



Project Number: U2716-0276-211

May 6, 2022

Sunmodo  
14800 NE 65<sup>th</sup> Street  
Vancouver, WA 98682

**REFERENCE: Sunmodo Sunturf Ground Mount A9  
Ground Mount PV Array Installation**

To Whom It May Concern:

Per request of Sunmodo, we have been asked to prepare the structural design of a ground-mounted PV solar array system with several foundation options as shown in the attached calculations. The adopted building code in this jurisdiction is the International Building Code, 2018 Edition. Vector Structural Engineering requires that we review each site-specific install, and we are not liable for installs at site specific locations we have not reviewed. The following design parameters are used in our analysis:

- Minimum Design Loads for Buildings and Other Structures (ASCE 7-16)
- Design wind speed for risk category I structures: 140 mph
- Wind exposure: C
- Ground snow load: 70 psf
- The ground screws and helical piers must be tested to 1.5 times uplift and 2.0 times lateral reactions found in the table below. A minimum of one ground screw or helical pier must be tested.

Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2942	1.5	4415
LATERAL	2035	2	4070

Foundation concrete shall have a minimum compressive strength of 2500 psi at 28 days. Cement for all concrete shall be Type I or II with a minimum of 6% entrained air with a water/cement ratio of 0.50. Maximum aggregate size shall be 3/4". No special inspection of concrete strength is required.

Footings are designed based on an allowable soil bearing pressure of 1500 psf an allowable skin friction of 250 psf, an allowable lateral bearing pressure of 150 pcf, and a coefficient of friction of 0.3. Vector Structural Engineering strongly recommends independent soils testing be performed by a licensed geotechnical engineer to verify the assumed soil parameters.

All ground mounts are to be installed per manufacturer’s recommendations. The use of solar panel support span tables provided by the manufacturer is allowed only where the site conditions and solar panel configuration match the description of the span tables. Electrical engineering is beyond our scope. All work performed must be in accordance with accepted industry-wide methods and applicable safety standards. Vector Structural Engineering assumes no responsibility for improper installation of the solar panels.

Very truly yours,

VECTOR STRUCTURAL ENGINEERING, LLC

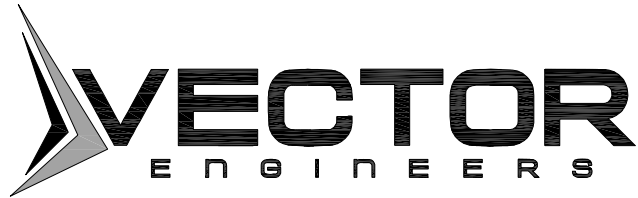
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Jacob Proctor, P.E.  
CA License: 70567  
Project Engineer

Enclosures

JSP/stb

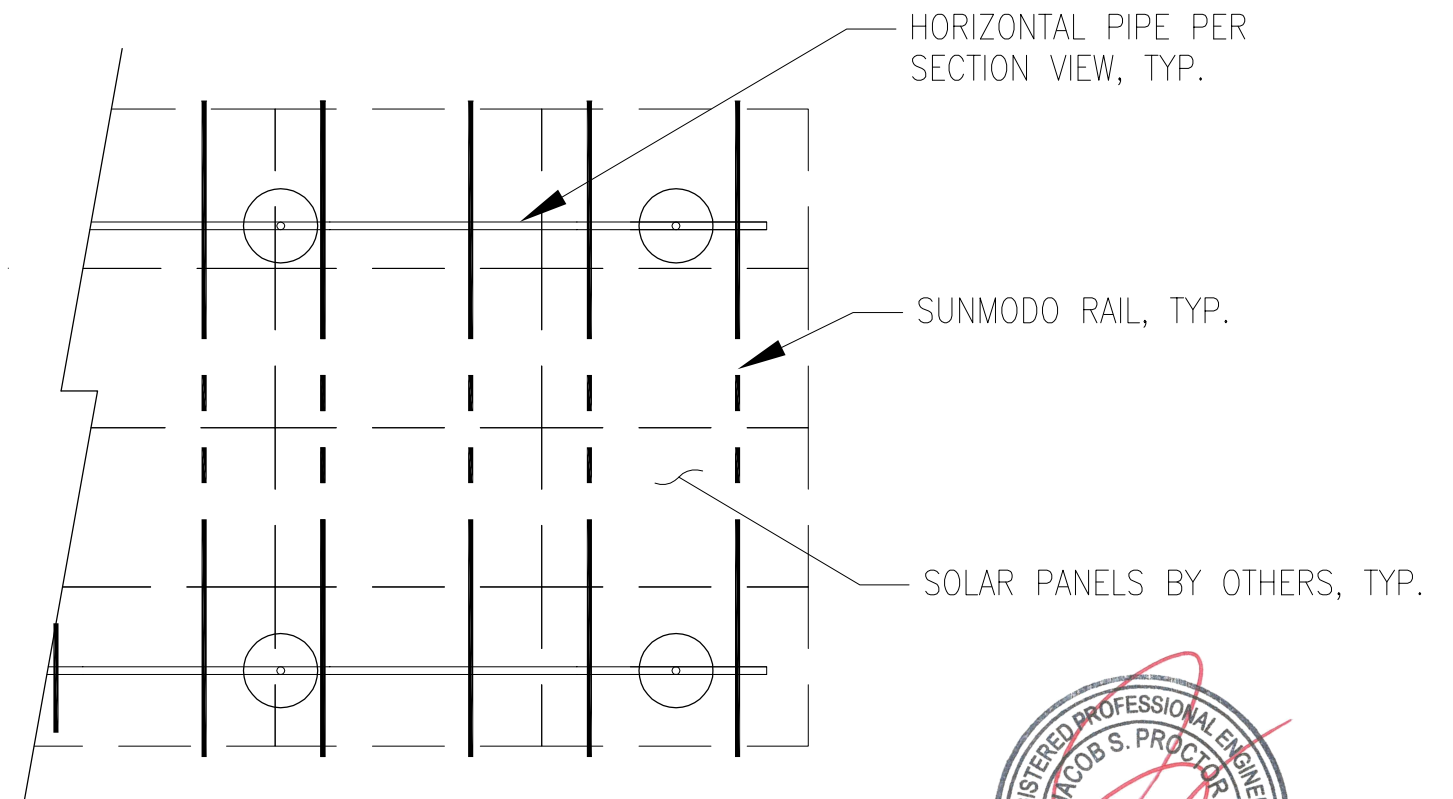
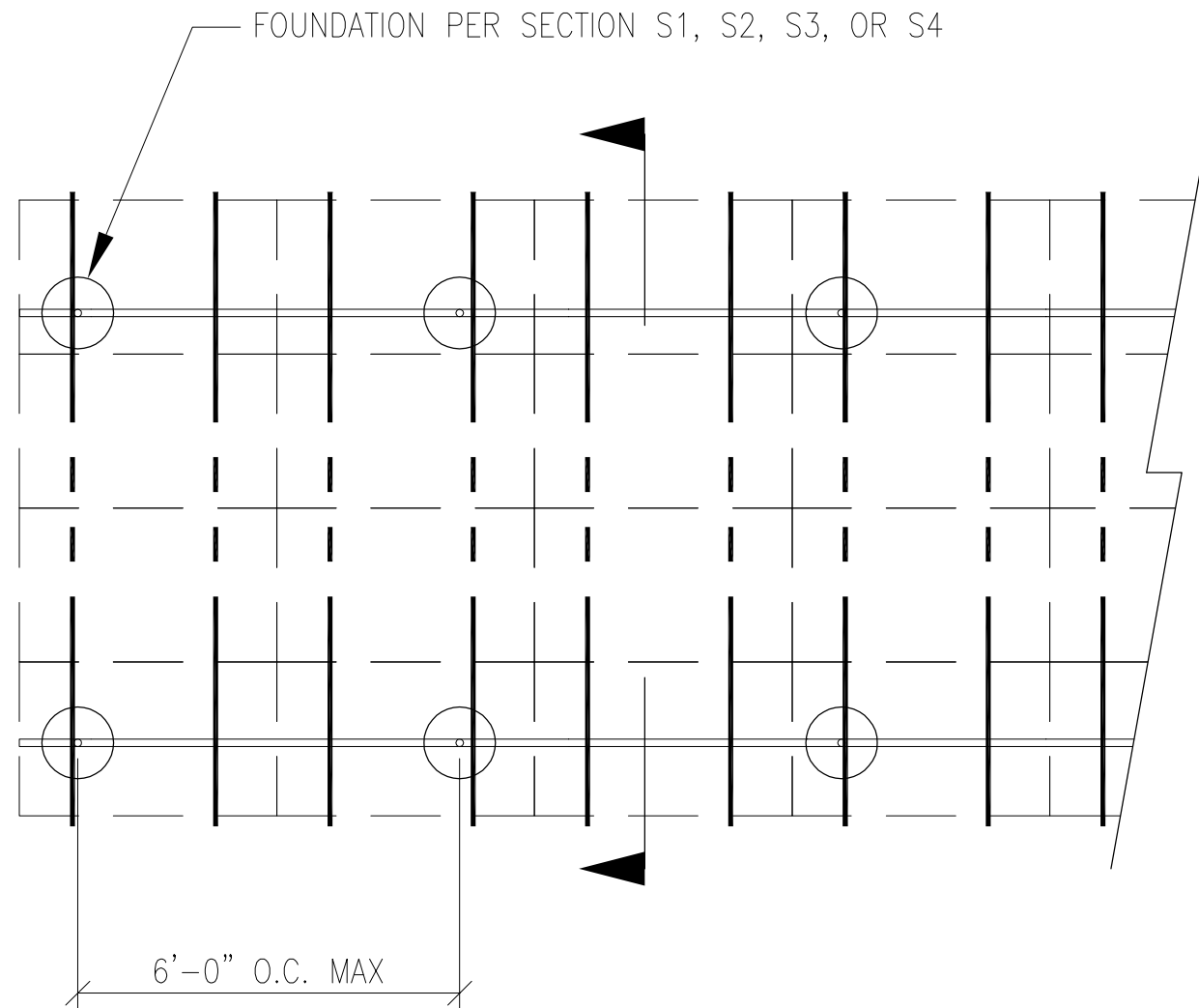


05/06/2022



JOB NO. U2716-0276-211  
 PROJECT SUNMODO SUNTURF GROUND MOUNTS A9  
 SUBJECT ALL OPTIONS

651 W GALENA PARK BLVD. #101 (801) 990-1775  
 DRAPER, UTAH 84020 (801) 990-1776 FAX



05/06/2022

**PV ARRAY PLAN**

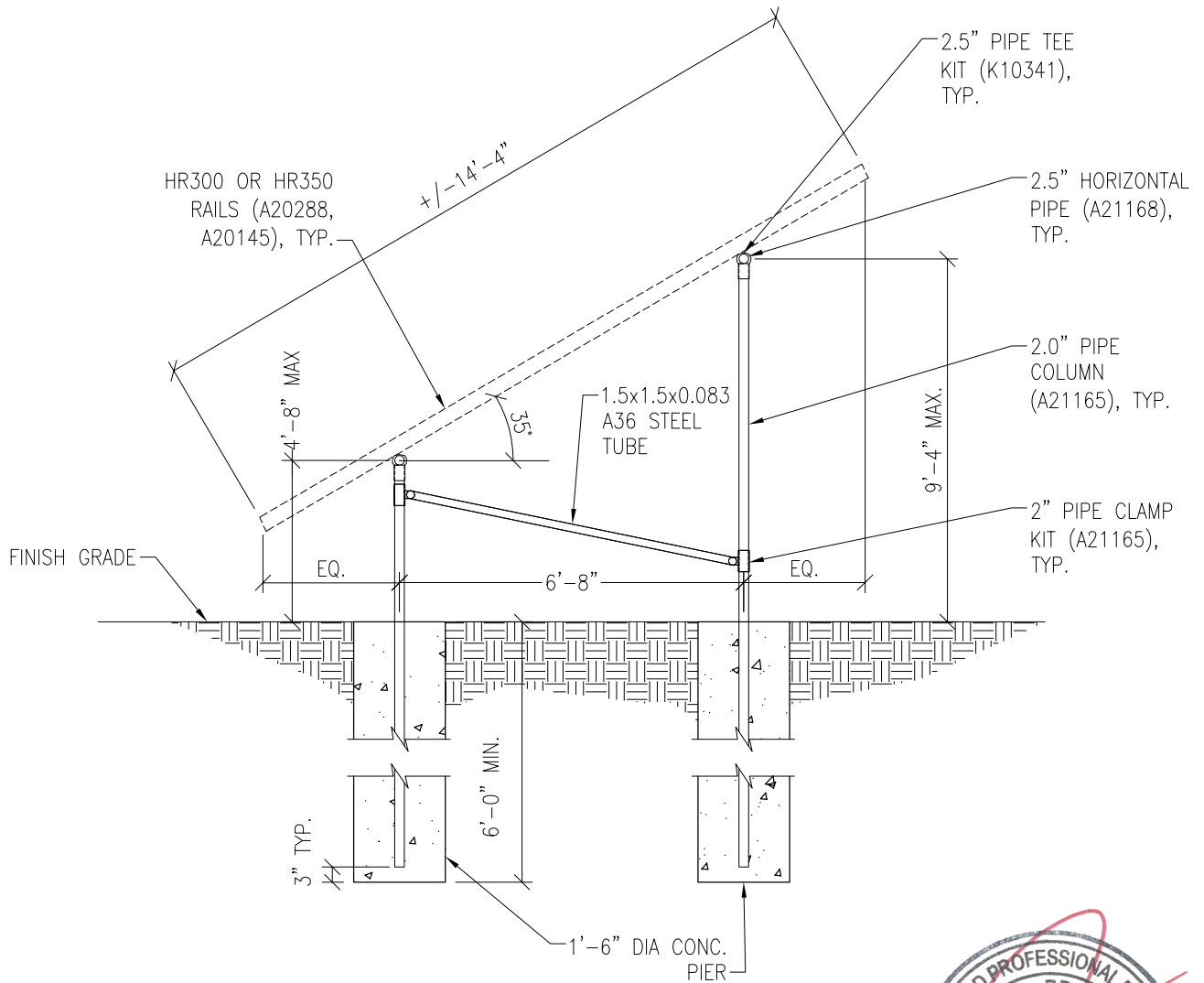
N.T.S.

**P1**

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PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT DRILLED PIER OPTION



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**PV ARRAY SECTION**

N.T.S.

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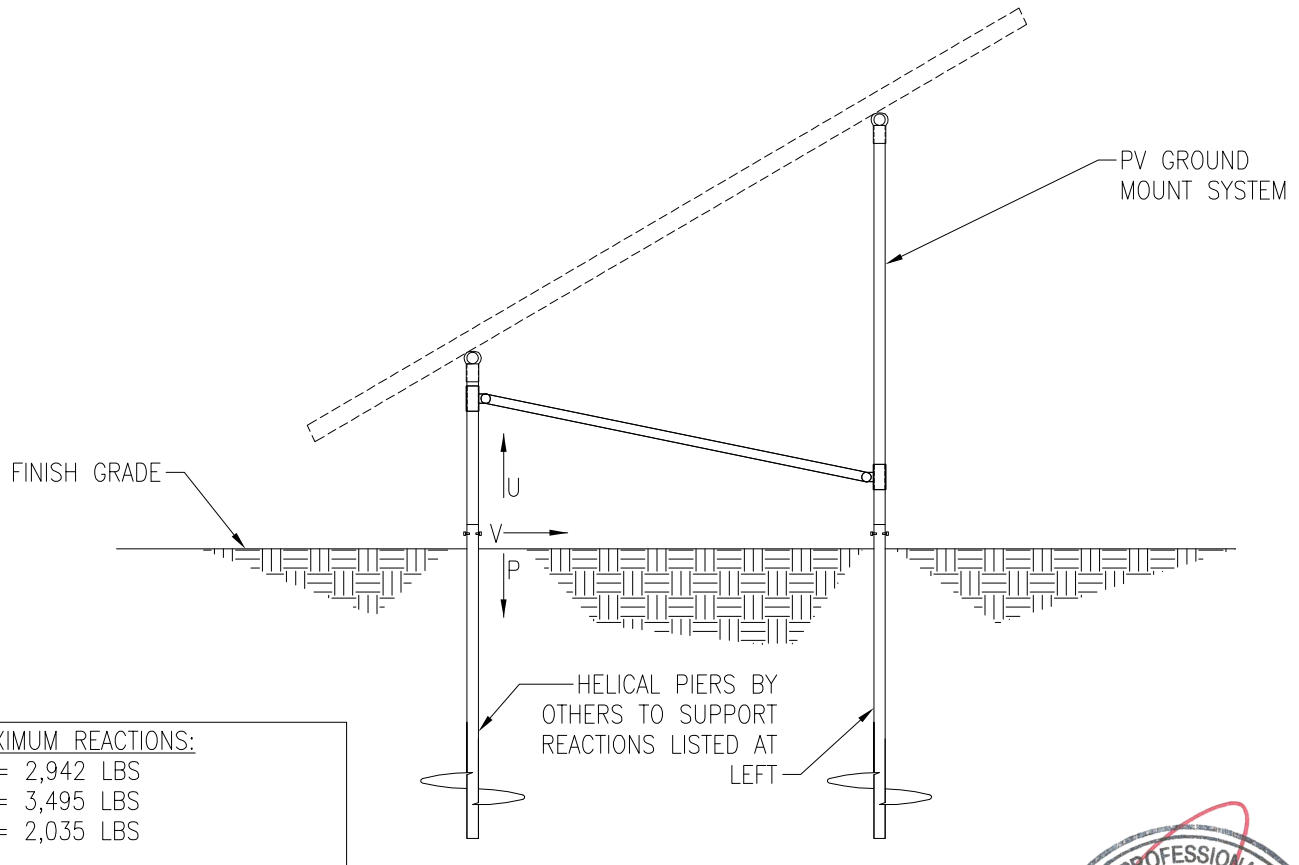
**S1**

PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT HELICAL PIER OPTION

**NOTES:**

1. For ground mount components see Section S1.
2. A minimum of (1) helical pier must be load-tested as follows:
  - 2.1. Safety factor for uplift = 1.5,
  - 2.2. Safety factor for lateral loads = 2.0
  - 2.3. Upward deflection limit = 1/2"
  - 2.4. Lateral deflection limit = 1"
  - 2.5. The load tests must be performed by an approved contractor.



**MAXIMUM REACTIONS:**  
 U = 2,942 LBS  
 P = 3,495 LBS  
 V = 2,035 LBS



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**PV ARRAY SECTION**

N.T.S.

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**S2**



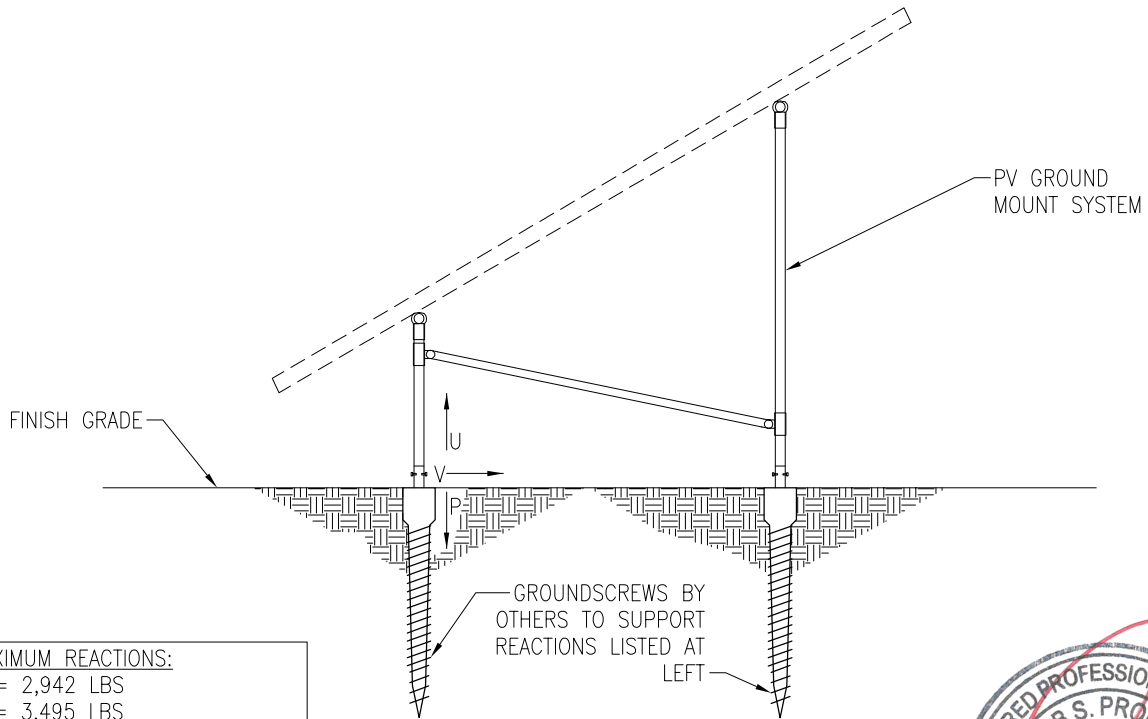
JOB NO. U2716-0276-211

PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT GROUND SCREW OPTION

NOTES:

1. For ground mount components see Section S1.
2. A minimum of (1) ground screw must be load-tested as follows:
  - 2.1. Safety factor for uplift = 1.5,
  - 2.2. Safety factor for lateral loads = 2.0
  - 2.3. Upward deflection limit = 1/2"
  - 2.4. Lateral deflection limit = 1"
  - 2.5. The load tests must be performed by an approved contractor.



MAXIMUM REACTIONS:  
 U = 2,942 LBS  
 P = 3,495 LBS  
 V = 2,035 LBS

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**PV ARRAY SECTION**

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DRAPER, UTAH 84020

(801) 990-1775  
(801) 990-1776 FAX

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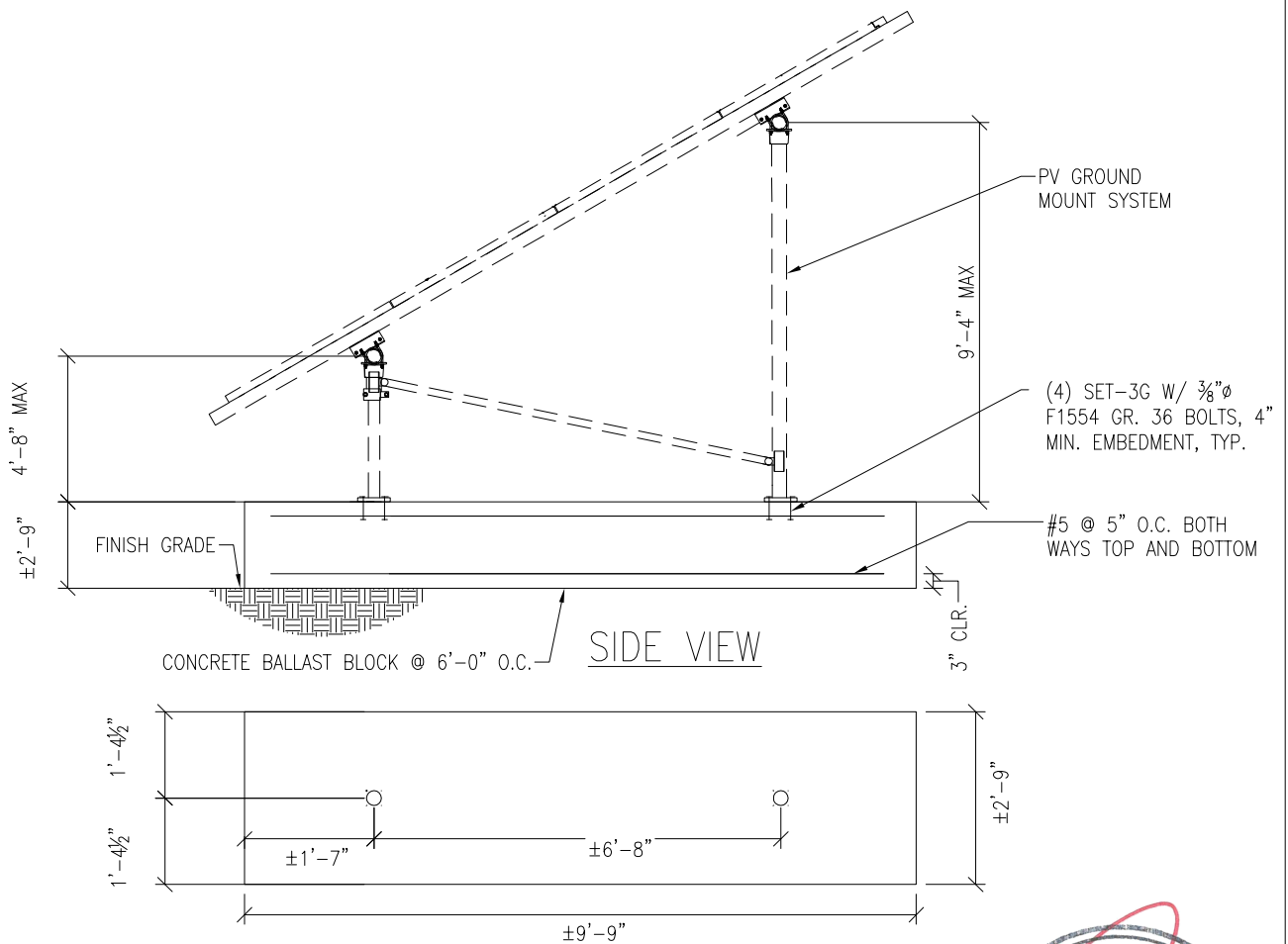
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PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT BALLASTED BLOCK OPTION

NOTES:

1. For ground mount components see Section S1.



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**PV ARRAY SECTION**

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**S4**

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 DRAPER, UTAH 84020

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**PROJECT:** Sunturf Package A9 Ground Mount

**SNOW LOADS**

Calculations Per:	ASCE 7-16	
Snow Ground Load, $p_g$ [psf]:	70.0	(Section 7.2)
Risk Category:	I	(Table 1.5-1)
Importance Factor, $I_s$ :	0.8	(Table 1.5-2)
Terrain Category:	C	(Section 26.7)
Exposure of Roof:	Fully Exposed	(Table 7-3.1)
Exposure Factor, $C_e$ :	0.9	(Table 7-3.1)
Thermal Factor, $C_t$ :	1.2	(Table 7-3.2)
Flat Roof Snow Load, $p_f$ [psf]:	42	(Equation 7.3-1)
Min. Roof Snow Load, $p_m$ [psf]:	0	(Section 7.3.4)
Panel Slope from Horizontal [°]:	35.0	
Unobstructed Slippery Surface?	Yes	(Section 7.4)
Slope Factor Figure:	Figure 7-2c	(of Figure 7.4-1 - See Section 7.4)
Roof Slope Factor, $C_s$ :	0.64	
Sloped Roof Snow Load, $p_s$ [psf]:	27	(Equation 7.4-1)
Design Snow Load, $S$ [psf]:	27	(1.0 Snow)



**PROJECT:** Sunturf Package A9 Ground Mount

**WIND PRESSURES**

Calculations per:	ASCE 7-16	
Design Wind Speed, V [mph]:	140	
Risk Category:	I	(Table 1.5-1)
Exposure Category:	C	(Section 26.7)
Elevation [ft]:	9.2	
Ground Elevation Factor, $K_e$ :	1.00	(Table 26.9-1)
$\alpha$ :	9.5	(Table 26.11-1)
$z_g$ [ft]:	900	(Table 26.11-1)
Velocity Pressure Exposure Coefficient, $K_h$ :	0.85	(Table 26.10-1)
Topographic Factor, $K_{ht}$ :	1.0	(Section 26.8)
Wind Directionality Factor, $K_d$ :	0.85	(Table 26.6-1)
Internal Pressure Coefficient, $GC_{pi}$ :	0.00	(Figure 26.13-1)
Velocity Pressure, $q_h$ [psf]:	36.19	(Equation 26.10-1)
Gust Effect Factor, G:	0.85	(Section 26.11.4)
Panel Slope [degrees]:	35.0	
Wind Flow:	Clear	
Roof Configuration:	Monoslope	

Wind Pressures in Transverse (N-S) Direction

Net Pressure Coefficients per Figure 27.3-4

Clear Wind Flow	$C_{NW}$	$C_{NL}$
Case 1 ( $\gamma = 0^\circ$ , Load Case A)	-1.8	-1.8
Case 2 ( $\gamma = 0^\circ$ , Load Case B)	-2.4	-0.6
Case 3 ( $\gamma = 180^\circ$ , Load Case A)	2.1	2.1
Case 4 ( $\gamma = 180^\circ$ , Load Case B)	2.7	1.1

Design Wind Pressures per Equation 27.3-2 [psf]

Clear Wind Flow	$q_h GC_{NW}$	$q_h GC_{NL}$
Case 1 ( $\gamma = 0^\circ$ , Load Case A)	-55.4	-55.4
Case 2 ( $\gamma = 0^\circ$ , Load Case B)	-73.8	-18.5
Case 3 ( $\gamma = 180^\circ$ , Load Case A)	64.6	64.6
Case 4 ( $\gamma = 180^\circ$ , Load Case B)	83.1	33.8
Case 5 ( $\gamma = 0^\circ$ , 16 psf Min. Horiz.)	-16.0	-16.0
Case 6 ( $\gamma = 180^\circ$ , 16 psf Min. Horiz.)	16.0	16.0



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DESIGNED: STB

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# Foundation Option 1: Drilled Concrete Pier



PROJECT: Sunturf Package A9 Ground Mount

**DRILLED CONCRETE PIER DESIGN**

**Column Reactions:**

Max. Shear, V [k]:	2.0	Max. Down, P <sub>d</sub> [k]:	3.5
Max. Moment, M [k-ft]:	0.0	Max. Uplift, P <sub>u</sub> [k]:	2.9

**Pier Properties:**

Pier Shape:	Round	Volume of Concrete [ft <sup>3</sup> ]:	11
Pier Diameter, b [ft]:	1.5	Volume of Concrete [yd <sup>3</sup> ]:	0.4
Top of Pier Elevation [ft]:	0.00	Weight of Concrete [k]:	1.6
Pier Depth, d [ft]:	6.0		

**Soil Properties:**

Allow. Bearing Pressure [psf]:	1,500	<u>Optional Parameters for Uplift:</u>	
1/3 increase for short term loads?	No		
Lateral Bearing, S [pcf]:	150	Skin Friction* [psf]:	250
Max. Lateral Bearing (opt'l) [psf]:		Top Length to Ignore [ft]:	0
Top Depth to Ignore [ft]:	0	1/3 increase for short term loads?	No
1/3 increase for short term loads?	No	Combine w/ Bearing:	No
1/2" deflection at t/o pier allowed:	Yes		

\*per IBC Section 1810.3.3.1.4

**Check Bearing:**

Bearing Capacity [k]:	7.1
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**Bearing capacity OK.**

**Check Uplift:**

Uplift Capacity [k]:	8.5
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**Uplift capacity OK.**

**Check Lateral Bearing:**

Top of Pier Constrained?:	No
Applied Lateral Force, P [lb]:	2,035
Point of Application, h [ft]:	0.0
S <sub>max</sub> [psf]:	
S [psf]:	600
A = 2.34*P/(Sb):	5.29
Required Pier Depth, d <sub>reqd</sub> [ft]:	5.30

IBC Section 1807.3.2.1

IBC Eq. 18-1

Result: **Lateral bearing capacity OK.**

# Foundation Option 2: Helical Pier

The ground screws and helical piers must be tested to 1.5 times uplift and 2.0 times lateral reactions found in the table below.

Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2942	1.5	4415
LATERAL	2035	2	4070

# Foundation Option 3: Ground Screw

The ground screws and helical piers must be tested to 1.5 times uplift and 2.0 times lateral reactions found in the table below.

Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2942	1.5	4415
LATERAL	2035	2	4070

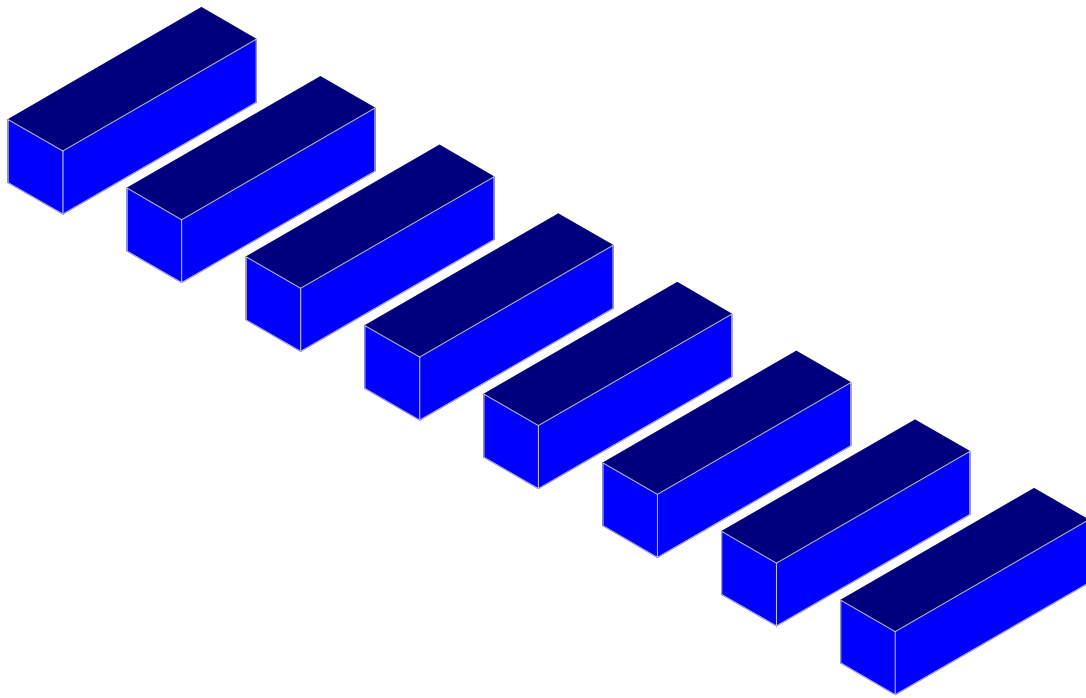


JOB NO.: U2716-0276-211

DESIGNED: STB

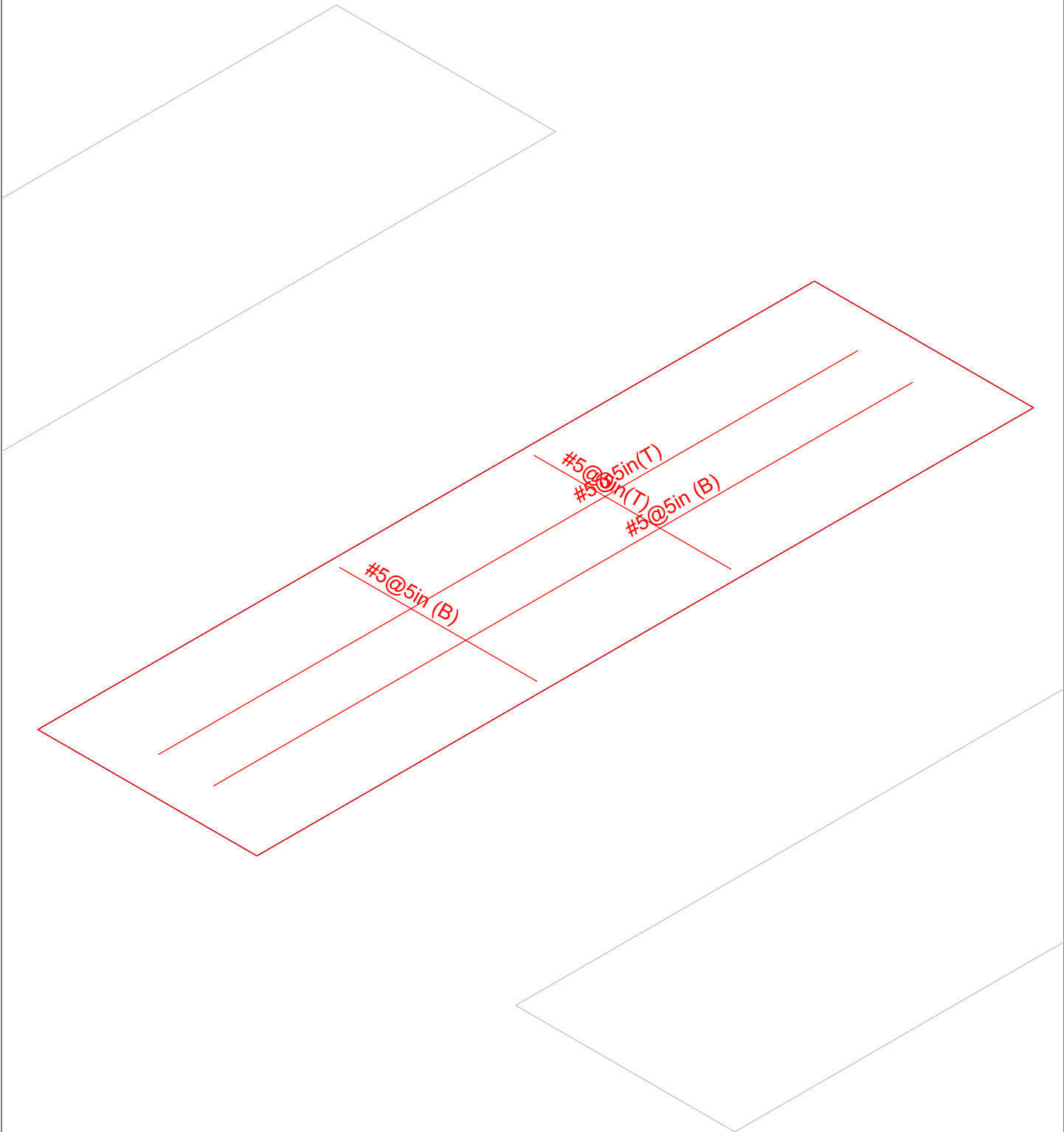
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# Foundation Option 4: Ballasted Block



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 2
STB		Jan 26, 2021 at 1:53 PM
U2716.0276.211		Sunmodo Sunturf A9 v2.r3d



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 1
STB		Jan 26, 2021 at 1:53 PM
U2716.0276.211		Sunmodo Sunturf A9 v2.r3d



**(Global) Model Settings**

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	100
Mesh Size (in)	12
Max Iterations	10
Merge Tolerance (in)	.12
Solver	Sparse Accelerated
Coefficient of Friction	.3
No. of Shear Regions	4
Shear Region Spacing Increment (in)	4
Min 1 Bar Dia Spacing for Beams?	No
Optimize footings for OTM / Sliding?	Yes
Parame Beta Factor	.65
Pile Safety Factor	3
Concrete Stress Block	0
Concrete Rebar Set	Rectangular
Concrete Code	ASTM A615
HR Steel Pile Code	ACI 318-14
Wood Pile Code	AISC 14th (360-10): ASD AWC NDS-15: ASD

**Concrete Properties**

	Label	E [ksi]	G [ksi]	Nu	Therm (/...	Density[lb/ft^3]	fc[psi]	Lambda	Flex Stee...	Shear St...
1	Conc3000NW	3156	1372	.15	.6	145	3000	1	60000	60000
2	Conc3500NW	3409	1482	.15	.6	145	3500	1	60000	60000
3	Conc4000NW	3644	1584	.15	.6	145	4000	1	60000	60000
4	Conc3000LW	2085	907	.15	.6	109.999	3000	.75	60000	60000
5	Conc3500LW	2252	979	.15	.6	109.999	3500	.75	60000	60000
6	Conc4000LW	2408	1047	.15	.6	109.999	4000	.75	60000	60000
7	Conc2500NW	3156	1372	.15	.6	145	2500	1	60000	60000

**General Design Parameters**

	Label	Max Bending Chk	Max Shear Chk	Top Cover[in]	Bottom Cover[in]
1	Typical	1	1	3	3

**Slab Rebar Parameters**

	Label	Top Bar	Bottom Bar	Max Top Bar Sp...	Min Top Bar Sp...	Max Bot Bar Sp...	Min Bot Bar Sp...	Spacing Incr...	Rebar Options
1	Typical	#5	#5	12	3	12	3	1	Optimize

**Soil Definitions**

	Label	Subgrade Modulus[lb/ft^3]	Allowable Bearing[psf]	Depth Properties	Default?
1	Default	1e+5	1500	None	Yes

**Point Loads and Moments (Cat 1 : DL)**

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1	X	-7.756
2	R3D_N1	Y	178.817
3	R3D_N2_1	Y	150.068
4	R3D_N132	Y	186.134
5	R3D_N133	Y	178.988
6	R3D_N109	Y	180.271
7	R3D_N110A	X	1.331
8	R3D_N110A	Y	185.813

**Point Loads and Moments (Cat 1 : DL) (Continued)**

	Label	Direction	Magnitude[lb,lb-ft]
9	R3D_N121	Y	187.203
10	R3D_N122	Y	177.849
11	R3D_N133B_1	Y	186.101
12	R3D_N134B	Y	178.975
13	R3D_N151	Y	187.104
14	R3D_N152	Y	177.898
15	R3D_N143A_1	X	7.839
16	R3D_N143A_1	Y	179.075
17	R3D_N144A_1	Y	149.435
18	R3D_N149A	Y	181.201
19	R3D_N150A	X	-1.347
20	R3D_N150A	Y	185.493

**Point Loads and Moments (Cat 6 : RLL)**

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1	X	-43.782
2	R3D_N1	Y	809.394
3	R3D_N2_1	X	-3.39
4	R3D_N2_1	Y	759.359
5	R3D_N132	Y	893.109
6	R3D_N133	Y	932.693
7	R3D_N109	X	1.185
8	R3D_N109	Y	847.187
9	R3D_N110A	X	8.715
10	R3D_N110A	Y	977.681
11	R3D_N121	Y	901.952
12	R3D_N122	X	1.102
13	R3D_N122	Y	925.33
14	R3D_N133B_1	Y	892.857
15	R3D_N134B	Y	932.591
16	R3D_N151	Y	901.166
17	R3D_N152	X	-1.133
18	R3D_N152	Y	925.6
19	R3D_N143A_1	X	44.399
20	R3D_N143A_1	Y	810.346
21	R3D_N144A_1	X	3.376
22	R3D_N144A_1	Y	753.671
23	R3D_N149A	X	-1.533
24	R3D_N149A	Y	854.221
25	R3D_N149A	Z	1.168
26	R3D_N150A	X	-8.864
27	R3D_N150A	Y	975.636

**Point Loads and Moments (Cat 16 : OL1)**

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1	X	111.913
2	R3D_N1	Y	-3970.239
3	R3D_N1	Z	2236.473
4	R3D_N2_1	X	21.233
5	R3D_N2_1	Y	713.831
6	R3D_N2_1	Z	-110.999
7	R3D_N132	X	-1.368
8	R3D_N132	Y	-4619.09
9	R3D_N132	Z	2744.636
10	R3D_N133	X	6.458
11	R3D_N133	Y	870.632

**Point Loads and Moments (Cat 16 : OL1) (Continued)**

	Label	Direction	Magnitude[lb,lb-ft]
12	R3D_N133	Z	-125.963
13	R3D_N109	X	-3.023
14	R3D_N109	Y	-4688.486
15	R3D_N109	Z	2906.006
16	R3D_N110A	X	-12.438
17	R3D_N110A	Y	987.941
18	R3D_N110A	Z	-125.43
19	R3D_N121	Y	-4632.521
20	R3D_N121	Z	2724.376
21	R3D_N122	X	-10.936
22	R3D_N122	Y	879.89
23	R3D_N122	Z	-125.752
24	R3D_N133B_1	X	1.297
25	R3D_N133B_1	Y	-4619.124
26	R3D_N133B_1	Z	2744.883
27	R3D_N134B	X	-5.775
28	R3D_N134B	Y	870.258
29	R3D_N134B	Z	-125.95
30	R3D_N151	Y	-4637.516
31	R3D_N151	Z	2726.979
32	R3D_N152	X	10.847
33	R3D_N152	Y	883.448
34	R3D_N152	Z	-125.799
35	R3D_N143A_1	X	-112.791
36	R3D_N143A_1	Y	-3977.52
37	R3D_N143A_1	Z	2239.959
38	R3D_N144A_1	X	-20.781
39	R3D_N144A_1	Y	715.549
40	R3D_N144A_1	Z	-111.053
41	R3D_N149A	X	3.605
42	R3D_N149A	Y	-4677.98
43	R3D_N149A	Z	2900.619
44	R3D_N150A	X	11.393
45	R3D_N150A	Y	984.564
46	R3D_N150A	Z	-125.345

**Point Loads and Moments (Cat 17 : OL2)**

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1	X	143.281
2	R3D_N1	Y	-4397.127
3	R3D_N1	Z	1889.423
4	R3D_N2_1	X	13.742
5	R3D_N2_1	Y	1551.964
6	R3D_N2_1	Z	-93.673
7	R3D_N132	X	-1.668
8	R3D_N132	Y	-5064.489
9	R3D_N132	Z	2310.808
10	R3D_N133	X	7.457
11	R3D_N133	Y	1905.897
12	R3D_N133	Z	-106.072
13	R3D_N109	X	-3.939
14	R3D_N109	Y	-5114.597
15	R3D_N109	Z	2446.488
16	R3D_N110A	X	2.833
17	R3D_N110A	Y	2108.301
18	R3D_N110A	Z	-105.721



**Point Loads and Moments (Cat 18 : OL3) (Continued)**

	Label	Direction	Magnitude[lb,lb-ft]
25	R3D_N133B_1	Y	5386.199
26	R3D_N133B_1	Z	-3200.712
27	R3D_N134B	X	6.734
28	R3D_N134B	Y	-1014.778
29	R3D_N134B	Z	146.865
30	R3D_N151	Y	5407.645
31	R3D_N151	Z	-3179.834
32	R3D_N152	X	-12.649
33	R3D_N152	Y	-1030.158
34	R3D_N152	Z	146.69
35	R3D_N143A_1	X	131.521
36	R3D_N143A_1	Y	4638.047
37	R3D_N143A_1	Z	-2611.938
38	R3D_N144A_1	X	24.232
39	R3D_N144A_1	Y	-834.377
40	R3D_N144A_1	Z	129.495
41	R3D_N149A	X	-4.204
42	R3D_N149A	Y	5454.829
43	R3D_N149A	Z	-3382.31
44	R3D_N150A	X	-13.284
45	R3D_N150A	Y	-1148.065
46	R3D_N150A	Z	146.161

**Point Loads and Moments (Cat 19 : OL4)**

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1	X	-73.451
2	R3D_N1	Y	3217.27
3	R3D_N1	Z	-2336.092
4	R3D_N2_1	X	-25.92
5	R3D_N2_1	Y	100.322
6	R3D_N2_1	Z	116.034
7	R3D_N132	Y	3788.758
8	R3D_N132	Z	-2873.955
9	R3D_N133	X	-4.962
10	R3D_N133	Y	133.97
11	R3D_N133	Z	131.881
12	R3D_N109	X	1.923
13	R3D_N109	Y	3868.84
14	R3D_N109	Z	-3043.09
15	R3D_N110A	X	24.887
16	R3D_N110A	Y	103.528
17	R3D_N110A	Z	131.236
18	R3D_N121	Y	3793.828
19	R3D_N121	Z	-2848.225
20	R3D_N122	X	8.56
21	R3D_N122	Y	118.744
22	R3D_N122	Z	131.524
23	R3D_N133B_1	Y	3788.86
24	R3D_N133B_1	Z	-2874.237
25	R3D_N134B	X	4.837
26	R3D_N134B	Y	134.139
27	R3D_N134B	Z	131.873
28	R3D_N151	Y	3797.53
29	R3D_N151	Z	-2850.415
30	R3D_N152	X	-8.481
31	R3D_N152	Y	116.768

**Point Loads and Moments (Cat 19 : OL4) (Continued)**

	Label	Direction	Magnitude[lb,lb-ft]
32	R3D_N152	Z	131.557
33	R3D_N143A_1	X	74.071
34	R3D_N143A_1	Y	3223.101
35	R3D_N143A_1	Z	-2339.752
36	R3D_N144A_1	X	25.227
37	R3D_N144A_1	Y	99.775
38	R3D_N144A_1	Z	116.098
39	R3D_N149A	X	-2.33
40	R3D_N149A	Y	3860.603
41	R3D_N149A	Z	-3037.805
42	R3D_N150A	X	-24.149
43	R3D_N150A	Y	104.938
44	R3D_N150A	Z	131.152

**Slabs**

	Label	Thickness [in]	Material	Local Axis Angle ...	Analysis Offset [in]	Passive Pressur...	Soil Overburden [psf]
1	S1	33	Conc2500NW	0	0	0	0
2	S2	33	Conc2500NW	0	0	0	0
3	S3	33	Conc2500NW	0	0	0	0
4	S4	33	Conc2500NW	0	0	0	0
5	S5	33	Conc2500NW	0	0	0	0
6	S6	33	Conc2500NW	0	0	0	0
7	S7	33	Conc2500NW	0	0	0	0
8	S8	33	Conc2500NW	0	0	0	0

**Load Combinations**

Label	Solve	Service A...	SF	Cat...Fa...	Cat...Fa...	Cat...Fa...	Cat...Fa...	Cat...Fa...	Cat...Fa...	Cat...Fa...	Cat...Fa...	Cat...Fa...	C...	F...	C...	F...
1	1.0 D	Yes	Yes	1.5	DL	1										
2	1.0 D + 1....	Yes	Yes	1.5	DL	1	RLL	1								
3	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL1	.6						
4	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL2	.6						
5	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL3	.6						
6	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL		OL4	.6						
7	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL1	.45						
8	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL2	.45						
9	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL3	.45						
10	1.0 D + 0....	Yes	Yes	1.5	DL	1	RLL	.75	OL4	.45						
11	0.9 D + 0....	Yes	Yes		DL	.9	RLL		OL1	.6						
12	0.9 D + 0....	Yes	Yes		DL	.9	RLL		OL2	.6						
13	0.9 D + 0....	Yes	Yes		DL	.9	RLL		OL3	.6						
14	0.9 D + 0....	Yes	Yes		DL	.9	RLL		OL4	.6						
15																
16	1.4D	Yes			DL	1.4										
17	1.2D+1.6SL	Yes			DL	1.2	RLL	1.6								
18	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL1	.5						
19	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL2	.5						
20	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL3	.5						
21	1.2D+1.6S...	Yes			DL	1.2	RLL	1.6	OL4	.5						
22	1.2D+1.0...	Yes			DL	1.2			OL1	1						
23	1.2D-1.0Wx	Yes			DL	1.2			OL2	1						
24	1.2D+1.0...	Yes			DL	1.2			OL3	1						
25	1.2D-1.0Wz	Yes			DL	1.2			OL4	1						
26	.9D+1.0Wx	Yes			DL	.9			OL1	1						
27	.9D-1.0Wx	Yes			DL	.9			OL2	1						
28	.9D+1.0Wz	Yes			DL	.9			OL3	1						
29	.9D-1.0Wz	Yes			DL	.9			OL4	1						





Company : Vector Structural Engineering  
 Designer : STB  
 Job Number : U2716.0276.211  
 Model Name : Ground Mount

Jan 26, 2021  
 1:53 PM  
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**Slab Overturning Safety Factors (By Combination) (Continued)**

LC	Slab	Angle[deg]	Mo-xx[lb-ft]	Ms-xx[lb-ft]	Mo-zz[lb-ft]	Ms-zz[lb-ft]	Ms-xx/Mo-xx	Ms-zz/Mo-zz
37	5	S5	0	4946.816	53892.526	0	18818.682	9.999+
38	5	S6	0	4966.717	53885.071	0	18834.993	9.999+
39	5	S7	0	5840.492	53938.382	0	18790.66	9.235
40	5	S8	0	3820.061	53637.54	0	18011.996	9.999+
41	6	S1	0	110.105	53642.354	0	18075.34	9.999+
42	6	S2	0	616.706	53939.552	0	18433.49	9.999+
43	6	S3	0	290.645	53884.824	0	18416.511	9.999+
44	6	S4	0	261.507	53892.369	0	18431.29	9.999+
45	6	S5	0	261.962	53892.526	0	18447.296	9.999+
46	6	S6	0	300.471	53885.071	0	18445.983	9.999+
47	6	S7	0	608.972	53938.382	0	18523.987	9.999+
48	6	S8	0	113.207	53637.54	0	17708.493	9.999+
49	7	S1	0	16739.098	59618.457	2179.671	16889.433	3.562
50	7	S2	0	20004.323	60161.044	2308.846	17110.155	3.007
51	7	S3	0	19646.421	60482.252	2335.474	17089.42	3.079
52	7	S4	0	19628.823	60427.402	2325.152	17085.289	3.079
53	7	S5	0	19628.123	60429.35	2325.657	17085.717	3.079
54	7	S6	0	19665.54	60477.012	2336.253	17088.884	3.075
55	7	S7	0	19961.432	60206.534	2303.861	17117.21	3.016
56	7	S8	0	16768.942	59619.047	2183.64	16885.503	3.555
57	8	S1	0	17334.132	59618.457	1954.76	16889.433	3.439
58	8	S2	0	20269.767	60161.044	1858.777	17061.999	2.968
59	8	S3	0	20116.651	60482.252	1980.758	17089.42	3.007
60	8	S4	0	20054.364	60427.402	1960.448	17085.289	3.013
61	8	S5	0	20053.905	60429.35	1961.543	17085.717	3.013
62	8	S6	0	20138.447	60477.012	1982.527	17088.884	3.003
63	8	S7	0	20223.381	60206.534	1855.32	17066.911	2.977
64	8	S8	0	17365.699	59619.047	1959.197	16885.503	3.433
65	9	S1	0	2858.701	59302.04	0	19431.071	9.999+
66	9	S2	0	4393.91	60994.981	0	19709.641	9.999+
67	9	S3	0	3710.097	60681.364	0	19776.628	9.999+
68	9	S4	0	3708.839	60723.038	0	19783.645	9.999+
69	9	S5	0	3710.112	60724.122	0	19797.584	9.999+
70	9	S6	0	3725.038	60682.353	0	19813.107	9.999+
71	9	S7	0	4380.369	60991.919	0	19803.661	9.999+
72	9	S8	0	2865.046	59263.164	0	18806.096	9.999+
73	10	S1	0	82.579	59302.04	0	19065.165	9.999+
74	10	S2	0	462.529	60994.981	0	19486.724	9.999+
75	10	S3	0	217.984	60681.364	0	19495.186	9.999+
76	10	S4	0	196.13	60723.038	0	19506.66	9.999+
77	10	S5	0	196.471	60724.122	0	19519.045	9.999+
78	10	S6	0	225.353	60682.353	0	19521.351	9.999+
79	10	S7	0	456.729	60991.919	0	19603.657	9.999+
80	10	S8	0	84.905	59263.164	0	18578.469	9.999+
81	11	S1	0	22318.798	48425.952	2906.229	13656.927	2.17
82	11	S2	0	26672.43	48484.892	3078.461	13687.057	1.818
83	11	S3	0	26195.228	48525.097	3113.965	13682.487	1.852
84	11	S4	0	26171.764	48518.513	3100.203	13682.516	1.854
85	11	S5	0	26170.831	48518.773	3100.876	13682.573	1.854
86	11	S6	0	26220.719	48524.435	3115.005	13682.425	1.851
87	11	S7	0	26615.243	48491.298	3071.815	13687.852	1.822
88	11	S8	0	22358.59	48426.994	2911.52	13656.667	2.166
89	12	S1	0	23112.176	48425.952	2606.347	13656.927	2.095
90	12	S2	0	27026.356	48484.892	2482.018	13687.057	1.794
91	12	S3	0	26822.201	48525.097	2641.011	13682.487	1.809
92	12	S4	0	26739.152	48518.513	2613.931	13682.516	1.815
93	12	S5	0	26738.54	48518.773	2615.39	13682.573	1.815





Company : Vector Structural Engineering  
 Designer : STB  
 Job Number : U2716.0276.211  
 Model Name : Ground Mount

Jan 26, 2021  
 1:53 PM  
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**Slab Sliding Safety Factors (By Combination) (Continued)**

	LC	Slab	Angle[deg]	Va-xx[lb]	Vr-xx[lb]	Va-zz[lb]	Vr-zz[lb]	SR-xx	SR-zz
35	5	S3	0	7.651	4104.613	1818.099	4104.613	9.999+	2.258
36	5	S4	0	3.133	4103.83	1832.308	4103.83	9.999+	2.24
37	5	S5	0	3.561	4103.758	1832.126	4103.758	9.999+	2.24
38	5	S6	0	7.589	4104.899	1819.886	4104.899	9.999+	2.256
39	5	S7	0	11.84	4092.676	1941.689	4092.676	9.999+	2.108
40	5	S8	0	101.291	3990.665	1489.466	3990.665	9.999+	2.679
41	6	S1	0	67.379	3903.283	1332.035	3903.283	9.999+	2.93
42	6	S2	0	17.416	4032.302	1747.112	4032.302	9.999+	2.308
43	6	S3	0	5.136	4021.23	1630.02	4021.23	9.999+	2.467
44	6	S4	0	2.902	4023.113	1645.418	4023.113	9.999+	2.445
45	6	S5	0	2.977	4023.078	1645.245	4023.078	9.999+	2.445
46	6	S6	0	5.088	4021.525	1631.315	4021.525	9.999+	2.465
47	6	S7	0	17.235	4031.256	1743.992	4031.256	9.999+	2.312
48	6	S8	0	67.417	3904.122	1334.192	3904.122	9.999+	2.926
49	7	S1	0	16.781	3219.471	956.463	3219.471	9.999+	3.366
50	7	S2	0	1.798	3228.298	1251.259	3228.298	9.999+	2.58
51	7	S3	0	4.095	3221.5	1169.381	3221.5	9.999+	2.755
52	7	S4	0	2.015	3221.603	1178.52	3221.603	9.999+	2.734
53	7	S5	0	2.291	3221.751	1178.403	3221.751	9.999+	2.734
54	7	S6	0	4.032	3221.175	1170.531	3221.175	9.999+	2.752
55	7	S7	0	2.396	3230.566	1249.749	3230.566	9.999+	2.585
56	7	S8	0	16.438	3217.542	958.008	3217.542	9.999+	3.359
57	8	S1	0	27.525	3274.989	808.087	3274.989	9.999+	4.053
58	8	S2	0	8.258	3322.021	1053.345	3322.021	9.999+	3.154
59	8	S3	0	4.31	3299.021	986.745	3299.021	9.999+	3.343
60	8	S4	0	2.09	3301.22	992.221	3301.22	9.999+	3.327
61	8	S5	0	2.605	3301.383	992.131	3301.383	9.999+	3.328
62	8	S6	0	4.713	3298.76	987.975	3298.76	9.999+	3.339
63	8	S7	0	8.902	3324.234	1052.035	3324.234	9.999+	3.16
64	8	S8	0	27.414	3273.097	809.388	3273.097	9.999+	4.044
65	9	S1	0	113.001	4171.706	1115.298	4171.706	9.999+	3.74
66	9	S2	0	16.869	4310.407	1459.049	4310.407	9.999+	2.954
67	9	S3	0	6.565	4318.839	1363.574	4318.839	9.999+	3.167
68	9	S4	0	2.35	4317.841	1374.231	4317.841	9.999+	3.142
69	9	S5	0	2.671	4317.87	1374.095	4317.87	9.999+	3.142
70	9	S6	0	6.542	4318.935	1364.915	4318.935	9.999+	3.164
71	9	S7	0	17.015	4310.59	1455.391	4310.59	9.999+	2.962
72	9	S8	0	113.759	4171.403	1117.1	4171.403	9.999+	3.734
73	10	S1	0	87.852	4106.961	999.026	4106.961	9.999+	4.111
74	10	S2	0	20.82	4264.141	1310.334	4264.141	9.999+	3.254
75	10	S3	0	4.678	4256.302	1222.515	4256.302	9.999+	3.482
76	10	S4	0	2.176	4257.304	1234.064	4257.304	9.999+	3.45
77	10	S5	0	2.233	4257.361	1233.933	4257.361	9.999+	3.45
78	10	S6	0	4.666	4256.404	1223.486	4256.404	9.999+	3.479
79	10	S7	0	21.061	4264.525	1307.118	4264.525	9.999+	3.263
80	10	S8	0	88.354	4106.496	1000.644	4106.496	9.999+	4.104
81	11	S1	0	72.907	2389.351	1275.284	2389.351	9.999+	1.874
82	11	S2	0	8.079	2319.45	1668.345	2319.45	9.999+	1.39
83	11	S3	0	6.562	2309.796	1559.174	2309.796	9.999+	1.481
84	11	S4	0	2.687	2310.48	1571.36	2310.48	9.999+	1.47
85	11	S5	0	3.054	2310.566	1571.204	2310.566	9.999+	1.471
86	11	S6	0	6.508	2309.524	1560.708	2309.524	9.999+	1.48
87	11	S7	0	7.786	2320.898	1665.164	2320.898	9.999+	1.394
88	11	S8	0	73.089	2388.249	1277.344	2388.249	9.999+	1.87
89	12	S1	0	87.233	2463.375	1077.45	2463.375	9.999+	2.286
90	12	S2	0	.534	2444.415	1404.46	2444.415	9.999+	1.74
91	12	S3	0	6.848	2413.158	1315.661	2413.158	9.999+	1.834





Company:		Date:	5/14/2018
Engineer:		Page:	1/6
Project:			
Address:			
Phone:			
E-mail:			

**1. Project information**

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

Project description:  
Location:  
Fastening description:

**2. Input Data & Anchor Parameters**

**General**

Design method: ACI 318-14  
Units: Imperial units

**Anchor Information:**

Anchor type: Bonded anchor  
Material: F1554 Grade 36  
Diameter (inch): 0.375  
Effective Embedment depth,  $h_{ef}$  (inch): 4.000  
Code report: ICC-ES ESR-4057  
Anchor category: -  
Anchor ductility: Yes  
 $h_{min}$  (inch): 5.25  
 $c_{ac}$  (inch): 7.12  
 $c_{min}$  (inch): 1.75  
 $s_{min}$  (inch): 3.00

**Base Material**

Concrete: Normal-weight  
Concrete thickness,  $h$  (inch): 30.00  
State: Cracked  
Compressive strength,  $f'_c$  (psi): 2500  
 $\Psi_{c,v}$ : 1.0  
Reinforcement condition: B tension, B shear  
Supplemental reinforcement: Not applicable  
Reinforcement provided at corners: No  
Ignore concrete breakout in tension: No  
Ignore concrete breakout in shear: No  
Hole condition: Dry concrete  
Inspection: Periodic  
Temperature range, Short/Long: 150/110°F  
Ignore 6do requirement: Not applicable  
Build-up grout pad: No

**Base Plate**

Length x Width x Thickness (inch): 4.75 x 4.75 x 0.31

**Recommended Anchor**

Anchor Name: SET-3G - SET-3G w/ 3/8"Ø F1554 Gr. 36  
Code Report: ICC-ES ESR-4057





Company:		Date:	5/14/2018
Engineer:		Page:	2/6
Project:			
Address:			
Phone:			
E-mail:			

**Load and Geometry**

Load factor source: ACI 318 Section 5.3

Load combination: not set

Seismic design: No

Anchors subjected to sustained tension: No

Apply entire shear load at front row: No

Anchors only resisting wind and/or seismic loads: No

Strength level loads:

$N_{ua}$  [lb]: 4921

$V_{uax}$  [lb]: 160

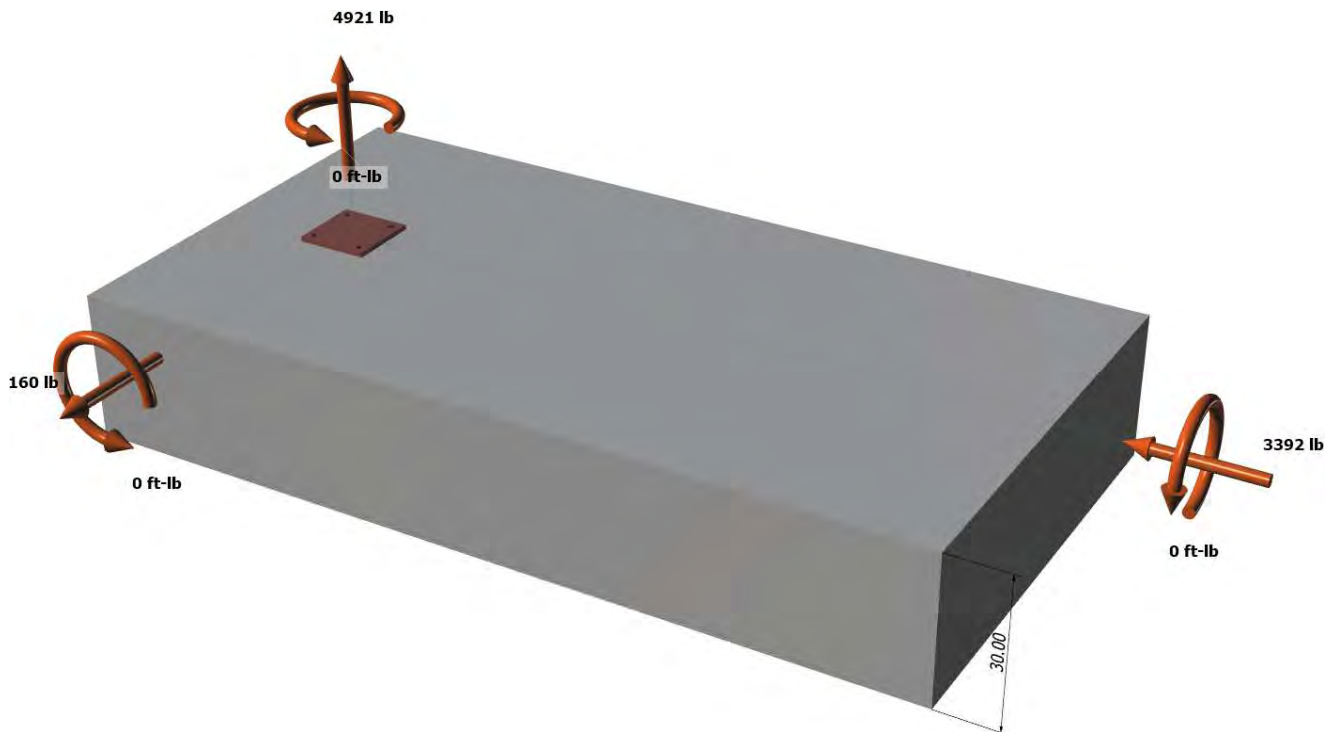
$V_{uay}$  [lb]: -3392

$M_{ux}$  [ft-lb]: 0

$M_{uy}$  [ft-lb]: 0

$M_{uz}$  [ft-lb]: 0

<Figure 1>





Company:		Date:	5/14/2018
Engineer:		Page:	3/6
Project:			
Address:			
Phone:			
E-mail:			

<Figure 2>





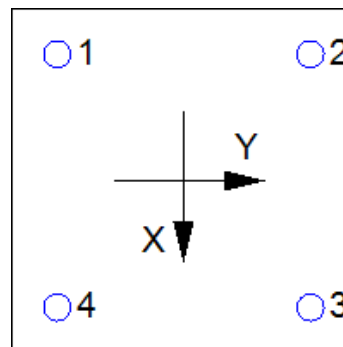
Company:		Date:	5/14/2018
Engineer:		Page:	4/6
Project:			
Address:			
Phone:			
E-mail:			

### 3. Resulting Anchor Forces

Anchor	Tension load, N <sub>ua</sub> (lb)	Shear load x, V <sub>uax</sub> (lb)	Shear load y, V <sub>uay</sub> (lb)	Shear load combined, $\sqrt{(V_{uax})^2 + (V_{uay})^2}$ (lb)
1	1230.3	40.0	-848.0	848.9
2	1230.3	40.0	-848.0	848.9
3	1230.3	40.0	-848.0	848.9
4	1230.3	40.0	-848.0	848.9
Sum	4921.0	160.0	-3392.0	3395.8

Maximum concrete compression strain (%): 0.00  
 Maximum concrete compression stress (psi): 0  
 Resultant tension force (lb): 4921  
 Resultant compression force (lb): 0  
 Eccentricity of resultant tension forces in x-axis, e'<sub>Nx</sub> (inch): 0.00  
 Eccentricity of resultant tension forces in y-axis, e'<sub>Ny</sub> (inch): 0.00  
 Eccentricity of resultant shear forces in x-axis, e'<sub>Vx</sub> (inch): 0.00  
 Eccentricity of resultant shear forces in y-axis, e'<sub>Vy</sub> (inch): 0.00

<Figure 3>



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

N <sub>sa</sub> (lb)	φ	φN <sub>sa</sub> (lb)
4525	0.75	3394

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

$$N_b = K_c \lambda_a \sqrt{f_c} h_{ef}^{1.5} \text{ (Eq. 17.4.2.2a)}$$

K <sub>c</sub>	λ <sub>a</sub>	f <sub>c</sub> (psi)	h <sub>ef</sub> (in)	N <sub>b</sub> (lb)
17.0	1.00	2500	4.000	6800

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

A <sub>Nc</sub> (in <sup>2</sup> )	A <sub>Nco</sub> (in <sup>2</sup> )	C <sub>a,min</sub> (in)	Ψ <sub>ec,N</sub>	Ψ <sub>ed,N</sub>	Ψ <sub>c,N</sub>	Ψ <sub>cp,N</sub>	N <sub>b</sub> (lb)	φ	φN <sub>cbg</sub> (lb)
240.25	144.00	7.25	1.000	1.000	1.00	1.000	6800	0.65	7374

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

$$\tau_{k,cr} = \tau_{k,cr,short-term} K_{sat} (f_c / 2,500)^n$$

τ <sub>k,cr</sub> (psi)	f <sub>short-term</sub>	K <sub>sat</sub>	f <sub>c</sub> (psi)	n	τ <sub>k,cr</sub> (psi)
1346	1.00	1.00	2500	0.24	1346

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

λ <sub>a</sub>	τ <sub>cr</sub> (psi)	d <sub>a</sub> (in)	h <sub>ef</sub> (in)	N <sub>ba</sub> (lb)
1.00	1346	0.38	4.000	6343

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

A <sub>Na</sub> (in <sup>2</sup> )	A <sub>Na0</sub> (in <sup>2</sup> )	C <sub>Na</sub> (in)	C <sub>a,min</sub> (in)	Ψ <sub>ec,Na</sub>	Ψ <sub>ed,Na</sub>	Ψ <sub>cp,Na</sub>	N <sub>ba</sub> (lb)	φ	φN <sub>ag</sub> (lb)
198.45	112.09	5.29	7.25	1.000	1.000	1.000	6343	0.55	6176



Company:		Date:	5/14/2018
Engineer:		Page:	5/6
Project:			
Address:			
Phone:			
E-mail:			

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

$V_{sa}$ (lb)	$\phi_{grout}$	$\phi$	$\phi_{grout}\phi V_{sa}$ (lb)
2715	1.0	0.65	1765

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

**Shear perpendicular to edge in x-direction:**

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

$l_e$ (in)	$d_a$ (in)	$\lambda_a$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{bx}$ (lb)
3.00	0.375	1.00	2500	16.75	22270

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

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	$V_{bx}$ (lb)	$\phi$	$\phi V_{cbgx}$ (lb)
901.36	1262.53	1.000	0.787	1.000	1.000	22270	0.70	8754

**Shear perpendicular to edge in y-direction:**

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

$l_e$ (in)	$d_a$ (in)	$\lambda_a$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{by}$ (lb)
3.00	0.375	1.00	2500	10.75	11450

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

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	$V_{by}$ (lb)	$\phi$	$\phi V_{cbgy}$ (lb)
483.75	520.03	1.000	0.947	1.000	1.000	11450	0.70	7057

**Shear parallel to edge in y-direction:**

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

$l_e$ (in)	$d_a$ (in)	$\lambda_a$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{bx}$ (lb)
3.00	0.375	1.00	2500	13.25	15668

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

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	$V_{bx}$ (lb)	$\phi$	$\phi V_{cbgy}$ (lb)
608.67	790.03	1.000	1.000	1.000	1.000	15668	0.70	16900

**Shear parallel to edge in x-direction:**

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

$l_e$ (in)	$d_a$ (in)	$\lambda_a$	$f_c$ (psi)	$c_{a1}$ (in)	$V_{by}$ (lb)
3.00	0.375	1.00	2500	7.25	6342

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

$A_{Vc}$ (in <sup>2</sup> )	$A_{Vco}$ (in <sup>2</sup> )	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	$V_{by}$ (lb)	$\phi$	$\phi V_{cbgx}$ (lb)
274.59	236.53	1.000	1.000	1.000	1.000	6342	0.70	10307

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

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

$k_{cp}$	$A_{Na}$ (in <sup>2</sup> )	$A_{Na0}$ (in <sup>2</sup> )	$\Psi_{ed,Na}$	$\Psi_{ec,Na}$	$\Psi_{cp,Na}$	$N_{ba}$ (lb)	$N_a$ (lb)
2.0	198.45	112.09	1.000	1.000	1.000	6343	11230

$A_{Nc}$ (in <sup>2</sup> )	$A_{Nco}$ (in <sup>2</sup> )	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	$N_b$ (lb)	$N_{cb}$ (lb)	$\phi$
240.25	144.00	1.000	1.000	1.000	1.000	6800	11345	0.70

Input data and results must be checked for agreement with the existing circumstances, the standards and guidelines must be checked for plausibility.



Company:		Date:	5/14/2018
Engineer:		Page:	6/6
Project:			
Address:			
Phone:			
E-mail:			

$\phi V_{cpq}$  (lb)  
15722

## 11. Results

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

Tension	Factored Load, $N_{ua}$ (lb)	Design Strength, $\phi N_n$ (lb)	Ratio	Status
Steel	1230	3394	0.36	Pass
Concrete breakout	4921	7374	0.67	Pass
<b>Adhesive</b>	<b>4921</b>	<b>6176</b>	<b>0.80</b>	<b>Pass (Governs)</b>

Shear	Factored Load, $V_{ua}$ (lb)	Design Strength, $\phi V_n$ (lb)	Ratio	Status
<b>Steel</b>	<b>849</b>	<b>1765</b>	<b>0.48</b>	<b>Pass (Governs)</b>
T Concrete breakout x+	160	8754	0.02	Pass
T Concrete breakout y-	3392	7057	0.48	Pass
Concrete breakout x+	1696	16900	0.10	Pass
Concrete breakout y-	80	10307	0.01	Pass
Concrete breakout, combined	-	-	0.48	Pass
Pryout	3396	15722	0.22	Pass

Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.68	0.30	98.0%	1.0	Pass

**SET-3G w/ 3/8"Ø F1554 Gr. 36 with hef = 4.000 inch meets the selected design criteria.**

## 12. Warnings

- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.

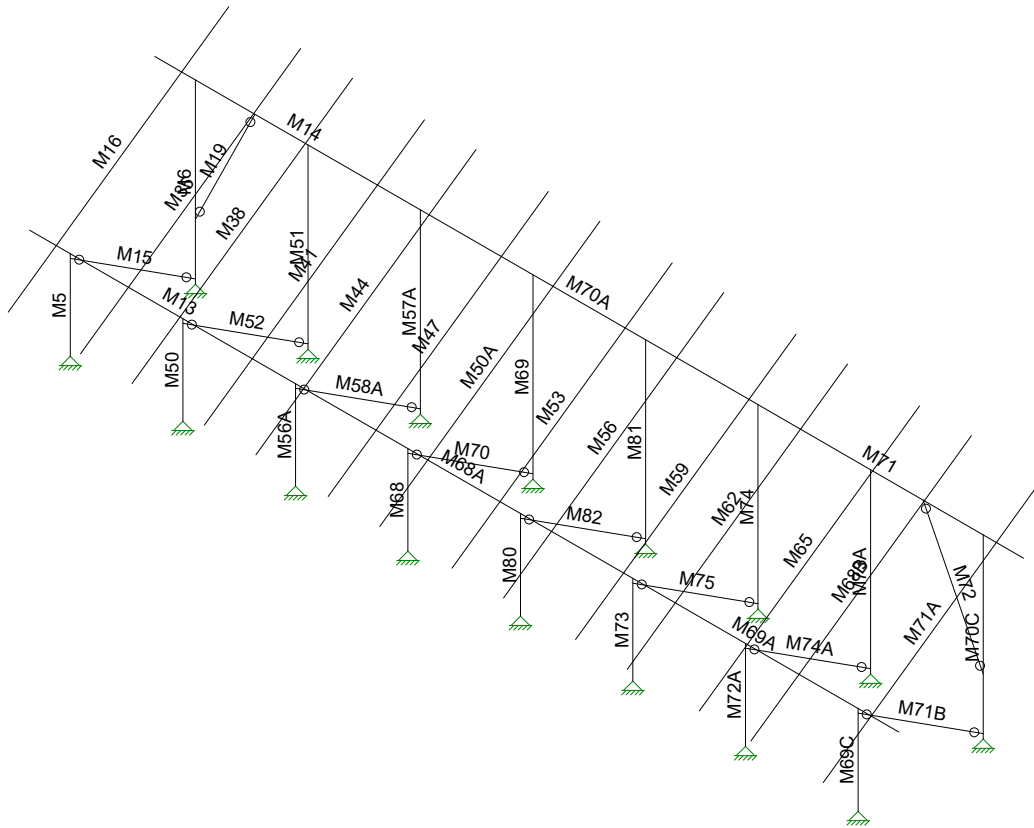


JOB NO.: U2716-0276-211

DESIGNED: STB

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# Framing Analysis



Vector Structural Engineeri...

STB

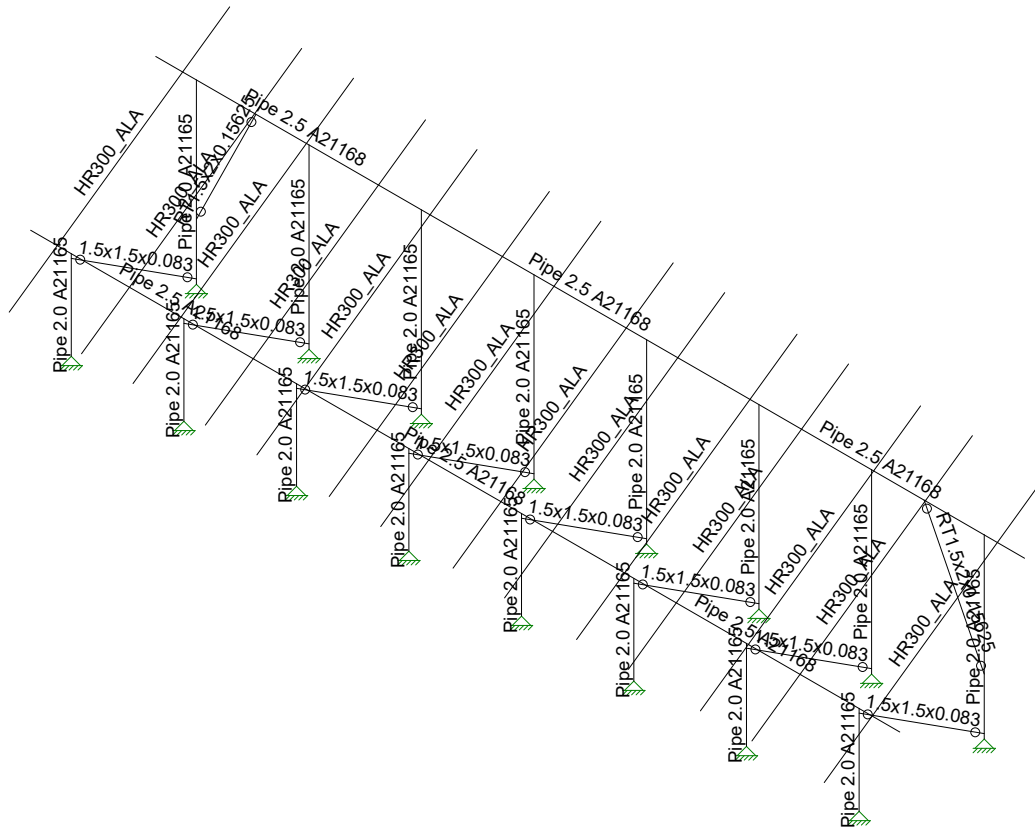
U2716.0276.211

Ground Mount

SK - 1

Jan 26, 2021 at 10:39 AM

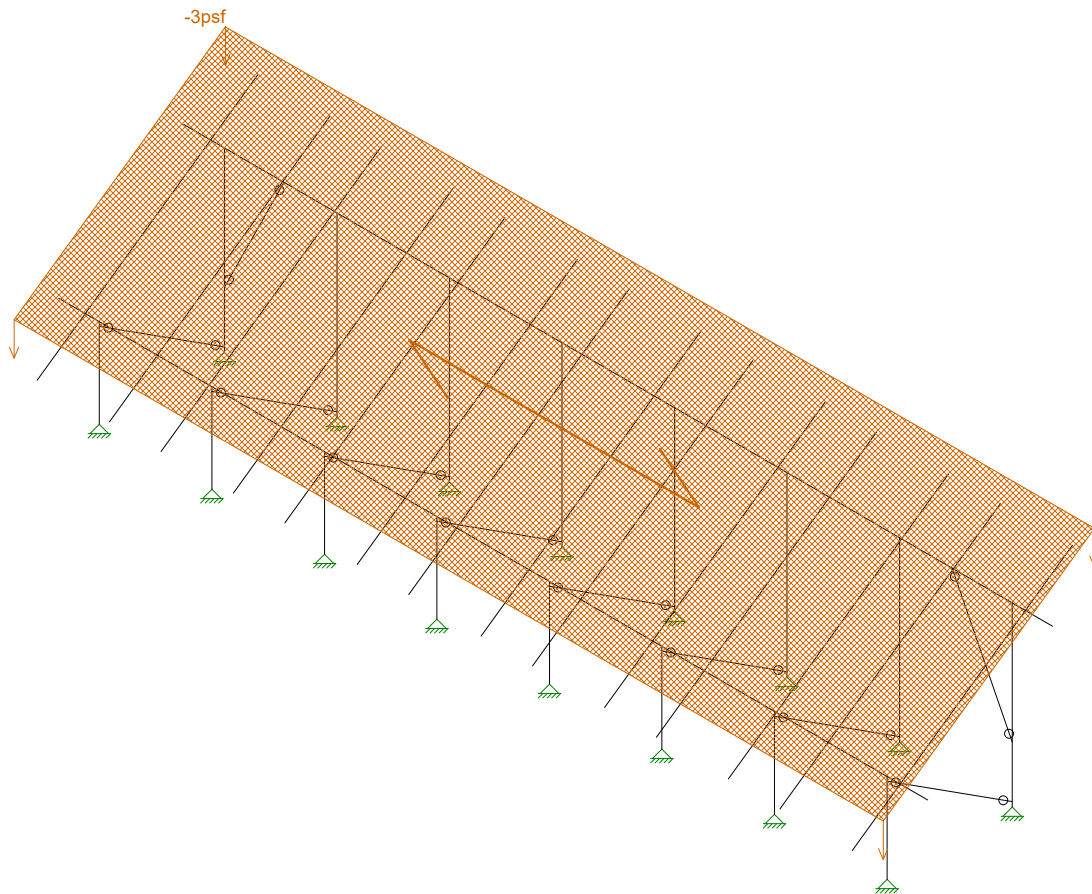
Sunmodo Sunturf A9 v2.r3d



Vector Structural Engineeri...  
STB  
U2716.0276.211

Ground Mount

SK - 3  
Jan 26, 2021 at 10:29 AM  
Sunmodo Sunturf A9 v2.r3d



Loads: BLC 2, Solar Panel Weight

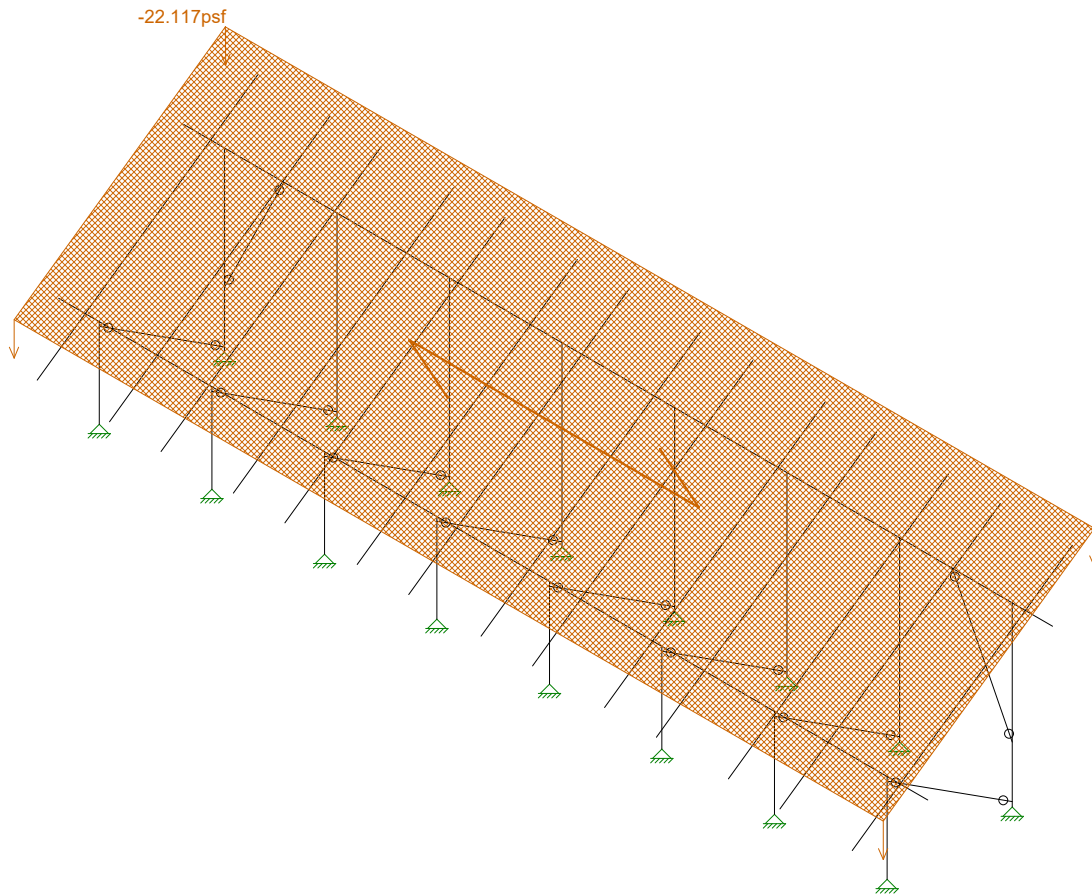
Vector Structural Engineeri...  
STB  
U2716.0276.211

Ground Mount

SK - 4

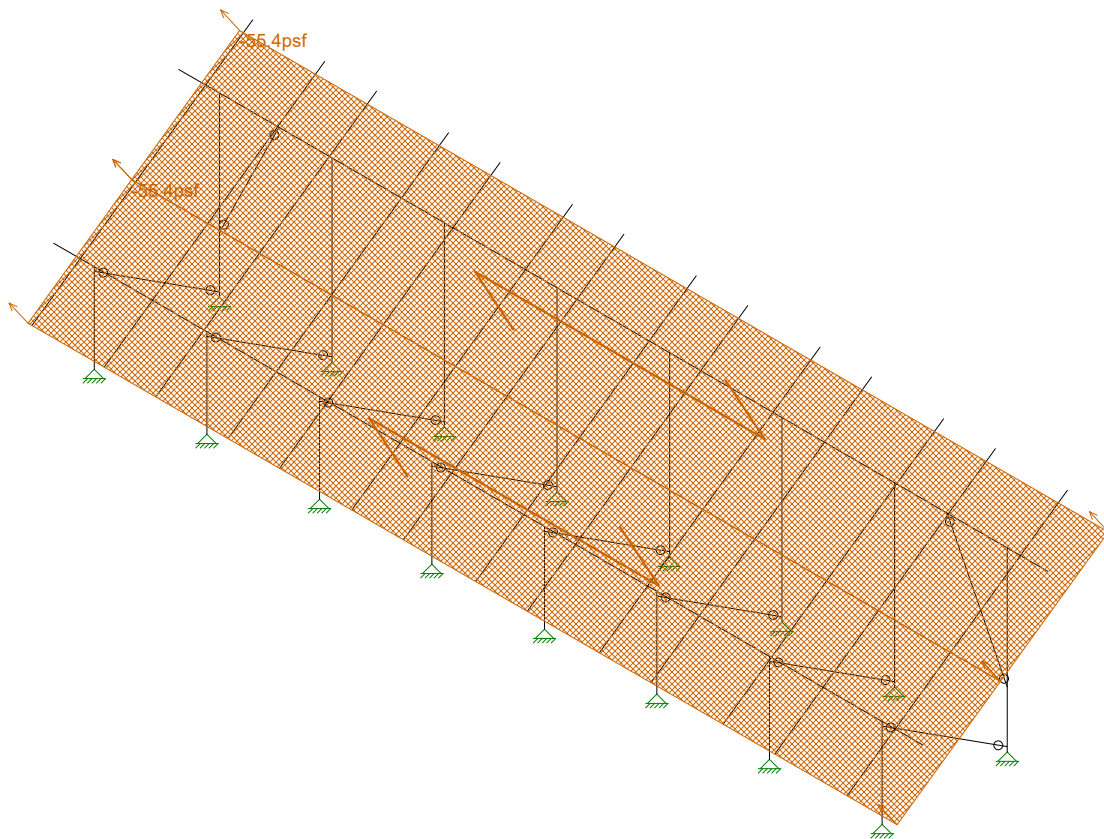
Jan 26, 2021 at 10:29 AM

Sunmodo Sunturf A9 v2.r3d



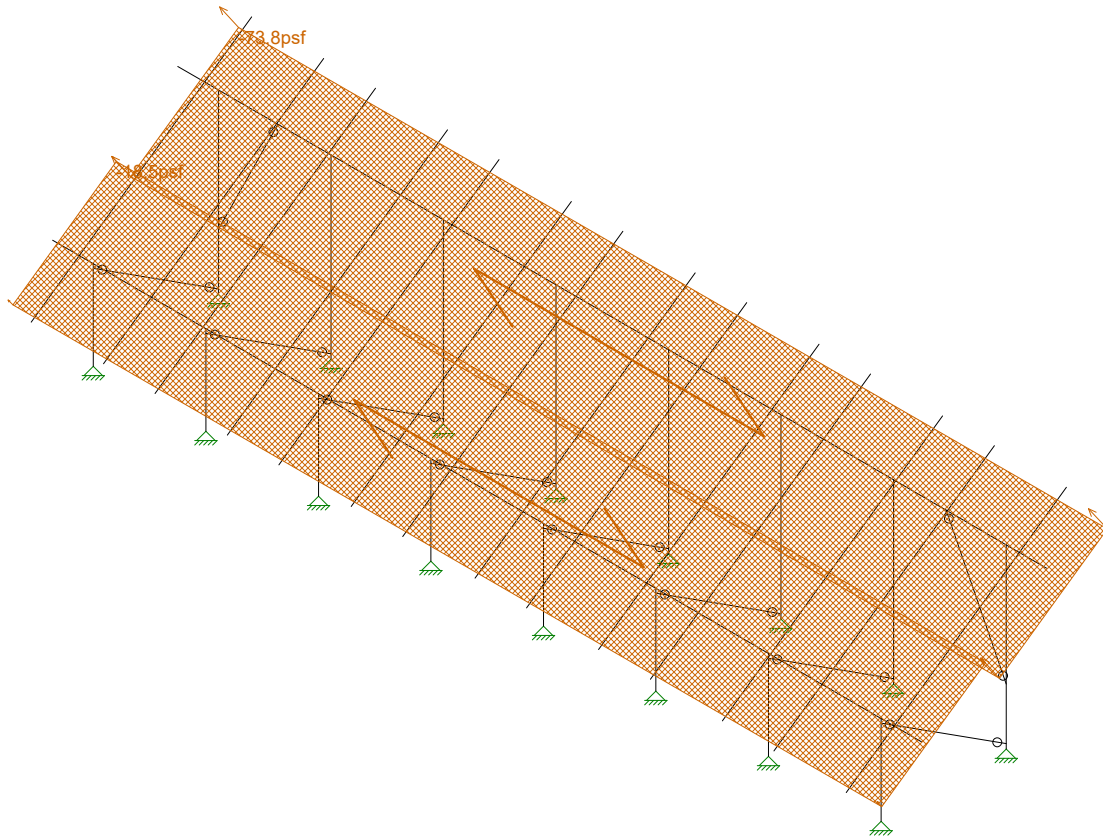
Loads: BLC 3, Roof Live/Snow

Vector Structural Engineeri...	Ground Mount	SK - 5
STB		Jan 26, 2021 at 10:29 AM
U2716.0276.211		Sunmodo Sunturf A9 v2.r3d



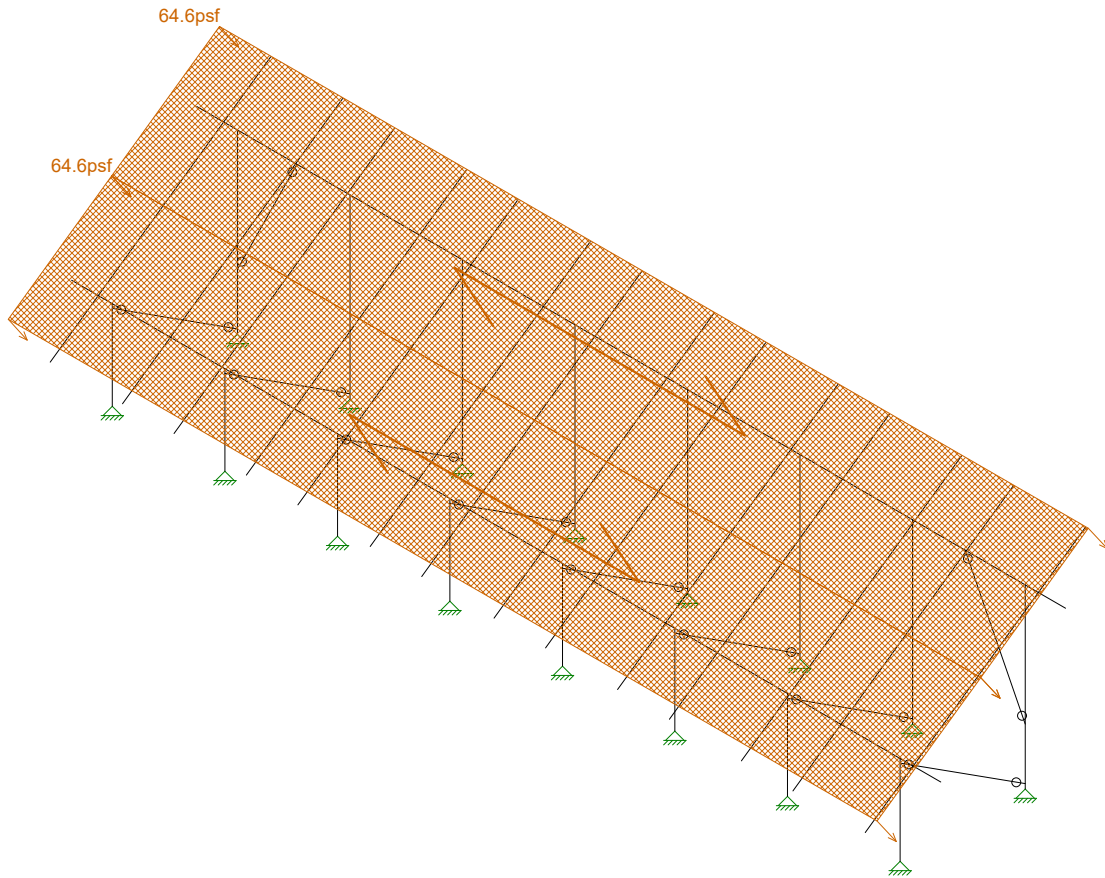
Loads: BLC 4, Wind A 0 deg

Vector Structural Engineeri..	Ground Mount	SK - 6
STB		Jan 26, 2021 at 10:29 AM
U2716.0276.211		Sunmodo Sunturf A9 v2.r3d



Loads: BLC 5, Wind B 0 deg

Vector Structural Engineeri..	Ground Mount	SK - 9
STB		Jan 26, 2021 at 10:30 AM
U2716.0276.211		Sunmodo Sunturf A9 v2.r3d



Loads: BLC 6, Wind A 180 deg

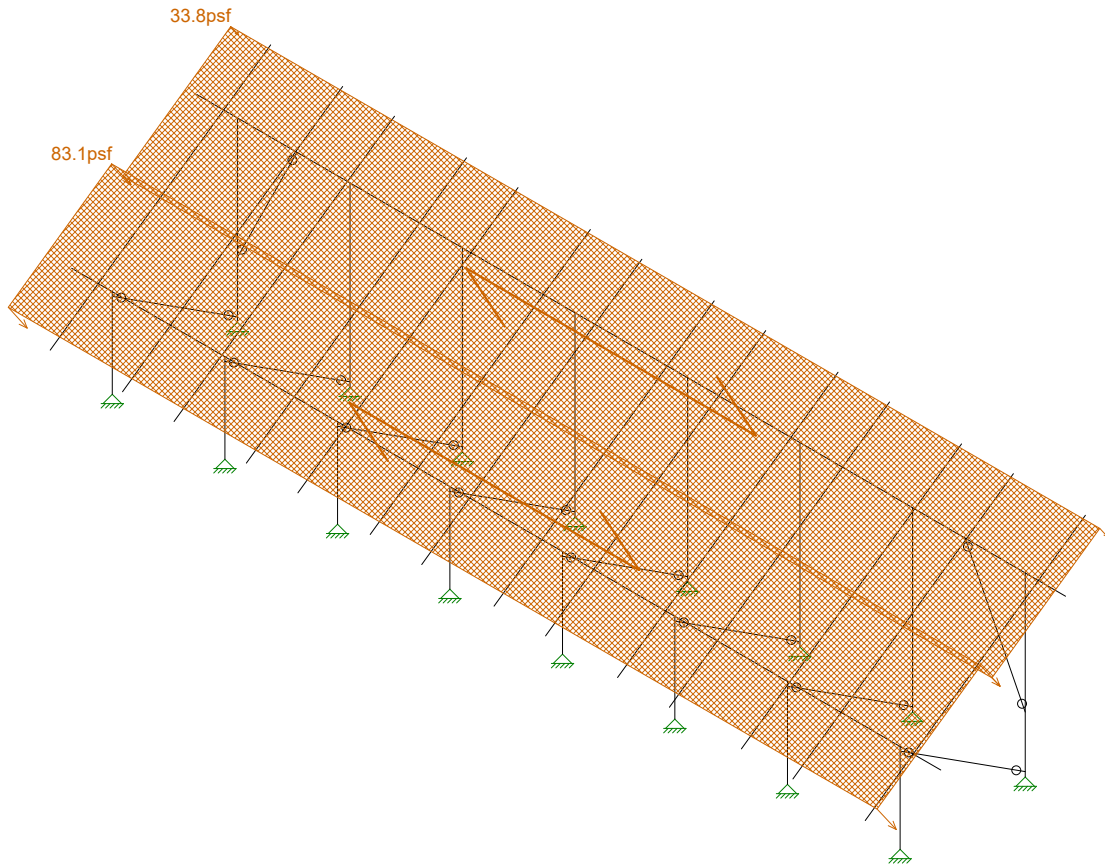
Vector Structural Engineeri...  
STB  
U2716.0276.211

Ground Mount

SK - 7

Jan 26, 2021 at 10:29 AM

Sunmodo Sunturf A9 v2.r3d



Loads: BLC 7, Wind B 180 deg

Vector Structural Engineeri...  
STB  
U2716.0276.211

Ground Mount

SK - 8

Jan 26, 2021 at 10:29 AM

Sunmodo Sunturf A9 v2.r3d







Company : Vector Structural Engineering  
Designer : STB  
Job Number : U2716.0276.211  
Model Name : Ground Mount

Jan 26, 2021  
10:37 AM  
Checked By: \_\_\_\_\_

### (Global) Model Settings

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	97
Include Shear Deformation?	Yes
Increase Nailing Capacity for Wind?	Yes
Include Warping?	Yes
Trans Load Btwn Intersecting Wood Wall?	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Include P-Delta for Walls?	Yes
Automatically Iterate Stiffness for Walls?	Yes
Max Iterations for Wall Stiffness	3
Gravity Acceleration (in/sec^2)	386.4
Wall Mesh Size (in)	24
Eigensolution Convergence Tol. (1.E-)	4
Vertical Axis	Y
Global Member Orientation Plane	XZ
Static Solver	Sparse Accelerated
Dynamic Solver	Accelerated Solver

Hot Rolled Steel Code	AISC 15th(360-16): ASD
Adjust Stiffness?	Yes(Iterative)
RISACONNECTION CODE	AISC 15th(360-16): ASD
Cold Formed Steel Code	AISI S100-16: ASD
Wood Code	AWC NDS-18: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-14
Masonry Code	None
Aluminum Code	AA ADM1-15: ASD - Building
Stainless Steel Code	AISC 14th(360-10): ASD
Adjust Stiffness?	Yes(Iterative)

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	Exact Integration
Parame Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections?	Yes
Use Cracked Sections Slab?	No
Bad Framing Warnings?	No
Unused Force Warnings?	Yes
Min 1 Bar Diam. Spacing?	No
Concrete Rebar Set	REBAR SET ASTMA615
Min % Steel for Column	1
Max % Steel for Column	8





### Load Combinations (Continued)

	Description	S...	PD...	SRSS	BLC	Fa...	BLC	Fa...	BLC	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...
5	1.0 D + 0.6 W3	Yes	Y		DL	1	RLL		OL3	.6													
6	1.0 D + 0.6 W4	Yes	Y		DL	1	RLL		OL4	.6													
7	1.0 D + 0.45 W1 + 0....	Yes	Y		DL	1	RLL	.75	OL1	.45													
8	1.0 D + 0.45 W2 + 0....	Yes	Y		DL	1	RLL	.75	OL2	.45													
9	1.0 D + 0.45 W3 + 0....	Yes	Y		DL	1	RLL	.75	OL3	.45													
10	1.0 D + 0.45 W4 + 0....	Yes	Y		DL	1	RLL	.75	OL4	.45													
11	0.6 D + 0.6 W1	Yes	Y		DL	.6	RLL		OL1	.6													
12	0.6 D + 0.6 W2	Yes	Y		DL	.6	RLL		OL2	.6													
13	0.6 D + 0.6 W3	Yes	Y		DL	.6	RLL		OL3	.6													
14	0.6 D + 0.6 W4	Yes	Y		DL	.6	RLL		OL4	.6													
15																							
16	1.4D		Y		DL	1.4																	
17	1.2D+1.6SL		Y		DL	1.2	RLL	1.6															
18	1.2D+1.6SL+.5Wx		Y		DL	1.2	RLL	1.6	OL1	.5													
19	1.2D+1.6SL-.5Wx		Y		DL	1.2	RLL	1.6	OL2	.5													
20	1.2D+1.6SL+.5Wz		Y		DL	1.2	RLL	1.6	OL3	.5													
21	1.2D+1.6SL-.5Wz		Y		DL	1.2	RLL	1.6	OL4	.5													
22	1.2D+1.0Wx		Y		DL	1.2			OL1	1	1												
23	1.2D-1.0Wx		Y		DL	1.2			OL2	1	1												
24	1.2D+1.0Wz		Y		DL	1.2			OL3	1	1												
25	1.2D-1.0Wz		Y		DL	1.2			OL4	1	1												
26	.9D+1.0Wx		Y		DL	.9			OL1	1	1												
27	.9D-1.0Wx		Y		DL	.9			OL2	1	1												
28	.9D+1.0Wz		Y		DL	.9			OL3	1	1												
29	.9D-1.0Wz		Y		DL	.9			OL4	1	1												

### Envelope Joint Reactions

	Joint	X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb...	LC	MZ [lb-ft]	LC	
1	N2	max	16.399	6	1417.293	8	67.292	3	0	14	0	14	0	14
2		min	-12.087	11	-420.444	13	-77.26	5	0	1	0	1	0	1
3	N1	max	86.602	9	2949.431	5	1564.2...	5	0	14	0	14	0	14
4		min	-88.761	12	-2539.694	12	-1342...	3	0	1	0	1	0	1
5	N132	max	.964	4	3428.891	5	1920.1...	5	0	14	0	14	0	14
6		min	-1.006	13	-2920.93	12	-1647...	3	0	1	0	1	0	1
7	N133	max	4.63	5	1735.684	8	76.593	3	0	14	0	14	0	14
8		min	-4.373	12	-511.718	13	-87.92	5	0	1	0	1	0	1
9	N109	max	1.853	12	3491.542	5	2034.0...	5	0	14	0	14	0	14
10		min	-3.243	9	-2939.719	12	-1744...	3	0	1	0	1	0	1
11	N110A	max	6.558	11	1867.675	8	76.463	3	0	14	0	14	0	14
12		min	-19.152	10	-588.293	13	-87.435	5	0	1	0	1	0	1
13	N121	max	.646	13	3431.505	5	1904.7...	5	0	14	0	14	0	14
14		min	-.938	8	-2938.404	12	-1636...	3	0	1	0	1	0	1
15	N122	max	7.354	12	1729.874	8	76.462	3	0	14	0	14	0	14
16		min	-7.803	5	-515.938	13	-87.778	5	0	1	0	1	0	1
17	N133B	max	.895	13	3428.936	5	1920.3...	5	0	14	0	14	0	14
18		min	-.973	12	-2920.877	12	-1647...	3	0	1	0	1	0	1
19	N134B	max	3.669	12	1735.347	8	76.585	3	0	14	0	14	0	14
20		min	-4.124	5	-511.516	13	-87.912	5	0	1	0	1	0	1
21	N151	max	.847	8	3434.75	5	1906.5...	5	0	14	0	14	0	14
22		min	-.446	13	-2942.147	12	-1637...	3	0	1	0	1	0	1
23	N152	max	7.793	5	1732.38	8	76.495	3	0	14	0	14	0	14
24		min	-7.252	12	-518.281	13	-87.803	5	0	1	0	1	0	1
25	N143A	max	89.406	12	2954.79	5	1566.7...	5	0	14	0	14	0	14
26		min	-87.437	9	-2544.516	12	-1344...	3	0	1	0	1	0	1
27	N144A	max	11.838	11	1413.578	8	67.324	3	0	14	0	14	0	14



**Envelope Joint Reactions (Continued)**

Joint	X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC MY [lb-ft]	LC	MZ [lb-ft]	LC
28	min -16.002	6	-422.252	13	-77.293	5	0	1	0	1	0
29	N149A max 3.728	9	3485.376	5	2030.1...	5	0	14	0	14	0
30	min -2.321	12	-2931.713	12	-1741...	3	0	1	0	1	0
31	N150A max 18.931	10	1863.427	8	76.405	3	0	14	0	14	0
32	min -5.914	11	-586.169	13	-87.385	5	0	1	0	1	0
33	Totals: max .001	8	28593.284	9	14166...	13					
34	min 0	9	-15639.563	11	-1214...	3					

**Envelope AISC 15th(360-16): ASD Steel Code Checks**

Member	Shape	Code Check	Loc[in]	LC Shear	...	Loc[in]	Dir	LC Pnc/om	[..Pnt/om	[lb]Mnyy/om	..Mnzz/om	Cb	Eqn
1	M5	Pipe 2.0 A2...	.266	54.562	5	.229	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
2	M6	Pipe 2.0 A2...	.713	2.359	5	.239	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
3	M13	Pipe 2.5 A2...	.490	63.25	10	.234	97.75	6	11641.036	28358.413	2081.747	2081.747	1 H1-1b
4	M14	Pipe 2.5 A2...	.426	170....	9	.227	97.75	9	11641.036	28358.413	2081.747	2081.747	1... H1-1b
5	M15	1.5x1.5x0.083	.746	49.521	5	.039	0	y	2626.519	14085.15	624.421	624.421	1... H1-1a
6	M80	Pipe 2.0 A2...	.298	53.969	13	.274	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
7	M81	Pipe 2.0 A2...	.841	2.359	5	.293	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
8	M82	1.5x1.5x0.083	.912	49.521	5	.004	95.081	y	2626.519	14085.15	624.421	624.421	1... H1-1a
9	M50	Pipe 2.0 A2...	.300	53.969	13	.291	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
10	M51	Pipe 2.0 A2...	.867	2.359	5	.310	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
11	M52	1.5x1.5x0.083	.965	49.521	5	.005	95.081	y	2626.519	14085.15	624.421	624.421	1... H1-1a
12	M56A	Pipe 2.0 A2...	.298	53.969	13	.272	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
13	M57A	Pipe 2.0 A2...	.840	2.359	5	.290	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
14	M58A	1.5x1.5x0.083	.904	49.521	5	.007	95.081	y	2626.519	14085.15	624.421	624.421	1... H1-1a
15	M68	Pipe 2.0 A2...	.298	53.969	13	.274	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
16	M69	Pipe 2.0 A2...	.841	2.359	5	.293	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
17	M70	1.5x1.5x0.083	.912	49.521	5	.004	0	y	2626.519	14085.15	624.421	624.421	1... H1-1a
18	M68A	Pipe 2.5 A2...	.506	58.125	6	.143	129....	6	11641.036	28358.413	2081.747	2081.747	2... H1-1b
19	M69A	Pipe 2.5 A2...	.484	128	10	.231	94	6	11641.036	28358.413	2081.747	2081.747	1 H1-1b
20	M70A	Pipe 2.5 A2...	.542	58.125	9	.156	129....	9	11641.036	28358.413	2081.747	2081.747	2... H1-1b
21	M71	Pipe 2.5 A2...	.451	166	9	.225	94	9	11641.036	28358.413	2081.747	2081.747	1... H1-1b
22	M73	Pipe 2.0 A2...	.299	53.969	13	.272	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
23	M74	Pipe 2.0 A2...	.840	2.359	5	.291	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
24	M75	1.5x1.5x0.083	.905	49.521	5	.007	0	y	2626.519	14085.15	624.421	624.421	1... H1-1a
25	M69C	Pipe 2.0 A2...	.266	53.969	13	.230	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
26	M70C	Pipe 2.0 A2...	.714	2.359	5	.240	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
27	M71B	1.5x1.5x0.083	.747	49.521	5	.039	95.081	y	2626.519	14085.15	624.421	624.421	1... H1-1a
28	M72A	Pipe 2.0 A2...	.300	53.969	13	.290	54.562	5	16072.847	23232.186	1397.505	1397.505	1... H1-1b
29	M73A	Pipe 2.0 A2...	.865	2.359	5	.309	0	5	5849.89	23232.186	1397.505	1397.505	1... H1-1a
30	M74A	1.5x1.5x0.083	.963	49.521	5	.005	0	y	2626.519	14085.15	624.421	624.421	1... H1-1a

**Envelope AA ADM1-15: ASD - Building Aluminum Code Checks**

Member	Shape	Code C...	Loc[in]	LC Shear	...	Loc[in]	Dir	LC Pnc/O...	Pnt/Om...	Mny/O...	Mnz/O...	Vny/O...	Vnz/O...	Cb	Eqn	
1	M19	RT1.5x2x...	.165	52.977	9	.016	0	z	5	2260.001	19411....	770.742	927.083	5889.423	3966.346	1... H.1-1
2	M16	HR300_A...	.755	37.631	10	.108	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2... H.1-1
3	M35	HR300_A...	.866	37.631	10	.113	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2... H.1-1
4	M38	HR300_A...	.804	89.599	12	.111	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1... H.1-1
5	M41	HR300_A...	.769	37.631	10	.109	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2... H.1-1
6	M44	HR300_A...	.787	87.807	9	.109	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1... H.1-1
7	M47	HR300_A...	.769	37.631	10	.109	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2... H.1-1
8	M50A	HR300_A...	.773	87.807	9	.109	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1... H.1-1
9	M53	HR300_A...	.774	87.807	9	.109	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1.4 H.1-1
10	M56	HR300_A...	.769	37.631	10	.109	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2... H.1-1
11	M59	HR300_A...	.788	87.807	9	.109	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1... H.1-1



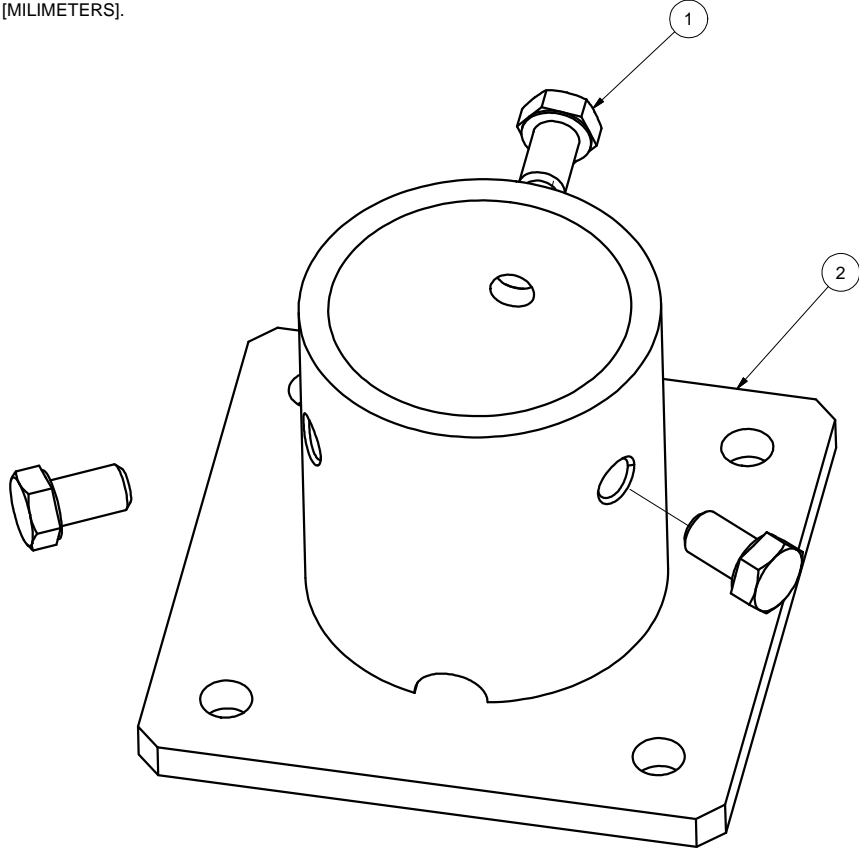
Company : Vector Structural Engineering  
 Designer : STB  
 Job Number : U2716.0276.211  
 Model Name : Ground Mount

Jan 26, 2021  
 10:37 AM  
 Checked By: \_\_\_\_\_

**Envelope AA ADM1-15: ASD - Building Aluminum Code Checks (Continued)**

Member	Shape	Code C...	Loc[fin]	LC Shear ...	Loc[fin]	Dir	LC Pnc/O...	Pnt/Om...	Mny/O...	Mnz/O...	Vny/O...	Vnz/O...	Cb Eqn			
12	M62	HR300_A...	.769	37.631	10	.109	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H.1-1
13	M65	HR300_A...	.804	89.599	12	.111	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1...H.1-1
14	M68B	HR300_A...	.864	37.631	10	.113	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H.1-1
15	M71A	HR300_A...	.760	37.631	10	.104	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H.1-1
16	M72	RT1.5x2x...	.166	53.045	9	.016	0	z	5	2254.199	19411....	770.742	927.083	5889.423	3966.346	1...H.1-1

NOTES: UNLESS OTHERWISE SPECIFIED  
 1. DIMENSIONS SHOWN ARE INCHES [MILLIMETERS].



REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	10/20/2016

2	A21120-001	2" PIPE BASE	1
1	B15018-011	HEX CAP SCREW 3/8-16 X 5/8	3
ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS		<b>Sunmodo Corp.</b> 1905 E 5TH STREET, STE A, VANCOUVER, WA 98661	
Tolerances		TITLE	
X.XXX ±0.01 [0.25mm]		2" PIPE BASE KIT	
X.XX ±0.02 [0.50mm]		DRAWING NUMBER	
X.X ±0.039 [1.0mm]		B K10268-001	
Unless otherwise spec'd		SCALE: NONE	
DRAWN BY		SHEET 1 of 1	
LWF		DATE	
CHECKED BY		10/20/2016	
APPROVALS			

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NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
2. MATERIAL: ALUMINUM 6005-T5.  
FINISH: CLEAR ANODIZED 10  $\mu$ m THICK.
3. THE UNSPECIFIED DIMENSIONS ARE SPECIFIED BY 2D CAD FILE.

## Section properties:

Weight: 1.156 lbs/ft

Area: 0.992 in<sup>2</sup>

Perimeter: 12.601 in

Bounding Box: X: -1.000,1.000

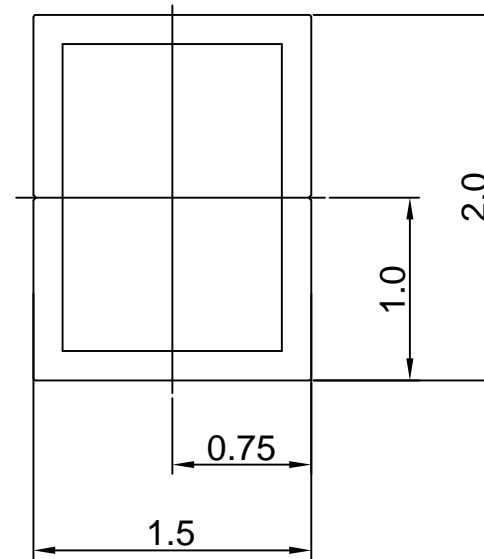
Y: -0.750, 0.750

Centroid:(0.000,0.000)

Moments of Inertia(in<sup>4</sup>): Ix=0.506,Iy=0.322

Section modulus in bending(in<sup>3</sup>): Wx=0.675,Wy=0.322

Radii of Gyration: X: 0.714, Y: 0.570



MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS			
All Dimensions in inches [millimeters]			
Tolerances			
X.XXX ± 0.01 [0.25mm]		Break all sharp edges	
X.XX ± 0.02 [0.50mm]		.010-.020 unless	
X.X ± 0.039 [1.0mm]		otherwise specified.	
Unless otherwise specified			
DRAWN BY	DATE		
zcg	03/12/2014		
CHECKED BY		B	DRAWING NUMBER
			A20164
APPROVALS		SCALE:	NONE
		SHEET	1 of 1

**Sunmodo Corp.**

1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661

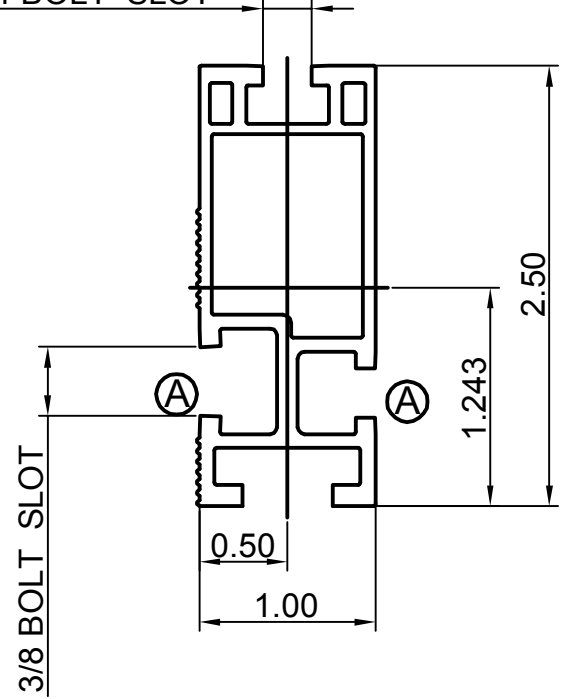
TITLE  
1.5X2 AL TUBE BRACE EXTRUSION

REVISIONS			
REV	DESCRIPTION	BY	DATE
A	ADDED BOTTOM CHANNEL & CHANGED ONE 3/8 CHANNEL TO 1/4	zcg	02/21/2013

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
2. MATERAIL: ALUMINUM 6005-T5.  
FINISH: CLEAR ANODIZED 15  $\mu$ m THICK.
3. THE UNSPECIFIED DIMENSIONS ARE SPECIFIED BY 2D CAD FILE.

2X 1/4 BOLT SLOT



### Section properties:

Weight: 0.850 lbs/ft  
 Area: 0.723 in<sup>2</sup>  
 Perimeter: 17.325 in  
 Bounding Box: X: -0.500,0.500  
 Y: -1.243,1.257

Centroid:(0.000,0.000)  
 Moments of Incertia(in<sup>4</sup>): Ix=0.486,Iy=0.095  
 Section modulus in bending(in<sup>3</sup>): Wx=0.387,Wy=0.190  
 Radii of Gyration: X: 0.820, Y: 0.363

MATERIAL <b>SEE NOTES</b>		<b>Sunmodo Corp.</b>	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters]		1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661	
Tolerances: X.XXX ± 0.01 [0.25mm] X.XX ± 0.02 [0.50mm] X.X ± 0.039 [1.0mm] Unless otherwise spec'd		TITLE HELIO STANDARD RAIL	
DRAWN BY zcg	DATE 02/21/2013	DRAWING NUMBER A20144	
CHECKED BY		SCALE: NONE SHEET 1 of 1	
APPROVALS			

4

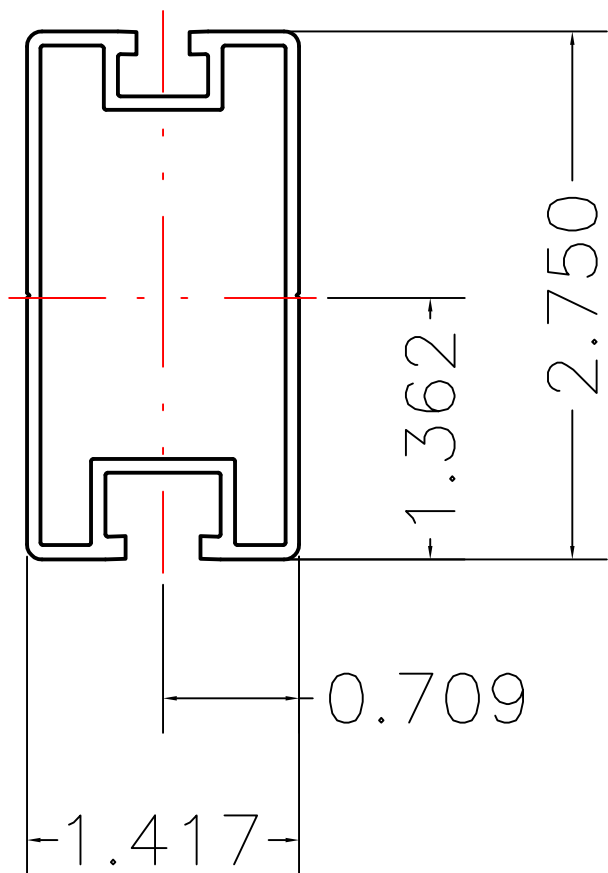
3

2

1

NOTES: UNLESS OTHERWISE SPECIFIED

- 1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
- 2. MATERIAL: 6005-T5.  
FINISH: CLEAR ANODIZED 10um THICK.
- 3. THE UNSPECIFIED RADII ARE .02" MAX.
- 4. THE UNSPECIFIED DIMENSIONS ARE SPECIFIED BY 2D CAD FILE.



### Section properties:

Weight: 0.862 lbs/ft  
 Area: 0.736 in<sup>2</sup>  
 Perimeter: 19.824 in  
 Bounding Box: X: -0.709,0.709  
                   Y: -1.362,1.388  
 Centroid:(0.000,0.000)  
 Moments of Inertia(in<sup>4</sup>): I<sub>x</sub>=0.727,I<sub>y</sub>=0.214  
 Section modulus in bending(in<sup>3</sup>): W<sub>x</sub>=0.524,W<sub>y</sub>=0.302  
 Radii of Gyration: X: 0.994, Y: 0.539

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MATERIAL SEE NOTES		<b>SunModo Corp.</b> 14800 NE 65TH STREET, VANCOUVER WA 98682	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters]		TITLE RAIL, HR300 (SUNRAY), EXTRUSION	
Tolerances X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] Break all sharp edges X.X ±0.039 [1.0mm] .010-.020 unless otherwise specified. Unless otherwise spec'd			
DRAWN BY KYY	DATE 01/18/2018	B	DRAWING NUMBER A20288
CHECKED BY			
APPROVALS		SCALE: NONE	SHEET 1 of 1

4

3

2

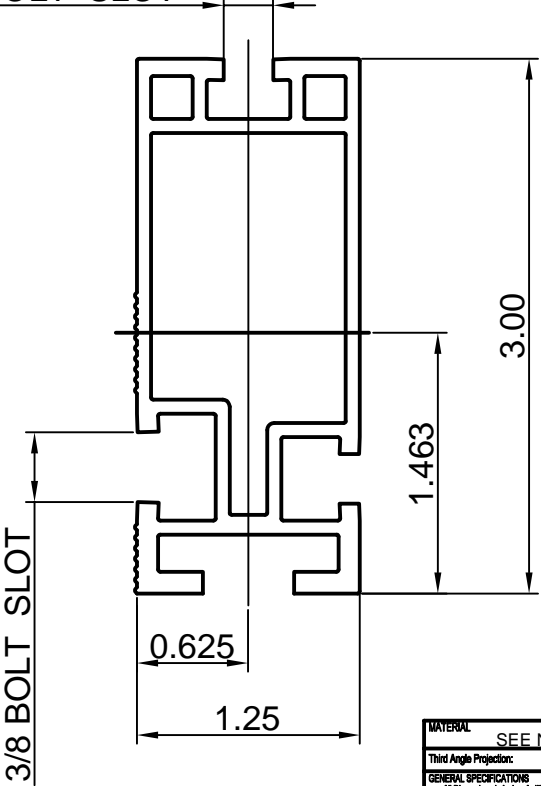
1

REV	DESCRIPTON	BY	DATE
A	0.44 WAS 0.41, 0.44 WAS 0.33	LWF	11/30/2015

NOTES: UNLESS OTHERWISE SPECIFIED

- 1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
- 2. MATERIAL: ALUMINUM 6005-T5.  
FINISH: CLEAR ANODIZED 15 μm THICK.
- 3. THE UNSPECIFIED DIMENSIONS ARE SPECIFIED BY 2D CAD FILE.

2X 1/4 BOLT SLOT

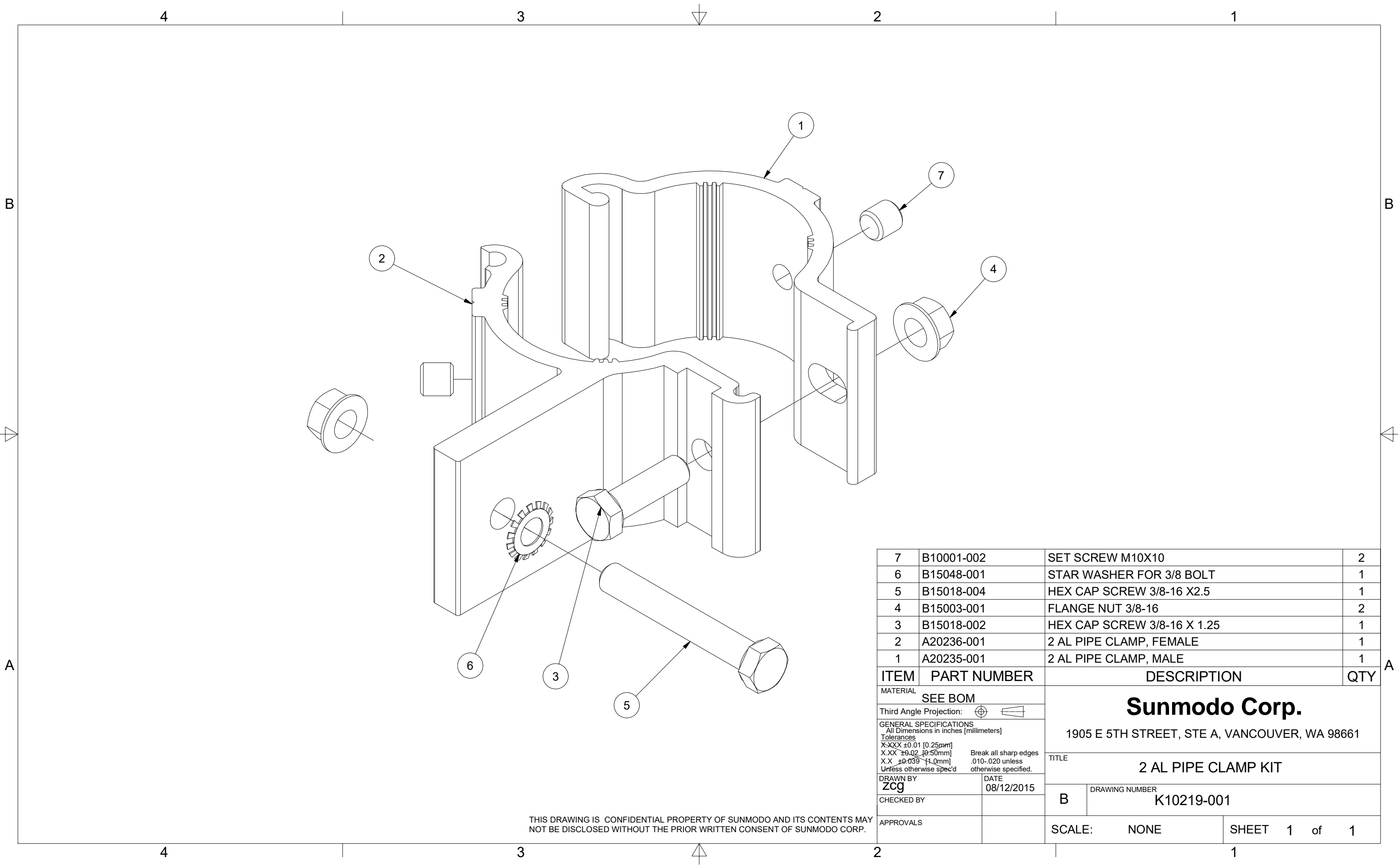


**Section properties:**

Weight: 1.151 lbs/ft  
 Area: 0.980 in<sup>2</sup>  
 Perimeter: 22.104 in  
 Bounding Box: X: -0.625,0.625  
                   Y: -1.463,1.537  
 Centroid:(0.000,0.000)  
 Moments of Inertia(in<sup>4</sup>): Ix=1.047,Iy=0.207  
 Section modulus in bending(in<sup>3</sup>): Wx=0.681,Wy=0.331  
 Radii of Gyration: X: 1.034, Y: 0.460

MATERIAL		SEE NOTES	
Third Angle Projection			
GENERAL SPECIFICATIONS			
All Dimensions in Inches [millimeters]			
Tolerances			
XXX ±0.01 (0.25mm)			
XX ±0.02 (0.50mm)			
X ±0.03 (1.0mm)			
Unless otherwise specified.			
DRAWN BY		DATE	
ZCJ		02/21/2013	
CHECKED BY			
APPROVALS			

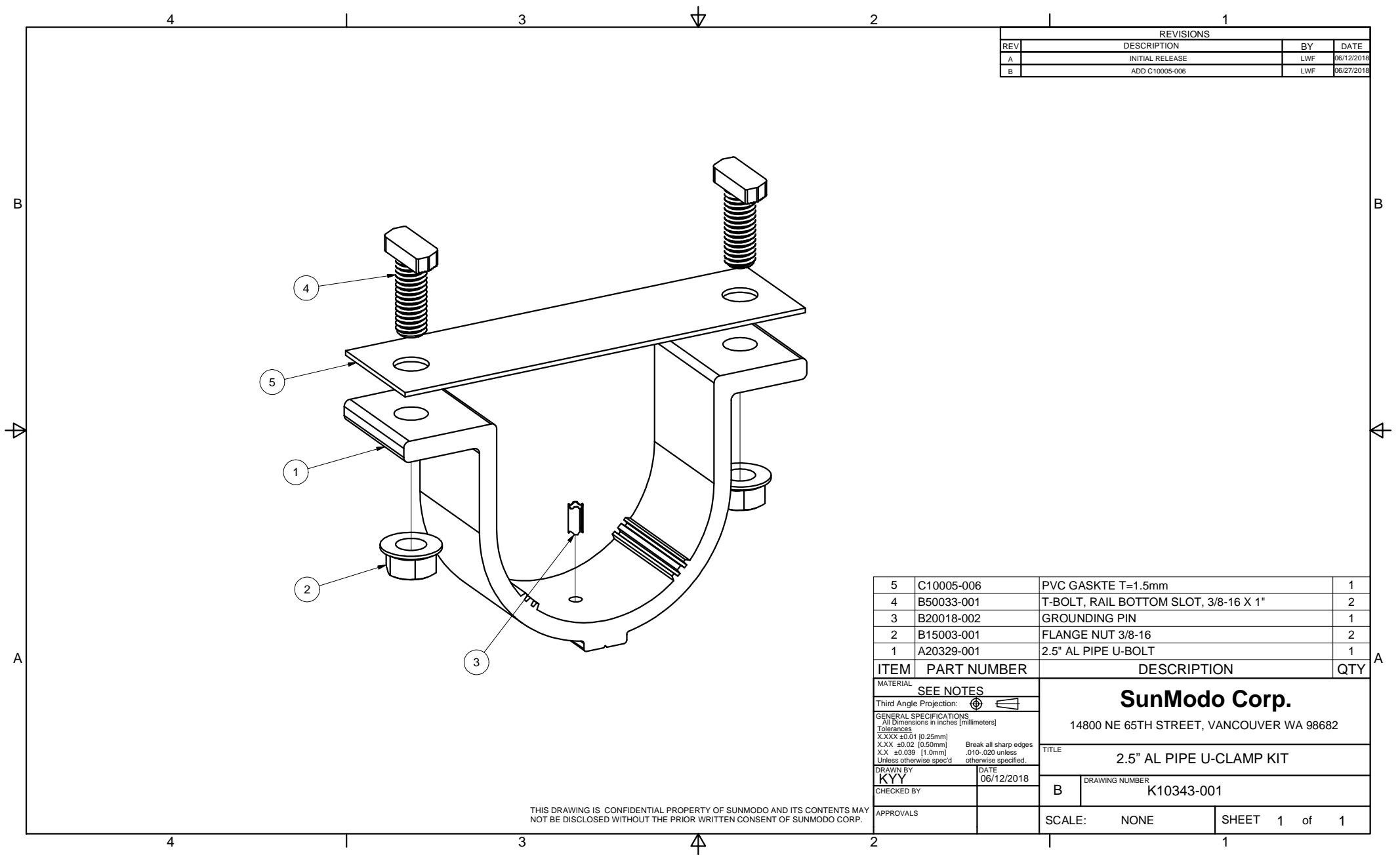
<b>Sunmodo Corp.</b>	
1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661	
TITLE HELIO HEAVY RAIL	
B	DRAWING NUMBER A20145
SCALE: NONE	SHEET 1 of 1



7	B10001-002	SET SCREW M10X10	2
6	B15048-001	STAR WASHER FOR 3/8 BOLT	1
5	B15018-004	HEX CAP SCREW 3/8-16 X2.5	1
4	B15003-001	FLANGE NUT 3/8-16	2
3	B15018-002	HEX CAP SCREW 3/8-16 X 1.25	1
2	A20236-001	2 AL PIPE CLAMP, FEMALE	1
1	A20235-001	2 AL PIPE CLAMP, MALE	1

ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE BOM	
Third Angle Projection:			
<b>GENERAL SPECIFICATIONS</b> All Dimensions in inches (millimeters)			
<b>Tolerances</b> X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] X.X ±0.039 [1.0mm] Unless otherwise spec'd			
DRAWN BY		DATE	
zcg		08/12/2015	
CHECKED BY		B	
APPROVALS		TITLE: <b>2 AL PIPE CLAMP KIT</b> DRAWING NUMBER: <b>K10219-001</b>	
SCALE:		NONE	SHEET 1 of 1

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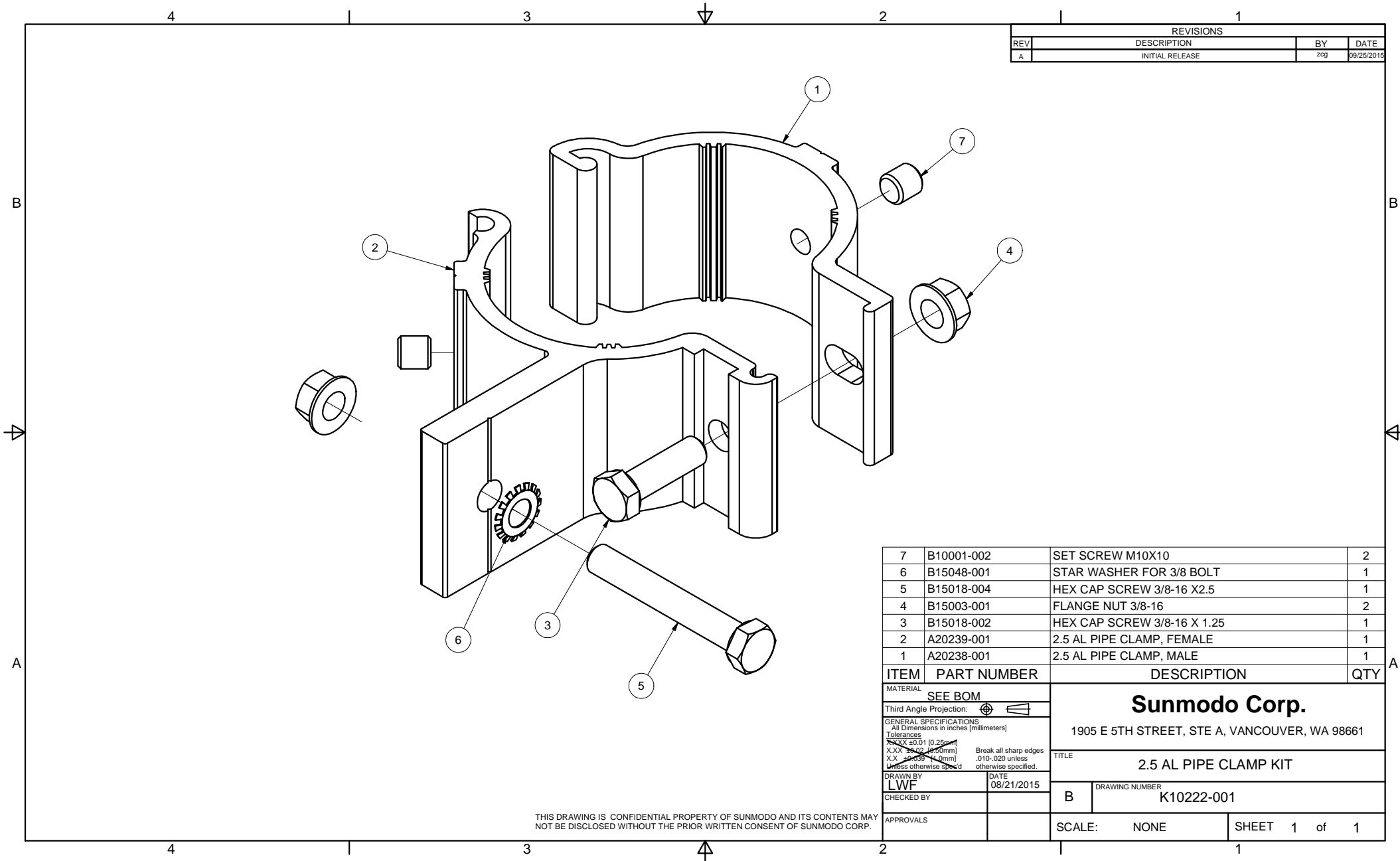


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018
B	ADD C10005-006	LWF	06/27/2018

ITEM	PART NUMBER	DESCRIPTION	QTY
5	C10005-006	PVC GASKTE T=1.5mm	1
4	B50033-001	T-BOLT, RAIL BOTTOM SLOT, 3/8-16 X 1"	2
3	B20018-002	GROUNDING PIN	1
2	B15003-001	FLANGE NUT 3/8-16	2
1	A20329-001	2.5" AL PIPE U-BOLT	1

MATERIAL		<b>SEE NOTES</b>	
Third Angle Projection:			
GENERAL SPECIFICATIONS		<p><b>SunModo Corp.</b> 14800 NE 65TH STREET, VANCOUVER WA 98682</p>	
All Dimensions in inches [millimeters] Tolerances X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] X.X ±0.039 [1.0mm] Unless otherwise spec'd			
TITLE		2.5" AL PIPE U-CLAMP KIT	
DRAWN BY		DATE	DRAWING NUMBER
KYY		06/12/2018	
CHECKED BY		B	K10343-001
APPROVALS		SCALE:	NONE
		SHEET	1 of 1

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REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	zcg	09/25/2015

ITEM	PART NUMBER	DESCRIPTION	QTY
7	B10001-002	SET SCREW M10X10	2
6	B15048-001	STAR WASHER FOR 3/8 BOLT	1
5	B15018-004	HEX CAP SCREW 3/8-16 X2.5	1
4	B15003-001	FLANGE NUT 3/8-16	2
3	B15018-002	HEX CAP SCREW 3/8-16 X 1.25	1
2	A20239-001	2.5 AL PIPE CLAMP, FEMALE	1
1	A20238-001	2.5 AL PIPE CLAMP, MALE	1

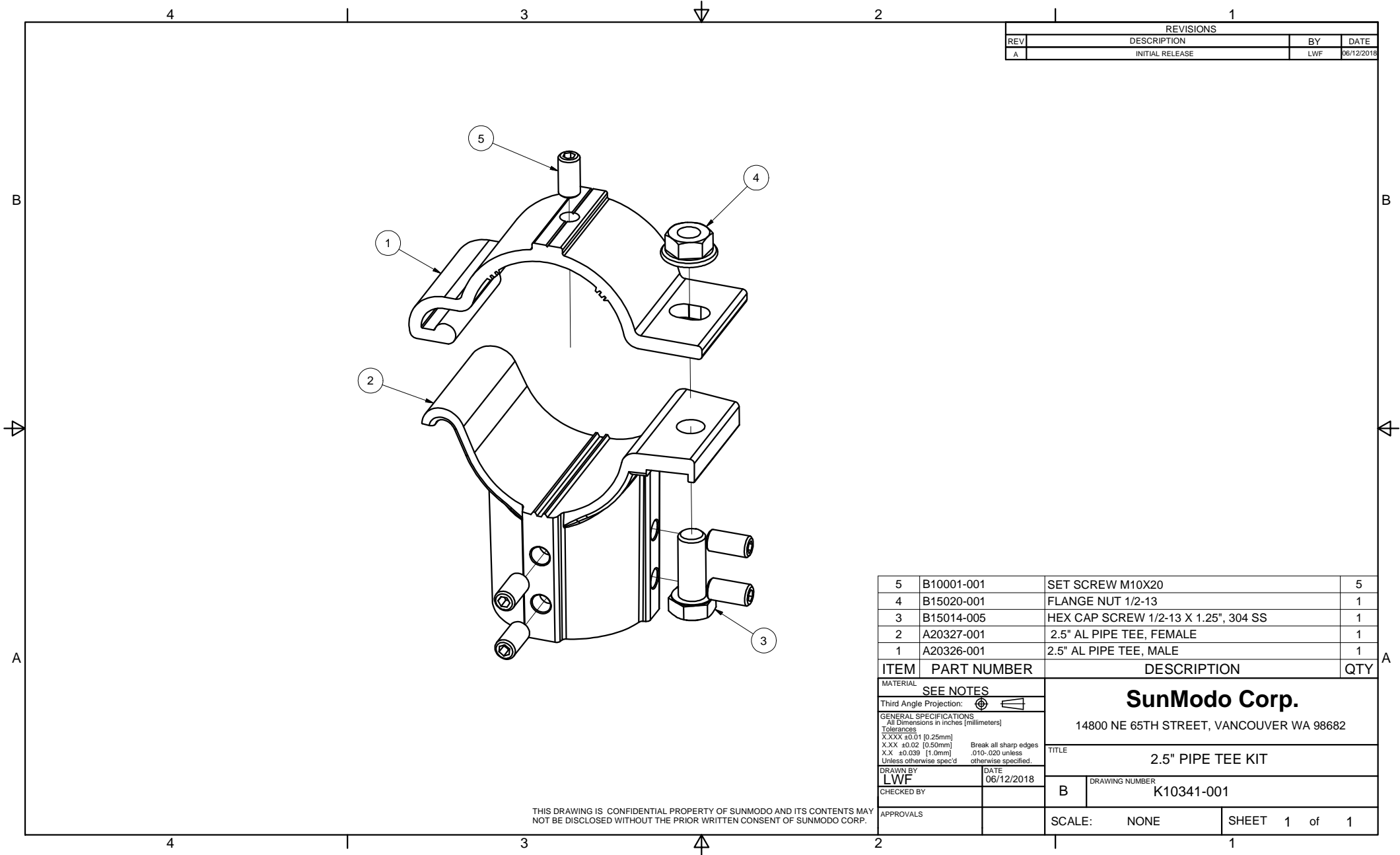
MATERIAL		SEE BOM	
Third Angle Projection:			
<b>GENERAL SPECIFICATIONS</b> All Dimensions in inches [millimeters] <b>Tolerances</b> X.XX ±0.01 (0.25mm) X.X ±0.02 (0.5mm) X.X ±0.03 (0.75mm) Unless otherwise specified.			
DRAWN BY		DATE	
LWF		08/21/2015	
CHECKED BY		B	
APPROVALS		SCALE: NONE	
		SHEET 1 of 1	

**Sunmodo Corp.**  
 1905 E 5TH STREET, STE A, VANCOUVER, WA 98661

TITLE  
**2.5 AL PIPE CLAMP KIT**

DRAWING NUMBER  
**K10222-001**

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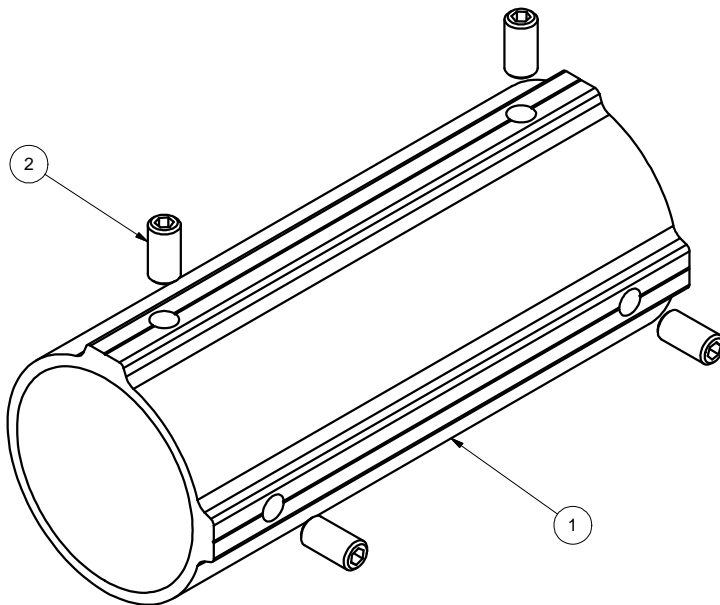
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018

ITEM	PART NUMBER	DESCRIPTION	QTY
5	B10001-001	SET SCREW M10X20	5
4	B15020-001	FLANGE NUT 1/2-13	1
3	B15014-005	HEX CAP SCREW 1/2-13 X 1.25", 304 SS	1
2	A20327-001	2.5" AL PIPE TEE, FEMALE	1
1	A20326-001	2.5" AL PIPE TEE, MALE	1

MATERIAL		SEE NOTES	
Third Angle Projection:			
<b>GENERAL SPECIFICATIONS</b> All Dimensions in inches [millimeters] <b>Tolerances</b> X.XXX ±0.01 [0.25mm] Break all sharp edges X.XX ±0.02 [0.50mm] .010-.020 unless X.X ±0.039 [1.0mm] otherwise specified. Unless otherwise spec'd otherwise specified.			
DRAWN BY	DATE	TITLE	
LWF	06/12/2018	2.5" PIPE TEE KIT	
CHECKED BY		B	DRAWING NUMBER
			K10341-001
APPROVALS		SCALE:	SHEET 1 of 1
		NONE	

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REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018



2	B10001-001	SET SCREW M10X20	4
1	A20328-001	2.5" PIPE SPLICE	1
ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS		<b>SunModo Corp.</b> 14800 NE 65TH STREET, VANCOUVER WA 98682	
All Dimensions in inches [millimeters] Tolerances X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] X.X ±0.039 [1.0mm] Unless otherwise spec'd		Break all sharp edges .010-.020 unless otherwise specified.	
DRAWN BY		TITLE	
LWF		2.5" PIPE SPLICE KIT	
CHECKED BY		DRAWING NUMBER	
		B K10342-001	
APPROVALS		SCALE: NONE SHEET 1 of 1	

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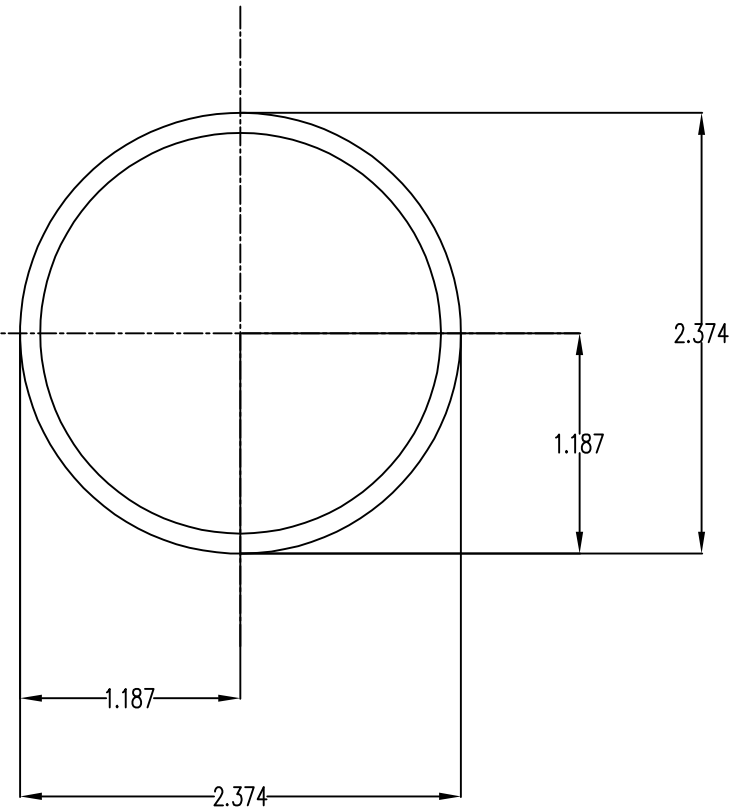
NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
2. MATERIAL: HIGH STRENGTH STEEL PIPE OR TUBE.
3. FINISH: HOT DIP GALVANIZE PER ASTM A123 / A123M - 02.

MINIMUM 50 KSI YIELD STRESS.

4. BREAK ALL BURRS AND SHARP EDGES.

5. ALL WELDING MUST BE IN COMPLIANCE WITH AWS CODE D1;1.



## Section properties:

Weight: 2.641 lbs/ft

Area: 0.776 in<sup>2</sup>

Perimeter: 14.238 in

Bounding Box: X: -1.187, 1.187

Y: -1.187, 1.187

Centroid: (0.000, 0.000)

Moments of Inertia (in<sup>4</sup>): I<sub>x</sub>=0.499, I<sub>y</sub>=0.499

Section modulus in bending (in<sup>3</sup>): W<sub>x</sub>=0.420, W<sub>y</sub>=0.420

Radii of Gyration: X: 0.802, Y: 0.802

MATERIAL		SEE NOTES		<b>Sunmodo Corp.</b> 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS				TITLE	
All Dimensions in Inches (millimeters)				PIPE, HSS, 2.375" OD X 12 GAUGE, L=XXX	
Tolerances				Break all sharp edges .010-.020 unless otherwise specified.	
XXX ±0.01 (0.25mm)					
XX ±0.02 (0.50mm)					
X ±0.050 (1.27mm)					
Unless otherwise specified					
DRAWN BY		DATE		DRAWING NUMBER	
LWF		04/03/2019		A21165	
CHECKED BY				B	
APPROVALS				SCALE: NONE	
				SHEET 1 of 1	

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
2. MATERAIL:HIGH STRENGTH STEEL PIPE OR TUBE.
3. FINISH: HOT DIP GALVANIZE PER ASTM A123 / A123M - 02.

MINIMUM 50 KSI YIELD STRESS.

4. BREAK ALL BURRS AND SHARP EDGES.
5. ALL WELDING MUST BE IN COMPLIANCE WITH AWS CODE D1;1.

### Section properties:

Weight: 3.201 lbs/ft

Area: 0.941 in<sup>2</sup>

Perimeter: 17.378 in

Bounding Box: X: -1.437,1.437

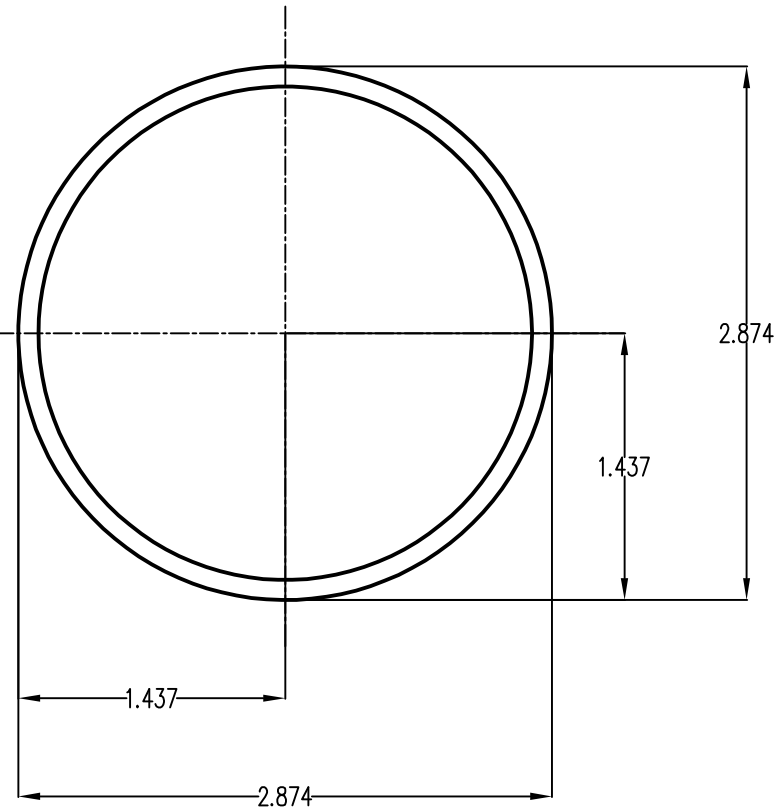
Y: -1.437,1.437

Centroid:(0.000,0.000)

Moments of Inertia(in<sup>4</sup>): Ix=0.901,Iy=0.901

Section modulus in bending(in<sup>3</sup>): Wx=0.627,Wy=0.627

Radii of Gyration: X: 0.979, Y: 0.979



MATERIAL		SEE NOTES		<b>Sunmodo Corp.</b> 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS All Dimensions in Inches (millimeters)				TITLE	
Tolerances XXX ±0.01 (0.25mm) XX ±0.02 (0.50mm) X ±0.030 (1.0mm) Unless otherwise specified				PIPE, HSS, 2.875" OD X 12 GAUGE,L=XXX	
DRAWN BY LWF		DATE 04/03/2019		DRAWING NUMBER A21168	
CHECKED BY				B	
APPROVALS				SCALE: NONE SHEET 1 of 1	