



Project Number: U2716-0276-211

January 21, 2021

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 Florida Building Code 2020 Edition (2018 IBC). 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: B
- 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	2320	1.5	3480
LATERAL	1690	2	3380

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.

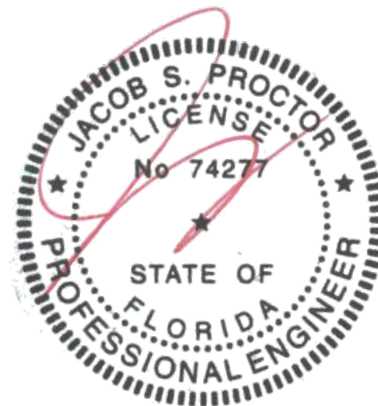
Very truly yours,

VECTOR STRUCTURAL ENGINEERING, LLC  
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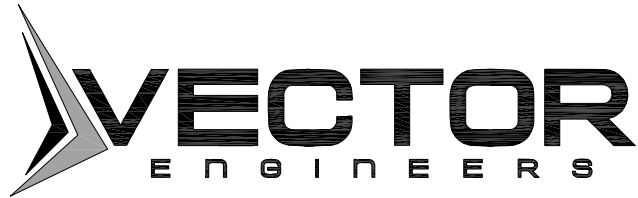
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Jacob Proctor, P.E.  
FL License: 74277  
Project Engineer

Enclosures

JSP/stb

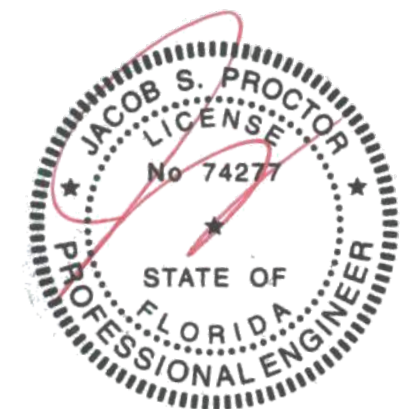
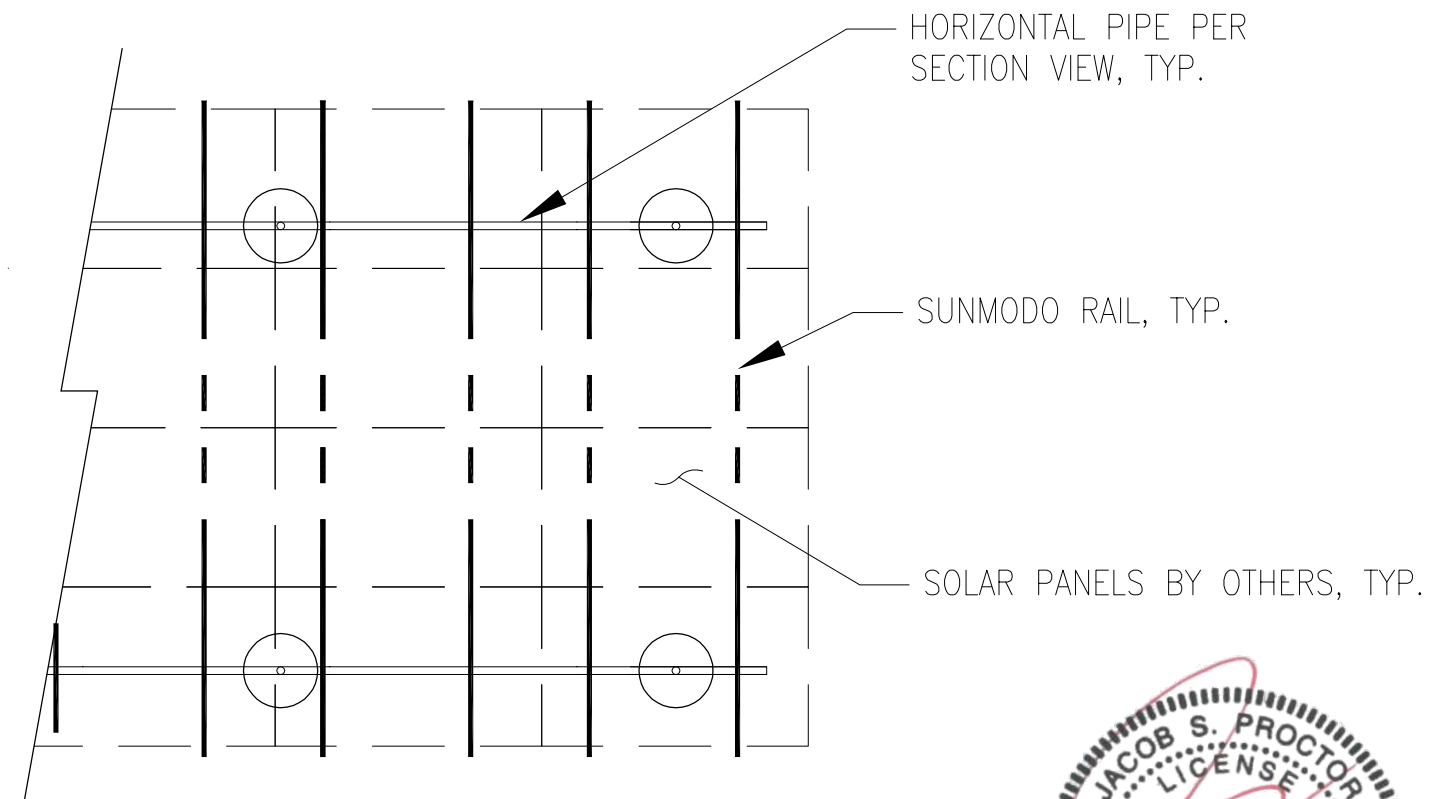
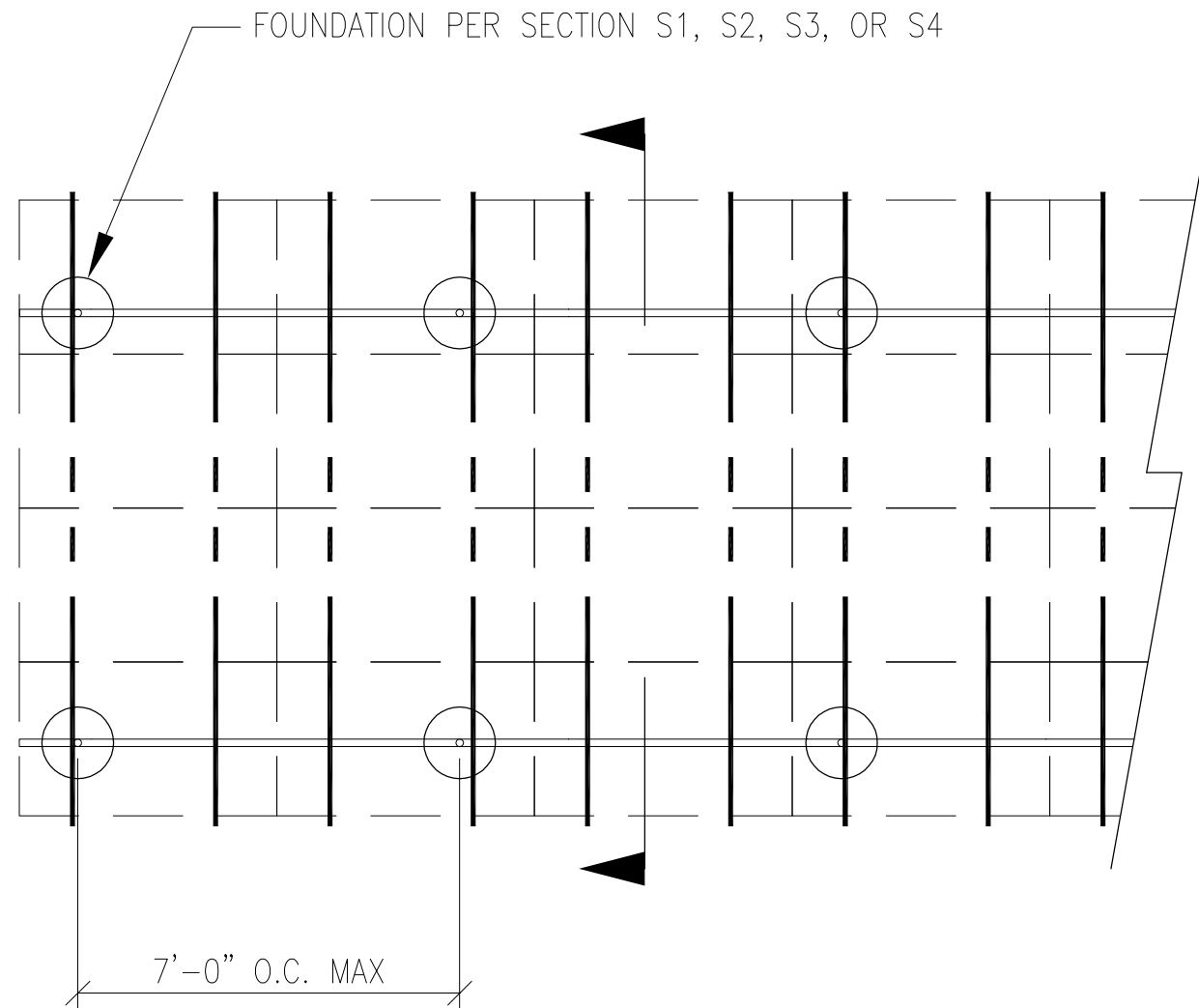


01/21/2021



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



**PV ARRAY PLAN**

N.T.S.

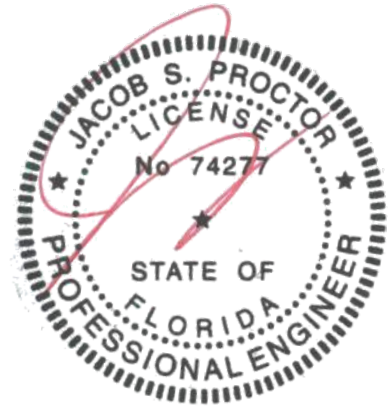
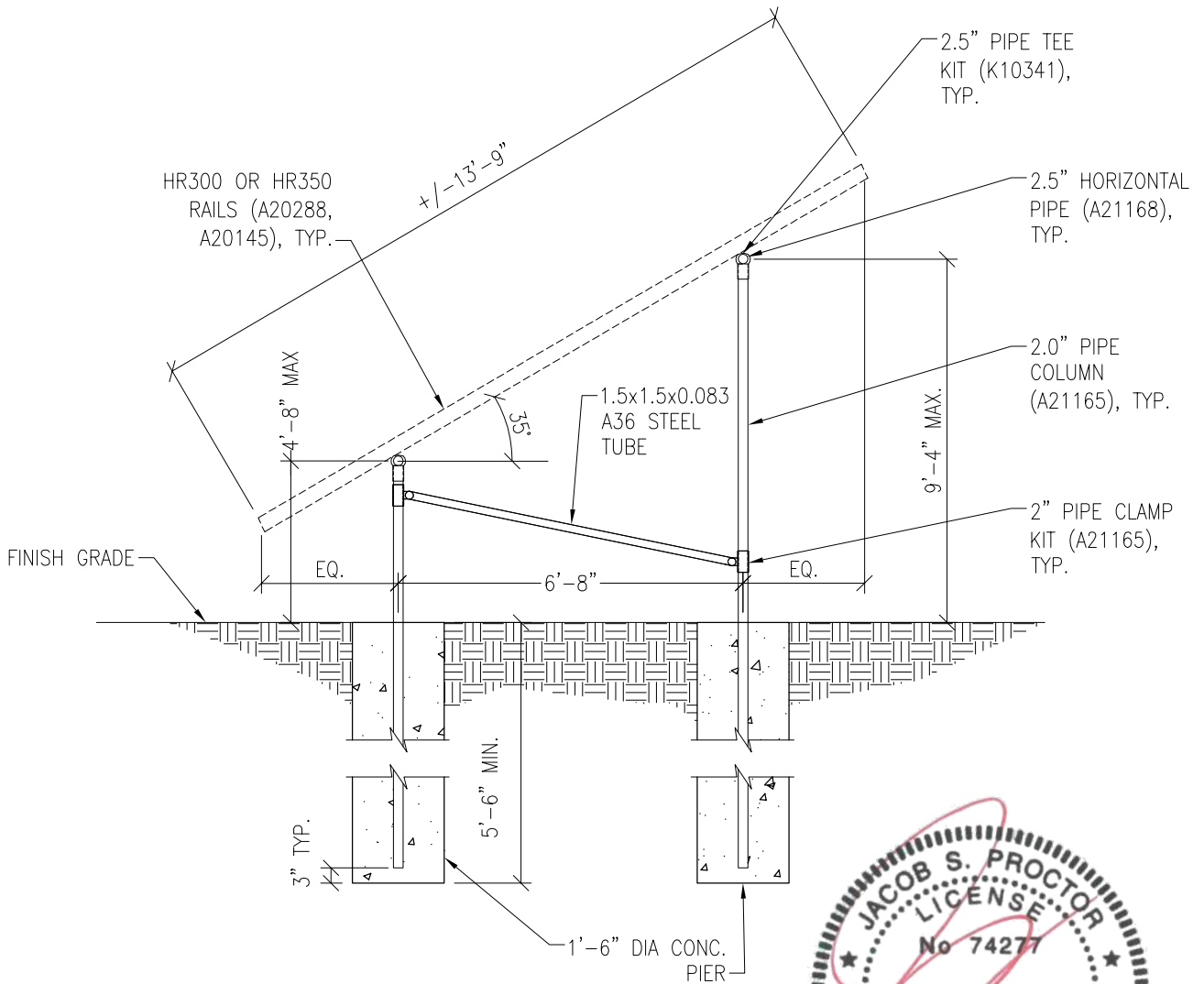
**P1**

01/21/2021

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PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT DRILLED PIER OPTION



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**PV ARRAY SECTION**

01/21/2021

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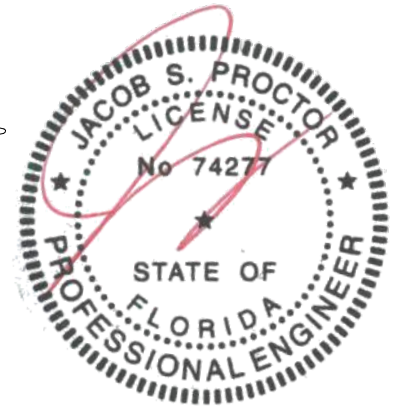
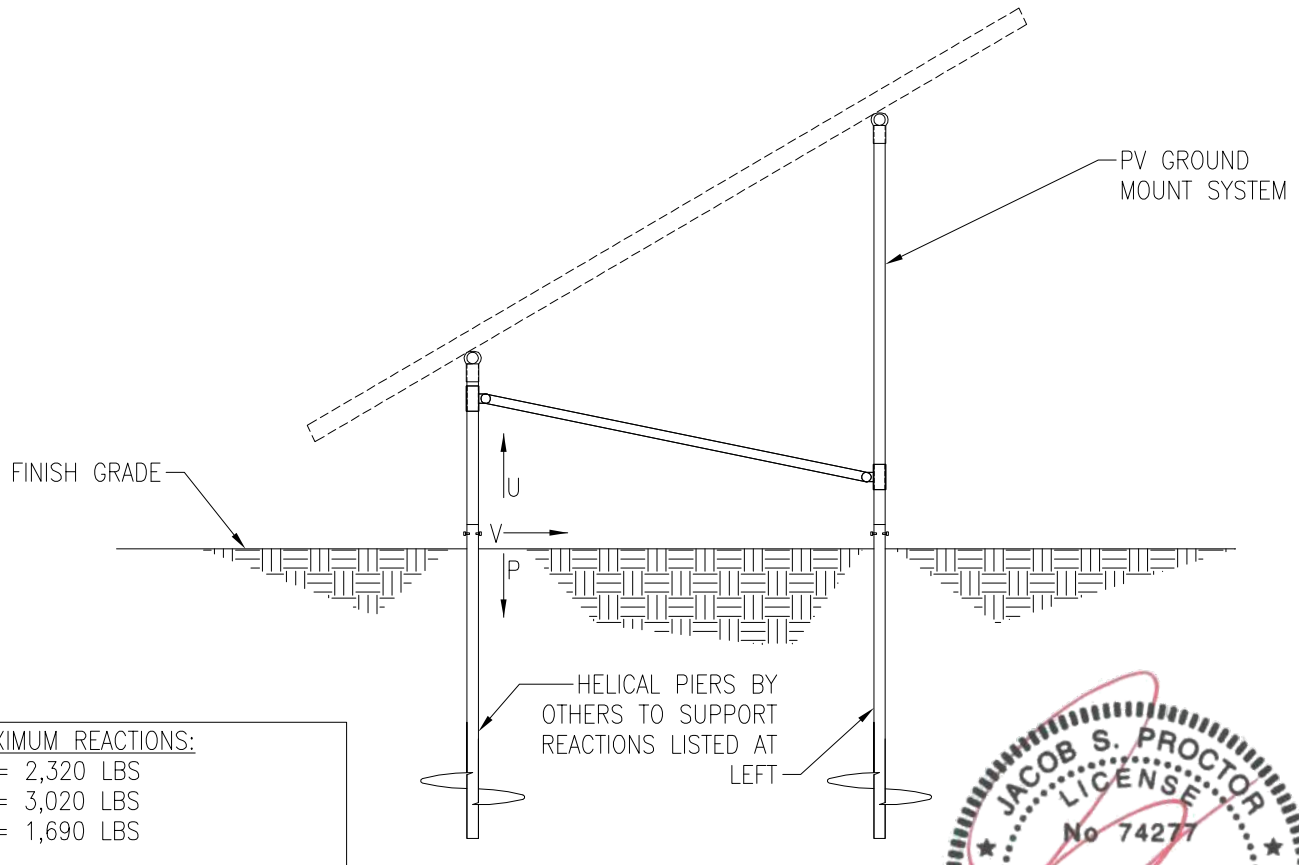
**S1**

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.

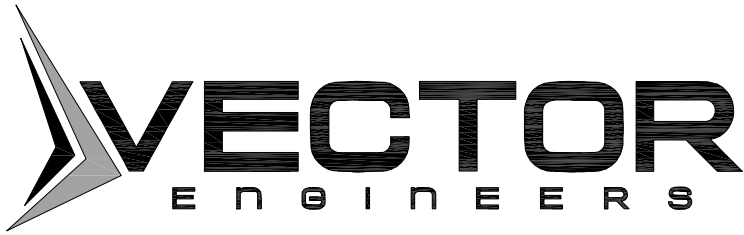


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**PV ARRAY SECTION**

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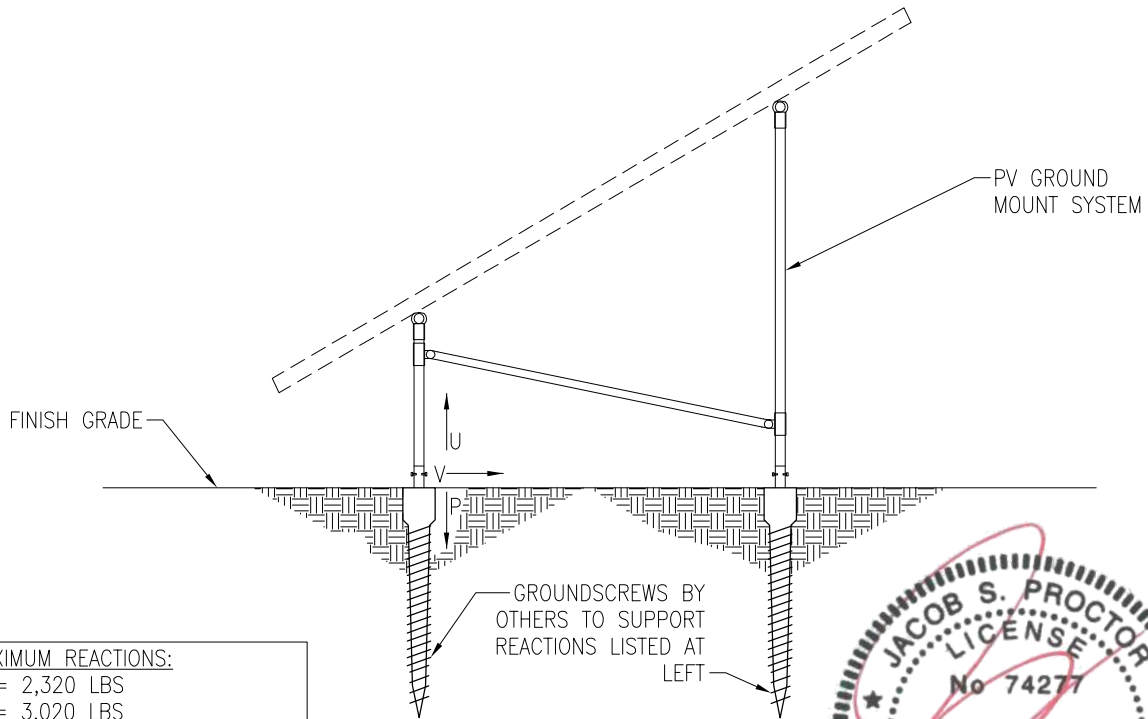
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PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

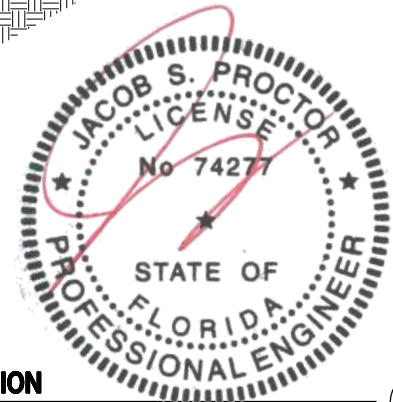
SUBJECT GROUND SCREW OPTION

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 = 2,320 LBS  
 P = 3,020 LBS  
 V = 1,690 LBS



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PV ARRAY SECTION

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S3



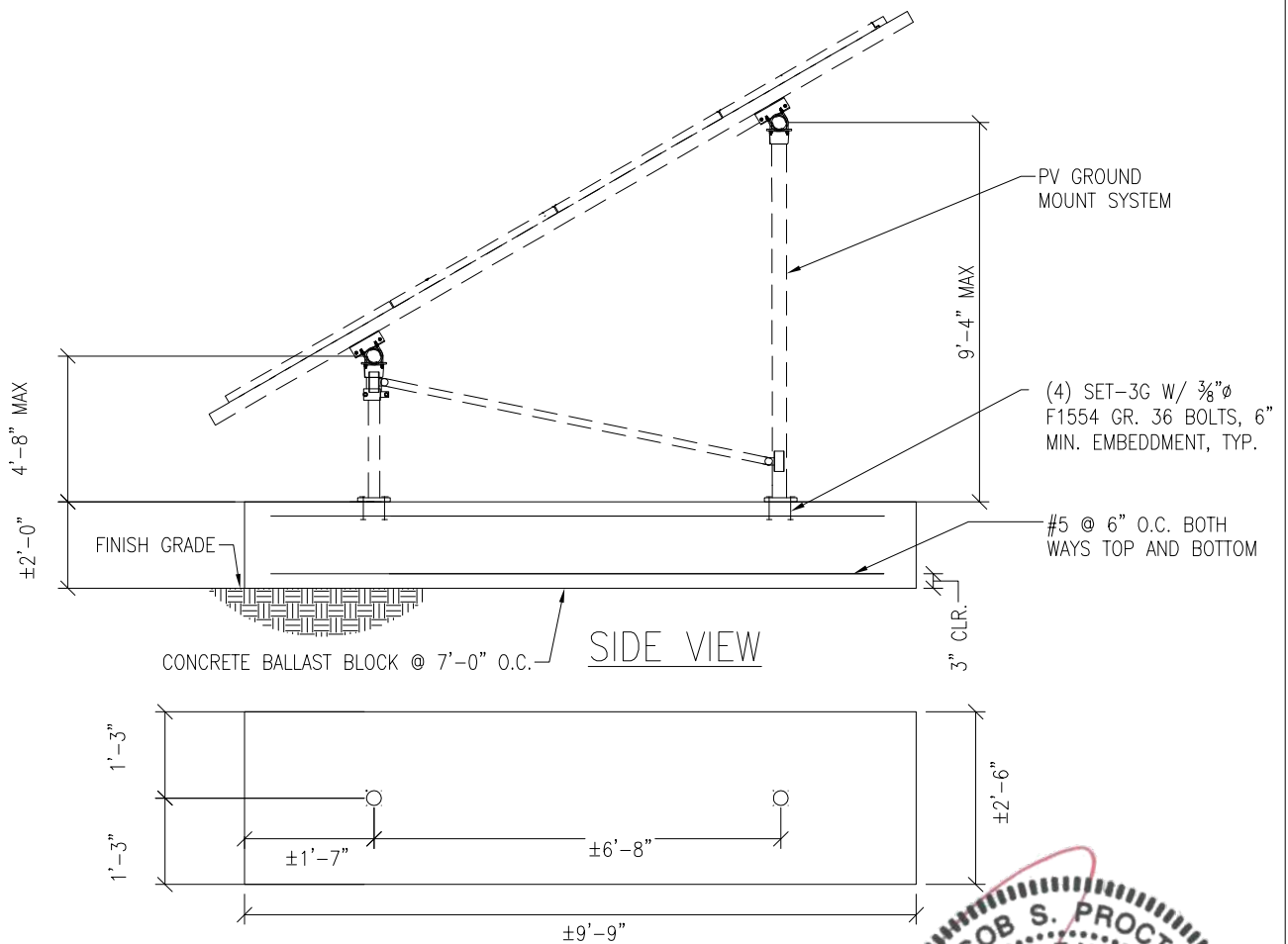
JOB NO. U2716-0276-211

PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT BALLASTED BLOCK OPTION

NOTES:

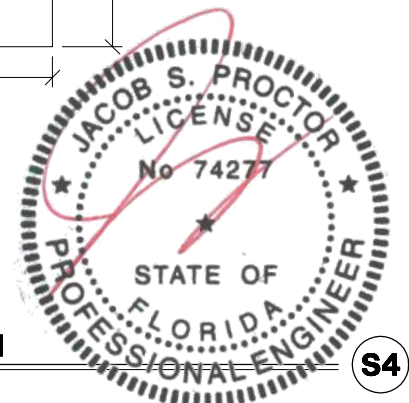
1. For ground mount components see Section S1.



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**PV ARRAY SECTION**

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**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:	B	(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:	B	(Section 26.7)
Elevation [ft]:	9.2	
Ground Elevation Factor, $K_e$ :	1.00	(Table 26.9-1)
$\alpha$ :	7.0	(Table 26.11-1)
$z_g$ [ft]:	1200	(Table 26.11-1)
Velocity Pressure Exposure Coefficient, $K_h$ :	0.57	(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]:	24.50	(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)	-37.5	-37.5
Case 2 ( $\gamma = 0^\circ$ , Load Case B)	-50.0	-12.5
Case 3 ( $\gamma = 180^\circ$ , Load Case A)	43.7	43.7
Case 4 ( $\gamma = 180^\circ$ , Load Case B)	56.2	22.9
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





JOB NO.: U2716-0276-211

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]:	1.7	Max. Down, P <sub>d</sub> [k]:	3.0
Max. Moment, M [k-ft]:	0.0	Max. Uplift, P <sub>u</sub> [k]:	2.3

**Pier Properties:**

Pier Shape:	Round	Volume of Concrete [ft <sup>3</sup> ]:	10
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]:	1.5
Pier Depth, d [ft]:	5.5		

**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]:	6.5
-----------------------	-----

**Bearing capacity OK.**

**Check Uplift:**

Uplift Capacity [k]:	7.8
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**Uplift capacity OK.**

**Check Lateral Bearing:**

Top of Pier Constrained?:	No
Applied Lateral Force, P [lb]:	1,690
Point of Application, h [ft]:	0.0
S <sub>max</sub> [psf]:	
S [psf]:	550
A = 2.34*P/(Sb):	4.79
Required Pier Depth, d <sub>reqd</sub> [ft]:	4.80

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	2320	1.5	3480
LATERAL	1690	2	3380

# 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	2320	1.5	3480
LATERAL	1690	2	3380

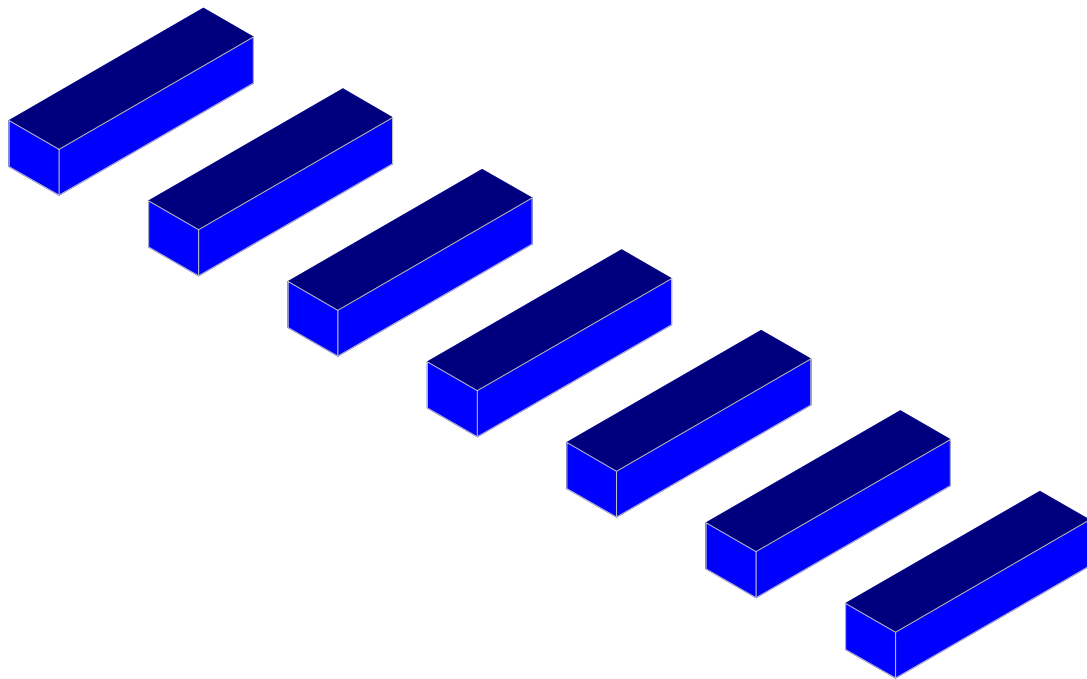


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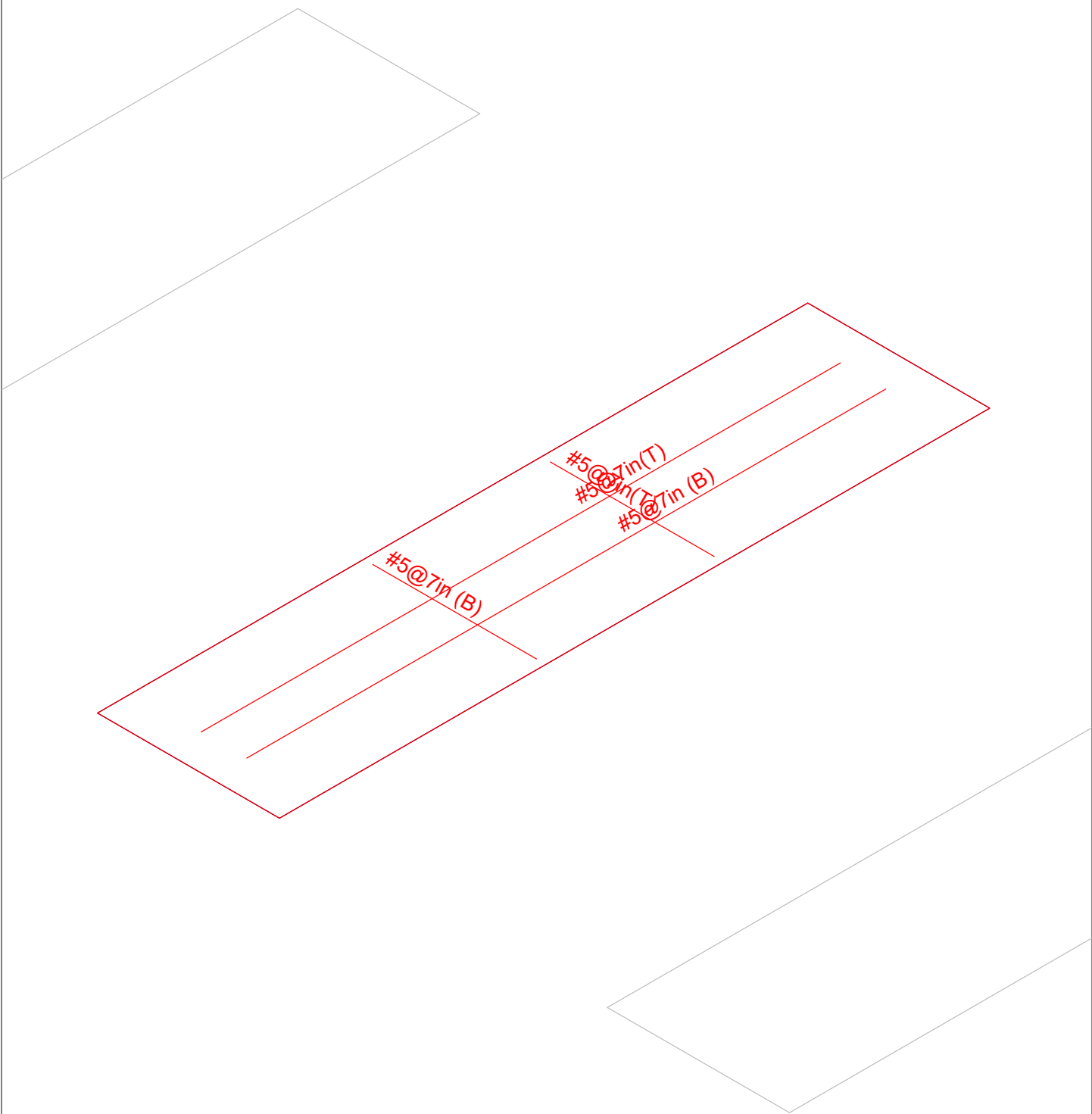
DESIGNED: STB

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# Foundation Option 4: Ballasted Block



Vector Structural Engineeri..	Ground Mount	SK - 1
STB		Jan 20, 2021 at 10:58 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 2
STB		Jan 20, 2021 at 11:01 AM
U2716.0276.211		Sunmodo Sunturf A9.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
Parme 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	8	3	8	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_1	X	-11.287
2	R3D_N1_1	Y	216.657
3	R3D_N2	Y	184.866
4	R3D_N132_2	Y	211.672
5	R3D_N133_1	Y	202.778
6	R3D_N109_1	Y	196.676
7	R3D_N110A_1	Y	208.331
8	R3D_N121_1	Y	214.372





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

	Label	Direction	Magnitude[lb,lb-ft]
12	R3D_N133_1	Z	-99.656
13	R3D_N109_1	X	2.071
14	R3D_N109_1	Y	-3540.869
15	R3D_N109_1	Z	2222.931
16	R3D_N110A_1	X	5.765
17	R3D_N110A_1	Y	733.406
18	R3D_N110A_1	Z	-99.53
19	R3D_N121_1	Y	-3679.993
20	R3D_N121_1	Z	2158.169
21	R3D_N122_1	X	3.802
22	R3D_N122_1	Y	695.72
23	R3D_N122_1	Z	-100.159
24	R3D_N133B	X	2.494
25	R3D_N133B	Y	-3659.823
26	R3D_N133B	Z	2179.688
27	R3D_N134B_1	X	3.502
28	R3D_N134B_1	Y	703.284
29	R3D_N134B_1	Z	-100.441
30	R3D_N151_1	X	2.849
31	R3D_N151_1	Y	-3823.28
32	R3D_N151_1	Z	2388.75
33	R3D_N152_1	X	16.827
34	R3D_N152_1	Y	811.889
35	R3D_N152_1	Z	-98.225
36	R3D_N143A	X	-124.174
37	R3D_N143A	Y	-2487.288
38	R3D_N143A	Z	1368.627
39	R3D_N144A	X	-43.23
40	R3D_N144A	Y	424.749
41	R3D_N144A	Z	-76.161

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

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1_1	X	145.931
2	R3D_N1_1	Y	-3800.934
3	R3D_N1_1	Z	1625.787
4	R3D_N2	X	4.748
5	R3D_N2	Y	1350.077
6	R3D_N2	Z	-78.539
7	R3D_N132_2	X	4.451
8	R3D_N132_2	Y	-3990.076
9	R3D_N132_2	Z	1799.961
10	R3D_N133_1	X	-3.975
11	R3D_N133_1	Y	1493.143
12	R3D_N133_1	Z	-84.06
13	R3D_N109_1	X	2.632
14	R3D_N109_1	Y	-3853.421
15	R3D_N109_1	Z	1870.245
16	R3D_N110A_1	X	11.67
17	R3D_N110A_1	Y	1584.153
18	R3D_N110A_1	Z	-83.834
19	R3D_N121_1	Y	-4044.899
20	R3D_N121_1	Z	1820.129
21	R3D_N122_1	Y	1512.4
22	R3D_N122_1	Z	-84.403
23	R3D_N133B	X	3.258



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

Jan 21, 2021  
 10:58 AM  
 Checked By: RNE

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

	Label	Direction	Magnitude[lb,lb-ft]
24	R3D N133B	Y	-4016.352
25	R3D N133B	Z	1837.501
26	R3D N134B_1	X	-2.341
27	R3D N134B_1	Y	1529.81
28	R3D N134B_1	Z	-84.664
29	R3D N151_1	X	3.985
30	R3D N151_1	Y	-4162.296
31	R3D N151_1	Z	2009.133
32	R3D N152_1	X	-1.042
33	R3D N152_1	Y	1706.165
34	R3D N152_1	Z	-82.717
35	R3D N143A	X	-159.408
36	R3D N143A	Y	-2770.891
37	R3D N143A	Z	1158.422
38	R3D N144A	X	-9.721
39	R3D N144A	Y	956.285
40	R3D_N144A	Z	-64.422

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

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D N1_1	X	-132.826
2	R3D N1_1	Y	3992.528
3	R3D N1_1	Z	-2240.794
4	R3D N2	X	-14.094
5	R3D N2	Y	-722.506
6	R3D N2	Z	108.364
7	R3D N132_2	X	-4.176
8	R3D N132_2	Y	4231.275
9	R3D N132_2	Z	-2484.386
10	R3D N133_1	X	-1.429
11	R3D N133_1	Y	-799.525
12	R3D N133_1	Z	116.132
13	R3D N109_1	X	-2.413
14	R3D N109_1	Y	4126.293
15	R3D N109_1	Z	-2590.455
16	R3D N110A_1	X	-6.718
17	R3D N110A_1	Y	-854.663
18	R3D N110A_1	Z	115.985
19	R3D N121_1	Y	4288.418
20	R3D N121_1	Z	-2514.986
21	R3D N122_1	X	-4.431
22	R3D N122_1	Y	-810.746
23	R3D N122_1	Z	116.718
24	R3D N133B	X	-2.906
25	R3D N133B	Y	4264.914
26	R3D N133B	Z	-2540.063
27	R3D N134B_1	X	-4.081
28	R3D N134B_1	Y	-819.56
29	R3D N134B_1	Z	117.048
30	R3D N151_1	X	-3.319
31	R3D N151_1	Y	4455.395
32	R3D N151_1	Z	-2783.69
33	R3D N152_1	X	-19.609
34	R3D N152_1	Y	-946.121
35	R3D N152_1	Z	114.465
36	R3D_N143A	X	144.705



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

	Label	Direction	Magnitude[lb,lb-ft]
37	R3D N143A	Y	2898.52
38	R3D N143A	Z	-1594.907
39	R3D N144A	X	50.377
40	R3D N144A	Y	-494.975
41	R3D N144A	Z	88.753

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

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D N1 1	X	-74.971
2	R3D N1 1	Y	2773.447
3	R3D N1 1	Z	-2007.227
4	R3D N2	X	-17.49
5	R3D N2	Y	86.177
6	R3D N2	Z	97.143
7	R3D N132 2	X	-2.478
8	R3D N132 2	Y	2973.17
9	R3D N132 2	Z	-2227.702
10	R3D N133 1	X	-5.73
11	R3D N133 1	Y	94.606
12	R3D N133 1	Z	104.204
13	R3D N109 1	X	-1.379
14	R3D N109 1	Y	2932.842
15	R3D N109 1	Z	-2328.643
16	R3D N110A 1	Y	90.507
17	R3D N110A 1	Z	104.178
18	R3D N121 1	Y	3012.49
19	R3D N121 1	Z	-2256.919
20	R3D N122 1	X	-6.248
21	R3D N122 1	Y	94.426
22	R3D N122 1	Z	104.802
23	R3D N133B	X	-1.582
24	R3D N133B	Y	3001.642
25	R3D N133B	Z	-2280.112
26	R3D N134B 1	X	-8.364
27	R3D N134B 1	Y	96.311
28	R3D N134B 1	Z	105.077
29	R3D N151 1	X	-1.574
30	R3D N151 1	Y	3165.394
31	R3D N151 1	Z	-2502.901
32	R3D N152 1	X	-31.125
33	R3D N152 1	Y	58.005
34	R3D N152 1	Z	102.829
35	R3D N143A	X	81.297
36	R3D N143A	Y	2003.302
37	R3D N143A	Z	-1427.551
38	R3D N144A	X	68.951
39	R3D N144A	Y	86.897
40	R3D N144A	Z	79.477

**Slabs**

	Label	Thickness [in]	Material	Local Axis Angle ...	Analysis Offset [in]	Passive Pressur...	Soil Overburden [psf]
1	S1	24	Conc2500NW	0	0	0	0
2	S2	24	Conc2500NW	0	0	0	0
3	S3	24	Conc2500NW	0	0	0	0
4	S4	24	Conc2500NW	0	0	0	0
5	S5	24	Conc2500NW	0	0	0	0





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

Jan 21, 2021  
 10:58 AM  
 Checked By: RNE

**Slab Overturning Safety Factors (By Combination)**

	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
1	1	S1	0	0	36328.458	0	9360.43	9.999+	9.999+
2	1	S2	0	0	36490.407	0	9342.211	9.999+	9.999+
3	1	S3	0	0	36490.926	0	9360.165	9.999+	9.999+
4	1	S4	0	0	36493.985	0	9359.784	9.999+	9.999+
5	1	S5	0	0	36468.338	0	9354.015	9.999+	9.999+
6	1	S6	0	0	36594.423	0	9376.866	9.999+	9.999+
7	1	S7	0	0	35880.418	0	9187.345	9.999+	9.999+
8	2	S1	0	0	45913.253	0	11981.771	9.999+	9.999+
9	2	S2	0	0	47134.367	0	11915.979	9.999+	9.999+
10	2	S3	0	0	47120.548	0	12047.55	9.999+	9.999+
11	2	S4	0	0	47140.099	0	12040.881	9.999+	9.999+
12	2	S5	0	0	46961.953	0	12015.246	9.999+	9.999+
13	2	S6	0	0	47845.035	0	12155.661	9.999+	9.999+
14	2	S7	0	0	42827.748	0	10799.821	9.999+	9.999+
15	3	S1	0	18425.706	36506.946	2255.853	9360.43	1.981	4.149
16	3	S2	0	19238.31	36378.965	2115	9342.211	1.891	4.417
17	3	S3	0	19875.466	36518.487	2242.767	9360.165	1.837	4.173
18	3	S4	0	19795.31	36496.212	2224.599	9359.784	1.844	4.207
19	3	S5	0	19612.949	36493.106	2214.42	9354.015	1.861	4.224
20	3	S6	0	20752.039	36503.639	2282.154	9376.866	1.759	4.109
21	3	S7	0	13356.423	36072.567	1747.789	9262.107	2.701	5.299
22	4	S1	0	19266.234	36506.946	2018.957	9360.43	1.895	4.636
23	4	S2	0	19599.747	36378.965	1719.114	9342.211	1.856	5.434
24	4	S3	0	20541.746	36518.487	1899.374	9360.165	1.778	4.928
25	4	S4	0	20406.732	36496.212	1866.008	9359.784	1.788	5.016
26	4	S5	0	20266.654	36493.106	1873.271	9354.015	1.801	4.993
27	4	S6	0	21171.433	36503.639	1845.629	9376.866	1.724	5.081
28	4	S7	0	14029.535	36072.567	1563.91	9262.107	2.571	5.922
29	5	S1	0	2342.425	36328.458	0	11989.251	9.999+	9.999+
30	5	S2	0	3279.975	36490.407	0	11806.892	9.999+	9.999+
31	5	S3	0	2817.124	36490.926	0	11973.737	9.999+	9.999+
32	5	S4	0	2912.781	36493.985	0	11952.183	9.999+	9.999+
33	5	S5	0	2779.852	36468.338	0	11934.553	9.999+	9.999+
34	5	S6	0	3653.751	36594.423	0	12036.337	9.999+	9.999+
35	5	S7	0	1503.922	35880.418	0	10755.905	9.999+	9.999+
36	6	S1	0	0	37097.7	0	11616.101	9.999+	9.999+
37	6	S2	0	0	37055.254	0	11611.378	9.999+	9.999+
38	6	S3	0	0	37237.651	0	11697.85	9.999+	9.999+
39	6	S4	0	0	37212.233	0	11695.183	9.999+	9.999+
40	6	S5	0	0	37212.942	0	11664.697	9.999+	9.999+
41	6	S6	0	0	37008.579	0	11833.654	9.999+	9.999+
42	6	S7	0	0	36596.003	0	10574.696	9.999+	9.999+
43	7	S1	0	13819.28	43885.639	1691.89	11326.436	3.176	6.695
44	7	S2	0	14428.733	43421.249	1586.25	11272.537	3.009	7.106
45	7	S3	0	14906.6	44229.31	1682.076	11375.704	2.967	6.763
46	7	S4	0	14846.483	44099.916	1668.449	11370.606	2.97	6.815
47	7	S5	0	14709.711	44093.958	1660.815	11349.939	2.998	6.834
48	7	S6	0	15564.029	44097.894	1711.616	11460.962	2.833	6.696
49	7	S7	0	10017.317	41547.18	1310.842	10792.517	4.148	8.233
50	8	S1	0	14449.676	43885.639	1514.218	11326.436	3.037	7.48
51	8	S2	0	14699.81	43421.249	1289.336	11272.537	2.954	8.743
52	8	S3	0	15406.31	44229.31	1424.53	11365.912	2.871	7.979
53	8	S4	0	15305.049	44099.916	1397.854	11341.787	2.881	8.114
54	8	S5	0	15199.99	44093.958	1404.096	11325.024	2.901	8.066
55	8	S6	0	15878.574	44097.894	1378.926	11392.916	2.777	8.262
56	8	S7	0	10522.151	41547.18	1172.933	10792.517	3.949	9.201
57	9	S1	0	1756.819	43517.054	0	13298.052	9.999+	9.999+



**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	
58	9	S2	0	2459.982	44473.377	0	13121.047	9.999+	9.999+
59	9	S3	0	2112.843	44463.142	0	13335.882	9.999+	9.999+
60	9	S4	0	2184.586	44478.571	0	13314.906	9.999+	9.999+
61	9	S5	0	2084.889	44338.549	0	13285.342	9.999+	9.999+
62	9	S6	0	2740.314	45032.382	0	13455.565	9.999+	9.999+
63	9	S7	0	1127.941	41090.916	0	11573.122	9.999+	9.999+
64	10	S1	0	0	44093.986	0	13018.189	9.999+	9.999+
65	10	S2	0	0	44897.012	0	12974.412	9.999+	9.999+
66	10	S3	0	0	45023.186	0	13128.967	9.999+	9.999+
67	10	S4	0	0	45017.257	0	13122.156	9.999+	9.999+
68	10	S5	0	0	44897.002	0	13082.95	9.999+	9.999+
69	10	S6	0	0	45342.999	0	13303.553	9.999+	9.999+
70	10	S7	0	0	41627.605	0	11437.216	9.999+	9.999+
71	11	S1	0	18425.706	32856.251	2255.853	8424.387	1.783	3.734
72	11	S2	0	19238.31	32741.069	2115	8407.99	1.702	3.975
73	11	S3	0	19875.466	32866.638	2242.767	8424.149	1.654	3.756
74	11	S4	0	19795.31	32846.591	2224.599	8423.805	1.659	3.787
75	11	S5	0	19612.949	32843.796	2214.42	8418.614	1.675	3.802
76	11	S6	0	20752.039	32853.275	2282.154	8439.18	1.583	3.698
77	11	S7	0	13356.423	32465.311	1747.789	8335.897	2.431	4.769
78	12	S1	0	19266.234	32856.251	2018.957	8424.387	1.705	4.173
79	12	S2	0	19599.747	32741.069	1719.114	8407.99	1.67	4.891
80	12	S3	0	20541.746	32866.638	1899.374	8424.149	1.6	4.435
81	12	S4	0	20406.732	32846.591	1866.008	8423.805	1.61	4.514
82	12	S5	0	20266.654	32843.796	1873.271	8418.614	1.621	4.494
83	12	S6	0	21171.433	32853.275	1845.629	8439.18	1.552	4.573
84	12	S7	0	14029.535	32465.311	1563.91	8335.897	2.314	5.33
85	13	S1	0	2342.425	32695.612	0	11053.208	9.999+	9.999+
86	13	S2	0	3279.975	32841.367	0	10872.671	9.999+	9.999+
87	13	S3	0	2817.124	32841.833	0	11037.72	9.999+	9.999+
88	13	S4	0	2912.781	32844.586	0	11016.205	9.999+	9.999+
89	13	S5	0	2779.852	32821.504	0	10999.151	9.999+	9.999+
90	13	S6	0	3653.751	32934.981	0	11098.65	9.014	9.999+
91	13	S7	0	1503.922	32292.376	0	9837.171	9.999+	9.999+
92	14	S1	0	0	33464.854	0	10680.058	9.999+	9.999+
93	14	S2	0	0	33406.213	0	10677.157	9.999+	9.999+
94	14	S3	0	0	33588.558	0	10761.833	9.999+	9.999+
95	14	S4	0	0	33562.835	0	10759.204	9.999+	9.999+
96	14	S5	0	0	33566.108	0	10729.295	9.999+	9.999+
97	14	S6	0	0	33349.137	0	10895.967	9.999+	9.999+
98	14	S7	0	0	33007.961	0	9655.962	9.999+	9.999+

**Slab Sliding Safety Factors (By Combination)**

LC	Slab	Angle[deg]	Va-xx[lb]	Vr-xx[lb]	Va-zz[lb]	Vr-zz[lb]	SR-xx	SR-zz	
1	1	S1	0	11.287	2241.086	0	2241.086	9.999+	9.999+
2	1	S2	0	0	2242.131	0	2242.131	9.999+	9.999+
3	1	S3	0	0	2246.44	0	2246.44	9.999+	9.999+
4	1	S4	0	1.041	2245.848	0	2245.848	9.999+	9.999+
5	1	S5	0	0	2244.964	0	2244.964	9.999+	9.999+
6	1	S6	0	2.668	2249.167	0	2249.167	9.999+	9.999+
7	1	S7	0	18.691	2213.934	0	2213.934	9.999+	9.999+
8	2	S1	0	76.892	2838.717	0	2838.717	9.999+	9.999+
9	2	S2	0	2.676	2858.55	0	2858.55	9.999+	9.999+
10	2	S3	0	3.264	2889.845	1.207	2889.845	9.999+	9.999+
11	2	S4	0	9.259	2885.367	1.059	2885.367	9.999+	9.999+
12	2	S5	0	8.305	2879.673	0	2879.673	9.999+	9.999+



**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
13	2	S6	0	21.793	2906.898	0	2906.898	9.999+	9.999+
14	2	S7	0	125.708	2652.297	0	2652.297	9.999+	9.999+
15	3	S1	0	64.358	1735.991	1097.933	1735.991	9.999+	1.581
16	3	S2	0	4.702	1736.787	1274.041	1736.787	9.999+	1.363
17	3	S3	0	2.281	1709.271	1234.806	1709.271	9.999+	1.384
18	3	S4	0	2.556	1713.671	1247.548	1713.671	9.999+	1.374
19	3	S5	0	2.886	1714.888	1219.352	1714.888	9.999+	1.406
20	3	S6	0	9.137	1707.117	1374.315	1707.117	9.999+	1.242
21	3	S7	0	81.752	1842.677	775.48	1842.677	9.999+	2.376
22	4	S1	0	79.12	1799.931	928.349	1799.931	9.999+	1.939
23	4	S2	0	8.581	1833.662	1071.846	1833.662	9.999+	1.711
24	4	S3	0	0	1790.59	1041.436	1790.59	9.999+	1.719
25	4	S4	0	.49	1798.271	1051.702	1798.271	9.999+	1.71
26	4	S5	0	.286	1795.516	1029.54	1795.516	9.999+	1.744
27	4	S6	0	.903	1807.064	1155.85	1807.064	9.999+	1.563
28	4	S7	0	82.787	1887.305	656.4	1887.305	9.999+	2.875
29	5	S1	0	99.439	2829.69	1279.458	2829.69	9.999+	2.212
30	5	S2	0	5.479	2831.024	1484.682	2831.024	9.999+	1.907
31	5	S3	0	2.659	2872.421	1438.961	2872.421	9.999+	1.996
32	5	S4	0	5.233	2866.012	1453.809	2866.012	9.999+	1.971
33	5	S5	0	3.363	2862.679	1420.952	2862.679	9.999+	2.015
34	5	S6	0	16.425	2880.837	1601.535	2880.837	9.999+	1.799
35	5	S7	0	135.74	2646.572	903.692	2646.572	9.999+	2.929
36	6	S1	0	66.764	2755.818	1146.05	2755.818	9.999+	2.405
37	6	S2	0	.827	2786.334	1334.679	2786.334	9.999+	2.088
38	6	S3	0	3.749	2805.685	1291.27	2805.685	9.999+	2.173
39	6	S4	0	7.008	2803.48	1305.021	2803.48	9.999+	2.148
40	6	S5	0	4.925	2797.163	1274.099	2797.163	9.999+	2.195
41	6	S6	0	22.287	2829.379	1440.043	2829.379	9.999+	1.965
42	6	S7	0	108.839	2590.17	808.844	2590.17	9.999+	3.202
43	7	S1	0	3.757	2310.488	823.45	2310.488	9.999+	2.806
44	7	S2	0	1.519	2325.438	955.53	2325.438	9.999+	2.434
45	7	S3	0	.737	2326.117	927.01	2326.117	9.999+	2.509
46	7	S4	0	4.507	2326.354	934.867	2326.354	9.999+	2.488
47	7	S5	0	4.064	2323.439	914.514	2323.439	9.999+	2.541
48	7	S6	0	8.158	2335.928	1030.736	2335.928	9.999+	2.266
49	7	S7	0	23.622	2264.264	581.61	2264.264	9.999+	3.893
50	8	S1	0	7.315	2358.443	696.262	2358.443	9.999+	3.387
51	8	S2	0	4.429	2398.094	803.885	2398.094	9.999+	2.983
52	8	S3	0	2.448	2387.107	781.982	2387.107	9.999+	3.053
53	8	S4	0	6.792	2389.804	787.982	2389.804	9.999+	3.033
54	8	S5	0	6.014	2383.91	772.155	2383.91	9.999+	3.087
55	8	S6	0	15.688	2410.888	866.887	2410.888	9.999+	2.781
56	8	S7	0	22.846	2297.734	492.3	2297.734	9.999+	4.667
57	9	S1	0	126.605	3130.762	959.593	3130.762	9.999+	3.263
58	9	S2	0	6.116	3146.115	1113.512	3146.115	9.999+	2.825
59	9	S3	0	4.442	3198.48	1078.315	3198.48	9.999+	2.966
60	9	S4	0	10.349	3190.61	1091.151	3190.61	9.999+	2.924
61	9	S5	0	8.751	3184.282	1065.714	3184.282	9.999+	2.988
62	9	S6	0	27.33	3216.217	1201.151	3216.217	9.999+	2.678
63	9	S7	0	186.741	2867.185	677.769	2867.185	9.999+	4.23
64	10	S1	0	102.098	3075.358	859.538	3075.358	9.999+	3.578
65	10	S2	0	2.628	3112.598	1001.009	3112.598	9.999+	3.109
66	10	S3	0	5.259	3148.428	967.548	3148.428	9.999+	3.254
67	10	S4	0	11.68	3143.711	979.561	3143.711	9.999+	3.209
68	10	S5	0	9.922	3135.145	955.574	3135.145	9.999+	3.281
69	10	S6	0	31.726	3177.624	1080.032	3177.624	9.999+	2.942





**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
70	10	S7	0	166.565	2824.883	606.633	2824.883	9.999+	4.657
71	11	S1	0	65.487	1511.882	1097.933	1511.882	9.999+	1.377
72	11	S2	0	4.702	1512.574	1274.041	1512.574	9.999+	1.187
73	11	S3	0	2.281	1484.627	1234.806	1484.627	9.999+	1.202
74	11	S4	0	2.661	1489.086	1247.548	1489.086	9.999+	1.194
75	11	S5	0	2.886	1490.392	1219.352	1490.392	9.999+	1.222
76	11	S6	0	9.404	1482.2	1374.315	1482.2	9.999+	1.079
77	11	S7	0	83.621	1621.284	775.48	1621.284	9.999+	2.091
78	12	S1	0	80.249	1575.823	928.349	1575.823	9.999+	1.697
79	12	S2	0	8.581	1609.449	1071.846	1609.449	9.999+	1.502
80	12	S3	0	0	1565.946	1041.436	1565.946	9.999+	1.504
81	12	S4	0	.386	1573.686	1051.702	1573.686	9.999+	1.496
82	12	S5	0	.286	1571.02	1029.54	1571.02	9.999+	1.526
83	12	S6	0	.636	1582.147	1155.85	1582.147	9.999+	1.369
84	12	S7	0	84.656	1665.912	656.4	1665.912	9.999+	2.538
85	13	S1	0	98.31	2605.581	1279.458	2605.581	9.999+	2.036
86	13	S2	0	5.479	2606.811	1484.682	2606.811	9.999+	1.756
87	13	S3	0	2.659	2647.777	1438.961	2647.777	9.999+	1.84
88	13	S4	0	5.129	2641.427	1453.809	2641.427	9.999+	1.817
89	13	S5	0	3.363	2638.182	1420.952	2638.182	9.999+	1.857
90	13	S6	0	16.159	2655.92	1601.535	2655.92	9.999+	1.658
91	13	S7	0	133.871	2425.179	903.692	2425.179	9.999+	2.684
92	14	S1	0	65.635	2531.709	1146.05	2531.709	9.999+	2.209
93	14	S2	0	.827	2562.121	1334.679	2562.121	9.999+	1.92
94	14	S3	0	3.749	2581.041	1291.27	2581.041	9.999+	1.999
95	14	S4	0	6.904	2578.895	1305.021	2578.895	9.999+	1.976
96	14	S5	0	4.925	2572.667	1274.099	2572.667	9.999+	2.019
97	14	S6	0	22.02	2604.462	1440.043	2604.462	9.999+	1.809
98	14	S7	0	106.97	2368.777	808.844	2368.777	9.999+	2.929

**Envelope Slab Soil Pressures**

	Label	UC	LC	Soil Pressure[psf]	Allowable Bearing[psf]	Point
1	S1	.414	5	621.04	1500	N198
2	S2	.421	5	630.792	1500	N205
3	S3	.429	5	643.93	1500	N212
4	S4	.428	5	642.028	1500	N219
5	S5	.426	5	639.201	1500	N226
6	S6	.439	5	658.562	1500	N233
7	S7	.354	5	531.162	1500	N240



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### 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): 6.000  
Code report: ICC-ES ESR-4057  
Anchor category: -  
Anchor ductility: Yes  
 $h_{min}$  (inch): 7.25  
 $c_{ac}$  (inch): 10.99  
 $c_{min}$  (inch): 1.75  
 $s_{min}$  (inch): 3.00

#### Base Material

Concrete: Normal-weight  
Concrete thickness,  $h$  (inch): 24.00  
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





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**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]: 3932

$V_{uax}$  [lb]: 175

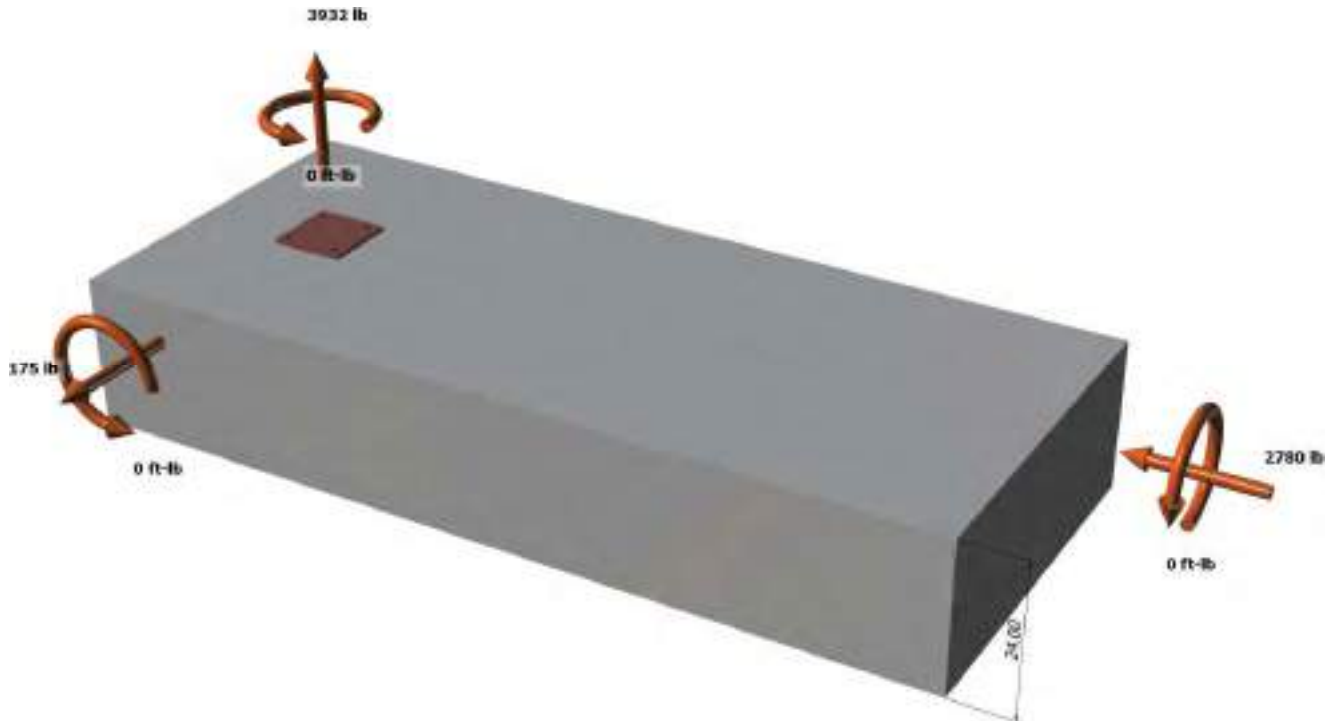
$V_{uay}$  [lb]: -2780

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

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

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

<Figure 1>





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<Figure 2>





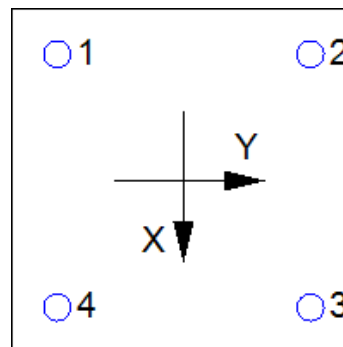
Company:		Date:	5/14/2018
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E-mail:			

### 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	983.0	43.8	-695.0	696.4
2	983.0	43.8	-695.0	696.4
3	983.0	43.8	-695.0	696.4
4	983.0	43.8	-695.0	696.4
Sum	3932.0	175.0	-2780.0	2785.5

Maximum concrete compression strain (%): 0.00  
 Maximum concrete compression stress (psi): 0  
 Resultant tension force (lb): 3932  
 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	6.000	12492

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

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)
424.63	324.00	7.25	1.000	0.942	1.00	1.000	12492	0.65	10021

### 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	6.000	9514

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

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	9514	0.55	9265



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**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	13.75	16564

$\phi V_{cbgx} = \phi (A_{Vc} / A_{Vco}) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_{bx}$  (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)
647.11	850.78	1.000	0.805	1.000	1.000	16564	0.70	7103

**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)
387.00	520.03	1.000	0.891	1.000	1.000	11450	0.70	5313

**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)
261.00	236.53	1.000	1.000	1.000	1.000	6342	0.70	9797

**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	10.25	10661

$\phi V_{cbgy} = \phi (2)(A_{Vc} / A_{Vco}) \Psi_{ec,V} \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} V_{bx}$  (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)
401.67	472.78	1.000	1.000	1.000	1.000	10661	0.70	12680

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

$\phi V_{cp} = \phi \min|k_{cp} N_{ag}; k_{cp} N_{cbg}| = \phi \min|k_{cp} (A_{Na} / A_{Na0}) \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba}; k_{cp} (A_{Nc} / A_{Nco}) \Psi_{ec,N} \Psi_{ed,N} \Psi_{cp,N} N_{b}|$  (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	9514	16845

$A_{Nc}$ (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)	$\phi$
424.63	324.00	1.000	0.942	1.000	1.000	12492	15417	0.70

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



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$\phi V_{cpq}$  (lb)  
21584

## 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	983	3394	0.29	Pass	
Concrete breakout	3932	10021	0.39	Pass	
<b>Adhesive</b>	<b>3932</b>	<b>9265</b>	<b>0.42</b>	<b>Pass (Governs)</b>	
Shear	Factored Load, $V_{ua}$ (lb)	Design Strength, $\phi V_n$ (lb)	Ratio	Status	
Steel	696	1765	0.39	Pass	
T Concrete breakout x+	175	7103	0.02	Pass	
T Concrete breakout y-	2780	5313	0.52	Pass	
Concrete breakout y-	88	9797	0.01	Pass	
Concrete breakout x-	1390	12680	0.11	Pass	
<b>Concrete breakout, combined</b>	<b>-</b>	<b>-</b>	<b>0.52</b>	<b>Pass (Governs)</b>	
Pryout	2786	21584	0.13	Pass	
Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.24	0.34	58.0%	1.0	Pass

**SET-3G w/ 3/8"Ø F1554 Gr. 36 with hef = 6.000 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.



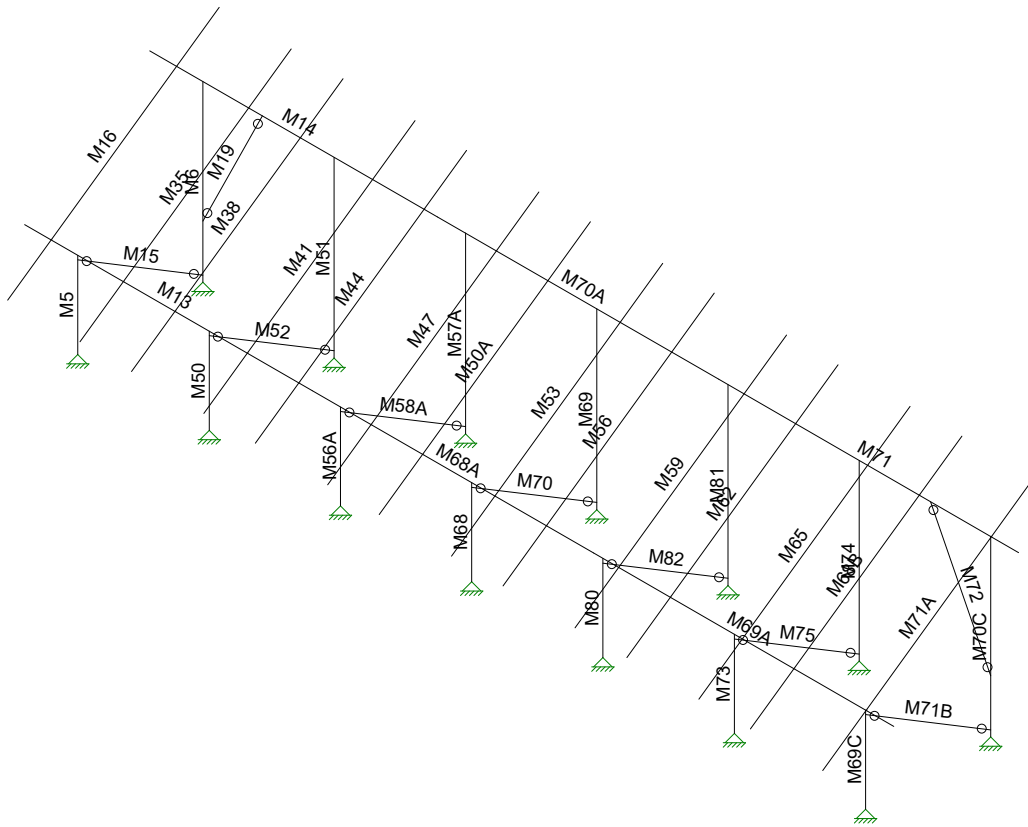
JOB NO.: U2716-0276-211

DESIGNED: STB

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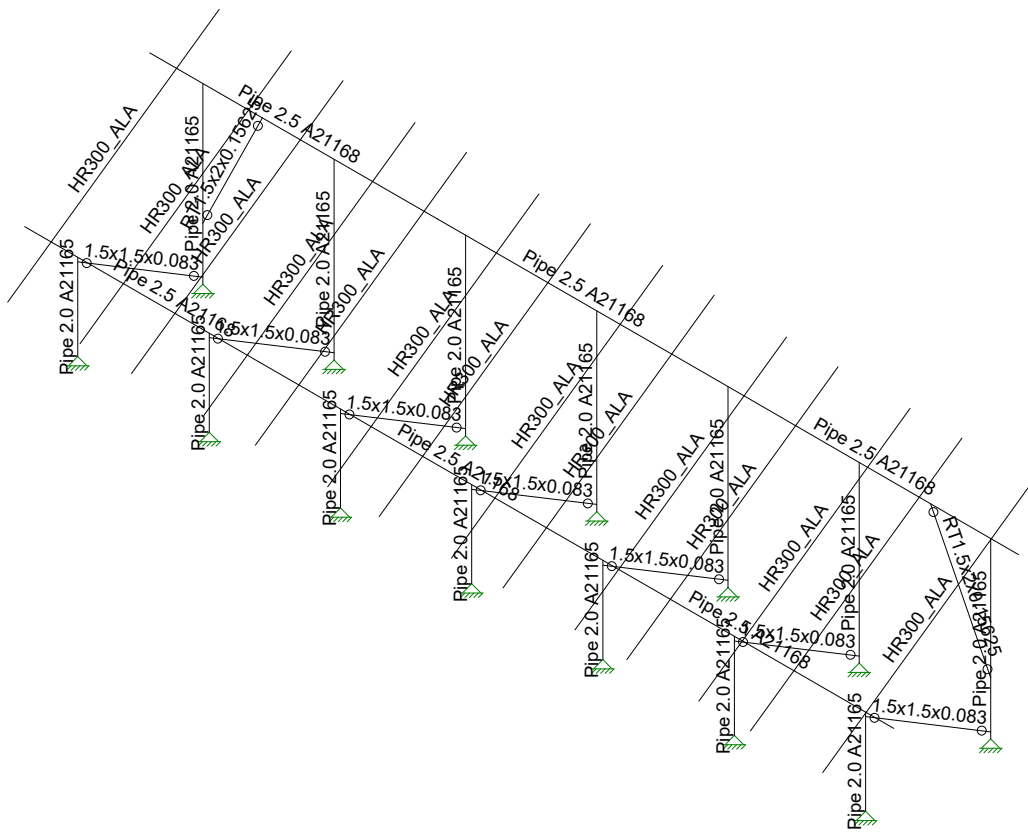




Vector Structural Engineeri...  
STB  
U2716.0276.211

Ground Mount

SK - 3  
Jan 20, 2021 at 10:55 AM  
Sunmodo Sunturf A9.r3d



Vector Structural Engineeri...

STB

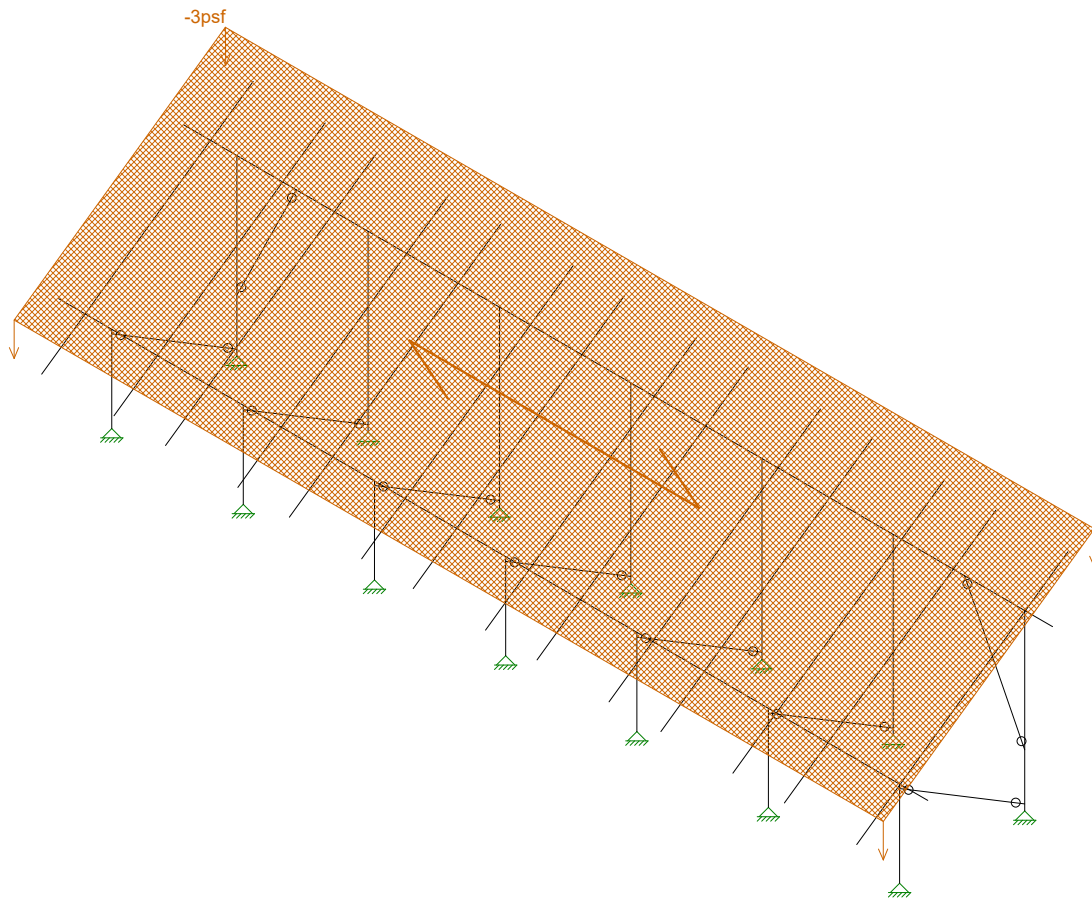
U2716.0276.211

Ground Mount

SK - 4

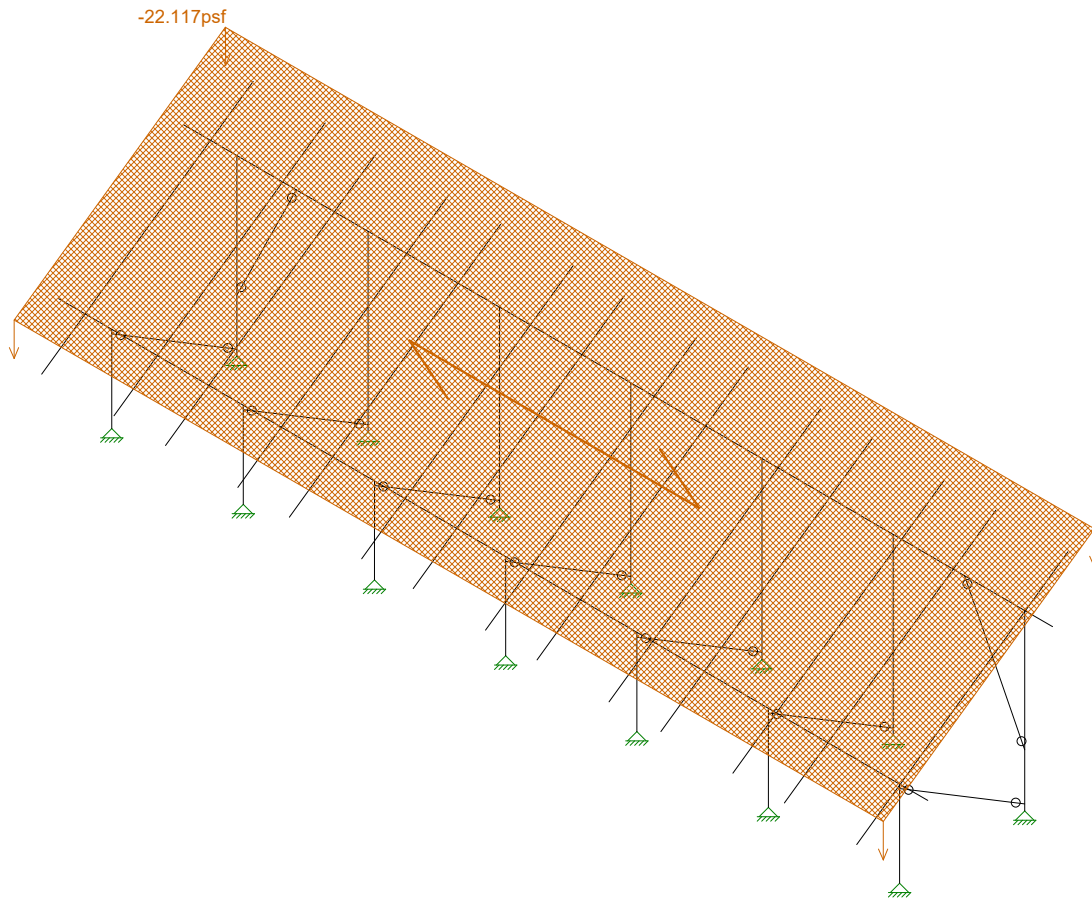
Jan 20, 2021 at 10:55 AM

Sunmodo Sunturf A9.r3d



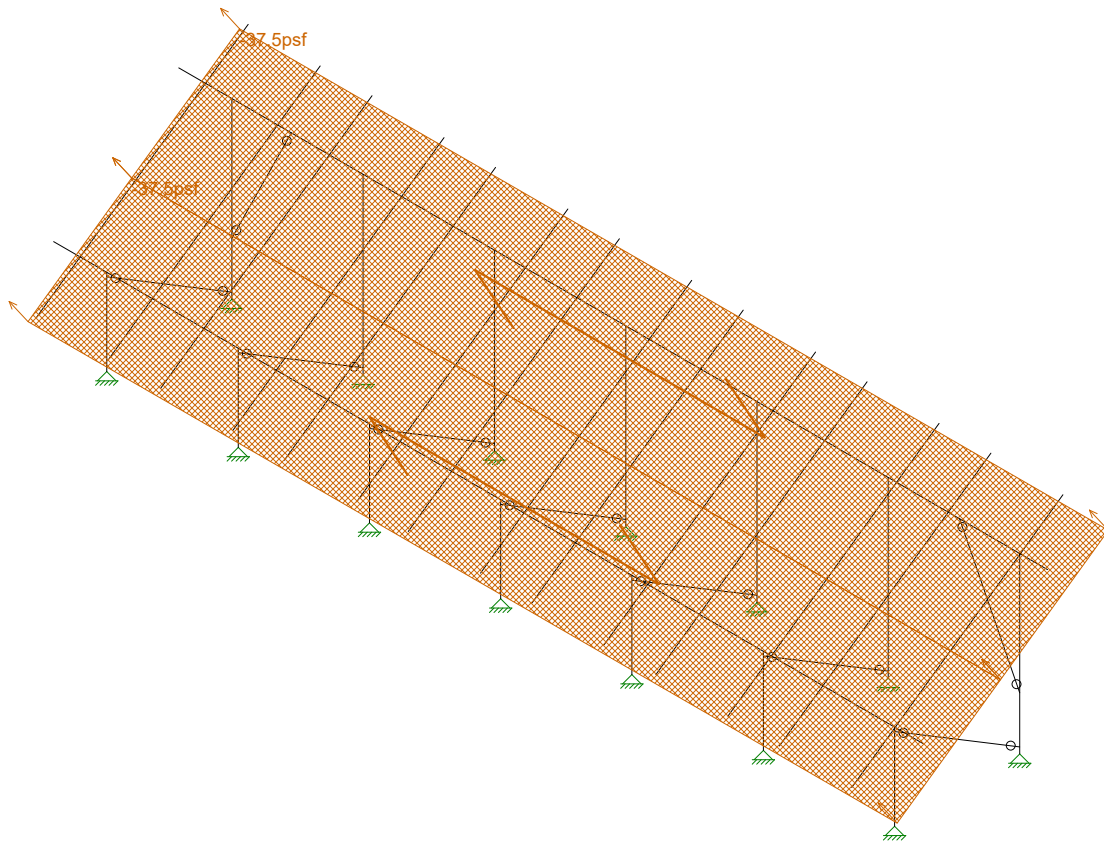
Loads: BLC 2, Solar Panel Weight

Vector Structural Engineeri...	Ground Mount	SK - 5
STB		Jan 20, 2021 at 10:55 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



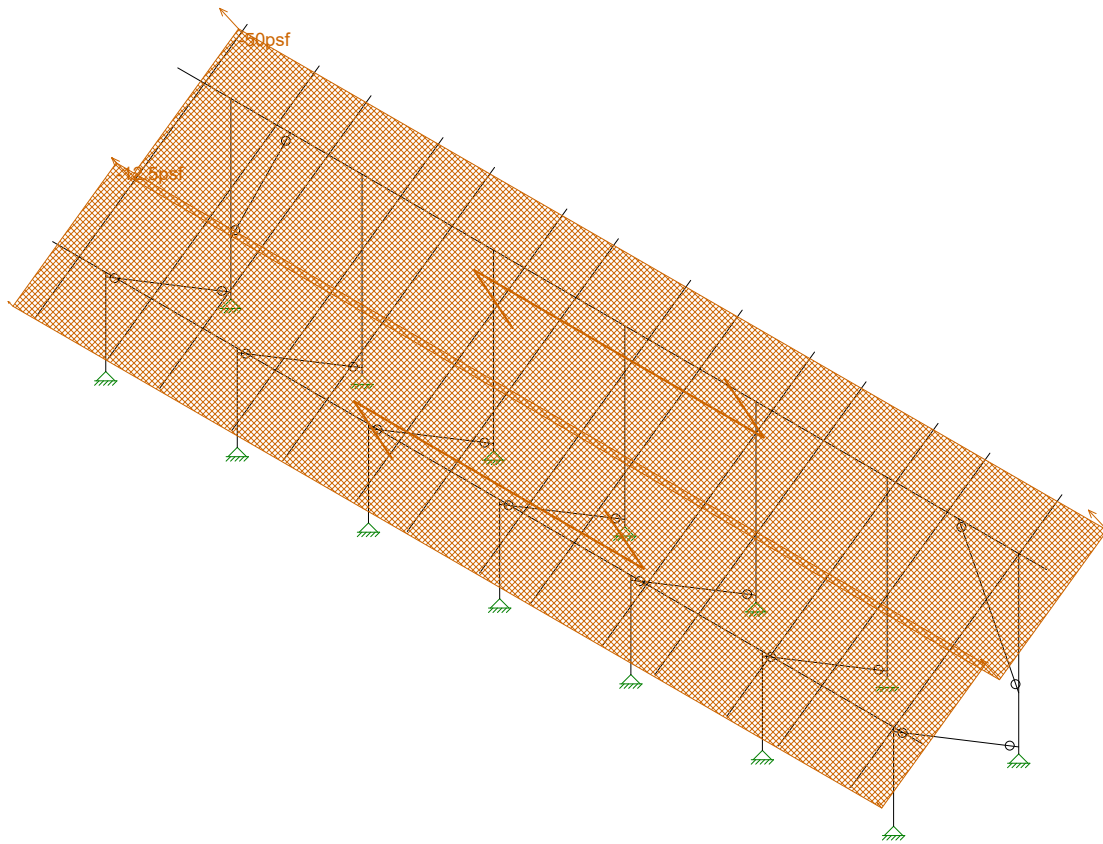
Loads: BLC 3, Roof Live/Snow

Vector Structural Engineeri..	Ground Mount	SK - 6
STB		Jan 20, 2021 at 10:55 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



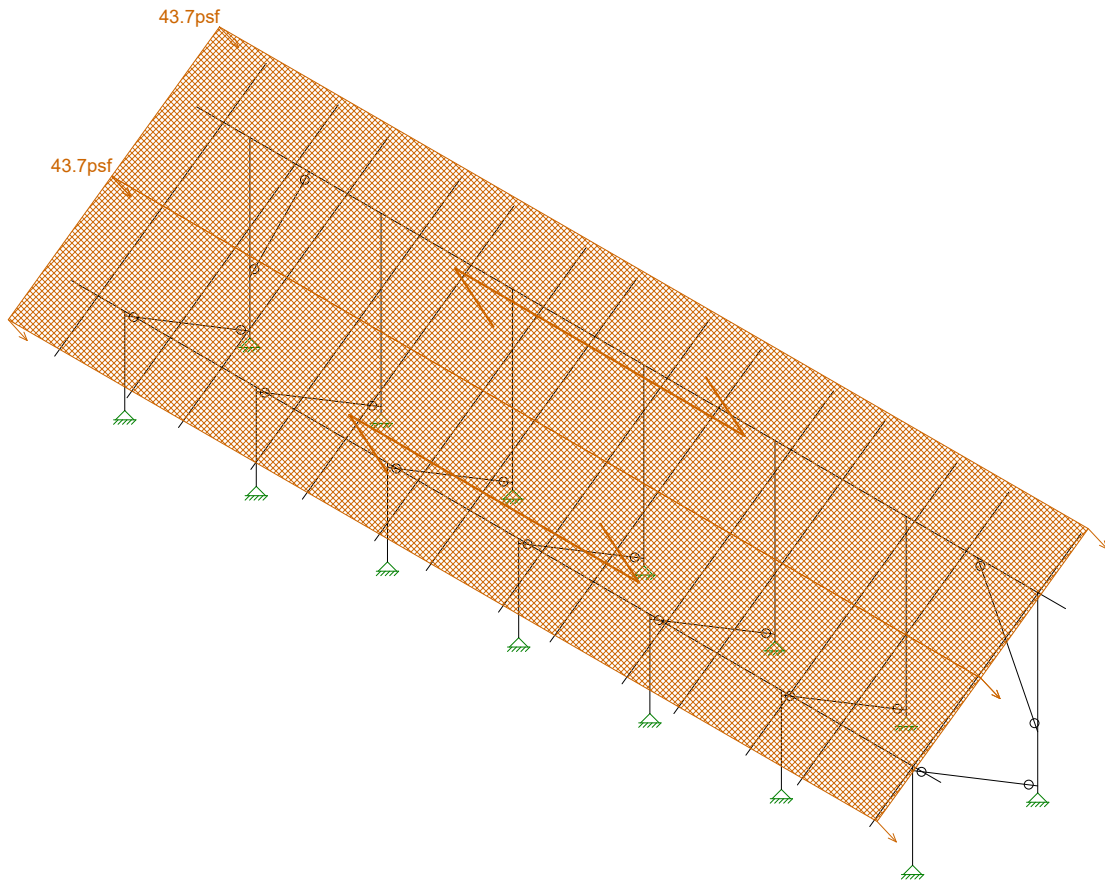
Loads: BLC 4, Wind A 0 deg

Vector Structural Engineeri..	Ground Mount	SK - 7
STB		Jan 20, 2021 at 10:55 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



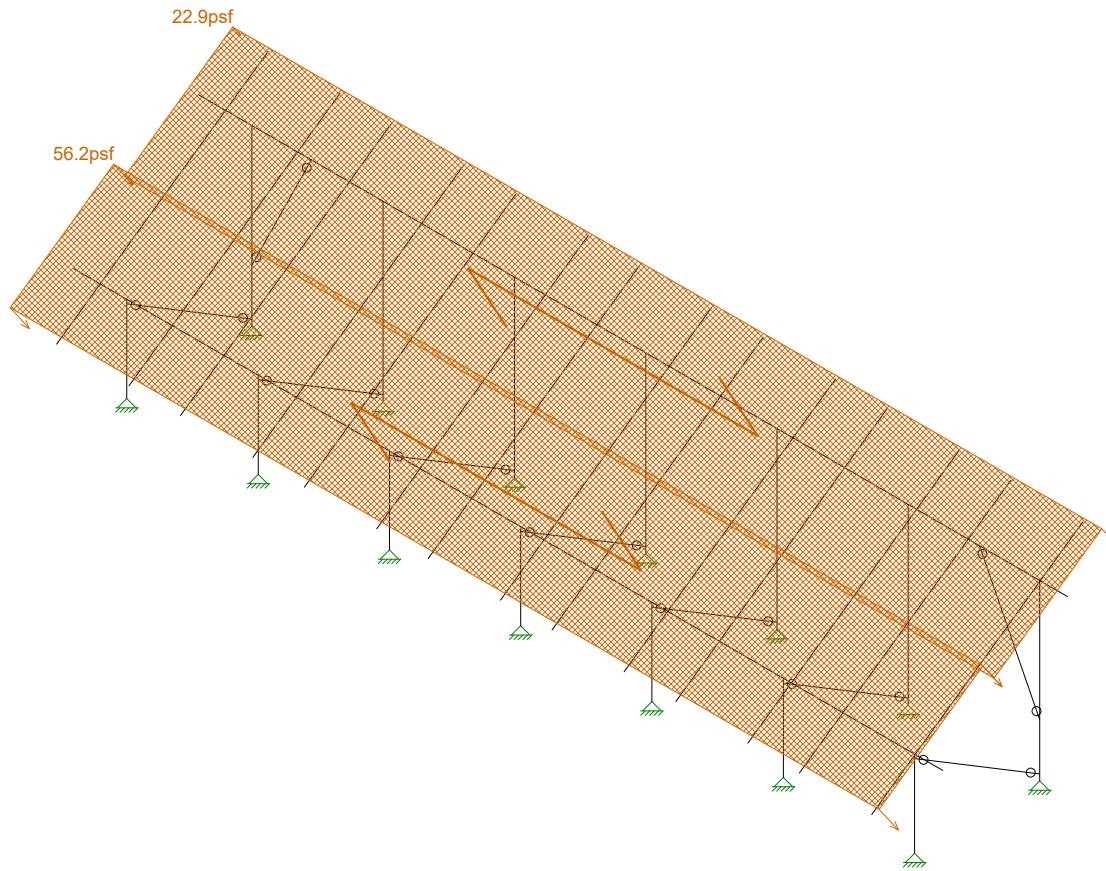
Loads: BLC 5, Wind B 0 deg

Vector Structural Engineeri..	Ground Mount	SK - 8
STB		Jan 20, 2021 at 10:56 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



Loads: BLC 6, Wind A 180 deg

Vector Structural Engineeri...	Ground Mount	SK - 9
STB		Jan 20, 2021 at 10:56 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



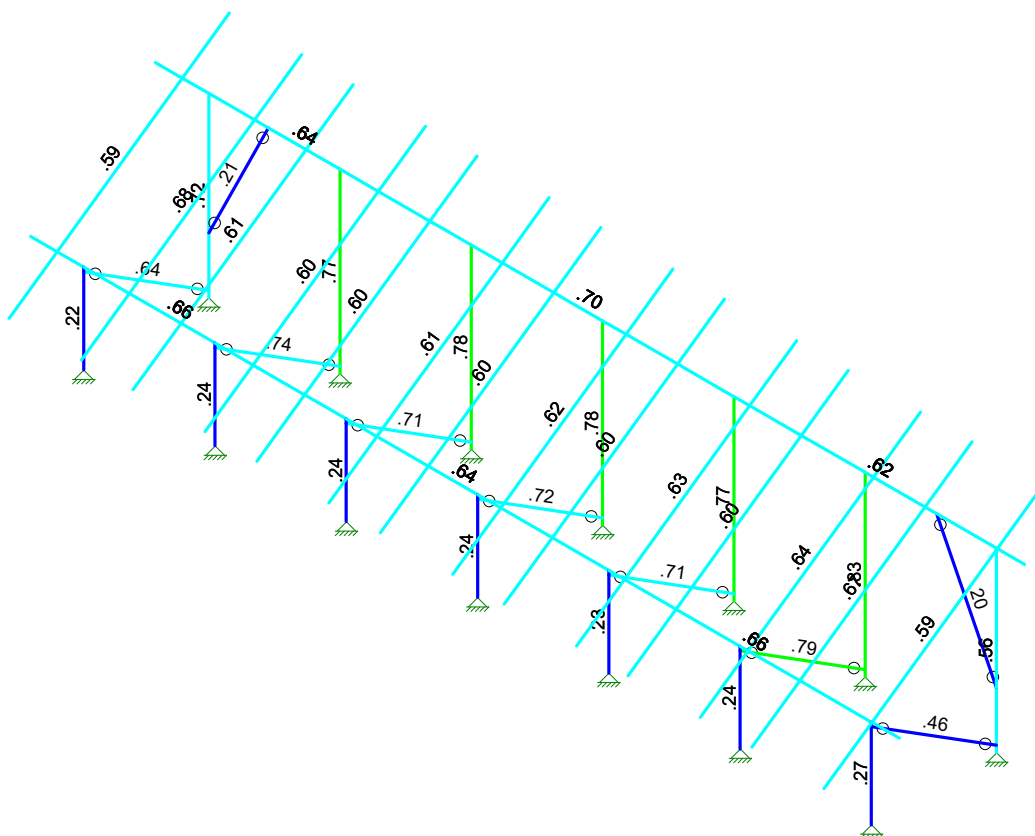
Loads: BLC 7, Wind B 180 deg

Vector Structural Engineeri...	Ground Mount	SK - 10
STB		Jan 20, 2021 at 10:56 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d





Code Check ( Env )	
Black	No Calc
Red	> 1.0
Magenta	.90-1.0
Green	.75-.90
Cyan	.50-.75
Blue	0-.50



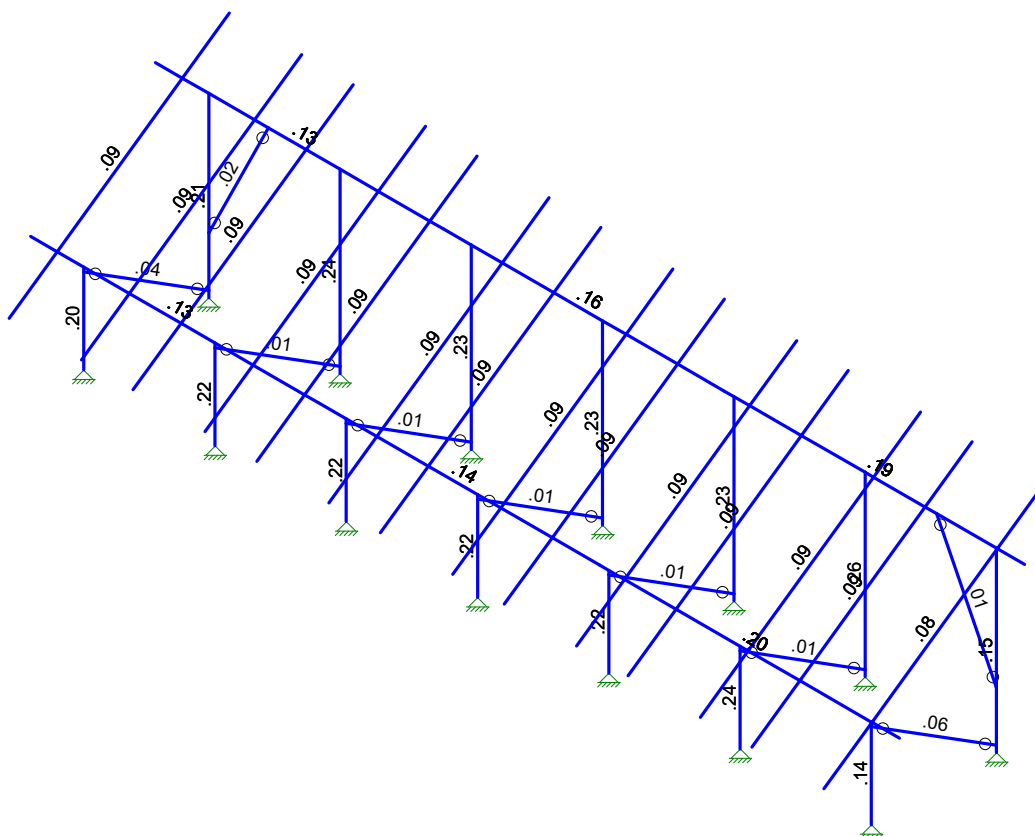
Member Code Checks Displayed (Enveloped)  
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 1
STB		Jan 21, 2021 at 11:06 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



Shear Check  
( Env )

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



Member Shear Checks Displayed (Enveloped)  
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 2
STB		Jan 21, 2021 at 11:06 AM
U2716.0276.211		Sunmodo Sunturf A9.r3d



**(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
Parme 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



**(Global) Model Settings, Continued**

Seismic Code	ASCE 7-16
Seismic Base Elevation (in)	15600
Add Base Weight?	Yes
Ct X	.02
Ct Z	.02
T X (sec)	Not Entered
T Z (sec)	Not Entered
R X	3
R Z	3
Ct Exp. X	.75
Ct Exp. Z	.75
SD1	1
SDS	1
S1	1
TL (sec)	5
Risk Cat	I or II
Drift Cat	Other
Om Z	1
Om X	1
Cd Z	4
Cd X	4
Rho Z	1
Rho X	1

**Hot Rolled Steel Properties**

	Label	E [ksi]	G [ksi]	Nu	Therm (/1E5 F)	Density[lb/ft^3]	Yield[psi]	Ry	Fu[psi]	Rt
1	A992	29000	11154	.3	.65	490	50000	1.1	65000	1.1
2	A36 Gr.36	29000	11154	.3	.65	490	36000	1.5	58000	1.2
3	A572 Gr.50	29000	11154	.3	.65	490	50000	1.1	65000	1.1
4	A500 Gr.B R...	29000	11154	.3	.65	527	42000	1.4	58000	1.3
5	A500 Gr.B Re...	29000	11154	.3	.65	527	46000	1.4	58000	1.3
6	A53 Gr.B	29000	11154	.3	.65	490	35000	1.6	60000	1.2
7	A1085	29000	11154	.3	.65	490	50000	1.4	65000	1.3

**Aluminum Properties**

	Label	E [ksi]	G [ksi]	Nu	Therm (...Density[... Table B.4	kt	Ftu[psi]	Fty[psi]	Fcy[psi]	Fsu[psi]	Ct
1	3003-H14	10100	3787.5	.33	1.3 172.8 Table B.4-1	1	19000	16000	13000	12000	141
2	6061-T6	10100	3787.5	.33	1.3 172.8 Table B.4-2	1	38000	35000	35000	24000	141
3	6063-T5	10100	3787.5	.33	1.3 172.8 Table B.4-2	1	22000	16000	16000	13000	141
4	6063-T6	10100	3787.5	.33	1.3 172.8 Table B.4-2	1	30000	25000	25000	19000	141
5	5052-H34	10200	3787.5	.33	1.3 172.8 Table B.4-1	1	34000	26000	24000	20000	141
6	6061-T6 W	10100	3787.5	.33	1.3 172.8 Table B.4-1	1	24000	15000	15000	15000	141
7	6005-T5	10100	3787.5	.33	1.3 172.8 Table B.4-1	1	38000	35000	35000	24000	141

**Hot Rolled Steel Section Sets**

	Label	Shape	Type	Design List	Material	Design R...	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	Post	Pipe 2.0 A21165	Column	Pipe	A572 Gr.50	Typical	.776	.499	.499	.998
2	Cross Beam	Pipe 2.5 A21168	Beam	Wide Flange	A572 Gr.50	Typical	.947	.907	.907	1.814
3	Diagonal Brace	1.5x1.5x0.083	HBrace	SquareTube	A572 Gr.50	Typical	.47	.158	.158	.236



**Aluminum Section Sets**

	Label	Shape	Type	Design List	Material	Design R...	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	AL Posts	2.375ODX0.188	Column	Pipe	6005-T5	Typical	1.29	.778	.778	1.54
2	AL Brace	RT1.5x2x0.15625	VBrace	Rectangular Tubes	6005-T5	Typical	.996	.327	.524	.602
3	AL Rails	HR300 ALA	Beam	Rectangular Tubes	6005-T5	Typical	.736	.214	.727	.614
4	AL Cross Beam	Cross Rail	Beam	Rectangular Tubes	6005-T5	Typical	1.909	1.97	4.366	4.017

**Member Area Loads (BLC 2 : Solar Panel Weight)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N199	N196	Y	A-B	-3

**Member Area Loads (BLC 3 : Roof Live/Snow)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N199	N196	PY	A-B	-27

**Member Area Loads (BLC 4 : Wind A 0 deg)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N201	N198	Perp	A-B	-37.5
2	N198	N201	N199	N196	Perp	A-B	-37.5

**Member Area Loads (BLC 5 : Wind B 0 deg)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N201	N198	Perp	A-B	-50
2	N198	N201	N199	N196	Perp	A-B	-12.5

**Member Area Loads (BLC 6 : Wind A 180 deg)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N201	N198	Perp	A-B	43.7
2	N198	N201	N199	N196	Perp	A-B	43.7

**Member Area Loads (BLC 7 : Wind B 180 deg)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N201	N198	Perp	A-B	22.9
2	N198	N201	N199	N196	Perp	A-B	56.2

**Basic Load Cases**

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area(M...Surface...
1	Self Weight	DL		-1.05					
2	Solar Panel Weight	DL							1
3	Roof Live/Snow	RLL							1
4	Wind A 0 deg	OL1							2
5	Wind B 0 deg	OL2							2
6	Wind A 180 deg	OL3							2
7	Wind B 180 deg	OL4							2
8	BLC 2 Transient Area ...	None						38	
9	BLC 3 Transient Area ...	None						38	
10	BLC 4 Transient Area ...	None						120	
11	BLC 5 Transient Area ...	None						120	
12	BLC 6 Transient Area ...	None						120	
13	BLC 7 Transient Area ...	None						120	

**Load Combinations**

	Description	S...	PD...	SRSS	BLC	Fa...	BLC	Fa...	BLC	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...
1	1.0 D	Yes	Y		DL	1																
2	1.0 D + 1.0 S	Yes	Y		DL	1	RLL	1														
3	1.0 D + 0.6 W1	Yes	Y		DL	1	RLL		OL1	.6												
4	1.0 D + 0.6 W2	Yes	Y		DL	1	RLL		OL2	.6												
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	11.191	6	1516.108	8	56.835	3	0	14	0	14	14
2		min	-7	11	-335.348	13	-64.528	5	0	1	0	1	1
3	N1	max	106.454	9	2776.994	9	1343.9...	5	0	14	0	14	14
4		min	-84.891	12	-2152.767	12	-1154....	3	0	1	0	1	1
5	N132	max	3.275	9	2901.461	9	1490.6...	5	0	14	0	14	14
6		min	-2.12	12	-2265.277	12	-1280....	3	0	1	0	1	1
7	N133	max	8.393	10	1679.558	8	61.006	3	0	14	0	14	14
8		min	-.38	11	-366.356	13	-69.564	5	0	1	0	1	1
9	N109	max	2.582	2	2796.693	9	1555.4...	5	0	14	0	14	14
10		min	-1.3	12	-2180.274	12	-1334....	3	0	1	0	1	1
11	N110A	max	3.691	5	1755.066	8	60.987	3	0	14	0	14	14
12		min	-7.575	4	-397.135	13	-69.641	5	0	1	0	1	1
13	N121	max	1.09	4	2943.069	9	1507.75	5	0	14	0	14	14
14		min	-.537	14	-2296.036	12	-1296....	3	0	1	0	1	1
15	N122	max	6.268	10	1700.893	8	61.345	3	0	14	0	14	14
16		min	-2.112	11	-372.024	13	-69.951	5	0	1	0	1	1
17	N133B	max	2.626	9	2922.812	9	1523.9...	5	0	14	0	14	14
18		min	-1.358	12	-2277.638	12	-1308....	3	0	1	0	1	1
19	N134B	max	9.877	10	1714.206	8	61.547	3	0	14	0	14	14
20		min	-1.678	11	-377.599	13	-70.074	5	0	1	0	1	1
21	N151	max	4.331	9	3019.463	9	1669.2...	5	0	14	0	14	14
22		min	-1.424	12	-2356.741	12	-1435....	3	0	1	0	1	1



**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
23	N152	max	29.42	10	1862.408	8	60.576	3	0	14	0	14
24		min	-8.526	11	-444.327	13	-68.165	5	0	1	0	1
25	N143A	max	93.521	12	2034.223	9	957.392	5	0	14	0	14
26		min	-120.3...	9	-1566.01	12	-821.4...	3	0	1	0	1
27	N144A	max	22.133	11	1092.028	8	46.145	3	0	14	0	14
28		min	-61.555	10	-218.848	13	-53.277	5	0	1	0	1
29	Totals:	max	.006	12	23630.837	9	9583.0...	5				
30		min	-.013	10	-10065.554	11	-8223...	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]	Mny/om...	Mnz/om...Cb	Eqn	
1	M5	Pipe 2.0 A2...	.220	54.562	5	.199	54.562	5	16072.847	23232.186	1397.505	1397.505	1...H1-1b	
2	M6	Pipe 2.0 A2...	.718	3.539	5	.208	0	5	5849.89	23232.186	1397.505	1397.505	1...H1-1a	
3	M13	Pipe 2.5 A2...	.665	118....	10	.130	116....	10	11641.036	28358.413	2081.747	2081.747	2...H1-1b	
4	M14	Pipe 2.5 A2...	.636	118....	9	.127	116....	9	11641.036	28358.413	2081.747	2081.747	2...H1-1b	
5	M15	1.5x1.5x0.083	.640	49.242	5	.038	0	y	9	2656.423	14085.15	624.421	624.421	1...H1-1a
6	M80	Pipe 2.0 A2...	.235	53.969	13	.215	54.562	5	16072.847	23232.186	1397.505	1397.505	1...H1-1b	
7	M81	Pipe 2.0 A2...	.769	3.539	5	.228	0	5	5849.89	23232.186	1397.505	1397.505	1...H1-1a	
8	M82	1.5x1.5x0.083	.706	49.242	5	.010	0	y	8	2656.423	14085.15	624.421	624.421	1...H1-1a
9	M50	Pipe 2.0 A2...	.236	53.969	13	.224	54.562	5	16072.847	23232.186	1397.505	1397.505	1...H1-1b	
10	M51	Pipe 2.0 A2...	.772	3.539	5	.238	0	5	5849.89	23232.186	1397.505	1397.505	1...H1-1a	
11	M52	1.5x1.5x0.083	.737	49.242	5	.006	0	y	9	2656.423	14085.15	624.421	624.421	1...H1-1a
12	M56A	Pipe 2.0 A2...	.236	53.969	13	.218	54.562	5	16072.847	23232.186	1397.505	1397.505	1...H1-1b	
13	M57A	Pipe 2.0 A2...	.780	3.539	5	.231	0	5	5849.89	23232.186	1397.505	1397.505	2...H1-1a	
14	M58A	1.5x1.5x0.083	.715	49.242	5	.006	94.544	y	4	2656.423	14085.15	624.421	624.421	1...H1-1a
15	M68	Pipe 2.0 A2...	.237	53.969	13	.220	54.562	5	16072.847	23232.186	1397.505	1397.505	1...H1-1b	
16	M69	Pipe 2.0 A2...	.781	3.539	5	.234	0	5	5849.89	23232.186	1397.505	1397.505	1...H1-1a	
17	M70	1.5x1.5x0.083	.722	49.242	5	.009	94.544	y	8	2656.423	14085.15	624.421	624.421	1...H1-1a
18	M68A	Pipe 2.5 A2...	.642	18.75	10	.140	103....	10	11641.036	28358.413	2081.747	2081.747	2...H1-1b	
19	M69A	Pipe 2.5 A2...	.662	90	10	.197	90	10	11641.036	28358.413	2081.747	2081.747	1...H1-1b	
20	M70A	Pipe 2.5 A2...	.697	18.75	9	.159	103....	9	11641.036	28358.413	2081.747	2081.747	2...H1-1b	
21	M71	Pipe 2.5 A2...	.623	6	9	.194	90	9	11641.036	28358.413	2081.747	2081.747	2...H1-1b	
22	M73	Pipe 2.0 A2...	.237	54.562	6	.242	54.562	5	16072.847	23232.186	1397.505	1397.505	1...H1-1b	
23	M74	Pipe 2.0 A2...	.831	3.539	5	.256	0	5	5849.89	23232.186	1397.505	1397.505	1.6H1-1a	
24	M75	1.5x1.5x0.083	.790	49.242	5	.011	94.544	y	8	2656.423	14085.15	624.421	624.421	1...H1-1a
25	M69C	Pipe 2.0 A2...	.275	54.562	10	.145	54.562	5	16072.847	23232.186	1397.505	1397.505	1...H1-1b	
26	M70C	Pipe 2.0 A2...	.560	35.392	9	.145	0	5	5849.89	23232.186	1397.505	1397.505	1...H1-1a	
27	M71B	1.5x1.5x0.083	.458	49.242	5	.061	94.544	y	9	2656.423	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...	.209	52.977	9	.022	0	z	5	2260.001	19411....	770.742	927.083	5889.423	3966.346	1...H-1-1
2	M16	HR300_ A...	.585	37.631	10	.085	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H-1-1
3	M35	HR300_ A...	.677	37.631	10	.092	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H-1-1
4	M38	HR300_ A...	.607	87.807	9	.091	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1...H-1-1
5	M41	HR300_ A...	.599	87.807	9	.086	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1...H-1-1
6	M44	HR300_ A...	.600	87.807	9	.086	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1...H-1-1
7	M47	HR300_ A...	.613	87.807	9	.086	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1...H-1-1
8	M50A	HR300_ A...	.596	37.631	10	.086	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H-1-1
9	M53	HR300_ A...	.624	87.807	9	.086	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1...H-1-1
10	M56	HR300_ A...	.596	37.631	10	.086	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H-1-1
11	M59	HR300_ A...	.632	87.807	9	.085	39.423	y	10	3914.169	14342....	494.953	934.619	6030.769	2749.538	1...H-1-1
12	M62	HR300_ A...	.596	37.631	10	.085	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...H-1-1
13	M65	HR300_ A...	.638	87.807	9	.090	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

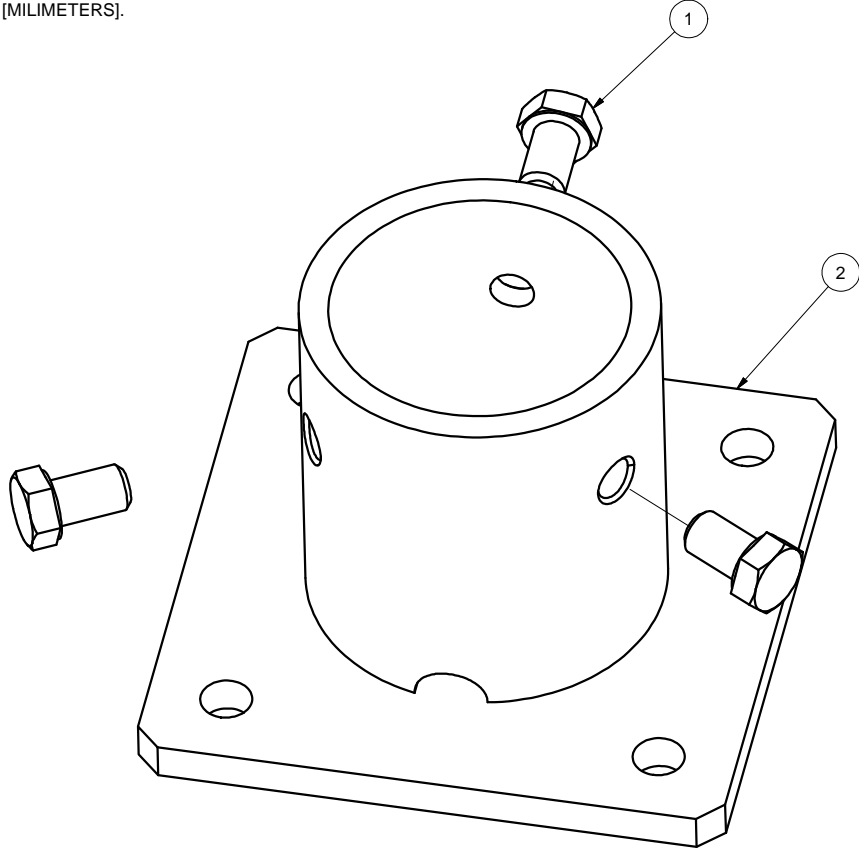
Jan 21, 2021  
 11:06 AM  
 Checked By: \_\_\_\_\_

**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			
14	M68B	HR300_A...	.673	37.631	10	.091	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...	H.1-1
15	M71A	HR300_A...	.593	37.631	10	.082	39.423	y	10	6230.805	14342....	494.953	934.619	6030.769	2749.538	2...	H.1-1
16	M72	RT1.5x2x...	.196	53.045	9	.012	0	z	10	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].



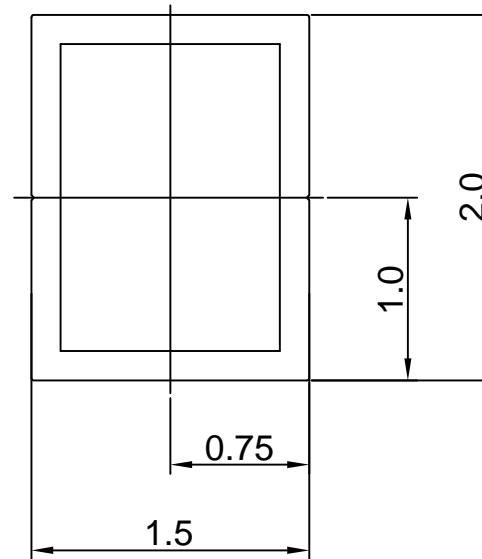
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	10/20/2016

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] X.XX ±0.02 [0.50mm] X.X ±0.039 [1.0mm] Unless otherwise spec'd		2" PIPE BASE KIT	
DRAWN BY		DATE	
LWF		10/20/2016	
CHECKED BY		DRAWING NUMBER	
		B K10268-001	
APPROVALS		SCALE: NONE	
		SHEET 1 of 1	

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NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
2. MATERAIL: 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>): I<sub>x</sub>=0.506,I<sub>y</sub>=0.322

Section modulus in bending(in<sup>3</sup>): W<sub>x</sub>=0.675,W<sub>y</sub>=0.322

Radii of Gyration: X: 0.714, Y: 0.570

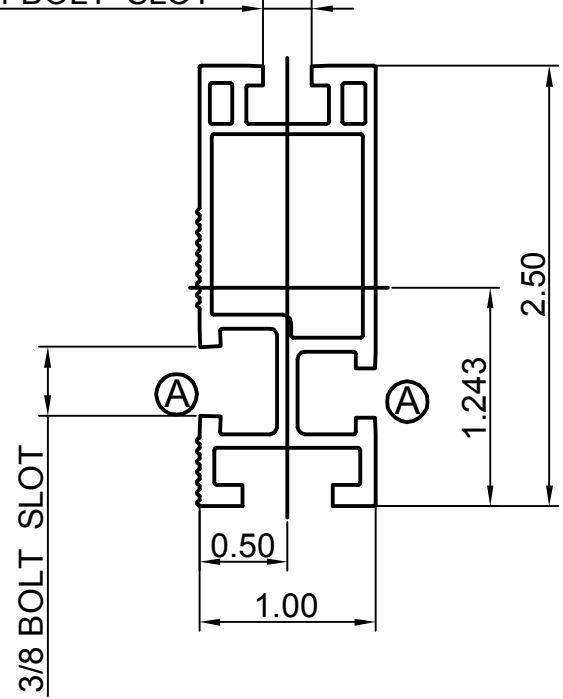
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS			
All Dimensions in inches [millimeters]			
Tolerances			
X.XXX ± 0.01 [0.25mm]	Break all sharp edges		
X.XX ± 0.02 [0.50mm]	.010-.020 unless		
X.X ± 0.039 [1.0mm]	otherwise specified.		
DRAWN BY		DATE	
zcg		03/12/2014	
CHECKED BY			
APPROVALS			
		1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661	
		TITLE	
		1.5X2 AL TUBE BRACE EXTRUSION	
		DRAWING NUMBER	
		A20164	
		SCALE: NONE	
		SHEET 1 of 1	

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:

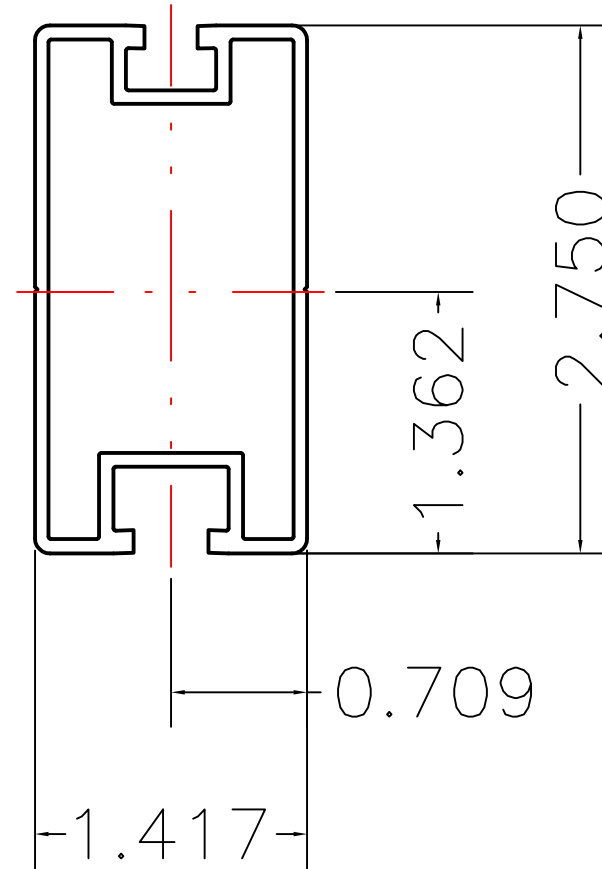
Weight: 0.850 lbs/ft  
 Area: 0.723 in<sup>2</sup>  
 Perimeter: 17.325 in  
 Bounding Box: X: -0.500,0.500  
 Y: -1.243,1.257

Centroid:(0.000,0.000)  
 Moments of Inertia(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 SEE NOTES		<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			

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: 994, Y: 0.539

MATERIAL SEE NOTES	
Third Angle Projection:	
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters]	
Tolerances	
X.XXX ±0.01 [0.25mm]	Break all sharp edges .010-.020 unless otherwise specified.
X.XX ±0.02 [0.50mm]	
X.X ±0.039 [1.0mm]	
Unless otherwise spec'd	
DRAWN BY KYY	DATE 01/18/2018
CHECKED BY	
APPROVALS	

<b>SunModo Corp.</b>	
14800 NE 65TH STREET, VANCOUVER WA 98682	
TITLE RAIL, HR300 (SUNRAY), EXTRUSION	
B	DRAWING NUMBER A20288
SCALE: NONE	SHEET 1 of 1

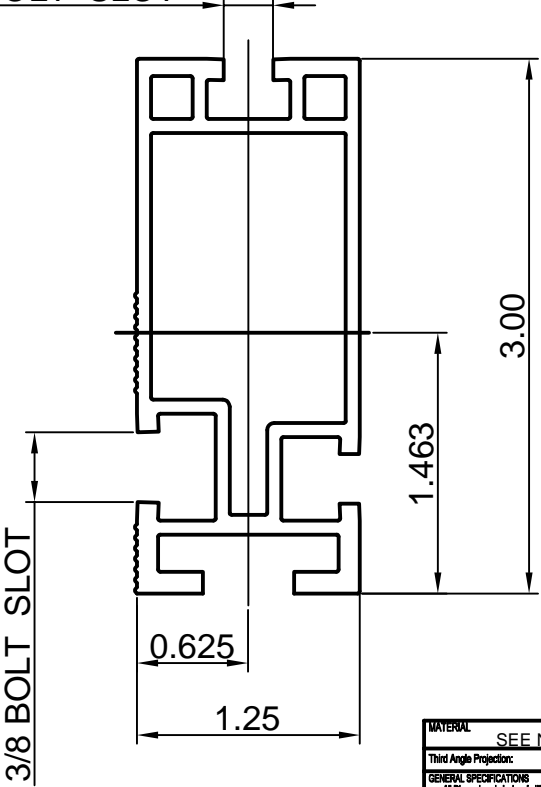
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REV	DESCRIPTON	BY	DATE
A	0.44 WAS 0.41, 0.44 WAS 0.33	LWF	11/30/2015

NOTES: UNLESS OTHERWISE SPECIFIED

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

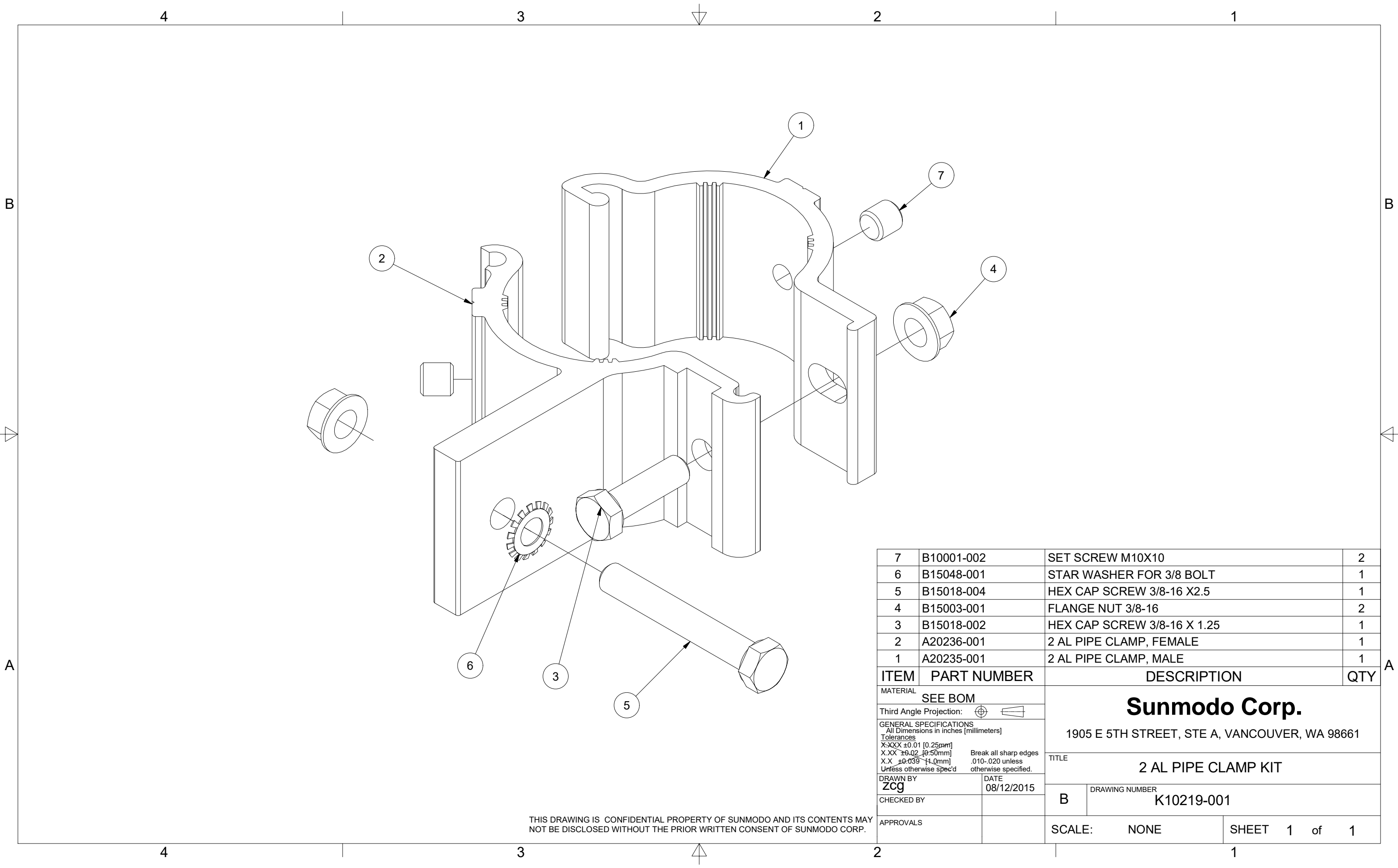
2X 1/4 BOLT SLOT



**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			
XXXX ±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		DATE	
APPROVALS		DATE	
Sunmodo Corp.		1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661	
TITLE		HELIO HEAVY RAIL	
DRAWING NUMBER		A20145	
SCALE:		NONE	
SHEET		1 of 1	



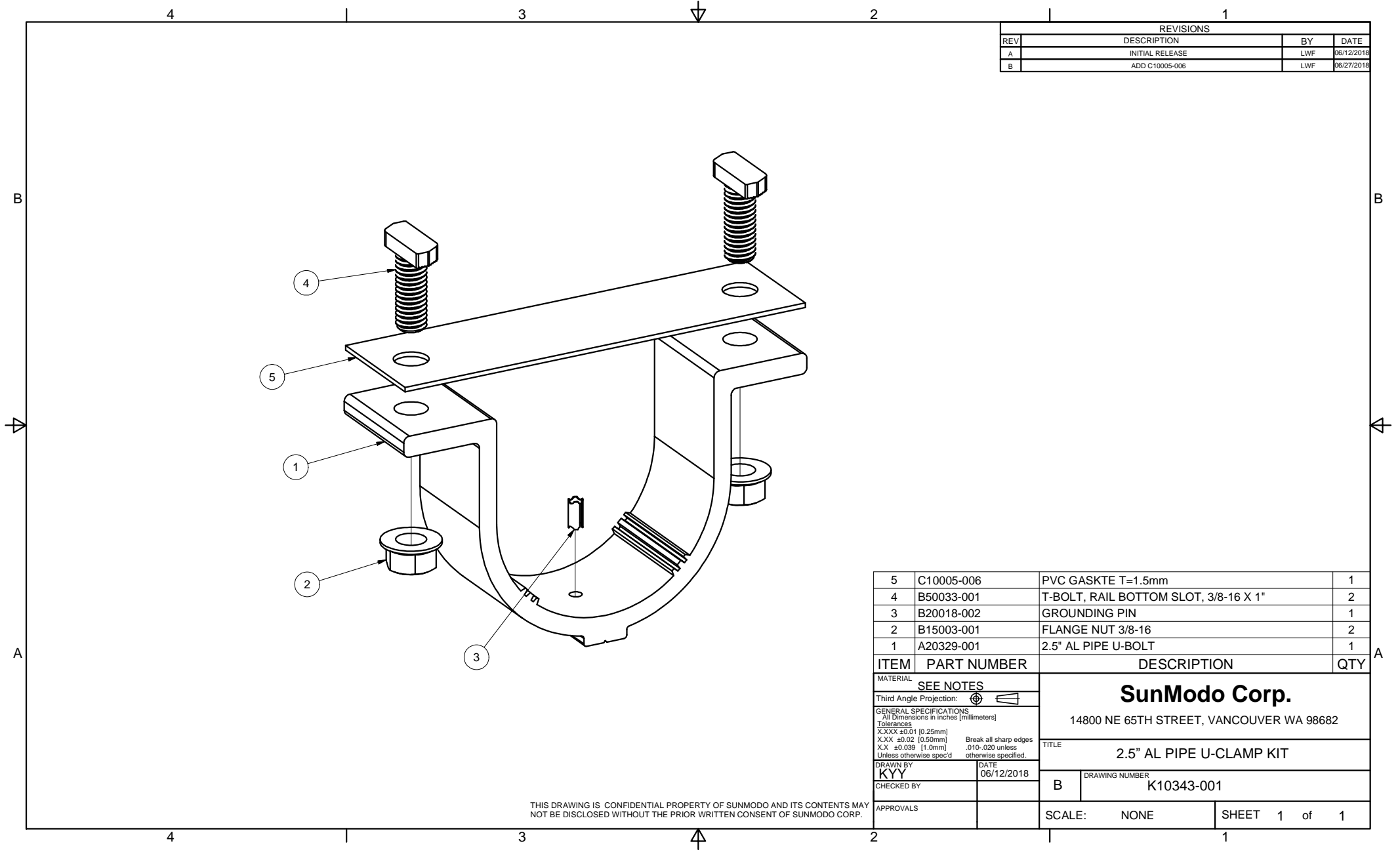
7	B10001-002	SET SCREW M10X10	2
6	B15048-001	STAR WASHER FOR 3/8 BOLT	1
5	B15018-004	HEX CAP SCREW 3/8-16 X2.5	1
4	B15003-001	FLANGE NUT 3/8-16	2
3	B15018-002	HEX CAP SCREW 3/8-16 X 1.25	1
2	A20236-001	2 AL PIPE CLAMP, FEMALE	1
1	A20235-001	2 AL PIPE CLAMP, MALE	1

ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE BOM	
Third Angle Projection:			
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.	
DRAWN BY		DATE	
zcg		08/12/2015	
CHECKED BY		B	
APPROVALS		DRAWING NUMBER	
		K10219-001	
SCALE:		NONE	SHEET 1 of 1

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

TITLE: 2 AL PIPE CLAMP KIT  
DRAWING NUMBER: B K10219-001

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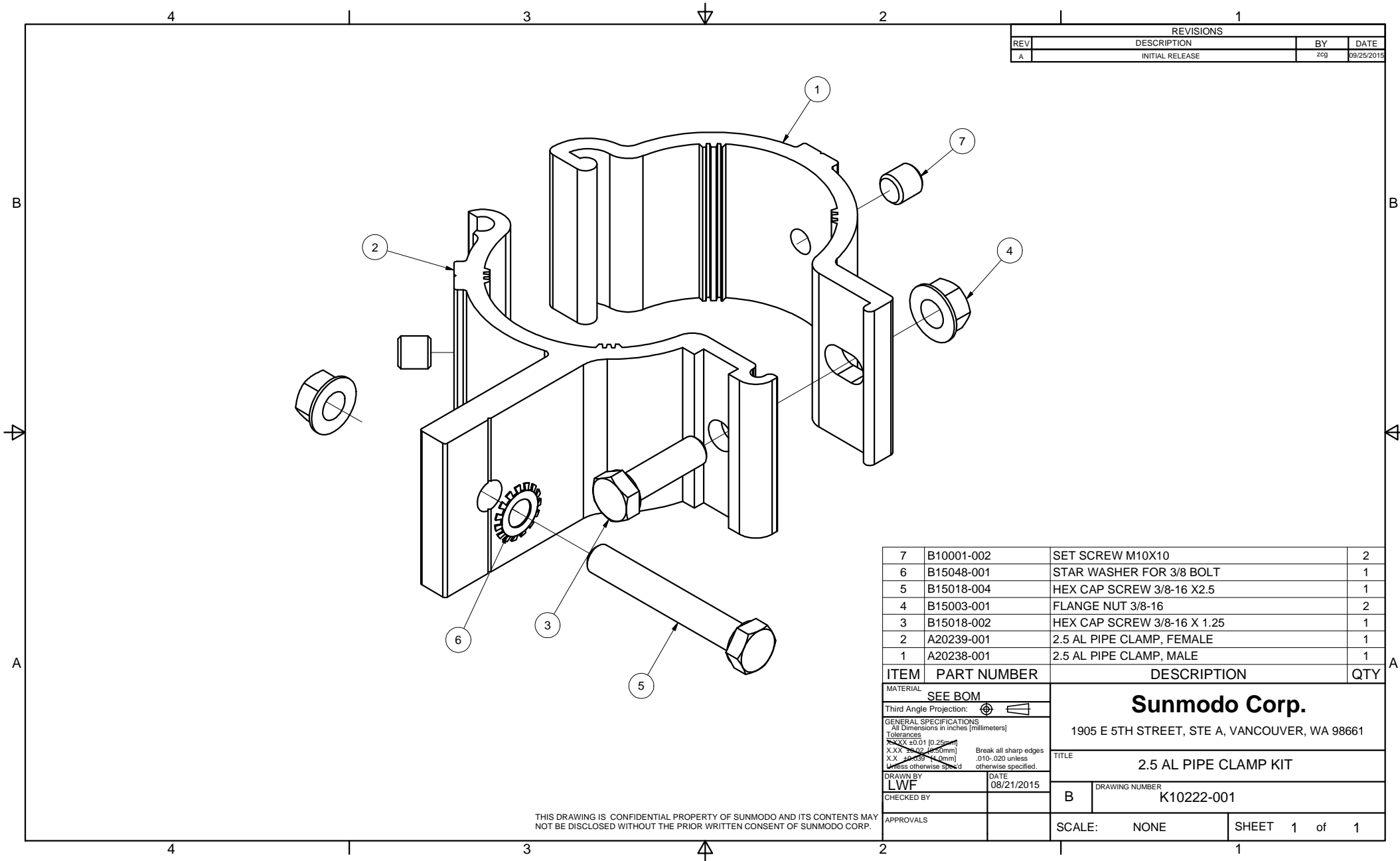


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018
B	ADD C10005-006	LWF	06/27/2018

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 style="text-align: center;"><b>SunModo Corp.</b></p> <p style="text-align: center;">14800 NE 65TH STREET, VANCOUVER WA 98682</p>	
<small>All Dimensions in inches [millimeters]</small> <small>Tolerances</small> 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	B K10343-001	
CHECKED BY		SCALE: NONE SHEET 1 of 1	
APPROVALS			

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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		<b>SEE BOM</b>	
Third Angle Projection:			
<b>GENERAL SPECIFICATIONS</b> All Dimensions in inches [millimeters] <b>Tolerances</b> X.XX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] 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	

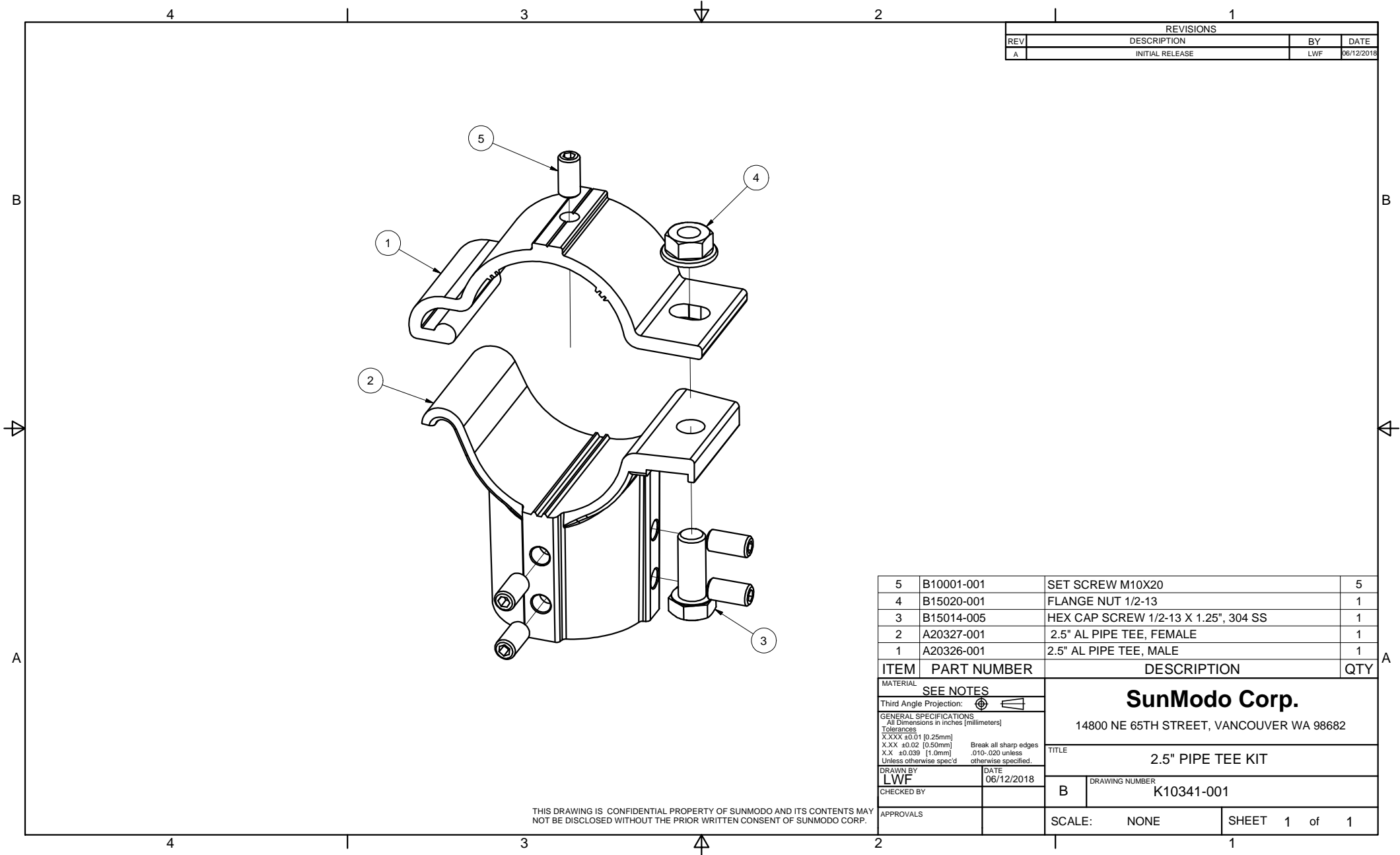
**Sunmodo Corp.**  
 1905 E 5TH STREET, STE A, VANCOUVER, WA 98661

TITLE: **2.5 AL PIPE CLAMP KIT**

DRAWING NUMBER: **K10222-001**

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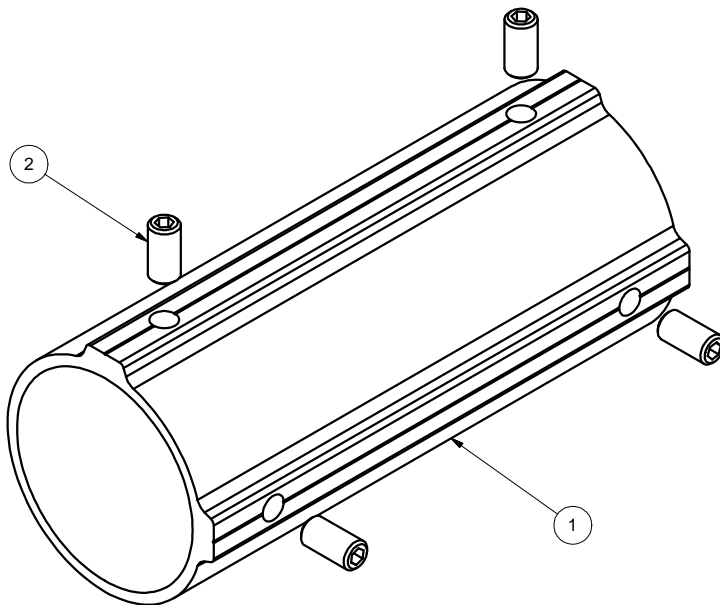
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018

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:			
GENERAL SPECIFICATIONS		<b>SunModo Corp.</b> 14800 NE 65TH STREET, VANCOUVER WA 98682	
Tolerances		TITLE	
X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] X.X ±0.039 [1.0mm] Unless otherwise spec'd		2.5" PIPE TEE KIT	
DRAWN BY		DATE	
LWF		06/12/2018	
CHECKED BY		DRAWING NUMBER	
		B K10341-001	
APPROVALS		SCALE: NONE SHEET 1 of 1	

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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		<p style="text-align: center;"><b>SunModo Corp.</b></p> <p style="text-align: center;">14800 NE 65TH STREET, VANCOUVER WA 98682</p>	
SEE NOTES			
Third Angle Projection:		TITLE	
<p>GENERAL SPECIFICATIONS</p> <p>All Dimensions in inches [millimeters]</p> <p>Tolerances</p> <p>X.XXX ±0.01 [0.25mm]</p> <p>X.XX ±0.02 [0.50mm]</p> <p>X.X ±0.039 [1.0mm]</p> <p>Unless otherwise spec'd</p>		<p>2.5" PIPE SPLICE KIT</p>	
DRAWN BY	DATE	DRAWING NUMBER	
LWF	06/12/2018	B K10342-001	
CHECKED BY		SCALE: NONE SHEET 1 of 1	
APPROVALS			

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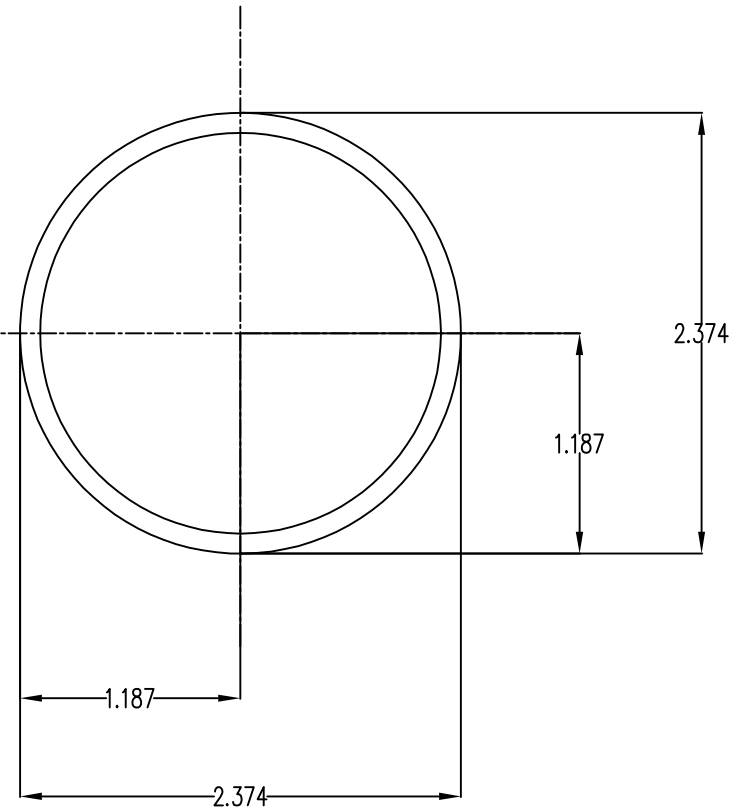
NOTES: UNLESS OTHERWISE SPECIFIED

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

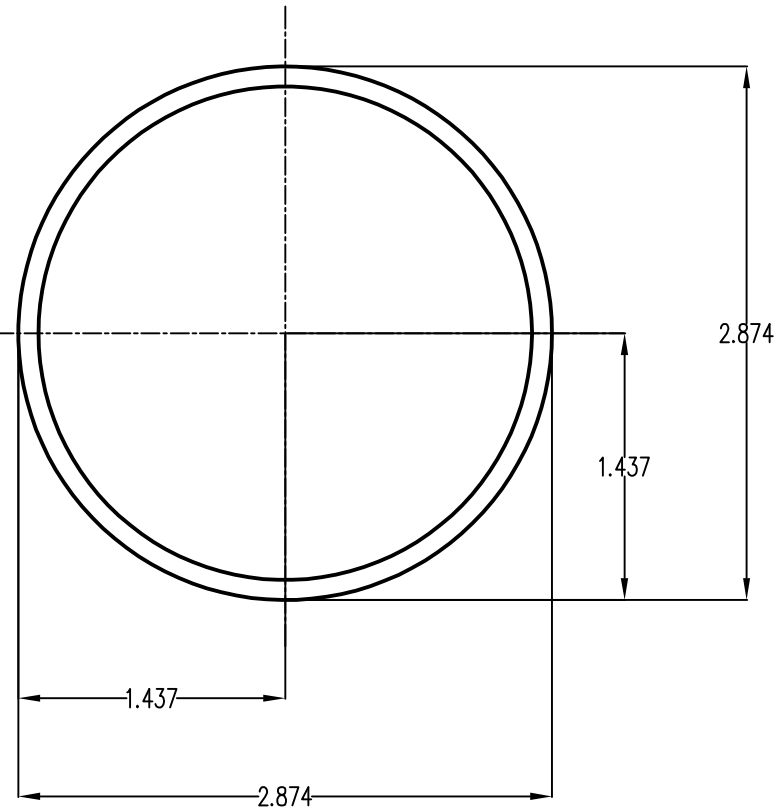
MATERIAL		SEE NOTES		<b>Sunmodo Corp.</b> 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS				TITLE	
All Dimensions in Inches (millimeters)				PIPE, HSS, 2.375" OD X 12 GAUGE,L=XXX	
Tolerances				Break all sharp edges .010-.020 unless otherwise specified.	
XXX ±0.01 (0.25mm)					
XX ±0.02 (0.50mm)					
X ±0.050 (1.2mm)					
Unless otherwise specified					
DRAWN BY	DATE	B		DRAWING NUMBER	
LWF	04/03/2019			A21165	
CHECKED BY					
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>	
Third Angle Projection:					
GENERAL SPECIFICATIONS				14800 NE 85TH STREET, VANCOUVER WA 98682	
All Dimensions in Inches (millimeters)				TITLE	
Tolerances				PIPE, HSS, 2.875" OD X 12 GAUGE,L=XXX	
XXX ±0.01 (0.25mm)				Break all sharp edges .010-.020 unless otherwise specified.	
XX ±0.02 (0.50mm)				DRAWING NUMBER	
X ±0.050 (1.2mm)				B A21168	
Unless otherwise specified				APPROVALS	
DRAWN BY		DATE		SCALE: NONE	
LWF		04/03/2019		SHEET 1 of 1	
CHECKED BY					