Larson Engineering, Inc.
1488 Bond Street, Suite 100
Naperville, IL 60563-6503
630.357.0540
www.larsonengr.com

Larson

Wonderlove Stairs
Portland, OR

Structural Calculations
Steel Stairs

Book 1 of 1
Calculation Release #1

Prepared for
Pragmatic, Inc.
Alpharetta, GA

STRUCTURAL
REGISTERED PROFESSIONAL
ENGINEER
94113PE
Amber DellAngelo
OREGON
NOVEMBER 13, 2018
AMBER D. DELLANGELO
EXPIRATION DATE: 12/31/23

Digitally signed by
Amber D. DellAngelo
Date: 2023.07.18
13:12:45-05'00'

Larson Engineering, Inc.
Naperville, Illinois
Project Number 21230501.000

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WONDERLOVE STAIRS
PORTLAND, OR

Design Criteria

CLIENT:
PRAGMATIC, INC
ALPHARETTA, GA

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Design Criteria

Project Information:

Project: Wonderlove Stairs
Project Location: 1300 SE 2nd Ave
Portland, OR
Project Number: 21230501.000

Load Criteria

1. Structural calculations for stair and handrails based on Pragmatic, Inc. drawings dated 7/12/2023. Guardrails are excluded from LEI's scope.

2. Structural Loads per 2022 Oregon Structural Specialty Code (OSSC).

3. Stair Loads: Uniform Live Load: 100 psf
   Concentrated Live Load: 300 lbf applied on 4 in^2 area

4. Handrail Loads: Uniform Load: 50 lbf/ft. applied in any direction
   Concentrated Load: 200 lbf applied in any Direction

5. Wind and Seismic: See separate calculations.

Structural Steel

1. Steel plates, shapes and bars shall meet the requirements of ASTM A-36 (F_y = 36 ksi, F_u = 58 ksi).

2. Square and rectangular steel tubes shall meet the requirements of ASTM A-500, Grade B, (F_y = 46 ksi, F_u = 58 ksi).

3. Steel members are designed per the ("Manual of Steel Construction, Allowable Stress Design", Fifteenth Edition).

Concrete

1. Slab-on-grade concrete strength is assumed to be f'_c = 3,000 psi, (normal weight).

2. Masonry grout strength is assumed to be f'_c = 2,000 psi.

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3. Masonry is assumed to be grouted solid at all connection points analyzed.

Fasteners, Welds & Anchors

1. Structural bolts shall be ASTM A325N at connections with diameters as shown on drawings.

2. Steel welding electrode to be minimum E70XX low hydrogen for Grade 50 steel and E70XX for Grade 36 steel.

3. All welding shall be by certified welders and shall conform to the latest "Structural Welding Code", AWS D1.1 and meet AISC minimum requirements for weld size.

4. Calculations are not performed for complete joint penetration weld connections.

5. Concrete wedge anchors shall be ("Hilti Kwik Bolt TZ", anchors having diameter and embedment as called for in the calculations. Install per manufacturer's recommendations.

6. Substitution requests for alternate products must be approved in writing by the engineer prior to use. Contractor shall provide product/technical information demonstrating that the substituted product is capable of achieving the performance values of the specified product including an icc-es report showing compliance with the relevant building code, seismic use, load resistance, installation category, in-service temperature, installation temperature, etc.

Disclaimers

1. These calculations are inclusive of revisions and markups shown in the calculation package and based on the shop drawings titled Wonderlove Stairs and dated 7/12/2023. See table of contents for location of markups, sketches and connection maps in the calculation package.

2. The following calculation package represents Larson Engineering's interpretation of the design intent of the shop drawings and specifications. Larson Engineering is not responsible for verification of dimensions, material take-offs, installation and coordination with other building trades. If as built conditions differ from the conditions shown in this calculation package, Pragmatic must bring these differences to the attention of Larson Engineering so that the as built conditions can be structurally verified.

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3. The structural engineer of record (EOR) shall assume responsibility for the design of all members supporting the stairs for the maximum loads imposed by the stairs.

4. The scope of this calculation package is limited to the stairs and handrails. Shear, brace frame, and moment connections are not included in this submittal.

5. The structural engineer of record (EOR) shall verify that all surrounding structures to which stair and handrail framing is to be anchored are structurally sound and capable of supporting the weights and reactions of all attached stair supporting members under maximum design loads.

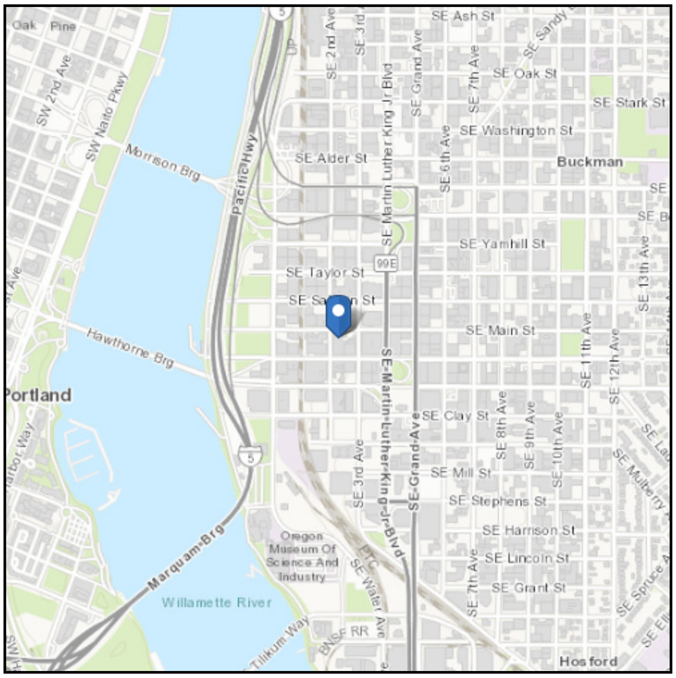
6. LEI's analysis assumes that seismic building drift has been accommodated within the structure and that no additional loading will be imposed on the stair. EOR to provide expected building drift value(s) if connections between the stair and building are to be slotted to account for the drift at each level.

ASCE 7 Hazards Report

Address:
1300 SE 2nd Ave
Portland, Oregon
97214

Standard: ASCE/SEI 7-22
Risk Category: II
Soil Class: Default

Latitude: 45.513441
Longitude: -122.663543
Elevation: 43.96604568512864 ft (NAVD 88)



Wind

Results:

Wind Speed	97 Vmph
10-year MRI	67 Vmph
25-year MRI	73 Vmph
50-year MRI	77 Vmph
100-year MRI	82 Vmph
300-year MRI	91 Vmph
700-year MRI	97 Vmph
1,700-year MRI	103 Vmph
3,000-year MRI	107 Vmph
10,000-year MRI	116 Vmph
100,000-year MRI	134 Vmph
1,000,000-year MRI	152 Vmph

Data Source: ASCE/SEI 7-22, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Fri Jul 14 2023

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Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-22 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years). Values for 10-year MRI, 25-year MRI, 50-year MRI and 100-year MRI are Service Level wind speeds, all other wind speeds are Ultimate wind speeds.

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-22 Section 26.2.

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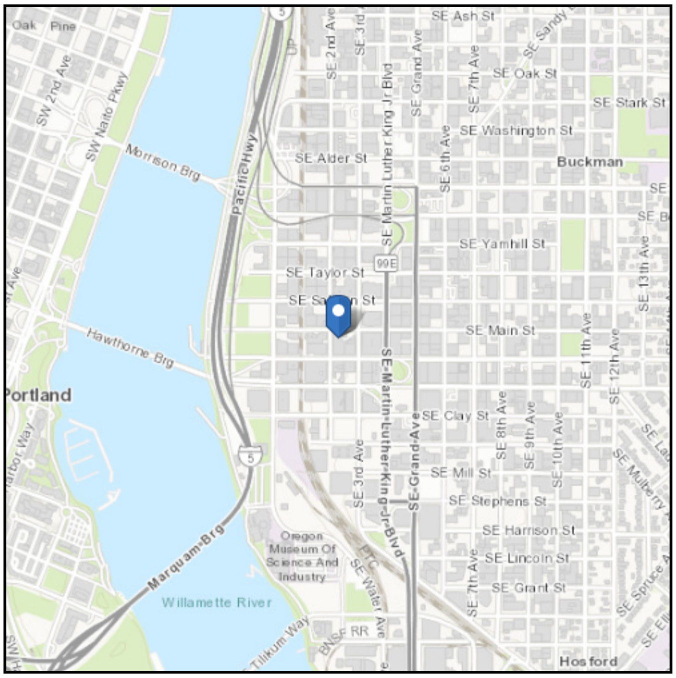
Risk Category:	II	**Longitude:**	-122.663543
Soil Class:	Default	**Elevation:**	43.96604568512864 ft (NAVD 88)



ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

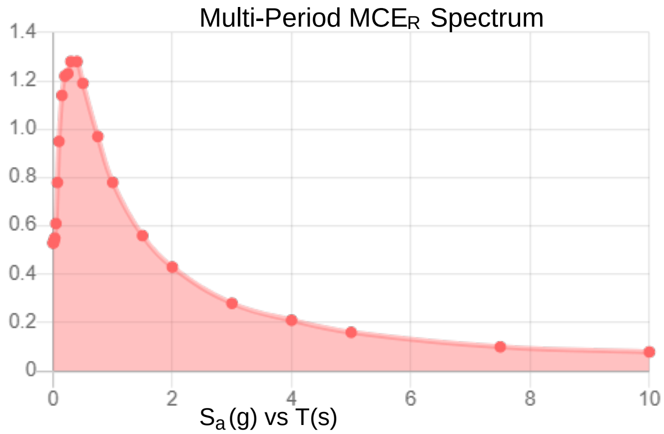
Default

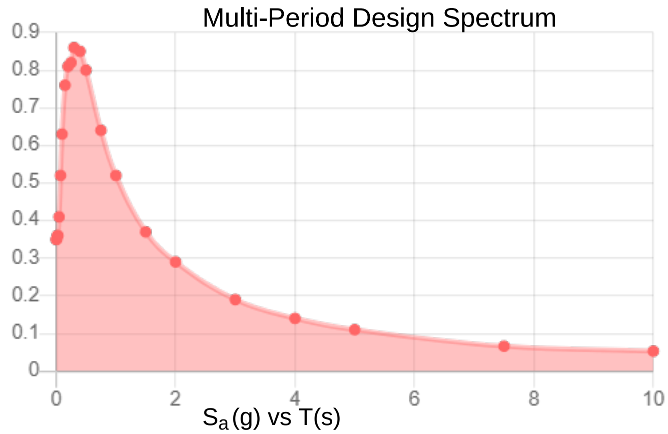
Site Soil Class:

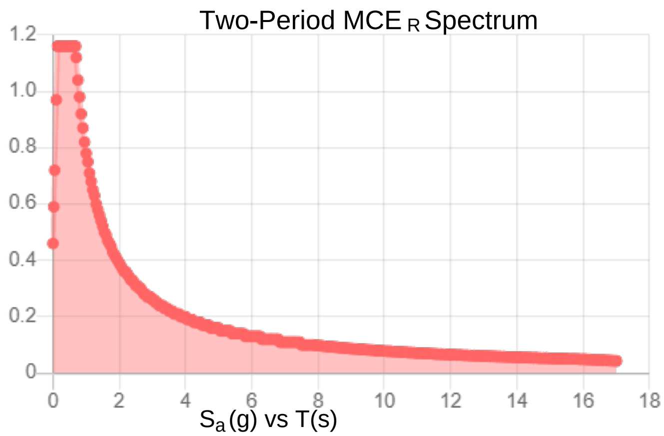
Results:

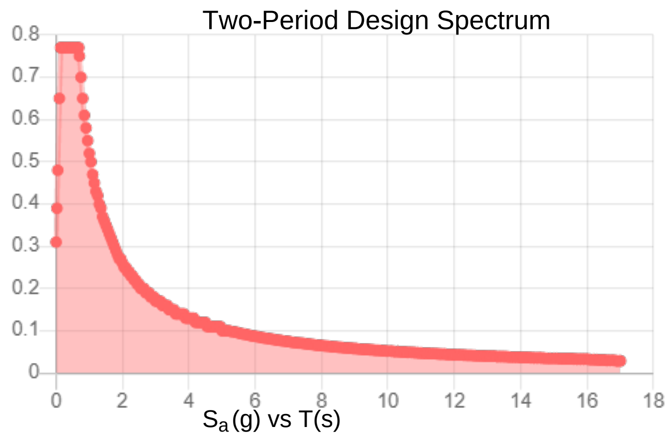
PGA_M :	0.5	T_L :	16
S_{MS} :	1.16	S_S :	0.94
S_{M1} :	0.78	S_1 :	0.36
S_{DS} :	0.77	V_{S30} :	260
S_{D1} :	0.52		

Seismic Design Category: D









MCE$_R$ Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Fri Jul 14 2023**

Date Source:

USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

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STRINGER

LOAD DETERMINATION - @ Stair:

Stair Width: $W_s := 36 \cdot in$

Thickness of Concrete: $C_s := 0 \cdot in$

Weight of Concrete: $C_{w1} := 150 \cdot pcf$

Miscellaneous Steel: $M_s := 15 \cdot psf$

Dead Load: $DL_s := (C_s \cdot C_{w1}) + M_s$ $\quad DL_s = 15 \cdot psf$

Live Load: $LL_s := 100 \cdot psf$ $\quad LL_s := 100 \cdot psf$

Wind Load:

$V_{wind} := 97mph \quad K_z := 0.85 \quad K_{zt} := 1 \quad K_d := 0.85$

exposure 'C' $\quad K_e := 1$

$$q_z := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot K_e \cdot \left(\frac{V_{wind}}{mph}\right)^2 \cdot psf = 17.403 \cdot psf$$

$G_f := 0.85 \quad C_f := 2.0$ Fig 29.4-2

$WL := q_z \cdot G_f \cdot C_f = 29.585 \cdot psf$

Seismic Criteria (stair):

$I_p := 1.5 \quad S_{ds} := 0.77$

$R_p := 2.5 \quad a_p := 1$

$\Omega := 2.5$

$W_{seis} := DL_s = 15 \cdot psf$

Seismic Horizontal Load:

$$F_{ph} := \frac{0.4 a_p \cdot S_{ds}}{\frac{R_p}{I_p}} \cdot (1 + 2 \cdot 1) = 0.554$$ (to be applied to Dead Load)

$F_{pmin} := 0.3 \cdot I_p \cdot S_{ds} = 0.346$

$F_{pmax} := 1.6 \cdot S_{ds} \cdot I_p = 1.848$

Seismic Vertical Load: $F_{pv} := 0.2 \cdot S_{ds} = 0.154$ (to be applied to Dead Load)

$w_{seismic\_horz} := W_{seis} \cdot F_{ph} = 8.316 \cdot psf$

$w_{seismic\_vert} := W_{seis} \cdot F_{pv} = 2.31 \cdot psf$

Seismic Criteria (fasteners):

$I_p := 1.5 \quad S_{ds} := 0.77$

$R_p := 2.5 \quad a_p := 2.5$

Seismic Horizontal Load:

$$F_{ph} := \frac{0.4 a_p \cdot S_{ds}}{\frac{R_p}{I_p}} \cdot (1 + 2 \cdot 1) = 1.386$$ (to be applied to Dead Load)

$F_{pmin} := 0.3 \cdot I_p \cdot S_{ds} = 0.346$

$F_{pmax} := 1.6 \cdot S_{ds} \cdot I_p = 1.848$

Seismic Vertical Load: $F_{pv} := 0.2 \cdot S_{ds} = 0.154$ (to be applied to Dead Load)

Note: Concrete anchors to be designed for Ωo=2.5 times reactions from seismic criteria for fasteners

$w_{seismic\_horz\_f} := W_{seis} \cdot F_{ph} = 20.79 \cdot psf$

$w_{seismic\_vert\_f} := W_{seis} \cdot F_{pv} = 2.31 \cdot psf$

STRINGER

STRINGER ANALYSIS: (See Following RISA Results)

Max Moment of Stringer: $M_{act} := 2.9 \cdot kip \cdot ft$

Max Deflection of Stringer: $\Delta_{act} := 0.057 \cdot in$

CHECK BENDING IN STRINGER:

Stringer Unbraced Length: $L_b := 12 \cdot in$

$M_{all} := 26.6 \cdot kip \cdot ft$

M.act < M.all

CHECK DEFLECTION IN STRINGER:

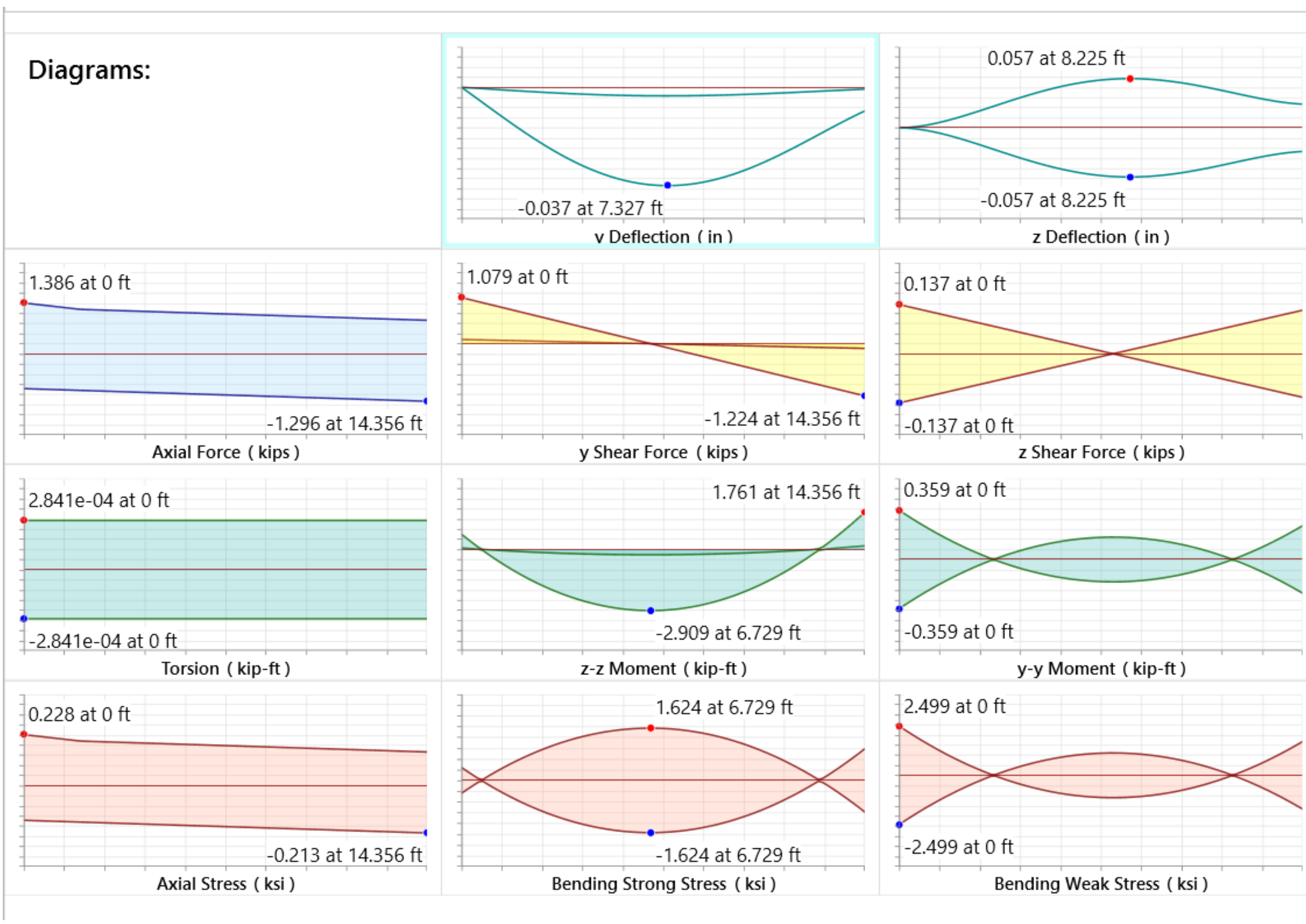
Length of Stringer: $L_s := 172 \cdot in$

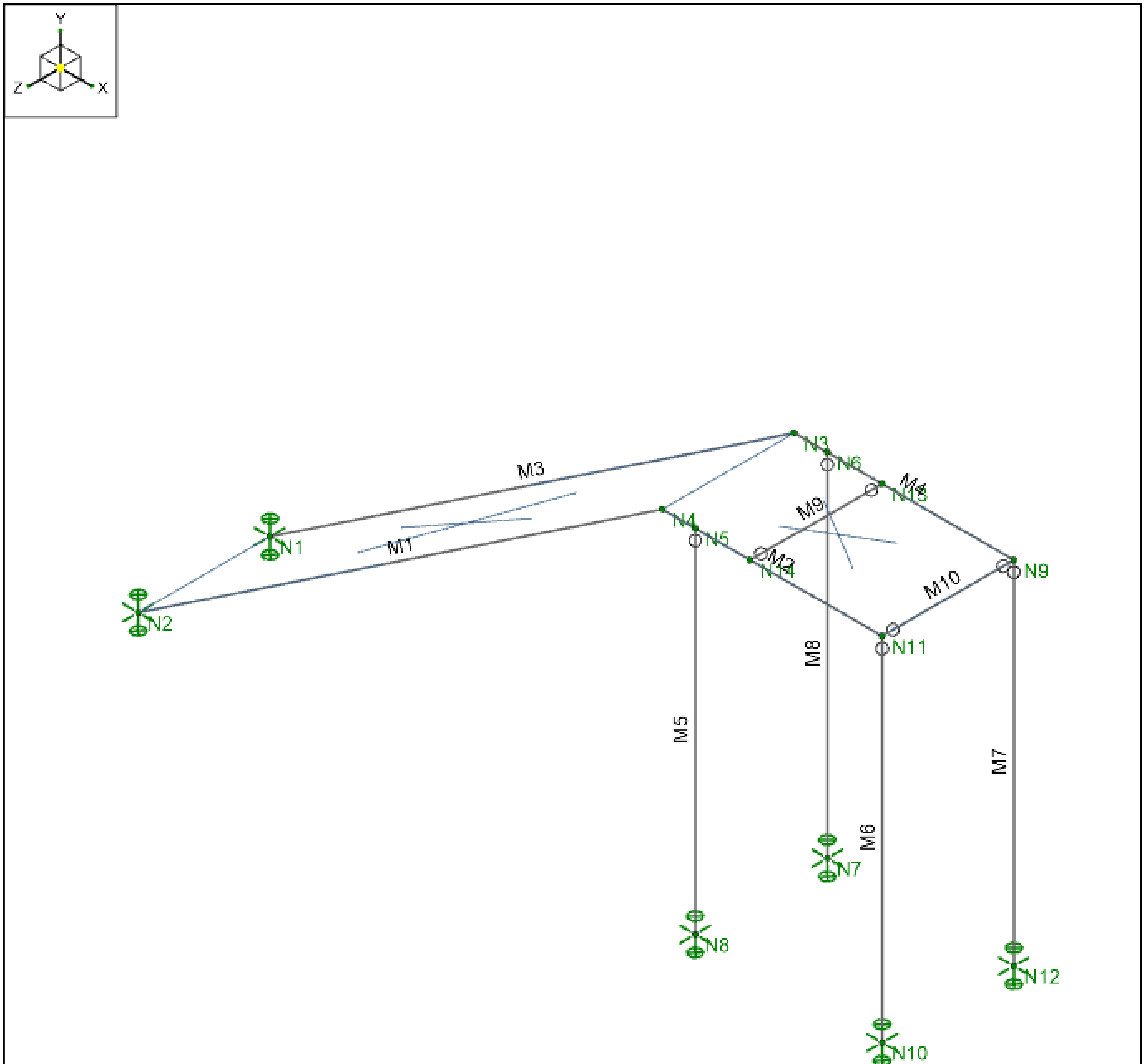
Deflection Factor: $\Delta_{all} := \frac{L_s}{360}$

Allowable Deflection: $\Delta_{all} = 0.478 \cdot in$ > $\Delta_{act} = 0.057 \cdot in$ ok

Provide C12x20.7, A36 steel

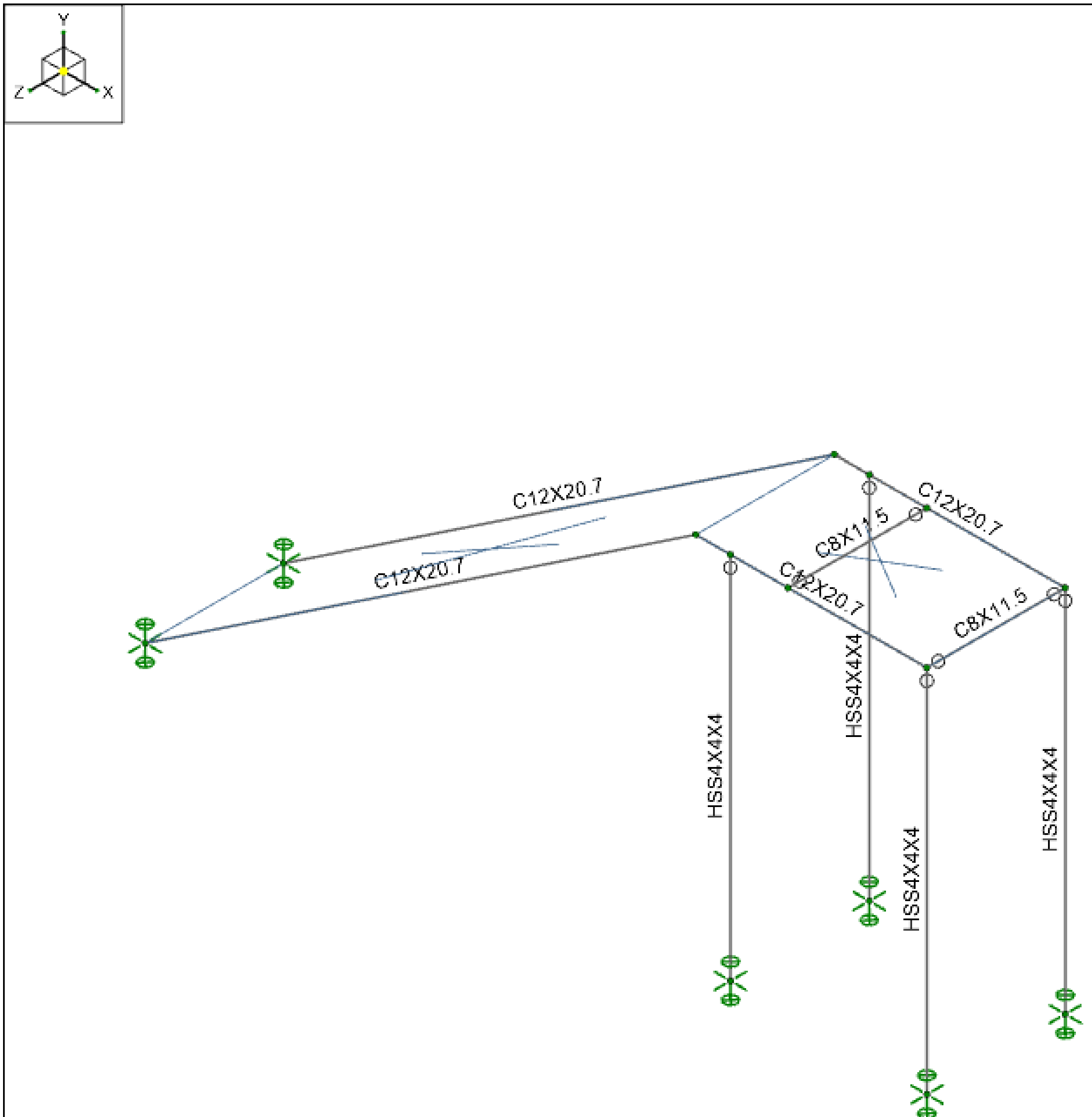
RISA RESULTS:





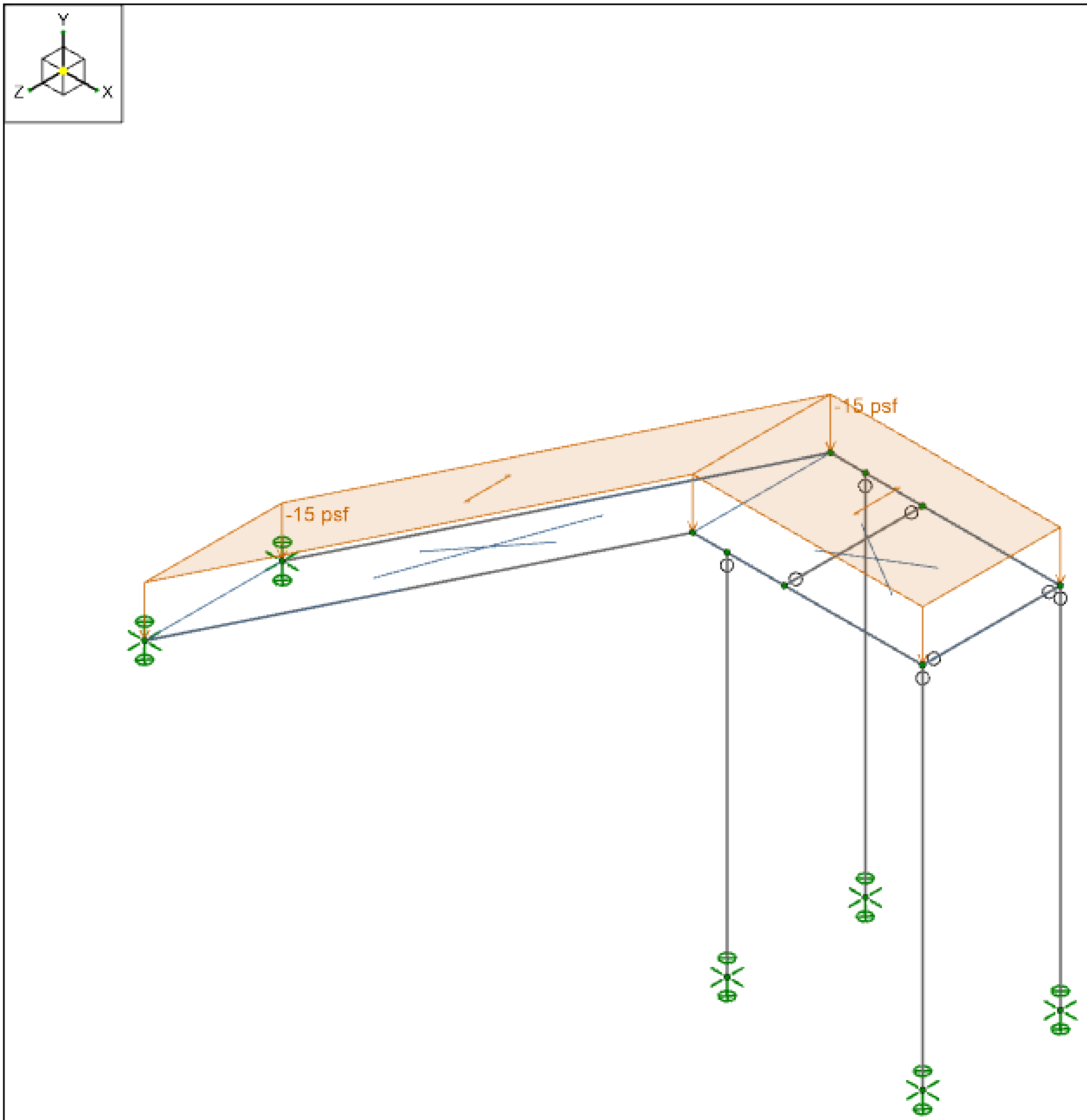
Envelope Only Solution

LEI	Wonderlove stairs	SK-1
MJB		Jul 17, 2023
21230501.000	Node & Member Label	Stair.r3d



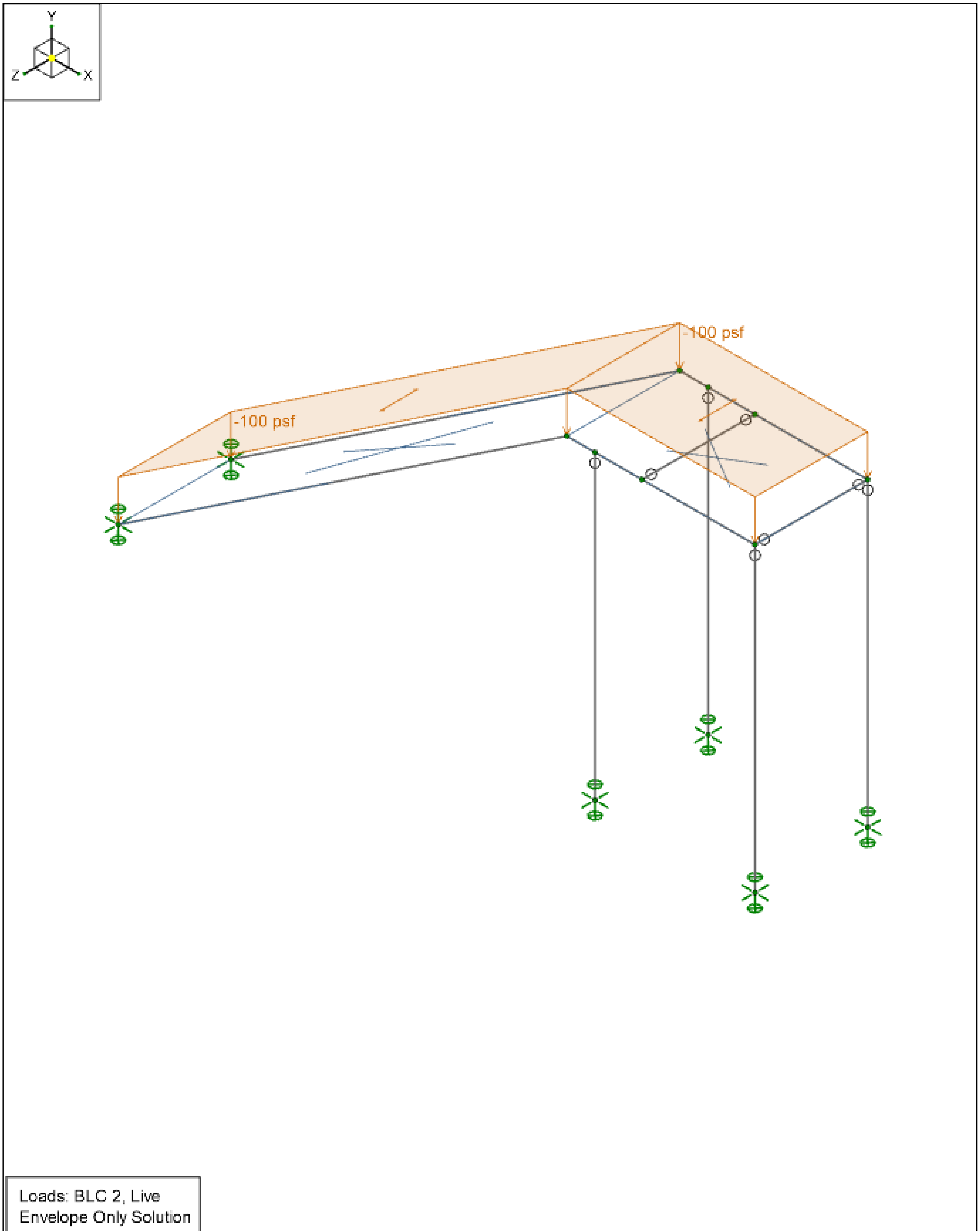
Envelope Only Solution

LEI	Wonderlove stairs	SK-2
MJB		Jul 17, 2023
21230501.000	Member Shape	Stair.r3d

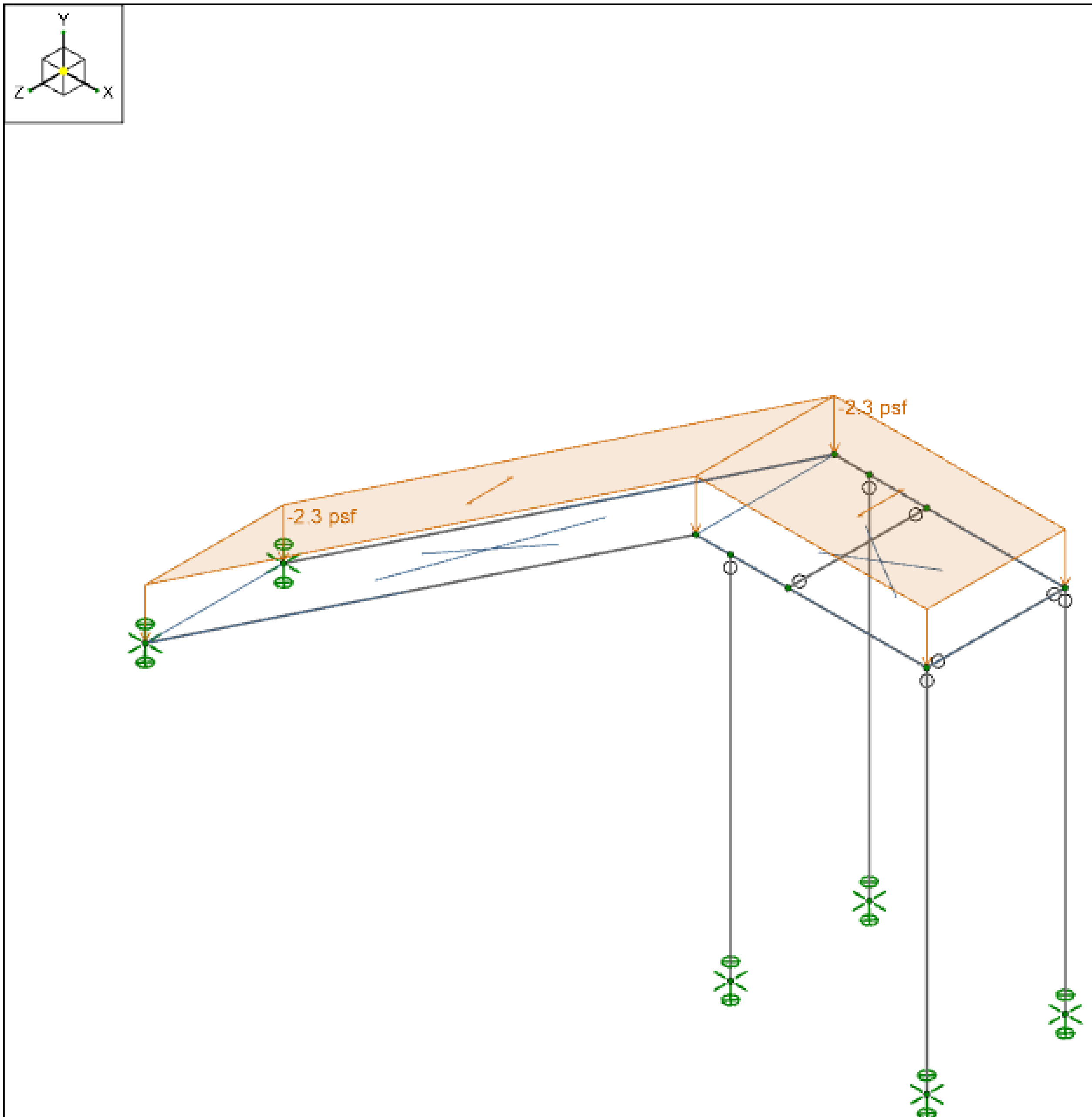


Loads: BLC 1, Dead
Envelope Only Solution

LEI	Wonderlove stairs	SK-3
MJB		Jul 17, 2023
21230501.000	Dead Load	Stair.r3d

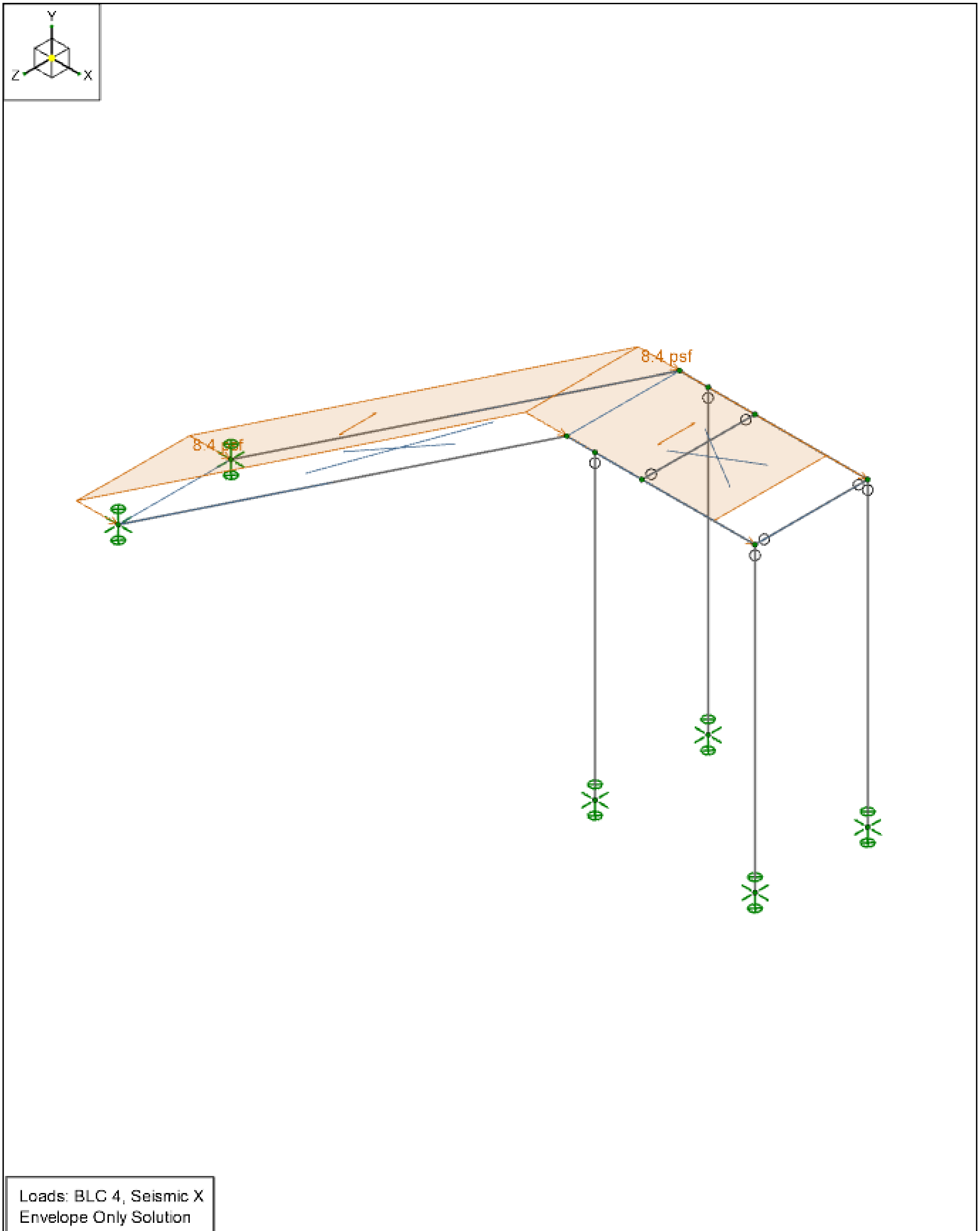


LEI	Wonderlove stairs	SK-4
MJB		Jul 17, 2023
21230501.000	Live Load	Stair.r3d

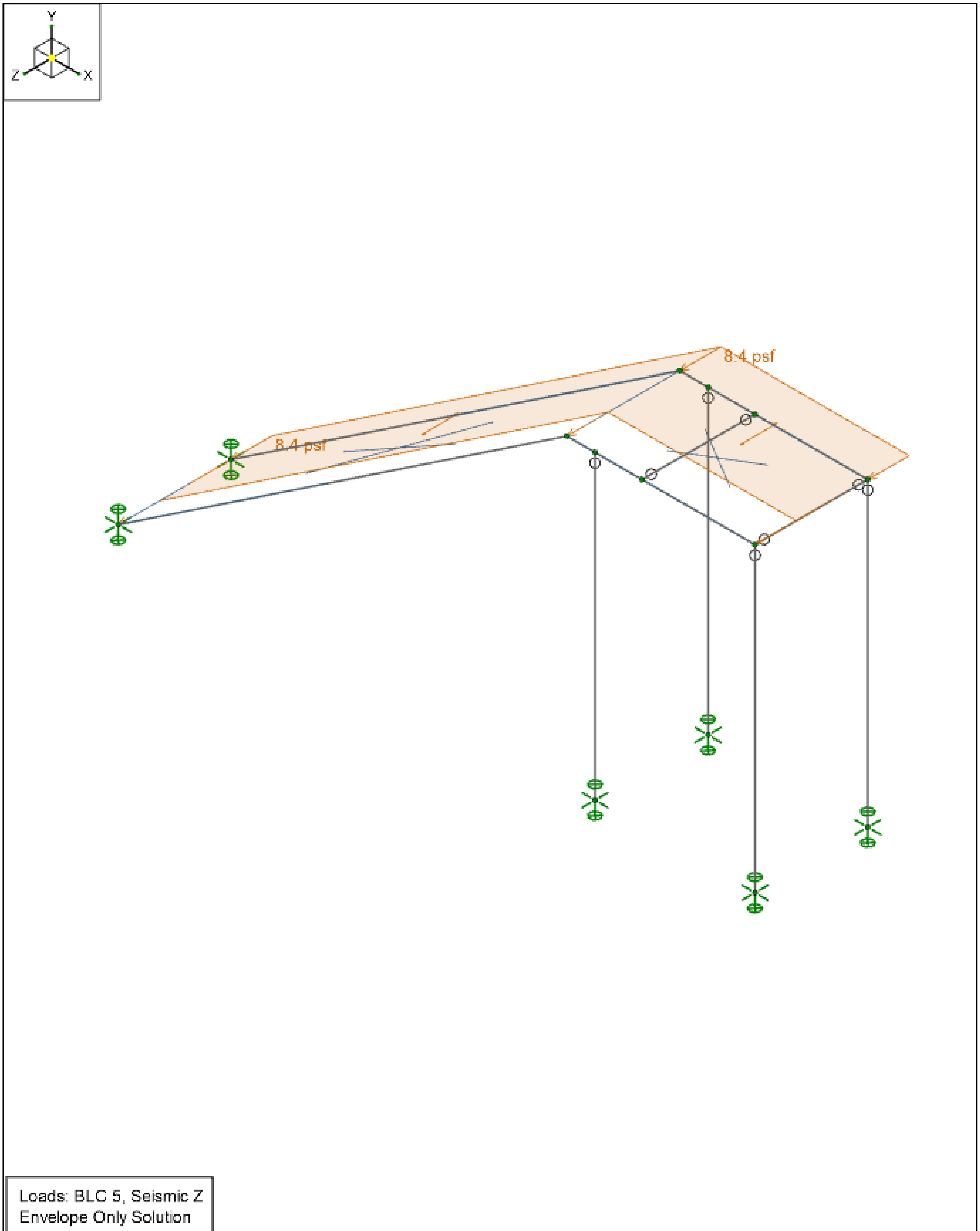


Loads: BLC 3, Seismic Y
Envelope Only Solution

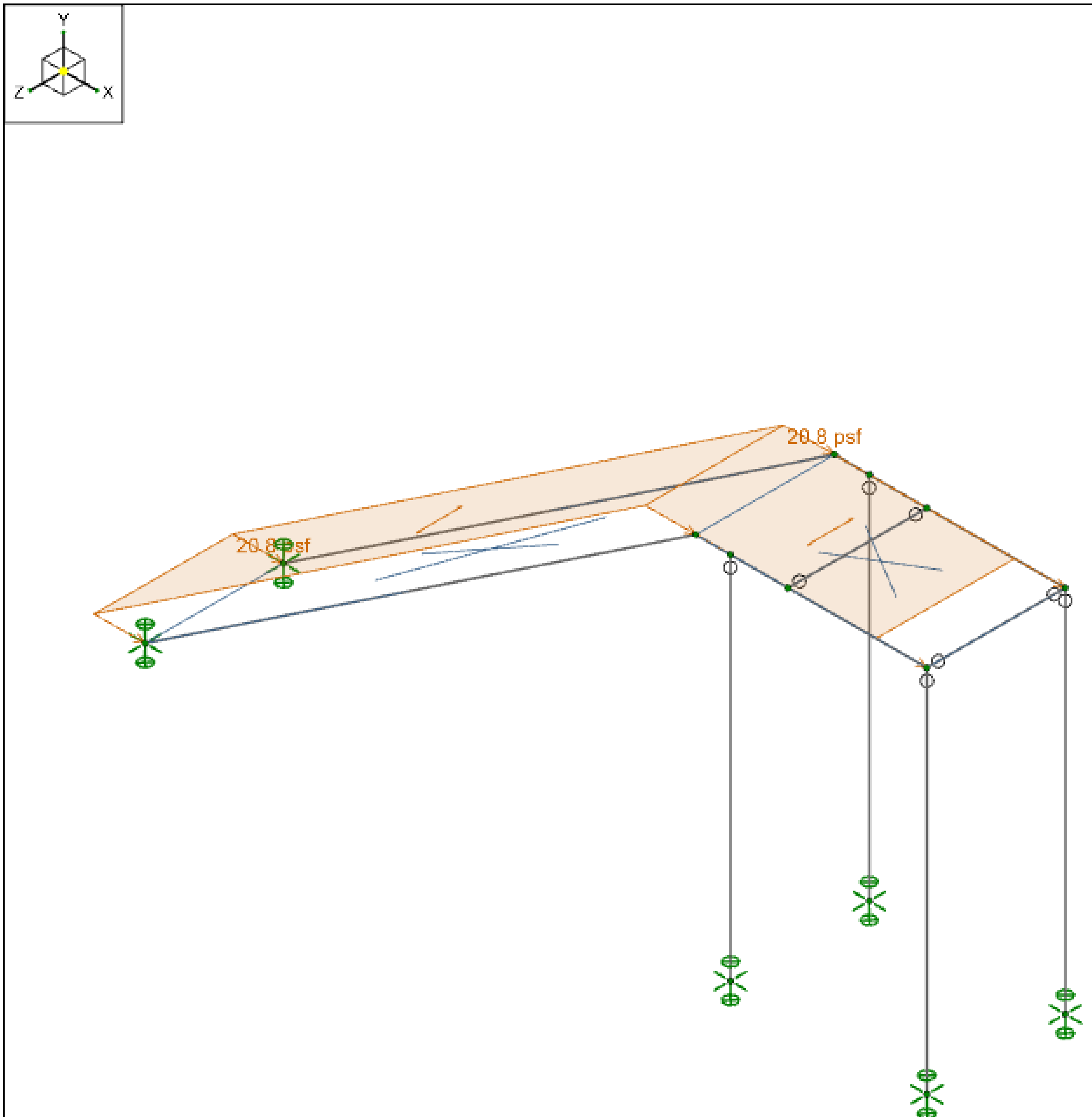
LEI	Wonderlove stairs	SK-5
MJB		Jul 17, 2023
21230501.000	Seismic Y - Strength	Stair.r3d



LEI	Wonderlove stairs	SK-6
MJB		Jul 17, 2023
21230501.000	Seismic X - Strength	Stair.r3d

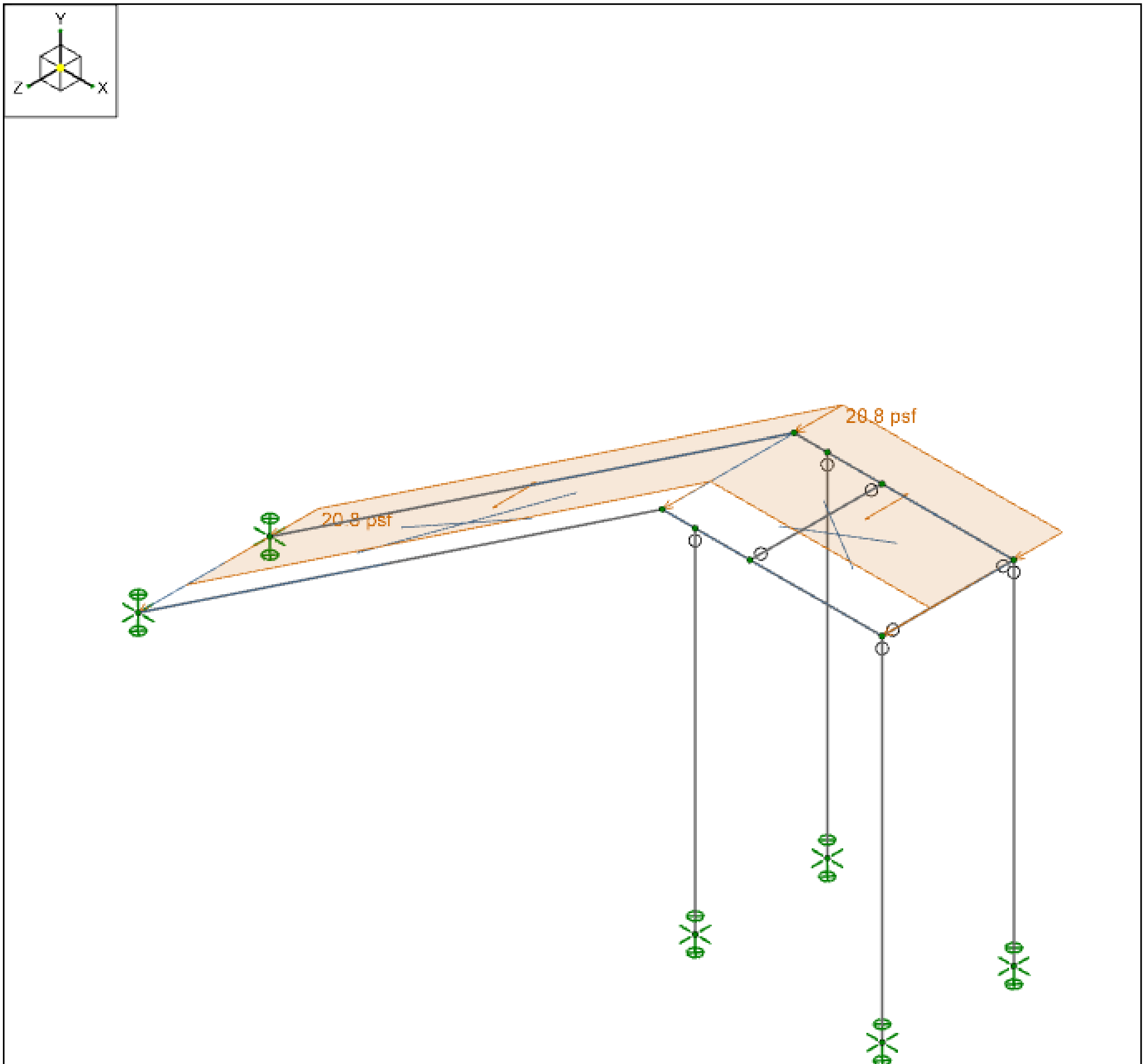


LEI	Wonderlove stairs	SK-7
MJB		Jul 17, 2023
21230501.000	Seismic Z - Strength	Stair.r3d



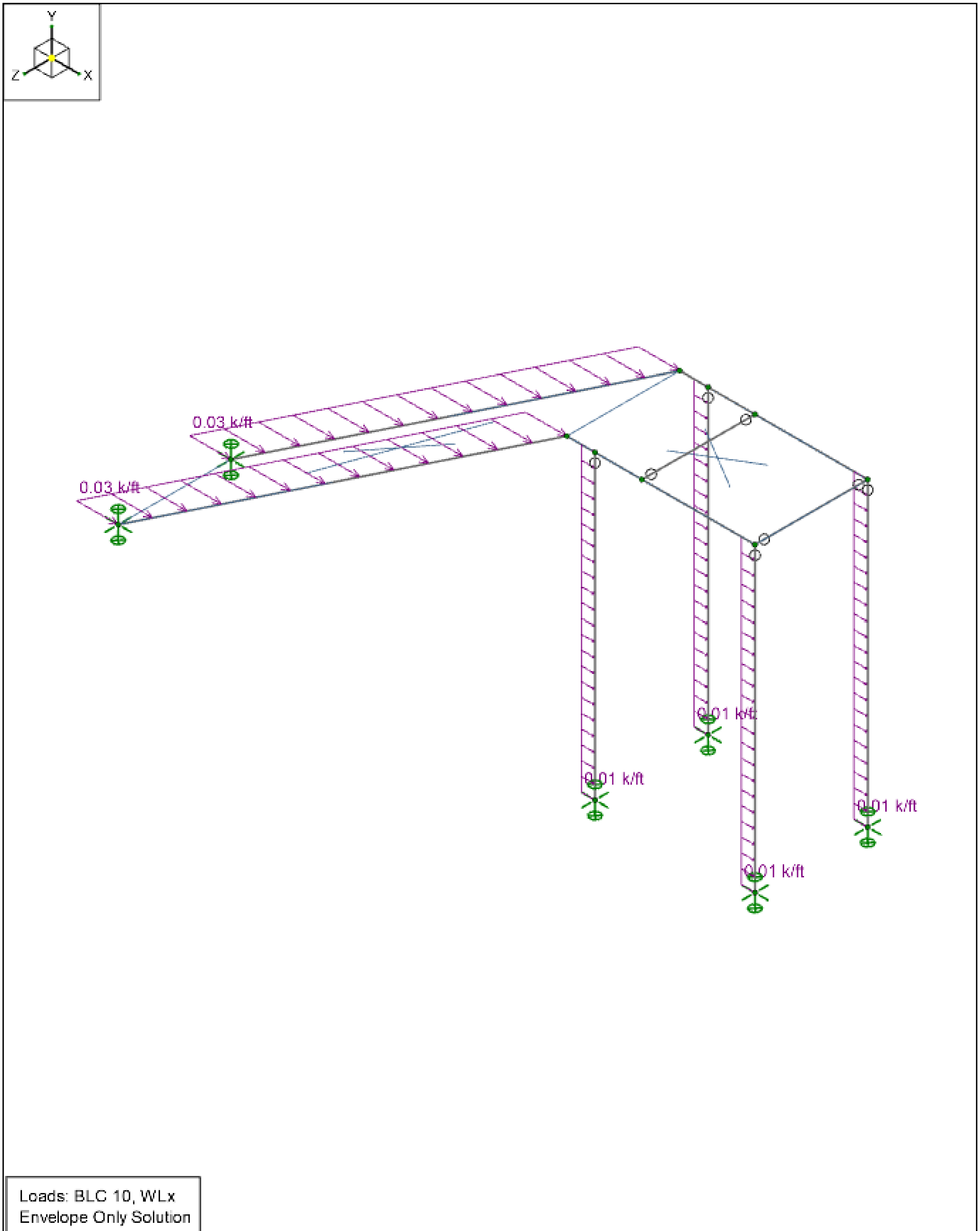
Loads: BLC 7, Seismic X (Fastener)
Envelope Only Solution

LEI	Wonderlove stairs	SK-8
MJB		Jul 17, 2023
21230501.000	Seismic X-Fasteners - Strength	Stair.r3d

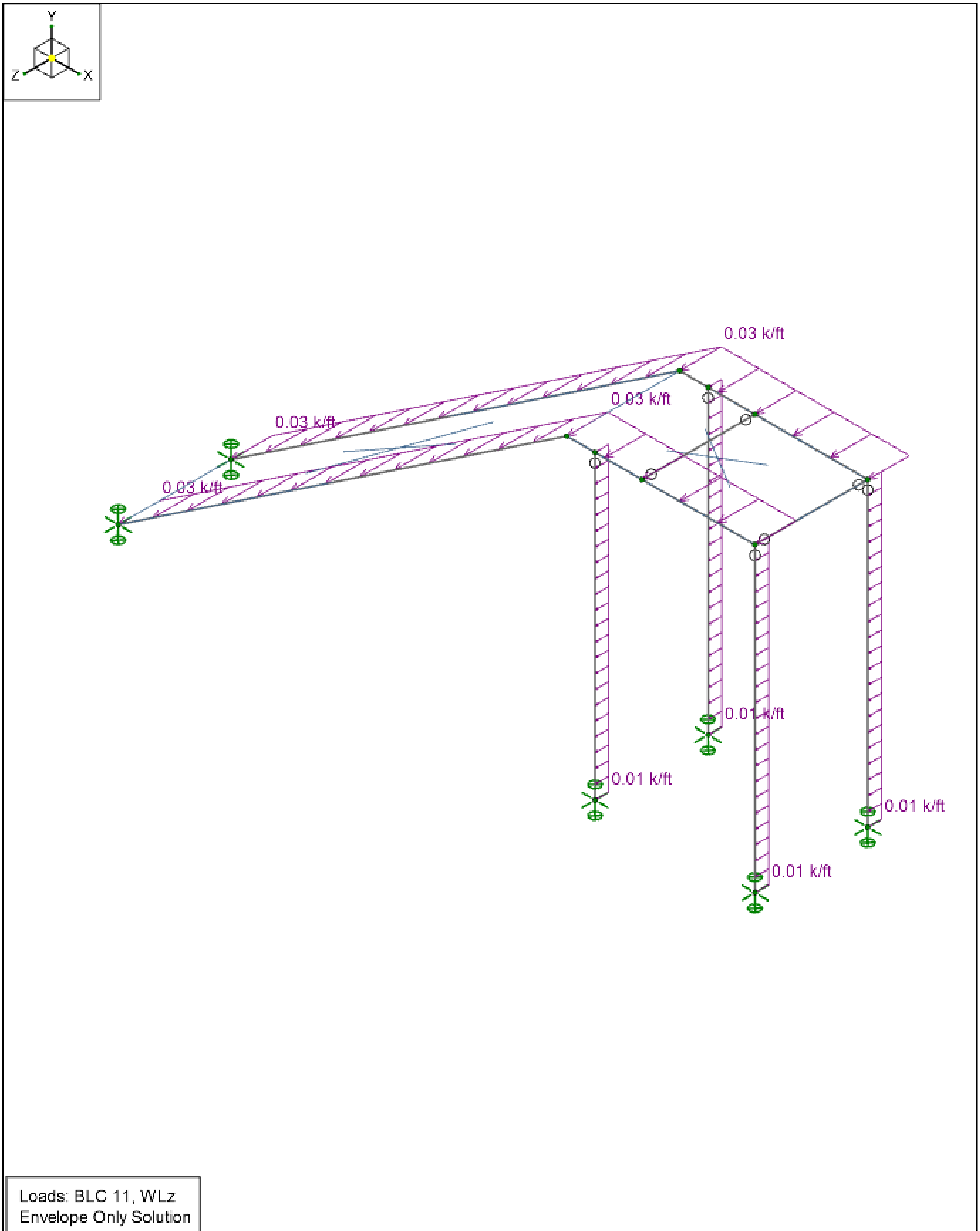


Loads: BLC 8, Seismic Z (Fastener)
Envelope Only Solution

LEI	Wonderlove stairs	SK-9
MJB		Jul 17, 2023
21230501.000	Seismic Z-Fasteners - Strength	Stair.r3d



LEI	Wonderlove stairs	SK-10
MJB		Jul 17, 2023
21230501.000	Wind Load X- Strength	Stair.r3d

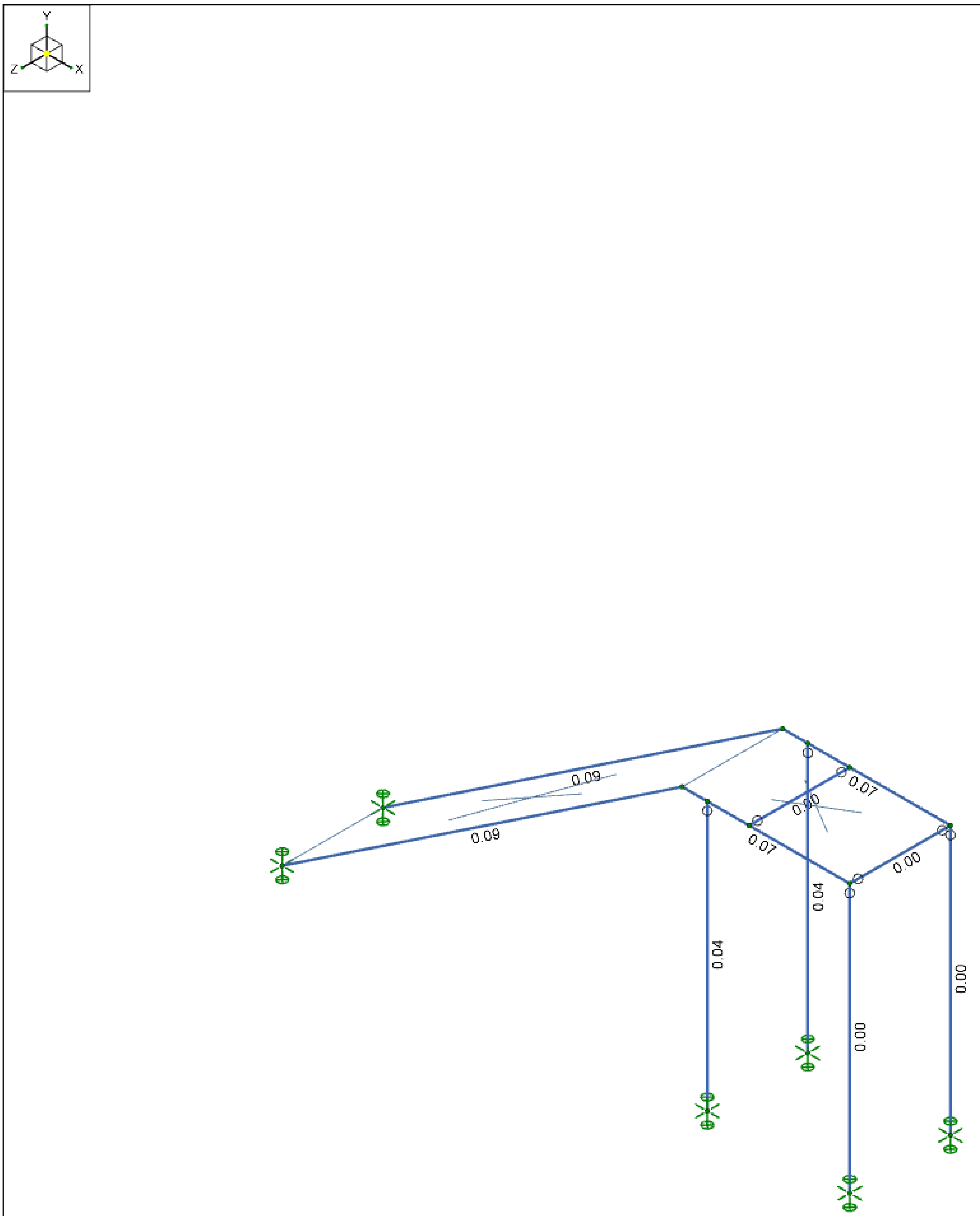


LEI	Wonderlove stairs	SK-11
MJB		Jul 17, 2023
21230501.000	Wind Load Z- Strength	Stair.r3d

ST14

Code Check
(Env)

- No Calc
- > 1.0
- .90-1.0
- .75-.90
- .50-.75
- 0.-.50



Member Code Checks Displayed (Enveloped)
Envelope Only Solution

LEI	Wonderlove stairs	SK-1
MJB		Jul 17, 2023
21230501.000	Envelope Member Unity	Stair.r3d

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	0	0	3	
3	N3	11.92	8	0	
4	N4	11.92	8	3	
5	N5	12.67	8	3	
6	N6	12.67	8	0	
7	N7	12.67	0	0	
8	N8	12.67	0	3	
9	N9	16.92	8	0	
10	N10	16.92	0	3	
11	N11	16.92	8	3	
12	N12	16.92	0	0	
13	N13	13.92	8	0	
14	N14	13.92	8	3	

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]	Y Rot [k-ft/rad]
1	N2	Reaction	Reaction	Reaction	Reaction
2	N1	Reaction	Reaction	Reaction	Reaction
3	N8	Reaction	Reaction	Reaction	Reaction
4	N7	Reaction	Reaction	Reaction	Reaction
5	N10	Reaction	Reaction	Reaction	Reaction
6	N12	Reaction	Reaction	Reaction	Reaction

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Yield [ksi]	Ry	Fu [ksi]	Rt
1	A992	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
2	A36 Gr.36	29000	11154	0.3	0.65	0.49	36	1.5	58	1.2
3	A572 Gr.50	29000	11154	0.3	0.65	0.49	50	1.1	65	1.1
4	A500 Gr.B RND	29000	11154	0.3	0.65	0.527	42	1.4	58	1.3
5	A500 Gr.B Rect	29000	11154	0.3	0.65	0.527	46	1.4	58	1.3
6	A53 Gr.B	29000	11154	0.3	0.65	0.49	35	1.6	60	1.2
7	A1085	29000	11154	0.3	0.65	0.49	50	1.4	65	1.3

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	stringer	C12X20.7	Beam	Channel	A36 Gr.36	Typical	6.08	3.86	129	0.369
2	Column	HSS4X4X4	Column	Tube	A500 Gr.B Rect	Typical	3.37	7.8	7.8	12.8
3	INFILL	C8X11.5	Beam	Channel	A36 Gr.36	Typical	3.37	1.31	32.5	0.13

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N2	N4	stringer	Beam	Channel	A36 Gr.36	Typical
2	M2	N4	N11	stringer	Beam	Channel	A36 Gr.36	Typical
3	M3	N1	N3	stringer	Beam	Channel	A36 Gr.36	Typical
4	M4	N3	N9	stringer	Beam	Channel	A36 Gr.36	Typical
5	M5	N8	N5	Column	Column	Tube	A500 Gr.B Rect	Typical
6	M6	N10	N11	Column	Column	Tube	A500 Gr.B Rect	Typical
7	M7	N12	N9	Column	Column	Tube	A500 Gr.B Rect	Typical
8	M8	N7	N6	Column	Column	Tube	A500 Gr.B Rect	Typical
9	M9	N14	N13	INFILL	Beam	Channel	A36 Gr.36	Typical
10	M10	N11	N9	INFILL	Beam	Channel	A36 Gr.36	Typical

Member Advanced Data

	Label	I Release	J Release	Physical	Deflection Ratio Options	Seismic DR
1	M1			Yes	Default	None
2	M2			Yes	Default	None
3	M3			Yes	Default	None
4	M4			Yes	Default	None
5	M5		BenPIN	Yes	** NA **	None
6	M6		BenPIN	Yes	** NA **	None

Member Advanced Data (Continued)

	Label	I Release	J Release	Physical	Deflection Ratio Options	Seismic DR
7	M7		BenPIN	Yes	** NA **	None
8	M8		BenPIN	Yes	** NA **	None
9	M9	BenPIN	BenPIN	Yes	Default	None
10	M10	BenPIN	BenPIN	Yes	Default	None

Hot Rolled Steel Design Parameters

	Label	Shape	Length [ft]	Lb y-y [ft]	Lcomp top [ft]	Channel Conn.	a [ft]	Function
1	M1	stringer	14.356	1	1	N/A	N/A	Lateral
2	M2	stringer	5		Lbyy	N/A	N/A	Lateral
3	M3	stringer	14.356	1	1	N/A	N/A	Lateral
4	M4	stringer	5		Lbyy	N/A	N/A	Lateral
5	M5	Column	8		Lbyy	N/A	N/A	Lateral
6	M6	Column	8		Lbyy	N/A	N/A	Lateral
7	M7	Column	8		Lbyy	N/A	N/A	Lateral
8	M8	Column	8		Lbyy	N/A	N/A	Lateral
9	M9	INFILL	3		Lbyy	N/A	N/A	Lateral
10	M10	INFILL	3		Lbyy	N/A	N/A	Lateral

Member Distributed Loads (BLC 10 : WLx)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	X	0.03	0.03	0	%100
2	M3	X	0.03	0.03	0	%100
3	M5	X	0.01	0.01	0	%100
4	M8	X	0.01	0.01	0	%100
5	M6	X	0.01	0.01	0	%100
6	M7	X	0.01	0.01	0	%100

Member Distributed Loads (BLC 11 : WLz)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M5	Z	0.01	0.01	0	%100
2	M6	Z	0.01	0.01	0	%100
3	M8	Z	0.01	0.01	0	%100
4	M7	Z	0.01	0.01	0	%100
5	M3	Z	0.03	0.03	0	%100
6	M4	Z	0.03	0.03	0	%100
7	M1	Z	0.03	0.03	0	%100
8	M2	Z	0.03	0.03	0	%100

Member Distributed Loads (BLC 6 : BLC 1 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	Y	-0.022	-0.022	1.665e-15	14.356
2	M3	Y	-0.023	-0.023	1.332e-15	14.356
3	M2	Y	-0.013	-0.023	0	2.5
4	M2	Y	-0.023	-0.032	2.5	5
5	M4	Y	-0.013	-0.023	0	2.5
6	M4	Y	-0.023	-0.032	2.5	5

Member Distributed Loads (BLC 9 : BLC 2 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	Y	-0.15	-0.15	1.665e-15	14.356
2	M3	Y	-0.15	-0.15	1.332e-15	14.356
3	M2	Y	-0.09	-0.15	0	2.5
4	M2	Y	-0.15	-0.21	2.5	5
5	M4	Y	-0.09	-0.15	0	2.5
6	M4	Y	-0.15	-0.21	2.5	5

Member Distributed Loads (BLC 12 : BLC 3 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M4	Y	-0.003	-0.005	2.5	5
2	M1	Y	-0.003	-0.003	1.665e-15	14.356

Member Distributed Loads (BLC 12 : BLC 3 Transient Area Loads) (Continued)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
3	M3	Y	-0.003	-0.003	1.332e-15	14.356
4	M2	Y	-0.002	-0.003	0	2.5
5	M2	Y	-0.003	-0.005	2.5	5
6	M4	Y	-0.002	-0.003	0	2.5

Member Distributed Loads (BLC 13 : BLC 4 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	X	0.013	0.013	1.665e-15	14.356
2	M3	X	0.013	0.013	1.332e-15	14.356
3	M2	X	0.008	0.013	0	2.5
4	M2	X	0.013	0.018	2.5	5
5	M4	X	0.008	0.013	0	2.5
6	M4	X	0.013	0.018	2.5	5

Member Distributed Loads (BLC 14 : BLC 5 Transient Area Loads)

	Member Label	Direction	Start Magnitude [k/ft, F, psf, k-ft/ft]	End Magnitude [k/ft, F, psf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	Z	0.013	0.013	1.665e-15	14.356
2	M3	Z	0.013	0.013	1.332e-15	14.356
3	M2	Z	0.008	0.013	0	2.5
4	M2	Z	0.013	0.018	2.5	5
5	M4	Z	0.008	0.013	0	2.5
6	M4	Z	0.013	0.018	2.5	5

Member Area Loads (BLC 1 : Dead)

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [psf]
1	N1	N2	N4	N3	Y	A-B	-15
2	N3	N4	N11	N9	Y	A-B	-15

Member Area Loads (BLC 2 : Live)

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [psf]
1	N1	N2	N4	N3	Y	A-B	-100
2	N3	N4	N11	N9	Y	A-B	-100

Member Area Loads (BLC 3 : Seismic Y)

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [psf]
1	N1	N2	N4	N3	Y	A-B	-2.3
2	N3	N4	N11	N9	Y	A-B	-2.3

Member Area Loads (BLC 4 : Seismic X)

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [psf]
1	N1	N2	N4	N3	X	A-B	8.4
2	N3	N4	N11	N9	X	A-B	8.4

Member Area Loads (BLC 5 : Seismic Z)

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [psf]
1	N1	N2	N4	N3	Z	A-B	8.4
2	N3	N4	N11	N9	Z	A-B	8.4

Member Area Loads (BLC 7 : Seismic X (Fastener))

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [psf]
1	N1	N2	N4	N3	X	A-B	20.8
2	N3	N4	N11	N9	X	A-B	20.8

Member Area Loads (BLC 8 : Seismic Z (Fastener))

	Node A	Node B	Node C	Node D	Direction	Load Direction	Magnitude [psf]
1	N1	N2	N4	N3	Z	A-B	20.8
2	N3	N4	N11	N9	Z	A-B	20.8

Basic Load Cases

	BLC Description	Category	Y Gravity	Distributed	Area(Member)
1	Dead	None	-1		2
2	Live	None			2
3	Seismic Y	None			2
4	Seismic X	None			2
5	Seismic Z	None			2
6	BLC 1 Transient Area Loads	None		6	
7	Seismic X (Fastener)	None			2
8	Seismic Z (Fastener)	None			2
9	BLC 2 Transient Area Loads	None		6	
10	WLx	None		6	
11	WLz	None		8	
12	BLC 3 Transient Area Loads	None		6	
13	BLC 4 Transient Area Loads	None		6	
14	BLC 5 Transient Area Loads	None		6	

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	D+L	Yes	Y	1	1	2	1				
2	D+0.7Ev+0.7Ehx	Yes	Y	1	1	3	0.7	4	0.7		
3	D+0.7Ev-0.7Ehx	Yes	Y	1	1	3	0.7	4	-0.7		
4	D+0.7Ev+0.7Ehz	Yes	Y	1	1	3	0.7	5	0.7		
5	D+0.7Ev-0.7Ehz	Yes	Y	1	1	3	0.7	5	-0.7		
6	D+0.525Ev+0.525Ehx+0.75L	Yes	Y	1	1	3	0.525	4	0.525	2	0.75
7	D+0.525Ev-0.525Ehx+0.75L	Yes	Y	1	1	3	0.525	4	-0.525	2	0.75
8	D+0.525Ev+0.525Ehz+0.75L	Yes	Y	1	1	3	0.525	5	0.525	2	0.75
9	D+0.525Ev-0.525Ehz+0.75L	Yes	Y	1	1	3	0.525	5	-0.525	2	0.75
10	0.6D-0.7Ev+0.7Ehx	Yes	Y	1	0.6	3	-0.7	4	0.7		
11	0.6D-0.7Ev-0.7Ehx	Yes	Y	1	0.6	3	-0.7	4	-0.7		
12	0.6D-0.7Ev+0.7Ehz	Yes	Y	1	0.6	3	-0.7	5	0.7		
13	0.6D-0.7Ev-0.7Ehz	Yes	Y	1	0.6	3	-0.7	5	-0.7		
14	D+0.6WLx	Yes	Y	1	1	10	0.6				
15	D-.6WLx	Yes	Y	1	1	10	-0.6				
16	D+0.6WLz	Yes	Y	1	1	11	0.6				
17	D-0.6WLz	Yes	Y	1	1	11	-0.6				
18	D+.75L+.45WLX	Yes	Y	1	1	2	0.75	10	0.45		
19	D+.75L-.45WLX	Yes	Y	1	1	2	0.75	10	-0.45		
20	D+.75L+.45WLZ	Yes	Y	1	1	2	0.75	11	0.45		
21	D+.75L-.45WLZ	Yes	Y	1	1	2	0.75	11	0.45		
22	Concrete Connections										
23	1.2D+1.6L		Y	1	1.2	2	1.6				
24	1.2D+Ev+Emhx+L		Y	1	1.2	3	1	7	2.5	2	1
25	1.2D+Ev-Emhx+L		Y	1	1.2	3	1	7	-2.5	2	1
26	1.2D+Ev+Emhz+L		Y	1	1.2	3	1	8	2.5	2	1
27	1.2D+Ev-Emhz+L		Y	1	1.2	3	1	8	-2.5	2	1
28	0.9D-Ev+Emhx		Y	1	0.9	3	-1	7	2.5		
29	0.9D-Ev-Emhx		Y	1	0.9	3	-1	7	-2.5		
30	0.9D-Ev+Emhz		Y	1	0.9	3	-1	8	2.5		
31	0.9D-Ev-Emhz		Y	1	0.9	3	-1	8	-2.5		
32	Fasteners		Y	1	1						
33	D+0.7Ev+0.7Ehx		Y	1	1	3	0.7	7	0.7		
34	D+0.7Ev-0.7Ehx		Y	1	1	3	0.7	7	-0.7		
35	D+0.7Ev+0.7Ehz		Y	1	1	3	0.7	8	0.7		
36	D+0.7Ev-0.7Ehz		Y	1	1	3	0.7	8	-0.7		
37	D+0.525Ev+0.525Ehx+0.75L		Y	1	1	3	0.525	7	0.525	2	0.75
38	D+0.525Ev-0.525Ehx+0.75L		Y	1	1	3	0.525	7	-0.525	2	0.75
39	D+0.525Ev+0.525Ehz+0.75L		Y	1	1	3	0.525	8	0.525	2	0.75
40	D+0.525Ev-0.525Ehz+0.75L		Y	1	1	3	0.525	8	-0.525	2	0.75
41	0.6D-0.7Ev+0.7Ehx		Y	1	0.6	3	-0.7	7	0.7		
42	0.6D-0.7Ev-0.7Ehx		Y	1	0.6	3	-0.7	7	-0.7		
43	0.6D-0.7Ev+0.7Ehz		Y	1	0.6	3	-0.7	8	0.7		

Load Combinations (Continued)

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
44	0.6D-0.7Ev-0.7Ehz		Y	1	0.6	3	-0.7	8	-0.7		
45	DL		Y	1	1						
46	LL		Y	2	1						
47	Ev		Y	3	1						
48	Ehx		Y	4	1						
49	Ehz		Y	5	1						

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N2	max	2.064	16	2.14	21	0.398	17	0	21	0.433	16	0	21
2		min	-2.064	17	-1.304	17	-0.395	16	0	1	-0.433	17	0	1
3	N1	max	2.064	17	1.842	17	0.395	17	0	21	0.433	16	0	21
4		min	-2.064	16	-1.304	16	-0.398	16	0	1	-0.433	17	0	1
5	N8	max	0.024	15	3.061	1	0.024	17	0	21	0.009	16	0	21
6		min	-0.024	14	0.327	11	-0.024	16	0	1	-0.009	17	0	1
7	N7	max	0.024	15	3.061	1	0.024	17	0	21	0.009	16	0	21
8		min	-0.024	14	0.327	11	-0.024	16	0	1	-0.009	17	0	1
9	N10	max	0.024	15	0.083	15	0.024	17	0	21	0.014	16	0	21
10		min	-0.024	14	-0.265	1	-0.024	16	0	1	-0.014	17	0	1
11	N12	max	0.024	15	0.083	15	0.024	17	0	21	0.014	16	0	21
12		min	-0.024	14	-0.265	1	-0.024	16	0	1	-0.014	17	0	1
13	Totals:	max	0.709	15	7.966	1	0.889	17						
14		min	-0.709	14	1.202	11	-0.889	16						

Envelope Node Displacements

	Node Label		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation [rad]	LC	Y Rotation [rad]	LC	Z Rotation [rad]	LC
1	N1	max	0	16	0	16	0	16	3.852e-5	16	0	17	-5.627e-5	11
2		min	0	17	0	17	0	17	-3.85e-5	17	0	16	-6.465e-4	1
3	N2	max	0	17	0	17	0	16	3.85e-5	16	0	17	-5.627e-5	11
4		min	0	16	0	20	0	17	-3.852e-5	17	0	16	-6.465e-4	1
5	N3	max	0.006	21	-0.001	11	0.029	16	1.285e-4	17	5.607e-5	16	4.179e-4	1
6		min	-0.001	17	-0.008	1	-0.029	17	-1.285e-4	16	-5.605e-5	17	3.593e-5	11
7	N4	max	0.005	1	-0.001	11	0.029	16	1.285e-4	17	5.605e-5	16	4.179e-4	1
8		min	-0.001	16	-0.008	1	-0.029	17	-1.285e-4	16	-5.607e-5	17	3.593e-5	11
9	N5	max	0.005	1	0	11	0.029	16	1.01e-4	17	7.188e-5	17	3.176e-4	1
10		min	-0.001	16	-0.004	1	-0.029	17	-1.01e-4	16	-7.194e-5	16	2.666e-5	11
11	N6	max	0.006	21	0	11	0.029	16	1.01e-4	17	7.194e-5	17	3.176e-4	1
12		min	-0.001	17	-0.004	1	-0.029	17	-1.01e-4	16	-7.188e-5	16	2.666e-5	11
13	N7	max	0	14	0	11	0	16	4.091e-4	16	0	17	9.628e-5	15
14		min	0	15	0	1	0	17	-4.091e-4	17	0	16	-1.257e-4	18
15	N8	max	0	14	0	11	0	16	4.091e-4	16	0	17	9.628e-5	15
16		min	0	15	0	1	0	17	-4.091e-4	17	0	16	-1.257e-4	18
17	N9	max	0.006	21	0	1	0.037	16	5.513e-5	16	1.158e-4	17	2.793e-6	16
18		min	-0.001	17	0	15	-0.037	17	-5.508e-5	17	-1.159e-4	16	-2.796e-6	17
19	N10	max	0	14	0	1	0	16	4.884e-4	16	0	17	9.637e-5	15
20		min	0	15	0	15	0	17	-4.884e-4	17	0	16	-1.258e-4	18
21	N11	max	0.005	1	0	1	0.037	16	5.508e-5	16	1.159e-4	17	2.793e-6	17
22		min	-0.001	16	0	15	-0.037	17	-5.513e-5	17	-1.158e-4	16	-3.581e-6	20
23	N12	max	0	14	0	1	0	16	4.884e-4	16	0	17	9.637e-5	15
24		min	0	15	0	15	0	17	-4.884e-4	17	0	16	-1.258e-4	18
25	N13	max	0.006	21	0	13	0.031	16	5.509e-5	17	1.686e-4	17	1.507e-4	1
26		min	-0.001	17	-0.001	1	-0.031	17	-5.505e-5	16	-1.686e-4	16	1.23e-5	11
27	N14	max	0.005	1	0	12	0.031	16	5.505e-5	17	1.686e-4	17	1.507e-4	1
28		min	-0.001	16	-0.001	1	-0.031	17	-5.509e-5	16	-1.686e-4	16	1.23e-5	11

Envelope Maximum Member Section Forces

	Member		Axial[k]	Loc[ft]	LC	y Shear[k]	Loc[ft]	LC	z Shear[k]	Loc[ft]	LC	Torque[k-ft]	Loc[ft]	LC	y-y Moment[k-ft]	Loc[ft]	LC	z-z Moment[k-ft]	Loc[ft]	LC
1	M1	max	1.438	0	21	1.08	0	1	0.137	0	17	0	14.356	16	0.36	0	16	1.724	14.356	1
2		min	-1.398	14.356	17	-1.223	14.356	1	-0.137	0	16	0	0	17	-0.36	0	17	-2.934	6.729	1
3	M2	max	0.064	0.729	16	1.139	0.781	1	0.099	0	17	0.004	0.729	17	0.141	0	16	3.414	0.781	1
4		min	-0.065	0	17	-1.816	0.729	1	-0.099	0	16	-0.004	0	16	-0.141	0	17	0.029	5	11
5	M3	max	1.35	0	17	1.08	0	1	0.137	0	17	0	14.356	16	0.36	0	16	1.724	14.356	1
6		min	-1.614	14.356	20	-1.223	14.356	1	-0.137	0	16	0	0	17	-0.36	0	17	-2.934	6.729	1
7	M4	max	0.064	0.729	17	1.139	0.781	1	0.099	0	17	0.004	1.979	17	0.141	0	16	3.414	0.781	1
8		min	-0.065	0	16	-1.816	0.729	1	-0.099	0	16	-0.004	0	16	-0.141	0	17	0.029	5	11

Envelope Maximum Member Section Forces (Continued)

	Member		Axial[k]	Loc[ft]	LC	y Shear[k]	Loc[ft]	LC	z Shear[k]	Loc[ft]	LC	Torque[k-ft]	Loc[ft]	LC	y-y Moment[k-ft]	Loc[ft]	LC	z-z Moment[k-ft]	Loc[ft]	LC
9	M5	max	3.061	0	1	0.024	8	15	0.024	8	16	0.009	8	16	0.048	4	17	0.048	4	15
10		min	0.268	8	11	-0.024	8	14	-0.024	0	16	-0.009	0	17	-0.048	4	16	-0.048	4	14
11	M6	max	0.083	0	15	0.024	8	15	0.024	0	17	0.014	8	16	0.048	4	17	0.048	4	15
12		min	-0.364	8	1	-0.024	8	14	-0.024	0	16	-0.014	0	17	-0.048	4	16	-0.048	4	14
13	M7	max	0.083	0	15	0.024	8	15	0.024	8	16	0.014	8	16	0.048	4	17	0.048	4	15
14		min	-0.364	8	1	-0.024	8	14	-0.024	8	17	-0.014	0	17	-0.048	4	16	-0.048	4	14
15	M8	max	3.061	0	1	0.024	8	15	0.024	8	16	0.009	8	16	0.048	4	17	0.048	4	15
16		min	0.268	8	11	-0.024	8	14	-0.024	8	17	-0.009	0	17	-0.048	4	16	-0.048	4	14
17	M9	max	0	3	18	0.017	0	16	0	3	21	0	3	16	0	3	21	0	3	21
18		min	0	0	15	-0.017	3	17	0	0	1	0	0	17	0	0	1	-0.013	1.5	16
19	M10	max	0.001	3	15	0.017	0	21	0	3	21	0	3	16	0	3	21	0	3	21
20		min	-0.001	0	18	-0.017	3	1	0	0	1	0	0	17	0	0	1	-0.013	1.5	1

Envelope Member Section Deflections - Strength

	Member	Sec		x [in]	LC	y [in]	LC	z [in]	LC	x Rotate [rad]	LC	(n) L/y' Ratio	LC	(n) L/z' Ratio	LC
1	M1	1	max	0	21	0	21	0	21	0	16	NC	21	NC	21
2			min	0	1	0	1	0	1	0	17	NC	1	NC	1
3		2	max	0	17	-0.002	11	0.028	16	0	16	NC	17	NC	19
4			min	0	16	-0.026	1	-0.028	17	0	17	6575.942	1	6226.816	17
5		3	max	0.001	17	-0.003	11	0.056	16	0	17	NC	17	NC	19
6			min	-0.001	16	-0.038	1	-0.056	17	0	16	4562.814	1	3072.288	17
7		4	max	0.001	17	-0.002	11	0.049	16	0	17	NC	17	NC	19
8			min	-0.001	16	-0.029	1	-0.049	17	0	16	5963.059	1	3489.986	17
9		5	max	0.001	17	-0.001	12	0.029	16	0	17	NC	21	NC	19
10			min	-0.001	16	-0.009	1	-0.029	17	0	16	NC	1	5879.747	17
11	M2	1	max	0.005	1	-0.001	11	0.029	16	0	17	NC	19	NC	21
12			min	-0.001	16	-0.008	1	-0.029	17	0	16	7561.694	1	NC	1
13		2	max	0.005	1	0	11	0.03	16	0	17	NC	21	NC	21
14			min	-0.001	16	-0.002	1	-0.03	17	0	16	NC	1	NC	1
15		3	max	0.005	1	0	16	0.032	16	0	17	NC	21	NC	21
16			min	-0.001	16	0	17	-0.032	17	0	16	NC	1	NC	1
17		4	max	0.005	1	0.001	1	0.035	16	0	16	NC	21	NC	21
18			min	-0.001	16	0	15	-0.035	17	0	17	NC	1	NC	1
19		5	max	0.005	1	0	1	0.037	16	0	16	NC	21	NC	21
20			min	-0.001	16	0	15	-0.037	17	0	17	NC	1	NC	1
21	M3	1	max	0	21	0	21	0	21	0	16	NC	21	NC	21
22			min	0	1	0	1	0	1	0	17	NC	1	NC	1
23		2	max	0	16	-0.002	11	0.028	16	0	16	NC	17	NC	19
24			min	0	17	-0.026	1	-0.028	17	0	17	6575.942	1	6226.816	16
25		3	max	0.001	16	-0.003	11	0.056	16	0	17	NC	17	NC	19
26			min	-0.001	17	-0.038	1	-0.056	17	0	16	4562.814	1	3072.288	16
27		4	max	0.001	16	-0.002	11	0.049	16	0	17	NC	17	NC	19
28			min	-0.001	17	-0.029	1	-0.049	17	0	16	5963.059	1	3489.986	16
29		5	max	0.001	16	-0.001	13	0.029	16	0	17	NC	21	NC	19
30			min	-0.001	17	-0.009	1	-0.029	17	0	16	NC	1	5879.747	16
31	M4	1	max	0.006	21	-0.001	11	0.029	16	0	17	NC	19	NC	21
32			min	-0.001	17	-0.008	1	-0.029	17	0	16	7561.694	1	NC	1
33		2	max	0.006	21	0	11	0.03	16	0	17	NC	21	NC	21
34			min	-0.001	17	-0.002	1	-0.03	17	0	16	NC	1	NC	1
35		3	max	0.006	21	0	17	0.032	16	0	17	NC	21	NC	21
36			min	-0.001	17	0	20	-0.032	17	0	16	NC	1	NC	1
37		4	max	0.006	21	0.001	1	0.035	16	0	16	NC	21	NC	21
38			min	-0.001	17	0	15	-0.035	17	0	17	NC	1	NC	1
39		5	max	0.006	21	0	1	0.037	16	0	16	NC	21	NC	21
40			min	-0.001	17	0	15	-0.037	17	0	17	NC	1	NC	1
41	M5	1	max	0	21	0	21	0	21	0	21	NC	21	NC	21
42			min	0	1	0	1	0	1	0	1	NC	1	NC	1
43		2	max	0	11	0.002	15	0.01	16	0	17	NC	21	NC	21
44			min	-0.001	1	-0.003	18	-0.01	17	0	16	NC	1	NC	1
45		3	max	0	11	0.003	15	0.018	16	0	17	NC	21	NC	21
46			min	-0.002	1	-0.005	18	-0.018	17	0	16	NC	1	NC	1
47		4	max	0	11	0.002	15	0.024	16	0	17	NC	21	NC	21
48			min	-0.003	1	-0.005	18	-0.024	17	0	16	NC	1	NC	1
49		5	max	0	11	0.001	16	0.029	16	0	17	NC	21	NC	21
50			min	-0.004	1	-0.005	1	-0.029	17	0	16	NC	1	NC	1
51	M6	1	max	0	21	0	21	0	21	0	21	NC	21	NC	21
52			min	0	1	0	1	0	1	0	1	NC	1	NC	1
53		2	max	0	1	0.002	15	0.011	16	0	17	NC	21	NC	21

Envelope Member Section Deflections - Strength (Continued)

	Member	Sec		x [in]	LC	y [in]	LC	z [in]	LC	x Rotate [rad]	LC	(n) L/y' Ratio	LC	(n) L/z' Ratio	LC
54			min	0	15	-0.003	18	-0.011	17	0	16	NC	1	NC	1
55		3	max	0	1	0.003	15	0.022	16	0	17	NC	21	NC	21
56			min	0	15	-0.005	18	-0.022	17	0	16	NC	1	NC	1
57		4	max	0	1	0.002	15	0.03	16	0	17	NC	21	NC	21
58			min	0	15	-0.005	18	-0.03	17	0	16	NC	1	NC	1
59		5	max	0	1	0.001	16	0.037	16	0	17	NC	21	NC	21
60			min	0	15	-0.005	1	-0.037	17	0	16	NC	1	NC	1
61	M7	1	max	0	21	0	21	0	21	0	21	NC	21	NC	21
62			min	0	1	0	1	0	1	0	1	NC	1	NC	1
63		2	max	0	1	0.002	15	0.011	16	0	17	NC	21	NC	21
64			min	0	15	-0.003	18	-0.011	17	0	16	NC	1	NC	1
65		3	max	0	1	0.003	15	0.022	16	0	17	NC	21	NC	21
66			min	0	15	-0.005	18	-0.022	17	0	16	NC	1	NC	1
67		4	max	0	1	0.002	15	0.03	16	0	17	NC	21	NC	21
68			min	0	15	-0.005	18	-0.03	17	0	16	NC	1	NC	1
69		5	max	0	1	0.001	17	0.037	16	0	17	NC	21	NC	21
70			min	0	15	-0.006	20	-0.037	17	0	16	NC	1	NC	1
71	M8	1	max	0	21	0	21	0	21	0	21	NC	21	NC	21
72			min	0	1	0	1	0	1	0	1	NC	1	NC	1
73		2	max	0	11	0.002	15	0.01	16	0	17	NC	21	NC	21
74			min	-0.001	1	-0.003	18	-0.01	17	0	16	NC	1	NC	1
75		3	max	0	11	0.003	15	0.018	16	0	17	NC	21	NC	21
76			min	-0.002	1	-0.005	18	-0.018	17	0	16	NC	1	NC	1
77		4	max	0	11	0.002	15	0.024	16	0	17	NC	21	NC	21
78			min	-0.003	1	-0.005	18	-0.024	17	0	16	NC	1	NC	1
79		5	max	0	11	0.001	17	0.029	16	0	17	NC	21	NC	21
80			min	-0.004	1	-0.006	20	-0.029	17	0	16	NC	1	NC	1
81	M9	1	max	0.031	17	0	12	0.005	1	0	11	NC	21	NC	21
82			min	-0.031	16	-0.001	1	-0.001	16	0	1	NC	1	NC	1
83		2	max	0.031	17	0	12	0.005	1	0	11	NC	21	NC	21
84			min	-0.031	16	-0.001	1	0	16	0	1	NC	1	NC	1
85		3	max	0.031	17	0	11	0.005	1	0	11	NC	21	NC	21
86			min	-0.031	16	-0.001	1	0	11	0	1	NC	1	NC	1
87		4	max	0.031	17	0	13	0.005	1	0	11	NC	21	NC	21
88			min	-0.031	16	-0.001	1	0	17	0	1	NC	1	NC	1
89		5	max	0.031	17	0	13	0.006	21	0	11	NC	21	NC	21
90			min	-0.031	16	-0.001	1	-0.001	17	0	1	NC	1	NC	1
91	M10	1	max	0.037	17	0	1	0.005	1	0	21	NC	21	NC	21
92			min	-0.037	16	0	15	-0.001	16	0	17	NC	1	NC	1
93		2	max	0.037	17	0	1	0.005	1	0	21	NC	21	NC	21
94			min	-0.037	16	0	15	0	16	0	17	NC	1	NC	1
95		3	max	0.037	17	0	1	0.005	1	0	18	NC	21	NC	21
96			min	-0.037	16	0	15	0	11	0	15	NC	1	NC	1
97		4	max	0.037	17	0	1	0.005	1	0	18	NC	21	NC	21
98			min	-0.037	16	0	15	0	17	0	16	NC	1	NC	1
99		5	max	0.037	17	0	1	0.006	21	0	17	NC	21	NC	21
100			min	-0.037	16	0	15	-0.001	17	0	16	NC	1	NC	1

Envelope Beam Deflections

	Member Label	Span		Location [ft]	y' [in]	(n) L'/y' Ratio	LC
1	M1	1	max	5.682	0.001	NC	12
2		1	min	14.356	0.102	3371	1
3	M2	1	max	0.417	-0.001	NC	7
4		1	min	0	-0.003	5750	1
5		2	max	3.906	0.001	NC	6
6		2	min	0.781	0	NC	1
7	M3	1	max	5.682	0.001	NC	13
8		1	min	14.356	0.102	3371	1
9	M4	1	max	0.417	-0.001	NC	7
10		1	min	0	-0.003	5750	1
11		2	max	3.906	0.001	NC	6
12		2	min	0.781	0	NC	1
13	M9	1	max	3	0	NC	21
14		1	min	0	0	NC	1
15	M10	1	max	3	0	NC	21
16		1	min	0	0	NC	1

Envelope Beam Deflection Checks

	Beam	Design Rule	Span	Defl [in]	Ratio	LC	Defl [in]	Ratio	LC	Defl [in]	Ratio	LC
1	M1	Typical	1	0.102	3371	1(1+2)	0.0009388	NC	2(1+3+4)	0.0009679	NC	3(1+3+4)
2	M2	Typical	1	-0.003	5750	1(1+2)	-2.579e-5	NC	2(1+3+4)	-1.855e-5	NC	3(1+3+4)
3			2	-4.337e-19	NC	1(1+2)	-1.084e-19	NC	2(1+3+4)	0	NC	3(1+3+4)
4	M3	Typical	1	0.102	3371	1(1+2)	0.0009388	NC	2(1+3+4)	0.0009679	NC	3(1+3+4)
5	M4	Typical	1	-0.003	5750	1(1+2)	-2.579e-5	NC	2(1+3+4)	-1.855e-5	NC	3(1+3+4)
6			2	3.253e-19	NC	1(1+2)	0	NC	2(1+3+4)	-5.421e-20	NC	3(1+3+4)
7	M9	Typical	1	0	NC	1(1+2)	0	NC	2(1+3+4)	0	NC	3(1+3+4)
8	M10	Typical	1	0	NC	1(1+2)	0	NC	2(1+3+4)	0	NC	3(1+3+4)

Envelope AISC 15TH (360-16): ASD Member Steel Code Checks

	Member	Shape	Code Check	Loc[ft]	LC	Shear Check	Loc[ft]	Dir	LC	Pnc/om [k]	Pnt/om [k]	Mnyy/om [k-ft]	Mnzz/om [k-ft]	Cb	Eqn
1	M1	C12X20.7	0.092	14.356	21	0.028	14.356	y	1	84.639	131.066	4.949	26.624	1.213	H1-1b
2	M2	C12X20.7	0.074	0.781	1	0.041	0.729	y	1	97.24	131.066	4.949	45.988	1.609	H1-1b
3	M3	C12X20.7	0.095	14.356	21	0.028	14.356	y	1	84.639	131.066	4.949	26.488	1.207	H1-1b
4	M4	C12X20.7	0.074	0.781	1	0.041	0.729	y	1	97.24	131.066	4.949	45.988	1.609	H1-1b
5	M5	HSS4X4X4	0.043	0	1	0.002	8	z	16	71.015	92.826	10.765	10.765	1	H1-1b*
6	M6	HSS4X4X4	0.005	4.167	18	0.003	8	z	17	71.015	92.826	10.765	10.765	1.136	H1-1b
7	M7	HSS4X4X4	0.005	4.167	18	0.003	8	z	16	71.015	92.826	10.765	10.765	1.136	H1-1b
8	M8	HSS4X4X4	0.043	0	1	0.002	8	z	17	71.015	92.826	10.765	10.765	1	H1-1b*
9	M9	C8X11.5	0	3	18	0.001	3	y	16	60.952	72.647	2.231	17.299	1.136	H1-1b*
10	M10	C8X11.5	0	3	18	0.001	3	y	16	60.952	72.647	2.231	17.299	1.136	H1-1b*

Envelope Fastener Reactions

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N2	max	2.064	16	2.14	21	0.424	36	0	44	0.519	35	0	44
2		min	-2.064	17	-1.398	44	-0.422	43	0	14	-0.519	36	0	14
3	N1	max	2.064	17	2.131	40	0.422	44	0	44	0.519	35	0	44
4		min	-2.064	16	-1.398	43	-0.424	35	0	14	-0.519	36	0	14
5	N8	max	0.024	15	2.713	37	0.024	17	0	44	0.009	16	0	44
6		min	-0.024	14	0.173	42	-0.024	16	0	14	-0.009	17	0	14
7	N7	max	0.024	15	2.713	37	0.024	17	0	44	0.009	16	0	44
8		min	-0.024	14	0.173	42	-0.024	16	0	14	-0.009	17	0	14
9	N10	max	0.024	15	0.093	34	0.024	17	0	44	0.014	16	0	44
10		min	-0.024	14	-0.246	37	-0.024	16	0	14	-0.014	17	0	14
11	N12	max	0.024	15	0.093	34	0.024	17	0	44	0.014	16	0	44
12		min	-0.024	14	-0.246	37	-0.024	16	0	14	-0.014	17	0	14
13	Totals:	max	0.845	42	6.584	38	0.889	17						
14		min	-0.845	33	1.202	43	-0.889	16						

Reactions w/ Overstrength Factor

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N2	max	7.045	26	6.801	26	1.524	27	0	31	1.853	26	0	31
2		min	-7.046	27	-5.299	31	-1.505	26	0	23	-1.853	27	0	23
3	N1	max	7.045	27	6.801	27	1.505	27	0	31	1.853	26	0	31
4		min	-7.046	26	-5.299	30	-1.524	26	0	23	-1.853	27	0	23
5	N8	max	0.001	27	4.585	23	0.005	26	0	31	0.015	26	0	31
6		min	0	26	-0.276	29	-0.006	27	0	23	-0.015	27	0	23
7	N7	max	0.001	26	4.585	23	0.006	26	0	31	0.015	26	0	31
8		min	0	27	-0.276	29	-0.005	27	0	23	-0.015	27	0	23
9	N10	max	0	26	0.278	29	0.001	27	0	31	0.048	30	0	31
10		min	0	24	-0.511	24	-0.001	26	0	23	-0.048	31	0	23
11	N12	max	0	27	0.278	29	0.001	27	0	31	0.048	30	0	31
12		min	0	24	-0.511	24	-0.001	26	0	23	-0.048	31	0	23
13	Totals:	max	3.019	29	11.882	23	3.019	27						
14		min	-3.019	24	1.81	30	-3.019	26						

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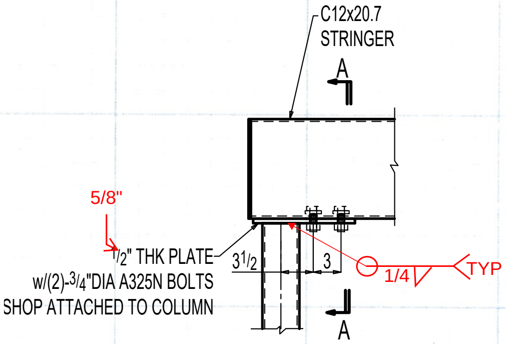
Larson

SUBJECT: Wonderlove Stair
Portland, OR

Connections

SHEET NO. ____ OF ____
PROJECT NO. 21230.ST25.00
BY: MJB   DATE: 7/17/23
CHECKED BY:



1 SECTION VIEW E7

NOTE SIMILAR REACTIONS ATE COLUMN BASE PLATE, SEE HILTI PROFIS FOR BASE PLATE ANALYSIS

Stringer to column cap pl connection

$R_x = R_z = 24 \text{ lb}$

$R_y = 2.7 \text{ k}$

Check Bolts: (2) 3/4" Ø A325-N

Table 7-1 → $\frac{r_n}{\Omega} = 11.9 \text{ k/bolt} \times 2$ $\Omega = 2.0$

$\frac{R_n}{\Omega} = 23.8 \text{ k} > R_x, R_y \therefore ok$

Check Plate Bending

$M = R_y \times 3" = 8.1 \text{ k-in}$

$Z = \frac{5/8^2 (5)}{4} = 0.488 \text{ in}^3$ $F_y = 36 \text{ ksi}$ $\Omega = 1.67$

$\frac{M_c}{\Omega} = \frac{F_y Z}{\Omega} = 10.5 \text{ k-in} > M \therefore ok$

$\boxed{\text{Provide min 5/8" thick cap pl}}$

Check cap PL to column weld:

2 7/8 × 2 7/8

1/4" Fillet E70xx

$A_w = 2(2.875) = 5.75 \text{ in}$

$S_w = 2.875^2 + \frac{2.875^2}{3} = 11.02 \text{ in}^2$

$f_w = \sqrt{\left(\frac{.024}{5.72}\right)^2 + \left(\frac{.024}{5.72}\right)^2 + \left(\frac{2.7}{5.72} + \frac{10.5}{11.02}\right)^2} = 1.42 \text{ k/in}$

$F_w = .3(.707)(70)(.75) = 3.71 \text{ k/in}$

$\boxed{F_w > f_w \therefore ok}$

NOTE: WELD SIM AT COLUMN TO BASE PLATE CONNECTION

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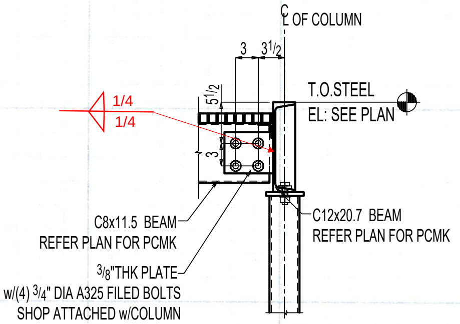
Larson

SUBJECT: Wonderlake stairs
Portland, OR
Connections

SHEET NO. ____ OF ____
PROJECT NO. 21230 ST2600
BY MJB DATE 7/17/23
CHECKED BY:



2 / E7 TYPICAL CHANNEL TO STRINGER CONNECTION

Landing Channel to stringer Connection

$R_y = 392$ lb

$e = 5"$

Check plate Bending

$M = R_y \times e = 1.96$ k-in

$Z = \frac{.375(6^2)}{4} = 3.375$ in^3 $F_y = 36$ ksi $\Omega = 1.67$

$\frac{M_n}{\Omega} = \frac{F_y Z}{\Omega} = \frac{36(3.375)}{1.67} = 72.75$ k-in

$\boxed{\frac{M_n}{\Omega} > M \therefore ok}$

Check Bolts:
(4) 3/4" Ø A325 N

Table 7-1 $\frac{r_n}{\Omega} = 11.9$ k/bolt $C = 1.42$ Table 7-7

$\boxed{\frac{R_n}{\Omega} = C \times \frac{r_n}{\Omega} = 1.42(11.9) = 16.8 \text{ k} > R_y \therefore ok}$

Check plate weld
1/4" Fillet E70xx

|| 6" $A_w = 12"$

$f_w = \frac{R_y}{A_w} = \frac{.392}{12} = 0.033$ k/in

$F_w = 3.71$ k/in

$\boxed{F_w > f_w \therefore ok}$

Hilti PROFIS Engineering 3.0.86

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Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Jul 17, 2023	Date:	7/18/2023
Fastening point:			

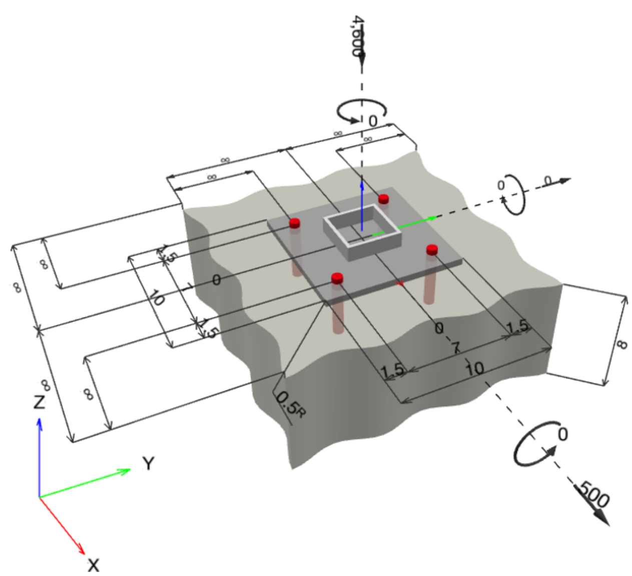
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ2 - CS 3/4 (3 3/4) hnom2**
Item number:	2210312 KB-TZ2 3/4x6 1/4
Effective embedment depth:	$h_{ef,act}$ = 3.750 in., h_{nom} = 4.500 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-4266
Issued I Valid:	12/17/2021 | 12/1/2023
Proof:	Design Method ACI 318-19 / Mech
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 = 10.000 in. x 10.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 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
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

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

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



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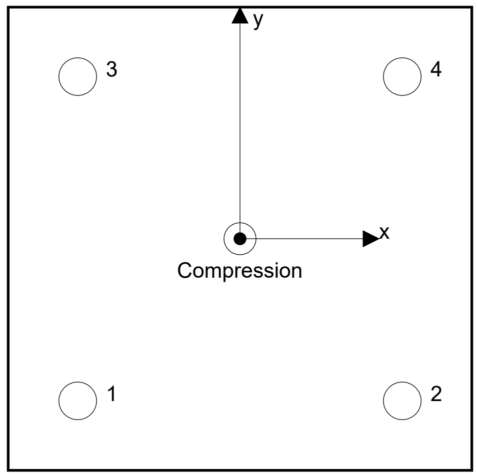
1.1 Design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = -4{,}600$; $V_x = 500$; $V_y = 0$; $M_x = 0$; $M_y = 0$; $M_z = 0$;	yes	2

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	0	125	125	0
2	0	125	125	0
3	0	125	125	0
4	0	125	125	0

max. concrete compressive strain:	0.01 [‰]
max. concrete compressive stress:	46 [psi]
resulting tension force in (x/y)=(0.000/0.000):	0 [lb]
resulting compression force in (x/y)=(-0.000/0.000):	4,600 [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*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A

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

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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*	125	8,977	2	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	500	30,773	2	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-4266
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.24	105,904	1.000

Calculations

$V_{sa,eq}$ [lb]
13,811

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ V_{sa,eq}$ [lb]	V_{ua} [lb]
13,811	0.650	1.000	8,977	125

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4.2 Pryout Strength

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b \right]$ ACI 318-19 Eq. (17.7.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ 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)

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

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0$ 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

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	3.750	0.000	0.000	∞

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	10.000	21	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]
333.06	126.56	1.000	1.000	1.000	1.000	8,353

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
43,962	0.700	1.000	1.000	30,773	500

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5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 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 CBFEM 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!
- 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://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- 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!

6 Installation data

Profile: Square HSS (AISC), HSS4X4X.25; (L x W x T) = 4.000 in. x 4.000 in. x 0.250 in.

Hole diameter in the fixture: d_f = 0.812 in.

Plate thickness (input): 0.500 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ2 - CS 3/4 (3 3/4) hnom2

Item number: 2210312 KB-TZ2 3/4x6 1/4

Maximum installation torque: 1,324 in.lb

Hole diameter in the base material: 0.750 in.

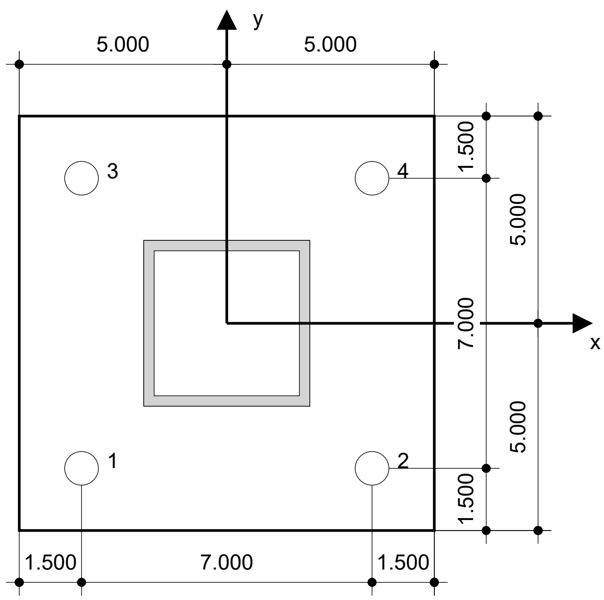
Hole depth in the base material: 4.750 in.

Minimum thickness of the base material: 6.000 in.

Hilti KB-TZ2 stud anchor with 4.5 in embedment, 3/4 (3 3/4) hnom2, Carbon steel, installation per ESR-4266

6.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench • Hammer



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-3.500	-3.500	-	-	-	-
2	3.500	-3.500	-	-	-	-
3	-3.500	3.500	-	-	-	-
4	3.500	3.500	-	-	-	-

7 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

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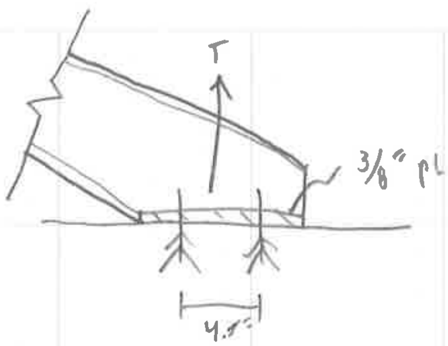
Larson

SUBJECT Wonderland Stairs
Portland, OR

Connections

SHEET NO. OF
PROJECT NO. 21230 ST33
BY MJB DATE 7/18/23
CHECKED BY:



Check Base stair plate

See Risa for Reactions → T = 1.4ᵏ

$M = T \times 4.5" = 6.3$ k-in

$Z = \frac{11"(.375^2)}{4} = 0.386 \text{ in}^3$ $F_y = 36$ ksi $\Omega = 1.67$

$\boxed{\frac{M_p}{\Omega} = \frac{F_y Z}{\Omega} = 8.33 \text{ k-in} > M \therefore OK}$

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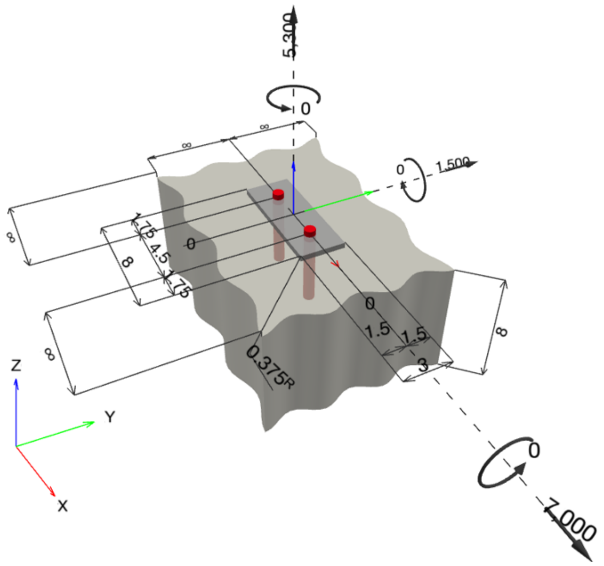
Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ2 - CS 3/4 (4 3/4) hnom3**
Item number:	2210313 KB-TZ2 3/4x7
Effective embedment depth:	$h_{ef,act}$ = 4.750 in., h_{nom} = 5.500 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-4266
Issued I Valid:	12/17/2021 | 12/1/2023
Proof:	Design Method ACI 318-19 / Mech
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate[R] :	l_x x l_y x t = 8.000 in. x 3.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
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
Seismic loads (cat. C, D, E, or F)	Tension load: yes (17.10.5.3 (d))
	Shear load: yes (17.10.6.3 (c))

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

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



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1.1 Design results

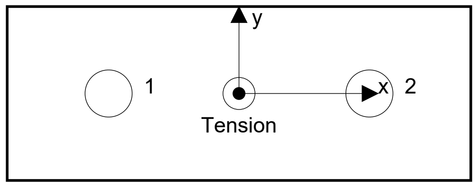
Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 5{,}300$; $V_x = 7{,}000$; $V_y = 1{,}500$; $M_x = 0$; $M_y = 0$; $M_z = 0$;	yes	76

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	2,650	3,579	3,500	750
2	2,650	3,579	3,500	750



max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.000/0.000): 5,300 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [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*	2,650	19,009	14	OK
Pullout Strength*	2,650	4,473	60	OK
Concrete Breakout Failure**	5,300	7,638	70	OK

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

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3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4266

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

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.24	105,904

Calculations

N_{sa} [lb]
25,345

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
25,345	0.750	1.000	19,009	2,650

3.2 Pullout Strength

$N_{pn,f_c'} = N_{p,2500}\ \lambda_a\ (f_c'/2500)^{0.3}$ refer to ICC-ES ESR-4266

$\phi\ N_{pn,f_c'} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

f_c' [psi]	λ_a	$N_{p,2500}$ [lb]
3,000	1.000	8,703

Calculations

$(f_c'/2500)^{0.3}$
1.054

Results

$N_{pn,f_c'}$ [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{pn,f_c'}$ [lb]	N_{ua} [lb]
9,176	0.650	0.750	1.000	4,473	2,650

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3.3 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)

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

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ 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.]	$\psi_{c,N}$
4.750	0.000	0.000	∞	1.000

c_{ac} [in.]	k_c	λ_a	f_c' [psi]
9.000	21	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]
267.19	203.06	1.000	1.000	1.000	1.000	11,907

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
15,668	0.650	0.750	1.000	7,638	5,300

4 Shear load

	Load V_{ua} [lb]	Capacity $\phi\ V_n$ [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	3,579	8,977	40	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	7,159	21,935	33	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

4.1 Steel Strength

$V_{sa,eq}$ = ESR value	refer to ICC-ES ESR-4266
$\phi\ V_{steel} \geq V_{ua}$	ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.24	105,904	1.000

Calculations

$V_{sa,eq}$ [lb]
13,811

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ V_{sa,eq}$ [lb]	V_{ua} [lb]
13,811	0.650	1.000	8,977	3,579

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4.2 Pryout Strength

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \ \psi_{ed,N} \ \psi_{c,N} \ \psi_{cp,N} \ N_b \right]$ ACI 318-19 Eq. (17.7.3.1b)

$\phi \ V_{cpg} \geq V_{ua}$ 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)

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

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0$ 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

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	4.750	0.000	0.000	∞

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f_c' [psi]
1.000	9.000	21	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]
267.19	203.06	1.000	1.000	1.000	1.000	11,907

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \ V_{cpg}$ [lb]	V_{ua} [lb]
31,335	0.700	1.000	1.000	21,935	7,159

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.694	0.399	5/3	76	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 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 CBFEM 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!
- 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://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- "An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17, Section 17.10.5.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.10.5.3 (b), Section 17.10.5.3 (c), or Section 17.10.5.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c)."
- Section 17.10.5.3 (b) / Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.5.3 (c) / Section 17.10.6.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.5.3 (d) / Section 17.10.6.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- 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!

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Company:		Page:	8
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Jul 17, 2023 (1)	Date:	7/18/2023
Fastening point:			

7 Installation data

Anchor type and diameter: Kwik Bolt TZ2 - CS 3/4 (4 3/4) hnom3

Item number: 2210313 KB-TZ2 3/4x7

Maximum installation torque: 1,324 in.lb

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 5.750 in.

Minimum thickness of the base material: 8.000 in.

Profile: no profile

Hole diameter in the fixture: d_f = 0.812 in.

Plate thickness (input): 0.375 in.

Recommended plate thickness: not calculated

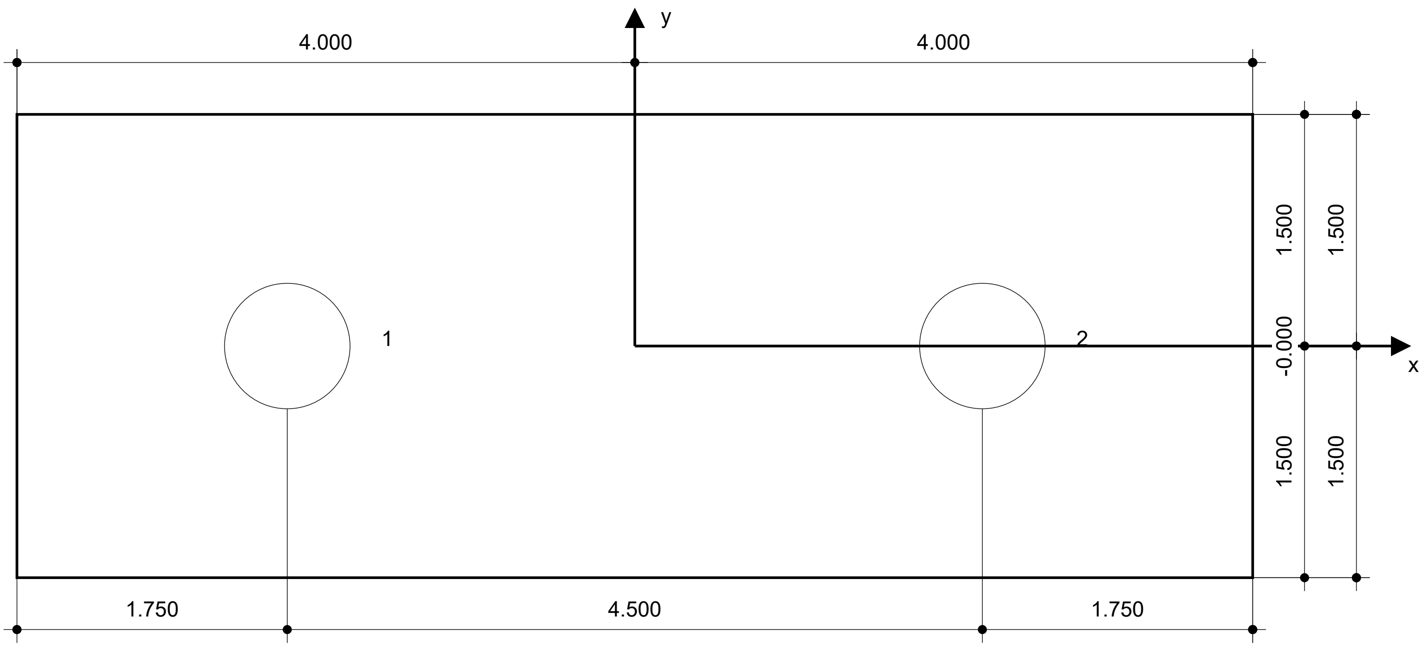
Drilling method: Hammer drilled

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Hilti KB-TZ2 stud anchor with 5.5 in embedment, 3/4 (4 3/4) hnom3, Carbon steel, installation per ESR-4266

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Manual blow-out pump	• Torque wrench • Hammer



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.250	0.000	-	-	-	-
2	2.250	-0.000	-	-	-	-

Company:		Page:	9
Address:		Specifier:	
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Design:	Concrete - Jul 17, 2023 (1)	Date:	7/18/2023
Fastening point:			

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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WONDERLOVE STAIRS
PORTLAND, OR

Handrail Calculations

NOTE: GUARDRAILS ARE NOT IN LEI'S SCOPE,
THESE ARE DETAILED PER THE EOR.

CLIENT:
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ALPHARETTA, GA

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Cable Handrail Analysis

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Handrail Analysis:

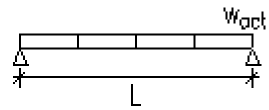
Post Spacing: $L := 43 \cdot in$

Distributed Loading: $w_{act} := 50 \cdot plf$

Point Load: $P_{act} := 200 \cdot lbf$

Load Case 1: Distributed Loading:

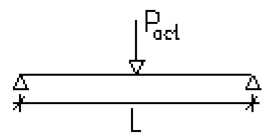
$P_1 := w_{act} \cdot L = 179.167 \cdot lbf$



Load Case 2: Point Load:

$P_2 := P_{act} = 200 \cdot lbf$

$P_{max} := \max(P_1, P_2) = 200 \cdot lbf$



Handrail Tube/Pipe Analysis:

Load Case 1: Distributed Loading:

$$M_1 := \frac{\left(w_{act} \cdot L^2\right)}{8} = 80.252 \cdot lbf \cdot ft$$

Load Case 2: Point Load:

$$M_2 := P_{max} \cdot \frac{L}{4} = 179.167 \cdot lbf \cdot ft$$

$$M_{max} := \max(M_1, M_2) = 179.167 \cdot lbf \cdot ft$$

Yield Strength: $F_{y2} := 46 \cdot ksi$

Plastic Section Modulus: $Z := 0.964 in^3$

Pipe Allowable Moment
(Check Local Buckling Separately)

$\Omega := 1.67$

$$M_{all} := \frac{\left(F_{y2} \cdot Z\right)}{\Omega} = 2.213 \times 10^3 \cdot lbf \cdot ft$$

$$\boxed{\frac{M_{max}}{M_{all}} = 0.081}$$

< 1.0 OK

Provide HSS2x2x1/4 (ASTM A500 Gr B)

Cable Loading:

Deflection ALLOWABLE Max:

$\Delta_{max} := 1 \cdot in$ Load = $W := 16.7 lbf$

Cable Length: $L := 43in$

$Pretension := 200lbf$

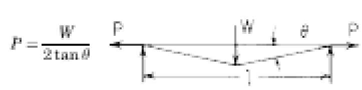
Cable Diameter: $d := 0.25in$

Cable Type: 1/4" wire rope

Cable Spacing: $Spacing := 4.25in$

$$\theta := \operatorname{atan}\left(\frac{\Delta_{max}}{\frac{L}{2}}\right) = 2.663 \cdot deg$$

$$P := \frac{W}{2 \cdot \tan(\theta)} = 179.525 \cdot lbf$$



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End Post Analysis:

$F_{y1} := 46 \cdot ksi$

$M_x := 0.98 kip \cdot ft$ $\quad M_y := 0.42 \cdot kip \cdot ft$ -See below for ouput on derivation of moment and shear

Plastic Section Modulus: $Z := 0.964 in^3$

$$M_{all} := \frac{(F_{y1} \cdot Z)}{\Omega} = 2213 \cdot lbf \cdot ft$$

$$\boxed{\left(\frac{M_x}{M_{all}}\right) + \left(\frac{M_y}{M_{all}}\right) = 0.633}$$ **< 1.0 OK**

Provide HSS2x2x1/4 (ASTM A500 Grade B Fy=46ksi)

Connection of Post the Steel Support:

$M_x = 0.98 \cdot kip \cdot ft$ $\quad M_y = 0.42 \cdot kip \cdot ft$ $\quad V_{act} := 1.5 kip$

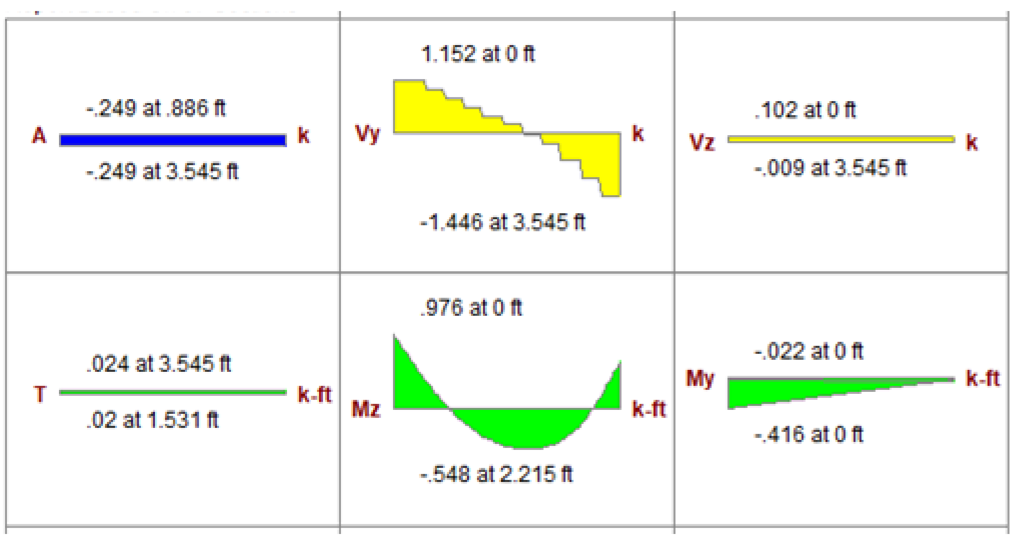
$b := 2 \cdot in$ $\quad d := 2 \cdot in$

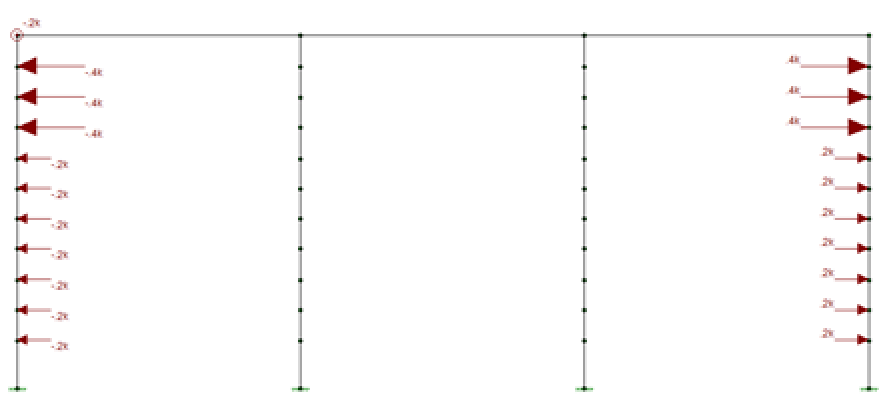
$$S_x := b \cdot d + \frac{d^2}{3} = 5.333 \cdot in^2 \qquad A := b \cdot d = 4 \cdot in^2$$

$$f_w := \sqrt{\left(\frac{V_{act}}{A}\right)^2 + \left(\frac{M_x}{S_x} + \frac{M_y}{S_x}\right)^2} = 3.172 \cdot \frac{kip}{in}$$

$$F_w := 0.707 \cdot 70 ksi \cdot 0.25 in \cdot 0.3 = 3.712 \cdot \frac{kip}{in}$$

Provide 1/4 all around filllet weld





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Intermediate Post Analysis:

Tube Post Height: $H_p := 36 \cdot in$ $F_{y1} := 36 \cdot ksi$

$M_{act} := P_{max} \cdot H_p = 600 \cdot lbf \cdot ft$

Plastic Section Modulus: $Z := 0.964 in^3$

$M_{all} := \frac{(F_{y1} \cdot Z)}{\Omega} = 1732 \cdot lbf \cdot ft$

$\boxed{\frac{M_{act}}{M_{all}} = 0.346}$ **< 1.0 OK**

Provide HSS2x2x1/4 (ASTM A500 Grade B Fy=46ksi)

Connection of Post the Steel Support:

$M_{act} = 0.6 \cdot kip \cdot ft$ $V_{act} := P_{max} = 200 \cdot lbf$

$b := 2 \cdot in$ $d := 2 \cdot in$

$S_x := b \cdot d + \frac{d^2}{3} = 5.333 \cdot in^2$ $A := b \cdot d = 4 \cdot in^2$

$f_w := \sqrt{\left(\frac{V_{act}}{A}\right)^2 + \left(\frac{M_{act}}{S_x}\right)^2} = 1.351 \cdot \frac{kip}{in}$

$F_w := 0.707 \cdot 70ksi \cdot 0.3 \cdot 0.25in = 3.712 \cdot \frac{kip}{in}$

Provide 1/4 all around filllet weld

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Wall Mounted Handrail Analysis:

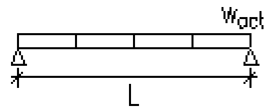
Connection of Bracket to Wall

Support Bracket Spacing: $L := 28 \cdot in$

Distributed Loading: $w_{act} := 50 \cdot plf$

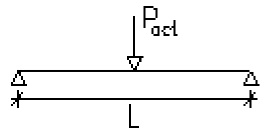
Point Load: $P_{act} := 200 \cdot lbf$

Load Case 1: Distributed Loading:



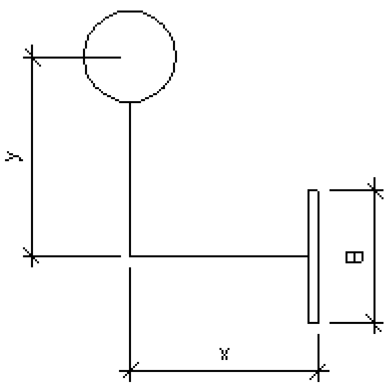
$P_1 := w_{act} \cdot L = 116.667 \cdot lbf$

Load Case 2: Point Load:



$P_2 := P_{act} = 200 \cdot lbf$

$P_{max} := \max(P_1, P_2) = 200 \cdot lbf$



Center of handrail to face of wall: $x := 2.5 \cdot in$

Center of handrail to center of connection: $y := 2.44 \cdot in$

Diameter of Bracket Plate: $B := 2.75 \cdot in$

Number of Fasteners in a row: $n := 1$

Bearing Arm Reduction: $z := 0.85$
[Steel-0.95]
[Masonry Concrete-0.85]
[Wood-0.75]

Handrail Pipe Analysis:

Load Case 1: Distributed Loading:

$$M_1 := \frac{(w_{act} \cdot L^2)}{8} = 34.028 \cdot lbf \cdot ft$$

Load Case 2: Point Load:

$$M_2 := P_{max} \cdot \frac{L}{4} = 116.667 \cdot lbf \cdot ft$$

$M_{max} := \max(M_1, M_2) = 116.667 \cdot lbf \cdot ft$

Yield Strength: $F_{y1} := 35 \cdot ksi$ Plastic Section Modulus: $Z := 0.305 in^3$

Tube Allowable Moment:
(Check Local Buckling Separately)

$\Omega := 1.67$

$$M_{all} := \frac{(F_{y1} \cdot Z)}{\Omega} = 533 \cdot lbf \cdot ft$$

$M_{max} < M_{all}$ OK

Provide 1-1/4" STD Pipe, A53

Bracket Arm:

NOTE: Bracket Arm per Wagner Co model 3418, it is assumed this bracket is structurally sound per manufacturer design and specifications. See Attached.

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Connection of Bracket to CMU Block Wall:

Load Parallel with Wall:

$$T_1 := \frac{(P_{max} \cdot x)}{\left(n \cdot z \cdot \frac{B}{2}\right)} = 427.807 \cdot lbf$$

$$V_1 := \frac{P_{max}}{n} = 200 \cdot lbf$$

Load Perpendicular with Wall:

$$T_2 := \frac{\left[P_{max} \cdot \left(y + z \cdot \frac{B}{2}\right)\right]}{\left(n \cdot z \cdot \frac{B}{2}\right)} = 617.54 \cdot lbf$$

Allowable Loads:

$T_p := 968lbf$

$V_p := 952lbf$

Load Factors:

$LFR_1 := 1$

$LFR_2 := 1$

$LFR_3 := 1$

$LFR_4 := 1$

$LFR_5 := 1$

$V_{a1} := LFR_1 \cdot LFR_2 \cdot V_p = 952 \cdot lbf$

$V_{a2} := LFR_1 \cdot LFR_5 \cdot V_p = 952 \cdot lbf$

$T_{a1} := LFR_3 \cdot LFR_4 \cdot T_p = 968 \cdot lbf$

$$\left(\frac{T_1}{T_{a1}}\right)^{\frac{5}{3}} + \left(\frac{V_1}{V_{a1}}\right)^{\frac{5}{3}} = 0.331$$

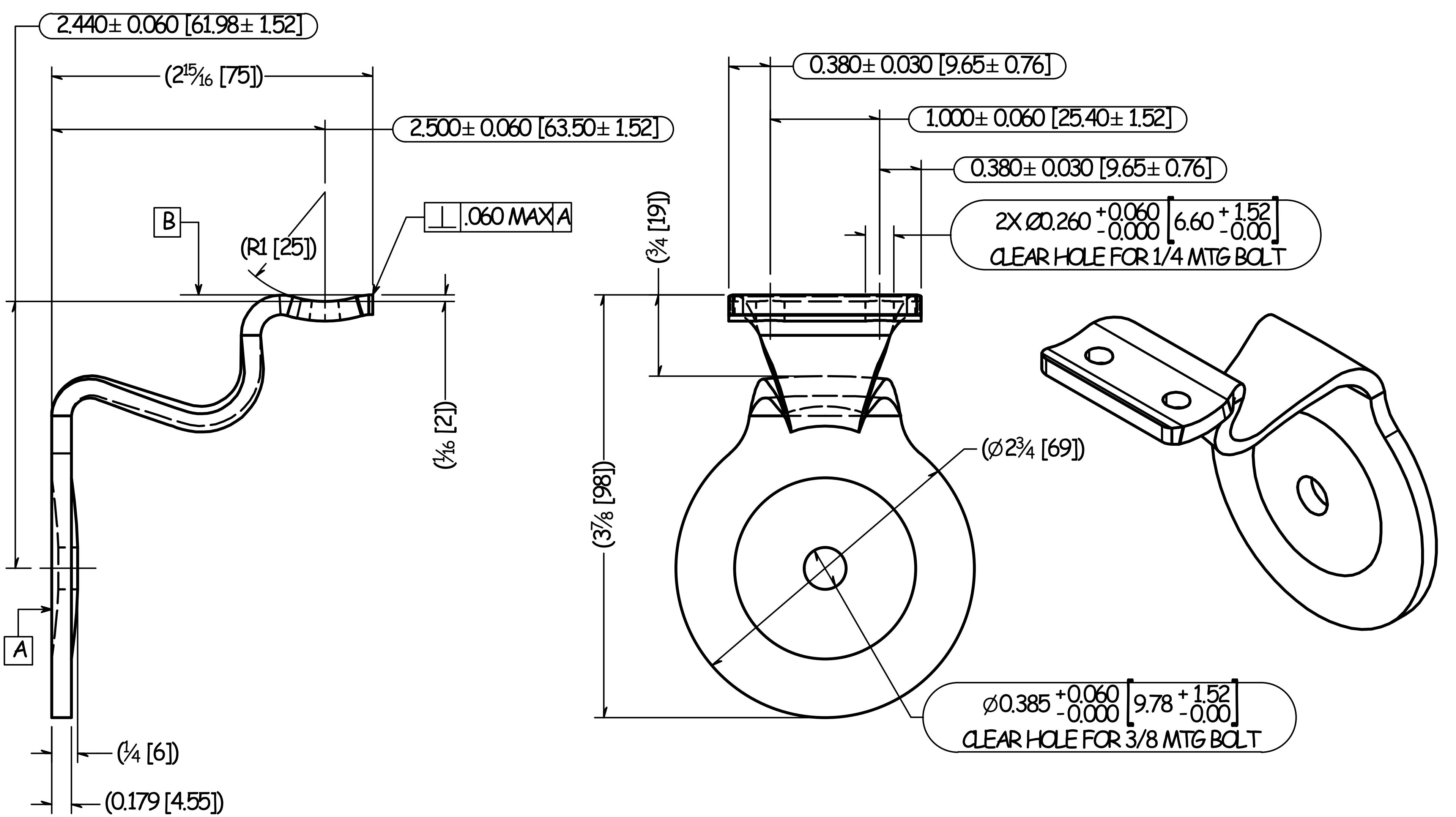
<1.0 ok -Parallel Loading

$$\left(\frac{T_2}{T_{a1}}\right)^{\frac{5}{3}} + \left(\frac{V_1}{V_{a2}}\right)^{\frac{5}{3}} = 0.547$$

<1.0 ok -Perpendicular Loading

Provide (1) 3/8" diameter Hilti Kwik HUS-EZ anchor w/ 3 1/4" embed into grouted masonry

HR6



NOTES:
1. DIMENSIONS SHOWN AS INCHES [MILLIMETERS].
2. DIMENSIONS WITH (XXX) DENOTE AS REFERENCE.
3. ENCIRCLED DIMENSIONS DENOTE AS CRITICAL DIMENSIONS.
4. BURRS 0.015 MAX. [0.381]

TOLERANCE			
FRACTION: X/XX..................= ± 1/16" over 4ft. DECIMAL: X.XX..................= ± .030 X.XXX................= ± .010 UNLESS OTHERWISE NOTED	CUT LENGTH:	FINISH: MILL	DESCRIPTION: BRACKET ST STYLE B 2.50 1HOLE
	DEVELOPED LENGTH:	WEIGHT: 0.52 lbmass	MATERIAL: C7100 / MATERIAL DESC: 7 Ga. Steel Coil 8 X .1793
	TOOL NUMBER: TL8011	SIZE: A	DATE: 10/8/2009 / DRAWN BY: / THE WAGNER COMPANIES R & B WAGNER, INC. AND J. G. BRAUN CO.
			ITEM NUMBER: 3418 / SHEET: 1 OF 1 / DRAWING NUMBER: 3418 / REV: 1

TABLE 2—HILTI KH-EZ SS316 AND KH-EZ C SS316 INSTALLATION INFORMATION AND ANCHOR SPECIFICATION[1,2,3,4] HR7

INSTALLATION DETAIL	UNITS	NOMINAL ANCHOR DIAMETERS (INCHES)					
		$\frac{1}{4}$		$\frac{3}{8}$		$\frac{1}{2}$	
Head Style	-	Hex and C		Hex and C		Hex	
Drill Bit Diameter	in. (mm)	$\frac{1}{4}$ (6.4)		$\frac{3}{8}$ (9.5)		$\frac{1}{2}$ (12.7)	
Minimum Baseplate Clearance Hole Diameter	in. (mm)	$\frac{3}{8}$ (9.5)		$\frac{1}{2}$ (12.7)		$\frac{5}{8}$ (15.9)	
Maximum Impact Wrench Torque Rating[5]	ft-lbf (Nm)	66 (89.5)		100 (135.6)		157 (212.9)	
Minimum Nominal Embedment Depth	in. (mm)	$1\frac{5}{8}$ (41)	$2\frac{1}{2}$ (64)	2 (52)	$3\frac{1}{4}$ (83)	$2\frac{1}{4}$ (57)	$4\frac{1}{4}$ (108)
Minimum Hole Depth	in. (mm)	2 (52)	$2\frac{7}{8}$ (73)	$2\frac{1}{4}$ (57)	$3\frac{1}{2}$ (89)	$2\frac{5}{8}$ (67)	$4\frac{5}{8}$ (118)
Critical Edge Distance	in. (mm)	4 (102)		6 (152)		8 (203)	
Minimum Edge Distance	in. (mm)	4 (102)					
Critical Spacing Distance	in. (mm)	4 (102)		6 (152)		8 (203)	
Minimum Spacing Distance	in. (mm)	4 (102)					
Wrench Socket Size	in. (mm)	$\frac{7}{16}$ (11.1)		$\frac{9}{16}$ (14.3)		$\frac{3}{4}$ (19.0)	

[1]Values in this table are to be used in conjunction with load values contained in Tables 4, 6, and 7, and the appropriate figures in this report, except for the minimum spacing, edge, and end distances for anchors installed in the top of grout filled concrete masonry, which are listed in Table 7.
[2]Critical spacings and edge distances are the anchor spacing and edge distances for which no reduction in load capacity is required.
[3]Minimum spacings and minimum edge distances in this report are the smallest values for which anchor installation is allowed.
[4]Anchors may be installed anywhere in the fully grouted masonry wall except within $1\frac{1}{4}$ inch of a vertical joint (see Figure 7).
[5]Because of the variability in measurement procedures, the published torque of an impact tool may not correlate properly with the above setting torques. Over-torqueing can damage the anchor and/or reduce its holding capacity.

TABLE 3—ALLOWABLE TENSION LOADS FOR KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C AND KH-EZ CRC IN THE FACE OF GROUT-FILLED MASONRY WALLS (POUNDS)[1,3,6]

NOMINAL ANCHOR DIAMETER (INCHES)	MINIMUM EMBEDMENT (INCHES)[2]	ALLOWABLE TENSION LOADS AT S_{CR} AND C_{CR}[5]	EDGE DISTANCE			SPACING		
			CRITICAL C_{CR} (INCHES)	MINIMUM C_{MIN} (INCHES)	LOAD REDUCTION FACTOR[4]	CRITICAL S_{CR} (INCHES)	MINIMUM S_{MIN} (INCHES)	LOAD REDUCTION FACTOR[4]
$\frac{1}{4}$	$1\frac{5}{8}$	424[7]	4	4	1.00	4	4	1.00
	$2\frac{1}{2}$	728[8]						
$\frac{3}{8}$	$1\frac{5}{8}$	428[8]	6	4	1.00	6	4	0.80
	$3\frac{1}{4}$	968						
$\frac{1}{2}$	$2\frac{1}{4}$	556	8	4	1.00	8	4	0.60
	$4\frac{1}{4}$	1,212						
$\frac{5}{8}$	$3\frac{1}{4}$	924	10	4	1.00	10	4	0.57
	5	1,388						
$\frac{3}{4}$	4	1,156	12	4	1.00	12	4	0.53
	$6\frac{1}{4}$	1,628						

[1]Anchors shall be installed in base materials in compliance with Section 3.6 of this report.
[2]Embedment depth is measured from the outside surface of the concrete masonry unit.
[3]Refer to Section 5.4 of this report for modifying allowable loads in this table for anchors resisting short-term loads.
[4]Allowable loads are based on installation at critical spacing and edge distance. Load reduction factors are applicable at the minimum spacing and edge distance. Linear interpolation of reduction factors is allowed for spacings and edge distances between critical and minimum.
[5]Tabulated allowable loads for the IBC/IRC are based on a safety factor of 5.0.
[6]Special inspection must be provided in accordance with Section 4.3 of this report.
[7]Load values for installations within $1\frac{1}{4}$ inch of bed joint for $\frac{1}{4}$" diameter at $1\frac{5}{8}$ inch embedment shall be reduced by 21%.
[8]Load values for installations within $1\frac{1}{4}$ inch of bed joint for $\frac{1}{4}$ inch diameter at $2\frac{1}{2}$ inch embedment and $\frac{3}{8}$ inch diameter at $1\frac{5}{8}$ inch embedment shall be reduced by 13%.

HR8

TABLE 4—ALLOWABLE TENSION LOADS FOR KH-EZ SS316 AND KH-EZ C SS316 IN THE FACE OF GROUT-FILLED MANSORY WALLS (POUNDS) [1,3,6]

NOMINAL ANCHOR DIAMETER (INCHES)	MINIMUM EMBEDMENT (INCHES)[2]	ALLOWABLE TENSION LOADS AT S_{CR} AND C_{CR} [5]	Spacing			Edge Distance		
			CRITICAL S_{CR} (INCHES)	MINIMUM S_{MIN} (INCHES)	LOAD REDUCTION FACTOR[4]	CRITICAL C_{CR} (INCHES)	MINIMUM C_{MIN} (INCHES)	LOAD REDUCTION FACTOR[4]
1/4	1 5/8	125	4	4	1.00	4	4	1.00
	2 1/2	194			1.00			1.00
3/8	2	332	6	4	0.74	6	4	0.71
	3 1/4	629			0.62			0.86
1/2	2 1/4	331	8	4	0.56	8	4	0.91
	4 1/4	874			0.56			0.75

[1]Anchors shall be installed in base materials in compliance with Section 3.6 of this report.
[2]Embedment depth is measured from the outside surface of the concrete masonry unit.
[3]Refer to Section 5.4 of this report for modifying allowable loads in this table for anchors resisting short-term loads.
[4]Allowable loads are based on installation at critical spacing and edge distance. Load reduction factors are applicable at the minimum spacing and edge distance. Linear interpolation of reduction factors is allowed for spacings and edge distances between critical and minimum.
[5]Tabulated allowable loads for the IBC/IRC are based on a safety factor of 5.0.
[6]Special inspection must be provided in accordance with Section 4.3 of this report.

TABLE 5—ALLOWABLE SHEAR LOADS FOR KH-EZ, KH-EZ P, KH-EZ PM, KH-EZ PL, KH-EZ C AND KH-EZ CRC INSTALLED IN THE FACE OF GROUT-FILLED MASONRY WALLS (POUNDS)[1,3,6]

NOMINAL ANCHOR DIAMETER (INCHES)	MINIMUM EMBEDMENT (INCHES)[2]	ALLOWABLE SHEAR LOADS AT S_{CR} AND C_{CR} [5]	SPACING			EDGE DISTANCE			
			CRITICAL S_{CR} (INCHES)	MINIMUM S_{MIN} (INCHES)	LOAD REDUCTION FACTOR[4]	CRITICAL C_{CR} (INCHES)	MINIMUM C_{MIN} (INCHES)	LOAD DIRECTION PERPENDICULAR TO EDGE	LOAD DIRECTION PARALLEL TO EDGE
1/4	1 5/8	532	4	4	1.00	4	4	1.00	1.00
	2 1/2	650						1.00	
3/8	1 5/8	912	6	4	0.94	6	4	0.61	1.00
	3 1/4	952						0.70	
1/2	2 1/4	1476	8	4	0.88	8	4	0.50	1.00
	4 1/4	1959						0.40	
5/8	3 1/4	2432	10	4	0.62	10	4	0.36	1.00
	5	2731						0.34	
3/4	4	2432	12	4	0.36	12	4	0.36	1.00
	6 1/4	2731						0.34	

[1]Anchors shall be installed in base materials in compliance with Section 3.6 of this report.
[2]Embedment depth is measured from the outside surface of the concrete masonry unit.
[3]Refer to Section 5.4 of this report for modifying allowable loads in this table for anchors resisting short-term loads.
[4]Allowable loads are based on installation at critical spacing and edge distance. Load reduction factors are applicable at the minimum spacing and edge distance. Linear interpolation of reduction factors is allowed for spacings and edge distances between critical and minimum.
[5]Tabulated allowable loads for the IBC/IRC are based on a safety factor of 5.0.
[6]Special inspection must be provided in accordance with Section 4.3 of this report.

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Naperville, IL 60563-6503
630.357.0540 Fax: 630.357.0164
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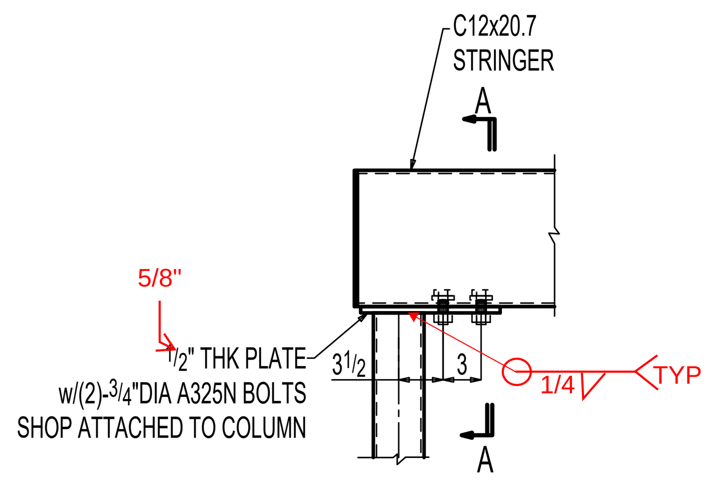
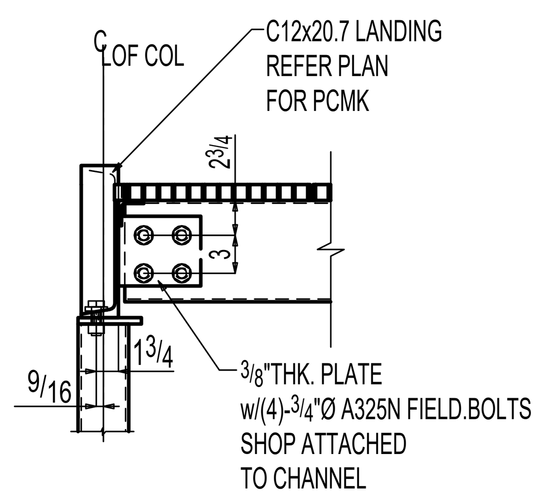
WONDERLOVE STAIRS
PORTLAND, OR

Appendix: Markups

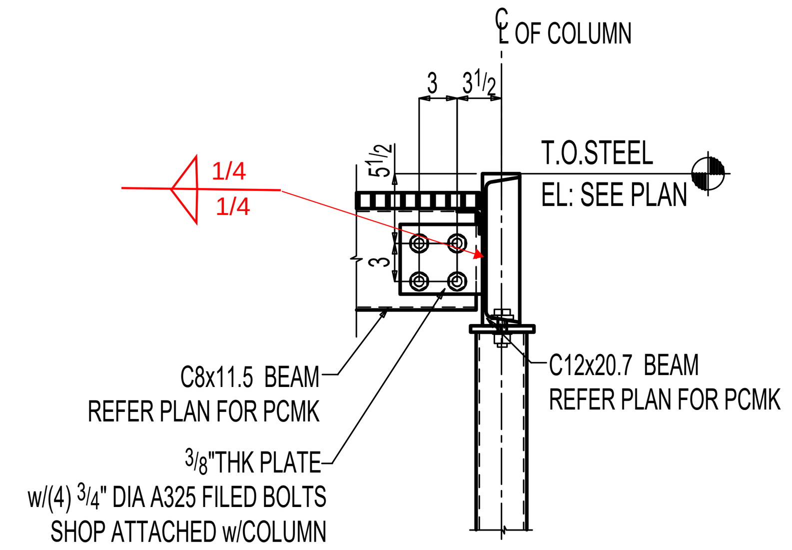
CLIENT:
PRAGMATIC, INC
ALPHARETTA, GA



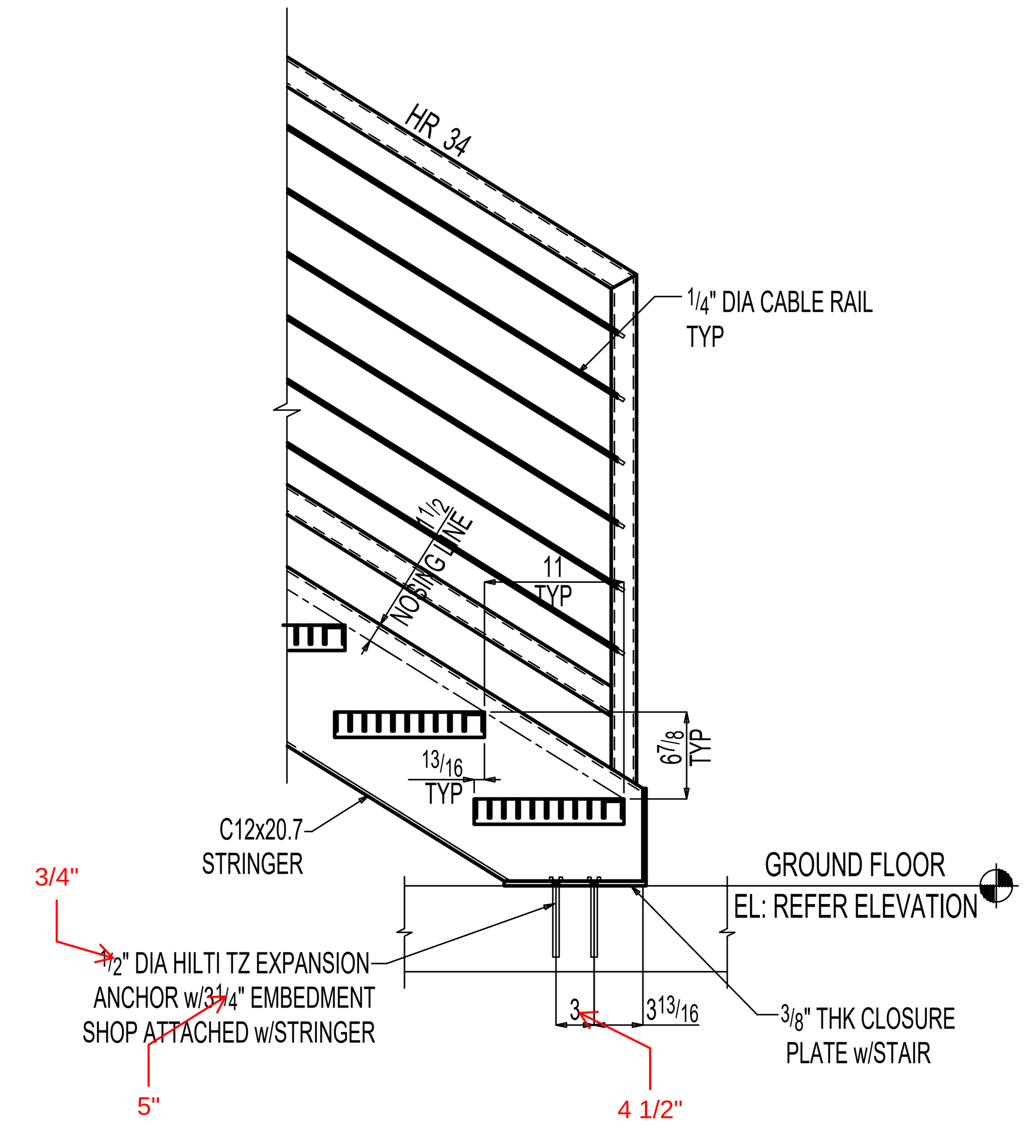
1 E7 SECTION VIEW



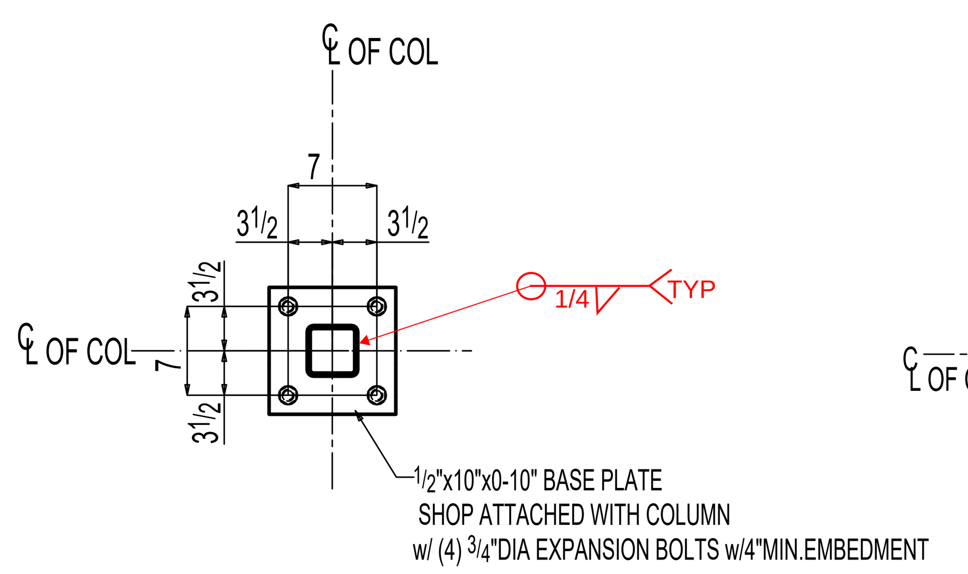
SECTION A-A



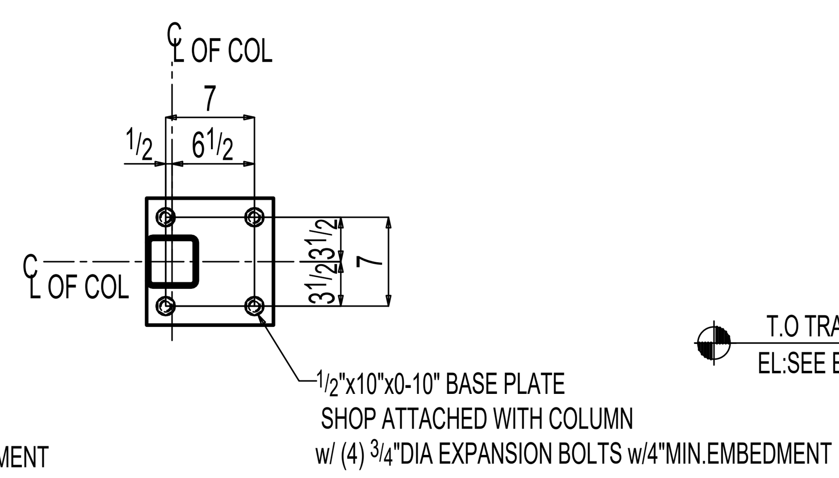
2 E7 TYPICAL CHANNEL TO STRINGER CONNECTION



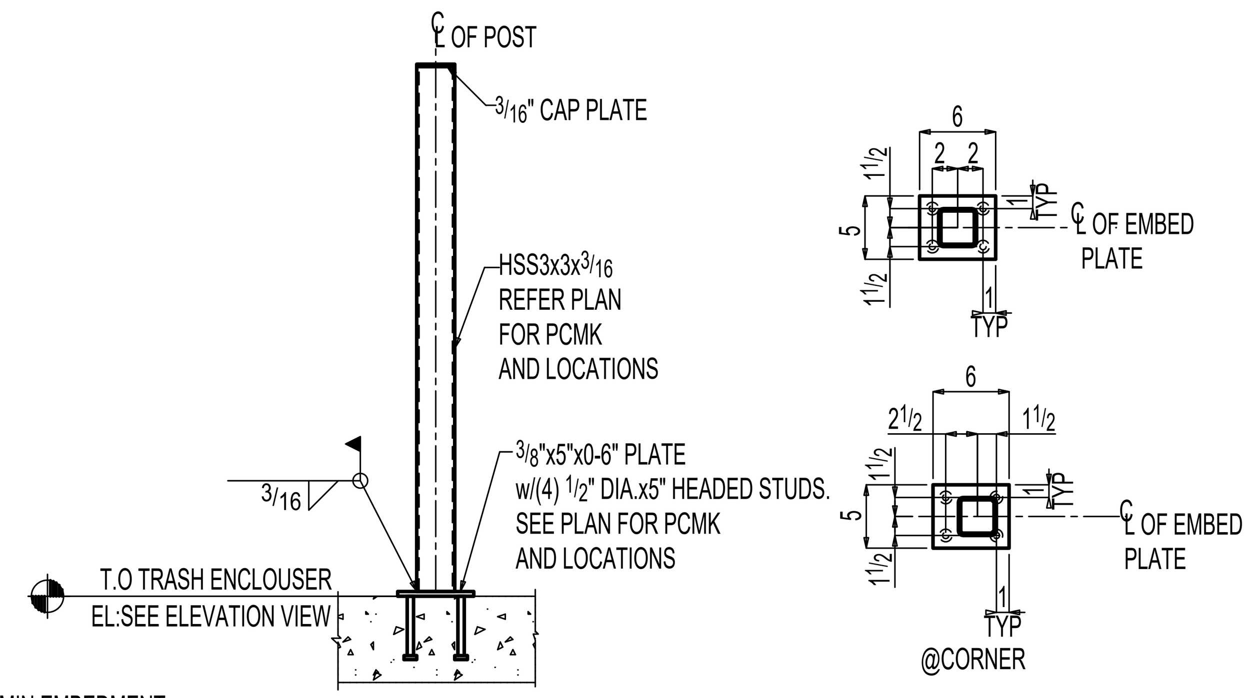
3 E7 SECTION VIEW
(REF: A3.01)



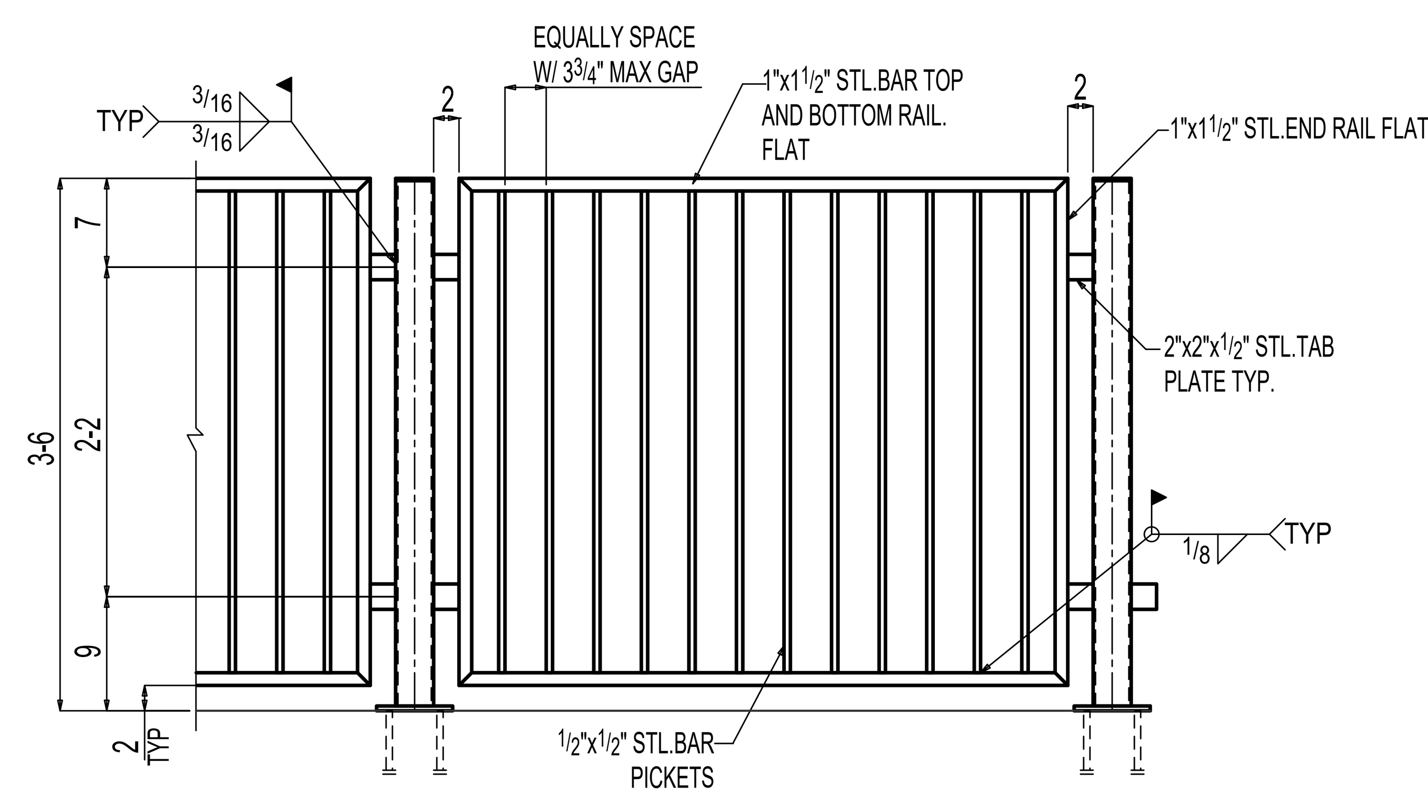
4 E7 SECTION VIEW



5 E7 SECTION VIEW



6 E7 TYPICAL EMBED PLATE DETAIL
(@POSTS)
(REF: S3.10)



7 E7 TYPICAL SECTION VIEW
(REF: S3.10)

EOR NOTE:
1.PLEASE VERIFY THE ALL CONNECTIONS ARRANGEMENTS AS DETAILED.(U.N.O)

REVISION	DATE	BY	DESCRIPTION
A	07-12-2023	KRK	ISSUED FOR APPROVAL

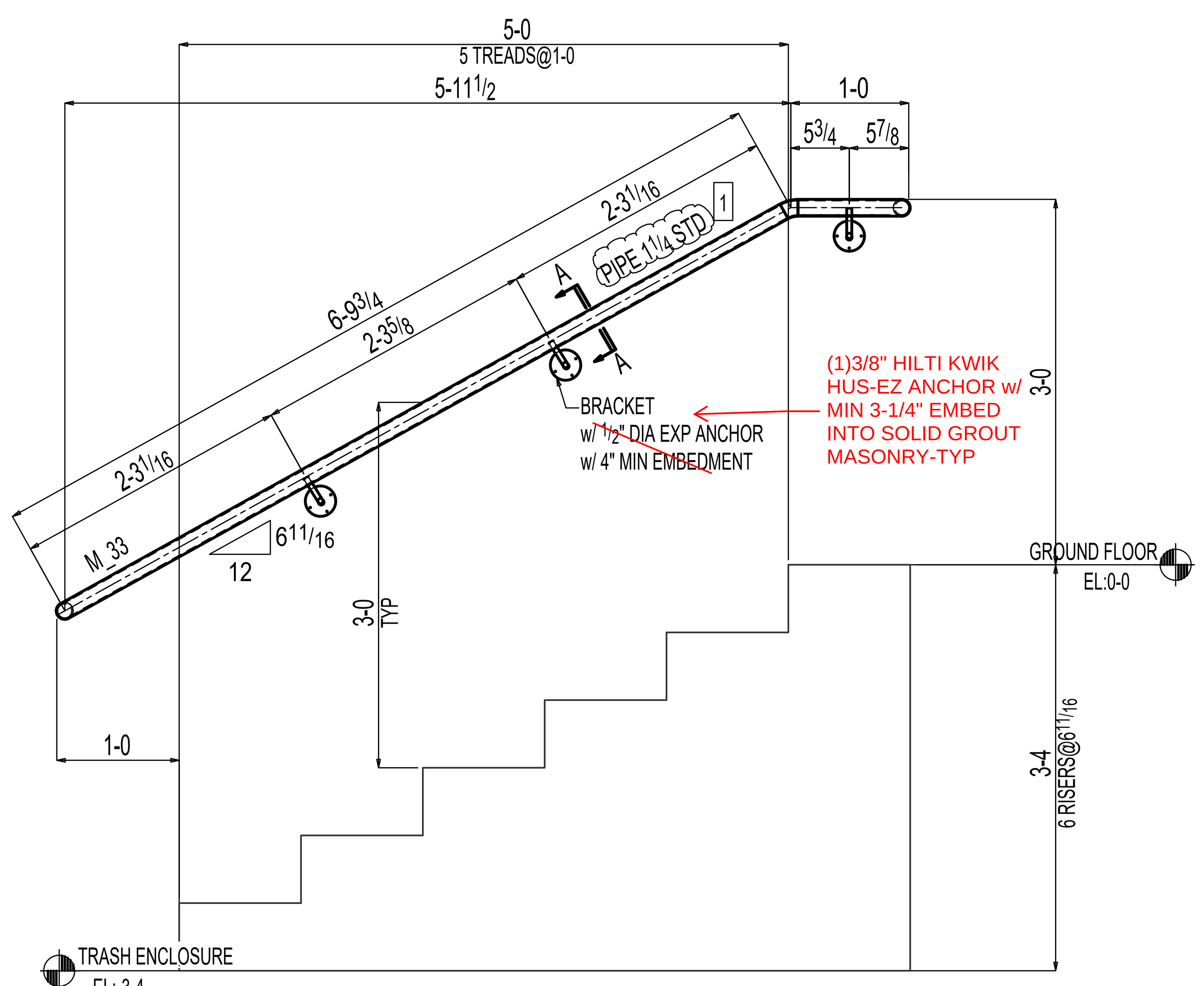
SUPERIOR METAL FAB

PROJECT: WONDERLOVE STAIRS
1300 SE 2ND AVE PORTLAND, OR 97214

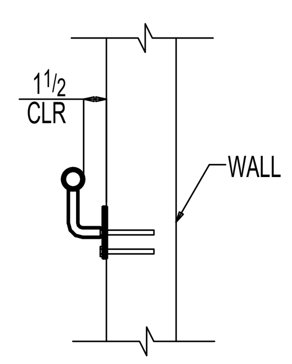
ITEM: SECTION VIEWS

CONTRACTOR: —	DETAILER: SUPERIOR METAL FAB	PROJECT MANAGER: JUSTIN	
DR. BY: MMR	DATE: 07-12-2023	CHK'D BY: KRK DATE: 07-12-2023	ERECTION REF.: -----
SCALE: NTS	JOB NO.: 220617	DWG. NO.: E7	A

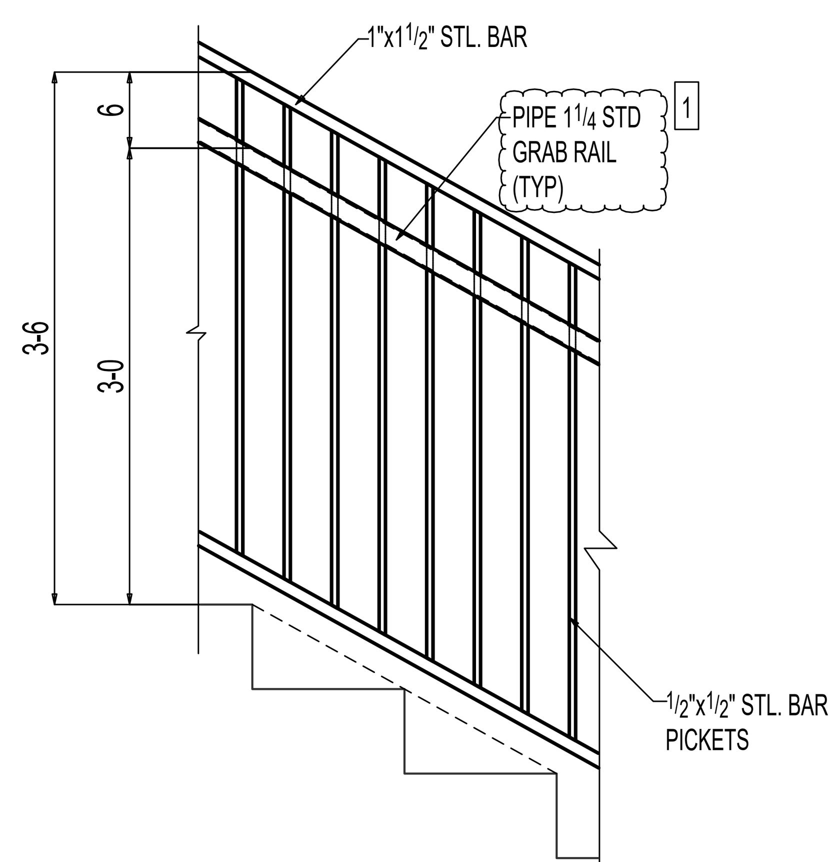
1 SECTION VIEW
E9
(REF: S3.10)



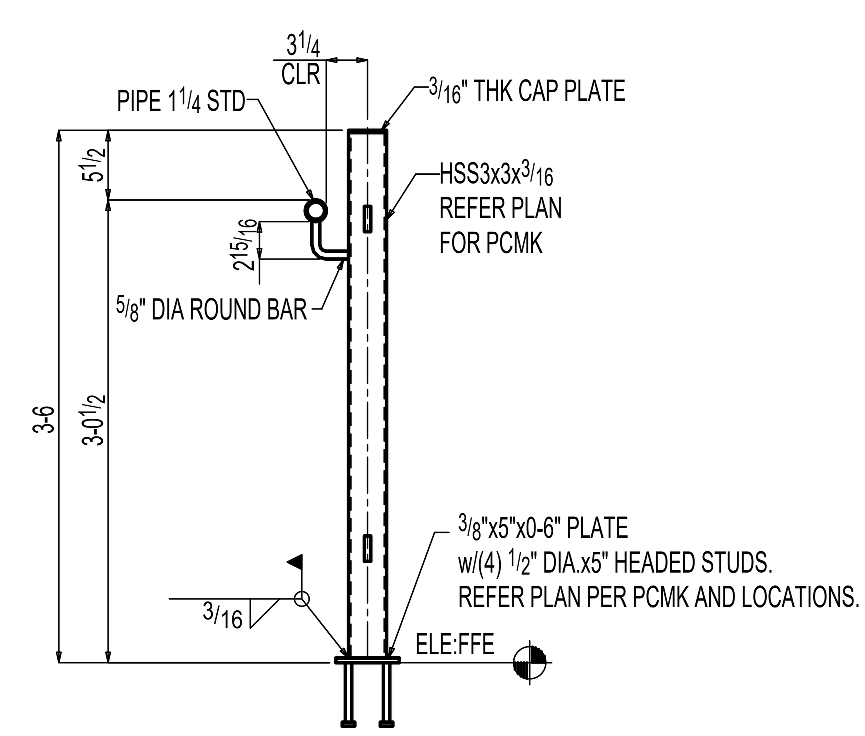
2 SECTION VIEW
E9
(REF: A6.02)
2



SECTION A-A



3 TYPICAL SECTION VIEW
E9
2



4 TYPICAL GUARDRAIL SECTION
E9

EOR NOTE:
1.PLEASE VERIFY THE CLOUDED SECTION SIZES.
2.PLEASE VERIFY CLOUDED CONNECTION ARRANGEMENT AS DETAILED.

REVISION	DATE	BY	DESCRIPTION
A	07-12-2023	KRK	ISSUED FOR APPROVAL

SUPERIOR METAL FAB

PROJECT: WONDERLOVE STAIRS 1300 SE 2ND AVE PORTLAND, OR 97214			
ITEM: ELEVATION & SECTION VIEWS			
CONTRACTOR: —		DETAILER: SUPERIOR METAL FAB	PROJECT MANAGER: JUSTIN
DR. BY: MMR	DATE: 07-12-2023	CHK'D BY: KRK DATE: 07-12-2023	ERECTION REF.: ------
SCALE: NTS	JOB NO.: 220617	DWG. NO.: E9	A