PSE Consulting Engineers Inc.

STRUCTURAL ENGINEERING CALCULATIONS

PROJECT: Stainless Cable & Railing

PROJECT LOCATION: California

PSE PROJECT NUMBER: Stainless Cable & Railing
223-801 Railing

DATE: April 25, 2023

4-25-2023

LICENSED PROFESSIONAL ENGINEER
NABIL TAHA
NO. C60802
CIVIL
STATE OF CALIFORNIA

BY: Adel Elfayoumy, Ph.D.
BY: Nabil Taha, Ph.D., P.E.

Expires 12/31/2024

Table of Contents:

References:

1- Literature:

a. 2021 International Building Code (IBC)

b. 2022 California Building Code based on 2018 International Building Code (IBC)

c. Aluminum Design Manual ADMI-15, The Aluminum Association.

2- Software:

a. RISA 3D Version 19.0.4
RISA Technologies,
26212 Dimension Dr. Suite 200

PSE CONSULTING ENGINEERS INC.

Design Criteria:

1- Location: California

2- Live Load on Handrail & guards:

a. Uniform Distributed load 50 p/f
b. Single Concentrated load 200 lbs

**Other criteria assumed as stated in design calculations.

250-A Main Street
Klamath Falls, OR. 97601

E-Mail: info@structure1.com
Web: www.structure1.com

ph. (541) 850-6300
fax (541) 850-6233

Conclusion

1- Post: 42” tall and 4’ apart Aluminum 6061-T6, 2.375”x2.375”x0.1”

2- Base plate minimum size 4.5”x4.5”x0.35”

3- Minimum Anchor bolt size to concrete ($f'_c \geq 3000$ psi) as follows:

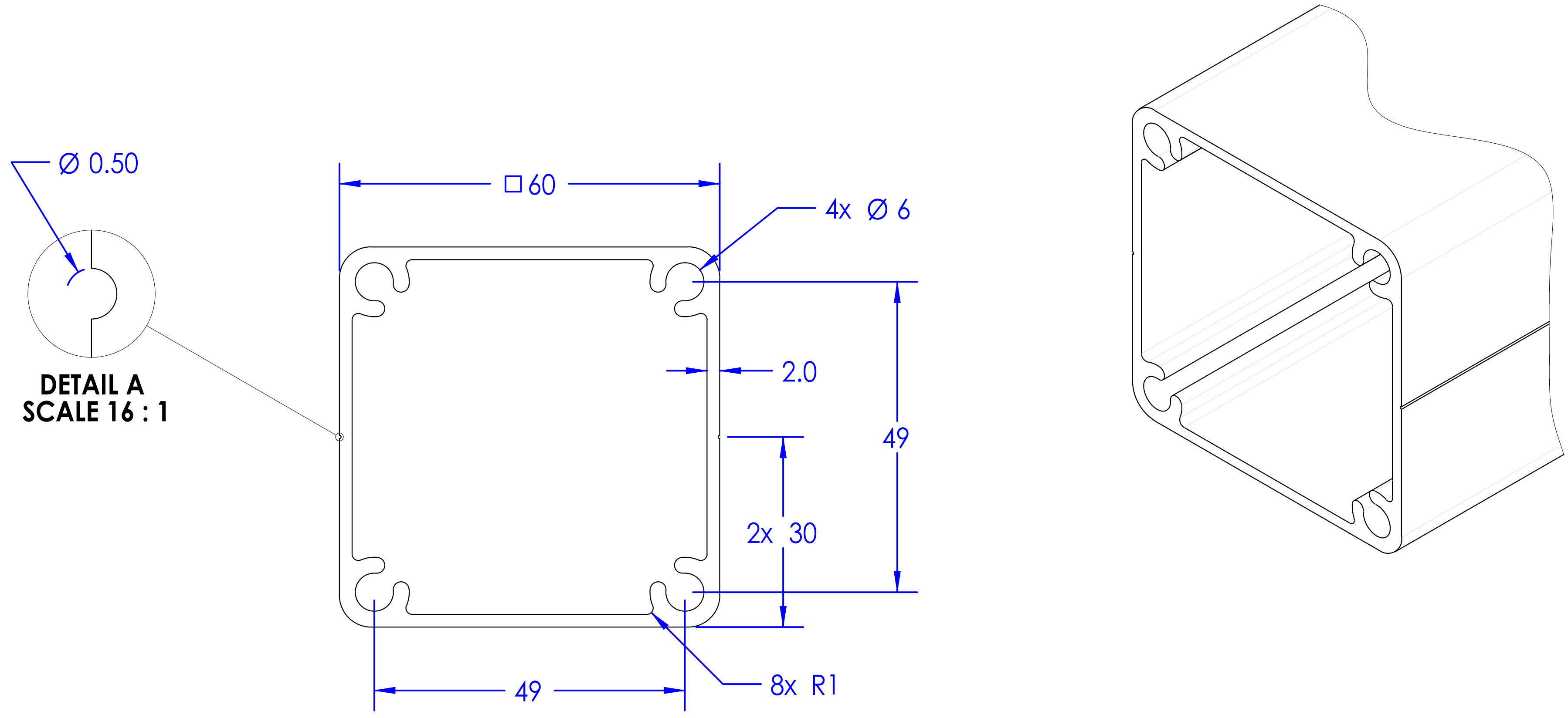
a. 4-3/8” Ø W/min. 4” embed. Red head ITW wedge
b. 4-3/8” Ø W/min. 4” embed. Red head LDT (SLDT-3816)
c. 4-1/2” Ø W/min. 4” embed. Red head SRM-38 or similar

4- Cable size 1/8” Ø or 3/16” Ø

5- Base plate to wood connection:

a. 4-3/8” Ø lag screw W/min. 4” embed.

DWG. NO. 03-001-02

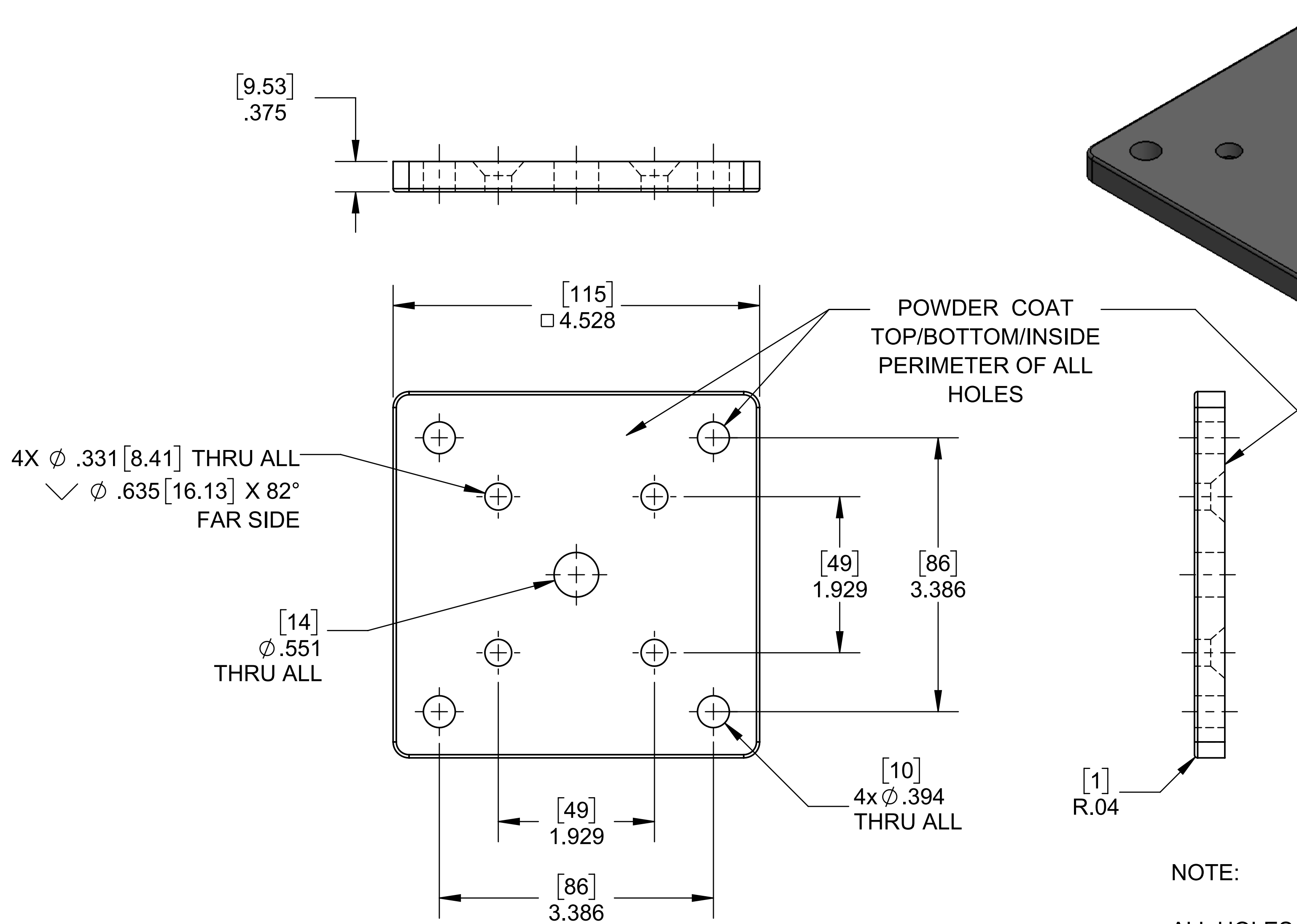


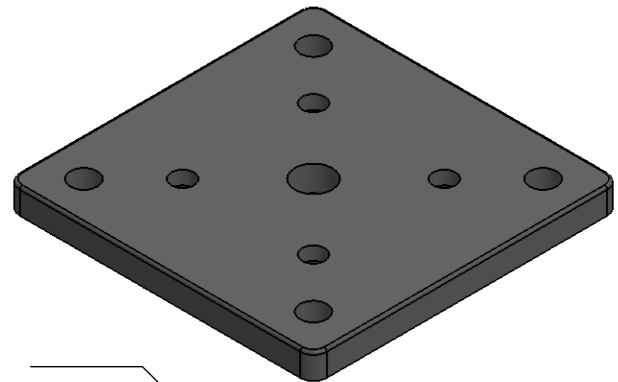
		UNLESS OTHERWISE SPECIFIED:		NAME	DATE	Stainless Cable & Railing, Inc. 888-686-7245 (RAIL)
		DIMENSIONS ARE IN Millimeters	DRAWN	GM	04/30/08	TITLE:
		TOLERANCES: x = 0.1, x.x = 0.1, x.xx = 0.01, x.xxx = 0.005	CHECKED			Intermediate Post
			ENG APPR.			
			MFG APPR.			
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			
		MATERIAL 6082 T6 Alu	COMMENTS: Powdercoating to meet or exceed AAMA2604 Salt Spray Resistance			SIZE A, DWG. NO. 03-001-02, REV PR1
NEXT ASSY	USED ON	FINISH Powdercoat				
APPLICATION		DO NOT SCALE DRAWING				SCALE: 1:1, WEIGHT:, SHEET 1 OF 1

PROPRIETARY AND CONFIDENTIAL

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF STAINLESS CABLE & RAILING, INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF STAINLESS CABLE & RAILING, INC. IS PROHIBITED.

5 4 3 2 1





NOTE:

ALL HOLES ARE CENTERED ON PART

SC&R Stainless Cable & Railing

PROPRIETARY AND CONFIDENTIAL

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN - INCHES [MM].
2. MACHINED SURFACES TO BE 63uIN MAX.
3. PART TO BE FREE OF BURRS AND SHARP EDGES.
4. ALL MATERIAL TO BE CLEAN, DEGREASED AND FREE OF ALL IMPURITIES.
5. ANY CHANGE MUST BE AUTHORIZED BY AN SC&R ENGINEER.

DIMENSIONS ARE IN INCHES
FRACTIONAL ±
ANGULAR: MACH ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL: ADC12

FINISH: POWDERCOAT

	NAME	DATE
DRAWN	SCR	08/25/18
ENG APPR.		
MFG APPR.		

COMMENTS:

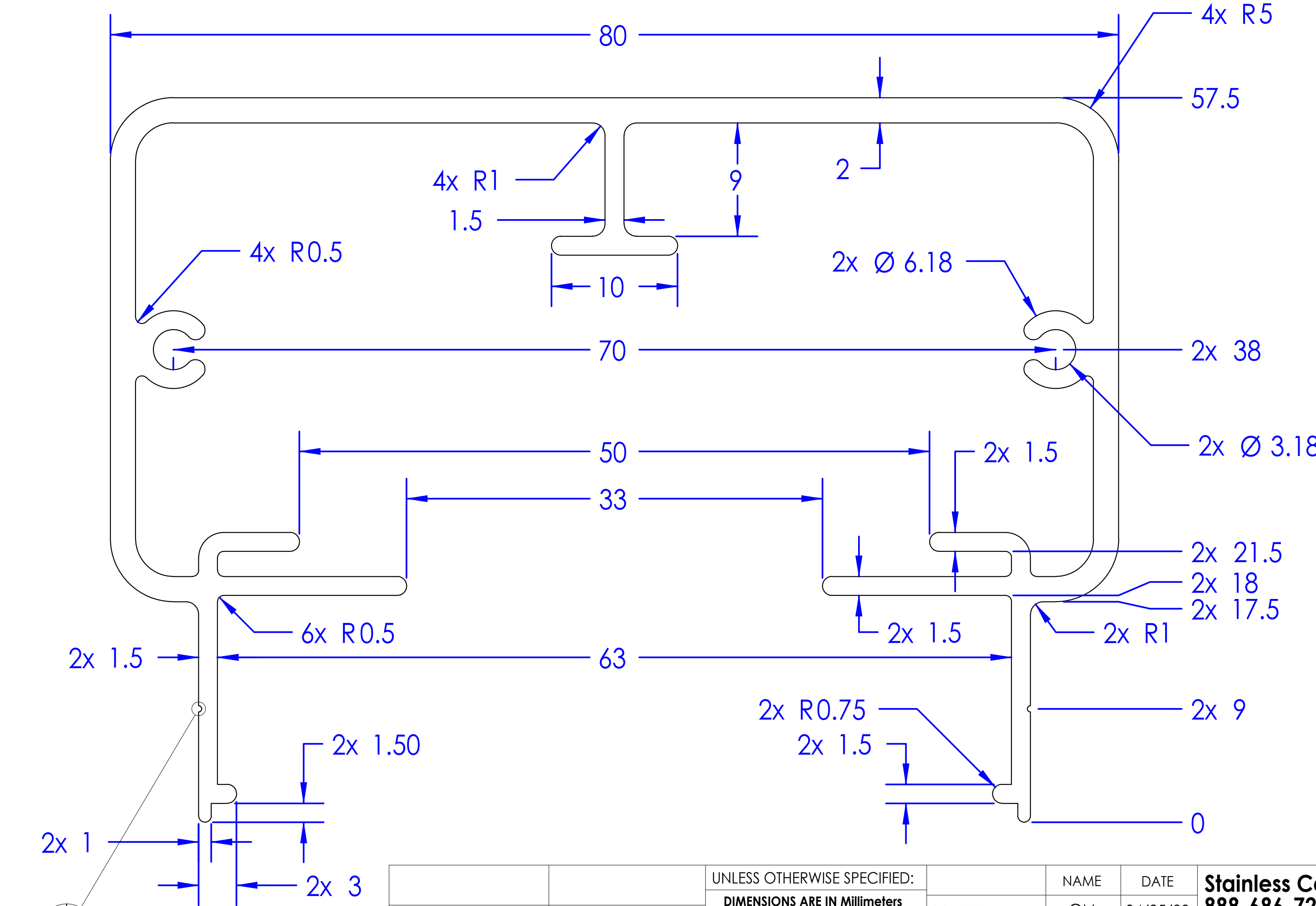
TITLE:

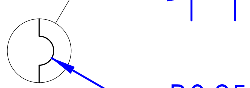
BASE PLATE

SIZE	DWG. NO.	REV
A	729141	01

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

DWG. NO. 03-004-01





DETAIL A
SCALE 8 : 1

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN Millimeters	DRAWN	GM	04/25/08
		TOLERANCES: x = 0.1 x.x = 0.1 x.xx = 0.01 x.xxx = 0.005	CHECKED		
			ENG APPR.		
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.		
		MATERIAL 6082 T6 Alu	COMMENTS: Powdercoating to meet or exceed AAMA2604 Salt Spray Resistance		
NEXT ASSY	USED ON	FINISH Powdercoat 6 Mil Min.			
APPLICATION		DO NOT SCALE DRAWING			

Stainless Cable & Railing, Inc.
888-686-7245 (RAIL)

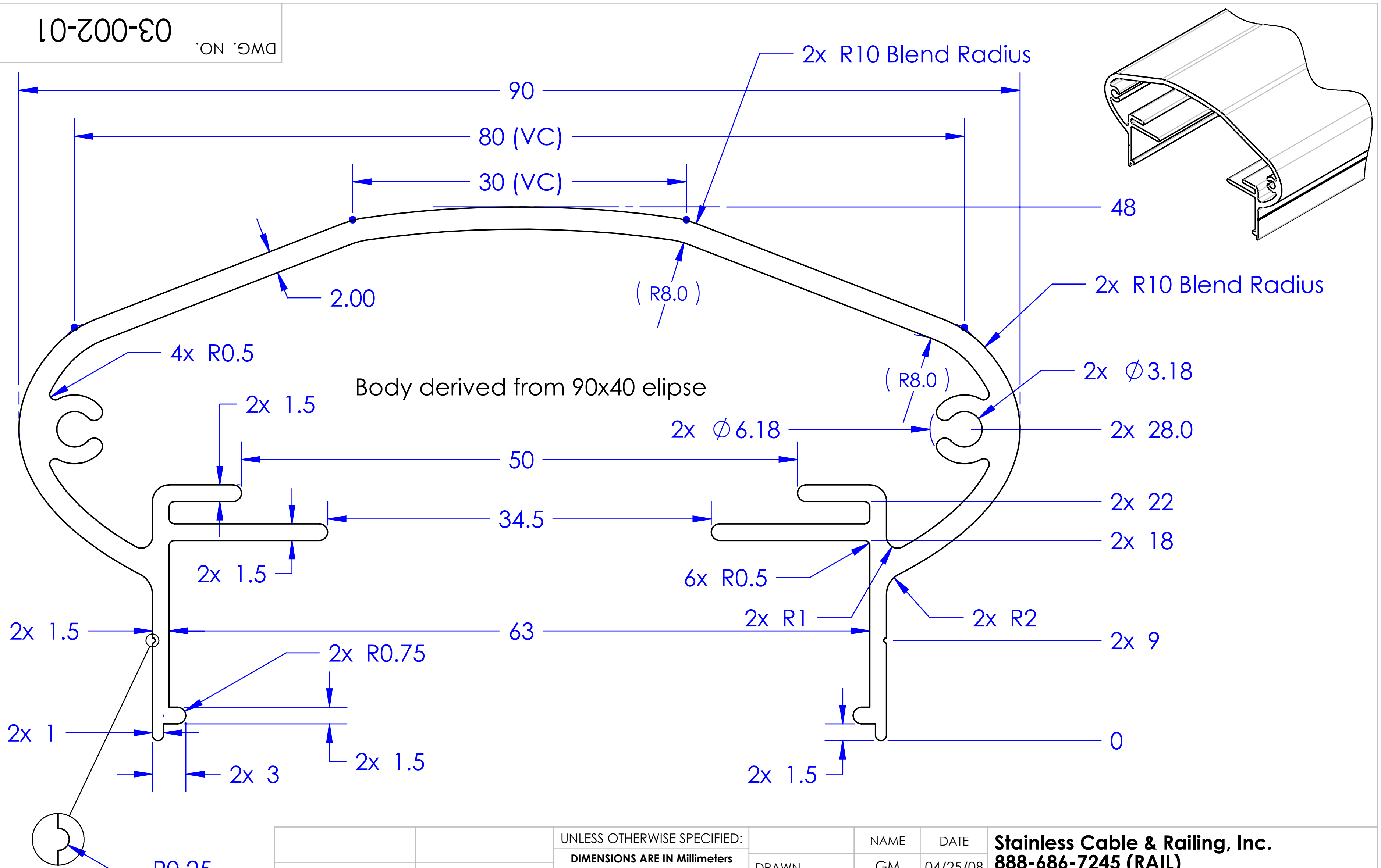
TITLE:

Rectangular Top Rail

SIZE	DWG. NO.	REV
A	03-004-01	PR1
SCALE: 2:1	WEIGHT:	SHEET 1 OF 1

5 4 3 2 1

DWG. NO. 03-002-01



DETAIL A
SCALE 8 : 1

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NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN Millimeters

TOLERANCES:
x = 0.1
x.x = 0.1
x.xx = 0.01
x.xxx = 0.005

INTERPRET GEOMETRIC TOLERANCING PER:

MATERIAL
6082 T6 Alu

FINISH
Powdercoat 6 Mil Min.

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	GM	04/25/08
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:
Powdercoating to meet or exceed AAMA2604 Salt Spray Resistance

Stainless Cable & Railing, Inc.
888-686-7245 (RAIL)

TITLE:

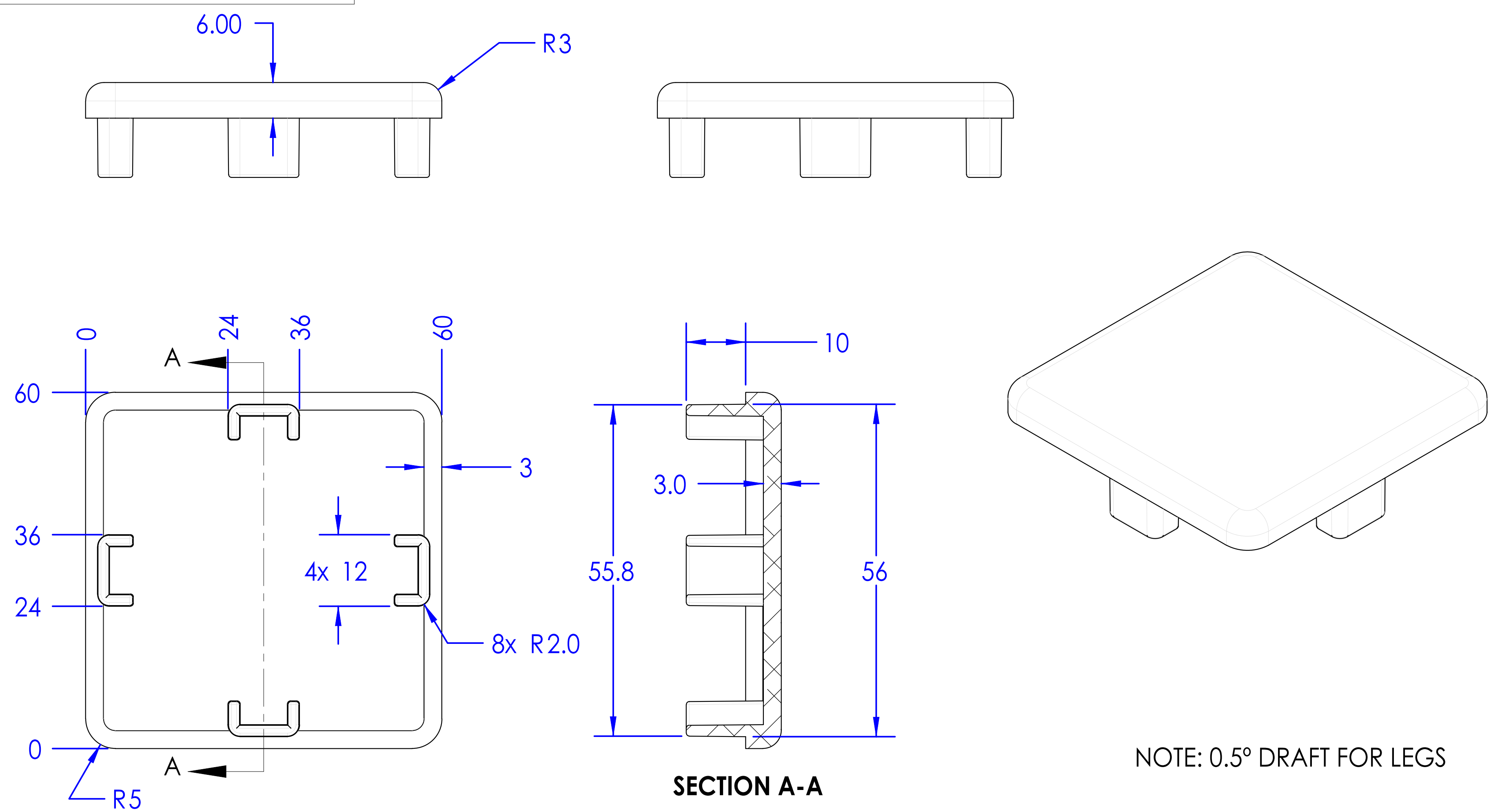
Eliptical Top Rail

SIZE	DWG. NO.	REV
A	03-002-01	PR1

SCALE: 2:1 | WEIGHT: | SHEET 1 OF 1

5 4 3 2 1

DWG. NO. 03-008-01



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE	**Stainless Cable & Railing, Inc.** **888-686-7245 (RAIL)**
		DIMENSIONS ARE IN Millimeters	DRAWN	GM	04/27/08	TITLE:
		TOLERANCES: x = 0.1 x.x = 0.1 x.xx = 0.01 x.xxx = 0.005	CHECKED			Post Cap
			ENG APPR.			
			MFG APPR.			
		INTERPRET GEOMETRIC TOLERANCING PER:	Q.A.			
		MATERIAL 6082 T6 Alu	COMMENTS:			SIZE A
NEXT ASSY	USED ON	FINISH	Powdercoating to meet or exceed AAMA2604 Salt Spray Resistance			DWG. NO. 03-008-01
APPLICATION		DO NOT SCALE DRAWING				REV PR2
						SCALE: 1:1
						WEIGHT:
						SHEET 1 OF 1

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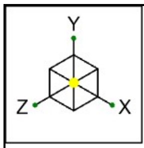
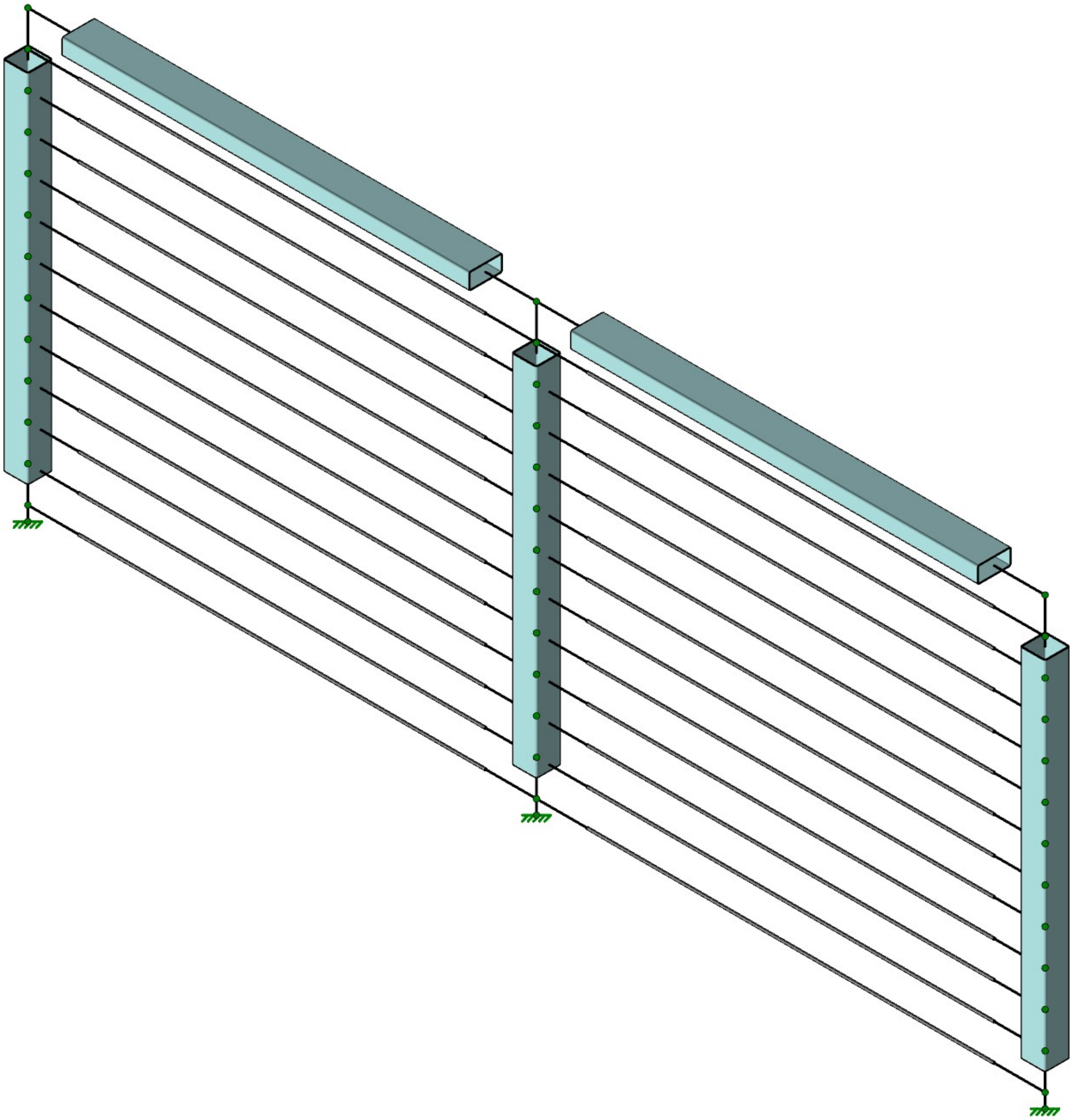
5 4 3 2 1

GUARD RAIL ANALYSIS & DESIGN:

Pages 1,000 - 1,999

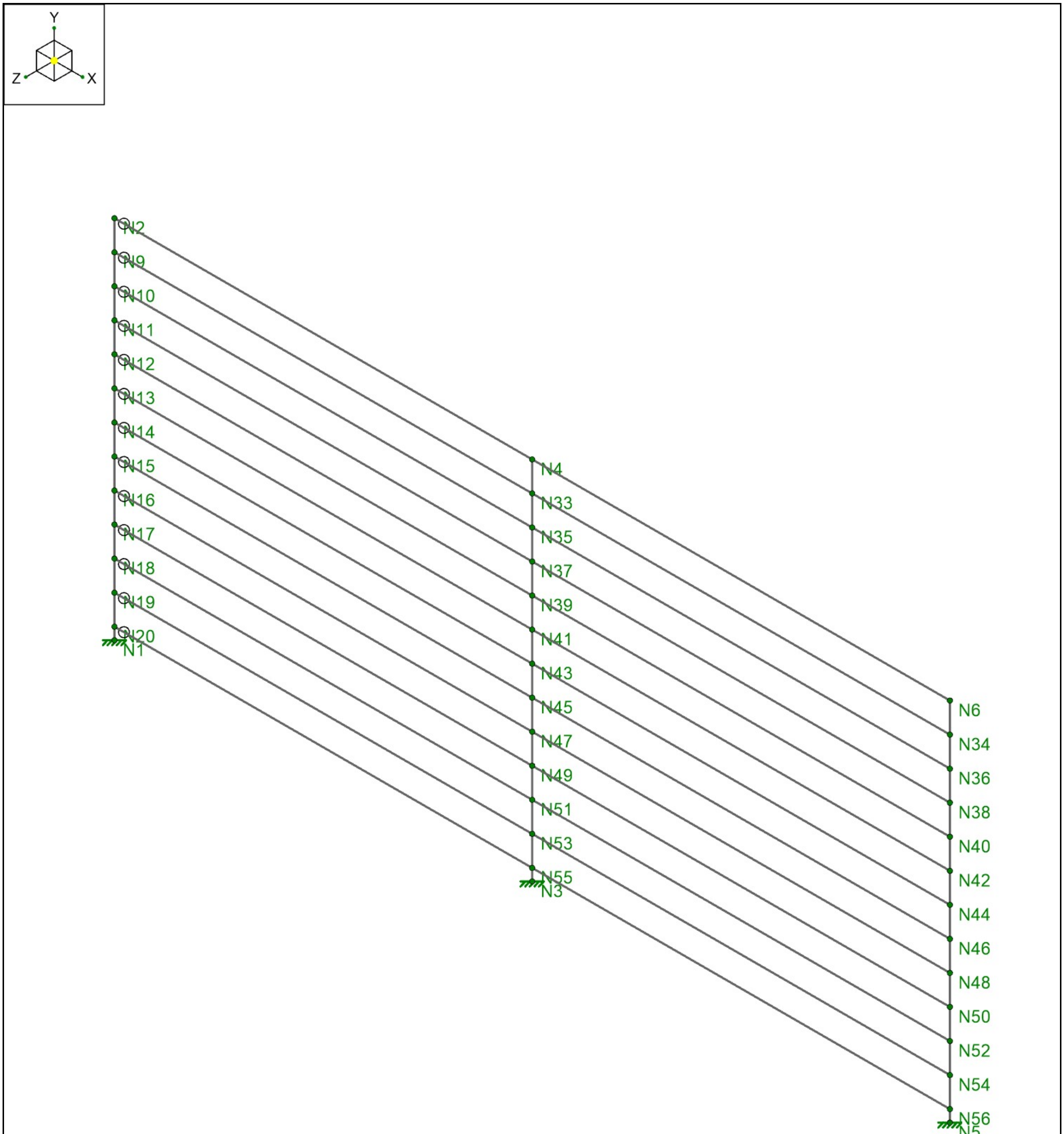
250-A Main Street
Klamath Falls, OR. 97601
E-Mail: info@structure1.com
Web: www.structure1.com
ph. (541) 850-6300
fax (541) 850-6233





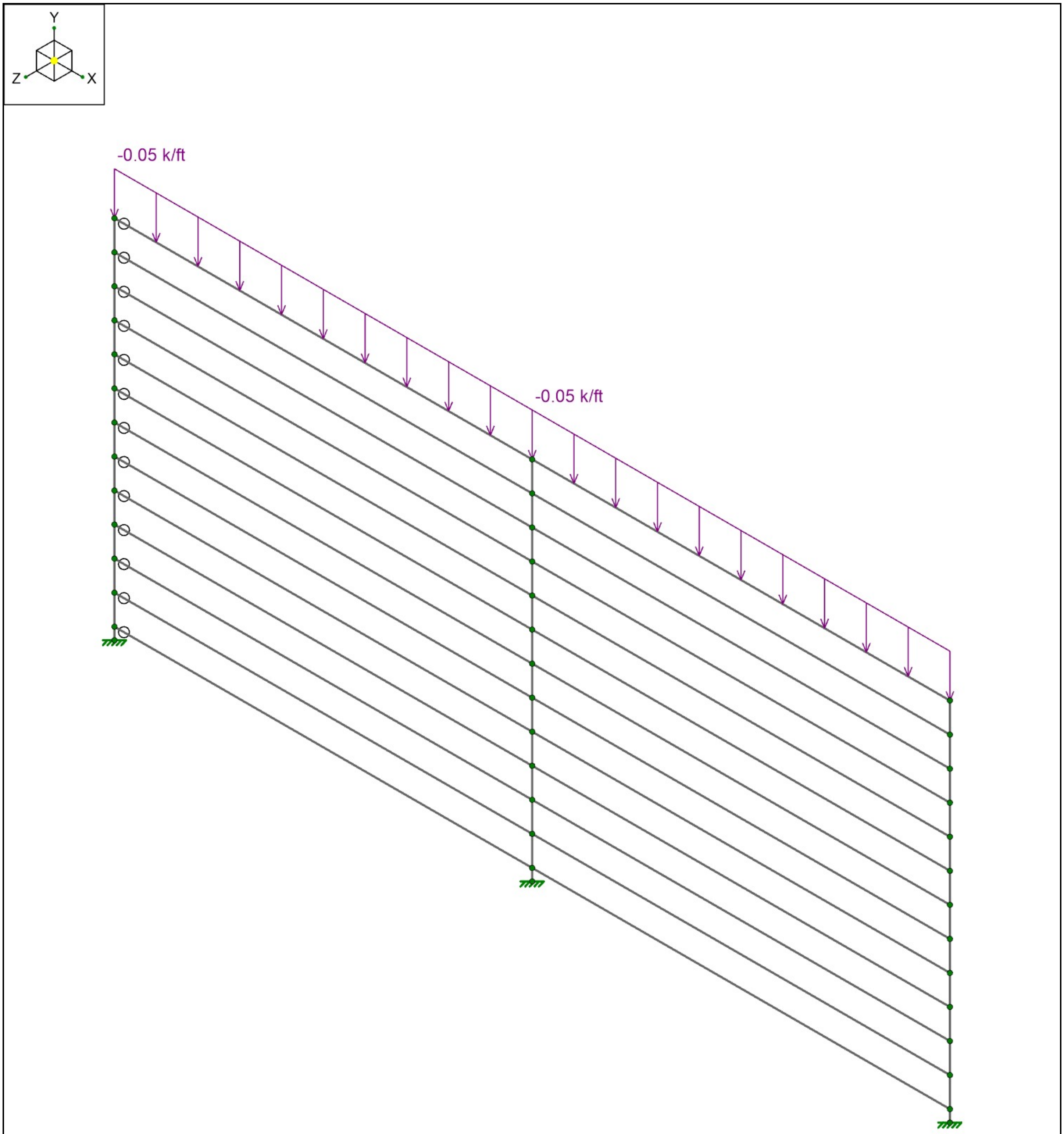
Envelope Only Solution

PSEI	GUARD RAIL SYSTEM WITH CABLES	SK-2
AF		Apr 25, 2023
Stainless Cable & Railing 223-801		



Envelope Only Solution

PSEI	GUARD RAIL SYSTEM WITH CABLES	SK-8
AF		Apr 25, 2023
Stainless Cable & Railing 223-801		



Loads: BLC 1, Distributed load-y at the top of
Envelope Only Solution

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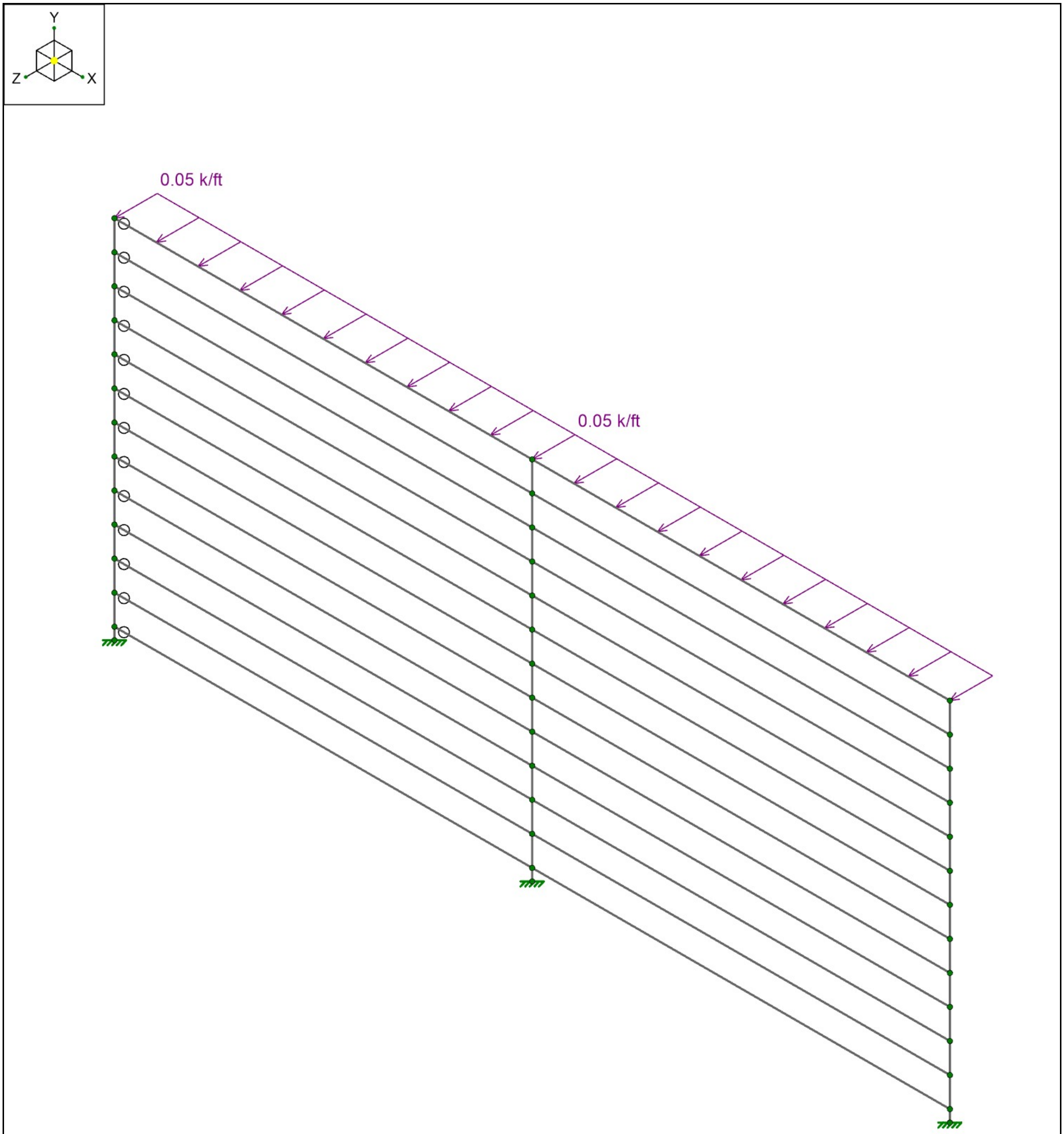
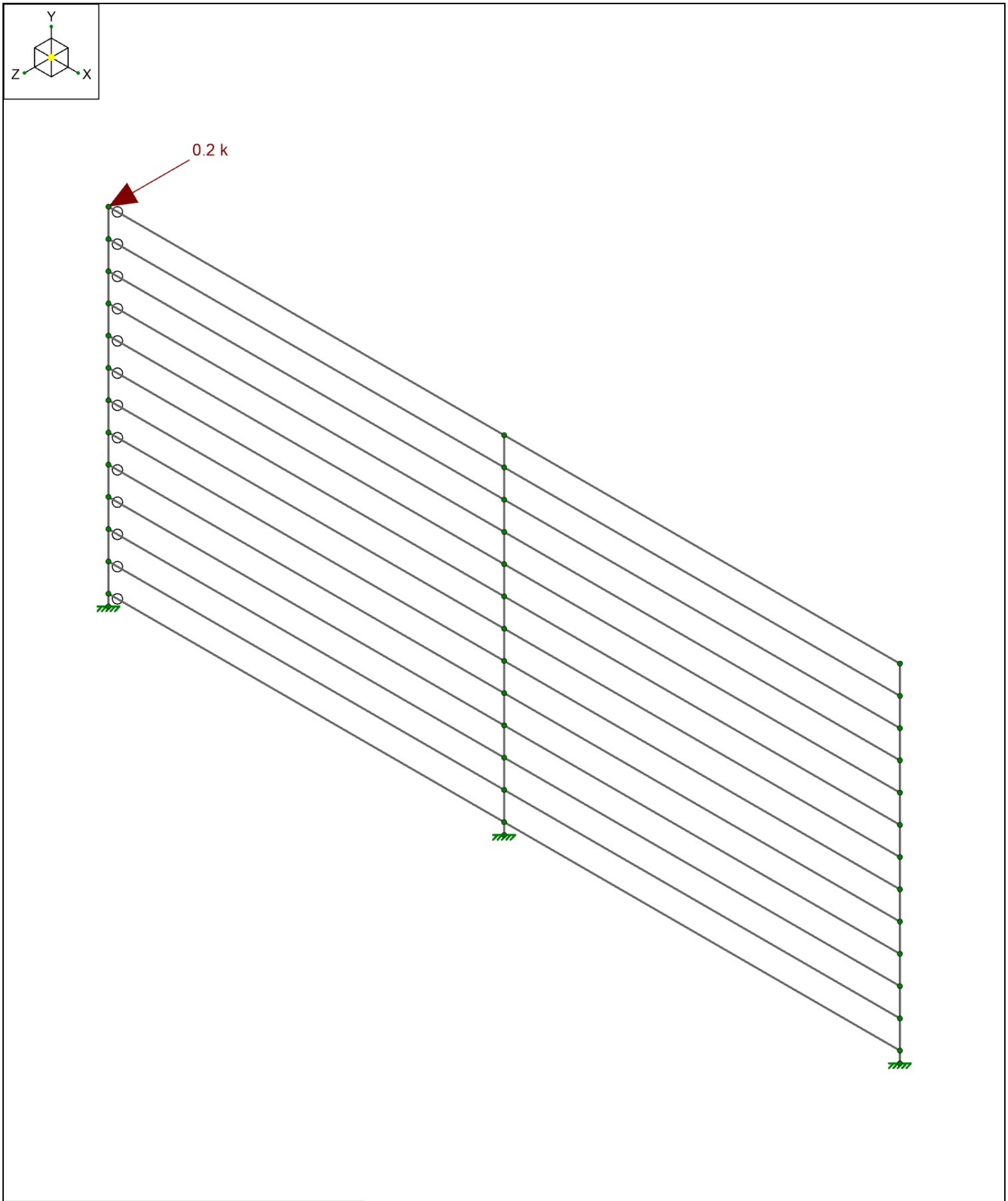
AF		Apr 25, 2023
Stainless Cable & Railing 223-801		



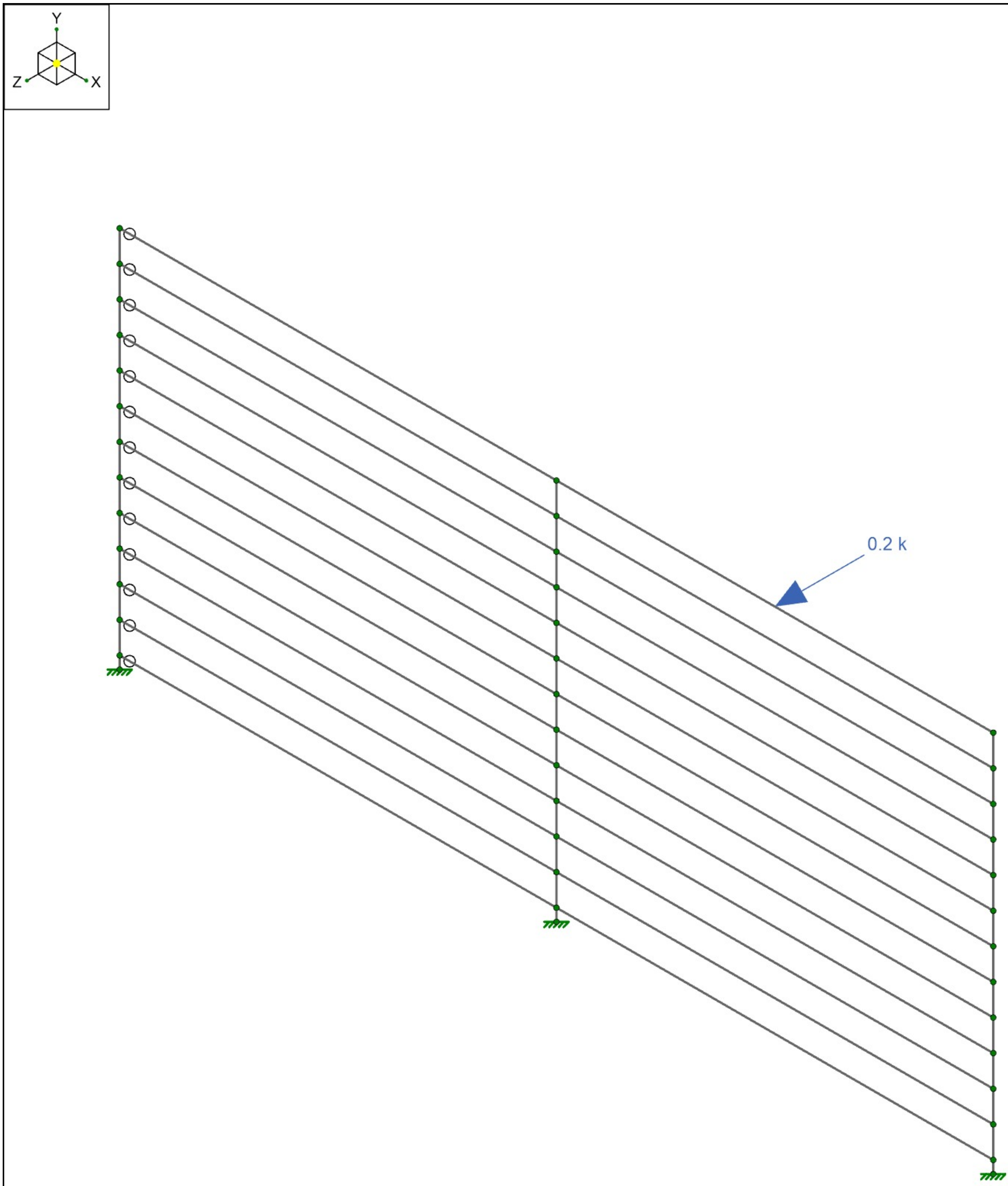
Loads: BLC 2, Distributed load-X at the side o
Envelope Only Solution

PSEI	GUARD RAIL SYSTEM WITH CABLES	SK-4
AF		Apr 25, 2023
Stainless Cable & Railing 223-801		



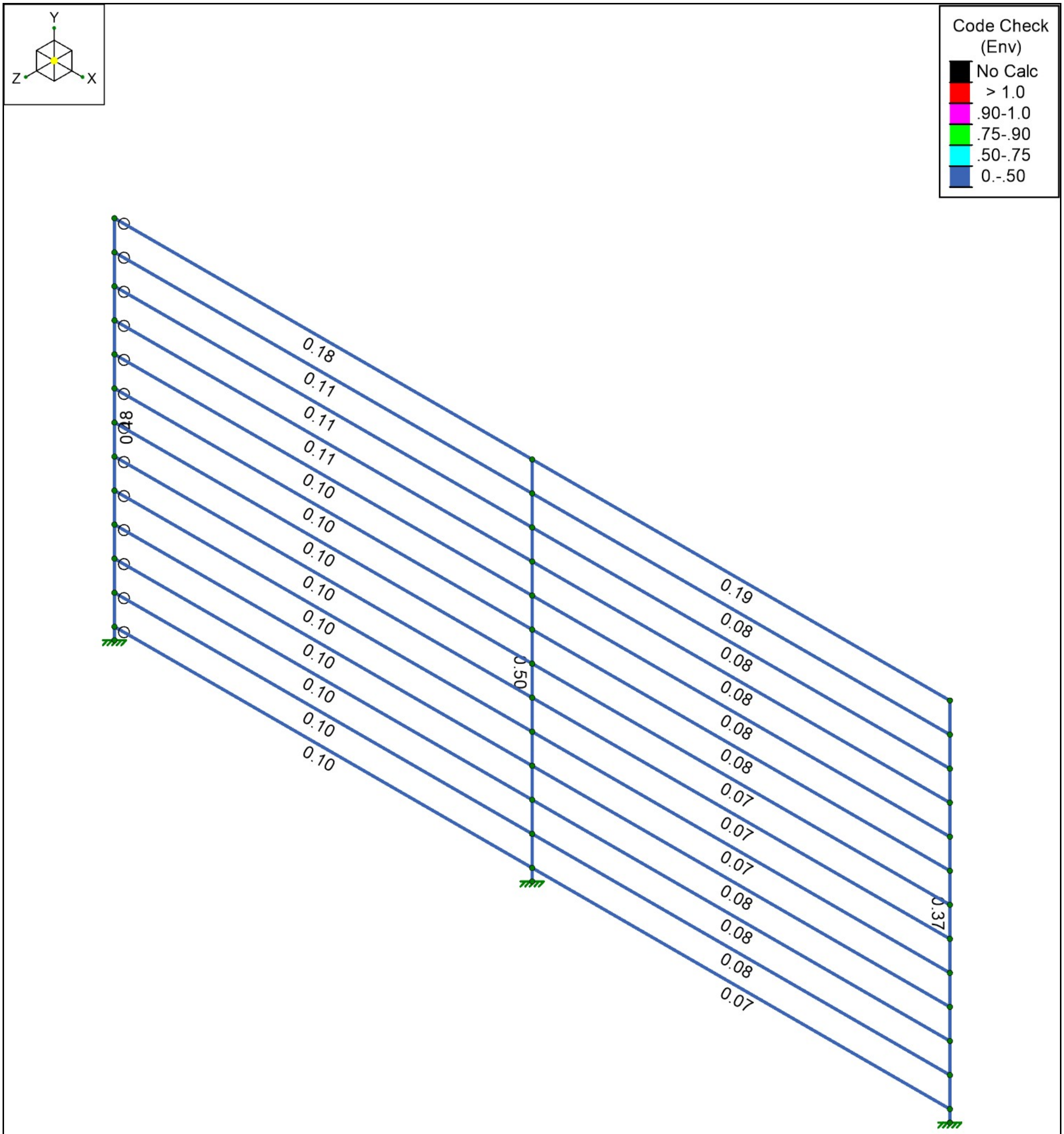
Loads: BLC 3, Point load applied at the corner
Envelope Only Solution

PSEI	GUARD RAIL SYSTEM WITH CABLES	SK-5
AF		Apr 25, 2023
Stainless Cable & Railing 223-801		



Loads: BLC 4, Point load applied at the middle
Envelope Only Solution

PSEI	GUARD RAIL SYSTEM WITH CABLES	SK-6
AF		Apr 25, 2023
Stainless Cable & Railing 223-801		



Member Code Checks Displayed (Enveloped)
Envelope Only Solution

PSEI	GUARD RAIL SYSTEM WITH CABLES	SK-7
AF		Apr 25, 2023
Stainless Cable & Railing 223-801		

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	0	3.5	0	
3	N3	4	0	0	
4	N4	4	3.5	0	
5	N5	8	0	0	
6	N6	8	3.5	0	
7	N9	0	3.217708	0	
8	N10	0	2.935417	0	
9	N11	0	2.653125	0	
10	N12	0	2.370833	0	
11	N13	0	2.088542	0	
12	N14	0	1.80625	0	
13	N15	0	1.523958	0	
14	N16	0	1.241667	0	
15	N17	0	0.959375	0	
16	N18	0	0.677083	0	
17	N19	0	0.394792	0	
18	N20	0	0.1125	0	
19	N33	4	3.217708	0	
20	N34	8	3.217708	0	
21	N35	4	2.935417	0	
22	N36	8	2.935417	0	
23	N37	4	2.653125	0	
24	N38	8	2.653125	0	
25	N39	4	2.370833	0	
26	N40	8	2.370833	0	
27	N41	4	2.088542	0	
28	N42	8	2.088542	0	
29	N43	4	1.80625	0	
30	N44	8	1.80625	0	
31	N45	4	1.523958	0	
32	N46	8	1.523958	0	
33	N47	4	1.241667	0	
34	N48	8	1.241667	0	
35	N49	4	0.959375	0	
36	N50	8	0.959375	0	
37	N51	4	0.677083	0	
38	N52	8	0.677083	0	
39	N53	4	0.394792	0	
40	N54	8	0.394792	0	
41	N55	4	0.1125	0	
42	N56	8	0.1125	0	

Aluminum Properties

	Label	E [ksi]	G [ksi]	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]	Table B.4	kt	Ftu [ksi]	Fty [ksi]	Fcy [ksi]	Fsu [ksi]	Ct
1	3003-H14	10100	3787.5	0.33	1.3	0.173	Table B.4-1	1	19	16	13	12	141
2	6061-T6	10100	3787.5	0.33	1.3	0.173	Table B.4-2	1	38	35	35	24	141
3	6063-T5	10100	3787.5	0.33	1.3	0.173	Table B.4-2	1	22	16	16	13	141
4	6063-T6	10100	3787.5	0.33	1.3	0.173	Table B.4-2	1	30	25	25	19	141
5	5052-H34	10200	3787.5	0.33	1.3	0.173	Table B.4-1	1	34	26	24	20	141
6	6061-T6 W	10100	3787.5	0.33	1.3	0.173	Table B.4-1	1	24	15	15	15	141

Aluminum Section Sets

	Label	Shape	Type	Design List	Material	Design Rule	Area [in²]	Iyy [in⁴]	Izz [in⁴]	J [in⁴]
1	POST	2.375x2.375x.100	Beam	Rectangular Tubes	6061-T6	Typical	0.91	0.786	0.786	1.177
2	TOP RAIL	3.15x1.575x0.078	Beam	Rectangular Tubes	6061-T6	Typical	0.713	0.313	0.929	0.722
3	BOTTOM RAIL	.735x2.125x.07	Beam	Rectangular Tubes	6061-T6	Typical	0.381	0.035	0.2	0.096

Aluminum Design Parameters

	Label	Shape	Length [ft]	Lcomp top [ft]	Function
1	M1	POST	3.5	Lbyy	Lateral
2	M2	TOP RAIL	4	Lbyy	Lateral
3	M3	POST	3.5	Lbyy	Lateral
4	M4	TOP RAIL	4	Lbyy	Lateral
5	M5	POST	3.5	Lbyy	Lateral

Member Distributed Loads (BLC 1 : Distributed load-y at the top of)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M2	Y	-0.05	-0.05	0	%100
2	M4	Y	-0.05	-0.05	0	%100

Member Distributed Loads (BLC 2 : Distributed load-X at the side o)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M2	Z	0.05	0.05	0	%100
2	M4	Z	0.05	0.05	0	%100

Node Loads and Enforced Displacements (BLC 3 : Point load applied at the corner)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N2	L	Z	0.2

Basic Load Cases

	BLC Description	Category	Y Gravity	Nodal	Point	Distributed
1	Distributed load-y at the top of	None	-1			2
2	Distributed load-X at the side o	None	-1			2
3	Point load applied at the corner	None	-1	1		
4	Point load applied at the middle	None	-1		1	

Load Combinations

	Description	Solve	P-Delta	BLC	Factor
1	Distributed load-y at the top of	Yes	Y	1	1
2	Distributed load-X at the side o	Yes	Y	2	1
3	Point load applied at the corner	Yes	Y	3	1
4	Point load applied at the middle	Yes	Y	4	1

Node Reactions

No Data to Print...

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	N1	max	0	3	0.085	1	0	1	0	1	0	4	-0.001	4
2		min	-0.001	1	0.007	2	-0.173	3	-0.549	3	0	1	-0.013	1
3	N3	max	0	4	0.248	1	0	1	0	1	0.039	4	-0.001	4
4		min	0	1	0.013	2	-0.175	2	-0.574	2	-0.048	3	-0.013	1
5	N5	max	0.001	1	0.094	1	0.009	3	0.003	3	0	1	-0.001	4
6		min	0	2	0.007	3	-0.118	2	-0.429	2	-0.041	2	-0.013	1
7	Totals:	max	0	4	0.427	1	0	1						
8		min	0	1	0.027	3	-0.4	2						

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
1	M1	1	max	0.085	1	0.001	1	0	1	0	4	0.549	3	-0.001	4
2			min	0.007	2	0	3	-0.173	3	0	1	0	1	-0.013	1
3		2	max	0.083	1	0.001	1	0	1	0	4	0.397	3	-0.001	4
4			min	0.005	2	0	3	-0.173	3	0	1	0	1	-0.013	1
5		3	max	0.082	1	0	4	0	1	0	4	0.245	3	0	4
6			min	0.004	2	-0.001	1	-0.173	3	0	1	0	1	-0.013	1
7		4	max	0.081	1	0	4	0	1	0	4	0.116	2	0	3
8			min	0.003	2	-0.007	1	-0.173	3	0	1	0	1	-0.009	1
9		5	max	0.079	1	0	3	0	1	0	4	0.035	4	0	4
10			min	0.001	2	-0.012	1	-0.173	3	0	1	-0.058	3	0	1
11	M2	1	max	0.011	1	0.027	3	-0.001	4	0.058	3	0	4	0	4
12			min	0	3	-0.108	2	-0.079	1	-0.035	4	0	1	0	1
13		2	max	0.011	1	0.027	3	-0.001	4	0.058	3	-0.001	4	0.083	2
14			min	0	3	-0.058	2	-0.028	1	-0.035	4	-0.054	1	-0.027	3
15		3	max	0.011	1	0.027	3	0.022	1	0.058	3	-0.001	4	0.115	2
16			min	0	3	-0.008	2	0	3	-0.035	4	-0.057	1	-0.053	3
17		4	max	0.011	1	0.042	2	0.073	1	0.058	3	0	4	0.098	2
18			min	0	3	-0.006	4	0.001	3	-0.035	4	-0.009	1	-0.08	3
19		5	max	0.011	1	0.092	2	0.124	1	0.058	3	0.09	1	0.03	2
20			min	0	3	-0.006	4	0.002	3	-0.035	4	0.001	3	-0.107	3
21	M3	1	max	0.239	1	0.023	1	0	1	0.039	4	0.039	2	0.003	1
22			min	0.004	2	0.001	2	-0.175	2	-0.048	3	-0.028	3	0	2
23		2	max	0.242	1	0.005	1	0	1	0.039	4	0	1	0	3
24			min	0.006	2	0	2	-0.175	2	-0.048	3	-0.115	2	-0.012	1
25		3	max	0.244	1	0	3	0	1	0.039	4	0	1	0	4
26			min	0.009	2	-0.001	1	-0.175	2	-0.048	3	-0.268	2	-0.013	1
27		4	max	0.246	1	0	3	0	1	0.039	4	0	1	-0.001	4
28			min	0.011	2	0	1	-0.175	2	-0.048	3	-0.421	2	-0.013	1
29		5	max	0.248	1	0	4	0	1	0.039	4	0	1	-0.001	4
30			min	0.013	2	0	1	-0.175	2	-0.048	3	-0.574	2	-0.013	1
31	M4	1	max	0.034	1	0	1	-0.002	4	0.03	3	0.093	1	0.03	2
32			min	0.001	3	-0.099	4	-0.115	1	-0.011	4	0.002	2	-0.059	3
33		2	max	0.034	1	0	1	-0.001	4	0.03	3	0.003	1	0.087	2
34			min	0.001	3	-0.099	4	-0.064	1	-0.011	4	0	2	-0.049	3
35		3	max	0.034	1	0.101	4	0	4	0.03	3	-0.001	4	0.184	4
36			min	0.001	3	-0.009	3	-0.014	1	-0.011	4	-0.036	1	-0.04	3
37		4	max	0.034	1	0.101	4	0.037	1	0.03	3	-0.001	4	0.083	4
38			min	0.001	3	-0.009	3	0.001	3	-0.011	4	-0.024	1	-0.03	3
39		5	max	0.034	1	0.118	2	0.088	1	0.03	3	0.039	1	0	1
40			min	0.001	3	-0.009	3	0.001	3	-0.011	4	0	3	-0.041	2
41	M5	1	max	0.088	1	-0.001	3	0.009	3	0	1	0.011	4	0	3
42			min	0.001	3	-0.034	1	-0.118	2	-0.041	2	-0.03	3	-0.039	1
43		2	max	0.09	1	0	3	0.009	3	0	1	0	1	0	3

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
44			min	0.003	3	-0.011	1	-0.118	2	-0.041	2	-0.12	2	-0.016	1
45		3	max	0.091	1	0	1	0.009	3	0	1	0	1	0	4
46			min	0.004	3	0	2	-0.118	2	-0.041	2	-0.223	2	-0.011	1
47		4	max	0.093	1	0.001	1	0.009	3	0	1	0	1	-0.001	4
48			min	0.006	3	0	2	-0.118	2	-0.041	2	-0.326	2	-0.012	1
49		5	max	0.094	1	0.001	1	0.009	3	0	1	0.003	3	-0.001	4
50			min	0.007	3	0	2	-0.118	2	-0.041	2	-0.429	2	-0.013	1
51	M8	1	max	0	3	0	1	0	3	0	3	0	4	0	4
52			min	0	1	0	2	0	2	0	4	0	1	0	1
53		2	max	0	3	0	1	0	3	0	3	0	3	0	4
54			min	0	1	0	2	0	2	0	4	0	2	0	1
55		3	max	0	3	0	1	0	3	0	3	0	3	0	4
56			min	0	1	0	2	0	2	0	4	0	2	0	1
57		4	max	0	3	0	1	0	3	0	3	0	3	0	4
58			min	0	1	0	2	0	2	0	4	0	2	0	1
59		5	max	0	3	0	1	0	3	0	3	0	3	0	4
60			min	0	1	0	2	0	2	0	4	0	2	0	1
61	M9	1	max	0	3	0	1	0	3	0	3	0	4	0	4
62			min	-0.002	1	0	2	0	2	0	4	0	1	0	1
63		2	max	0	3	0	1	0	3	0	3	0	3	0	4
64			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
65		3	max	0	3	0	1	0	3	0	3	0	3	0	4
66			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
67		4	max	0	3	0	1	0	3	0	3	0	3	0	4
68			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
69		5	max	0	3	0	1	0	3	0	3	0	3	0	4
70			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
71	M10	1	max	0	3	0	1	0	3	0	3	0	4	0	4
72			min	-0.002	1	0	2	0	2	0	4	0	1	0	1
73		2	max	0	3	0	1	0	3	0	3	0	3	0	4
74			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
75		3	max	0	3	0	1	0	3	0	3	0	3	0	4
76			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
77		4	max	0	3	0	1	0	3	0	3	0	3	0	4
78			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
79		5	max	0	3	0	1	0	3	0	3	0	3	0	4
80			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
81	M11	1	max	0	3	0	1	0	3	0	3	0	4	0	4
82			min	-0.002	1	0	2	0	2	0	4	0	1	0	1
83		2	max	0	3	0	1	0	3	0	3	0	3	0	4
84			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
85		3	max	0	3	0	1	0	3	0	3	0	3	0	4
86			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
87		4	max	0	3	0	1	0	3	0	3	0	3	0	4
88			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
89		5	max	0	3	0	1	0	3	0	3	0	3	0	4
90			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
91	M12	1	max	0	3	0	1	0	3	0	3	0	4	0	4
92			min	-0.002	1	0	2	0	2	0	4	0	1	0	1
93		2	max	0	3	0	1	0	3	0	3	0	3	0	4
94			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
95		3	max	0	3	0	1	0	3	0	3	0	3	0	4
96			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
97		4	max	0	3	0	1	0	3	0	3	0	3	0	4
98			min	-0.002	1	0	2	0	2	0	4	0	2	0	1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
99		5	max	0	3	0	1	0	3	0	3	0	3	0	4
100			min	-0.002	1	0	2	0	2	0	4	0	2	0	1
101	M13	1	max	0	3	0	1	0	4	0	3	0	4	0	4
102			min	-0.001	1	0	2	0	2	0	4	0	1	0	1
103		2	max	0	3	0	1	0	4	0	3	0	4	0	4
104			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
105		3	max	0	3	0	1	0	4	0	3	0	4	0	4
106			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
107		4	max	0	3	0	1	0	4	0	3	0	4	0	4
108			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
109		5	max	0	3	0	1	0	4	0	3	0	4	0	4
110			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
111	M14	1	max	0	3	0	1	0	4	0	3	0	4	0	4
112			min	-0.001	1	0	2	0	2	0	4	0	1	0	1
113		2	max	0	3	0	1	0	4	0	3	0	4	0	4
114			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
115		3	max	0	3	0	1	0	4	0	3	0	4	0	4
116			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
117		4	max	0	3	0	1	0	4	0	3	0	4	0	4
118			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
119		5	max	0	3	0	1	0	4	0	3	0	4	0	4
120			min	-0.001	1	0	2	0	2	0	4	0	2	0	1
121	M15	1	max	0	4	0	1	0	4	0	3	0	4	0	4
122			min	0	1	0	2	0	2	0	4	0	1	0	1
123		2	max	0	4	0	1	0	4	0	3	0	4	0	4
124			min	0	1	0	2	0	2	0	4	0	2	0	1
125		3	max	0	4	0	1	0	4	0	3	0	4	0	4
126			min	0	1	0	2	0	2	0	4	0	2	0	1
127		4	max	0	4	0	1	0	4	0	3	0	4	0	4
128			min	0	1	0	2	0	2	0	4	0	2	0	1
129		5	max	0	4	0	1	0	4	0	3	0	4	0	4
130			min	0	1	0	2	0	2	0	4	0	2	0	1
131	M16	1	max	0	4	0	1	0	4	0	3	0	4	0	4
132			min	0	1	0	2	0	3	0	4	0	1	0	1
133		2	max	0	4	0	1	0	4	0	3	0	4	0	4
134			min	0	1	0	2	0	3	0	4	0	3	0	1
135		3	max	0	4	0	1	0	4	0	3	0	4	0	4
136			min	0	1	0	2	0	3	0	4	0	3	0	1
137		4	max	0	4	0	1	0	4	0	3	0	4	0	4
138			min	0	1	0	2	0	3	0	4	0	3	0	1
139		5	max	0	4	0	1	0	4	0	3	0	4	0	4
140			min	0	1	0	2	0	3	0	4	0	3	0	1
141	M17	1	max	0	4	0	1	0	4	0	3	0	4	0	4
142			min	0	1	0	2	0	3	0	4	0	1	0	1
143		2	max	0	4	0	1	0	4	0	3	0	4	0	4
144			min	0	1	0	2	0	3	0	4	0	3	0	1
145		3	max	0	4	0	1	0	4	0	3	0	4	0	4
146			min	0	1	0	2	0	3	0	4	0	3	0	1
147		4	max	0	4	0	1	0	4	0	3	0	4	0	4
148			min	0	1	0	2	0	3	0	4	0	3	0	1
149		5	max	0	4	0	1	0	4	0	3	0	4	0	4
150			min	0	1	0	2	0	3	0	4	0	3	0	1
151	M18	1	max	0	1	0	1	0	4	0	3	0	4	0	4
152			min	0	3	0	2	0	3	0	4	0	1	0	1
153		2	max	0	1	0	1	0	4	0	3	0	4	0	4

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
154			min	0	3	0	2	0	3	0	4	0	3	0	1
155		3	max	0	1	0	1	0	4	0	3	0	4	0	4
156			min	0	3	0	2	0	3	0	4	0	3	0	1
157		4	max	0	1	0	1	0	4	0	3	0	4	0	4
158			min	0	3	0	2	0	3	0	4	0	3	0	1
159		5	max	0	1	0	1	0	4	0	3	0	4	0	4
160			min	0	3	0	2	0	3	0	4	0	3	0	1
161	M19	1	max	0	1	0	1	0	4	0	3	0	4	0	4
162			min	0	3	0	2	0	3	0	4	0	1	0	1
163		2	max	0	1	0	1	0	4	0	3	0	4	0	4
164			min	0	3	0	2	0	3	0	4	0	3	0	1
165		3	max	0	1	0	1	0	4	0	3	0	4	0	4
166			min	0	3	0	2	0	3	0	4	0	3	0	1
167		4	max	0	1	0	1	0	4	0	3	0	4	0	4
168			min	0	3	0	2	0	3	0	4	0	3	0	1
169		5	max	0	1	0	1	0	4	0	3	0	4	0	4
170			min	0	3	0	2	0	3	0	4	0	3	0	1
171	M32	1	max	0	4	0	1	0	2	0	3	0	3	0	1
172			min	-0.006	1	0	2	0	3	0	4	0	2	0	2
173		2	max	0	4	0	1	0	2	0	3	0	3	0	1
174			min	-0.006	1	0	2	0	3	0	4	0	4	0	2
175		3	max	0	4	0	1	0	2	0	3	0	3	0	4
176			min	-0.006	1	0	2	0	3	0	4	0	4	0	1
177		4	max	0	4	0	1	0	2	0	3	0	3	0	4
178			min	-0.006	1	0	2	0	3	0	4	0	4	0	1
179		5	max	0	4	0	1	0	2	0	3	0	3	0	4
180			min	-0.006	1	0	2	0	3	0	4	0	4	0	1
181	M33	1	max	0	4	0	1	0	2	0	3	0	3	0	1
182			min	-0.009	1	0	2	0	3	0	4	0	4	0	2
183		2	max	0	4	0	1	0	2	0	3	0	3	0	1
184			min	-0.009	1	0	2	0	3	0	4	0	4	0	2
185		3	max	0	4	0	1	0	2	0	3	0	3	0	3
186			min	-0.009	1	0	2	0	3	0	4	0	4	0	1
187		4	max	0	4	0	1	0	2	0	3	0	3	0	4
188			min	-0.009	1	0	2	0	3	0	4	0	4	0	1
189		5	max	0	4	0	1	0	2	0	3	0	1	0	4
190			min	-0.009	1	0	2	0	3	0	4	0	4	0	1
191	M34	1	max	0	4	0	1	0	4	0	3	0	3	0	1
192			min	-0.008	1	0	2	0	3	0	4	0	4	0	2
193		2	max	0	4	0	1	0	4	0	3	0	3	0	1
194			min	-0.008	1	0	2	0	3	0	4	0	4	0	2
195		3	max	0	4	0	1	0	4	0	3	0	3	0	1
196			min	-0.008	1	0	2	0	3	0	4	0	4	0	2
197		4	max	0	4	0	1	0	4	0	3	0	3	0	4
198			min	-0.008	1	0	2	0	3	0	4	0	4	0	1
199		5	max	0	4	0	1	0	4	0	3	0	1	0	4
200			min	-0.008	1	0	2	0	3	0	4	0	4	0	1
201	M35	1	max	0	3	0	1	0	4	0	3	0	3	0	1
202			min	-0.006	1	0	2	0	3	0	4	0	4	0	2
203		2	max	0	3	0	1	0	4	0	3	0	3	0	1
204			min	-0.006	1	0	2	0	3	0	4	0	4	0	2
205		3	max	0	3	0	1	0	4	0	3	0	3	0	1
206			min	-0.006	1	0	2	0	3	0	4	0	4	0	2
207		4	max	0	3	0	1	0	4	0	3	0	3	0	4
208			min	-0.006	1	0	2	0	3	0	4	0	4	0	1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
209		5	max	0	3	0	1	0	4	0	3	0	1	0	4
210			min	-0.006	1	0	2	0	3	0	4	0	4	0	1
211	M36	1	max	0	3	0	1	0	4	0	3	0	3	0	1
212			min	-0.004	1	0	2	0	3	0	4	0	4	0	2
213		2	max	0	3	0	1	0	4	0	3	0	3	0	1
214			min	-0.004	1	0	2	0	3	0	4	0	4	0	2
215		3	max	0	3	0	1	0	4	0	3	0	3	0	1
216			min	-0.004	1	0	2	0	3	0	4	0	4	0	2
217		4	max	0	3	0	1	0	4	0	3	0	1	0	4
218			min	-0.004	1	0	2	0	3	0	4	0	4	0	1
219		5	max	0	3	0	1	0	4	0	3	0	1	0	4
220			min	-0.004	1	0	2	0	3	0	4	0	2	0	1
221	M37	1	max	0	3	0	1	0	4	0	3	0	3	0	1
222			min	-0.002	1	0	2	0	3	0	4	0	4	0	2
223		2	max	0	3	0	1	0	4	0	3	0	3	0	1
224			min	-0.002	1	0	2	0	3	0	4	0	4	0	2
225		3	max	0	3	0	1	0	4	0	3	0	3	0	1
226			min	-0.002	1	0	2	0	3	0	4	0	4	0	2
227		4	max	0	3	0	1	0	4	0	3	0	1	0	4
228			min	-0.002	1	0	2	0	3	0	4	0	2	0	1
229		5	max	0	3	0	1	0	4	0	3	0	1	0	4
230			min	-0.002	1	0	2	0	3	0	4	0	2	0	1
231	M38	1	max	0	3	0	1	0	4	0	3	0	3	0	1
232			min	-0.001	1	0	2	0	3	0	4	0	4	0	2
233		2	max	0	3	0	1	0	4	0	3	0	3	0	1
234			min	-0.001	1	0	2	0	3	0	4	0	4	0	2
235		3	max	0	3	0	1	0	4	0	3	0	3	0	1
236			min	-0.001	1	0	2	0	3	0	4	0	4	0	3
237		4	max	0	3	0	1	0	4	0	3	0	1	0	4
238			min	-0.001	1	0	2	0	3	0	4	0	2	0	1
239		5	max	0	3	0	1	0	4	0	3	0	1	0	4
240			min	-0.001	1	0	2	0	3	0	4	0	3	0	1
241	M39	1	max	0	3	0	1	0	4	0	3	0	3	0	1
242			min	0	1	0	2	0	3	0	4	0	4	0	2
243		2	max	0	3	0	1	0	4	0	3	0	3	0	1
244			min	0	1	0	2	0	3	0	4	0	4	0	2
245		3	max	0	3	0	1	0	4	0	3	0	3	0	1
246			min	0	1	0	2	0	3	0	4	0	4	0	3
247		4	max	0	3	0	1	0	4	0	3	0	1	0	4
248			min	0	1	0	2	0	3	0	4	0	2	0	1
249		5	max	0	3	0	1	0	4	0	3	0	1	0	4
250			min	0	1	0	2	0	3	0	4	0	3	0	1
251	M40	1	max	0	1	0	1	0	4	0	3	0	3	0	1
252			min	0	2	0	2	0	3	0	4	0	4	0	2
253		2	max	0	1	0	1	0	4	0	3	0	3	0	1
254			min	0	2	0	2	0	3	0	4	0	4	0	2
255		3	max	0	1	0	1	0	4	0	3	0	3	0	1
256			min	0	2	0	2	0	3	0	4	0	4	0	3
257		4	max	0	1	0	1	0	4	0	3	0	1	0	4
258			min	0	2	0	2	0	3	0	4	0	2	0	1
259		5	max	0	1	0	1	0	4	0	3	0	1	0	4
260			min	0	2	0	2	0	3	0	4	0	3	0	1
261	M41	1	max	0	1	0	1	0	4	0	3	0	3	0	1
262			min	0	2	0	2	0	3	0	4	0	4	0	2
263		2	max	0	1	0	1	0	4	0	3	0	3	0	1

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
264			min	0	2	0	2	0	3	0	4	0	4	0	2
265		3	max	0	1	0	1	0	4	0	3	0	3	0	1
266			min	0	2	0	2	0	3	0	4	0	4	0	3
267		4	max	0	1	0	1	0	4	0	3	0	1	0	4
268			min	0	2	0	2	0	3	0	4	0	2	0	1
269		5	max	0	1	0	1	0	4	0	3	0	1	0	4
270			min	0	2	0	2	0	3	0	4	0	3	0	1
271	M42	1	max	0	1	0	1	0	4	0	3	0	3	0	1
272			min	0	2	0	2	0	3	0	4	0	4	0	2
273		2	max	0	1	0	1	0	4	0	3	0	3	0	1
274			min	0	2	0	2	0	3	0	4	0	4	0	2
275		3	max	0	1	0	1	0	4	0	3	0	3	0	4
276			min	0	2	0	2	0	3	0	4	0	4	0	1
277		4	max	0	1	0	1	0	4	0	3	0	1	0	4
278			min	0	2	0	2	0	3	0	4	0	2	0	1
279		5	max	0	1	0	1	0	4	0	3	0	1	0	4
280			min	0	2	0	2	0	3	0	4	0	3	0	1
281	M43	1	max	0	1	0	1	0	4	0	3	0	3	0	1
282			min	0	2	0	2	0	3	0	4	0	4	0	2
283		2	max	0	1	0	1	0	4	0	3	0	3	0	1
284			min	0	2	0	2	0	3	0	4	0	4	0	2
285		3	max	0	1	0	1	0	4	0	3	0	3	0	4
286			min	0	2	0	2	0	3	0	4	0	4	0	1
287		4	max	0	1	0	1	0	4	0	3	0	1	0	4
288			min	0	2	0	2	0	3	0	4	0	2	0	1
289		5	max	0	1	0	1	0	4	0	3	0	4	0	4
290			min	0	2	0	2	0	3	0	4	0	3	0	1

Envelope AA ADM1-15: ASD - BUILDING Member Aluminum Code Checks

	Member	Shape	Code Check	Loc[ft]	LC	Shear Check	Loc[ft]	Dir	LC	Pnc/Om[k]	Pnt/Om[k]	Mny/Om[k-ft]	Mnz/Om[k-ft]	Vny/Om[k]	Vnz/Om[k]	Cb	Eqn
1	M1	2.375x2.375x.100	0.476	0	3	0.034	1.786	z	3	14.249	17.733	1.156	1.156	5.108	5.108	1.728	H.1-1
2	M2	3.15x1.575x0.078	0.18	4	1	0.093	4	z	3	6.97	13.89	0.5	1.042	5.599	2.575	1	H.1-1
3	M3	2.375x2.375x.100	0.497	3.5	2	0.06	0.255	z	4	14.249	17.733	1.156	1.156	5.108	5.108	1.676	H.1-1
4	M4	3.15x1.575x0.078	0.186	0	1	0.048	0	z	3	6.97	13.89	0.5	1.042	5.599	2.575	1	H.1-1
5	M5	2.375x2.375x.100	0.372	3.5	2	0.067	0.255	z	2	14.249	17.733	1.156	1.156	5.108	5.108	1.668	H.1-1

BASE PLATE & ANCHORAGE DESIGN:

Pages 2,000 - 2,999

250-A Main Street
Klamath Falls, OR. 97601

E-Mail: info@structure1.com
Web: www.structure1.com

ph. (541) 850-6300
fax (541) 850-6233

PSE CONSULTING ENGINEERS INC.

Base plate Design

$$t \geq e\sqrt{\frac{2P_u}{0.9B.N.F_y}}$$

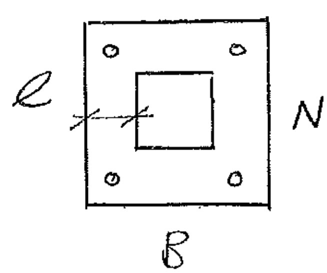
$t = 0.815''$, $e = (4.5 - 2.86)/2 = 1.07''$

$B = N = 4.5''$

$P_u = 810^{lb}$, $F_y = 30\ Ksi$

$$0.35'' \geqslant 1.07\left(\frac{2 * 0.810^{\ Kip}}{0.9 * 4.5 * 4.5 * 30}\right)^{1/2} \qquad (OK)$$

use [4.5" * 4.5" * 0.35 "] plate



PSE CONSULTING ENGINEERS INC.

* Connection Design

post height = 42"

applied load = 200 lb (Concentrated

∴ Moment = 200 lb * 42 in = 8400 lb·in

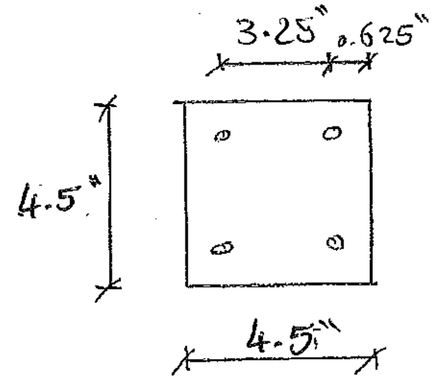
applied load = 50 lb/ft (distributed), 4' spacing

∴ Moment = 50 lb/ft * 4 ft * $\frac{42"}{12 \frac{in}{ft}}$ = 700 lb·ft

∴ Design moment = 700 lb·ft

1) Base plate to Concrete

use ITW Red head Trubolt wedge



Applied moment = 700 lb.ft

$$\text{Tension} = \frac{M}{d}$$

$$= \frac{700\ \text{lb.ft}}{3.875/12} = 2168\ \text{lb}$$

For Concrete > 3000 psi

$\frac{3}{8}"$ ϕ bolt w/ 4" Embedment Tension capacity = 4800 lb

Page 2004

$$\text{Allowable Tensile strength} = \frac{4800\ \text{lb}}{4} = 1200\ \text{lb}$$

F.o.S. → 4

T = 2258 lb is resisted by 2 - Anchors

$\therefore$ 2 bolts capacity (tension) = 2 * 1200 lb = 2400 lb > 2168 lb

PSE CONSULTING ENGINEERS INC.

*check for shear

Applied Shear = 200 lb

Page 2004

Ult. shear Capacity of $\frac{3}{8}"\phi$ bolt = 4000 lb

Allowable shear Capacity = $\frac{4000^{lb}}{4}$ = 1000 lb

Total shear capacity of 4 bolts = 4*1000 lb = 4000 lb > 200 lb OK

*check critical spacing

Min. Allowable spacing = 3" < 4" spacing

So use [4 - $\frac{3}{8}"\phi$ w/ min. 4" Embed.
ITW Red head Trubolt wedge]

Trubolt Wedge Anchor - Technical Data

RED HEAD

2004

PERFORMANCE TABLE

Trubolt
Wedge Anchors

Ultimate Tension and Shear Values (Lbs/kN) in Concrete*

ANCHOR DIA. In. (mm)	INSTALLATION TORQUE Ft. Lbs. (Nm)	EMBEDMENT DEPTH In. (mm)	ANCHOR TYPE	f'c = 2000 PSI (13.8 MPa) TENSION Lbs. (kN)	f'c = 2000 PSI (13.8 MPa) SHEAR Lbs. (kN)	f'c = 4000 PSI (27.6 MPa) TENSION Lbs. (kN)	f'c = 4000 PSI (27.6 MPa) SHEAR Lbs. (kN)	f'c = 6000 PSI (41.4 MPa) TENSION Lbs. (kN)	f'c = 6000 PSI (41.4 MPa) SHEAR Lbs. (kN)
1/4 (6.4)	4 (5.4)	1-1/8 (28.6)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	1,180 (5.2)	1,400 (6.2)	1,780 (7.9)	1,400 (6.2)	1,900 (8.5)	1,400 (6.2)
		1-15/16 (49.2)		2,100 (9.3)	1,680 (7.5)	3,300 (14.7)	1,680 (7.5)	3,300 (14.7)	1,680 (7.5)
		2-1/8 (54.0)		2,260 (10.1)	1,680 (7.5)	3,300 (14.7)	1,680 (7.5)	3,300 (14.7)	1,680 (7.5)
3/8 (9.5)	25 (33.9)	1-1/2 (38.1)		1,620 (7.5)	2,320 (10.3)	2,240 (10.0)	2,620 (11.7)	2,840 (12.6)	3,160 (14.1)
		3 (76.2)		3,480 (15.5)	4,000 (17.8)	5,940 (26.4)	4,140 (18.4)	6,120 (27.2)	4,500 (20.0)
		4 (101.6)		4,800 (21.4)	4,000 (17.8)	5,940 (26.4)	4,140 (18.4)	6,120 (27.2)	4,500 (20.0)
1/2 (12.7)	55 (74.6)	2-1/4 (57.2)		3,455 (20.7)	4,760 (21.2)	4,920 (22.7)	4,760 (21.2)	6,025 (31.3)	7,040 (31.3)
		4-1/8 (104.8)		4,660 (20.7)	7,240 (32.2)	9,640 (42.9)	7,240 (32.2)	10,820 (48.1)	8,160 (36.3)
		6 (152.4)		5,340 (23.8)	7,240 (32.2)	9,640 (42.9)	7,240 (32.2)	10,820 (48.1)	8,160 (36.3)
5/8 (15.9)	90 (122.0)	2-3/4 (69.9)		5,185 (29.3)	7,120 (31.7)	7,180 (31.9)	7,120 (31.7)	9,225 (43.2)	9,616 (42.8
		5-1/8 (130.2)		6,580 (29.3)	9,600 (42.7)	14,920 (66.4)	11,900 (52.9)	16,380 (72.9)	12,520 (55.7)
		7-1/2 (190.5)		7,060 (31.4)	9,600 (42.7)	15,020 (66.8)	11,900 (52.9)	16,380 (72.9)	12,520 (55.7)
3/4 (19.1)	110 (149.2)	3-1/4 (82.6)		6,765 (31.7)	10,120 (45.0)	10,840 (48.2)	13,720 (61.0)	13,300 (59.2)	15,980 (71.1)
		6-5/8 (168.3)		10,980 (48.8)	20,320 (90.4)	17,700 (78.7)	23,740 (105.6)	20,260 (90.1)	23,740 (105.6)
		10 (254.0)		10,980 (48.8)	20,320 (90.4)	17,880 (79.5)	23,740 (105.6)	23,580 (104.9)	23,740 (105.6)
7/8 (22.2)	250 (339.0)	3-3/4 (95.3)		9,290 (42.3)	13,160 (58.5)	14,740 (65.6)	16,580 (73.8)	17,420 (77.5)	19,160 (85.2)
		6-1/4 (158.8)		14,660 (65.2)	20,880 (92.9)	20,940 (93.1)	28,800 (128.1)	24,360 (108.4)	28,800 (128.1)
		8 (203.2)		14,660 (65.2)	20,880 (92.9)	20,940 (93.1)	28,800 (128.1)	24,360 (108.4)	28,800 (128.1)
1 (25.4)	300 (406.7)	4-1/2 (114.3)		11,770 (62.0)	16,080 (71.5)	19,245 (89.8)	22,820 (101.5)	21,180 (94.2)	24,480 (108.9)
		7-3/8 (187.3)		14,600 (64.9)	28,680 (127.6)	23,980 (106.7)	37,940 (168.8)	33,260 (148.0)	38,080 (169.4)
		9-1/2 (241.3)		18,700 (83.2)	28,680 (127.6)	26,540 (118.1)	37,940 (168.8)	33,260 (148.0)	38,080 (169.4)

* Allowable values are based upon a 4 to 1 safety factor. Divide by 4 for allowable load values.

* For Tie-Wire Wedge Anchor, TW-1400, use tension data from 1/4" diameter with 1-1/8" embedment.

* For continuous extreme low temperature applications, use stainless steel.

PERFORMANCE TABLE

Trubolt
Wedge Anchors

Ultimate Tension and Shear Values (Lbs/kN) in Lightweight Concrete*

ANCHOR DIA. In. (mm)	INSTALLATION TORQUE Ft. Lbs. (Nm)	EMBEDMENT DEPTH In. (mm)	ANCHOR TYPE	LIGHTWEIGHT CONCRETE f'c = 3000 PSI (20.7 MPa) TENSION Lbs. (kN)	LIGHTWEIGHT CONCRETE f'c = 3000 PSI (20.7 MPa) SHEAR Lbs. (kN)	LOWER FLUTE OF STEEL DECK WITH LIGHTWEIGHT CONCRETE FILL f'c = 3000 PSI (20.7 MPa) TENSION Lbs. (kN)	LOWER FLUTE OF STEEL DECK WITH LIGHTWEIGHT CONCRETE FILL f'c = 3000 PSI (20.7 MPa) SHEAR Lbs. (kN)
3/8 (9.5)	25 (33.9)	1-1/2 (38.1)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	1,175 (5.2)	1,480 (6.6)	1,900 (8.5)	3,160 (14.1)
		3 (76.2)		2,825 (12.6)	2,440 (10.9)	2,840 (12.6)	4,000 (17.8)
1/2 (12.7)	55 (74.6)	2-1/4 (57.2)		2,925 (13.0)	2,855 (12.7)	3,400 (15.1)	5,380 (23.9)
		3 (76.2)		3,470 (15.4)	3,450 (15.3)	4,480 (19.9)	6,620 (29.4)
		4 (101.6)		4,290 (19.1)	3,450 (15.3)	4,800 (21.4)	6,440 (28.6)
5/8 (15.9)	90 (122.0)	3 (76.2)		4,375 (19.5)	4,360 (19.4)	4,720 (21.0)	5,500 (24.5)
		5 (127.0)		6,350 (28.2)	6,335 (28.2)	6,580 (29.3)	9,140 (40.7)
3/4 (19.1)	110 (149.2)	3-1/4 (82.6)		5,390 (24.0)	7,150 (31.8)	5,840 (26.0)	8,880 (39.5)
		5-1/4 (133.4)		7,295 (32.5)	10,750 (47.8)	7,040 (31.3)	N/A

* Allowable values are based upon a 4 to 1 safety factor. Divide by 4 for allowable load values.

RED HEAD®

Trubolt Wedge Anchor - Technical Data

2005t

PERFORMANCE TABLE

Trubolt Wedge Anchors — Recommended Edge and Spacing Distance Requirements for Shear Loads*

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)	ANCHOR TYPE	EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)	MIN. EDGE DISTANCE AT WHICH THE LOAD FACTOR APPLIED = .60 In. (mm)	MIN. EDGE DISTANCE AT WHICH THE LOAD FACTOR APPLIED = .20 In. (mm)	SPACING REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)	MIN. ALLOWABLE SPACING BETWEEN ANCHORS In. (mm) LOAD FACTOR APPLIED = .40
1/4 (6.4)	1-1/8 (28.6) 1-15/16 (49.2)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	2 (50.8) 1-15/16 (49.2)	1-5/16 (33.3) 1 (25.4)	N/A N/A	3-15/16 (100.0) 3-7/8 (98.4)	2 (50.8) 1-15/16 (49.2)
3/8 (9.5)	1-1/2 (38.1) 3 (76.2)		2-5/8 (66.7) 3-3/4 (95.3)	1-3/4 (44.5) 3 (76.2)	N/A 1-1/2 (38.1)	5-1/4 (133.4) 6 (152.4)	2-5/8 (66.7) 3 (76.2)
1/2 (12.7)	2-1/4 (57.2) 4-1/8 (104.8)		3-15/16 (100.0) 5-3/16 (131.8)	2-9/16 (65.1) 3-1/8 (79.4)	N/A 1-9/16 (39.7)	7-7/8 (200.0) 6-3/16 (157.2)	3-15/16 (100.0) 3-1/8 (79.4)
5/8 (15.9)	2-3/4 (69.9) 5-1/8 (130.2)		4-13/16 (122.2) 6-7/16 (163.5)	3-1/8 (79.4) 3-7/8 (98.4)	N/A 1-15/16 (49.2)	9-5/8 (244.5) 7-11/16 (195.3)	4-13/16 (122.2) 3-7/8 (98.4)
3/4 (19.1)	3-1/4 (82.6) 6-5/8 (168.3)		5-11/16 (144.5) 6-5/16 (160.3)	3-3/4 (95.3) 5 (127.0)	N/A 2-1/2 (63.5)	11-3/8 (288.9) 9-15/16 (252.4)	5-11/16 (144.5) 5 (127.0)
7/8 (22.2)	3-3/4 (95.3) 6-1/4 (158.8)		6-9/16 (166.7) 8-1/2 (215.9)	4-5/16 (109.5) 6-1/4 (158.8)	N/A 3-1/8 (79.4)	13-1/8 (333.4) 12-1/2 (317.5)	6-9/16 (166.7) 6-1/4 (158.8)
1 (25.4)	4-1/4 (108.0) 7-3/8 (187.3)		7-7/8 (200.0) 10-1/16 (255.6)	5-1/8 (130.2) 7-3/8 (187.3)	N/A 3-11/16 (93.7)	15-3/4 (400.1) 14-3/4 (374.7)	7-7/8 (200.0) 7-3/8 (187.3)

* Spacing and edge distances shall be divided by 0.75 when anchors are placed in structural lightweight concrete. Linear interpolation may be used for intermediate spacing and edge distances.

PERFORMANCE TABLE

Trubolt Wedge Anchors — Recommended Edge and Spacing Distance Requirements for Tension Loads*

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)	ANCHOR TYPE	EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)	MIN. ALLOWABLE EDGE DISTANCE AT WHICH THE LOAD FACTOR APPLIED = .65 In. (mm)	SPACING REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)	MIN. ALLOWABLE SPACING AT WHICH THE LOAD FACTOR APPLIED = .70 In. (mm)
1/4 (6.4)	1-1/8 (28.6) 1-15/16 (49.2) 2-1/8 (54.0)	WS-Carbon or WS-G Hot-Dipped Galvanized or WW-304 S.S. or SWW-316 S.S.	2 (50.8) 1-15/16 (49.2) 1-5/8 (41.3)	1 (25.4) 1 (25.4) 13/16 (20.6)	3-15/16 (100.0) 3-7/8 (98.4) 3-3/16 (81.0)	2 (50.8) 1-15/16 (49.2) 1-5/8 (41.3)
3/8 (9.5)	1-1/2 (38.1) 3 (76.2) 4 (101.6)		2-5/8 (66.7) 3 (76.2) 3 (76.2)	1-5/16 (33.3) 1-1/2 (38.1) 1-1/2 (38.1)	5-1/4 (133.4) 6 (152.4) 6 (152.4)	2-5/8 (66.7) 3 (76.2) 3 (76.2)
1/2 (12.7)	2-1/4 (57.2) 4-1/8 (104.8) 6 (152.4)		3-15/16 (100.0) 3-1/8 (79.4) 4-1/2 (114.3)	2 (50.8) 1-9/16 (39.7) 2-1/4 (57.2)	7-7/8 (200.0) 6-3/16 (157.2) 9 (228.6)	3-15/16 (100.0) 3-1/8 (79.4) 4-1/2 (114.3)
5/8 (15.9)	2-3/4 (69.9) 5-1/8 (130.2) 7-1/2 (190.5)		4-13/16 (122.2) 3-7/8 (98.4) 5-5/8 (142.9)	2-7/16 (61.9) 1-15/16 (49.2) 2-13/16 (71.4)	9-5/8 (244.5) 7-1/16 (195.3) 11-1/4 (285.8)	4-13/16 (122.2) 3-7/8 (98.4) 5-5/8 (142.9)
3/4 (19.1)	3-1/4 (82.6) 6-5/8 (168.3) 10 (254.0)		5-11/16 (144.5) 5 (127.0) 7-1/2 (190.5)	2-7/8 (73.0) 2-1/2 (63.5) 3-3/4 (95.3)	11-3/8 (288.9) 9-15/16 (252.4) 15 (381.0)	5-11/16 (144.5) 5 (127.0) 7-1/2 (190.5)
7/8 (22.2)	3-3/4 (95.3) 6-1/4 (158.8) 8 (203.2)		6-9/16 (166.7) 6-1/4 (158.8) 6 (152.4)	3-5/16 (84.1) 3-1/8 (79.4) 3 (76.2)	13-1/8 (333.4) 12-1/2 (317.5) 12 (304.8)	6-9/16 (166.7) 6-1/4 (158.8) 6 (152.4)
1 (25.4)	4-1/2 (114.3) 7-3/8 (187.3) 9-1/2 (241.3)		7-7/8 (200.0) 7-3/8 (187.3) 7-1/8 (181.0)	3-15/16 (100.0) 3-11/16 (93.7) 3-9/16 (90.5)	15-3/4 (400.1) 14-3/4 (374.7) 14-1/4 (362.0)	7-7/8 (200.0) 7-3/8 (187.3) 7-1/8 (181.0)

* Spacing and edge distances shall be divided by 0.75 when anchors are placed in structural lightweight concrete. Linear interpolation may be used for intermediate spacing and edge distances.

Combined Tension and Shear Loading—for Trubolt Anchors

Allowable loads for anchors subjected to combined shear and tension forces are determined by the following equation:

$$(Ps/Pt)^{5/3} + (Vs/Vt)^{5/3} \le 1$$

Ps = Applied tension load Vs = Applied shear load Pt = Allowable tension load Vt = Allowable shear load

Trubolt Wedge Anchor - Technical Data

2006

ITW RED HEAD TRUBOLT WEDGE ANCHOR

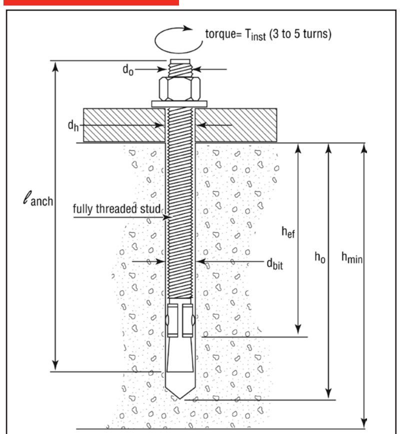
DESIGN INFORMATION TESTED TO ICC-ES AC193 AND ACI 355.2, IN ACCORDANCE WITH 2015 IBC

TRUBOLT WEDGE ANCHOR DESIGN INFORMATION[1,2,3]

DESIGN INFORMATION	Symbol	Units	Nominal Anchor Diameter									
			1/4		3/8		1/2		5/8		3/4	
Anchor O.D.	d_o	in	0.250		0.375		0.500		0.625		0.750	
Effective embedment	h_{ef}	in	1-1/2	2	1-3/4	2-5/8	1-7/8	3-3/8	2-1/2	4	3-1/2	4-3/4
Minimum member thickness	h_{min}	in	4	4	4	5	5	6	5	8	6	8
Critical edge distance	c_{ac}	in	2-5/8	3	2-5/8	5-1/4	3-3/4	6-3/4	5	8	7	9
Minimum edge distance	c_{min}	in	1-3/4	1-1/2	2-1/4	2	3-3/4	3-3/4	4-1/4	3-1/4	3-3/4	3-1/2
Minimum anchor spacing	s_{min}	in	1-3/4	1-1/2	2-1/4	2	3-3/4	3-3/4	4-1/4	3-1/4	3-3/4	3-1/2
Min. Specified Yield Strength	f_y	lb/in²	55,000									
Min. Specified Ultimate Strength	f_{uta}	lb/in²	75,000									
Effective tensile stress area	A_{se}	in²	0.032		0.078		0.142		0.226		0.334	
Steel strength in tension	N_s	lb	2,385		5,815		10,645		16,950		25,050	
Steel strength in shear	V_s	lb	1,430		2,975	3,490	4,450	6,385	6,045	10,170	10,990	15,030
Pullout strength, uncracked concrete	$N_{p,uncr}$	lb	1,392	1,706	2,198	3,469	2,400	4,168	4,155	6,638	8,031	10,561
Anchor Category (All anchors are ductile)			1									
Effectiveness factor k_{uncr} uncracked concrete			24									
Axial stiffness in service load range	β	lb/in	14,651	9,385	17,515	26,424	32,483	26,136	42,899	21,749	43,576	28,697
Coefficient for variation for axial stiffness in service load range			34	47	28	45	17	33	55	22	63	28
Strength reduction factor ϕ for tension, steel failure modes			0.75									
Strength reduction factor ϕ for shear, steel failure modes			0.65									
Strength reduction factor ϕ for tension, concrete failure modes, Condition B			0.65									
Strength reduction factor ϕ for shear, concrete failure modes, Condition B			0.70									

[1] Trubolt+ Anchor Design Strengths must be determined in accordance with ACI 318-05 Appendix D and this table
[2] The Trubolt+ Wedge Anchor is a ductile steel element as defined by ACI 318 D.1
[3] 1/4", 3/8", & 1/2" diameter data is listed in ICC-ES ESR-2251.

TRUBOLT WEDGE ANCHOR (IN-



TRUBOLT WEDGE INSTALLATION INFORMATION

	Symbol	Units	Nominal Anchor Diameter (in.)									
			1/4		3/8		1/2		5/8		3/4	
Anchor outer diameter	d_o	in	0.25		0.375		0.5		0.625		0.750	
Nominal carbide bit diameter	d_{bit}	in	1/4		3/8		1/2		5/8		3/4	
Effective embedment depth	h_{ef}	in	1-1/2	2	1-3/4	2-5/8	1-7/8	3-3/8	2-1/2	4	3-1/2	4-3/4
Min hole depth	h_o	in	2	2-1/2	2-1/2	3-3/8	2-3/4	4-1/4	3-3/4	5-1/4	4-3/4	6
Min slab thickness	h_{min}	in	4		4	5	5	6	5	8	6	8
Installation torque	T_{inst}	ft-lb	4		25		55		90		110	
Min hole diameter in fixture	d_h	in	5/16		7/16		9/16		11/16		13/16	

RED HEAD

Trubolt Wedge Anchor - Technical Data

Strength Design Performance values in accordance to 2015 IBC

2007

TRUBOLT WEDGE PULLOUT STRENGTH ($N_{p,unc}$) (POUNDS) [1]

Nominal Anchor Diameter (in.)	Effective Embedment Depth (in.)	Concrete Compressive Strength			
		f'c = 2,500 psi	f'c = 3,000 psi	f'c = 4,000 psi	f'c = 6,500 psi
1/4	1-1/2	1,392	1,525	1,610	1,822
	2	1,706	1,869	1,947	2,151
3/8	1-3/4	2,198	2,408	2,621	3,153
	2-5/8	3,469	3,800	3,936	4,275
1/2	1-7/8	2,400	2,629	3,172	4,520
	3-3/8	4,168	4,520	4,520	4,520
5/8	2-1/2	4,155	4,155	4,376	5,578
	4	6,638	6,900	7,968	10,157
3/4	3-1/2	8,031	8,322	9,610	12,251
	4-3/4	10,561	10,561	10,561	12,251

For SI: 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 0.006895 Mpa

1 Values are for single anchors with no edge distance or spacing reduction.

TRUBOLT WEDGE ANCHOR ALLOWABLE STATIC TENSION (ASD), NORMAL-WEIGHT UNCRACKED CONCRETE [1-6]

Nominal Anchor Diameter (in.)	Effective Embedment Depth (in.)	Concrete Compressive Strength			
		f'c = 2,500 psi	f'c = 3,000 psi	f'c = 4,000 psi	f'c = 6,500 psi
1/4	1-1/2	611	670	707	800
	2	749	821	855	945
3/8	1-3/4	965	1,058	1,151	1,385
	2-5/8	1,524	1,669	1,729	1,878
1/2	1-7/8	1,054	1,155	1,393	1,985
	3-3/8	1,831	1,985	1,985	1,985
5/8	2-1/2	1,825	1,825	1,922	2,450
	4	2,915	3,030	3,499	4,461
3/4	3-1/2	3,527	3,655	4,221	5,381
	4-3/4	4,638	4,638	4,638	5,381

For SI: 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 0.006895 Mpa

Design Assumptions:

1 Single anchor with static tension load only.

2 Concrete determined to remain uncracked for the life of the anchorage.

3 Load combinations from 2006 IBC, Sections 1605.2.1 and 1605.3.1 (no seismic loading).

4 Thirty percent dead load and 70 percent live load, controlling load combination 1.2D + 1.6L

5 Calculation of weighted average: 1.2D + 1.6L = 1.2 (0.3) + 1.6 (0.7) = 1.48

6 Values do not include edge distance or spacing reductions.

TRUBOLT WEDGE ANCHOR ALLOWABLE STATIC SHEAR (ASD), STEEL (POUNDS)[1-5]

Nominal Anchor Diameter (in.)	Effective Embedment Depth (in.)	Allowable Steel Capacity, Static Shear
1/4	1-1/2	628
	2	
3/8	1-3/4	1,307
	2-5/8	1,533
1/2	1-7/8	1,954
	3-3/8	2,804
5/8	2-1/2	2,655
	4	4,467
3/4	3-1/2	4,827
	4-3/4	6,601

For SI: 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 psi = 0.006895 Mpa

Design Assumptions:

1 Single anchor with static shear load only.

3 Load combinations from 2006 IBC, Sections 1605.2.1 and 1605.3.1 (no seismic loading).

3 Thirty percent dead load and 70 percent live load, controlling load combination 1.2D + 1.6L

4 Calculation of weighted average: 1.2D + 1.6L = 1.2 (0.3) + 1.6 (0.7) = 1.48

5 Values do not include edge distance or spacing reductions.

PSE CONSULTING ENGINEERS INC.

* Red head LDT (SLDT-3816

For Concrete > 3000 psi

$\frac{3}{8}$" ϕ bolt :

Page 2009

Allowable Tension Capacity = 1656 lb

$\therefore$ 2 bolts capacity = 2 * 1656 lb = 3312 lb > 2258 lb

Page 2009

Allowable shear capacity = 842 lb

$\therefore$ 4 bolts capacity = 4 * 842 lb = 3368 lb > 200 lb

Use [$\frac{3}{8}$" ϕ w/min 4" Embed Redhead LDT (SLDT-3816)]

LDT Anchor - Technical Data

2009

PERFORMANCE TABLE

LDT Anchors Ultimate Tension and Shear Values (Lbs/kN) in Concrete

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)	f'c = 2000 PSI (13.8 MPa) TENSION Lbs. (kN)	f'c = 2000 PSI (13.8 MPa) SHEAR Lbs. (kN)	f'c = 3000 PSI (20.7 MPa) TENSION Lbs. (kN)	f'c = 3000 PSI (20.7 MPa) SHEAR Lbs. (kN)	f'c = 4000 PSI (27.6 MPa) TENSION Lbs. (kN)	f'c = 4000 PSI (27.6 MPa) SHEAR Lbs. (kN)
3/8 (9.5)	1-1/2 (38.1)	1,336 (5.9)	2,108 (9.4)	1,652 (7.3)	2,764 (12.3)	1,968 (8.8)	3,416 (15.2)
	2 (50.8)	1,492 (6.6)	3,036 (13.5)	2,024 (9.0)	3,228 (14.4)	2,552 (11.4)	3,420 (15.2)
	2-1/2 (63.5)	3,732 (16.6)	3,312 (14.7)	3,748 (16.7)	3,364 (15.0)	3,760 (16.7)	3,424 (15.2)
	3-1/2 (88.9)	5,396 (24.0)	3,312 (14.7)	6,624 (29.5)	3,368 (15.0)	7,852 (34.9)	3,428 (15.2)
1/2 (12.7)	2 (50.8)	3,580 (15.9)	5,644 (25.1)	3,908 (17.4)	6,512 (29.0)	4,236 (18.8)	7,380 (32.8)
	3-1/2 (88.9)	7,252 (32.3)	6,436 (28.6)	8,044 (35.8)	7,288 (32.4)	8,836 (39.3)	8,140 (36.2)
	4-1/2 (114.3)	10,176 (45.3)	7,384 (32.8)	10,332 (46.0)	7,968 (35.4)	10,488 (46.7)	8,552 (38.0)
5/8 (15.9)	2-3/4 (69.9)	5,276 (23.5)	8,656 (38.5)	6,560 (29.2)	11,064 (49.2)	7,844 (34.8)	13,476 (59.9)
	3-1/2 (88.9)	7,972 (35.5)	10,224 (45.5)	9,848 (43.8)	12,144 (54.0)	11,724 (52.2)	14,060 (62.5)
	4-1/2 (114.3)	11,568 (51.5)	12,316 (54.8)	13,432 (59.8)	13,580 (60.4)	16,892 (75.1)	14,840 (66.0)
3/4 (19.1)	3-1/4 (82.6)	6,876 (30.6)	7,140 (31.8)	9,756 (43.4)	10,728 (47.7)	12,636 (56.2)	14,316 (63.6)
	4-1/2 (114.3)	10,304 (45.8)	13,120 (58.4)	14,424 (64.2)	16,868 (75.0)	18,540 (82.5)	20,612 (91.7)
	5-1/2 (139.7)	13,048 (58.0)	17,908 (79.7)	18,156 (80.8)	21,718 (96.9)	23,268 (130.5)	25,652 (114.1)

PERFORMANCE TABLE

LDT Anchors Allowable Tension and Shear Values* (Lbs/kN) in Concrete Carbon and Stainless Steel

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)	f'c = 2000 PSI (13.8 MPa) TENSION Lbs. (kN)	f'c = 2000 PSI (13.8 MPa) SHEAR Lbs. (kN)	f'c = 3000 PSI (20.7 MPa) TENSION Lbs. (kN)	f'c = 3000 PSI (20.7 MPa) SHEAR Lbs. (kN)	f'c = 4000 PSI (27.6 MPa) TENSION Lbs. (kN)	f'c = 4000 PSI (27.6 MPa) SHEAR Lbs. (kN)
3/8 (9.5)	1-1/2 (38.1)	334 (1.5)	527 (2.3)	413 (1.8)	691 (3.1)	492 (2.1)	854 (3.8)
	2 (50.8)	373 (1.7)	759 (3.4)	506 (2.2)	807 (3.6)	638 (2.8)	855 (3.8)
	2-1/2 (63.5)	933 (4.2)	828 (3.7)	937 (4.2)	841 (3.7)	940 (4.2)	856 (3.8)
	3-1/2 (88.9)	1,349 (6.0)	828 (3.7)	1,656 (7.4)	842 (3.7)	1,963 (8.7)	857 (3.8)
1/2 (12.7)	2 (50.8)	895 (4.0)	1,411 (6.3)	977 (4.3)	1,628 (7.2)	1,059 (4.7)	1,845 (8.2)
	3-1/2 (88.9)	1,813 (8.0)	1,609 (7.2)	2,011 (8.9)	1,822 (8.1)	2,209 (9.8)	2,035 (9.0)
	4-1/2 (114.3)	2,544 (11.3)	1,846 (8.2)	2,583 (11.5)	1,992 (8.9)	2,622 (11.7)	2,138 (9.5)
5/8 (15.9)	2-3/4 (69.9)	1,319 (5.9)	2,164 (9.7)	1,640 (7.3)	2,766 (12.3)	1,961 (8.7)	3,369 (15.0)
	3-1/2 (88.9)	1,993 (8.9)	2,556 (11.4)	2,462 (10.9)	3,036 (13.5)	2,931 (13.0)	3,515 (15.6)
	4-1/2 (114.3)	2,892 (12.9)	3,079 (13.7)	3,358 (14.9)	3,395 (15.1)	4,223 (18.8)	3,710 (16.5)
3/4 (19.1)	3-1/4 (82.6)	1,719 (7.6)	1,785 (7.9)	2,439 (10.8)	2,682 (11.9)	3,159 (14.0)	3,579 (15.9)
	4-1/2 (114.3)	2,576 (11.5)	3,280 (14.6)	3,606 (16.0)	4,217 (18.7)	4,635 (20.6)	5,153 (22.9)
	5-1/2 (139.7)	3,262 (14.5)	4,477 (19.9)	4,539 (20.2)	5,445 (24.2)	5,817 (25.9)	6,413 (28.5)

* Allowable values are based upon a 4 to 1 safety factor. (Ultimate/4)

RED HEAD®

LDT Anchor - Technical Data

2010

PERFORMANCE TABLE

LDT Anchors
*Recommended Edge & Spacing Requirements for Tension Loads**
Carbon and Stainless Steel

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)		EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)		AT MIN. EDGE DISTANCE 1-3/4 Inches (44mm)	SPACING DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)		LOAD FACTOR APPLIED AT MIN. SPACING DISTANCE 3 Inches (76mm)
3/8 (9.5)	1-1/2	(38.1)	2	(50.8)	70%	6	(152.4)	44%
	2	(50.8)	2	(50.8)	70%	6	(152.4)	44%
	2-1/2	(63.5)	3	(76.2)	70%	6	(152.4)	44%
	3-1/2	(88.9)	4	(101.6)	70%	6	(152.4)	44%
1/2 (12.7)	2	(50.8)	2-1/4	(57.2)	65%	8	(203.2)	27%
	3-1/2	(88.9)	3	(76.2)	65%	8	(203.2)	27%
	4-1/2	(114.3)	4	(101.6)	65%	8	(203.2)	27%
ANCHOR DIA. In. (mm)	**EMBEDMENT DEPTH In. (mm)**		**EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)**		**AT MIN. EDGE DISTANCE 1-3/4 Inches (44mm)**	**SPACING DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)**		**LOAD FACTOR APPLIED AT MIN. SPACING DISTANCE 3.75 Inches (95.2mm)**
5/8 (15.9)	2-3/4	(69.9)	6-1/4	(158.8)	65%	10	(254)	50%
	3-1/2	(88.9)	6-1/4	(158.8)	65%	10	(254)	50%
	4-1/2	(114.3)	6-1/4	(158.8)	65%	10	(254)	50%
ANCHOR DIA. In. (mm)	**EMBEDMENT DEPTH In. (mm)**		**EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)**		**AT MIN. EDGE DISTANCE 1-3/4 Inches (44mm)**	**SPACING DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)**		**LOAD FACTOR APPLIED AT MIN. SPACING DISTANCE 4.5 Inches (114.3mm)**
3/4 (19.1)	3-1/2	(82.6)	7-1/2	(191)	65%	12	(305)	50%
	4-1/2	(114.3)	7-1/2	(191)	65%	12	(305)	50%
	5-1/2	(139.7)	7-1/2	(191)	65%	12	(305)	50%

* Edge and spacing distance shall be divided by .75 when anchors are placed in structural lightweight concrete. Linear interpolation may be used for intermediate spacing and edge distances.

For 5/8" and 3/4" LDT Anchors, the critical edge distance for these anchors is 10 times the anchor diameter. The edge distance of these anchors may be reduced to 1-3/4" provided a 0.65 load factor is used for tension loads, a 0.15 load factor is used for shear loads applied perpendicular to the edge, or a 0.60 load factor is used for shear loads applied parallel to the edge. Linear interpolation may be used for intermediate edge distances.

PERFORMANCE TABLE

LDT Anchors
*Recommended Edge & Spacing Requirements for Shear Loads**
Carbon and Stainless Steel

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)		EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)		AT MIN. EDGE DISTANCE 1-3/4 Inches (44mm)	SPACING DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD In. (mm)		LOAD FACTOR APPLIED AT MIN. SPACING DISTANCE 3 Inches (76mm)
3/8 (9.5)	1-1/2	(38.1)	3	(76.2)	25%	6	(152.4)	57%
	2	(50.8)	4	(101.6)	25%	6	(152.4)	57%
	2-1/2	(63.5)	5	(127.0)	25%	6	(152.4)	57%
	3-1/2	(88.9)	5	(127.0)	25%	6	(152.4)	57%
1/2 (12.7)	2	(50.8)	5	(127.0)	25%	8	(203.2)	60%
	3-1/2	(88.9)	5	(127.0)	25%	8	(203.2)	60%
	4-1/2	(114.3)	5-1/2	(139.7)	25%	8	(203.2)	60%
5/8 (15.9)	2-3/4	(69.9)	6-1/4	(158.8)	15%**/60%***	10	(254)	75%
	3-1/2	(88.9)	6-1/4	(158.8)	15%**/60%***	10	(254)	75%
	4-1/2	(114.3)	6-1/4	(158.8)	15%**/60%***	10	(254)	75%
3/4 (19.1)	3-1/2	(82.6)	7-1/2	(191)	15%**/60%***	12	(305)	75%
	4-1/2	(114.3)	7-1/2	(191)	15%**/60%***	12	(305)	75%
	5-1/2	(139.7)	7-1/2	(191)	15%**/60%***	12	(305)	75%

* Edge and spacing distances shall be divided by .75 when anchors are placed in structural lightweight concrete. Linear interpolation may be used for intermediate spacing and edge distances.

** 15% = shear load applied perpendicular to the edge

*** 60% = shear load applied parallel to the edge

LDT Anchor - Technical Data

2011

PERFORMANCE TABLES

LDT Anchors — Ultimate Tension Load (Lbs/kN) in Concrete Block
(anchors should be installed by hand in hollow block)

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)	HOLLOW CONCRETE BLOCK		GROUT FILLED CONCRETE BLOCK	
		TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)
3/8 (9.5)	1-1/2 (38.1)	916 (4.1)	3,176 (14.1)	1,592 (7.1)	3,900 (17.3)
1/2 (12.7)	2-1/2 (63.5)	N/A	N/A	5,924 (26.4)	6,680 (29.7)

LDT Anchors — Allowable Tension and Shear* (Lbs/kN) in Concrete Block
(anchors should be installed by hand in hollow block)

ANCHOR DIA. In. (mm)	EMBEDMENT DEPTH In. (mm)	HOLLOW CONCRETE BLOCK		GROUT FILLED CONCRETE BLOCK	
		TENSION Lbs. (kN)	SHEAR Lbs. (kN)	TENSION Lbs. (kN)	SHEAR Lbs. (kN)
3/8 (9.5)	1-1/2 (38.1)	229 (1.0)	794 (3.5)	398 (1.8)	975 (4.3)
1/2 (12.7)	2-1/2 (63.5)	N/A	N/A	1,481 (6.6)	1,670 (7.4)

* Allowable values are based upon a 4 to 1 safety factor. (Ultimate/4)

LDT Anchors — Anchoring Overhead in 3000 PSI Lightweight Concrete On Metal Deck

ANCHOR	DRILL HOLE DIAMETER In. (mm)	EMBEDMENT In. (mm)	3000PSI (20.7 MPa) CONCRETE		
				ULTIMATE TENSION LOAD Lbs. (kN)	ALLOWABLE WORKING LOAD Lbs. (kN)
3/8″ LDT	5/16 (7.9)	1-1/2 (38.1)	Upper Flute	2,889 (12.9)	722 (3.2)
			Lower Flute	1,862 (8.3)	465 (2.1)

PSE CONSULTING ENGINEERS INC.

* Red head SRM-38 bolt

For Concrete > 3000 psi

$\frac{1}{2}$" ϕ bolt:

Page 2016

ultimate tension capacity = 5840 lb

allowable tension capacity = $\frac{5840^{lb}}{4}$ = 1460 lb

F.o.S

∴ 2 bolts tension capacity = 2 * 1460^{lb} = 2920 lb > 2168 lb

Page 2016

ultimate shear capacity = 4580 lb

allowable shear capacity = $\frac{4580}{4}$ = 2290 lb

∴ 4 bolts shear capacity = 4 * 2290^{lb} = 4580 lb > 200^{lb}

use [$\frac{1}{2}$" ϕ w/min 4" Embed, Red head SRM-38]

Multi-Set II® Drop-In Anchors

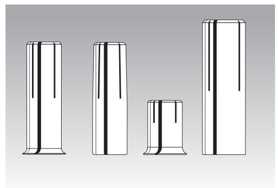
Internally Threaded Heavy-Duty Anchoring Systems

DESCRIPTION/SUGGESTED SPECIFICATIONS

Drop-In, Shell-Type Anchors—

SPECIFIED FOR ANCHORAGE INTO CONCRETE

Drop-In, shell-type anchors feature an internally threaded, all-steel shell with expansion cone insert and flush embedment lip. Anchors are manufactured from zinc-plated carbon steel, 18-8 stainless steel and 316 stainless steel.



Multi-Set II Drop-In Anchors

Anchors should be installed with carbide tipped hammer drill bits made in accordance to ANSI B212.15-1994 specifications.

The minimum concrete thickness for an anchor is 1-1/2 times the embedment depth – or the embedment depth plus three times the anchor diameter – whichever is greater.

Anchors should be tested to ASTM E488 criteria.

ADVANTAGES

Short Drop-In (RX) Anchors

Ideal for Hollow-Core, Pre-Cast Plank and Post Tension Slabs

DepthCharge™ Stop Drill

- Optimized for use in hollow-core, pre-cast plank and post-tension slabs
- Lip keeps anchor flush during installation
- Shallow drilling—fast installation

RX Drop-In Anchor

RM Drop-In Anchor

- Lipped anchor body keeps anchor flush
- Easy installation
- Keeps all rods same length
- Easy inspection
- Available in carbon steel, 18-8 and 316 stainless steel

RL Drop-In Anchor

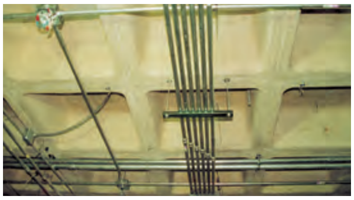
- Below surface setting for easy patch work

Coil Thread Anchor

- Quick thread attachment—ideal for 1 sided forming
- Use coil rod on job
- 2 diameters (1/2" and 3/4")

APPLICATIONS

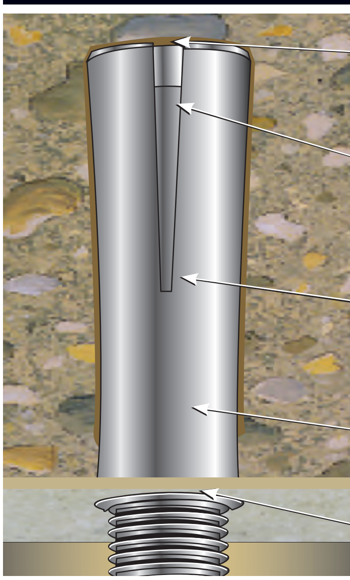
Pumps and heavy piping are common applications for larger diameter Multi-Set Drop-In Anchors.



Cable tray and strut suspended from concrete ceilings are ideal Multi-Set applications. In post-tension or hollow-core slabs use the RX-38.

The Multi-Set Anchor is the standard for pipe-hanging. The RM version has a retainer lip to keep all anchors flush at the surface, keeping all your threaded rod the same length.

FEATURES



Expander Slots—allow for easy setting and superior performance

Cone Insert—that expands the anchor when driven with setting tool and hammer

Body—available in zinc-plated steel, 18-8 stainless steel, and 316 stainless steel

Easy Depth Inspection—keeps threaded rod drop lengths consistent

Retainer Lip—to keep anchor flush with surface

For use with threaded rods or headed bolts (supplied by contractor)

APPROVALS/LISTINGS

Meets or exceeds U.S. Government G.S.A. Specification A-A-55614 Type 1 (Formerly GSA: FF-S-325 Group VIII)

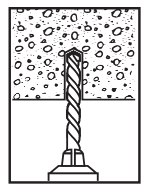
Multi-Set II Drop-in anchors may be covered by one or more of the following approvals/listings:

- Underwriters Laboratories
- Factory Mutual
- Caltrans

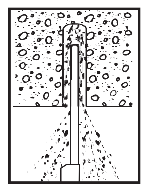
See Selection Chart next page.

INSTALLATION STEPS

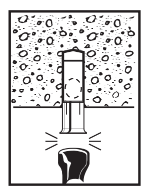
To set anchor flush with surface:



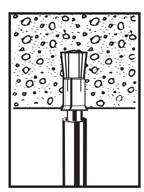
1. Drill hole to required embedment (see Table on page 82).



2. Clean hole with pressurized air.



3. Drive anchor flush with surface of concrete.



4. Expand anchor with setting tool provided (see chart on page 82). Anchor is properly expanded when shoulder of setting tool is flush with top of anchor.

SELECTION CHART

Bits for RX-38 and RX-12 Short Drop-Ins

BIT NO.	DESCRIPTION	DRILLING DEPTH
DCX-138	3/8" Depth Charge Stop Drill (RX-38)	3/4"
DCX-112	1/2" Depth Charge Stop Drill (RX-12)	1"

DepthCharge™ Stop Drill

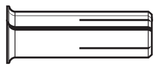
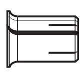
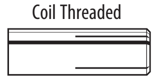
- Shoulder prevents over drilling. Less likely to hit reinforcing steel or post-tension cable in concrete
- No wasted time or energy drilling deeper than necessary
- Prevents anchor from dropping too far into hole below work surface

SELECTION CHARTS

Multi-Set II
Drop-In Anchors

PART NUMBER RTX-138
For use with RX-38 only.

PART NUMBER RTX-112
For use with RX-12 only.

USER TYPE / APPLICATION	BASE MATERIAL	DROP-IN ANCHOR TYPE	APPROVALS	PART NO.	SETTING TOOL PART NO.*	BOLT SIZE/ THREADS PER INCH	DRILL BIT DIAM. in.	DRILL BIT DIAM. (mm)	THREAD DEPTH in.	THREAD DEPTH (mm)	EMBEDMENT MIN. HOLE DEPTH*** in.	EMBEDMENT MIN. HOLE DEPTH*** (mm)	QTY/WT PER BOX qty / lbs.	QTY/ WT PER MASTER CARTON qty / lbs.
HVAC/Fire Sprinkler Plumber (Pipe-fitter)	Solid concrete/ lightweight fill deck	RM 	Caltrans	RM-14	RT-114	1/4" / 20	3/8	(9.5)	3/8	(9.5)	1	(25.4)	100 / 2.6	1000 / 28
			UL, FM	RM-38	RT-138	3/8" / 16	1/2	(12.7)	1/2	(12.7)	1-5/8	(41.3)	50 / 3.4	500 / 36
			UL, FM Caltrans	RM-12	RT-112	1/2" / 13	5/8	(15.9)	3/4	(19.1)	2	(50.8)	50 / 5.8	400 / 49
			UL, FM	RM-58	RT-158	5/8" / 11	7/8	(22.2)	1	(25.4)	2-1/2	(63.5)	25 / 7.8	125 / 41
			UL, FM Caltrans	RM-34	RT-134	3/4" / 10	1	(25.4)	1-1/4	(31.8)	3-3/16	(81.0)	25 / 11.9	100 / 49
	Hollow-core pre-cast or Post tension	RX 	N/A	RX-38	RTX-138	3/8" / 16	1/2	(12.7)	3/8	(9.5)	3/4	(19.1)	100 / 3.5	1000 / 36
			N/A	RX-12	RTX-112	1/2" / 13	5/8	(15.9)	1/2	(12.7)	1	(25.4)	50 / 3.0	500 / 31
	Solid concrete/ lightweight fill deck	SRM** 18-8 S.S. 	N/A	SRM-14	RT-114	1/4" / 20	3/8	(9.5)	3/8	(9.5)	1	(25.4)	100 / 2.7	1000 / 28
			UL, FM	SRM-38	RT-138	3/8" / 16	1/2	(12.7)	1/2	(12.7)	1-5/8	(41.3)	50 / 3.4	500 / 36
			UL, FM	SRM-12	RT-112	1/2" / 13	5/8	(15.9)	3/4	(19.1)	2	(50.8)	50 / 6.0	400 / 50
			UL, FM	SRM-58	RT-158	5/8" / 11	7/8	(22.2)	1	(25.4)	2-1/2	(63.5)	25 / 7.9	125 / 42
			N/A	SRM-34	RT-134	3/4" / 10	1	(25.4)	1-1/4	(31.8)	3-3/16	(81.0)	25 / 12.0	100 / 50
	Solid concrete	SSRM** 316 S.S.	N/A	SSRM-12	RT-112	1/2" / 13	5/8	(15.9)	3/4	(19.1)	2	(50.8)	50 / 6.0	400 / 50
Concrete Contractor, General Contractor	Solid concrete	CL Coil Threaded 	N/A	CL-12	RT-112	1/2" / 6	5/8	(15.9)	3/4	(19.1)	2	(50.8)	50 / 5.7	400 / 47
			N/A	CL-34	RT-134	3/4" / 4.5	1	(25.4)	1-1/4	(31.8)	3-3/16	(81.0)	25 / 11.9	100 / 49
Concrete Cutting/Sawing Contractor/Misc. Metal	Solid concrete/ lightweight fill deck	RL (w/o lip) 	N/A	RL-14	RT-114	1/4" / 20	3/8	(9.5)	3/8	(9.5)	1	(25.4)	100 / 2.6	1000 / 28
			N/A	RL-38	RT-138	3/8" / 16	1/2	(12.7)	1/2	(12.7)	1-5/8	(41.3)	50 / 3.4	500 / 36
			N/A	RL-12	RT-112	1/2" / 13	5/8	(15.9)	3/4	(19.1)	2	(50.8)	50 / 5.8	400 / 49
			N/A	RL-58	RT-158	5/8" / 11	7/8	(22.2)	1	(25.4)	2-1/2	(63.5)	25 / 7.8	125 / 41
			N/A	RL-34	RT-134	3/4" / 10	1	(25.4)	1-1/4	(31.8)	3-3/16	(81.0)	25 / 11.9	100 / 49

* 1 setting tool per master carton. ** For continuous extreme low temperature, use stainless steel. *** Embedment is equal to overall length of Drop-In Anchor

RX-38 and RX-12 Short Drop-In Kits

PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
RX-38	3/8″ drop-in	**RX-12**	1/2″ drop-in
RTX-138	Setting Tool for RX-38	**RTX-112**	Setting Tool for RX-12
DCX-138	Depth Charge Stop Drill – ½"	**DCX-112**	Depth Charge Stop Drill – ⅝"

PERFORMANCE TABLE

Multi-Set II Drop-In Anchors

Ultimate Tension and Shear Values (lbs/kN) in Solid Concrete*

BOLT DIAM. in.	(mm)	DRILL BIT SIZE in.	(mm)	MIN. EMBEDMENT DEPTH in.	(mm)	ANCHOR TYPE	TENSION lbs. (kN) f'c = 2000 PSI	(13.8 MPa)	f'c = 4000 PSI	(27.6 MPa)	f'c = 6000 PSI	(41.4 MPa)	SHEAR lbs. (kN) f'c ≥ 2000 PSI	(13.8 MPa)
1/4	(6.4)	3/8	(9.5)	1	(25.4)	RM, RL or CL-Carbon or SRM-18-8 S.S. or SSRM 316 S.S	1,680	(7.5)	2,360	(10.5)	2,980	(13.3)	1,080	(4.8)
3/8	(9.5)	1/2	(12.7)	1-5/8	(41.3)		2,980	(13.3)	3,800	(16.9)	6,240	(27.8)	3,160	(14.1)
1/2	(12.7)	5/8	(15.9)	2	(50.8)		3,300	(14.7)	5,840	(26.0)	8,300	(36.9)	4,580	(20.4)
5/8	(15.9)	7/8	(22.2)	2-1/2	(63.5)		5,500	(24.5)	8,640	(38.4)	11,020	(49.0)	7,440	(33.1)
3/4	(19.1)	1	(25.4)	3-3/16	(81.0)		8,280	(36.8)	9,480	(42.2)	12,260	(54.5)	10,480	(46.6)

* To calculate the Allowable Load of the anchor, divide the Ultimate Load by 4.

* For continuous extreme low temperature applications, use stainless steel.

PERFORMANCE TABLE

Multi-Set II Drop-In Anchors

Ultimate Tension and Shear Values (lbs/kN) in Lightweight Concrete*

BOLT DIAMETER in.	(mm)	DRILL BIT SIZE in.	(mm)	MINIMUM EMBEDMENT DEPTH in.	(mm)	ANCHOR TYPE	LIGHTWEIGHT CONCRETE f'c = 3000 PSI (20.7 MPa) TENSION lbs.	(kN)	SHEAR lbs.	(kN)	LOWER FLUTE OF STEEL DECK WITH LIGHTWEIGHT CONCRETE FILL f'c = 3000 PSI (20.7 MPa) TENSION lbs.	(kN)	SHEAR lbs.	(kN)
3/8	(9.5)	1/2	(12.7)	1-5/8	(39.7)	RM, RL or CL-Carbon or SRM-18-8 S.S or SSRM-316 S.S.	2,035	(9.1)	1,895	(8.4)	3,340	(14.9)	4,420	(19.6)
1/2	(12.7)	5/8	(15.9)	2	(50.8)		2,740	(12.2)	2,750	(12.2)	3,200	(14.2)	4,940	(22.0)
5/8	(15.9)	7/8	(22.2)	2-1/2	(63.5)		4,240	(18.9)	4,465	(19.9)	5,960	(26.5)	5,840	(26.0)
3/4	(19.1)	1	(25.4)	3-3/16	(81.0)		5,330	(23.7)	6,290	(28.0)	8,180	(36.4)	9,120	(40.6)

* To calculate the Allowable Load of the anchor, divide the Ultimate Load by 4.

PERFORMANCE TABLE

Multi-Set II Drop-In Anchors

Recommended Edge and Spacing Distance Requirements*

BOLT DIAMETER in.	(mm)	DRILL BIT SIZE in.	(mm)	EMBEDMENT DEPTH in.	(mm)	ANCHOR TYPE	EDGE DISTANCE REQUIRED TO OBTAIN MAX. WORKING LOAD in.	(mm)	MIN. EDGE DISTANCE AT WHICH LOAD FACTOR APPLIED =.80 FOR TENSION =.70 FOR SHEAR in.	(mm)	SPACING REQUIRED TO OBTAIN MAX. WORKING LOAD in.	(mm)	MIN. ALLWABLE SPACING BETWEEN ANCHORS LOAD FACTOR APPLIED =.80 FOR TENSION =.55 FOR SHEAR in.	(mm)
1/4	(6.4)	3/8	(9.5)	1	(25.4)	RM, RL or CL-Carbon or SRM-18-8 S.S. or SSRM-316 S.S.	1-3/4	(44.5)	7/8	(22.2)	3-1/2	(88.9)	1-3/4	(44.5)
3/8	(9.5)	1/2	(12.7)	1-5/8	(41.3)		2-7/8	(73.0)	1-7/16	(36.5)	5-11/16	(144.5)	2-7/8	(73.0)
1/2	(12.7)	5/8	(15.9)	2	(50.8)		3-1/2	(88.9)	1-3/4	(44.5)	7	(177.8)	3-1/2	(88.9)
5/8	(15.9)	7/8	(22.2)	2-1/2	(63.5)		4-3/8	(111.1)	2-3/16	(55.6)	8-3/4	(222.3)	4-3/8	(111.1)
3/4	(19.1)	1	(25.4)	3-3/16	(81.0)		5-5/8	(142.9)	2-13/16	(71.4)	11-3/16	(284.2)	5-5/8	(142.9)

* Spacing and edge distances shall be divided by 0.75 when anchors are placed in structural lightweight concrete. Linear interpolation may be used for intermediate spacing and edge distances.

PERFORMANCE TABLE

Multi-Set II Drop-In Anchors

Ultimate Tension and Shear Values (lbs/kN) for RX-series (3/4" and 1" Embedment)*

BOLT DIAMETER		DRILL BIT SIZE		EMBEDMENT		2500 PSI (17.2 MPa) CONCRETE				4000 PSI (27.6 MPa) CONCRETE				HOLLOW CORE			
						TENSION		SHEAR		TENSION		SHEAR		TENSION		SHEAR	
in.	(mm)	in.	(mm)	in.	(mm)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)	lbs.	(kN)
3/8	(9.5)	1/2	(12.7)	3/4	(19.1)	1,571	(7.0)	2,295	(10.2)	1,987	(8.8)	2,903	(12.9)	1,908	(8.5)	2,401	(10.7)
1/2	(12.7)	5/8	(15.9)	1	(25.4)	2,113	(9.4)	2,585	(11.5)	2,673	(11.9)	3,270	(14.5)	2,462	(11.0)	2,401	(10.7)

* The tabulated values are for RX anchors installed at a minimum of 12 diameters on center and minimum edge distance of 6 diameters for 100 percent anchor efficiency. Spacing and edge distance may be reduced to 6 diameters spacing and 3 diameter edge distance provided the values are reduced 50 percent. Linear Interpolation may be used for intermediate spacings and edge margins.

* To calculate the Allowable Load of the anchor, divide the Ultimate Load by 4

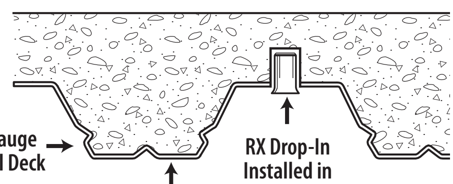
PERFORMANCE TABLE

Multi-Set II Drop-In Anchors

Anchoring Overhead in 3,000 PSI Lightweight Concrete on Metal Deck*

ANCHOR	DRILL HOLE DIAMETER		EMBEDMENT		3000 PSI (20.7 MPa) CONCRETE				
						ULTIMATE TENSION LOAD		ALLOWABLE WORKING LOAD	
	in.	(mm)	in.	(mm)		lbs.	(kN)	lbs.	(kN)
RX-38 Drop-In	1/2	(12.7)	3/4	(19.1)	Upper Flute	1,410	(6.3)	353	(1.6)
					Lower Flute	1,206	(5.4)	301	(1.3)

* To calculate the Allowable Load of the anchor, divide the Ultimate Load by 4



Combined Tension and Shear Loading—for Multi-Set Anchors

Allowable loads for anchors subjected to combined shear and tension forces are determined by the following equation:

$$(Ps/Pt)^{5/3} + (Vs/Vt)^{5/3} \leq 1$$

Ps = Applied tension load **Vs = Applied shear load** **Pt = Allowable tension load** **Vt = Allowable shear load**

PSE CONSULTING ENGINEERS INC.

2) Base plate to wood , wood specific weight ≮ 0.53 (option 2)

$T = Tension = \frac{M}{d} = \frac{875^{lb}}{3.875/12} = 2{,}168 \ lb$

Adjustment for wood bearing

$C_b = (4.5 + 0.375)/4.5 = 1.083$, NDS(3-10.2)

$a = \frac{2168}{1.083 * 625 * 4.5} = 0.711$

$T = \frac{700 * 12}{(3.875 - \frac{0.711}{2})} = 2387 \ lb$

$\frac{3}{8}$" Ø lag screw w/5" min Embed tension capacity

$= 305 * C_d * 5" = 305 * 1.1 * 4" = 1{,}220^{lb}$

2-lag screw capacity $= 2 * 1{,}220 = 2440^{lb} > 2387^{lb}$ (OK)

use [4 - $\frac{3}{8}$" lag screw w/ 4" min Embed]

Table 12.2A Lag Screw Reference Withdrawal Design Values, W[1]

Tabulated withdrawal design values (W) are in pounds per inch of thread penetration into side grain of wood member. Length of thread penetration in main member shall not include the length of the tapered tip (see 12.2.1.1).

Specific Gravity, G[2]	Lag Screw Diameter, D										
	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"
0.73	397	469	538	604	668	789	905	1016	1123	1226	1327
0.71	381	450	516	579	640	757	868	974	1077	1176	1273
0.68	357	422	484	543	600	709	813	913	1009	1103	1193
0.67	349	413	473	531	587	694	796	893	987	1078	1167
0.58	281	332	381	428	473	559	641	719	795	869	940
0.55	260	307	352	395	437	516	592	664	734	802	868
0.51	232	274	314	353	390	461	528	593	656	716	775
0.50	225	266	305	342	378	447	513	576	636	695	752
0.49	218	258	296	332	367	434	498	559	617	674	730
0.47	205	242	278	312	345	408	467	525	580	634	686
0.46	199	235	269	302	334	395	453	508	562	613	664
0.44	186	220	252	283	312	369	423	475	525	574	621
0.43	179	212	243	273	302	357	409	459	508	554	600
0.42	173	205	235	264	291	344	395	443	490	535	579
0.41	167	198	226	254	281	332	381	428	473	516	559
0.40	161	190	218	245	271	320	367	412	455	497	538
0.39	155	183	210	236	261	308	353	397	438	479	518
0.38	149	176	202	227	251	296	340	381	422	461	498
0.37	143	169	194	218	241	285	326	367	405	443	479
0.36	137	163	186	209	231	273	313	352	389	425	460
0.35	132	156	179	200	222	262	300	337	373	407	441
0.31	110	130	149	167	185	218	250	281	311	339	367

1. Tabulated withdrawal design values, W, for lag screw connections shall be multiplied by all applicable adjustment factors (see Table 11.3.1).
2. Specific gravity, G, shall be determined in accordance with Table 12.3.3A.

12.2.3.2 For calculation of the fastener reference withdrawal design value in pounds, the unit reference withdrawal design value in lbs/in. of fastener penetration from 12.2.3.1 shall be multiplied by the length of fastener penetration, p_t, into the wood member.

12.2.3.3 The reference withdrawal design value, in lbs/in. of penetration, for a single post-frame ring shank nail driven in the side grain of the main member, with the nail axis perpendicular to the wood fibers, shall be determined from Table 12.2D or Equation 12.2-4, within the range of specific gravities and nail diameters given in Table 12.2D. Reference withdrawal design values, W, shall be multiplied by all applicable adjustment factors (see Table 11.3.1) to obtain adjusted withdrawal design values, W'.

$$W = 1800 G^2 D \qquad (12.2\text{-}4)$$

12.2.3.4 For calculation of the fastener reference withdrawal design value in pounds, the unit reference withdrawal design value in lbs/in. of ring shank penetration from 12.2.3.3 shall be multiplied by the length of ring shank penetration, p_t, into the wood member.

12.2.3.5 Nails and spikes shall not be loaded in withdrawal from end grain of wood (C_{eg}=0.0).

12.2.3.6 Nails, and spikes shall not be loaded in withdrawal from end-grain of laminations in cross-laminated timber (C_{eg}=0.0).

12.2.4 Drift Bolts and Drift Pins

Reference withdrawal design values, W, for connections using drift bolt and drift pin connections shall be determined in accordance with 11.1.1.3.

DOWEL-TYPE FASTENERS

12

Cable Design

Max Tension = 248 lb

$S_g \geqslant 2.2T$ per 3.2.1 Structural applications of Steel cables

$2.2T = 679.8$ lb

$\frac{1}{8}$" ϕ Cable nominal strength = 2000 lb

$S_n = 2000$ lb

$\varphi_f = 0.8$ per table 3.2.1

$S_g = \phi_f \cdot S_n$

$= 0.8 \times 2000 = 1600 \text{ lb} > 679.8 \text{ lb}$

use [1/8" ϕ cable]

CABLE DESIGN

Project Number	STAINLESS CABLE 223-801	Sheet			
Project Name	GUARD RAIL	Designed by	ARUN	Date	
Subject	CABLE DESIGN	Checked by	ADEL	Date	

DESIGN OF CABLE

Maximum Tension	248.00	lbs
	Sg >= 2.2 T ***As Per 3.2.1 Structural applications of Steel Cables***	
2.2 T	545.60	lbs
Nominal Strength of 1/8" cables, Sn	2000.00	lbs
Number of Cables Provided	1.00	Nos
Fitting / deflector reduction factor	0.80	Page 2025
S_g =	**Sg = 0.8 * Sn**	
S_g =	1600.00	lbs

CHECK FOR SAFETY 545.60 **lbs** < 1600.000 **lbs**

SAFE

USE [1/8" DIAMETER SS CABLE]

2022

ASCE STANDARD

American Society of Civil Engineers

Structural Applications of Steel Cables for Buildings

This document uses both the International System of Units (SI) and customary units.

3.0 DESIGN CONSIDERATIONS

3.1 DESIGN BASIS

The cable system, including its masts and struts, shall be designed to safely support the design loading specified herein without exceeding the allowable force in any member. It shall also be designed to have adequate rigidity in order to limit displacements to values that would not adversely affect the serviceability of the structure.

3.1.1 Structural Integrity

The complete structural system of the building, including the cable system with its masts and struts, shall be configured with regard to maximizing structural redundancy and robustness. Failure or malfunction of any one local component should not create a dangerous condition or collapse of a larger part of the structure.

3.1.2 Replacement of Members

Cables and struts shall be designed to be replaceable.

3.2 DESIGN LOADINGS

3.2.1 Loads

In the absence of an applicable local building code, the design loads shall be those given in ASCE/SEI 7-10, *Minimum Design Loads for Buildings and Other Structures*. Additional load provisions shall be based on the following considerations: aerodynamic effects on individual cables and complete cable structures, either by means of numerical dynamic analysis or through wind tunnel tests; wind-induced structural vibration and fatigue effects; and the effects of creep.

3.2.2 Load Combinations

Cable tension, T_n, which is the effect of load, shall be calculated for the following load combinations:

T_1 = cable tension due to $D + P$
T_2 = cable tension due to $D + P + L$
T_3 = cable tension due to $D + P + (L_r$ or S or $R)$
T_4 = cable tension due to $D + P + 0.75\ L + 0.75\ (L_r$ or S or $R)$
T_5 = cable tension due to $D + P + (0.6\ W$ or $0.7\ E)$
T_{6a} = cable tension due to $D + P + 0.75\ L + 0.75\ (0.6\ W) + 0.75\ (L_r$ or S or $R)$
T_{6b} = cable tension due to $D + P + 0.75\ L + 0.75\ (0.7\ E) + 0.75\ S$
T_7 = cable tension due to $0.6\ D + P + 0.6\ W$
T_8 = cable tension due to $0.6\ D + P + 0.7\ E$
T_9 = cable tension due to C + the erection components of D, L, P, and W.

The tension T_2 and T_4 shall be computed for the full range of temperature to which the structure is assumed to be subjected.

3.2.3 Load Combinations Including Atmospheric Ice Loads

When the structure is subjected to atmospheric ice and wind-on-ice loads, cable tensions due to the following load combinations shall be considered:

1. $0.7\ D_i$ shall be added to the equation for T_2.
2. (L_r or S or R) in the equation for T_3 shall be replaced by $0.7\ D_i + 0.7\ W_i + S$.
3. W in the equation for T_7 shall be replaced by $0.7\ D_i + 0.7\ W_i$.

3.3 CABLE STRENGTH

3.3.1 Design Strength

The design strength, S_d, of each cable shall be equal to or greater than $2.2\ T_n$, where the load combination number $n = 1$ to 9.

The design strength, S_d, of the cable shall normally be taken as the smaller of:

$$S_d = S_n \times N_f \text{ or } S_d = S_n \times N_d$$

in which

S_n = nominal cable strength.
N_f = fitting reduction factor, and
N_d = deflector reduction factor ($N_d = 1$ for the case of no deflector).

3.3.1.1 Fitting Reduction Factor

To account for the reduction in available strength caused by the action of the end fitting in transferring tension from the cable to the fitting, the factor given in Table 3-1 shall be applied.

3.3.1.2 Deflection Reduction Factor

To account for the reduction in available strength due to curvature of the cable over a saddle, the factors given in Table 3-2 shall be applied.

Table 3-2 applies to saddles for which the live load changes the deflection angle of the cable less than 2 degrees for strand and 4 degrees for rope, per saddle end. For anticipated larger deflection angle changes, the deflection reduction factor shall be

3.4.4 Deflections

Cables shall be so proportioned that the maximum deflections under the combined action of applied loads, temperate change, and cable stretch will satisfy the serviceability requirements.

3.4.5 Erection Analysis

A structural analysis shall be performed for the suggested or mandatory erection procedure considering the effects listed in Section 3.4.1. Should deviations be made in the suggested erection procedure, the erector shall have an independent professional engineer experienced in cable-system erection perform an erection analysis to match the revised methods, equipment, and sequence.

4.0 CABLE MATERIALS

4.1 CABLE SPECIFICATIONS

This Standard applies to cables conforming to the following standard specifications:

ASTM A368-95a(2009). *Standard Specification for Stainless Steel Wire Strand*
ASTM A474-03(2008). *Standard Specification for Aluminum-Coated Steel Wire Strand*
ASTM A475-03(2009)e1. *Standard Specification for Zinc-Coated Steel Wire Strand*
ASTM A492-95(2009). *Standard Specification for Stainless Steel Rope Wire*
ASTM A586-04a(2009)e1. *Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand*
ASTM A603-98(2009)e1. *Standard Specification for Zinc-Coated Steel Structural Wire Rope*
ASTM A855/A855M-03(2009). *Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Wire Strand*
ASTM A1023/A1023M-09 (2009). *Standard Specification for Carbon Steel Wire Ropes for General Purposes*, *Table 9* (for specific application, see Commentary Section C4.0)
UNE-EN 12385-10:2004 + A1:2008 (2008). *Steel Wire Ropes – Safety – Part 10: Spiral Ropes for General Structural Applications*

Some of the above cable specifications apply to cables of a specific construction. This Standard does not exclude cables of other construction provided that the chemical and mechanical properties of the wires constituting the cables conform to the requirements of one of the above specifications, *and provided that the cables do not have nonmetallic (fiber) cores.* Stainless steel cable construction similar to the above specifications is acceptable provided that the stainless steel wire conforms to ASTM A492.

4.2 PRESTRETCHING

For each type and construction of cable specified in the Contract Documents, the prestretching requirements shall be explicitly stated. For prestretched cables, the minimum value of the modulus of elasticity, E_s, of the cable after prestretching shall be specified. Prestretching force shall not exceed 55% of the minimum breaking force. For cables more than 2.5 in. (63 mm) in diameter, consultation with cable manufacturers during structural design is recommended.

5.0 FITTINGS

5.1 MATERIALS

When selecting fitting materials, the compatibility of the cable and fitting materials shall be considered. Compatibility includes thermal expansion and corrodibility.

5.2 INSPECTION

Stock or standard sockets shall be subjected to the manufacturer's quality control testing. For special sockets, additional inspection and/or proof loading of the fittings shall be specified. Approved ASTM nondestructive testing procedures are: magnetic particle, dye penetrant, ultrasonics, and radiography. No cracks or other injurious defects shall be present in the fittings. The design documents shall specify the type of nondestructive tests, the frequency of testing, and acceptance criteria.

The following standards for nondestructive testing of *fittings* may be used:

ASTM E94-04 (2004). *Standard Guide for Radiographic Examination*
ASTM E125-63(2008). *Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings*
ASTM E165-09 (2009). *Standard Practice for Liquid Penetrant Examination for General Industry*
ASTM E709-08 (2008). *Standard Guide for Magnetic Particle Testing*
ASTM E1030-05 (2005). *Standard Test Method for Radiographic Examination of Metallic Castings*

Table 3-1 Fitting Reduction Factors

Type of Termination	Fitting Reduction Factor N_f	
	Rope	Strand
Poured socket (zinc, zinc-aluminum-mischmetal alloy, or resin)	1.00	1.00
Swaged socket	1.00[a]	0.90[b]

[a]Regular lay ropes only. Verify with manufacturer for sizes over 2 in. (51 mm).
[b]Confirm with manufacturer.

Table 3-2 Deflector Reduction Factors

Ratio: Saddle Radius to Rope Diameter	Ratio: Saddle Radius to Strand Diameter	Deflector Reduction Factor N_d
15 and over	20 and over	1.0
14	19	0.95
13	18	0.90
12	17	0.85
11	16	0.80
10 minimum	15 minimum	0.75

determined by an approved method. Table 3-2 is limited to curvature induced by saddles.

3.3.1.3 Elevated Temperature Effect

The possibility of elevated temperature above 200 °F (93 °C) and its effect on the mechanical and physical properties of cables and end fittings shall be considered during the design. For temperatures above 200 °F (93 °C), the nominal cable strength, S_n, and the cable's modulus of elasticity, E_s, shall be appropriately reduced in calculations.

3.3.1.4 Fatigue Strength

The possible reduction in cable strength due to fatigue shall be evaluated when the cable will undergo repetitive fluctuating loads, vibration due to wind or rain, or other dynamic effects. Fluctuating tension-tension or bending and tension shall be considered.

Factors that decrease a cable's fatigue strength are provided in the Commentary, Section C3.3.1.4.

3.3.1.5 Creep Effect

Creep, or long-term elongation of a prestretched cable, shall be evaluated. Factors influencing creep are provided in the Commentary, Section C3.3.1.5.

3.3.2 End Fittings

Fittings shall develop an ultimate strength greater than the specified nominal cable strength. Moreover, fittings shall be designed such that the computed average stresses across the fitting body are less than the yield stress of the fitting material under a static tension force. The static tension force shall be equal to the specified nominal strength of the rope or strand for which the fitting is designed. Localized yielding at stress concentrations, such as at the line contact of pins and the roots of screw threads, is permitted at the cable working tension. Under special circumstances, overdesigned cables may terminate with conventionally sized fittings, or conventionally designed cables may terminate with oversize fittings. Such designs shall be based on data supplied by an assembler or a fitting manufacturer regarding fit of the cable in the fitting and the stresses in the fitting.

3.4 STRUCTURAL ANALYSIS

3.4.1 General Considerations

Cable systems inherently exhibit nonlinear behavior. Therefore, the design basis for cable systems shall include nonlinear considerations and analyses. Commentary Section C3.4.1 provides a brief discussion of the nonlinear behavior of cable systems. The structural analysis shall be based on the following considerations in addition to those mentioned elsewhere in this Standard:

- Elastic stretch of the cables and deformation of the supporting structure shall be taken into account in the design.
- Nonlinear analyses shall be performed if it is determined that the magnitudes of the cable displacements are such that the equilibrium equations should be based on the geometry of the displaced structure.

3.4.2 Serviceability

At an early stage of the structural design, the Owner, Architect, and Engineer shall establish the serviceability requirements for the cable system, including requirements for cable repair and replacement. Local building ordinances shall be taken into account. Numerical analyses shall be performed to demonstrate that the serviceability requirements for deflection and vibration will be met.

3.4.3 Vibrations

The effect of dynamic loading on cable stresses, fatigue, and deflections of the individual cable and the entire structure shall be considered in the design.