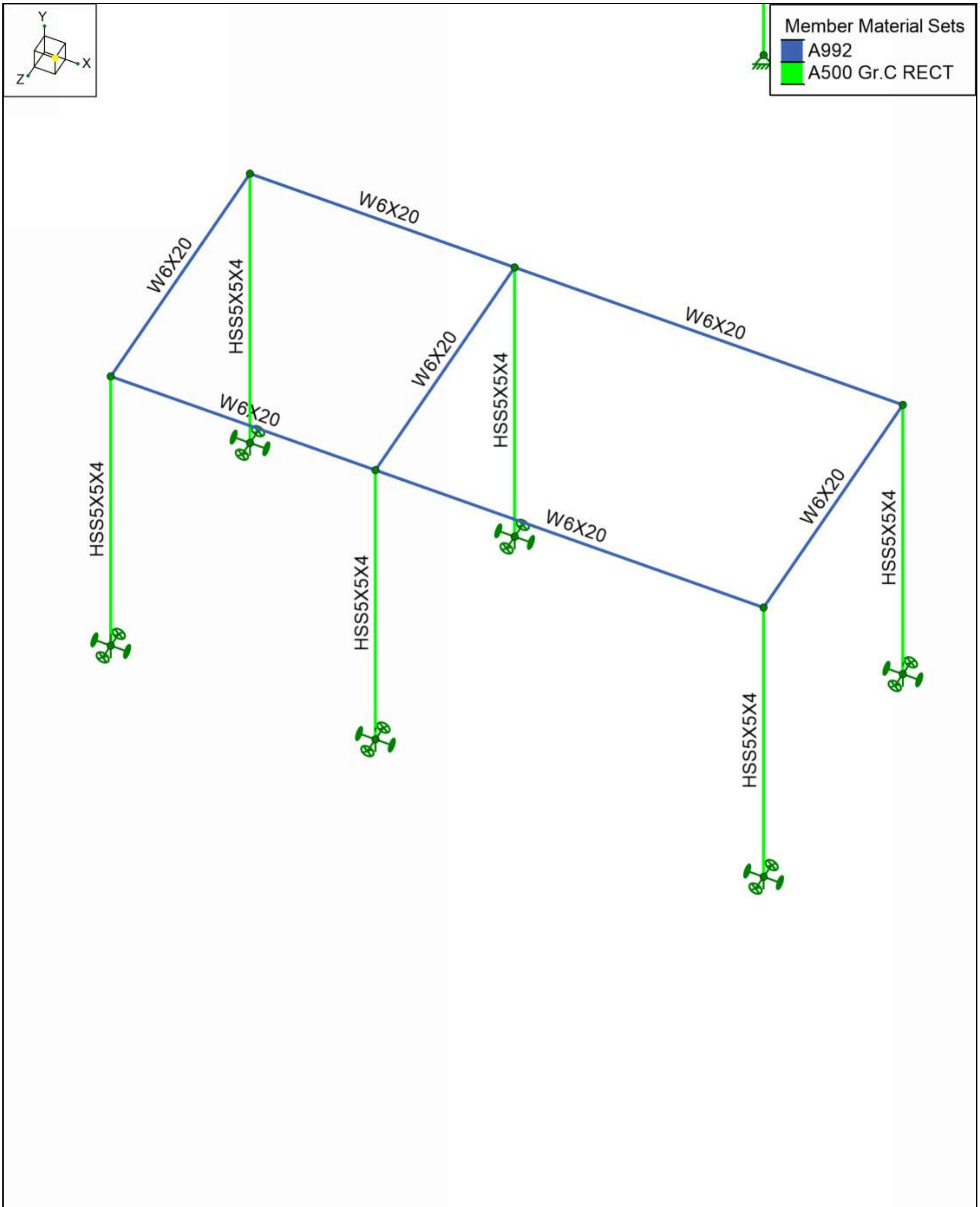
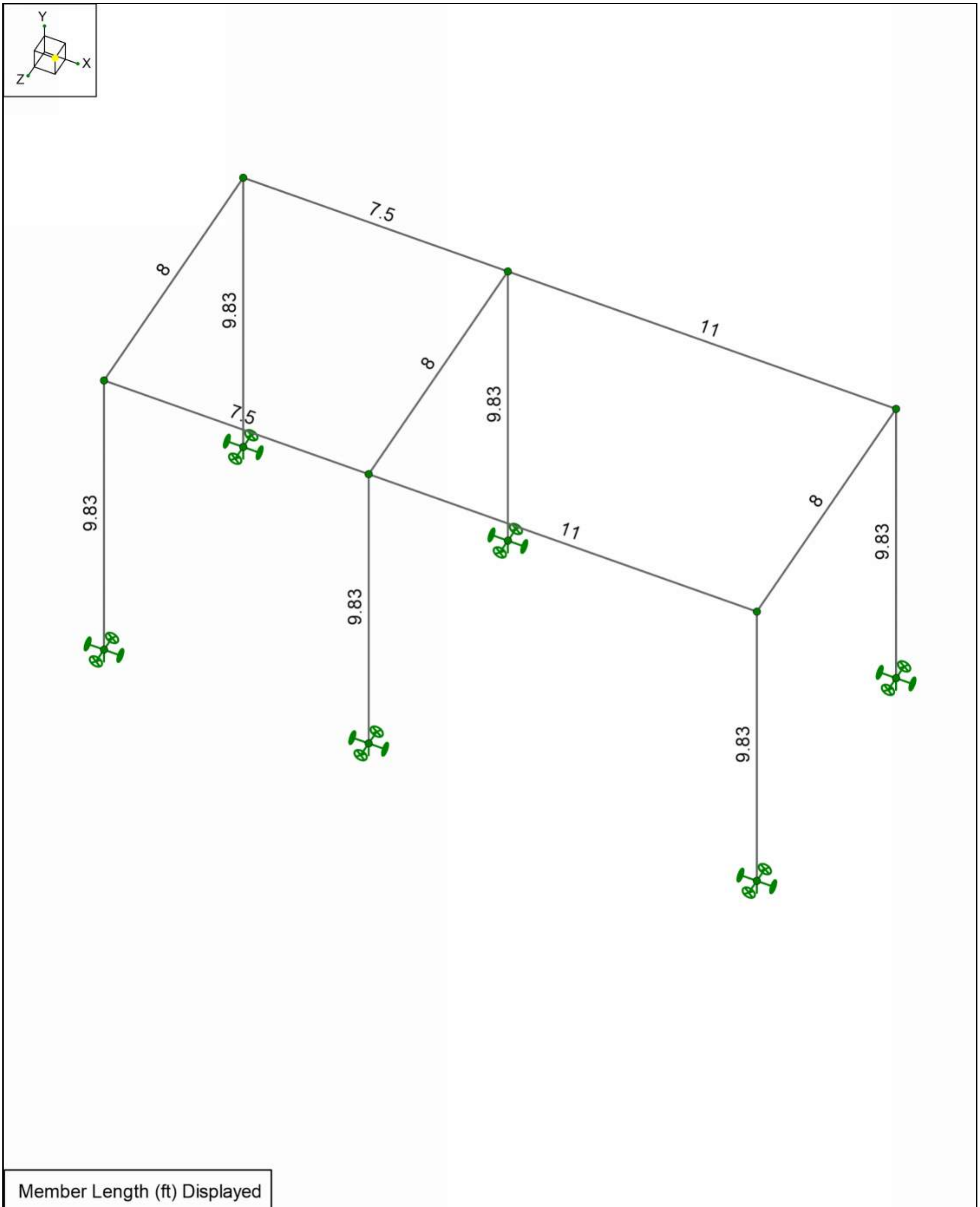


Quantum Consulting …	PS-02 Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:02 AM
23444.01		24-02-20 - Chiller PS-02…



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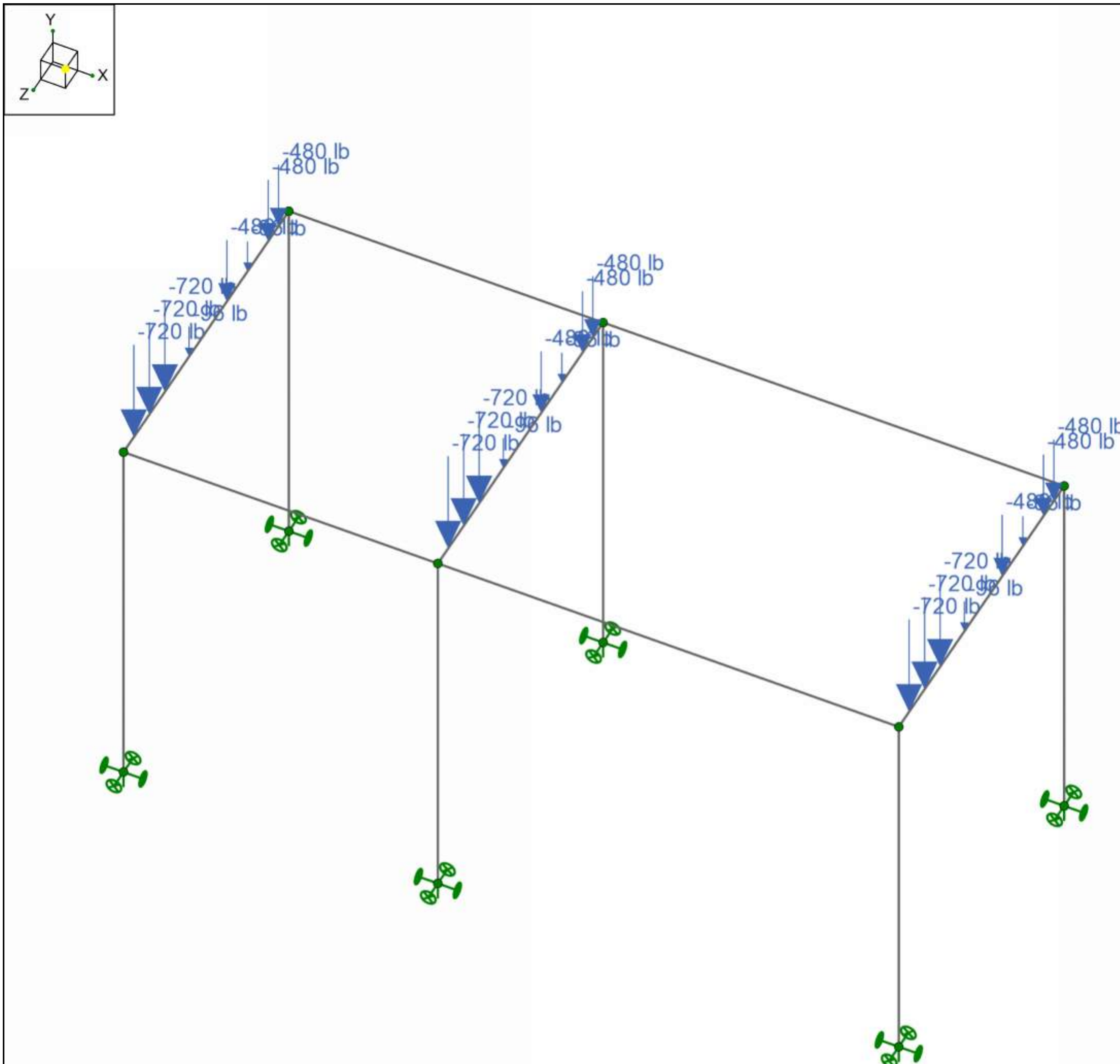
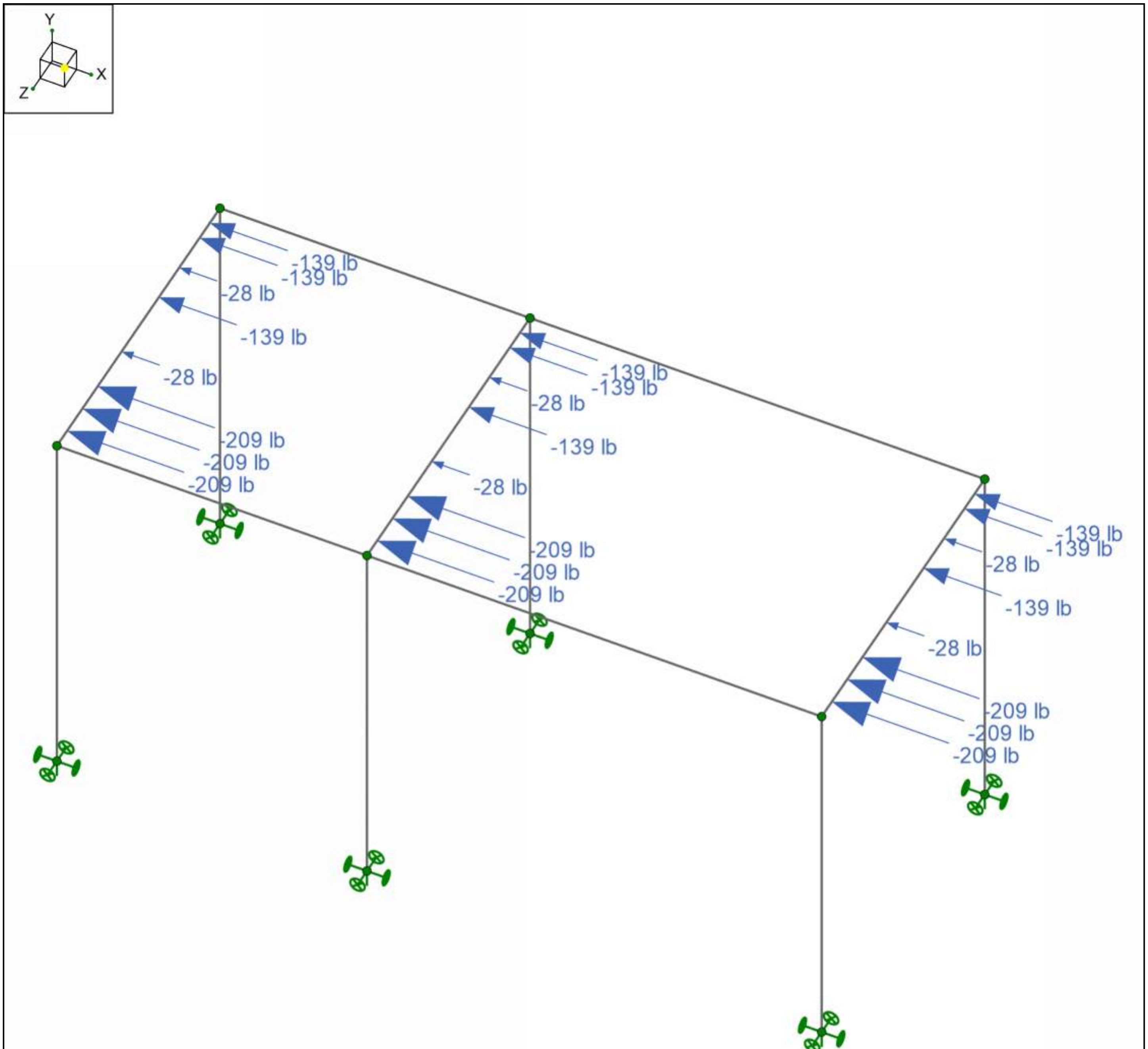


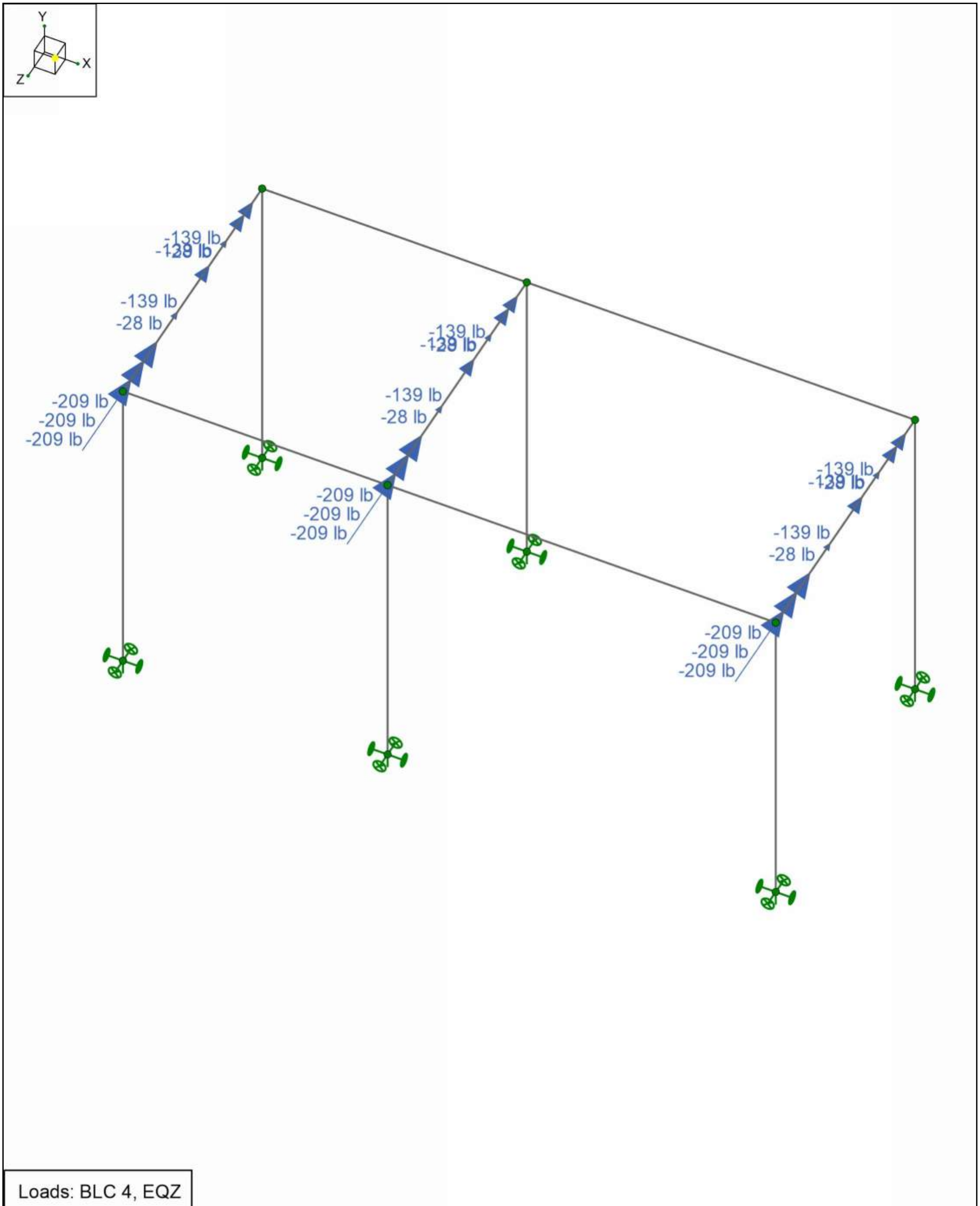
Loads: BLC 1, Dead

Quantum Consulting …	PS-02 Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:03 AM
23444.01		24-02-20 - Chiller PS-02…



Loads: BLC 3, EQX

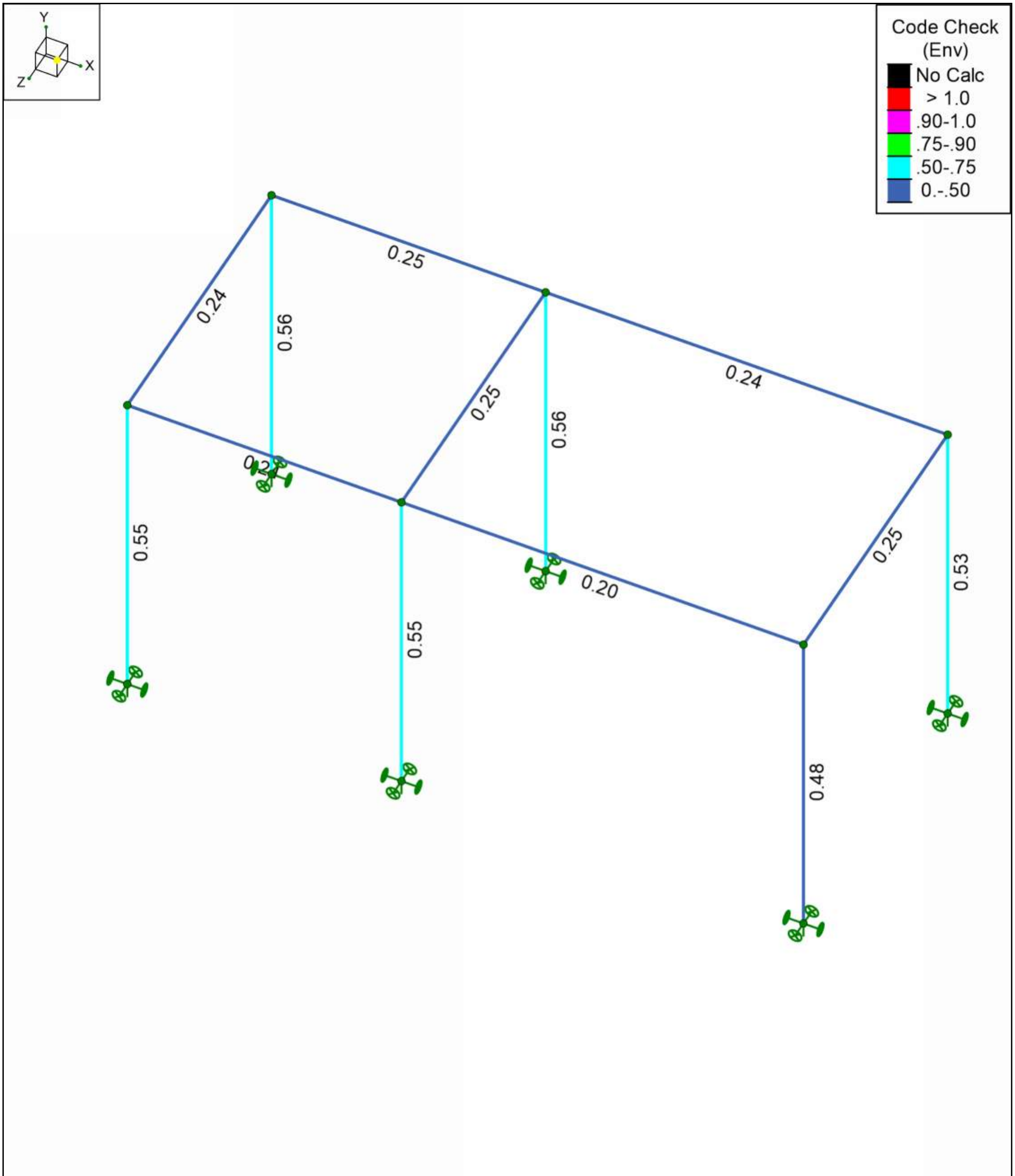
Quantum Consulting …	PS-02 Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:04 AM
23444.01		24-02-20 - Chiller PS-02…



Quantum Consulting …	PS-02 Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:04 AM
23444.01		24-02-20 - Chiller PS-02…

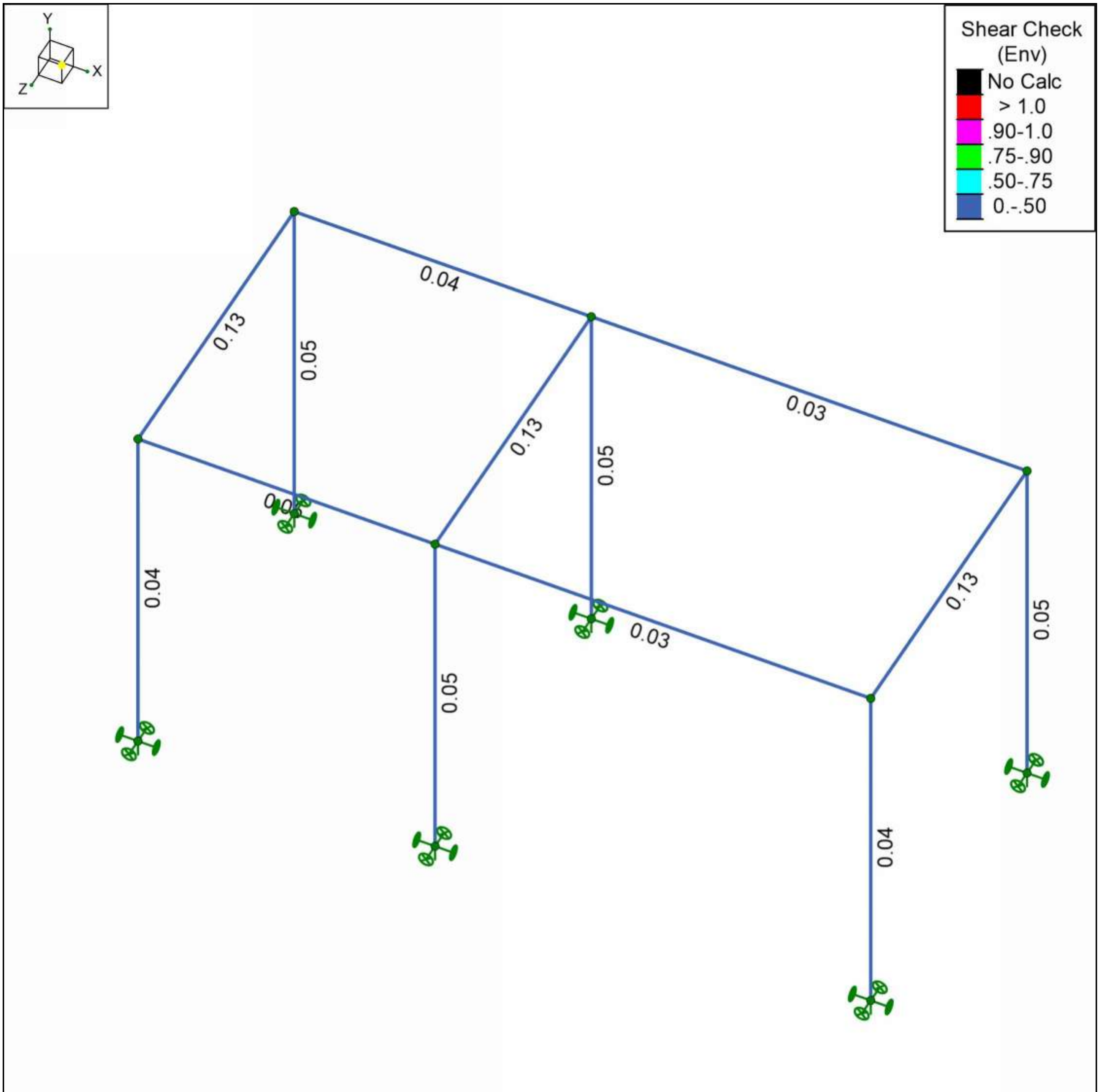
Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	DL		Y	DL	1						
2	ELX		Y	ELX	1						
3	ELZ		Y	ELZ	1						
4	ELX*Cd		Y	ELX	3						
5	ELZ*Cd		Y	ELZ	3						
6	ASD										
7	IBC 16-8	Yes	Y	DL	1						
8	IBC 16-10 (b)	Yes	Y	DL	1	SL	1				
9	IBC 16-12 (b) (a)	Yes	Y	DL	1	SDS*DL	0.14	ELX	0.7	ELZ	0.21
10		Yes	Y	DL	1	SDS*DL	0.14	ELZ	0.7	ELX	0.21
11	IBC 16-14 (a)	Yes	Y	DL	1	SDS*DL	0.105	ELX	0.525	ELZ	0.16
12		Yes	Y	DL	1	SDS*DL	0.105	ELZ	0.525	ELX	0.16
13	IBC 16-16 (a)	Yes	Y	DL	0.6	SDS*DL	-0.14	ELX	0.7	ELZ	0.21
14		Yes	Y	DL	0.6	SDS*DL	-0.14	ELZ	0.7	ELX	0.21
15	IBC 16-12 (b) (a) OS		Y	DL	1	SDS*DL	0.14	ELX	2.1	ELZ	0.63
16			Y	DL	1	SDS*DL	0.14	ELZ	2.1	ELX	0.63
17	IBC 16-14 (a) OS		Y	DL	1	SDS*DL	0.105	ELX	1.58	ELZ	0.48
18			Y	DL	1	SDS*DL	0.105	ELZ	1.58	ELX	0.48
19	IBC 16-16 (a) OS		Y	DL	0.6	SDS*DL	-0.14	ELX	2.1	ELZ	0.63
20			Y	DL	0.6	SDS*DL	-0.14	ELZ	2.1	ELX	0.63
21	Base Plate LRFD										
22	IBC 16-5		Y	DL	1.2	SDS*DL	0.2	ELX	1	ELZ	0.3
23			Y	DL	1.2	SDS*DL	0.2	ELZ	1	ELX	0.3
24	IBC 16-7		Y	DL	0.9	SDS*DL	-0.2	ELX	1	ELZ	0.3
25			Y	DL	0.9	SDS*DL	-0.2	ELZ	1	ELX	0.3
26	IBC 16-5 (os-a)	Yes	Y	DL	1.2	SDS*DL	0.2	ELX	3	ELZ	0.9
27		Yes	Y	DL	1.2	SDS*DL	0.2	ELZ	3	ELX	0.9
28	IBC 16-7 (os-a)	Yes	Y	DL	0.9	SDS*DL	-0.2	ELX	3	ELZ	0.9
29		Yes	Y	DL	0.9	SDS*DL	-0.2	ELZ	3	ELX	0.9



Member Code Checks Displayed (Enveloped)
Envelope Only Solution

Quantum Consulting …	PS-02 Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:05 AM
23444.01		24-02-20 - Chiller PS-02…



Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

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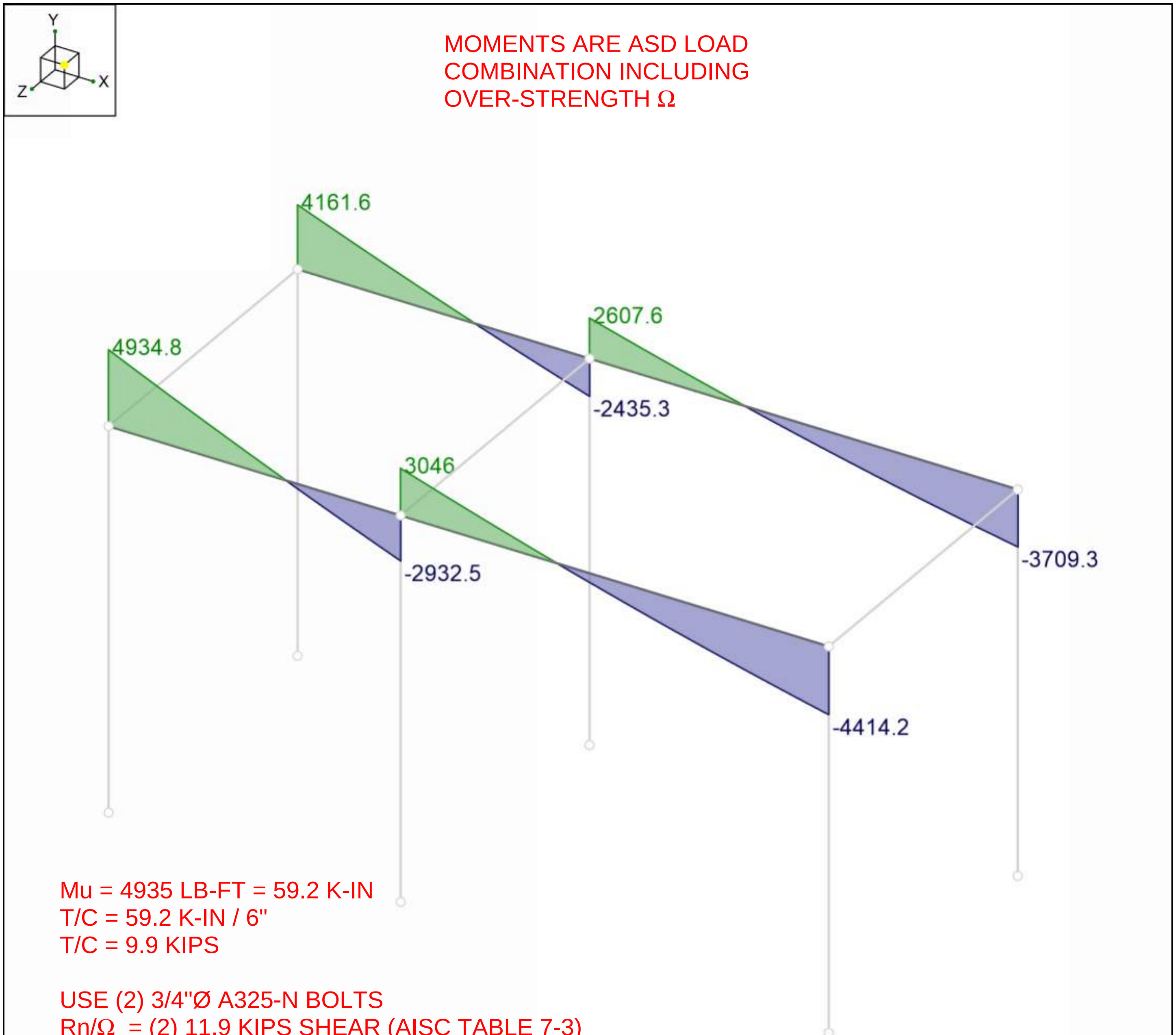


Mu = 4935 LB-FT = 59.2 K-IN
T/C = 59.2 K-IN / 6"
T/C = 9.9 KIPS

USE (2) 3/4"Ø A325-N BOLTS
Rn/Ω = (2) 11.9 KIPS SHEAR (AISC TABLE 7-3)
Rn/Ω = (2) 11.0 KIPS BEARING (AISC TABLE 7-5) CONTROLS
Rn/Ω = 22 KIPS > 9.9 KIPS OK

W6X20 Flange = 0.365"x6.02"
Area = 2.20 sqin
Tn/Ω= (50 ksi) (2.20 sqin) / 1.67
Tn/Ω = 65.9 KIPS > 9.9 KIPS

Net Area = 1.56 sqin
U = 0.90 (bf > 2/3 d case 7)
Tn/Ω = (65 ksi) (1.56 sqin) (0.90) /2.0
Tn/Ω = 46.6 k > 9.9 k

CHECK A36 3/8"x6" FLANGE PLATE
Area = 2.25 sqin
Tn/Ω= (36 ksi) (2.25 sqin) / 1.67
Tn/Ω = 48.5 KIPS > 9.9 KIPS

Net Area = 1.59 sqin
U = 1.0 (case 1)
Tn/Ω = (58 ksi) (1.59 sqin) (1.0) /2.0
Tn/Ω = 46.1 k > 9.9 k

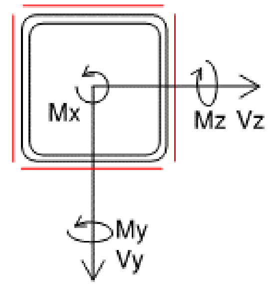
Results for LC 15, IBC 16-12 (b) (a) OS
Member z Bending Moments (lb-ft)

Quantum Consulting …	Chiller Pipe Frames	SK-1
Travis Michaud		Feb 21, 2024 at 05:33 AM
23444.01		24-02-20 - Chiller PS-02…

TUBE STEEL All Around Welded Connection

IBC 2018, AISC Manual 15th Edition (AISC 360-16)

Weld as a Line
HSS Sections Only



1.) Input

Member:		HSS5x5x1/4
Fillet Weld Size:	*dw* =	4/16"
Weld Strength:	*fw* =	70 ksi

Forces (ASD):			**Weld Properties:**		
Shear:	*Vuy* =		Ly =	10.0	in
	Vuz =	1.50 k	Lz =	10.0	in
Bending:	*Muz* =	68 k-in	Zz =	33.3	in^2
	Muy =		Zy =	33.3	in^2
Tension:	*Pu* =		A =	20.0	in
Torque:	*Tu* =		J =	166.7	in^2

2.) Connection Analysis

Weld Capacity:	*Vn/Ω*=	[0.6*fw*dw*√2/2]/Ω		AISC EQ 8-1 (ASD)
	Vn/Ω=	**3.71 k/in**		
Shear Capacity:	*Vny/Ω*=	Vn/Ω*Ly		
	Vny/Ω=	**37.12 k**	Uc =	0.00
	Vnz/Ω=	Vn/Ω*Lz		
	Vnz/Ω=	**37.12 k**	Uc =	0.04
Bending Capacity:	*Mnz/Ω*=	*Vn/Ω**Zz		
	Mnz/Ω=	**124 k-in**	Uc =	0.55
	Mny/Ω=	*Vn/Ω**Zy		
	Mny/Ω=	**124 k-in**	Uc =	0.00
Axial Capacity:	*Pn/Ω*=	*Vn/Ω**A		
	Pn/Ω=	**74.25 k**	Uc =	0.00
Twisting Capacity:	*Tn/Ω*=	*Vn/Ω**J		
	Tn/Ω=	**619 k-in**	Uc =	0.00

Combined Uc = 0.59 OK
1/4 " weld is acceptable

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 3.0.7947.0

Company:	QCE	Date:	1/4/2024
Engineer:	TVM	Page:	1/6
Project:	23444.01 - Centeris Pipe Moment Frames		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company: Centeris
Customer contact name:
Customer e-mail:
Comment:

Project description: Highest Uplift
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 12.500
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 14.25
c_{ac} (inch): 32.34
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 12.00 x 12.00 x 0.25
Yield stress: 36000 psi

Profile type/size: HSS5X5X1/4

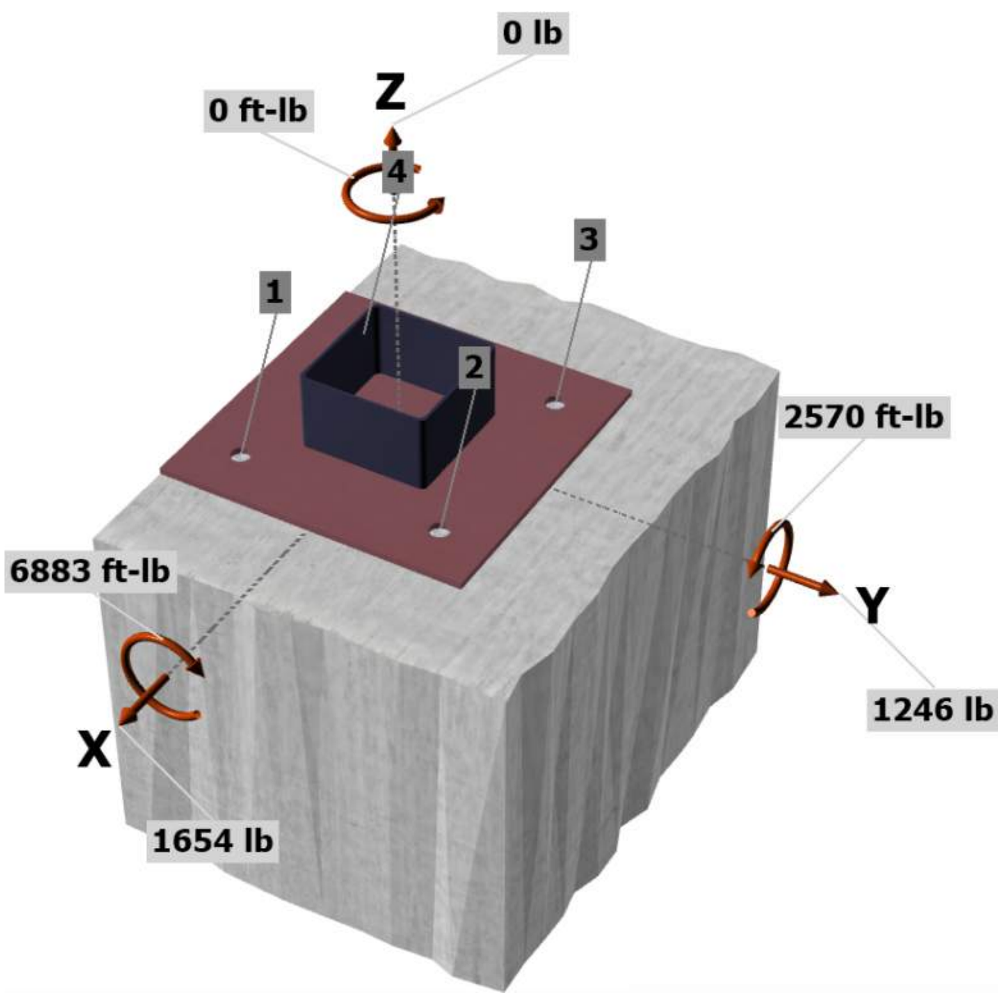
Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 3/4"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 1654
V_{uay} [lb]: 1246
M_{ux} [ft-lb]: -6883
M_{uy} [ft-lb]: 2570
M_{uz} [ft-lb]: 0

<Figure 1>



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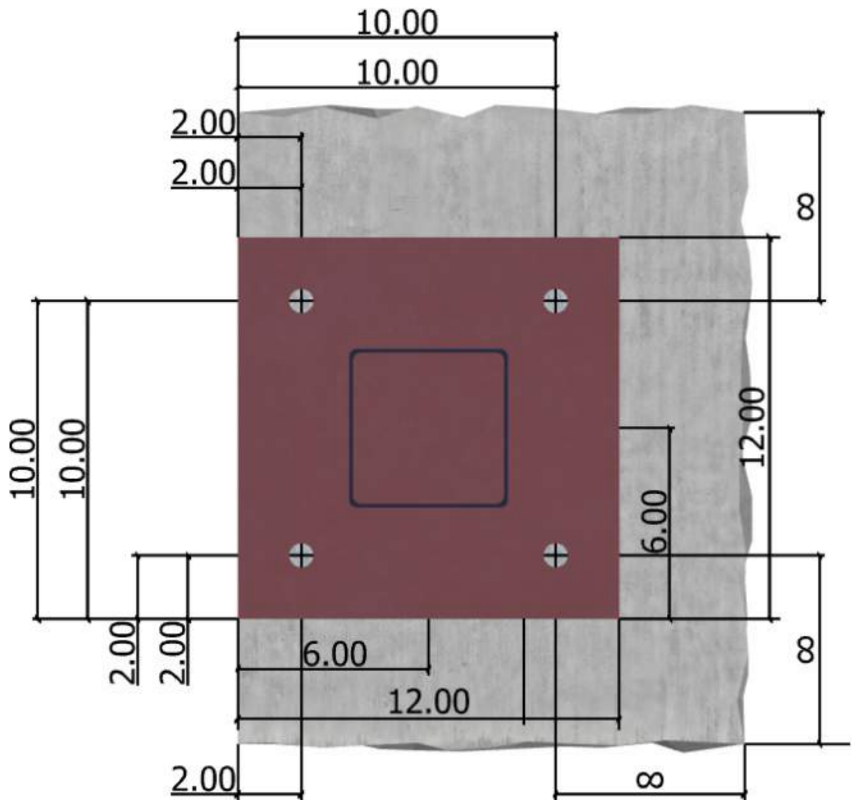
<Figure 2>

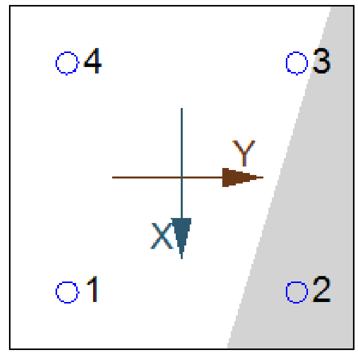


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	3864.8	413.5	311.5	517.7
2	0.0	413.5	311.5	517.7
3	379.8	413.5	311.5	517.7
4	5394.4	413.5	311.5	517.7
Sum	9638.9	1654.0	1246.0	2070.8

Maximum concrete compression strain (‰): 0.21
Maximum concrete compression stress (psi): 898
Resultant tension force (lb): 9639
Resultant compression force (lb): 9639
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 2.35
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.54
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	12.500	41150

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
1244.13	1406.25	2.00	0.864	0.732	1.00	1.000	41150	0.75	12946

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1310	1.00	1.00	1.00	3000	0.24	1369

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1369	0.75	12.500	40308

$0.75\phi N_{ag} = 0.75\phi\,(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
514.75	422.18	10.27	2.00	0.773	0.758	1.000	40308	0.65	14047

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8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11625	1.0	0.65	0.75	5667

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	2.00	1394

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
36.00	18.00	1.000	1.000	1.000	1.000	1394	0.75	4183

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	578.75	422.18	0.758	1.000	1.000	40308	41907

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
1308.13	1406.25	1.000	0.732	1.000	1.000	41150	28020	0.70

ϕV_{cpg} (lb)
39228

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	5394	14528	0.37	Pass
Concrete breakout	**9639**	**12946**	**0.74**	**Pass (Governs)**
Adhesive	9639	14047	0.69	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	518	5667	0.09	Pass
|| Concrete breakout y-	**827**	**4183**	**0.20**	**Pass (Governs)**
Pryout	2071	39228	0.05	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.74	0.00	74.5%	1.0	Pass

SET-3G w/ 3/4"Ø F1554 Gr. 36 with hef = 12.500 inch meets the selected design criteria.

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12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

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1.Project information

Customer company: Centeris
Customer contact name:
Customer e-mail:
Comment:

Project description: PS-02 Frame (Highest Moment)
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 12.500
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 14.25
c_{ac} (inch): 32.34
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 18.00
State: Cracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 12.00 x 12.00 x 0.25
Yield stress: 36000 psi

Profile type/size: HSS5X5X1/4

Recommended Anchor
Anchor Name: SET-3G - SET-3G w/ 3/4"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-4057

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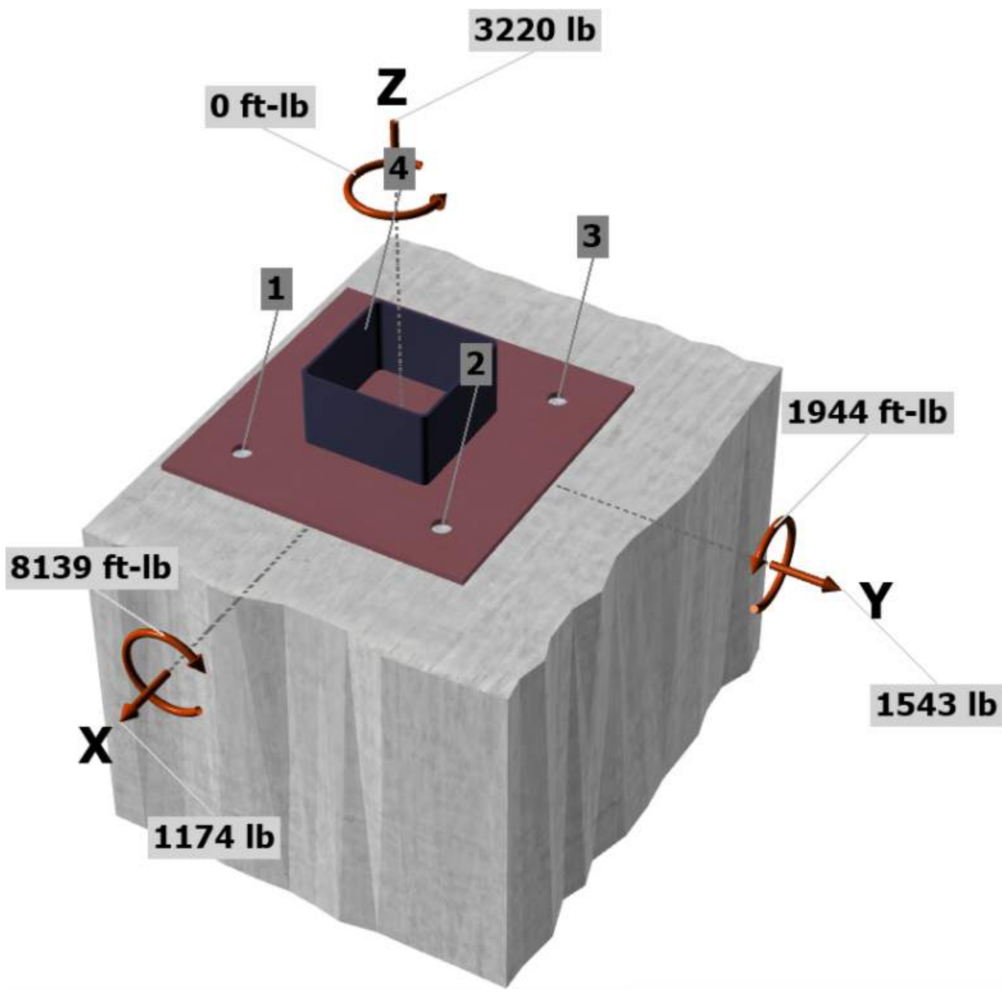
Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: No
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: -3220
V_{uax} [lb]: 1174
V_{uay} [lb]: 1543
M_{ux} [ft-lb]: -8139
M_{uy} [ft-lb]: 1944
M_{uz} [ft-lb]: 0

<Figure 1>



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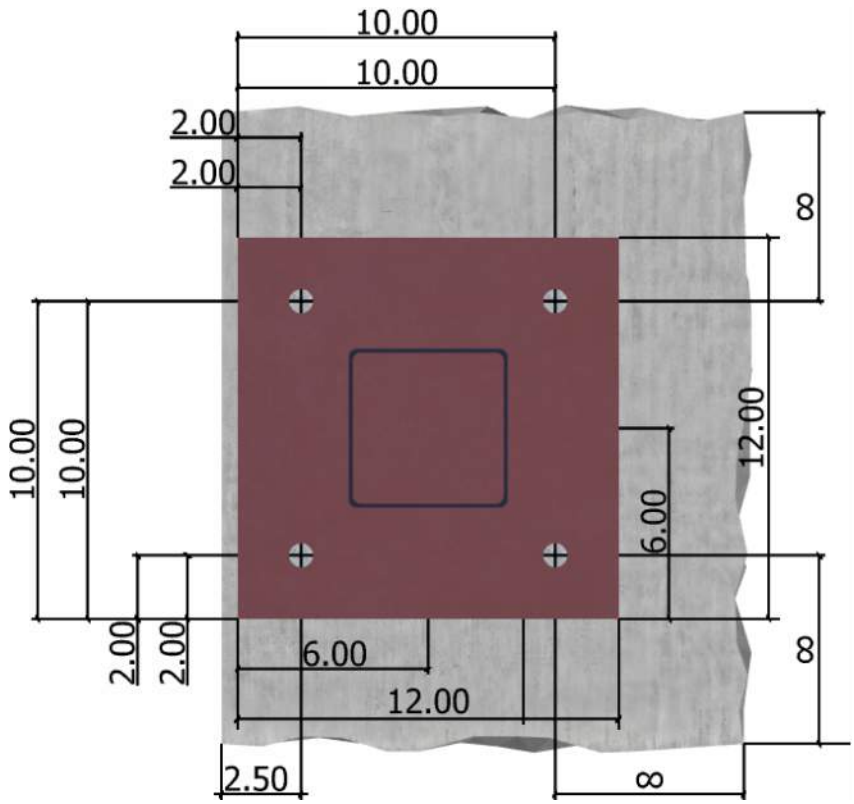
<Figure 2>



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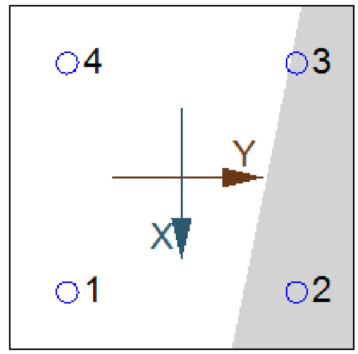
3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	4072.1	293.5	385.8	484.7
2	0.0	293.5	385.8	484.7
3	0.0	293.5	385.8	484.7
4	5151.2	293.5	385.8	484.7
Sum	9223.3	1174.0	1543.0	1938.8

Maximum concrete compression strain (‰): 0.21
Maximum concrete compression stress (psi): 909
Resultant tension force (lb): 9223
Resultant compression force (lb): 12443
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.47
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	12.500	41150

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
966.88	1406.25	2.50	0.976	0.740	1.00	1.000	41150	0.65	9958

6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,cr} = \tau_{k,cr} f_{short\text{-}term} K_{sat} (f'_c / 2{,}500)^n \alpha_{N.seis}$

$\tau_{k,cr}$ (psi)	$f_{short\text{-}term}$	K_{sat}	$\alpha_{N.seis}$	f'_c (psi)	n	$\tau_{k,cr}$ (psi)
1310	1.00	1.00	1.00	3000	0.24	1369

$N_{ba} = \lambda_a \tau_{cr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

λ_a	τ_{cr} (psi)	d_a (in)	h_{ef} (in)	N_{ba} (lb)
1.00	1369	0.75	12.500	40308

$0.75\phi N_{ag} = 0.75\phi\,(A_{Na} / A_{Na0})\,\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

A_{Na} (in^2)	A_{Na0} (in^2)	c_{Na} (in)	$c_{a,min}$ (in)	$\Psi_{ec,Na}$	$\Psi_{ed,Na}$	$\Psi_{cp,Na}$	N_{ba}(lb)	ϕ	$0.75\phi N_{ag}$ (lb)
364.65	422.18	10.27	2.50	0.956	0.773	1.000	40308	0.65	12548

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8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\alpha_{V,seis}$	$\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb)
11625	1.0	0.65	0.75	5667

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	2.50	1949

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
56.25	28.13	1.000	1.000	1.000	1.000	1949	0.70	5456

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi \min|k_{cp}N_{ag}\ ;\ k_{cp}N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\Psi_{ec,Na}\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Na} (in^2)	A_{Na0} (in^2)	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	N_{ba} (lb)	N_a (lb)
2.0	593.02	422.18	0.773	1.000	1.000	40308	43767

A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
1330.88	1406.25	1.000	0.740	1.000	1.000	41150	28819	0.70

ϕV_{cpg} (lb)
40347

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.6.)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	5151	14528	0.35	Pass
Concrete breakout	**9223**	**9958**	**0.93**	**Pass (Governs)**
Adhesive	9223	12548	0.74	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	485	5667	0.09	Pass
|| Concrete breakout y-	**587**	**5456**	**0.11**	**Pass (Governs)**
Pryout	1939	40347	0.05	Pass

Interaction check	$N_{ua}/\phi N_n$	$V_{ua}/\phi V_n$	Combined Ratio	Permissible	Status
Sec. 17.6..1	0.93	0.00	92.6%	1.0	Pass

SET-3G w/ 3/4"Ø F1554 Gr. 36 with hef = 12.500 inch meets the selected design criteria.

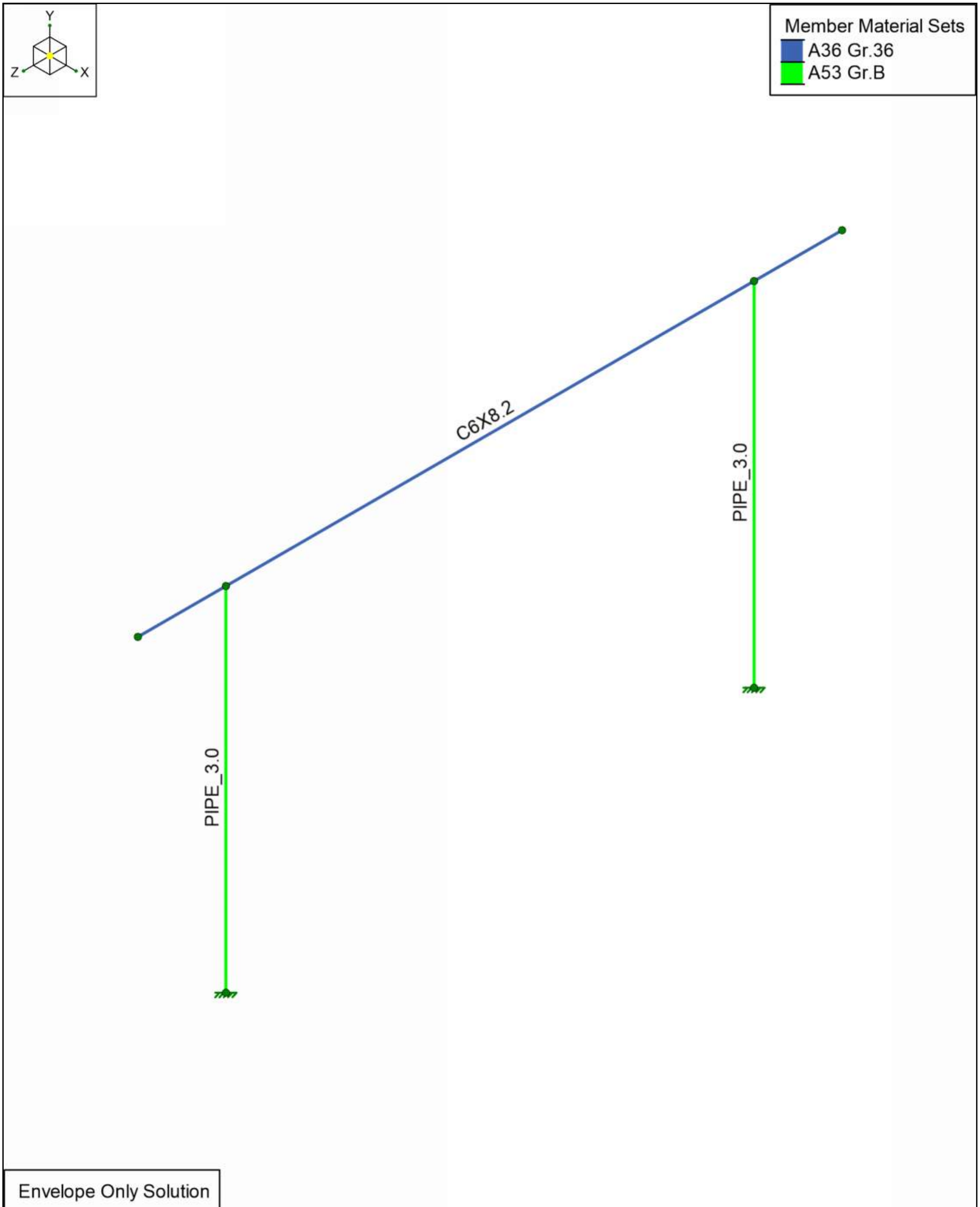
12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.



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Travis Michaud		Feb 22, 2024 at 08:09 AM
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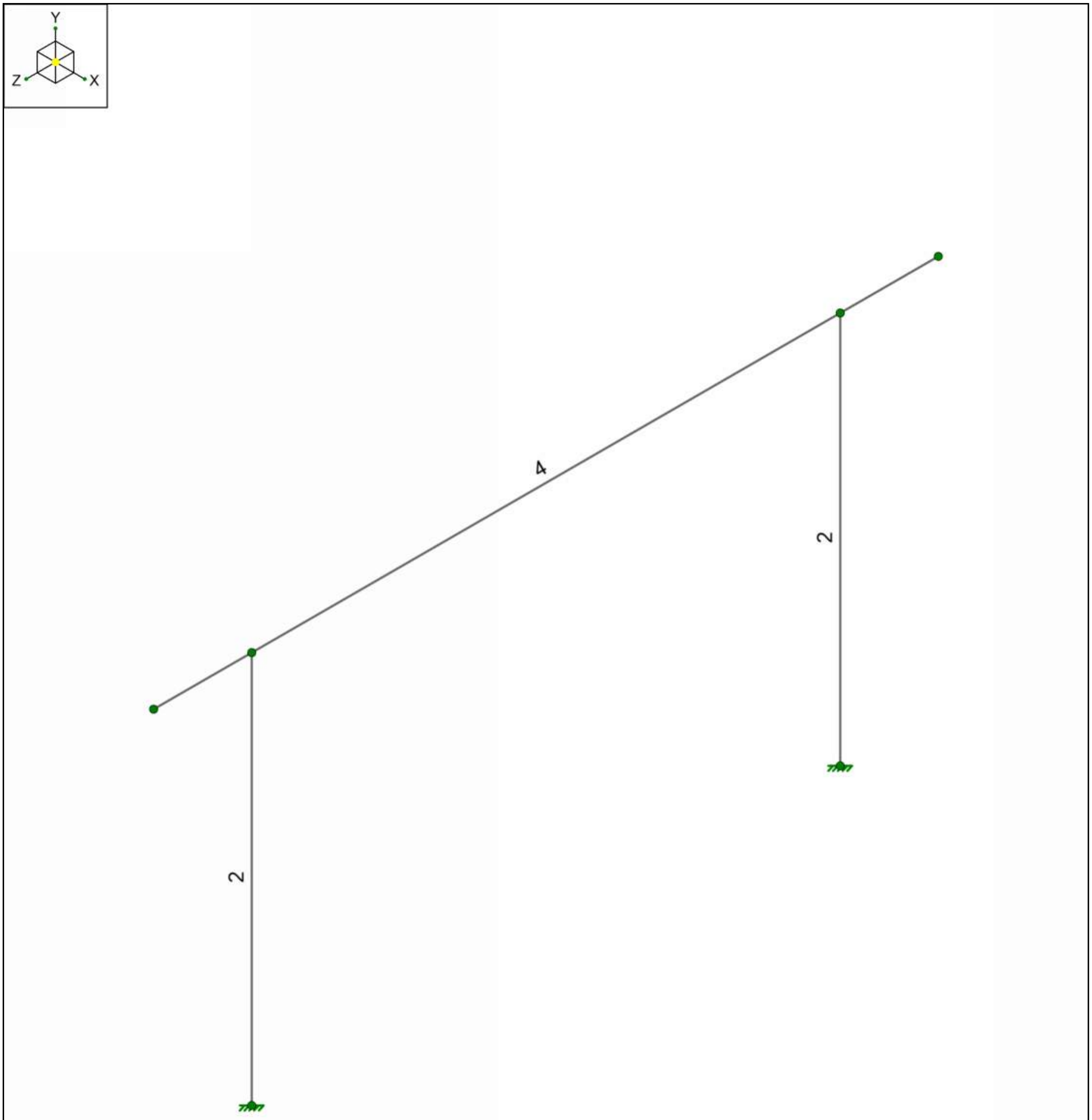

Member Length (ft) Displayed
Envelope Only Solution

Quantum Consulting …	Chiller Pipe Frames	
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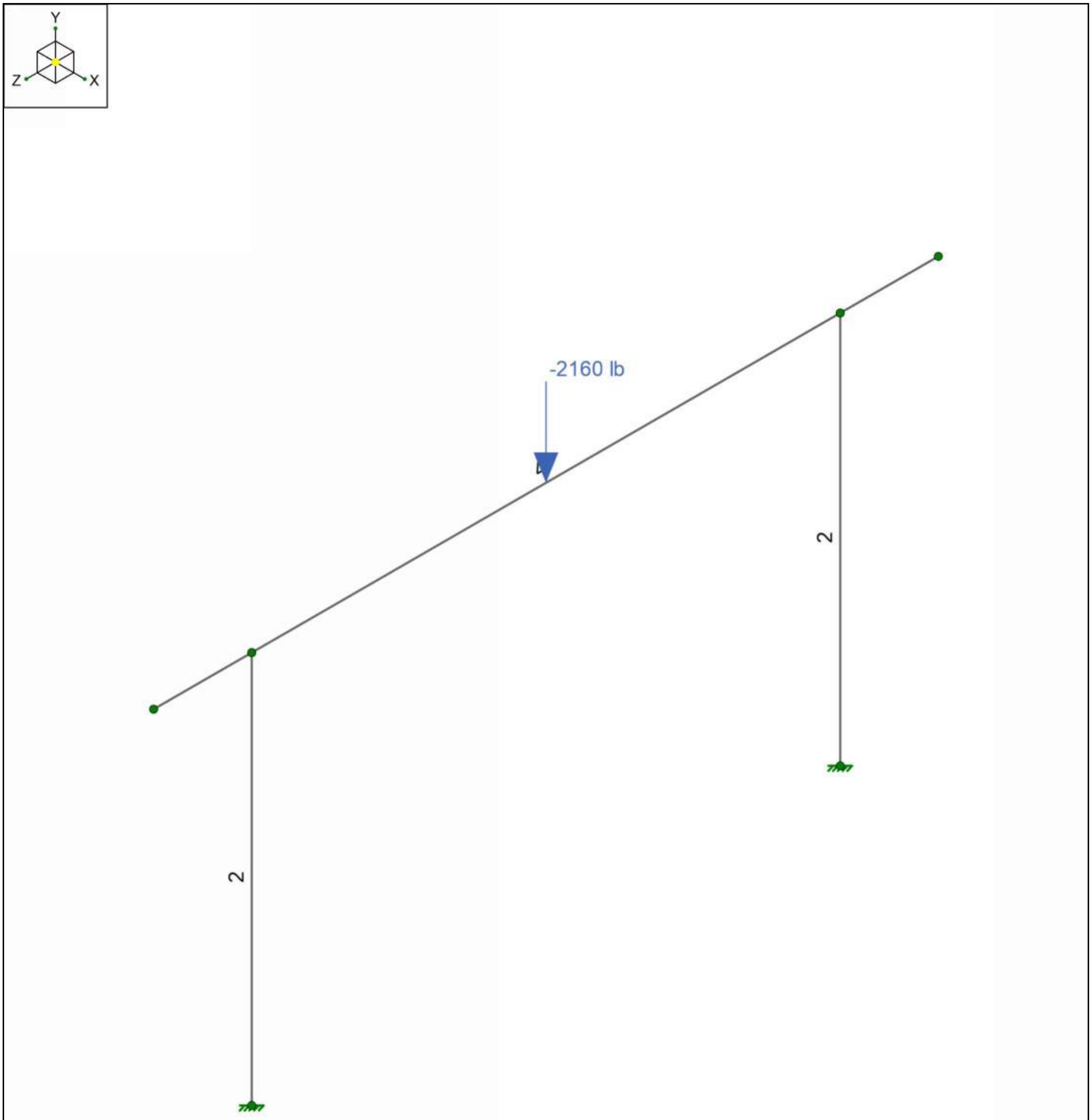
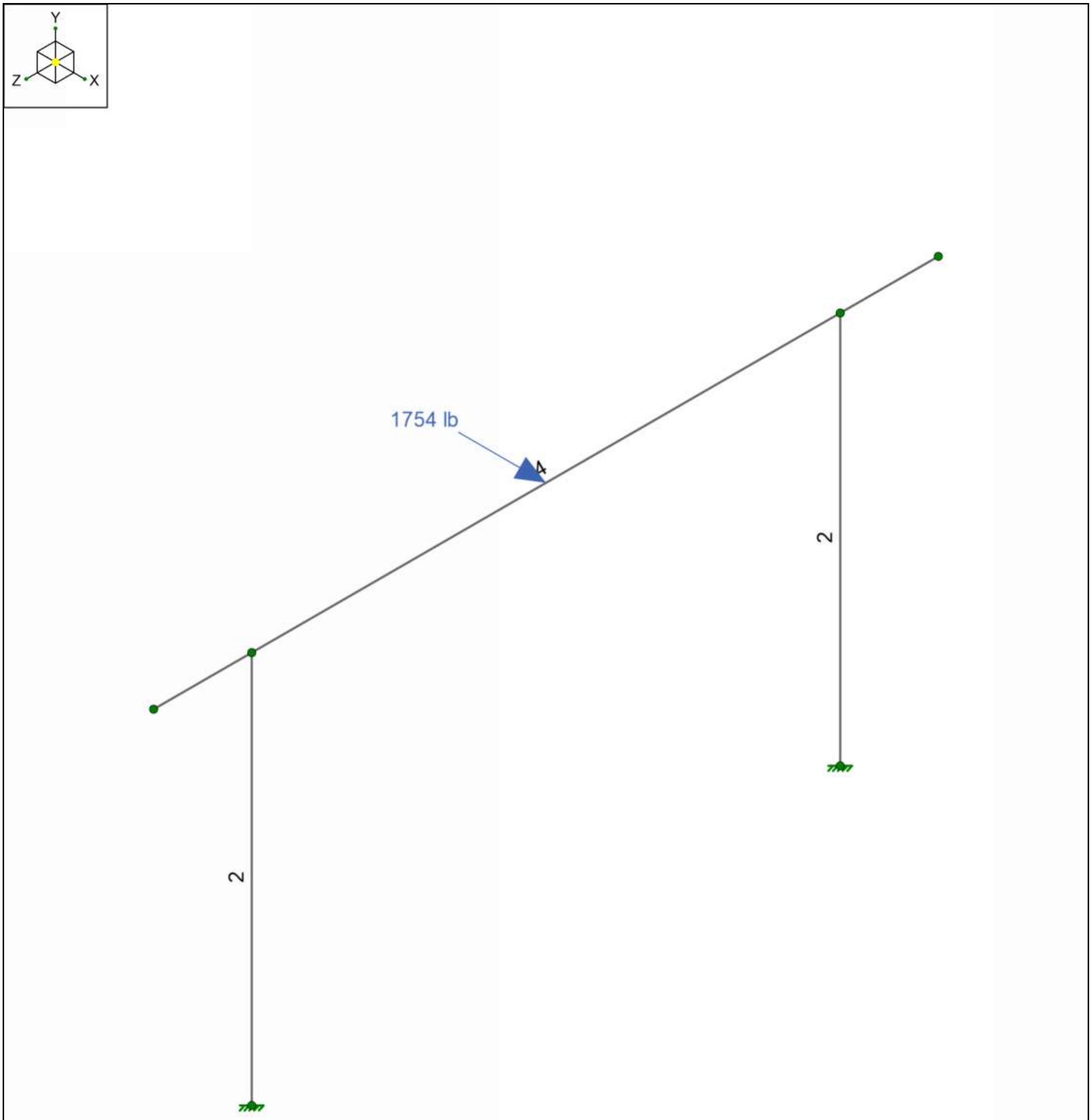


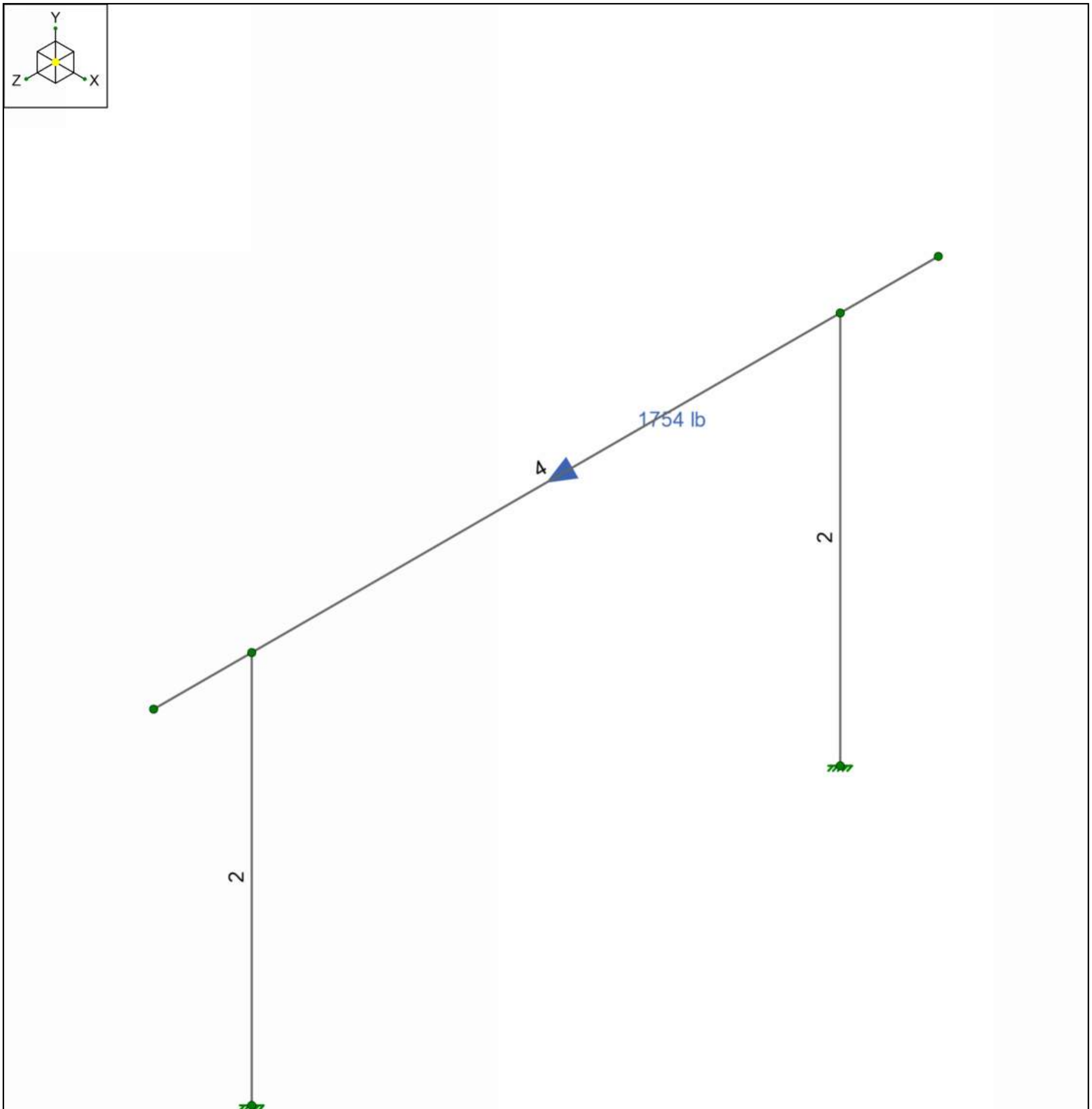
Member Length (ft) Displayed
Loads: BLC 1, Dead
Envelope Only Solution

Quantum Consulting …	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:10 AM
23444.01		24-02-20 - Chiller PS-03…



Member Length (ft) Displayed
Loads: BLC 3, EQX
Envelope Only Solution

Quantum Consulting …	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:10 AM
23444.01		24-02-20 - Chiller PS-03…

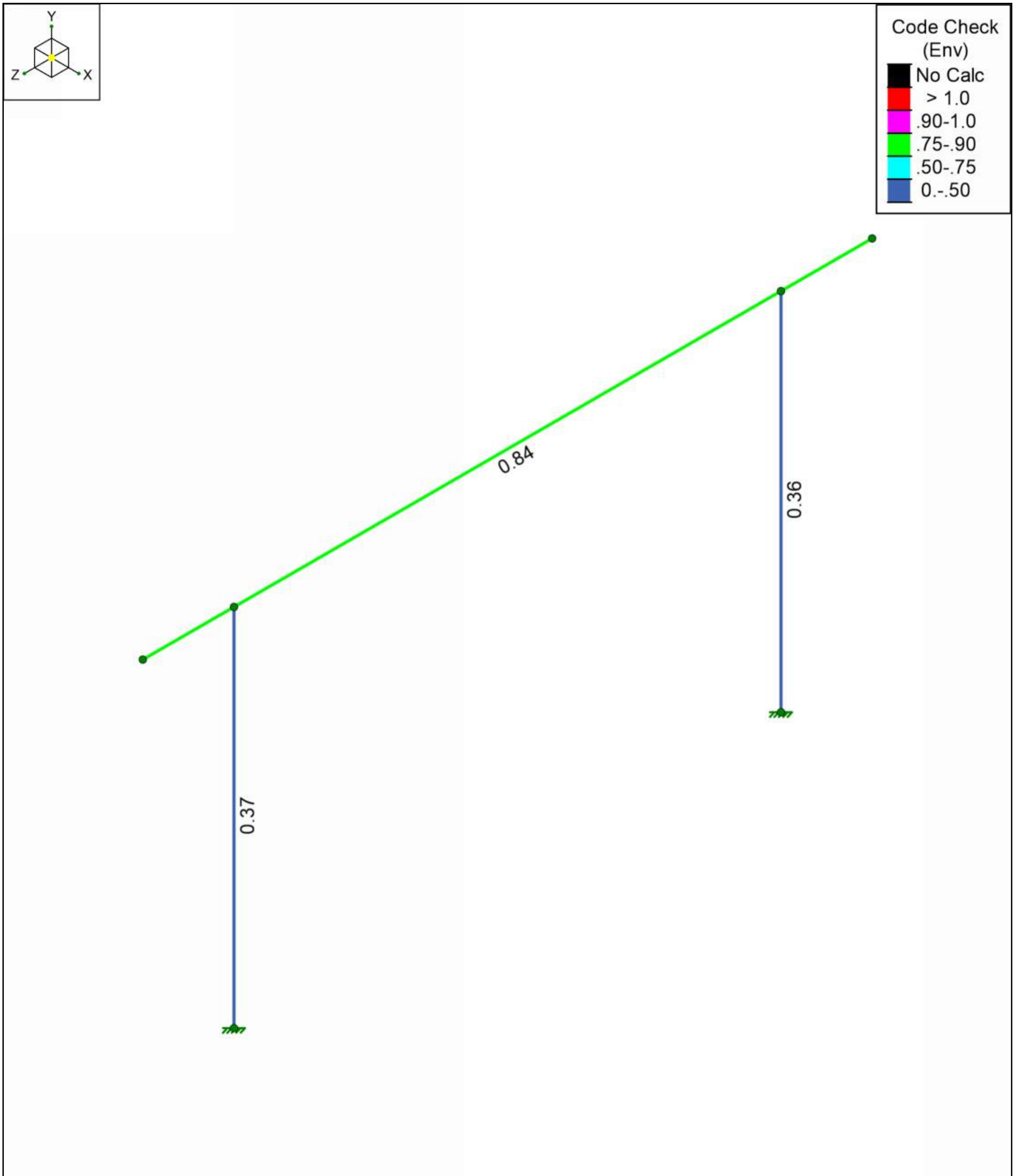


Member Length (ft) Displayed
Loads: BLC 4, EQZ
Envelope Only Solution

Quantum Consulting …	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:11 AM
23444.01		24-02-20 - Chiller PS-03…

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor
1	ELX		Y	ELX	1				
2	ELX*Cd		Y	ELX	3				
3	ELZ*Cd		Y	ELZ	3				
4	ASD								
5	IBC 16-8	Yes	Y	DL	1				
6	IBC 16-10 (b)	Yes	Y	DL	1	SL	1		
7	IBC 16-12 (b) (a)	Yes	Y	DL	1	SDS*DL	0.14	ELX	0.7
8		Yes	Y	DL	1	SDS*DL	0.14	ELZ	0.7
9	IBC 16-14 (a)	Yes	Y	DL	1	SDS*DL	0.105	ELX	0.525
10		Yes	Y	DL	1	SDS*DL	0.105	ELZ	0.525
11	IBC 16-16 (a)	Yes	Y	DL	0.6	SDS*DL	-0.14	ELX	0.7
12		Yes	Y	DL	0.6	SDS*DL	-0.14	ELZ	0.7
13	IBC 16-12 (b) (a) OS		Y	DL	1	SDS*DL	0.14	ELX	1.4
14	IBC 16-14 (a) OS		Y	DL	1	SDS*DL	0.105	ELX	1.05
15	IBC 16-16 (a) OS		Y	DL	0.6	SDS*DL	-0.14	ELX	1.4
16	Base Plate LRFD								
17	IBC 16-5		Y	DL	1.2	SDS*DL	0.2	ELX	1
18			Y	DL	1.2	SDS*DL	0.2	ELZ	1
19	IBC 16-7		Y	DL	0.9	SDS*DL	-0.2	ELX	1
20			Y	DL	0.9	SDS*DL	-0.2	ELZ	1
21	IBC 16-5 (os-a)		Y	DL	1.2	SDS*DL	0.2	ELX	1.25
22			Y	DL	1.2	SDS*DL	0.2	ELZ	1.25
23	IBC 16-7 (os-a)		Y	DL	0.9	SDS*DL	-0.2	ELX	1.25
24			Y	DL	0.9	SDS*DL	-0.2	ELZ	1.25



Member Code Checks Displayed (Enveloped)
Envelope Only Solution

Quantum Consulting …	Chiller Pipe Frames	
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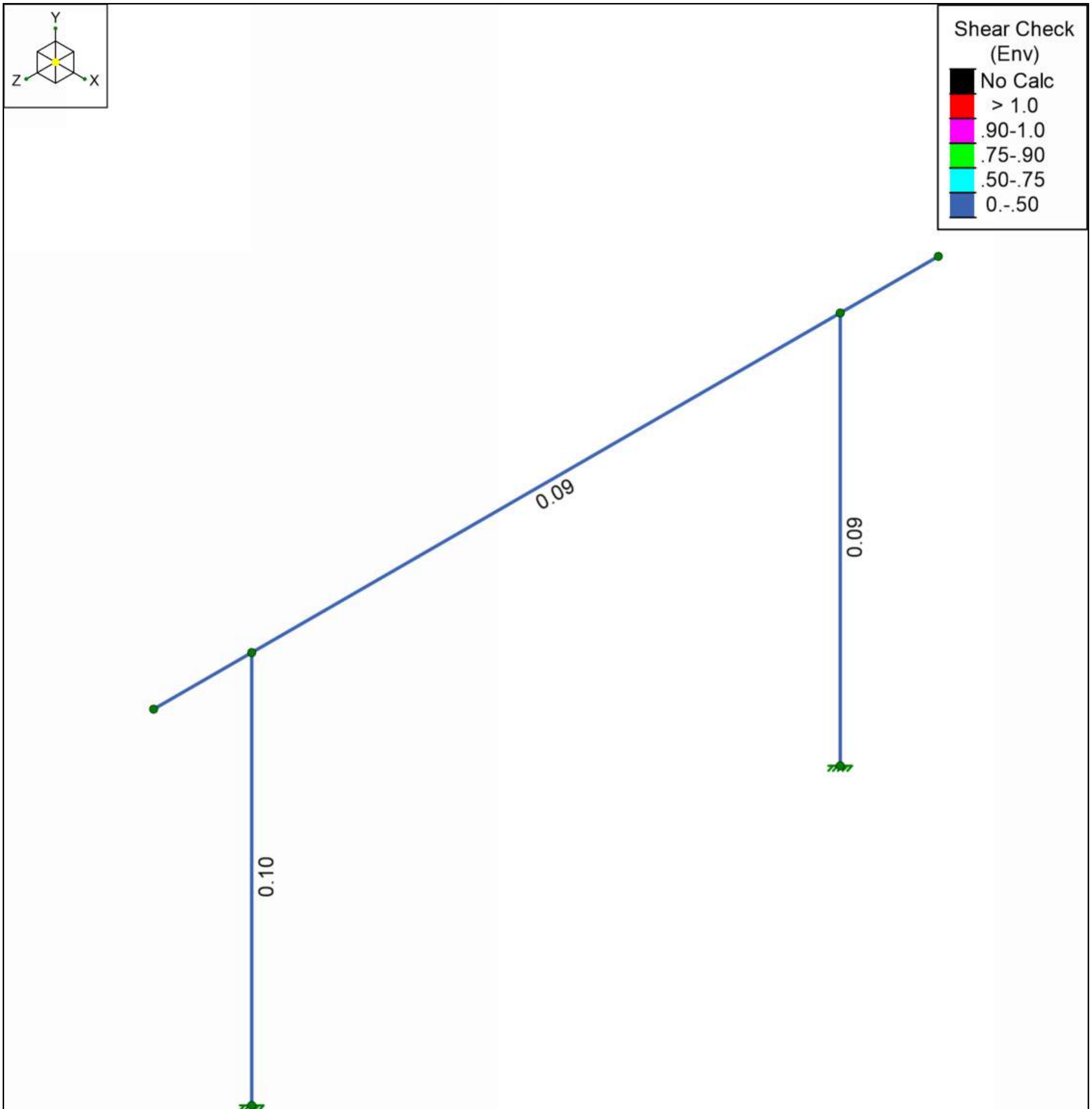
23444.01		24-02-20 - Chiller PS-03…



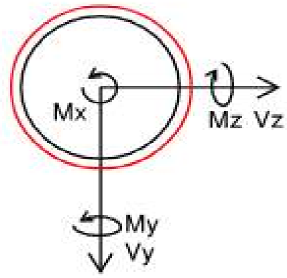
Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

Quantum Consulting …	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:13 AM
23444.01		24-02-20 - Chiller PS-03…

PIPE All Around Welded Connection

IBC 2018, AISC Manual 15th Edition (AISC 360-16)

Weld as a Line
Pipe & Round HSS Sections Only



1.) Input

Member:		Pipe3STD
Fillet Weld Size:	*dw* =	3/16"
Weld Strength:	*fw* =	70 ksi

Forces (ASD):

Shear:	*Vuy* =	0.00 k	L =	5.5	in
	Vuz =	1.00 k			
	Vu =	1.00 k	(Resultant Force)		
Bending:	*Muz* =	18.00 k-in	Z =	9.6	in^2
	Muy =				
	Mu =	18.00 k	(Resultant Moment)		
Tension:	*Pu* =		A =	5.5	in
Torque:	*Tu* =		J =	33.7	in^2

(Weld Properties columns: L, Z, A, J)

2.) Connection Analysis

Weld Capacity: *Vn/Ω*= [0.6*fw*dw*√2/2]/Ω — AISC EQ 8-1 (ASD)
Vn/Ω= **2.78 k/in**

Shear Capacity: *Vn/Ω*= Vn/Ω*L
Vn/Ω= **15.31 k** — Uc = 0.07

Bending Capacity: *Mn/Ω*= *Vn/Ω*Z*
Mn/Ω= **27 k-in** — Uc = 0.67

Axial Capacity: *Pn/Ω*= *Vn/Ω*A*
Pn/Ω= **15.31 k** — Uc = 0.00

Twisting Capacity: *Tn/Ω*= *Vn/Ω*J*
Tn/Ω= **94 k-in** — Uc = 0.00

Combined Uc = 0.74 OK
3/16" weld is acceptable

SIMPSON Strong-Tie®

Anchor Designer™ Software
Version 3.0.7947.0

Company:	QCE	Date:	1/4/2024
Engineer:	TVM	Page:	1/5
Project:	23444.01 - Centeris Pipe Moment Frames		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company: Centeris
Customer contact name:
Customer e-mail:
Comment:

Project description: PS-03 Frame (Cantilever Column)
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

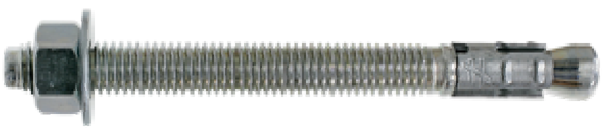
Anchor Information:
Anchor type: Torque controlled expansion anchor
Material: Carbon Steel
Diameter (inch): 0.750
Nominal Embedment depth (inch): 4.125
Effective Embedment depth, h_{ef} (inch): 3.375
Code report: ICC-ES ESR-3037
Anchor category: 1
Anchor ductility: Yes
h_{min} (inch): 6.00
c_{ac} (inch): 6.00
C_{min} (inch): 6.00
S_{min} (inch): 3.50

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 8.00
State: Cracked
Compressive strength, f'c (psi): 3000
$\Psi_{c,V}$: 1.0
Reinforcement condition: B tension, B shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 12.00 x 12.00 x 0.25
Yield stress: 36000 psi

Profile type/size: Pipe3STD

Recommended Anchor
Anchor Name: Strong-Bolt® 2 - 3/4"Ø CS Strong-Bolt 2, hnom:4.125" (105mm)
Code Report: ICC-ES ESR-3037



SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 3.0.7947.0

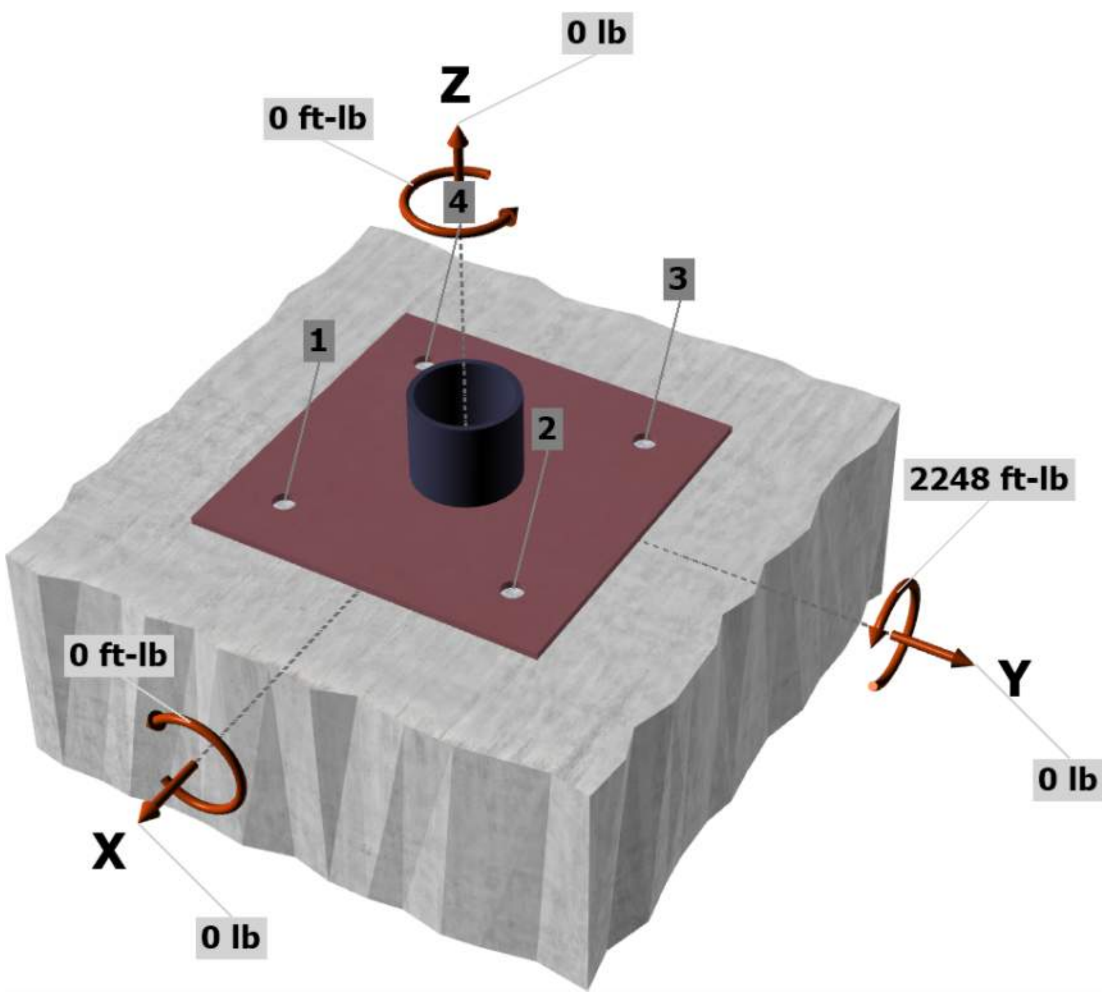
Company:	QCE	Date:	1/4/2024
Engineer:	TVM	Page:	2/5
Project:	23444.01 - Centeris Pipe Moment Frames		
Address:			
Phone:			
E-mail:			

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 0
V_{uax} [lb]: 0
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 2248
M_{uz} [ft-lb]: 0

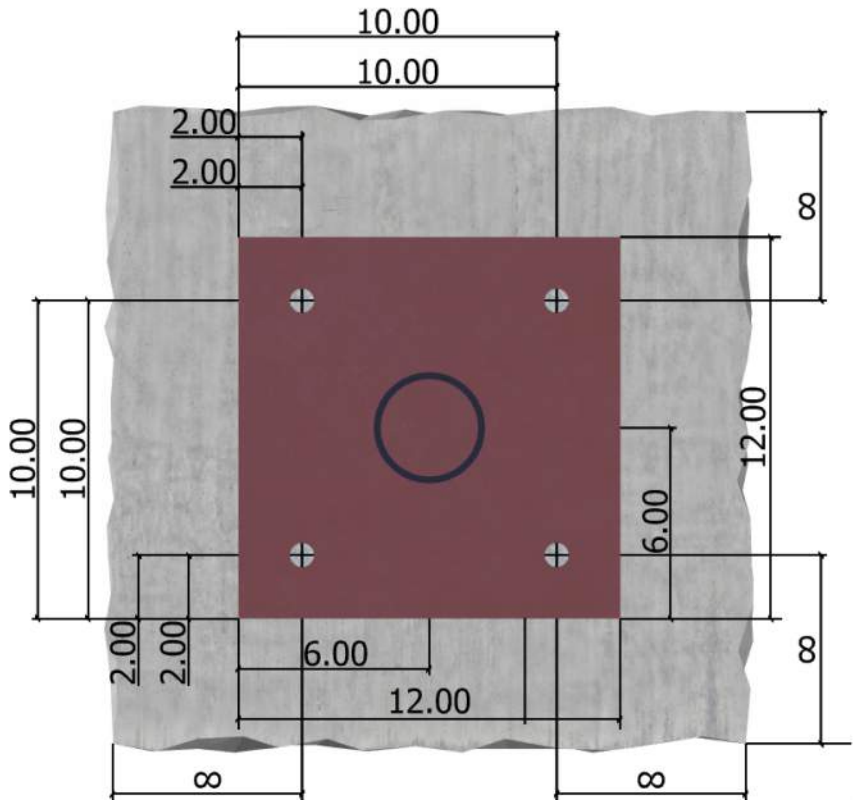
<Figure 1>



Anchor Designer™
Software
Version 3.0.7947.0

Company:	QCE	Date:	1/4/2024
Engineer:	TVM	Page:	3/5
Project:	23444.01 - Centeris Pipe Moment Frames		
Address:			
Phone:			
E-mail:			

<Figure 2>

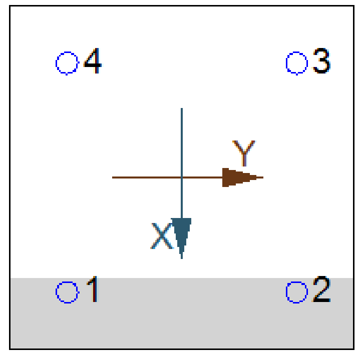


3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	1471.3	0.0	0.0	0.0
4	1471.3	0.0	0.0	0.0
Sum	2942.6	0.0	0.0	0.0

Maximum concrete compression strain (‰): 0.05
Maximum concrete compression stress (psi): 196
Resultant tension force (lb): 2943
Resultant compression force (lb): 2943
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
29700	0.75	22275

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
17.0	1.00	3000	3.375	5773

$0.75\phi N_{cbg} = 0.75\phi\,(A_{Nc}/A_{Nco})\,\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	$0.75\phi N_{cbg}$ (lb)
183.52	102.52	-	1.000	1.000	1.00	1.000	5773	0.65	5038

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}\lambda_a N_p(f'_c/2{,}500)^n$ (Sec. 17.3.1, Eq. 17.4.3.1 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	$0.75\phi N_{pn}$ (lb)
1.0	1.00	5271	3000	0.50	0.65	2815

SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 3.0.7947.0

Company:	QCE	Date:	1/4/2024
Engineer:	TVM	Page:	5/5
Project:	23444.01 - Centeris Pipe Moment Frames		
Address:			
Phone:			
E-mail:			

11. Results

11. Interaction of Tensile and Shear Forces (Sec. D.7)?

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	1471	22275	0.07	Pass
Concrete breakout	**2943**	**5038**	**0.58**	**Pass (Governs)**
Pullout	1471	2815	0.52	Pass

3/4"Ø CS Strong-Bolt 2, hnom:4.125" (105mm) meets the selected design criteria.

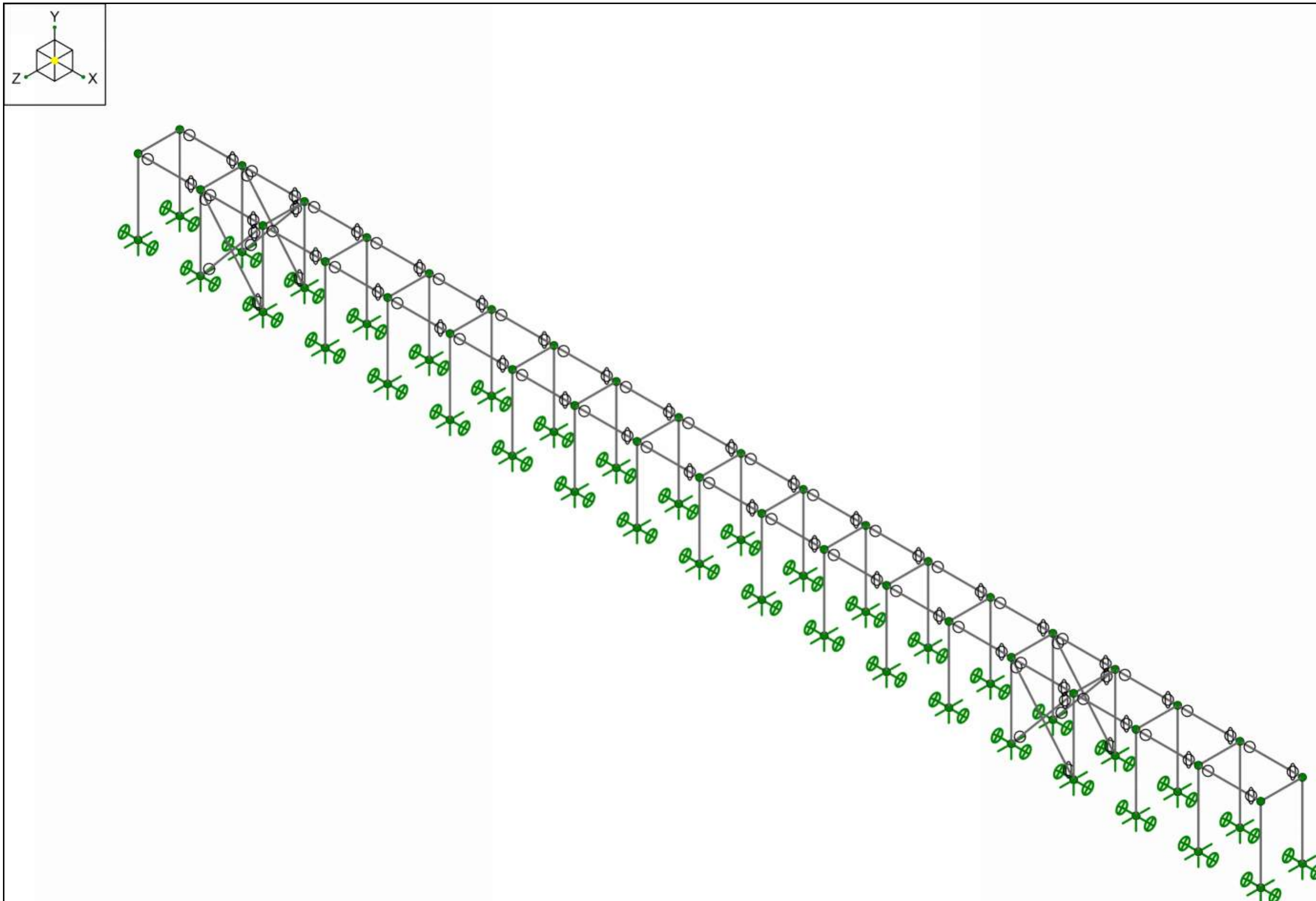
12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

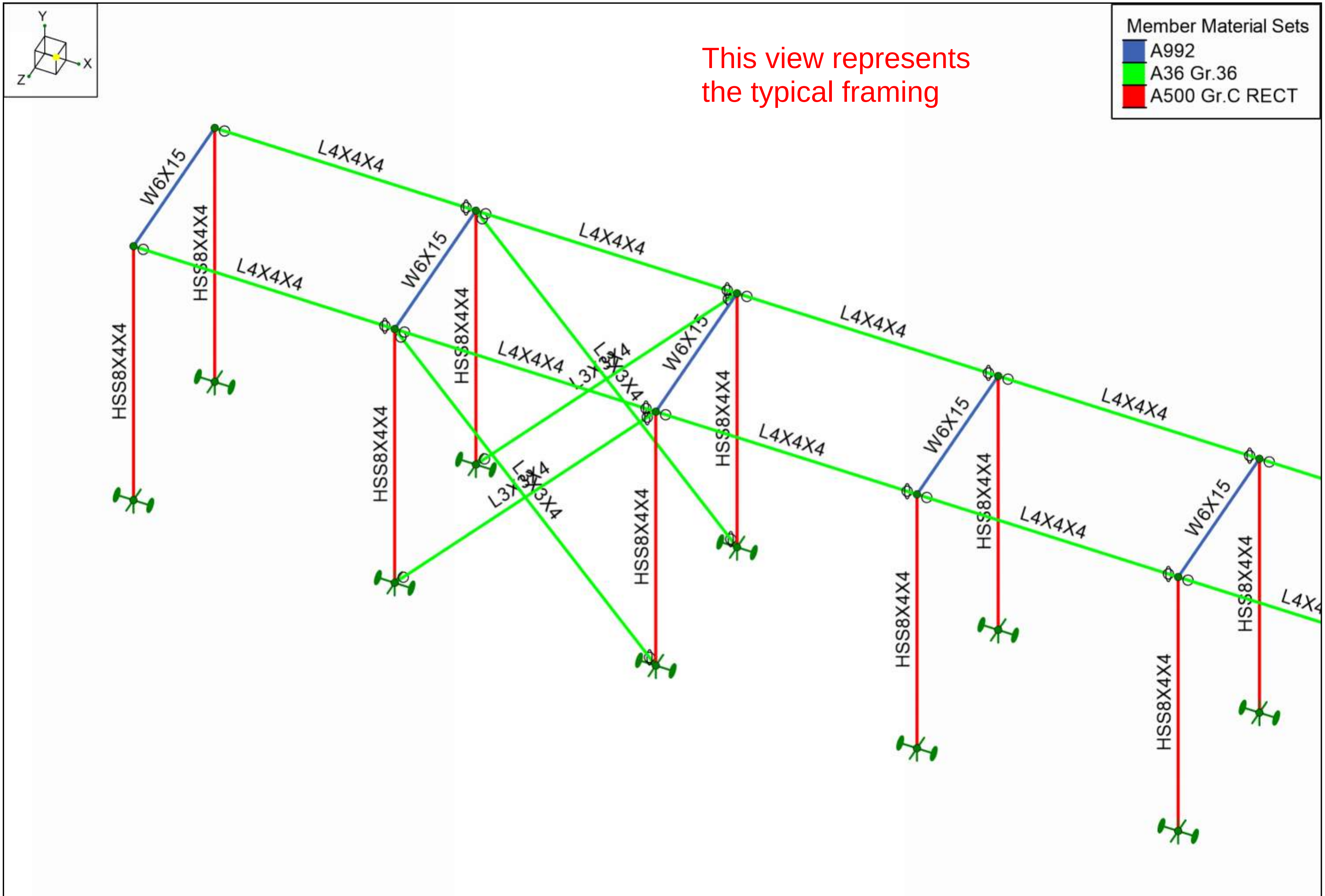
- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer's product literature for hole cleaning and installation instructions.

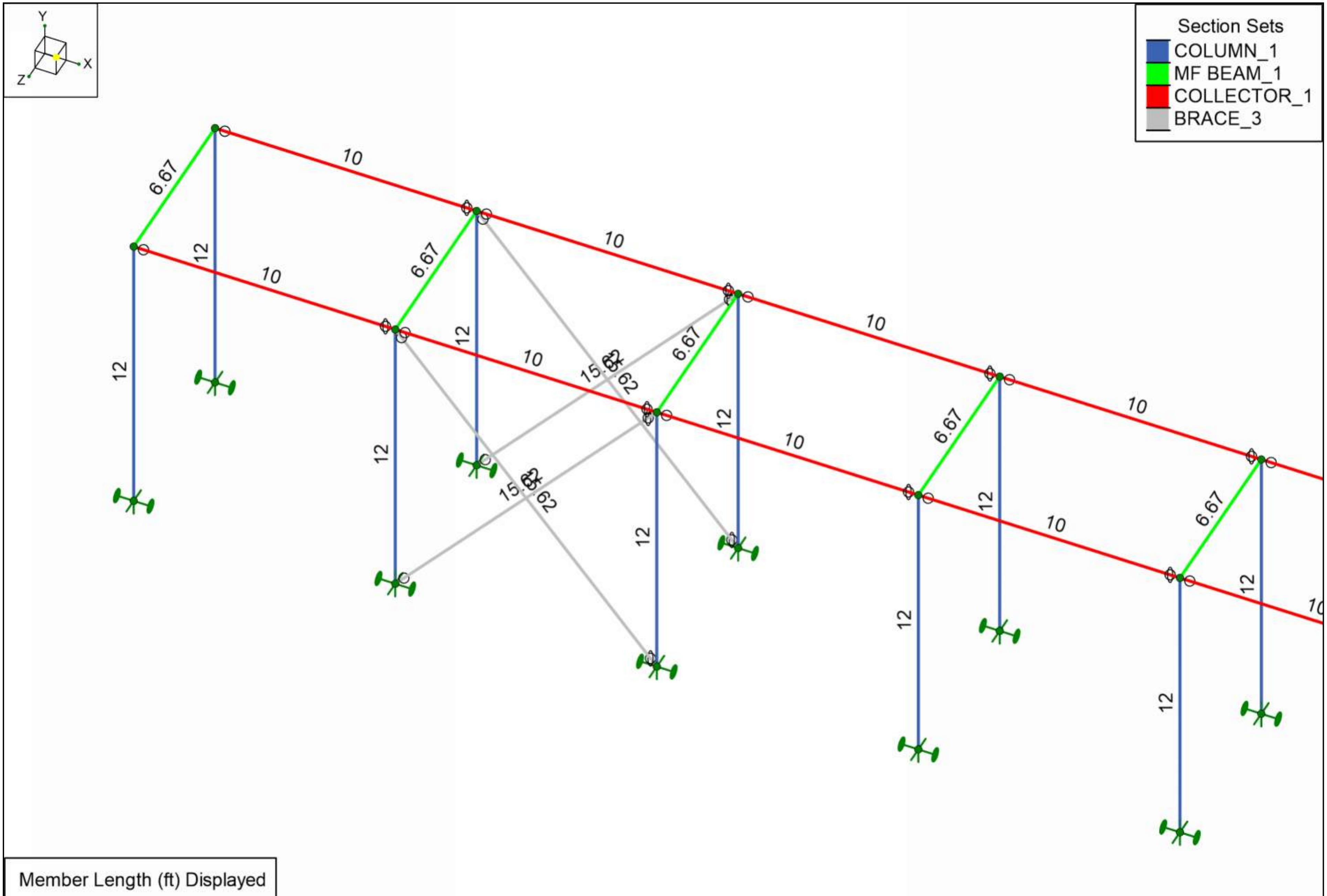


Quantum Consulting Engineers	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:17 AM
23444.01		24-02-20 - Chiller Pipe Frame.r3d



This view represents the typical framing

Quantum Consulting Engineers	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:18 AM
23444.01		24-02-20 - Chiller Pipe Frame.r3d



Quantum Consulting Engineers	Chiller Pipe Frames	
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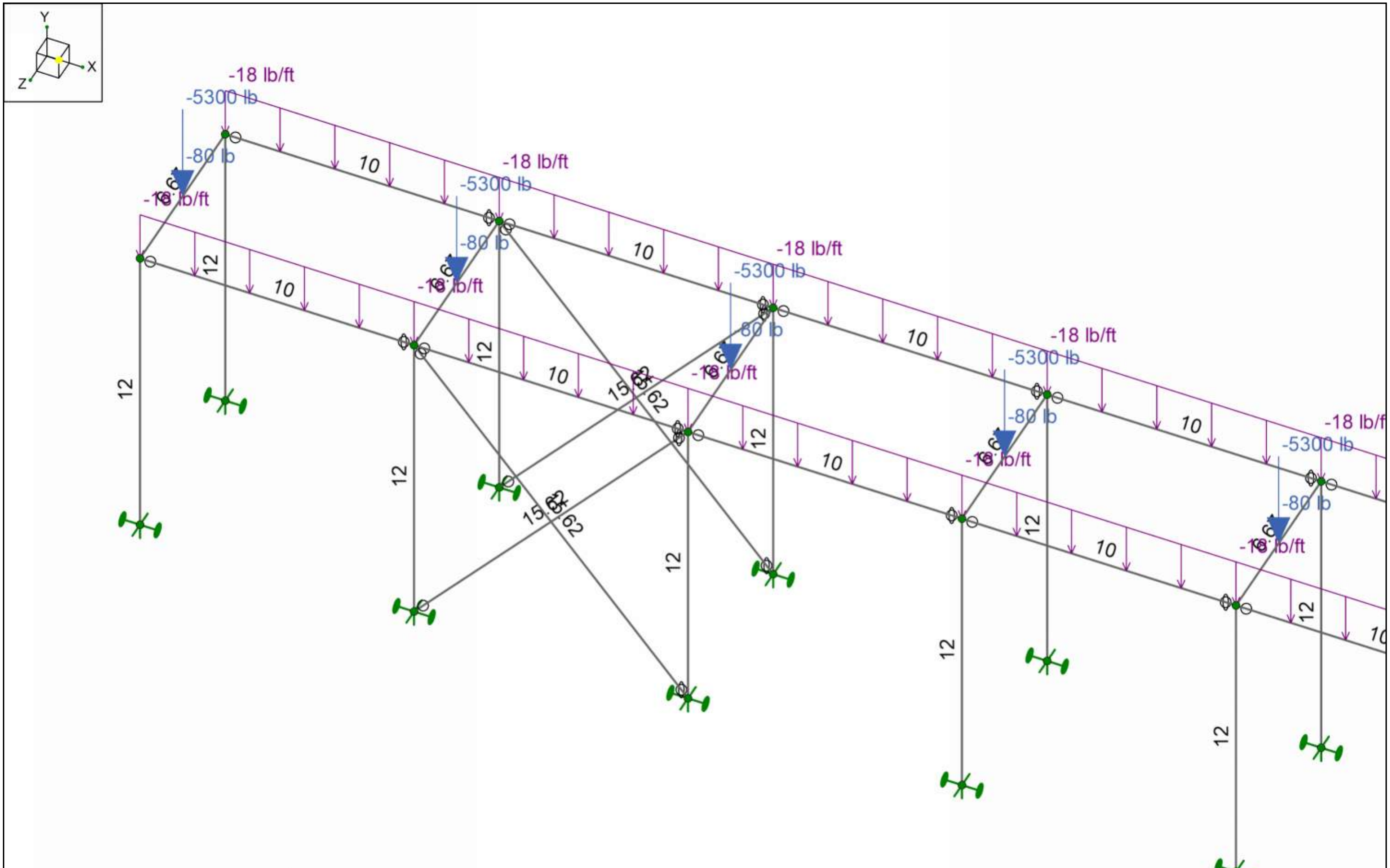

Member Length (ft) Displayed
Loads: BLC 1, Dead

Quantum Consulting Engineers	Chiller Pipe Frames	
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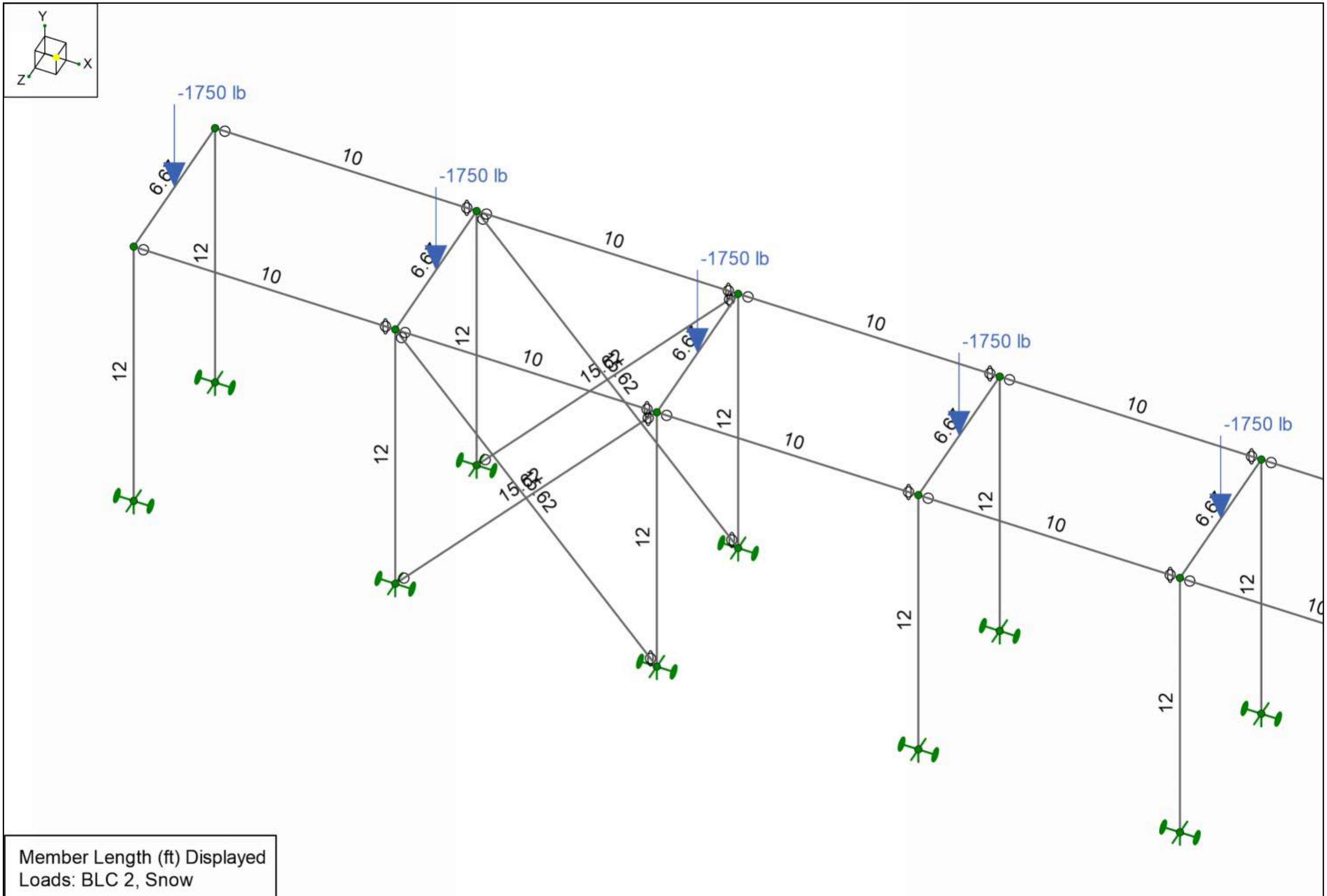
23444.01		24-02-20 - Chiller Pipe Frame.r3d



Member Length (ft) Displayed
Loads: BLC 2, Snow

Quantum Consulting Engineers	Chiller Pipe Frames	
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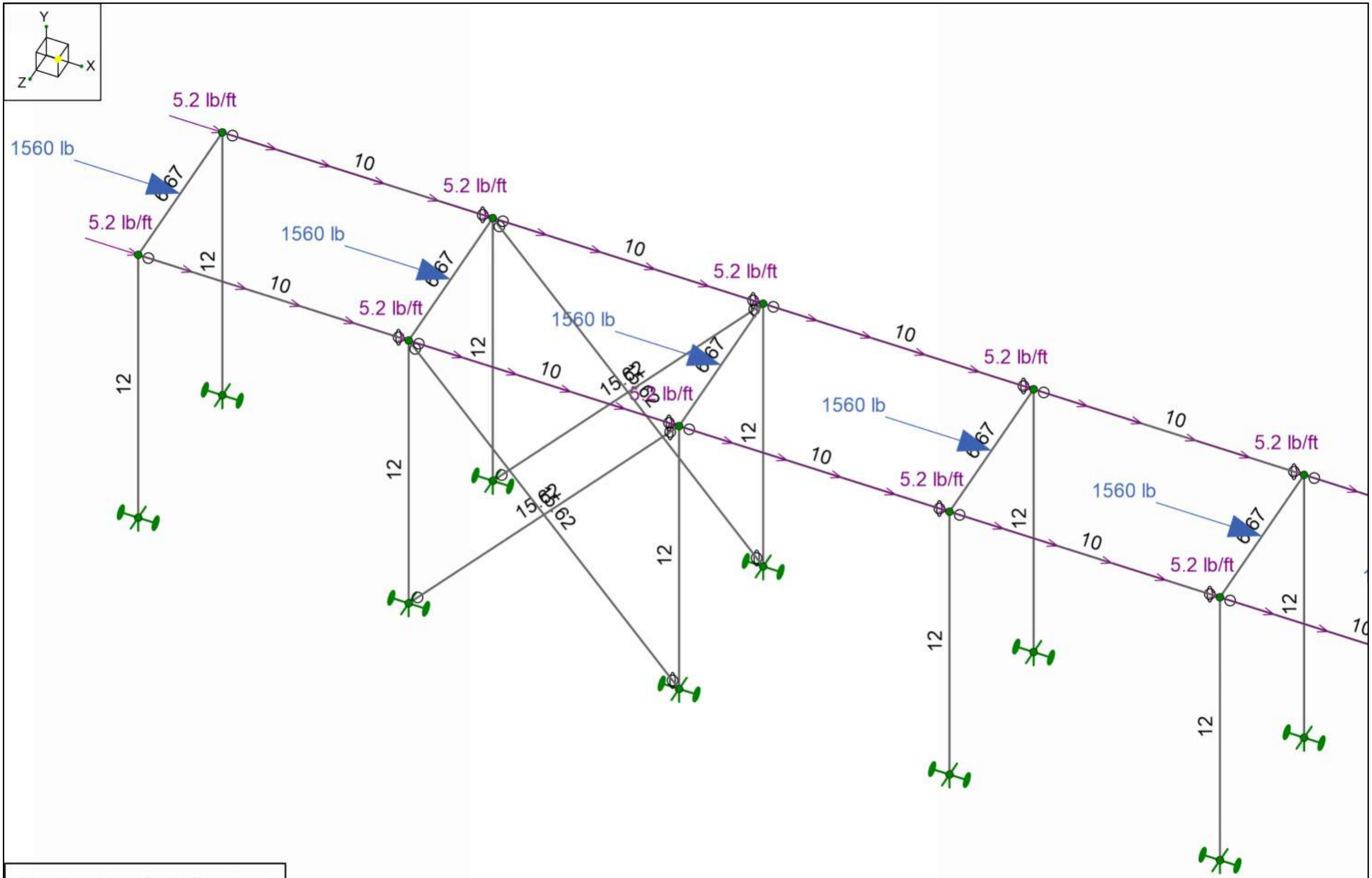
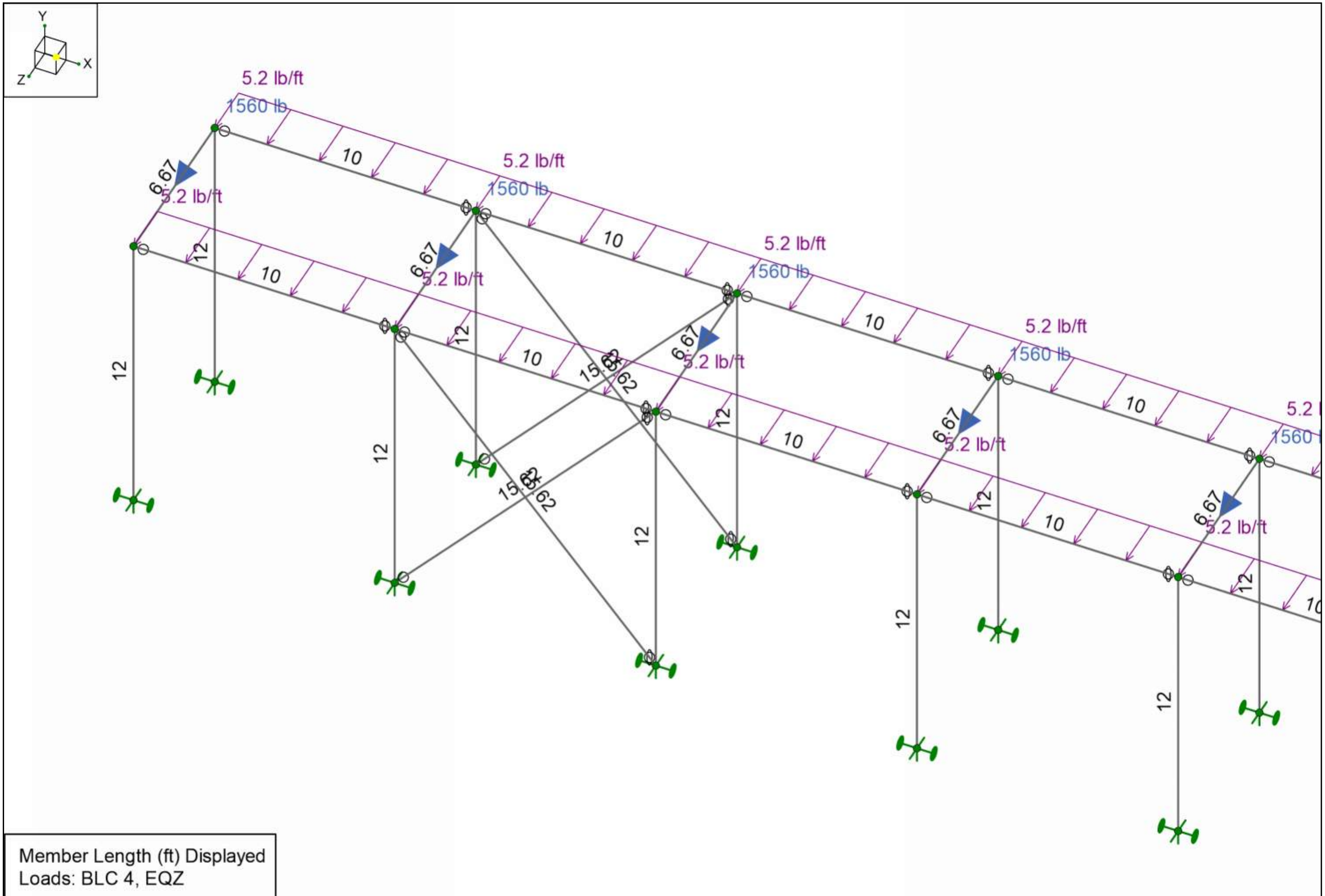
23444.01		24-02-20 - Chiller Pipe Frame.r3d



Member Length (ft) Displayed
Loads: BLC 3, EQX

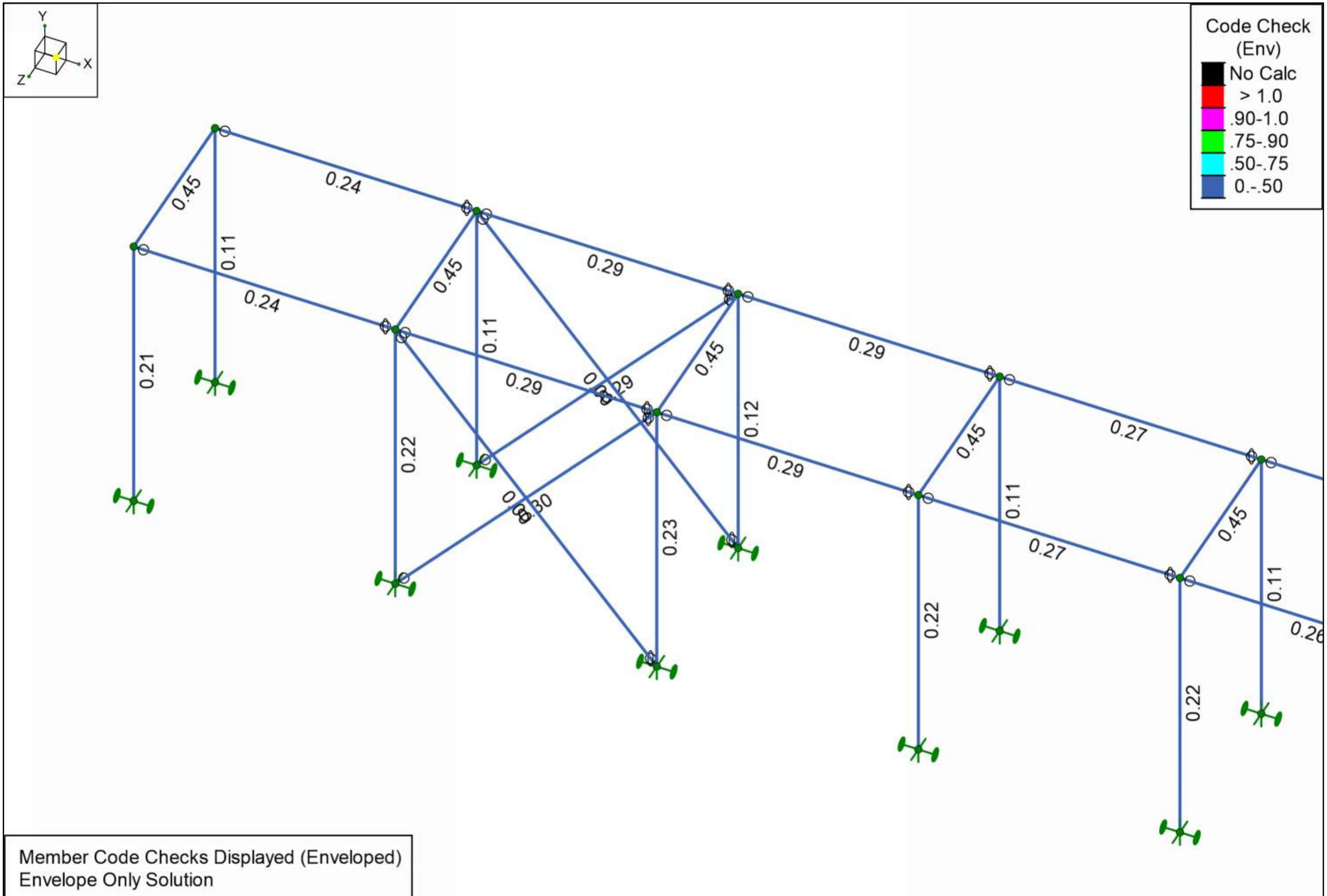
Quantum Consulting Engineers	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:25 AM
23444.01		24-02-20 - Chiller Pipe Frame.r3d



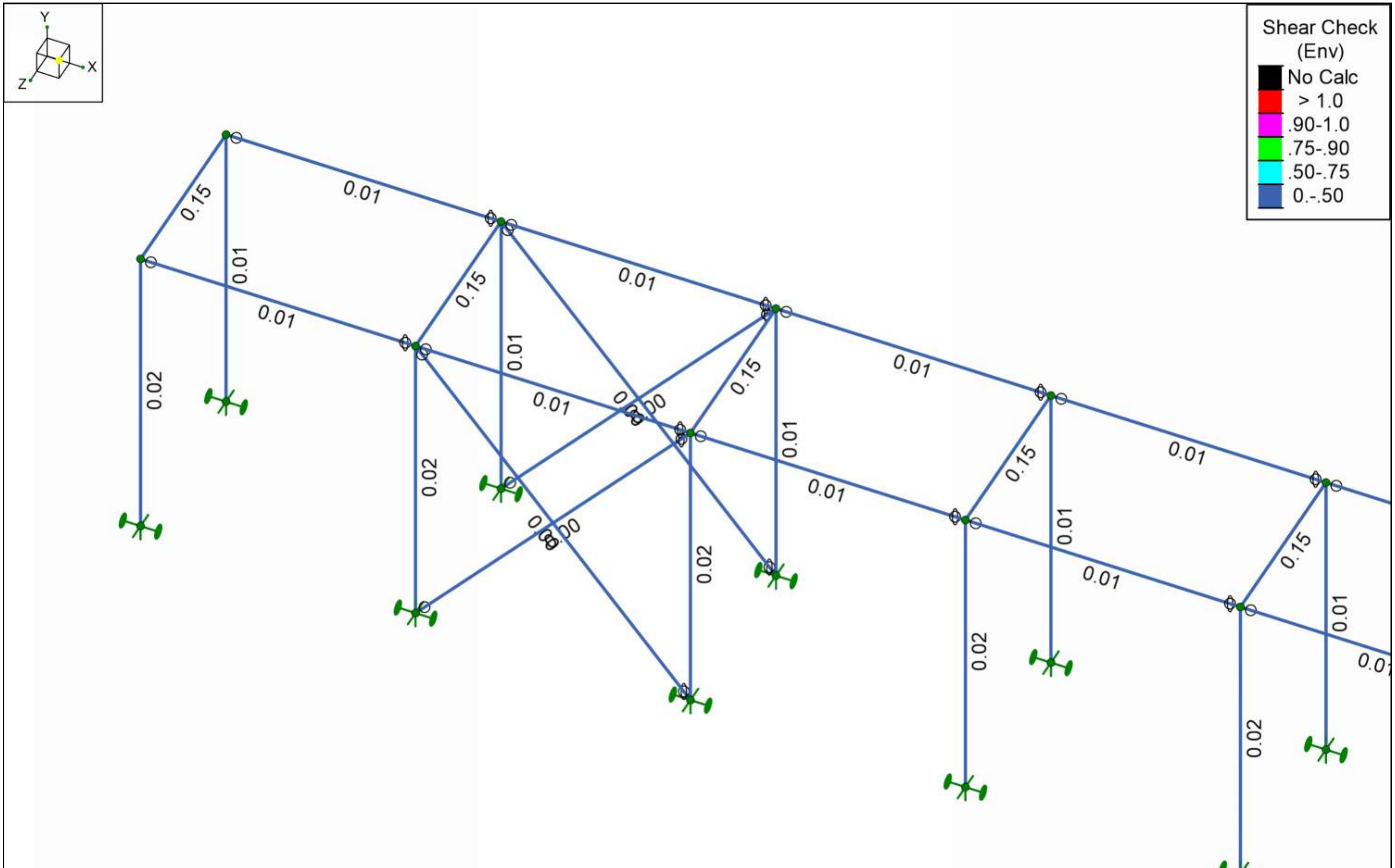
Quantum Consulting Engineers	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:25 AM
23444.01		24-02-20 - Chiller Pipe Frame.r3d

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	ELX		Y	ELX	1								
2	ELX*Cd		Y	ELX	3								
3	ELZ*Cd		Y	ELZ	3								
4	ASD												
5	IBC 16-8	Yes	Y	DL	1								
6	IBC 16-10 (b)	Yes	Y	DL	1	SL	1						
7	IBC 16-12 (b) (a)	Yes	Y	DL	1	S_{DS}*DL	0.14	ELX	0.7	ELZ	0.21		
8		Yes	Y	DL	1	S_{DS}*DL	0.14	ELZ	0.7	ELX	0.21		
9	IBC 16-14 (a)	Yes	Y	DL	1	S_{DS}*DL	0.105	ELX	0.525	ELZ	0.158	SL	0.75
10		Yes	Y	DL	1	S_{DS}*DL	0.105	ELZ	0.525	ELX	0.158	SL	0.75
11	IBC 16-16 (a)	Yes	Y	DL	0.6	S_{DS}*DL	-0.14	ELX	0.7	ELZ	0.21		
12		Yes	Y	DL	0.6	S_{DS}*DL	-0.14	ELZ	0.7	ELX	0.21		
13	IBC 16-12 (b) (a) OS		Y	DL	1	S_{DS}*DL	0.14	ELX	1.4	ELZ	0.21		
14	IBC 16-14 (a) OS		Y	DL	1	S_{DS}*DL	0.105	ELX	1.05	ELZ	0.316	SL	0.75
15	IBC 16-16 (a) OS		Y	DL	0.6	S_{DS}*DL	-0.14	ELX	1.4	ELZ	0.21		
16	Base Plate LRFD												
17	IBC 16-5		Y	DL	1.2	S_{DS}*DL	0.2	ELX	1	ELZ	0.3	SL	0.2
18			Y	DL	1.2	S_{DS}*DL	0.2	ELZ	1	ELX	0.3	SL	0.2
19	IBC 16-7		Y	DL	0.9	S_{DS}*DL	-0.2	ELX	1	ELZ	0.3		
20			Y	DL	0.9	S_{DS}*DL	-0.2	ELZ	1	ELX	0.3		
21	IBC 16-5 (os-a)		Y	DL	1.2	S_{DS}*DL	0.2	ELX	2	ELZ	0.9	SL	0.2
22			Y	DL	1.2	S_{DS}*DL	0.2	ELZ	3	ELX	0.6	SL	0.2
23	IBC 16-7 (os-a)		Y	DL	0.9	S_{DS}*DL	-0.2	ELX	2	ELZ	0.9		
24			Y	DL	0.9	S_{DS}*DL	-0.2	ELZ	3	ELX	0.6		



Quantum Consulting Engineers	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:26 AM
23444.01		24-02-20 - Chiller Pipe Frame.r3d



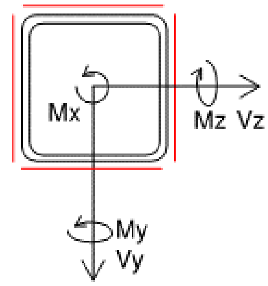
Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

Quantum Consulting Engineers	Chiller Pipe Frames	
Travis Michaud		Feb 22, 2024 at 08:26 AM
23444.01		24-02-20 - Chiller Pipe Frame.r3d

TUBE STEEL All Around Welded Connection

IBC 2018, AISC Manual 15th Edition (AISC 360-16)

Weld as a Line
HSS Sections Only



1.) Input

Member:		HSS8x4x1/4
Fillet Weld Size:	*dw* =	4/16"
Weld Strength:	*fw* =	70 ksi

Forces (ASD):

Shear:	*Vuy* =		
	Vuz =	0.93 k	
Bending:	*Muz* =	170 k-in	
	Muy =		
Tension:	*Pu* =		
Torque:	*Tu* =		

Weld Properties:

Ly =	16.0	in
Lz =	8.0	in
Zz =	53.3	in^2
Zy =	37.3	in^2
A =	24.0	in
J =	288.0	in^2

2.) Connection Analysis

Weld Capacity:	*Vn/Ω*=	[0.6*fw*dw*√2/2]/Ω		AISC EQ 8-1 (ASD)
	Vn/Ω=	**3.71 k/in**		
Shear Capacity:	*Vny/Ω*=	Vn/Ω*Ly		
	Vny/Ω=	**59.40 k**	Uc = 0.00	
	Vnz/Ω=	Vn/Ω*Lz		
	Vnz/Ω=	**29.70 k**	Uc = 0.03	
Bending Capacity:	*Mnz/Ω*=	Vn/Ω*Zz		
	Mnz/Ω=	**198 k-in**	Uc = 0.86	
	Mny/Ω=	Vn/Ω*Zy		
	Mny/Ω=	**139 k-in**	Uc = 0.00	
Axial Capacity:	*Pn/Ω*=	Vn/Ω*A		
	Pn/Ω=	**89.10 k**	Uc = 0.00	
Twisting Capacity:	*Tn/Ω*=	Vn/Ω*J		
	Tn/Ω=	**1069 k-in**	Uc = 0.00	

Combined Uc = 0.89 OK
1/4 " weld is acceptable

Grade Beam Stablity Check

IBC 2018, ASCE 7-16

Typical MF Brace Grade Beam Soil Design

Grade Beam Stability Check

LC From RISA

Uplift Case 0.45 DL+ 0.70 EQ)

Column	Load P	Location	Moment	Res M	OT M
1	4.92 k	1.00 '	-4.92 k-ft	4.92 k-ft	-4.92 k-ft
2	0.51 k	7.67 '	-3.65 k-ft	3.93 k-ft	-3.65 k-ft
FTG	2.45 k	4.34 '		10.62 k-ft	
				19.48 k-ft	-8.58 k-ft

OT Uc 0.44 OK

Grade Beam

Width:	1.50 '
Thickness	1.17 '
Length:	8.67 '
Cover	0.50 '
Soil Dens	0.12 kcf
P_gb:	3.06 k

Grade Beam Bearing Check

IBC 2018, ASCE 7-16

Typical MF Brace Grade Beam Soil Design

Grade Beam Bearing Check

LC From RISA

Downward Case 1.14 D + 0.7 E

Column	Load P	Location	e	Moment	Pe
1	4.64 k	1.00 '	-3.34 '	-5.90 k-ft	-21.4 k-ft
2	2.70 k	7.67 '	3.34 '	-2.75 k-ft	6.25 k-ft
FTG	3.49 k	4.34 '	0.00 '		0.00 k-ft
	10.83 k				-15.1 k-ft

Bearing Pressure

Width: 1.50 '

mid. 1/3 = 1.45 '

e: -1.40 ' Inside Middle 1/3

e': 2.94 '

qmax: 1.64 ksf < 1.33 * 2 ksf = 2.67 ksf OK

Length: 8.82 '

Grade Beam Bearing Check

LC From Ram

Downward Case 1.11D + 0.525 E + 0.75 SL

Column	Load P	Location	e	Moment	Pe
1	4.28 k	1.00 '	-3.34 '	-4.77 k-ft	-19.0 k-ft
2	2.83 k	7.67 '	3.34 '	-1.71 k-ft	7.73 k-ft
FTG	3.40 k	4.34 '	0.00 '		0.00 k-ft
	10.51 k				-11.3 k-ft

Bearing Pressure

Width: 1.50 '

mid. 1/3 = 1.45 '

e: -1.08 ' Inside middle third

e': 3.26 '

qmax: 1.41 ksf < 1.33 * 2 ksf = 2.67 ksf OK

Grade Beam Concrete Design

IBC 2018, ASCE 7-16, ACI 318-14

Concrete Design Load Case = (1.2+0.2(Sds)) DL + LL + 0.2 SL + EQ

Column	Load P	Location	e	Moment	Pe
1	5.90 k	1.00 '	-3.34 '	-8.13 k-ft	-28 k-ft
2	3.12 k	7.67 '	3.34 '	-4.26 k-ft	6 k-ft
GB	3.68 k	4.34 '	0.00 '		0 k-ft
					0 k-ft
	12.69 k				-21.7 k-ft

Bearing Pressure

Width:	1.50 '	
mid. 1/3 =	1.45 '	
e:	1.71 '	Outside Middle Third
e':	2.63 '	
qmax:	2.15 ksf	
Length:	7.88 '	
slope:	0.27 ksf	
GB:	0.42 klf	

Location	Length	Bearing	Shear Applied	Moment Left	Right	Moment Design
0.00 '		2.15 ksf	0.00 k	0.0 k-ft	-0.4 k-ft	0 k-ft
0.33 '	0.33	2.06 ksf	0.91 k	0.2 k-ft	-0.6 k-ft	-0.6 k-ft
0.67 '	0.33	1.97 ksf	1.77 k	0.6 k-ft	-1.0 k-ft	-1.0 k-ft
1.00 '	0.33	1.87 ksf	2.59 k	1.3 k-ft	-1.7 k-ft	-1.7 k-ft
1.00 '	0.00	1.87 ksf	-3.31 k	-6.8 k-ft	6.4 k-ft	-6.8 k-ft
2.33 '	1.33	1.51 ksf	-0.49 k	-9.3 k-ft	8.9 k-ft	-9.3 k-ft
3.67 '	1.33	1.15 ksf	1.61 k	-8.6 k-ft	8.2 k-ft	-8.6 k-ft
5.00 '	1.33	0.78 ksf	2.98 k	-5.5 k-ft	5.1 k-ft	-5.5 k-ft
6.34 '	1.33	0.42 ksf	3.62 k	-1.1 k-ft	0.7 k-ft	-1.1 k-ft
7.67 '	1.33	0.06 ksf	3.53 k	3.6 k-ft	-4.0 k-ft	-4.0 k-ft
7.67 '	0.00	0.06 ksf	0.41 k	-0.6 k-ft	0.2 k-ft	-0.6 k-ft
7.88 '	0.21	0.00 ksf	0.33 k	-0.5 k-ft	0.1 k-ft	-0.5 k-ft
8.67 '	0.79	0.00 ksf	0.00 k	-0.4 k-ft	0.0 k-ft	-0.4 k-ft

Grade Beam Concrete Design

IBC 2018, ASCE 7-16, ACI 318-14

Concrete Design:

f'c:	3000 psi
fy:	60000 psi

Shear

Vu =	3.6	kips
Vc =	20.8	kips
ϕVc =	15.6	kips OK

Moment

Mu =	9.3	k-ft
As =	0.93	sqin
d =	10.54	in
a =	1.22	in
Mn =	46.2	k-ft
ϕMn =	41.6	k-ft > Mu OK
As_min =	0.52	sqin

Use (3) #5 T&B

Grade Beam Stablity Check

IBC 2018, ASCE 7-16

Typical Brace Frame Grade Beam Soil Design

Grade Beam Stability Check

LC From RISA

Uplift Case 0.45 DL+ 0.70 EQ)

Column	Load P	Location	Moment	Res M	OT M
1	8.63 k	4.00 '		34.53 k-ft	0.00 k-ft
2	-6.19 k	14.00 '			-86.68 k-ft
GB	3.96 k	8.00 '		31.67 k-ft	
MF GB	1.23 k	4.00 '		4.91 k-ft	
MF GB	1.23 k	14.00 '		17.16 k-ft	
				88.26 k-ft	-86.68 k-ft

OT Uc 0.98 OK

Grade Beam

Width:	1.50 '
Thickness	1.17 '
Length:	16.00 '
Cover	0.50 '
Soil Dens	0.12 kcf

P_gb: 5.65 k

Grade Beam Bearing Check

IBC 2018, ASCE 7-16

Typical Brace Frame Grade Beam Soil Design

Grade Beam Bearing Check

LC From RISA

Downward Case 1.14 D + 0.7 E

Column	Load P	Location	e	Moment	Pe
1	10.90 k	4.00 '	-4.00 '		-43.59 k-ft
2	-3.98 k	14.00 '	6.00 '		-23.86 k-ft
GB	6.51 k	8.00 '	0.00 '		0.00 k-ft
MF GB	1.75 k	4.00 '	-4.00 '		-6.98 k-ft
MF GB	1.75 k	14.00 '	6.00 '		10.48 k-ft
	16.93 k				-64.0 k-ft

Bearing Pressure

Width:	1.50 '	
mid. 1/3 =	2.67 '	
e:	-3.78 '	Outside Middle Third
e':	4.22 '	
qmax:	1.78 ksf	< 1.33 * 2 ksf = 2.67 ksf OK
Length:	12.67 '	

Grade Beam Bearing Check

LC From Ram

Downward Case 1.11D + 0.525 E + 0.75 SL

Column	Load P	Location	e	Moment	Pe
1	9.00 k	4.00 '	-4.00 '		-35.98 k-ft
2	-2.16 k	14.00 '	6.00 '		-12.96 k-ft
GB	6.28 k	8.00 '	0.00 '		0.00 k-ft
MF GB	1.70 k	4.00 '	4.00 '		6.80 k-ft
MF GB	1.70 k	14.00 '	-6.00 '		-10.20 k-ft
	16.52 k				-52.3 k-ft

Bearing Pressure

Width:	1.50 '	
mid. 1/3 =	2.7	
e:	-3.17 '	Outside middle third
e':	4.83 '	
qmax:	1.52 ksf	< 1.33 * 2 ksf = 2.67 ksf OK

Grade Beam Concrete Design

IBC 2018, ASCE 7-16, ACI 318-14

Concrete Design Load Case = (1.2+0.2(Sds)) DL + LL + 0.2 SL + EQ

Column	Load P	Location	e	Moment	Pe
1	14.83 k	4.00 '	-4.00 '		-59 k-ft
2	-6.45 k	14.00 '	6.00 '		-39 k-ft
GB	6.78 k	8.00 '	0.00 '		0 k-ft
MF GB	1.84 k	4.00 '	4.00 '		7 k-ft
MF GB	1.84 k	14.00 '	-6.00 '		-11 k-ft
	18.84 k				-102 k-ft

Bearing Pressure

Width:	1.50 '	
mid. 1/3 =	2.67 '	
e:	5.40 '	Outside Middle Third
e':	2.60 '	
qmax:	3.22 ksf	
Length:	7.81 '	
slope:	0.41 ksf	
GB:	0.42 klf	

Location	Length	Bearing	Shear Applied	Moment Left	Right	Moment Design
0.00 '		3.22 ksf	0.00 k	0.0 k-ft	7.3 k-ft	0 k-ft
1.33 '	1.33	2.67 ksf	5.32 k	3.6 k-ft	3.7 k-ft	-3.7 k-ft
2.67 '	1.33	2.12 ksf	9.54 k	13.5 k-ft	-6.2 k-ft	-13.5 k-ft
4.00 '	1.33	1.57 ksf	12.67 k	28.3 k-ft	-21.0 k-ft	-28.3 k-ft
4.00 '	0.00	1.57 ksf	-4.01 k	28.3 k-ft	-21.0 k-ft	-28.3 k-ft
5.60 '	1.60	0.91 ksf	-1.72 k	23.7 k-ft	-16.4 k-ft	-23.7 k-ft
8.00 '	2.40	0.00 ksf	-1.09 k	20.4 k-ft	-13.1 k-ft	-20.4 k-ft
10.00 '	2.00	0.00 ksf	-1.94 k	17.3 k-ft	-10.0 k-ft	-17.3 k-ft
12.00 '	2.00	0.00 ksf	-2.79 k	12.6 k-ft	-5.3 k-ft	-12.6 k-ft
14.00 '	2.00	0.00 ksf	-3.63 k	6.2 k-ft	1.1 k-ft	-6.2 k-ft
14.00 '	0.00	0.00 ksf	0.98 k	6.2 k-ft	1.1 k-ft	-6.2 k-ft
14.00 '	0.00	0.00 ksf	0.98 k	6.2 k-ft	1.1 k-ft	-6.2 k-ft
16.00 '	2.00	0.00 ksf	0.13 k	7.3 k-ft	0.0 k-ft	-7.3 k-ft

Grade Beam Concrete Design

IBC 2018, ASCE 7-16, ACI 318-14

Concrete Design:

f'c:	3000 psi
fy:	60000 psi

Shear

Vu =	12.7	kips
Vc =	20.8	kips
ϕVc =	15.6	kips

Supply shear reinforcing at high shear areas

Moment

Mu =	28.3	k-ft
As =	0.93	sqin
d =	10.54	in
a =	1.22	in
Mn =	46.2	k-ft
ϕMn =	41.6	k-ft > Mu OK
As_min =	0.52	sqin

Use (3) #5 T&B

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Company:	QCE	Date:	1/4/2024
Engineer:	TVM	Page:	1/6
Project:	23444.01 - Centeris Pipe Moment Frames		
Address:			
Phone:			
E-mail:			

1.Project information

Customer company: Centeris
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

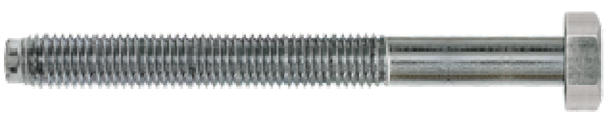
Anchor Information:
Anchor type: Cast-in-place
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 8.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.50
C_{min} (inch): 1.22
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 14.00
State: Uncracked
Compressive strength, f'_c (psi): 3000
$\Psi_{c,V}$: 1.4
Reinforcement condition: B tension, B shear
Supplemental reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 12.00 x 12.00 x 0.25
Yield stress: 36000 psi

Profile type/size: HSS8X4X1/4

Recommended Anchor
Anchor Name: Heavy Hex Bolt - 3/4"Ø Heavy Hex Bolt, F1554 Gr. 36

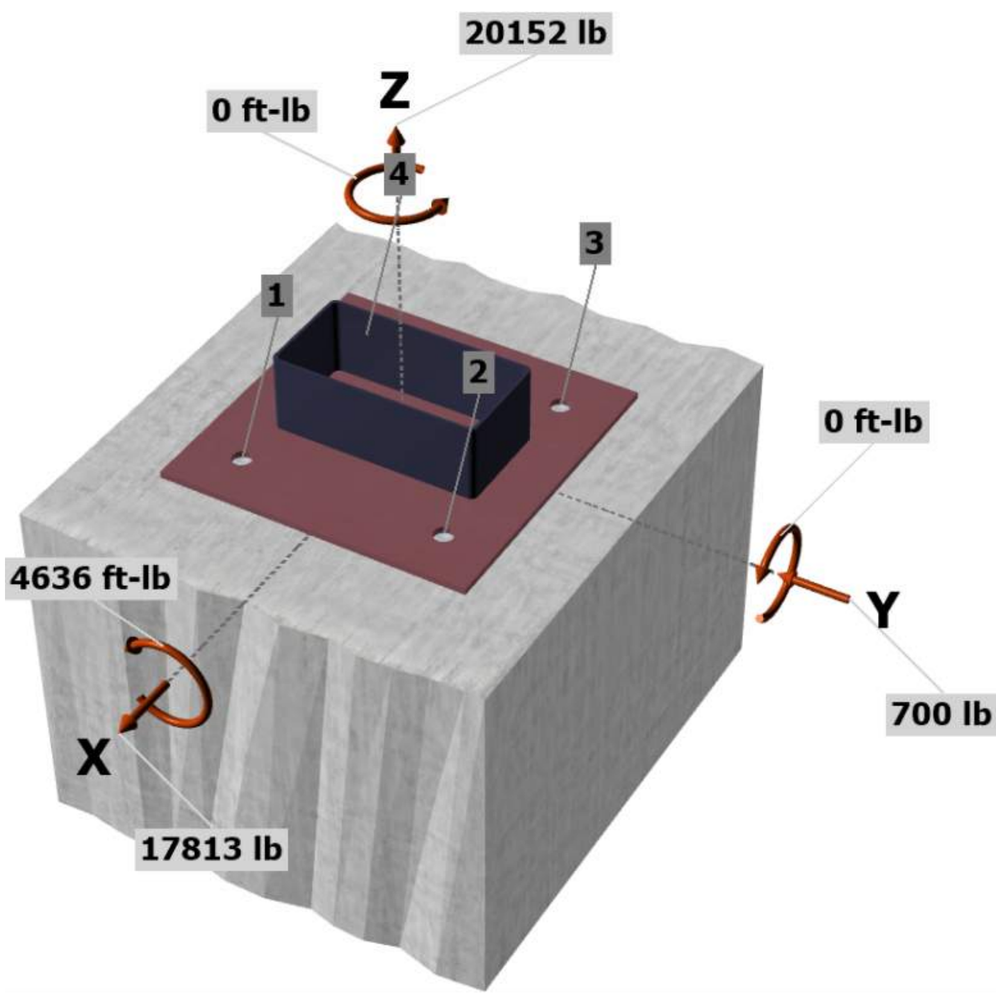


Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 20152
V_{uax} [lb]: 17813
V_{uay} [lb]: -700
M_{ux} [ft-lb]: 4636
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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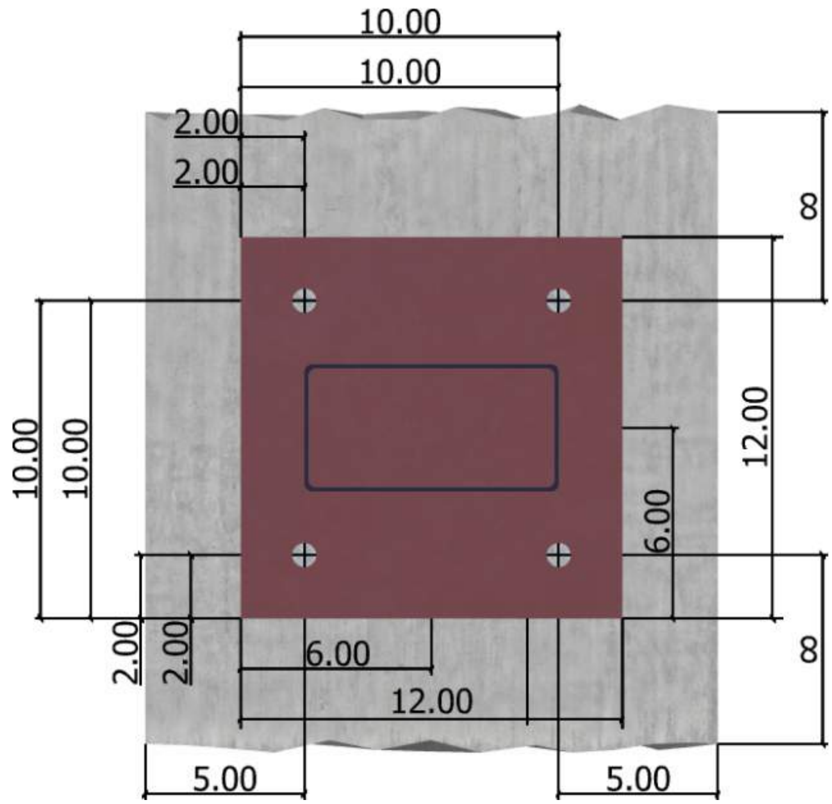
<Figure 2>



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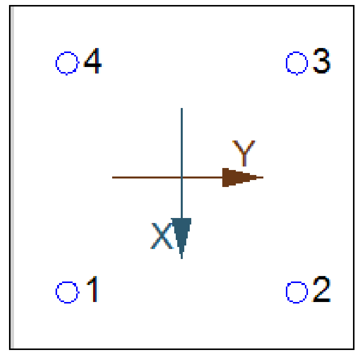
3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1589.0	4453.3	-175.0	4456.7
2	8509.2	4453.3	-175.0	4456.7
3	8509.2	4453.3	-175.0	4456.7
4	1589.0	4453.3	-175.0	4456.7
Sum	20196.4	17813.0	-700.0	17826.7

Maximum concrete compression strain (‰): 0.01
Maximum concrete compression stress (psi): 45
Resultant tension force (lb): 0
Resultant compression force (lb): 44
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi \Psi_{c,P} N_p = 0.75\phi \Psi_{c,P} 8 A_{brg} f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.4	0.91	3000	0.70	16070

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8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11625	1.0	0.65	7556

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	5.00	5511

$\phi V_{cbgy} = \phi\ (A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
172.50	112.50	1.000	1.000	1.400	1.000	5511	0.70	8282

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	5.00	5511

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
172.50	112.50	1.000	1.000	1.400	1.000	5511	0.70	16563

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi k_{cp}N_{cbg} = \phi k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cpg} (lb)
2.0	576.00	576.00	1.000	0.825	1.250	1.000	29745	0.70	42944

11. Results

Interaction of Tensile and Shear Forces (Sec. R17.6)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	**8509**	**14528**	**0.59**	**Pass (Governs)**
Pullout	8509	16070	0.53	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	**4457**	**7556**	**0.59**	**Pass (Governs)**
T Concrete breakout y-	350	8282	0.04	Pass
|| Concrete breakout y+	8907	16563	0.54	Pass
Pryout	17827	42944	0.42	Pass

Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.41	0.41	82.5%	1.0	Pass

3/4"Ø Heavy Hex Bolt, F1554 Gr. 36 with hef = 8.000 inch meets the selected design criteria.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

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Address:			
Phone:			
E-mail:			

1.Project information

Customer company: Centeris
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-14
Units: Imperial units

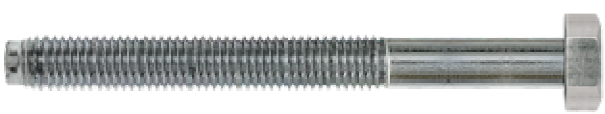
Anchor Information:
Anchor type: Cast-in-place
Material: F1554 Grade 36
Diameter (inch): 0.750
Effective Embedment depth, h_{ef} (inch): 8.000
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 9.50
C_{min} (inch): 1.22
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 14.00
State: Uncracked
Compressive strength, f'$_c$ (psi): 3000
$\Psi_{c,V}$: 1.4
Reinforcement condition: B tension, B shear
Supplemental reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: Yes
Ignore concrete breakout in shear: No
Ignore 6do requirement: Yes
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 12.00 x 12.00 x 0.25
Yield stress: 36000 psi

Profile type/size: HSS8X4X1/4

Recommended Anchor
Anchor Name: Heavy Hex Bolt - 3/4"Ø Heavy Hex Bolt, F1554 Gr. 36



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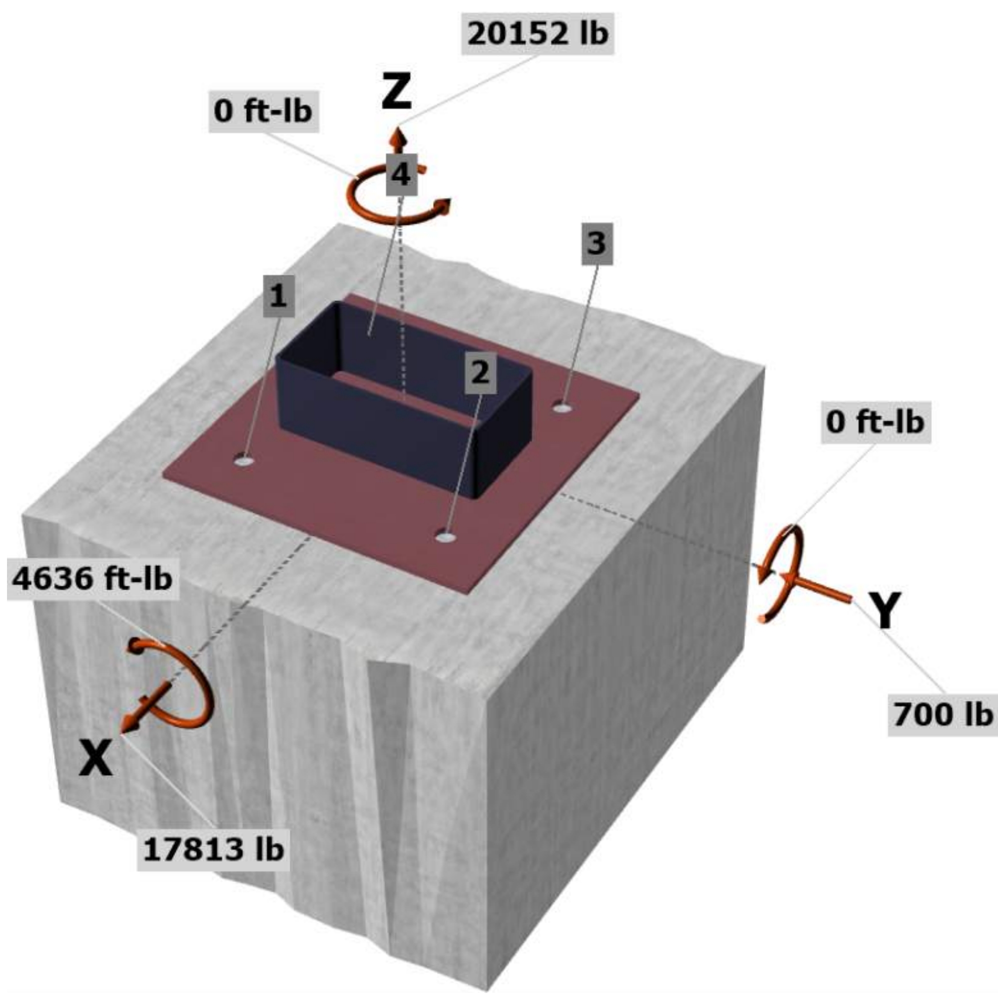
Address:			
Phone:			
E-mail:			

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (d) is satisfied
Ductility section for shear: 17.2.3.5.3 (c) is satisfied
Ω_0 factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

Strength level loads:

N_{ua} [lb]: 20152
V_{uax} [lb]: 17813
V_{uay} [lb]: -700
M_{ux} [ft-lb]: 4636
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



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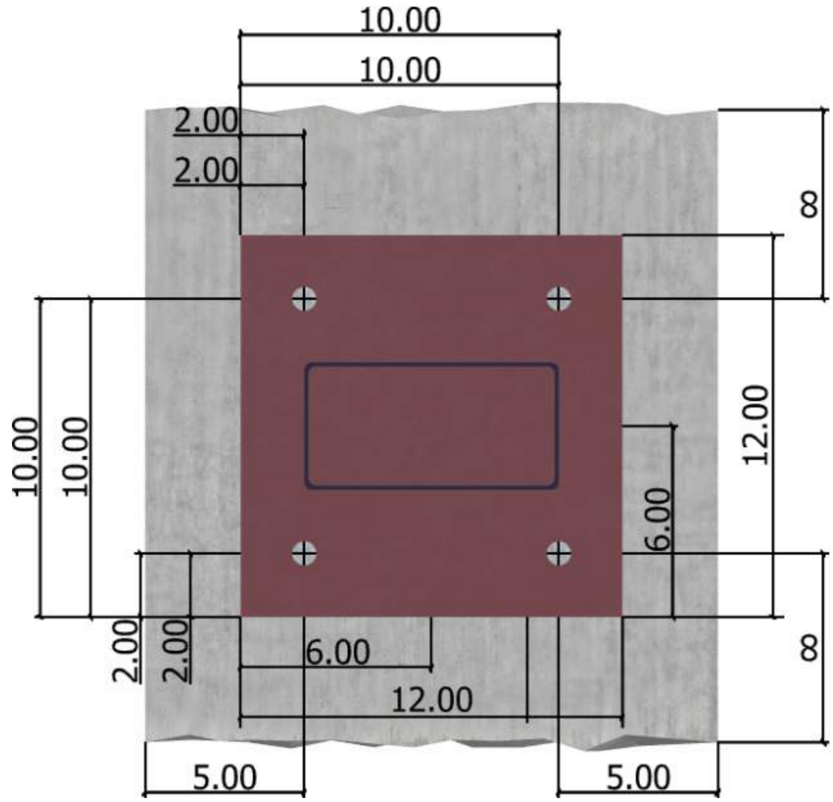
<Figure 2>



SIMPSON Strong-Tie®

Anchor Designer™
Software
Version 3.0.7947.0

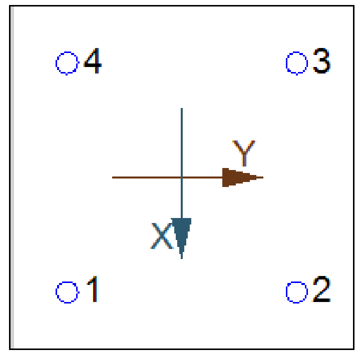
Company:	QCE	Date:	1/4/2024
Engineer:	TVM	Page:	4/6
Project:	23444.01 - Centeris Pipe Moment Frames (Braced Fram		
Address:			
Phone:			
E-mail:			

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	1589.0	4453.3	-175.0	4456.7
2	8509.2	4453.3	-175.0	4456.7
3	8509.2	4453.3	-175.0	4456.7
4	1589.0	4453.3	-175.0	4456.7
Sum	20196.4	17813.0	-700.0	17826.7

Maximum concrete compression strain (‰): 0.01
Maximum concrete compression stress (psi): 45
Resultant tension force (lb): 0
Resultant compression force (lb): 44
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
19370	0.75	14528

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

$\Psi_{c,P}$	A_{brg} (in^2)	f'_c (psi)	ϕ	$0.75\phi N_{pn}$ (lb)
1.4	0.91	3000	0.70	16070

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8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
11625	1.0	0.65	7556

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in y-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
6.00	0.750	1.00	3000	5.00	5511

$\phi V_{cbgy} = \phi\ (A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
172.50	112.50	1.000	1.000	1.400	1.000	5511	0.70	8282

Shear parallel to edge in y-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
6.00	0.750	1.00	3000	5.00	5511

$\phi V_{cbgy} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
172.50	112.50	1.000	1.000	1.400	1.000	5511	0.70	16563

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cpg} = \phi k_{cp}N_{cbg} = \phi k_{cp}(A_{Nc} / A_{Nco})\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1b)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cpg} (lb)
2.0	576.00	576.00	1.000	0.825	1.250	1.000	29745	0.70	42944

11. Results

Interaction of Tensile and Shear Forces (Sec. R17.6)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	**8509**	**14528**	**0.59**	**Pass (Governs)**
Pullout	8509	16070	0.53	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	**4457**	**7556**	**0.59**	**Pass (Governs)**
T Concrete breakout y-	350	8282	0.04	Pass
|| Concrete breakout y+	8907	16563	0.54	Pass
Pryout	17827	42944	0.42	Pass

Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.41	0.41	82.5%	1.0	Pass

3/4"Ø Heavy Hex Bolt, F1554 Gr. 36 with hef = 8.000 inch meets the selected design criteria.

12. Warnings

- Minimum spacing and edge distance requirement of 6da per ACI 318 Sections 17.7.1 and 17.7.2 for torqued cast-in-place anchor is waived per designer option.

- Concrete breakout strength in tension has not been evaluated against applied tension load(s) per designer option. Refer to ACI 318 Section 17.3.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, ductility requirements for shear have been determined to be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.