



Project Number: U2716-128-191

August 15, 2019

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

**REFERENCE: Sunmodo Sunturf Ground Mount A4a  
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 2015 International Building Code. 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 7-10)
- Design wind speed for risk category I structures: 115 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	2070	1.5	3105
LATERAL	1460	2	2920

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.

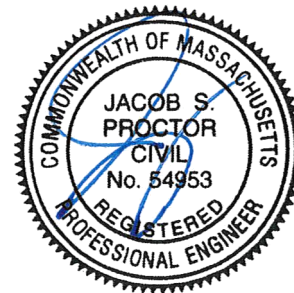
Very truly yours,

VECTOR STRUCTURAL ENGINEERING, LLC

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Jacob Proctor, P.E.  
License: 54953 - Expires: 06/30/2020  
Project Engineer

Enclosures

JSP/stb

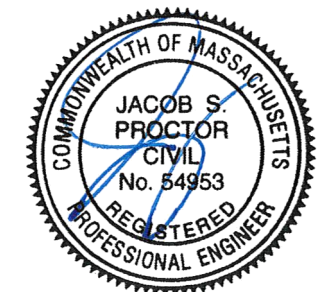
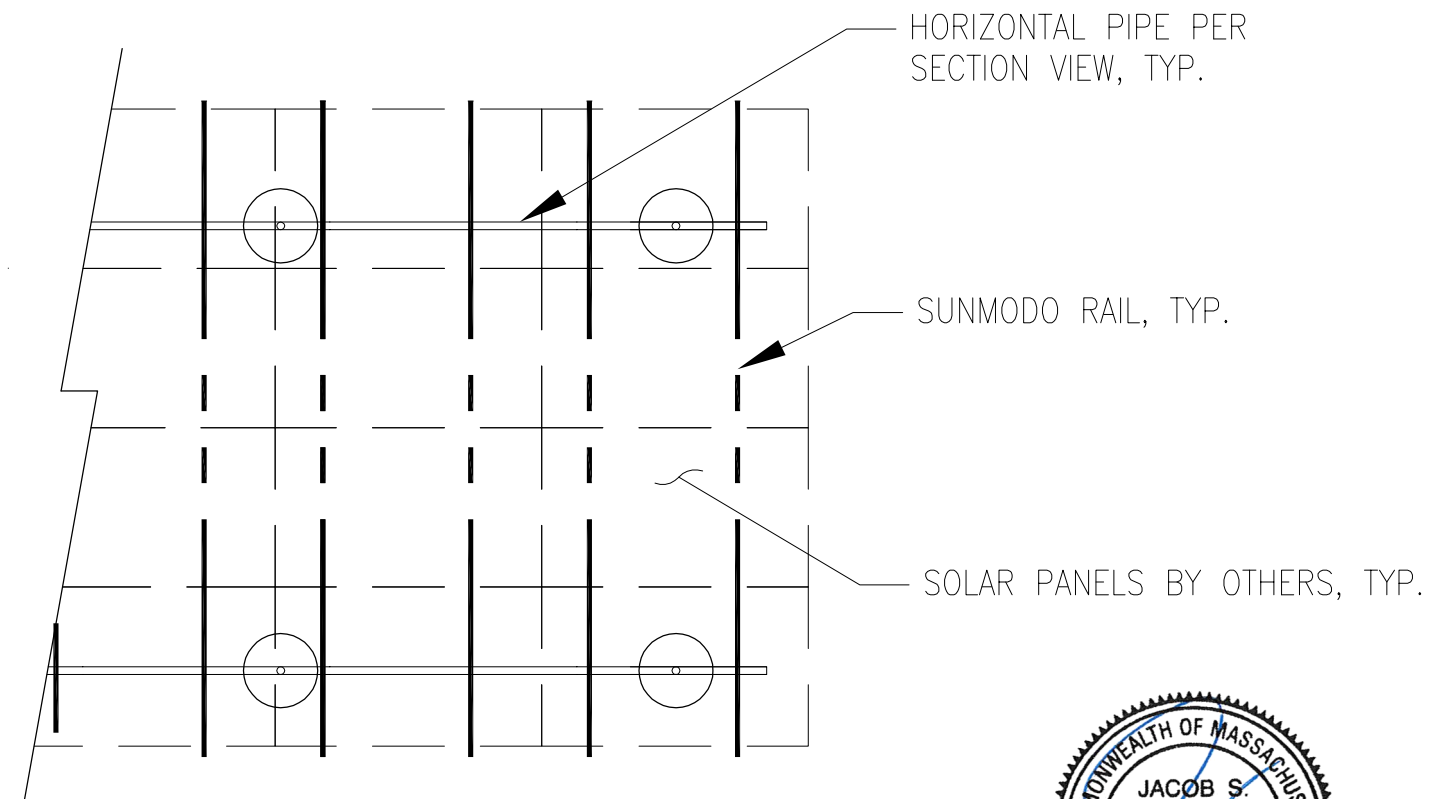
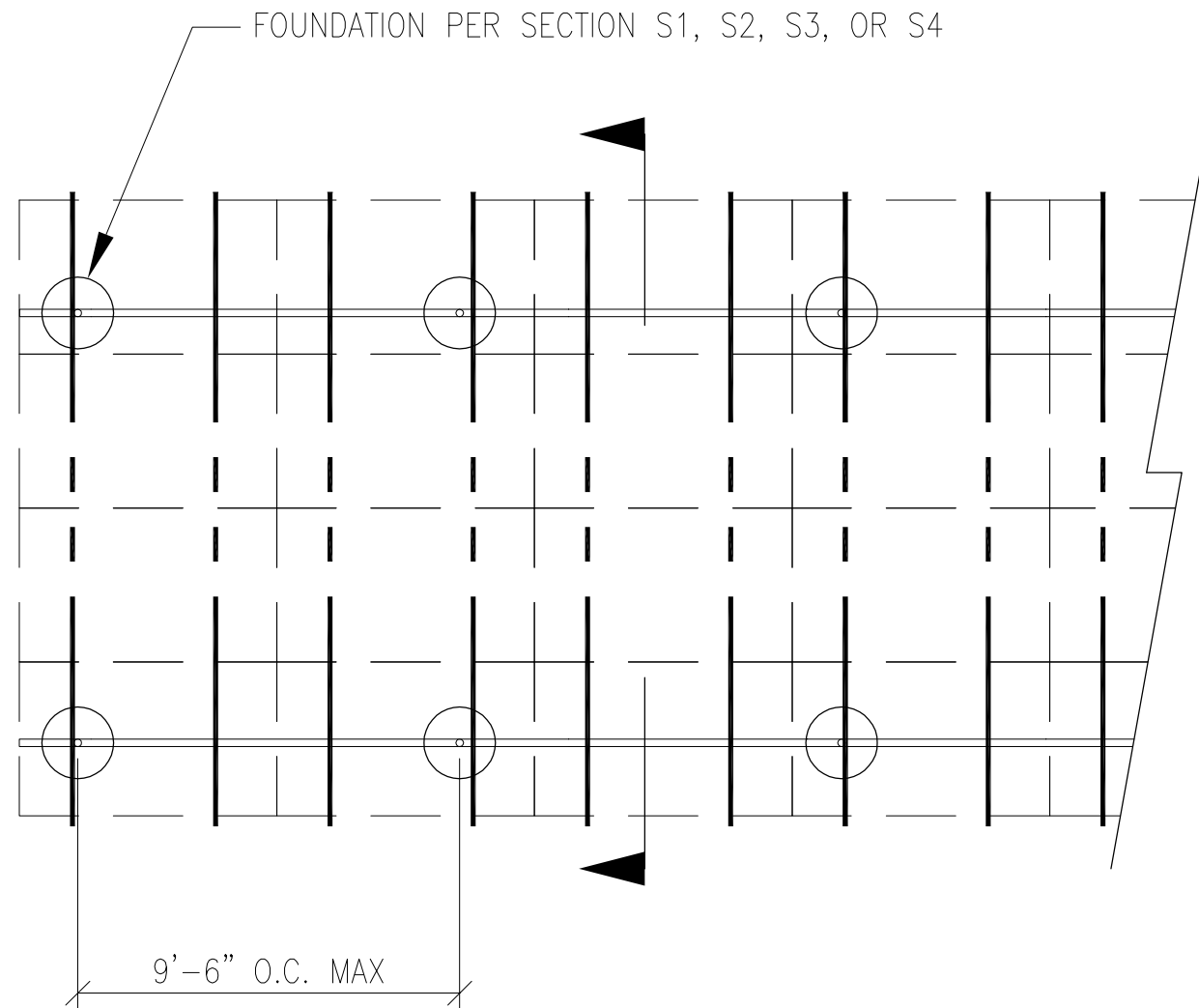


03/30/2020



JOB NO. U2716-128-191  
 PROJECT SUNMODO SUNTURF GROUND MOUNTS A4A  
 SUBJECT ALL OPTIONS

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



03/30/2020

**PV ARRAY PLAN**

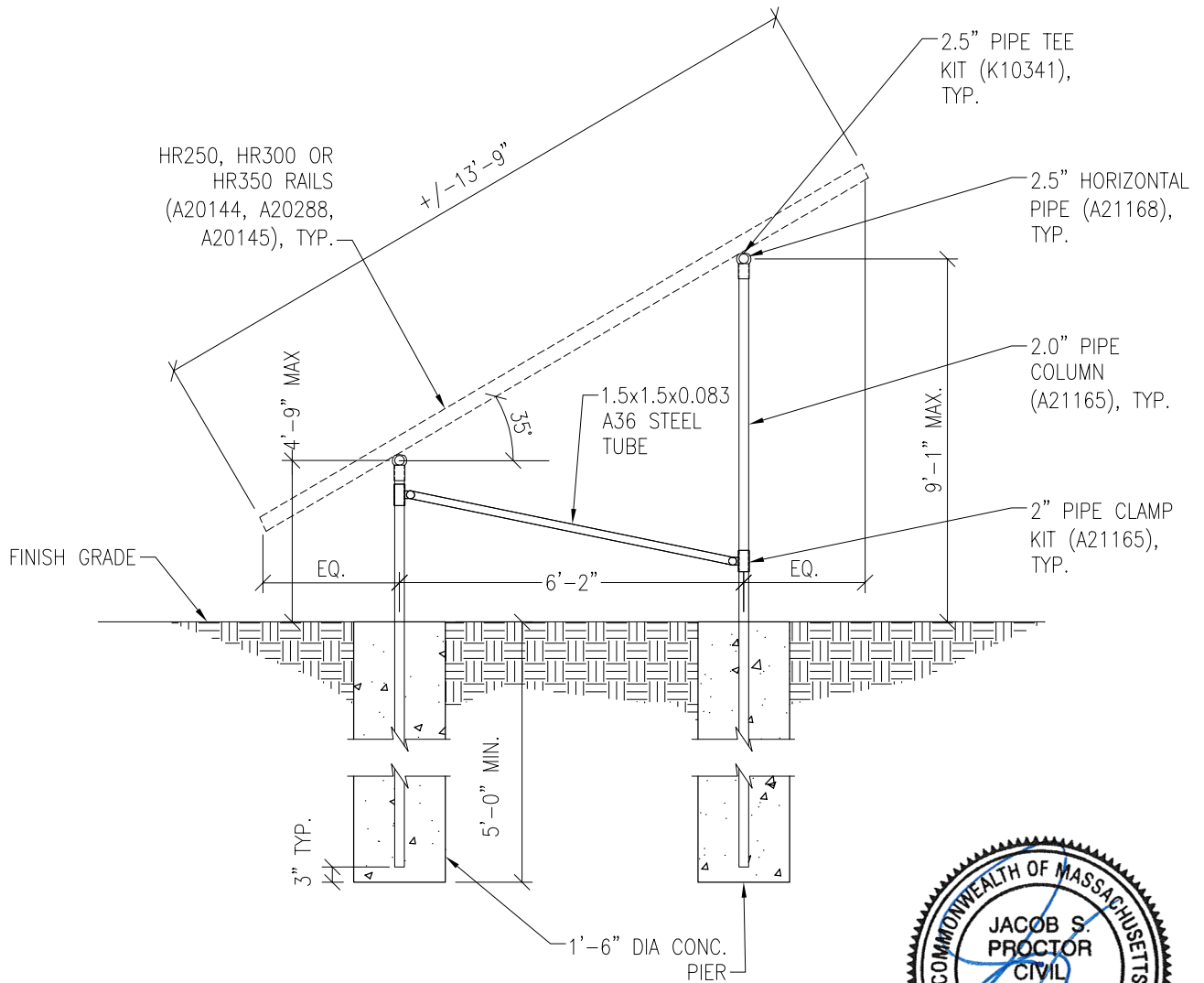
N.T.S.

**P1**

Vector Engineers requires that we review each site specific install and is not liable for installs at site specific locations we have not reviewed.

PROJECT SUNMODO SUNTURF GROUND MOUNTS A4A

SUBJECT DRILLED PIER OPTION



03/30/2020

Vector Engineers requires that we review each site specific install and is not liable for installs at site specific locations we have not reviewed.

**PV ARRAY SECTION**

N.T.S.

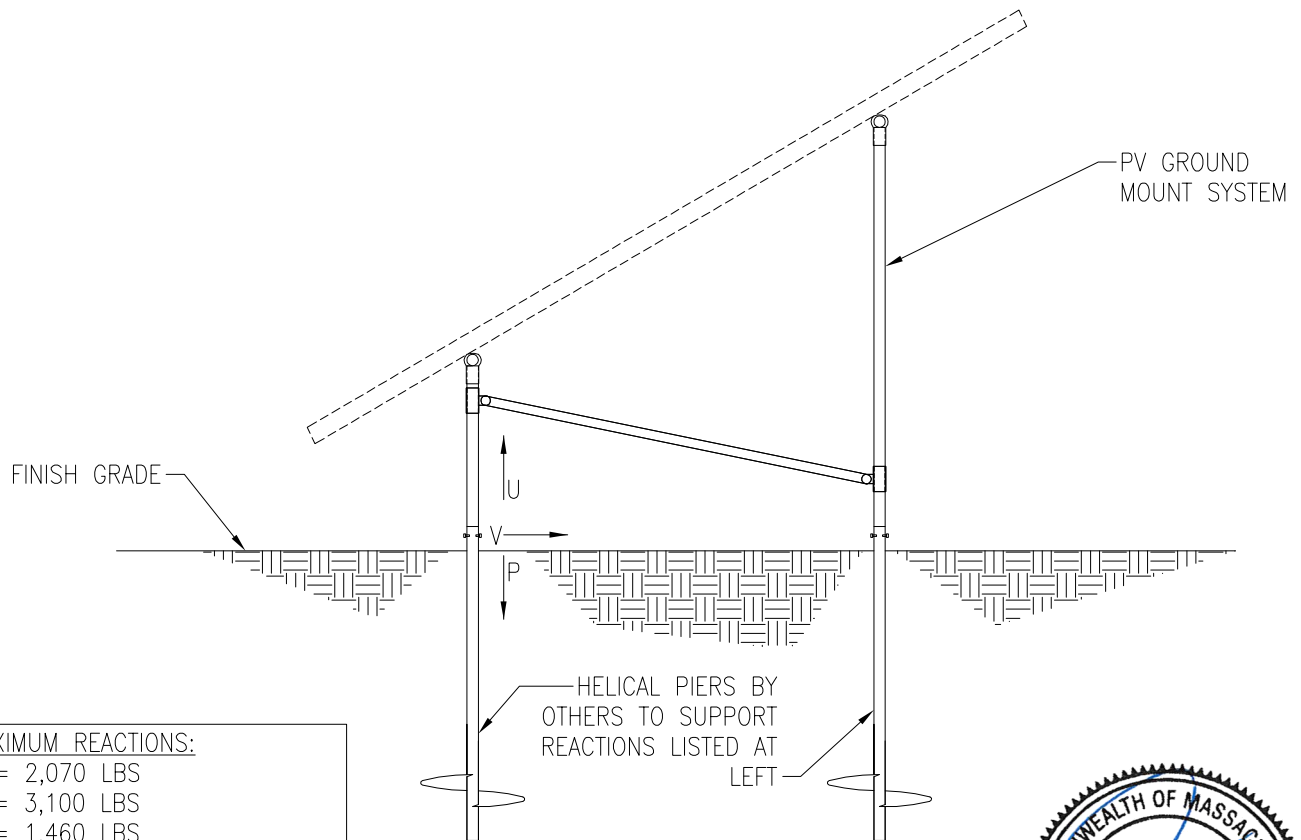
**S1**

PROJECT SUNMODO SUNTURF GROUND MOUNTS A4A

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 = 2,070 LBS  
 P = 3,100 LBS  
 V = 1,460 LBS

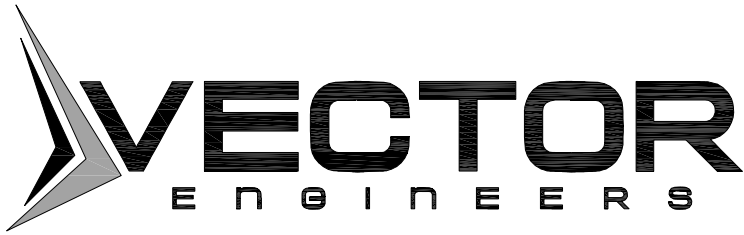


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**PV ARRAY SECTION**

N.T.S.

**S2**



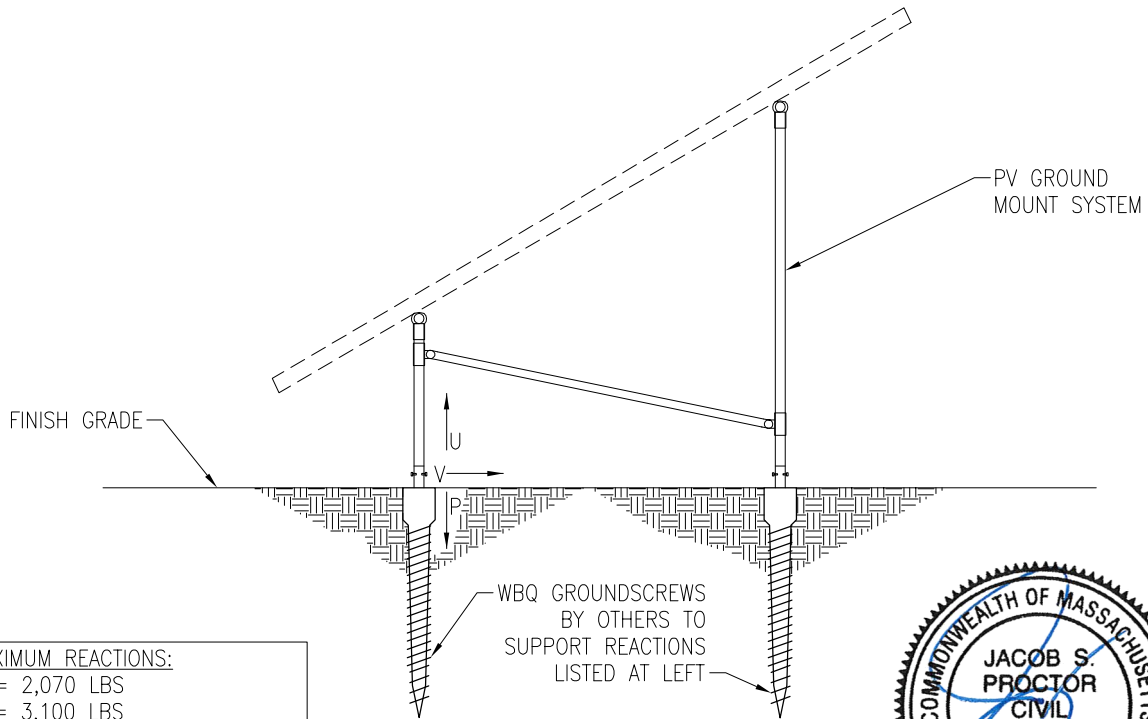
JOB NO. U2716-128-191

PROJECT SUNMODO SUNTURF GROUND MOUNTS A4A

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 = 2,070 LBS  
 P = 3,100 LBS  
 V = 1,460 LBS



PV ARRAY SECTION

03/30/2020

N.T.S.

S3



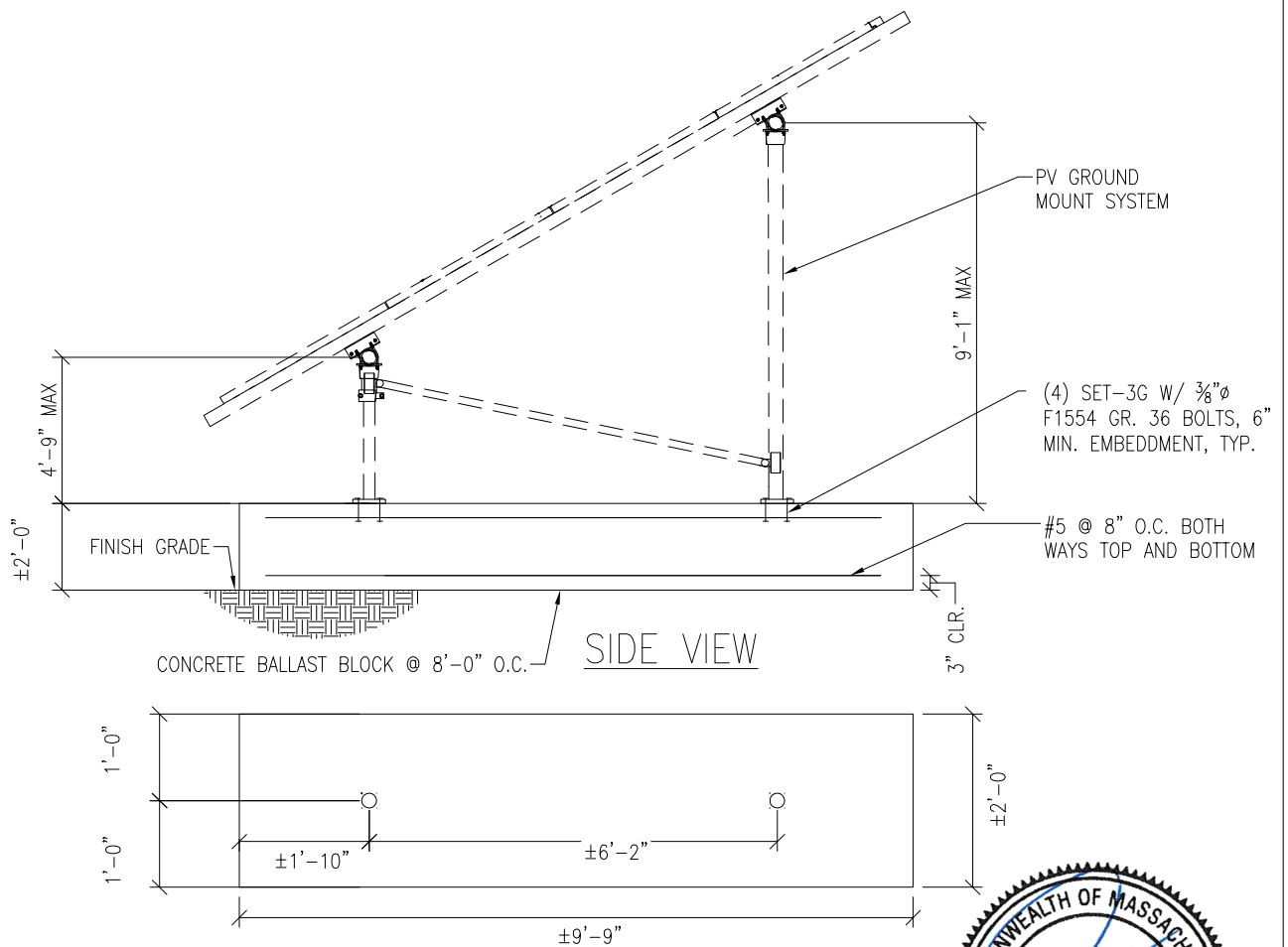
JOB NO. U2716-128-191

PROJECT SUNMOD0 SUNTURF GROUND MOUNTS A4A

SUBJECT BALLASTED BLOCK OPTION

NOTES:

1. For ground mount components see Section S1.



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**PV ARRAY SECTION**

03/30/2020

**S4**

N.T.S.

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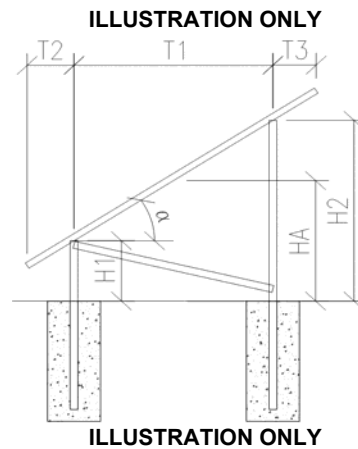
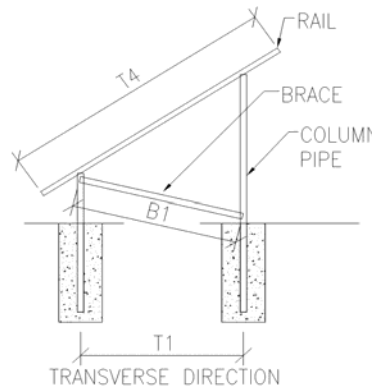
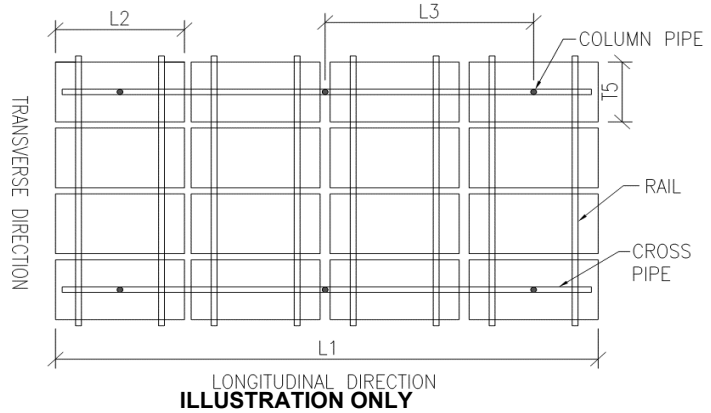


PROJECT: A4a – Sunmodo Suntuturf GM

SUBJECT: Dead Load

**Design Weight:**

Individual Panel Weight [lb]:	50.7
Panel Transverse Length (T5) [in]:	40.0
Panel Transverse Length (T5) [ft]:	3.3
Panel Longitudinal Length (L2) [in]:	67.0
Panel Longitudinal Length (L2) [ft]:	5.6
Individual Panel Area [ft <sup>2</sup> ]:	18.6
Individual Panel Weight [psf]:	2.7
# of Panels in Transverse Direction:	4
Approximate Transverse Length (T4) [ft]:	13.3
# of Panels in Longitudinal Direction:	12
Approximate Longitudinal Length (L1) [ft]:	67.0
Transverse Column Spacing (T1) [ft]:	6.2
Longitudinal Column Spacing (L3) [ft]:	9.5
# of Columns in Longitudinal Direction:	8
# of Columns in Transverse Direction:	2
Total Number of Columns:	16
Panel Slope from Horizontal (a) [°]:	35.0
Short Column Height (H1) [ft]:	4.6
Approximate Tall Column Height (H2) [ft]:	8.9
Transverse Brace between Columns :	Yes
Approximate Brace Length (B1) [ft]:	8.0
Weight of Columns [plf]:	3.7
Weight of Cross Pipe [plf]:	3.7
Weight of Brace [plf]:	3.7
Tributary Transverse Length per Column [ft]:	6.7
Tributary Longitudinal Length per Column [ft]:	9.5
Tributary Area per Column [ft <sup>2</sup> ]:	63.3
Rail Weight [plf]:	1.0
Transverse Rail Weight per Column [lb]:	26.7
Longitudinal Rail Weight per Column [lb]:	34.7
Tall Column Weight [lb]:	32.6
Panel Weight per Column [lb]:	172.5
Rail Weight per Column [lb]:	26.7
Cross Pipe Weight per Column [lb]:	34.7
Brace Weight per Column [lb]:	14.6
<b>Total Weight per Column (1.0 D) [lb]:</b>	<b>281.1</b>



**Assumptions:**

- T2 = T3



JOB NO.: U2716-128-191

DESIGNED: STB

DATE: 08/15/19

PROJECT: A4a – Sunmodo Sunturf GM

SUBJECT: Snow Load

**SNOW LOAD (S):**

ASCE 7 Standard:	10	
Panel Slope from Horizontal [°]:	35.0	
Snow Ground Load, $p_g$ [psf]:	70.0	(Section 7.2)
Terrain Category:	B	(Table 7-2)
Exposure of Roof:	Fully Exposed	(Table 7-2)
Exposure Factor, $C_e$ :	0.9	(Table 7-2)
Thermal Factor, $C_t$ :	1.2	(Table 7-3)
Risk Category:	I	(Table 1.5-1)
Importance Factor, $I_s$ :	0.8	(Table 1.5-2)
Flat Roof Snow Load, $p_f$ [psf]:	42	(Equation 7.3-1)
Minimum Roof Snow Load, $p_m$ [psf]:	0	(Section 7.3.4)
Unobstructed Slippery Surface?	Yes	(Section 7.4)
Slope Factor Figure:	Figure 7-2c	(Section 7.4)
Roof Slope Factor, $C_s$ :	0.636	(Figure 7-2)
Sloped Roof Snow Load, $p_s$ [psf]:	27	(Equation 7.4-1)
Design Snow Load, S [psf]:	27	
Tributary Transverse Length [ft]:	5.6	
Tributary Longitudinal Length [ft]:	8	
Tributary Area per Column [ft <sup>2</sup> ]:	45.0	
<b>Snow Load per Column (1.0 S) [lb]:</b>	<b>1212.3</b>	





PROJECT: A4a – Sunmodo Sunturf GM

SUBJECT: Wind Pressure

**Design Wind Load:**

ASCE 7 Standard:	10	
Basic Wind Speed, V [mph]:	115	
Risk Category:	I	
Exposure Category	B	(Section 26.7.3)
Velocity Pressure Exposure Coefficient, $K_h$ :	0.57	(Table 27.3-1)
Topographic Factor, $K_{ht}$ :	1.0	(Section 26.8.2)
Wind Directionality Factor, $K_d$ :	0.85	(Table 26.6-1)
Internal Pressure Coefficient, $GC_{pi}$ :	0.00	(Table 26.11-1)
Velocity Pressure, $q_h$ [psf]:	16.4	(Equation 27.3-1)
Gust Effect Factor, G:	0.85	(Section 26.9.1)
Panel Slope [degrees]:	35.0	

Net Pressure Coefficients ( $C_N$ ) per: (Figure 27.4-4)

Clear Wind Flow	$C_{NW}$	$C_{NL}$
Case 1 ( $\gamma = 0^\circ$ , Load Case A)	-1.80	-1.80
Case 2 ( $\gamma = 0^\circ$ , Load Case B)	-2.43	-0.57
Case 3 ( $\gamma = 180^\circ$ , Load Case A)	2.10	2.17
Case 4 ( $\gamma = 180^\circ$ , Load Case B)	2.67	1.07

Design Wind Pressures (p) [psf] per: (Equation 27.4-3)

Clear Wind Flow	$q_h GC_{NW}$	$q_h GC_{NL}$
Case 1 ( $\gamma = 0^\circ$ , Load Case A)	-25.1	-25.1
Case 2 ( $\gamma = 0^\circ$ , Load Case B)	-33.9	-7.9
Case 3 ( $\gamma = 180^\circ$ , Load Case A)	29.3	30.2
Case 4 ( $\gamma = 180^\circ$ , Load Case B)	37.2	14.9

Wind Pressure on Each Side of Panels [psf]

Clear Wind Flow	Short Col. Pressure	Long Col. Pressure
Case 1 ( $\gamma = 0^\circ$ , Load Case A)	-25.1	-25.1
Case 2 ( $\gamma = 0^\circ$ , Load Case B)	-7.9	-33.9
Case 3 ( $\gamma = 180^\circ$ , Load Case A)	29.3	30.2
Case 4 ( $\gamma = 180^\circ$ , Load Case B)	37.2	14.9



JOB NO.: U2716-128-191

PROJECT: A4a – Sunmodo Sunturf GM

SUBJECT: Open Building Wind Loads

### Design Wind Load Per ASCE 7-10

$$p = q_h G C_n$$

Velocity Pressure Exposure Coefficient, $K_{zt}$ :	0.57	(Table 27.3-1)
Topographic Factor, $K_{ht}$ :	1.0	(Section 26.8.2)
Wind Directionality Factor, $K_d$ :	0.85	(Table 26.6-1)
Ultimate Wind Speed, $V$ [mph]:	115	

Velocity Pressure, $q_h$ [psf]:	16.4	(Equation 27.3-1)
Gust Effect Factor, $G$ :	0.85	(Section 26.9.1)

$\gamma = 90^\circ$  or  $270^\circ$

Force Coefficient,  $C_N$ :

Horizontal Distance from Winward Edge	Roof angle			Obstructed Wind Flow		
	Roof angle	Load Case	Obstructed Wind Flow	Roof angle	Load Case	Obstructed Wind Flow
				CN		
<= h	35	A	-0.8	35	A	-0.6
		B	0.8		B	0.5
> h, <= 2h	35	A	-0.6	35	A	-0.3
		B	0.5		B	0.3
> 2h	35	A	-0.3	35	A	-0.3
		B	0.3		B	0.3

Design Wind Pressure,  $p$  [psf]:

Horizontal Distance from Winward Edge	Roof angle			Obstructed Wind Flow		
	Roof angle	Load Case	Obstructed Wind Flow	Roof angle	Load Case	Obstructed Wind Flow
<= h	35	A	-11.2	35	A	-8.4
		B	11.2		B	7.0
> h, <= 2h	35	A	-8.4	35	A	-4.2
		B	7.0		B	4.2
> 2h	35	A	-4.2	35	A	-4.2
		B	4.2		B	4.2



JOB NO.: U2716-113-191

DESIGNED: STB

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# Foundation Option 1: Drilled Concrete Pier



JOB NO.: U2716-128-191  
DATE: 08/15/19

DESIGNED: STB

PROJECT: A4a – Sunmodo Sunturf GM

**Drilled Pier Design**

**Design Loads:**

Max. Shear, V [k]:	1.5	Max. Down, $P_d$ [k]:	3.1
Max. Moment, M [k-ft]:	0.0	Max. Uplift, $P_u$ [k]:	2.1

**Pier Properties:**

Pier Diameter, b [ft]:	1.5	Volume of Concrete [ft <sup>3</sup> ]:	9
Min. Pier Diameter, $b_{min}$ (opt'l) [ft]:		Volume of Concrete [yd <sup>3</sup> ]:	0.3
Top of Pier Elevation [ft]:	0.00	Weight of Concrete [k]:	1.3
Pier Depth, d [ft]:	5.0		
Min. Pier Depth, $d_{min}$ (opt'l) [ft]:			
Max. Pier Depth, $d_{max}$ (opt'l) [ft]:			

**Soil Properties:**

Allow. Bearing Pressure [psf]:	1,500	<u>Optional Parameters for Uplift:</u>	
1/3 increase for short term loads?	No	Skin Friction [psf]:	250 (IBC 1810.3.3.1.4)
Lateral Bearing, S [pcf]:	150	Top Length to Ignore [ft]:	0.0
Max. Lateral Bearing (opt'l) [psf]:		1/3 increase for short term loads?	No
Top Depth to Ignore [ft]:	0.0	Combine w/ Bearing:	No
1/3 increase for short term loads?	No		
1/2" deflection at t/o pier allowed:	Yes		

**Check Bearing:**

Bearing Capacity [k]: 5.9      **Bearing capacity OK.**

**Check Uplift:**

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

**Check Lateral Bearing:**

Applied Lateral Force, P [lb]:	1,460	
Point of Application, h [ft]:	0.0	
$S_{1\_max}$ [psf]:		
$S_1$ [psf]:	500	
$A = 2.34 * P / (S_1 * b)$ :	4.56	
Required Pier Depth, $d_{reqd}$ [ft]:	4.6	<b>Lateral bearing capacity OK.</b>

# 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	2070	1.5	3105
LATERAL	1460	2	2920

# 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	2070	1.5	3105
LATERAL	1460	2	2920

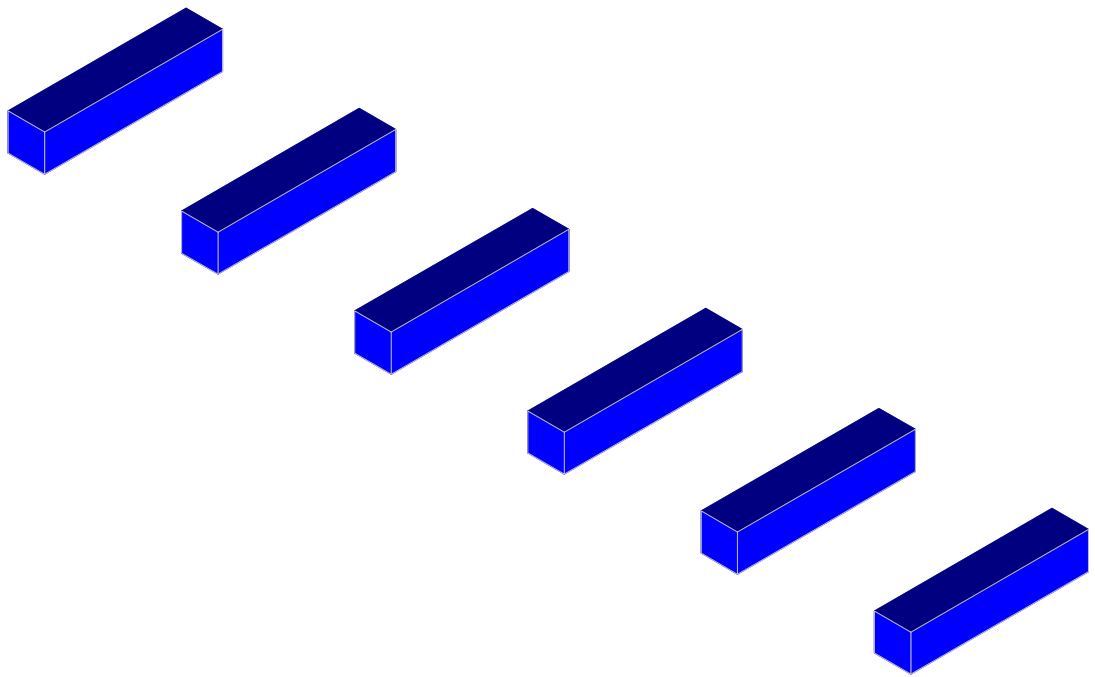


JOB NO.: U2716-113-191

DESIGNED: STB

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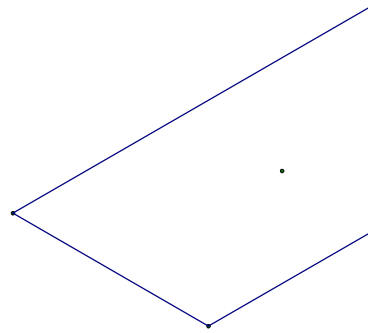
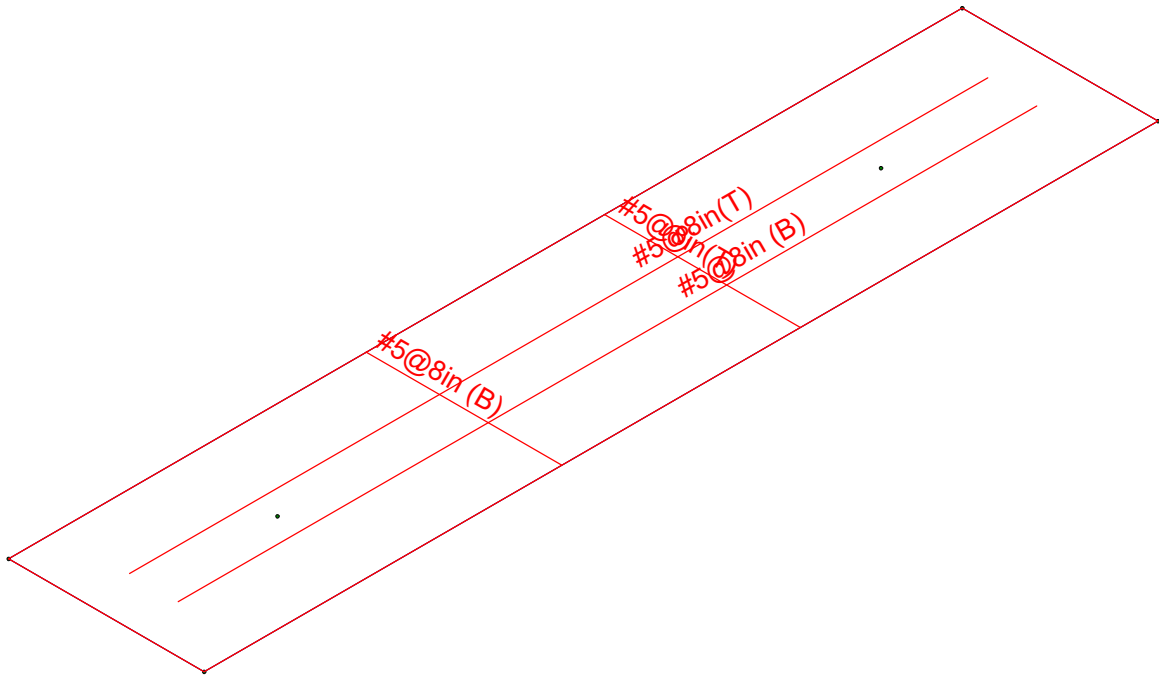
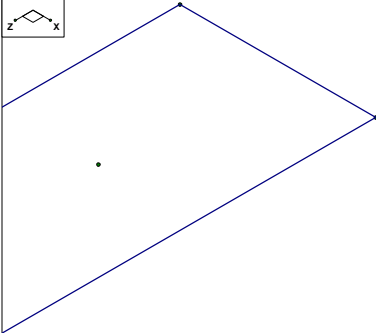
# Foundation Option 4: Ballasted Block



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 2
STB		Aug 15, 2019 at 2:30 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d





Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 1
STB		Aug 15, 2019 at 2:29 PM
U2716.128.191		Sunmodo Sunturf A4a.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	Rectangular
Concrete Rebar Set	ASTM A615
Concrete Code	ACI 318-14
HR Steel Pile Code	AISC 14th(360-10): ASD
Wood Pile Code	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	8	8	8	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	-23.552
2	R3D_N1	Y	239.595
3	R3D_N2_1	X	-8.345
4	R3D_N2_1	Y	204.429
5	R3D_N132_2	X	1.101
6	R3D_N132_2	Y	248.362
7	R3D_N133_1	Y	269.943
8	R3D_N109_1	Y	250.036
9	R3D_N110A_1	X	1.488



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

	Label	Direction	Magnitude[lb,lb-ft]
18	R3D_N121_1	X	-7.157
19	R3D_N121_1	Y	-3281.082
20	R3D_N121_1	Z	1864.733
21	R3D_N122_1	Y	692.861
22	R3D_N122_1	Z	-87.193
23	R3D_N133B	X	1.813
24	R3D_N133B	Y	-3326.039
25	R3D_N133B	Z	1893.696
26	R3D_N134B_1	X	-5.82
27	R3D_N134B_1	Y	718.492
28	R3D_N134B_1	Z	-87.488
29	R3D_N151_1	X	-117.356
30	R3D_N151_1	Y	-2687.473
31	R3D_N151_1	Z	1469.873
32	R3D_N152_1	X	-27.425
33	R3D_N152_1	Y	529.705
34	R3D_N152_1	Z	-73.074

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

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1	X	172.418
2	R3D_N1	Y	-2868.927
3	R3D_N1	Z	1183.771
4	R3D_N2_1	X	17.169
5	R3D_N2_1	Y	1047.082
6	R3D_N2_1	Z	-60.228
7	R3D_N132_2	X	-12.25
8	R3D_N132_2	Y	-3565.822
9	R3D_N132_2	Z	1655.587
10	R3D_N133_1	X	-10.159
11	R3D_N133_1	Y	1534.498
12	R3D_N133_1	Z	-72.932
13	R3D_N109_1	Y	-3701.914
14	R3D_N109_1	Z	1726.705
15	R3D_N110A_1	X	4.049
16	R3D_N110A_1	Y	1612.973
17	R3D_N110A_1	Z	-74.293
18	R3D_N121_1	X	-9.244
19	R3D_N121_1	Y	-3645.494
20	R3D_N121_1	Z	1570.206
21	R3D_N122_1	X	3.621
22	R3D_N122_1	Y	1454.475
23	R3D_N122_1	Z	-73.478
24	R3D_N133B	X	2.195
25	R3D_N133B	Y	-3694.149
26	R3D_N133B	Z	1596.428
27	R3D_N134B_1	X	-6.977
28	R3D_N134B_1	Y	1486.201
29	R3D_N134B_1	Z	-73.776
30	R3D_N151_1	X	-153.49
31	R3D_N151_1	Y	-2999.209
32	R3D_N151_1	Z	1238.549
33	R3D_N152_1	X	-7.686
34	R3D_N152_1	Y	1122.521
35	R3D_N152_1	Z	-61.554

















**Slab Overturning Safety Factors (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
115	20	S1	0	5678.452	17893.664	607.939	3697.696	3.151	6.082
116	20	S2	0	4951.214	18015.004	446.142	3708.466	3.639	8.312
117	20	S3	0	2852.865	18085.073	268.214	3709.853	6.339	9.999+
118	20	S4	0	2879.776	18088.808	265.342	3710.715	6.281	9.999+
119	20	S5	0	2823.366	18004.096	251.717	3705.31	6.377	9.999+
120	20	S6	0	2336.694	17901.611	268.856	3697.188	7.661	9.999+

**Slab Sliding Safety Factors**

	LC	Slab	Angle[deg]	Va-xx[lb]	Vr-xx[lb]	Va-zz[lb]	Vr-zz[lb]	SR-xx	SR-zz
1	1	S1	0	31.897	1829.71	0	1829.71	9.999+	9.999+
2	1	S2	0	1.488	1853.341	0	1853.341	9.999+	9.999+
3	1	S3	0	0	1854.926	0	1854.926	9.999+	9.999+
4	1	S4	0	0	1855.358	0	1855.358	9.999+	9.999+
5	1	S5	0	1.101	1851.994	0	1851.994	9.999+	9.999+
6	1	S6	0	29.81	1830.708	0	1830.708	9.999+	9.999+
7	2	S1	0	215.341	2504.226	0	2504.226	9.999+	9.999+
8	2	S2	0	6.77	2679.367	0	2679.367	9.999+	9.999+
9	2	S3	0	6.993	2691.153	0	2691.153	9.999+	9.999+
10	2	S4	0	4.4	2693.753	0	2693.753	9.999+	9.999+
11	2	S5	0	3.638	2672.781	0	2672.781	9.999+	9.999+
12	2	S6	0	202.769	2509.756	0	2509.756	9.999+	9.999+
13	3	S1	0	77.089	1453.125	800.877	1453.125	9.999+	1.814
14	3	S2	0	2.919	1393.365	1172.536	1393.365	9.999+	1.188
15	3	S3	0	4.294	1389.046	1066.524	1389.046	9.999+	1.302
16	3	S4	0	2.404	1385.999	1083.725	1385.999	9.999+	1.279
17	3	S5	0	9.639	1404.612	1124.243	1404.612	9.999+	1.249
18	3	S6	0	57.058	1442.31	838.079	1442.31	9.999+	1.721
19	4	S1	0	81.855	1501.778	674.126	1501.778	9.999+	2.228
20	4	S2	0	3.917	1477.331	991.448	1477.331	9.999+	1.49
21	4	S3	0	3.374	1460.543	898.037	1460.543	9.999+	1.626
22	4	S4	0	2.869	1457.927	913.591	1457.927	9.999+	1.596
23	4	S5	0	12.344	1486.356	949.593	1486.356	9.999+	1.565
24	4	S6	0	66.895	1492.904	706.197	1492.904	9.999+	2.114
25	5	S1	0	161.87	2276.558	949.498	2276.558	9.999+	2.398
26	5	S2	0	6.5	2398.289	1390.282	2398.289	9.999+	1.725
27	5	S3	0	5.158	2407.338	1264.452	2407.338	9.999+	1.904
28	5	S4	0	2.88	2411.898	1284.882	2411.898	9.999+	1.877
29	5	S5	0	13.987	2382.02	1332.986	2382.02	9.999+	1.787
30	5	S6	0	133.616	2291.559	993.63	2291.559	9.999+	2.306
31	6	S1	0	125.279	2208.231	824.962	2208.231	9.999+	2.677
32	6	S2	0	11.293	2336.728	1203.952	2336.728	9.999+	1.941
33	6	S3	0	5.496	2332.899	1098.334	2332.899	9.999+	2.124
34	6	S4	0	1.752	2336.811	1115.13	2336.811	9.999+	2.096
35	6	S5	0	8.386	2322.213	1155.241	2322.213	9.999+	2.01
36	6	S6	0	99.063	2221.458	862.634	2221.458	9.999+	2.575
37	7	S1	0	74.27	1991.796	350.475	1991.796	9.999+	5.683
38	7	S2	0	10.762	2002.277	384.848	2002.277	9.999+	5.203
39	7	S3	0	2.334	1935.171	178.774	1935.171	9.999+	9.999+
40	7	S4	0	1.81	1933.914	180.051	1933.914	9.999+	9.999+
41	7	S5	0	4.66	1925.32	193.316	1925.32	9.999+	9.959
42	7	S6	0	54.613	1897.464	136.019	1897.464	9.999+	9.999+
43	8	S1	0	7.269	1670.828	344.662	1670.828	9.999+	4.848
44	8	S2	0	7.043	1724.616	335.703	1724.616	9.999+	5.137
45	8	S3	0	2.012	1775.669	176.334	1775.669	9.999+	9.999+
46	8	S4	0	1.563	1776.693	180.748	1776.693	9.999+	9.83
47	8	S5	0	1.997	1778.338	193.17	1778.338	9.999+	9.206



**Slab Sliding Safety Factors (Continued)**

	LC	Slab	Angle[deg]	Va-xx[lb]	Vr-xx[lb]	Va-zz[lb]	Vr-zz[lb]	SR-xx	SR-zz
105	18	S3	0	5.496	1590.928	1098.334	1590.928	9.999+	1.448
106	18	S4	0	1.752	1594.668	1115.13	1594.668	9.999+	1.43
107	18	S5	0	7.945	1581.416	1155.241	1581.416	9.999+	1.369
108	18	S6	0	87.139	1489.175	862.634	1489.175	9.999+	1.726
109	19	S1	0	61.511	1259.912	350.475	1259.912	9.999+	3.595
110	19	S2	0	10.167	1260.941	384.848	1260.941	9.999+	3.276
111	19	S3	0	2.334	1193.2	178.774	1193.2	9.999+	6.674
112	19	S4	0	1.81	1191.771	180.051	1191.771	9.999+	6.619
113	19	S5	0	4.22	1184.522	193.316	1184.522	9.999+	6.127
114	19	S6	0	42.689	1165.181	136.019	1165.181	9.999+	8.566
115	20	S1	0	20.028	938.944	344.662	938.944	9.999+	2.724
116	20	S2	0	7.638	983.28	335.703	983.28	9.999+	2.929
117	20	S3	0	2.012	1033.699	176.334	1033.699	9.999+	5.862
118	20	S4	0	1.563	1034.55	180.748	1034.55	9.999+	5.724
119	20	S5	0	2.437	1037.54	193.17	1037.54	9.999+	5.371
120	20	S6	0	5.918	1032.05	136.041	1032.05	9.999+	7.586

**Envelope Slab Soil Pressures**

	Label	UC	LC	Soil Pressure[psf]	Allowable Bearing[psf]	Point
1	S1	.412	11	617.819	1500	N1
2	S2	.56	16	839.5	1500	N20
3	S3	.51	16	765.302	1500	N24
4	S4	.538	16	807.272	1500	N28
5	S5	.482	16	722.379	1500	N29
6	S6	.42	11	629.874	1500	N35





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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): 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





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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]: 3450

$V_{uax}$  [lb]: 300

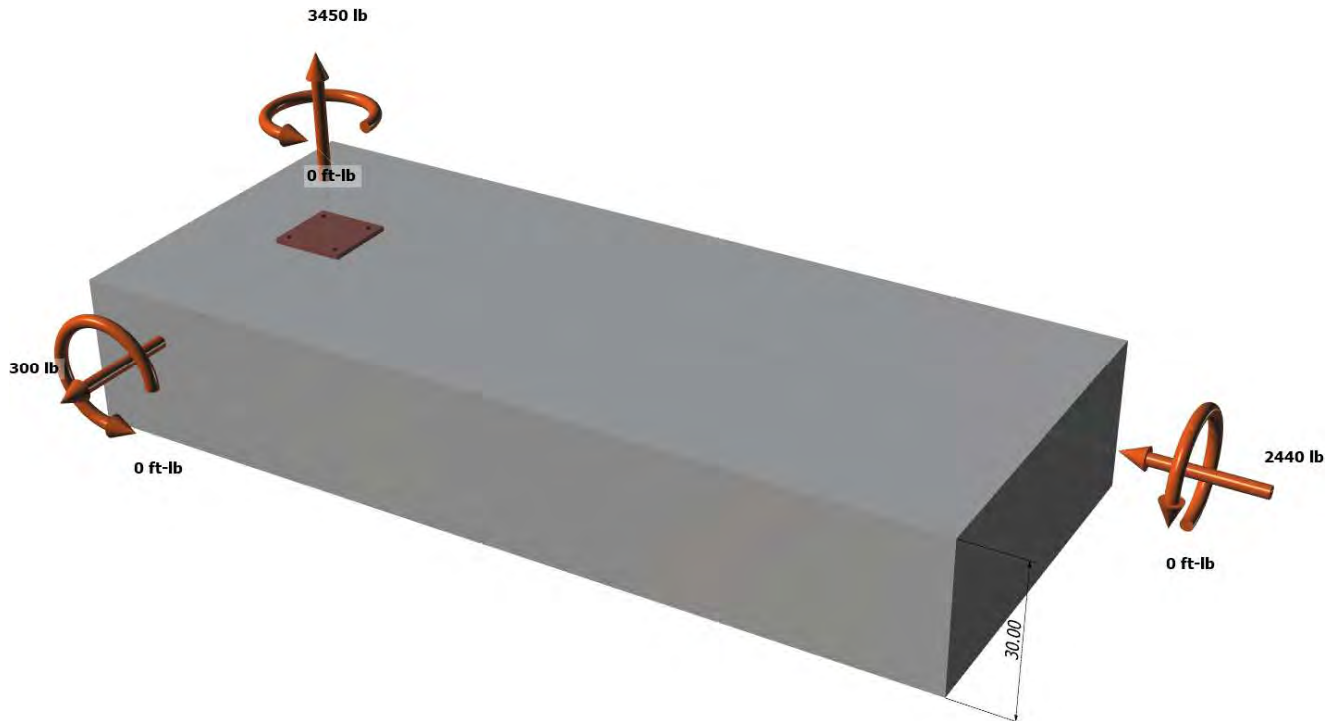
$V_{uay}$  [lb]: -2440

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

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

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

<Figure 1>





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<Figure 2>







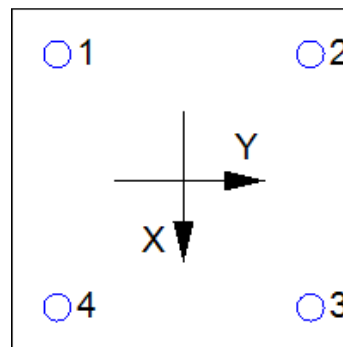
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### 3. Resulting Anchor Forces

Anchor	Tension load, N <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	862.5	75.0	-610.0	614.6
2	862.5	75.0	-610.0	614.6
3	862.5	75.0	-610.0	614.6
4	862.5	75.0	-610.0	614.6
Sum	3450.0	300.0	-2440.0	2458.4

Maximum concrete compression strain (%): 0.00  
 Maximum concrete compression stress (psi): 0  
 Resultant tension force (lb): 3450  
 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

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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**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)**

$\phi V_{cp} = \phi \min|k_{cp} N_{ba}; k_{cp} N_{cbg}| = \phi \min|k_{cp}(A_{Na} / A_{Na0}) \psi_{ec,Na} \psi_{ed,Na} \psi_{cp,Na} N_{ba}; k_{cp}(A_{Nc} / A_{Nco}) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b|$  (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.



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$\phi V_{cpq}$  (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	863	3394	0.25	Pass	
Concrete breakout	3450	7374	0.47	Pass	
<b>Adhesive</b>	<b>3450</b>	<b>6176</b>	<b>0.56</b>	<b>Pass (Governs)</b>	
Shear	Factored Load, $V_{ua}$ (lb)	Design Strength, $\phi V_n$ (lb)	Ratio	Status	
Steel	615	1765	0.35	Pass	
T Concrete breakout x+	300	7103	0.04	Pass	
T Concrete breakout y-	2440	5313	0.46	Pass	
Concrete breakout y-	150	9797	0.02	Pass	
Concrete breakout x-	1220	12680	0.10	Pass	
<b>Concrete breakout, combined</b>	<b>-</b>	<b>-</b>	<b>0.46</b>	<b>Pass (Governs)</b>	
Pryout	2458	15722	0.16	Pass	
Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.38	0.28	65.4%	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.



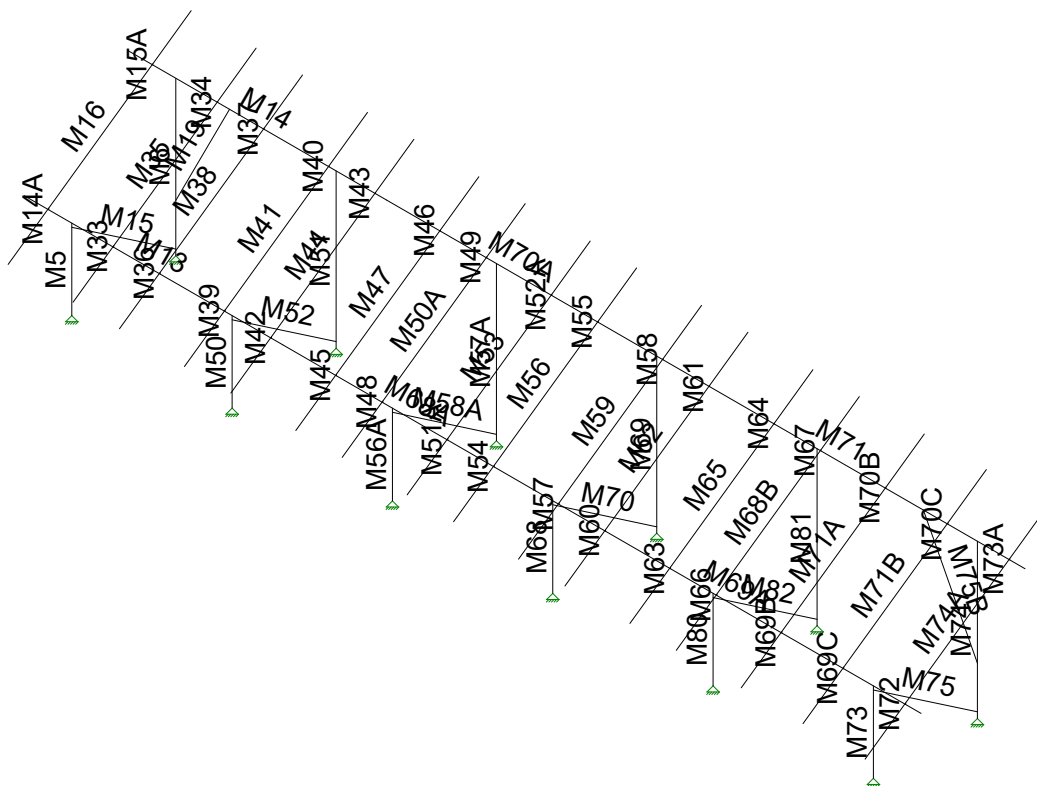
JOB NO.: U2716-070-181

DESIGNED: STB

PROJECT: Ground Mount Package for Ontario Canada

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# Framing Analysis



Vector Structural Engineeri...

STB

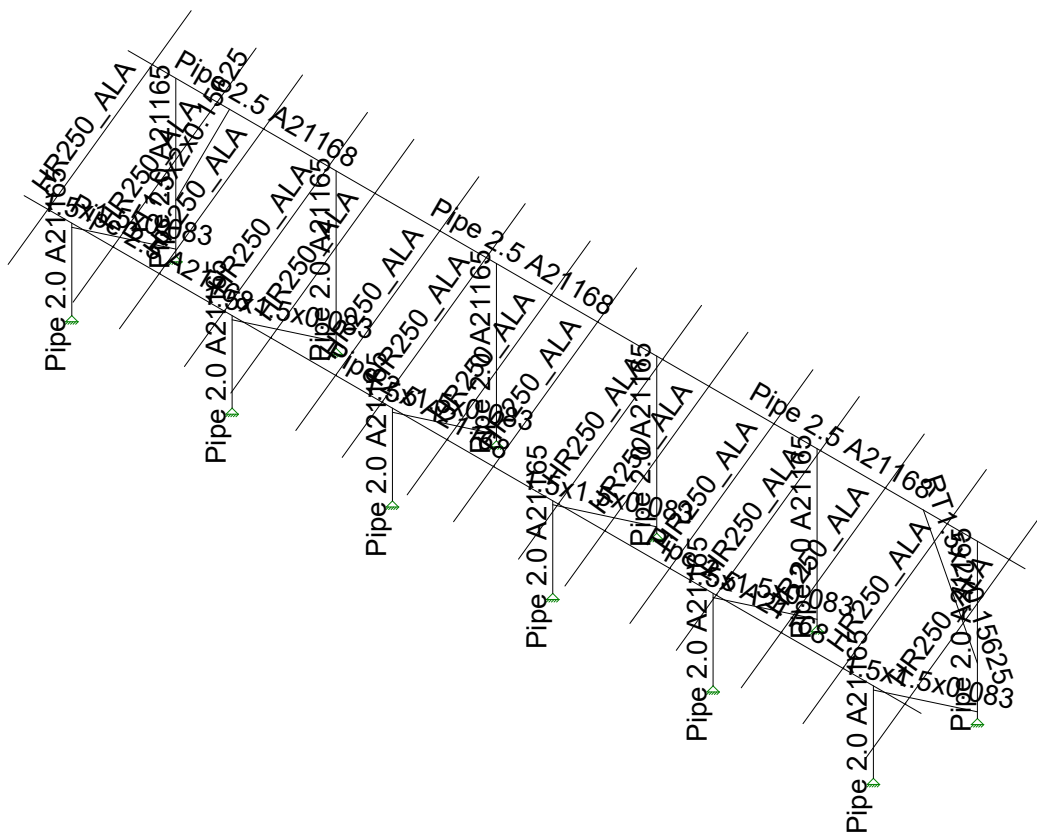
U2716.128.191

Ground Mount

SK - 6

Aug 15, 2019 at 2:46 PM

Sunmodo Sunturf A4a.r3d



Vector Structural Engineeri...

STB

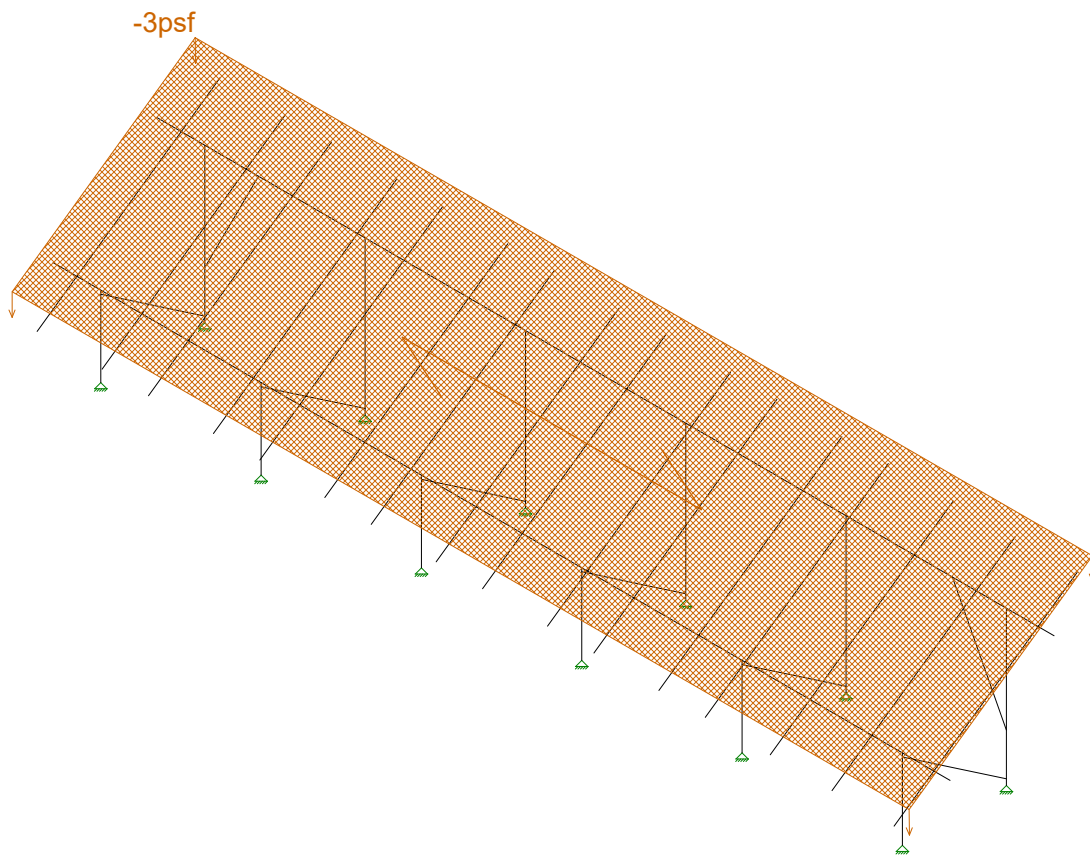
U2716.128.191

Ground Mount

SK - 7

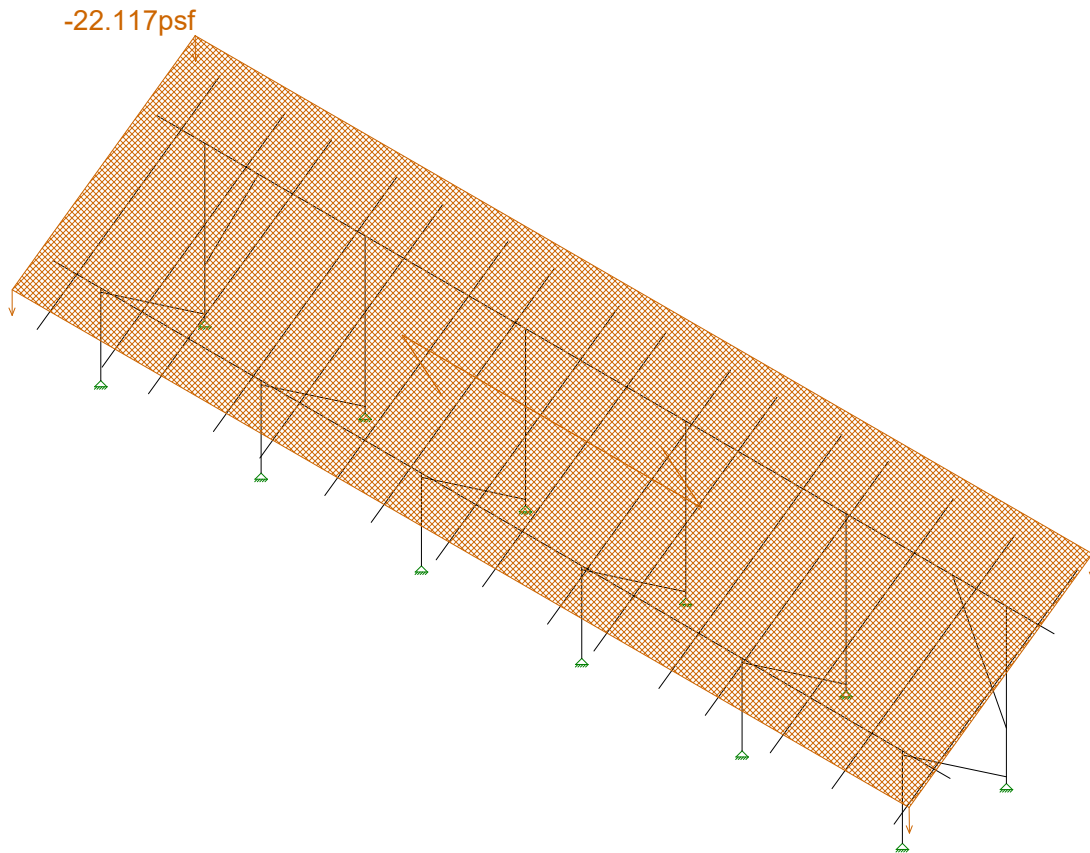
Aug 15, 2019 at 2:46 PM

Sunmodo Sunturf A4a.r3d



Loads: BLC 2, Solar Panel Weight

Vector Structural Engineeri..	Ground Mount	SK - 8
STB		Aug 15, 2019 at 2:46 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d



Loads: BLC 3, Roof Live/Snow

Vector Structural Engineeri..

STB

U2716.128.191

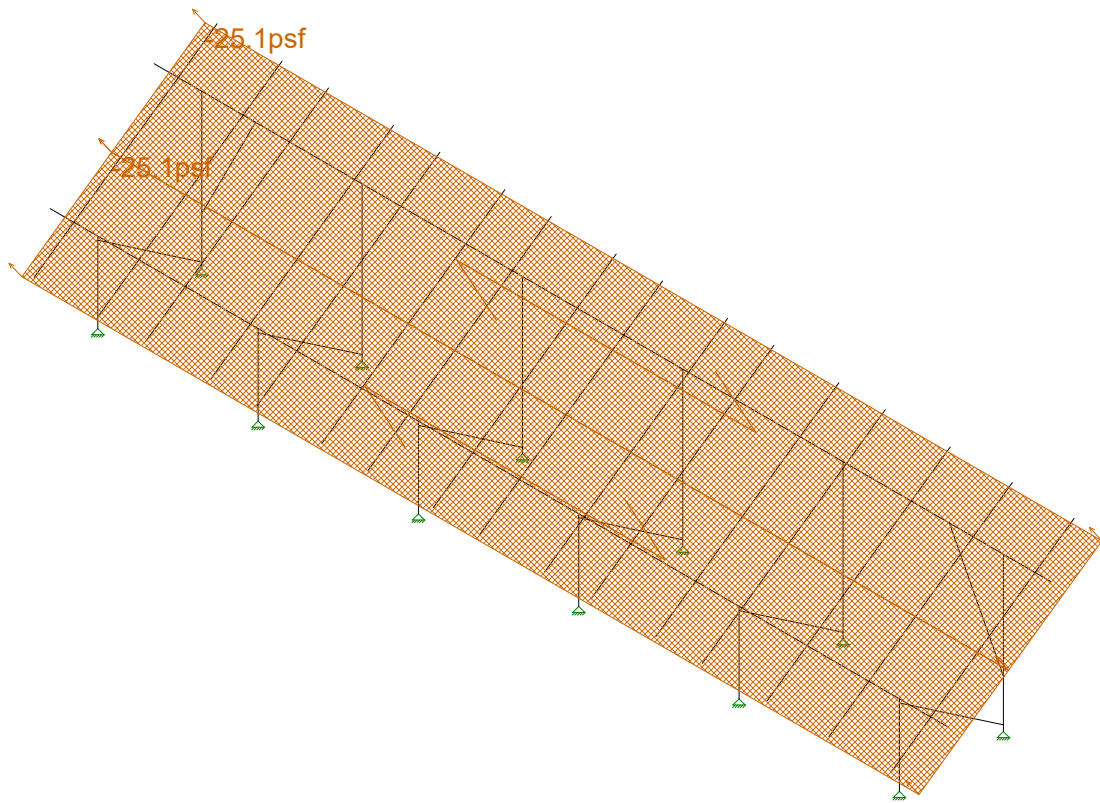
Ground Mount

SK - 9

Aug 15, 2019 at 2:47 PM

Sunmodo Sunturf A4a.r3d





Loads: BLC 4, Wind A 0 deg

Vector Structural Engineeri..

STB

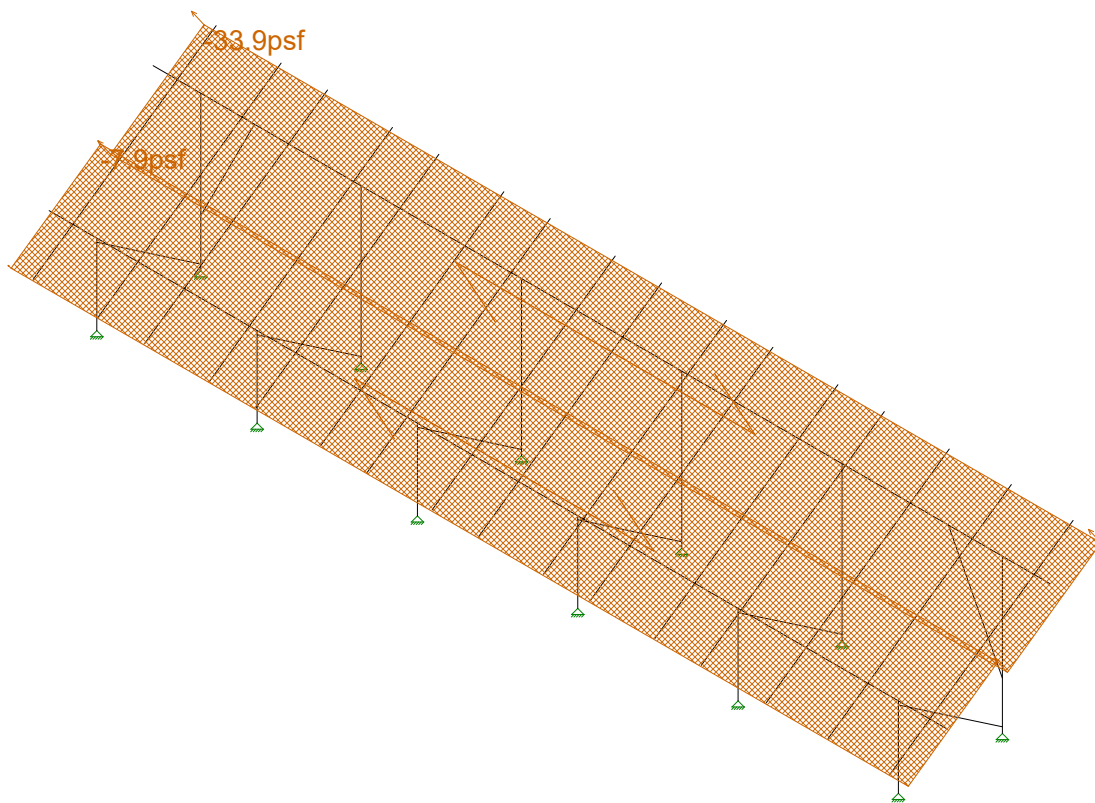
U2716.128.191

Ground Mount

SK - 10

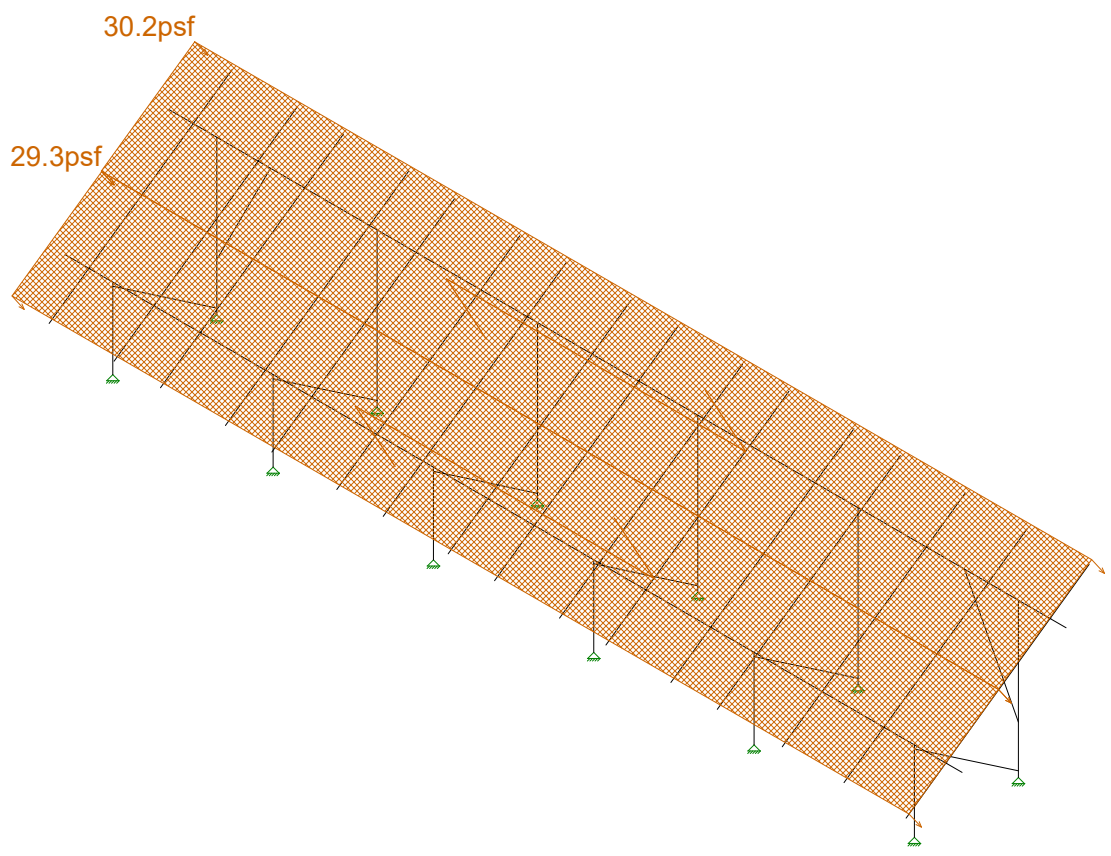
Aug 15, 2019 at 2:47 PM

Sunmodo Sunturf A4a.r3d



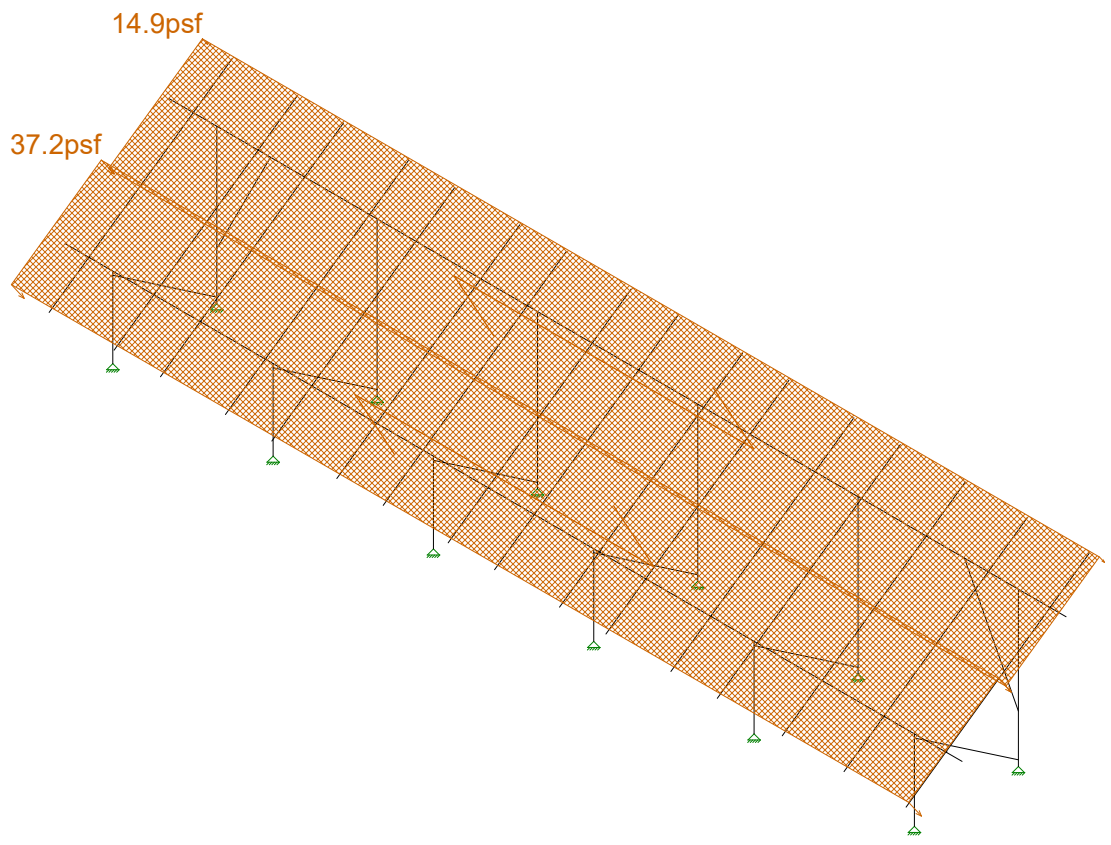
Loads: BLC 5, Wind B 0 deg

Vector Structural Engineeri..	Ground Mount	SK - 11
STB		Aug 15, 2019 at 2:47 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d



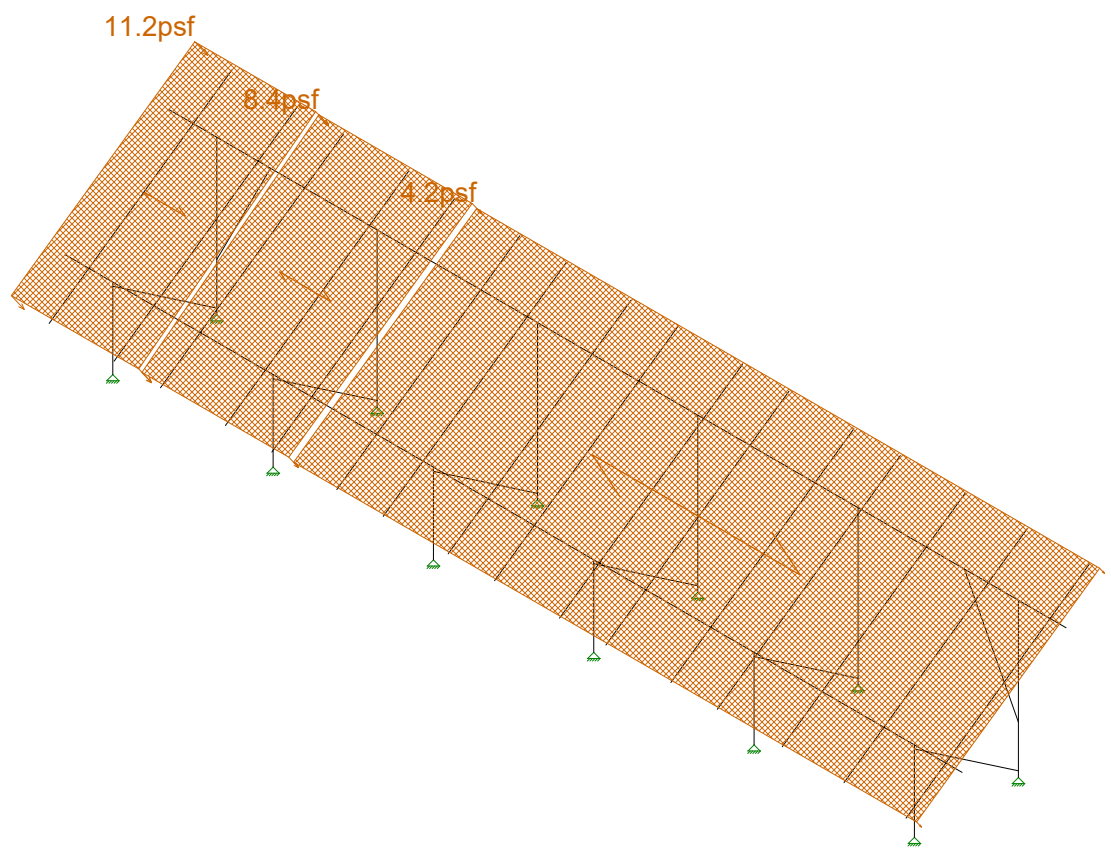
Loads: BLC 6, Wind A 180 deg

Vector Structural Engineeri..	Ground Mount	SK - 12
STB		Aug 15, 2019 at 2:47 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d



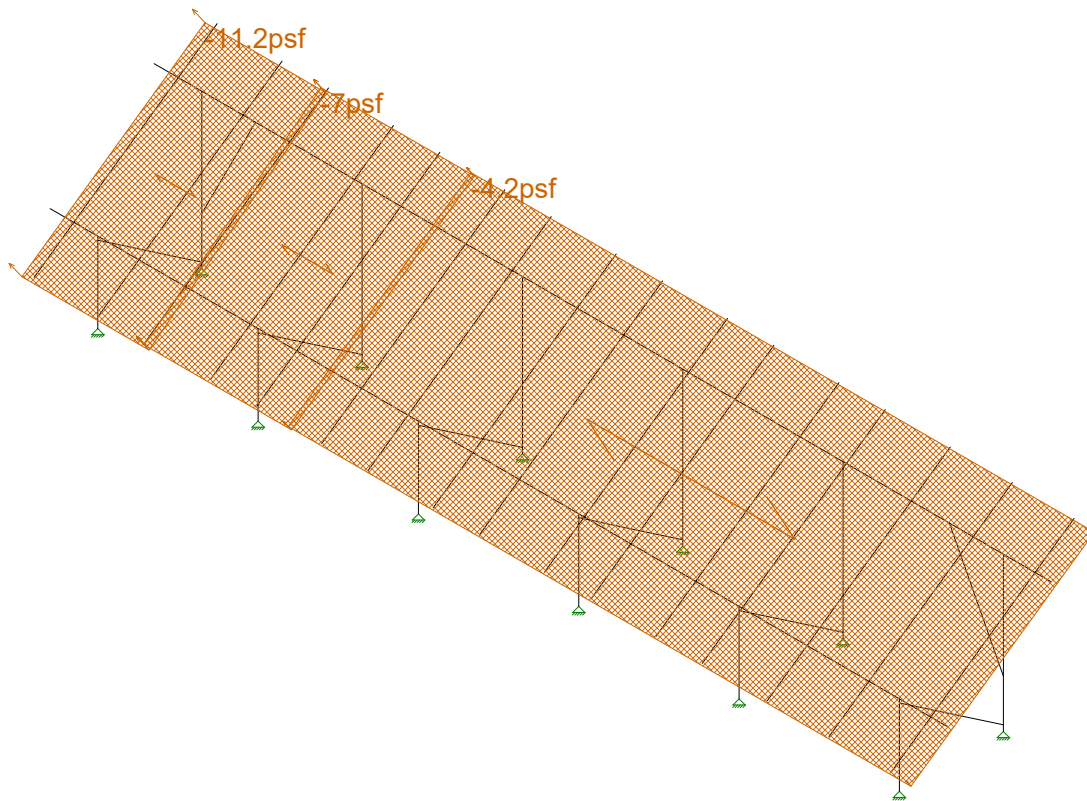
Loads: BLC 7, Wind B 180 deg

Vector Structural Engineeri..	Ground Mount	SK - 13
STB		Aug 15, 2019 at 2:47 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d



Loads: BLC 8, Wind A 90

Vector Structural Engineeri..	Ground Mount	SK - 14
STB		Aug 15, 2019 at 2:47 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d

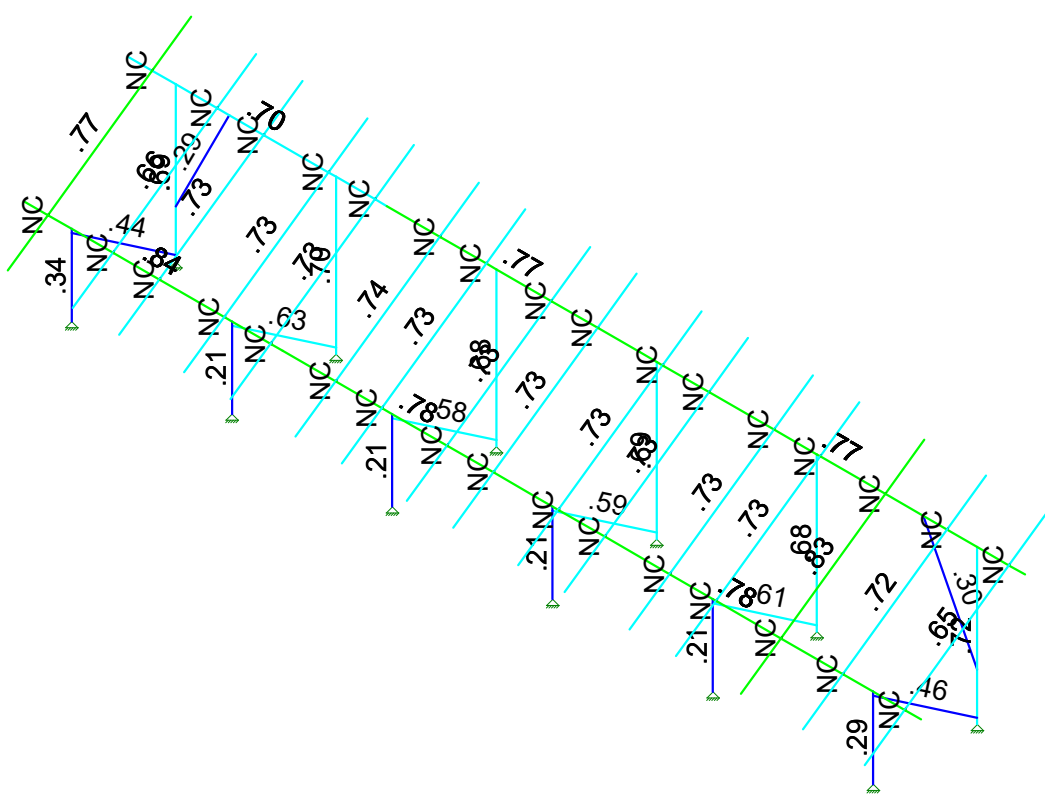


Loads: BLC 9, Wind B 90

Vector Structural Engineeri..	Ground Mount	SK - 15
STB		Aug 15, 2019 at 2:47 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d



Code	Check	(Min)
Black	No Calc	
Red	> 1.0	
Yellow	40-1.0	
Green	75-50	
Cyan	50-75	
Blue	0-.50	



Member Code Checks Displayed (Enveloped)  
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 3
STB		Aug 15, 2019 at 2:46 PM
U2716.128.191		Sunmodo Sunturf A4a.r3d







**(Global) Model Settings, Continued**

Seismic Code	ASCE 7-10
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



Company : Vector Structural Engineering  
 Designer : STB  
 Job Number : U2716.128.191  
 Model Name : Ground Mount

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**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	HR250 ALA	Beam	Rectangular Tubes	6005-T5	Typical	.723	.095	.486	.261
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	-25.1
2	N198	N201	N199	N196	Perp	A-B	-25.1

**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	-33.9
2	N198	N201	N199	N196	Perp	A-B	-7.9

**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	30.2
2	N198	N201	N199	N196	Perp	A-B	29.3

**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	14.9
2	N198	N201	N199	N196	Perp	A-B	37.2

**Member Area Loads (BLC 8 : Wind A 90)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N203	N202	N196	Perp	A-B	11.2
2	N203	N209	N208	N202	Perp	A-B	8.4
3	N209	N200	N199	N208	Perp	A-B	4.2

**Member Area Loads (BLC 9 : Wind B 90)**

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N203	N202	N196	Perp	A-B	-11.2
2	N203	N209	N208	N202	Perp	A-B	-7
3	N209	N200	N199	N208	Perp	A-B	-4.2

**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





Company : Vector Structural Engineering  
 Designer : STB  
 Job Number : U2716.128.191  
 Model Name : Ground Mount

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**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
14	min	-3.453	13	-2025.287	16	-1120....	3	0	1	0	1	0
15	N122	max	-.369	20	1976.181	10	53.578	3	0	1	0	1
16		min	-5.828	12	-360.82	17	-61.963	5	0	1	0	1
17	N133B	max	7.019	11	3098.368	11	1346.83	5	0	1	0	1
18		min	-.595	19	-2053.685	16	-1137....	3	0	1	0	1
19	N134B	max	4.998	10	1994.633	10	53.81	3	0	1	0	1
20		min	-5.873	17	-378.531	17	-62.103	5	0	1	0	1
21	N151	max	81.014	16	2569.492	11	1045.8...	5	0	1	0	1
22		min	-173.437	11	-1653.551	16	-882.598	3	0	1	0	1
23	N152	max	11.529	15	1533.959	10	44.622	3	0	1	0	1
24		min	-60.549	12	-274.136	17	-51.894	5	0	1	0	1
25	Totals:	max	.323	11	22406.625	11	7215.7...	17				
26		min	-.132	16	-6897.894	15	-6085....	15				

**Envelope AISC 14th(360-10): 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...	.337	54.657	12	.153	54.657	5	16052.041	23232.186	1397.505	1397.505	1...	H1-1b		
2	M6	Pipe 2.0 A2...	.692	32.973	11	.153	0	5	6297.608	23232.186	1397.505	1397.505	1...	H1-1a		
3	M13	Pipe 2.5 A2...	.844	147....	12	.165	147....	12	11641.036	28358.413	2081.747	2081.747	1...	H1-1b		
4	M14	Pipe 2.5 A2...	.696	147....	11	.168	147....	11	11641.036	28358.413	2081.747	2081.747	1...	H1-1b		
5	M15	1.5x1.5x0.083	.440	46.656	5	.070	0	y	11	2958.959	14085.15	624.421	624.421	1...	H1-1a	
6	M80	Pipe 2.0 A2...	.211	54.657	5	.204	54.657	5	16052.041	23232.186	1397.505	1397.505	1...	H1-1b		
7	M81	Pipe 2.0 A2...	.677	3.411	5	.212	0	5	6297.608	23232.186	1397.505	1397.505	1...	H1-1a		
8	M82	1.5x1.5x0.083	.608	46.656	5	.019	0	y	11	2958.959	14085.15	624.421	624.421	1...	H1-1a	
9	M50	Pipe 2.0 A2...	.215	54.063	17	.210	54.657	5	16052.041	23232.186	1397.505	1397.505	1...	H1-1b		
10	M51	Pipe 2.0 A2...	.705	3.411	5	.221	0	5	6297.608	23232.186	1397.505	1397.505	1...	H1-1a		
11	M52	1.5x1.5x0.083	.634	46.656	5	.006	0	y	14	2958.959	14085.15	624.421	624.421	1...	H1-1a	
12	M56A	Pipe 2.0 A2...	.211	54.657	5	.191	54.657	5	16052.041	23232.186	1397.505	1397.505	1...	H1-1b		
13	M57A	Pipe 2.0 A2...	.680	3.411	11	.202	0	5	6297.608	23232.186	1397.505	1397.505	1...	H1-1a		
14	M58A	1.5x1.5x0.083	.579	46.656	5	.010	0	y	13	2958.959	14085.15	624.421	624.421	1...	H1-1a	
15	M68	Pipe 2.0 A2...	.212	54.657	5	.195	54.657	5	16052.041	23232.186	1397.505	1397.505	1...	H1-1b		
16	M69	Pipe 2.0 A2...	.688	3.411	11	.205	0	5	6297.608	23232.186	1397.505	1397.505	1...	H1-1a		
17	M70	1.5x1.5x0.083	.588	46.656	5	.007	0	y	10	2958.959	14085.15	624.421	624.421	1...	H1-1a	
18	M68A	Pipe 2.5 A2...	.781	78.75	12	.158	76.875	12	11641.036	28358.413	2081.747	2081.747	1...	H1-1b		
19	M69A	Pipe 2.5 A2...	.781	125....	12	.164	128....	12	11641.036	28358.413	2081.747	2081.747	1...	H1-1b		
20	M70A	Pipe 2.5 A2...	.770	78.75	11	.194	76.875	11	11641.036	28358.413	2081.747	2081.747	1...	H1-1b		
21	M71	Pipe 2.5 A2...	.767	11.417	11	.201	14.271	11	11641.036	28358.413	2081.747	2081.747	2...	H1-1b		
22	M73	Pipe 2.0 A2...	.289	54.657	12	.157	54.657	5	16052.041	23232.186	1397.505	1397.505	1...	H1-1b		
23	M74	Pipe 2.0 A2...	.716	32.973	11	.160	0	5	6297.608	23232.186	1397.505	1397.505	1...	H1-1a		
24	M75	1.5x1.5x0.083	.460	46.656	5	.069	0	y	11	2958.959	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...	.293	51.823	11	.015	0	z	11	2361.808	19411....	770.742	927.083	6090.199	4101.563	1...	H.1-1
2	M16	HR250_A...	.775	34.788	12	.081	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
3	M35	HR250_A...	.661	81.171	11	.096	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
4	M38	HR250_A...	.729	34.788	12	.082	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
5	M41	HR250_A...	.731	34.788	12	.082	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
6	M44	HR250_A...	.731	34.788	12	.078	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
7	M47	HR250_A...	.741	36.444	12	.077	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
8	M50A	HR250_A...	.732	34.788	12	.075	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
9	M53	HR250_A...	.731	34.788	12	.079	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
10	M56	HR250_A...	.730	34.788	12	.078	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
11	M59	HR250_A...	.732	34.788	12	.075	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1



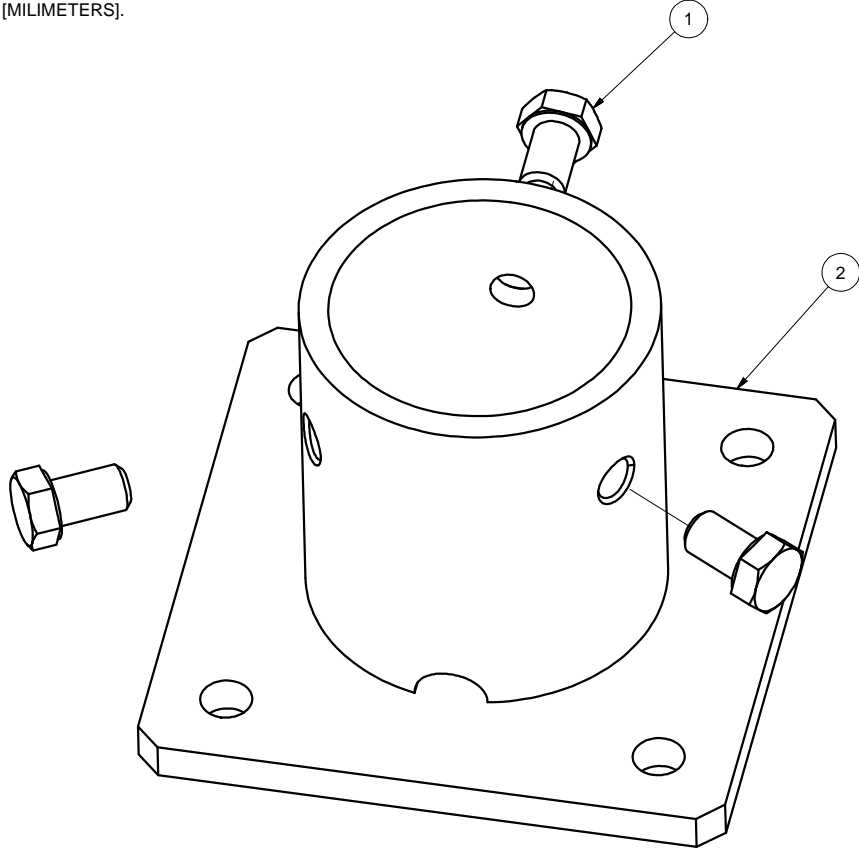
Company : Vector Structural Engineering  
 Designer : STB  
 Job Number : U2716.128.191  
 Model Name : Ground Mount

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**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	HR250_A...	.733	36.444	12	.077	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
13	M65	HR250_A...	.731	34.788	12	.078	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
14	M68B	HR250_A...	.732	34.788	12	.081	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
15	M71A	HR250_A...	.831	34.788	12	.093	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
16	M75B	RT1.5x2x...	.301	51.892	11	.024	0	z	5	2355.472	19411....	770.742	927.083	6090.199	4101.563	1....	H.1-1
17	M71B	HR250_A...	.722	34.788	12	.100	36.444	y	12	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1
18	M74A	HR250_A...	.646	34.788	12	.068	124.2...	y	11	2598.605	14089....	309.506	624.233	5108.727	1672.364	1	H.1-1

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



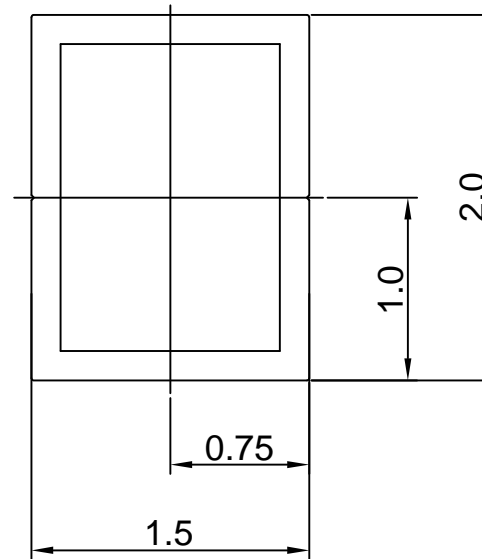
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	10/20/2016

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	

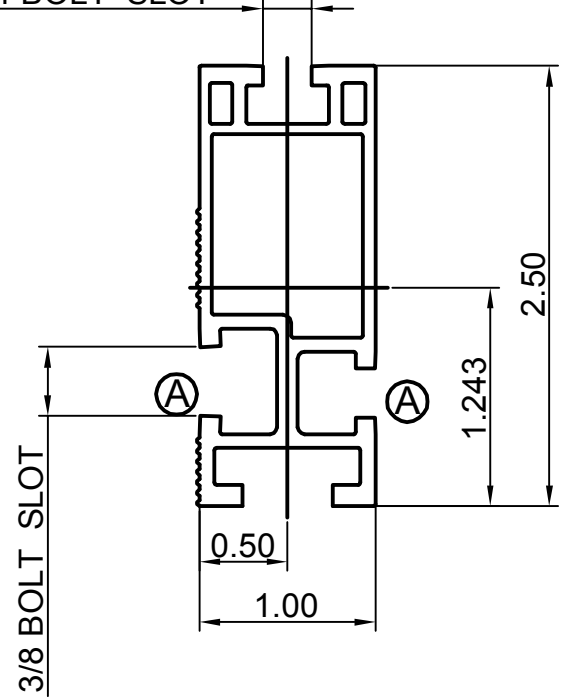


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	ADDED BOTTOM CHANNEL & CHANGED ONE 3/8 CHANNEL TO 1/4	zcg	02/21/2013

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:

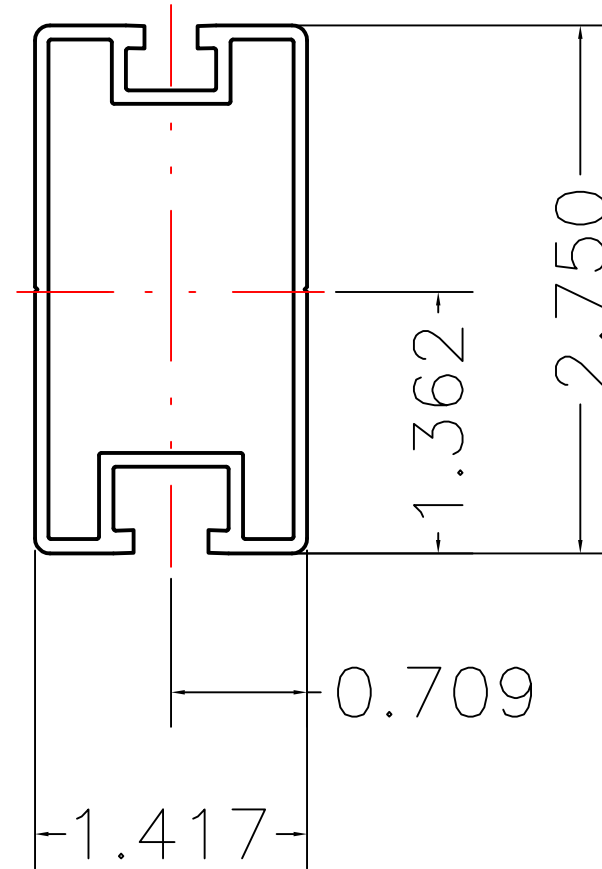
Weight: 0.850 lbs/ft  
 Area: 0.723 in<sup>2</sup>  
 Perimeter: 17.325 in  
 Bounding Box: X: -0.500,0.500  
 Y: -1.243,1.257

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: 0.994, Y: 0.539

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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 spec'd	
DRAWN BY KYY	DATE 01/18/2018
CHECKED BY	
APPROVALS	

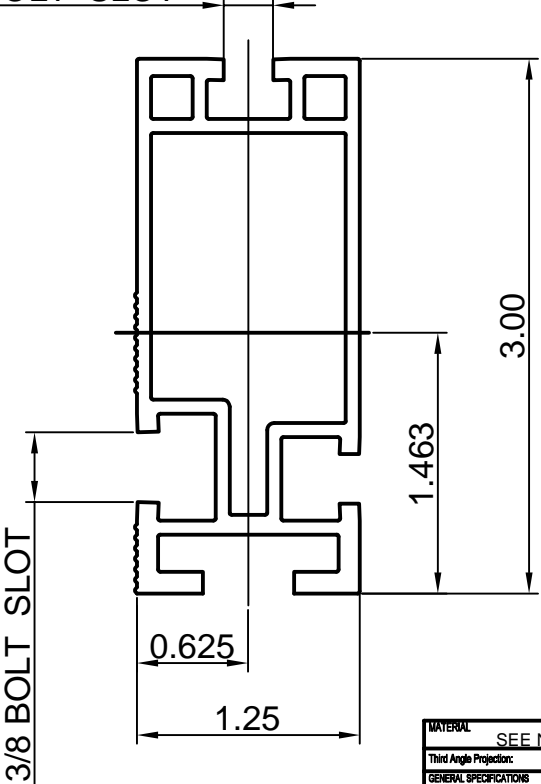
<b>SunModo Corp.</b>	
14800 NE 65TH STREET, VANCOUVER WA 98682	
TITLE RAIL, HR300 (SUNRAY), EXTRUSION	
B	DRAWING NUMBER A20288
SCALE: NONE	SHEET 1 of 1

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.

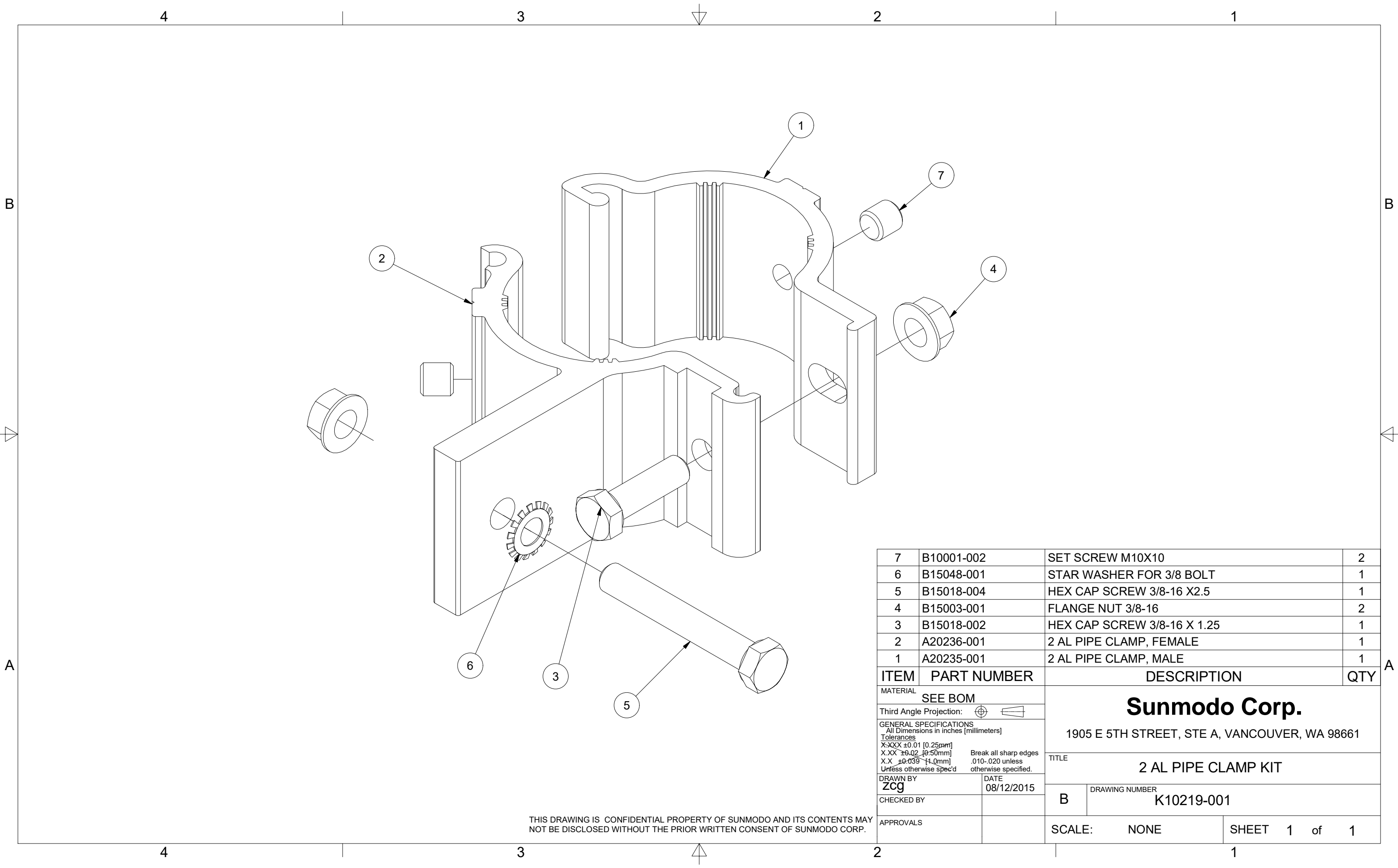
2X 1/4 BOLT SLOT



**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

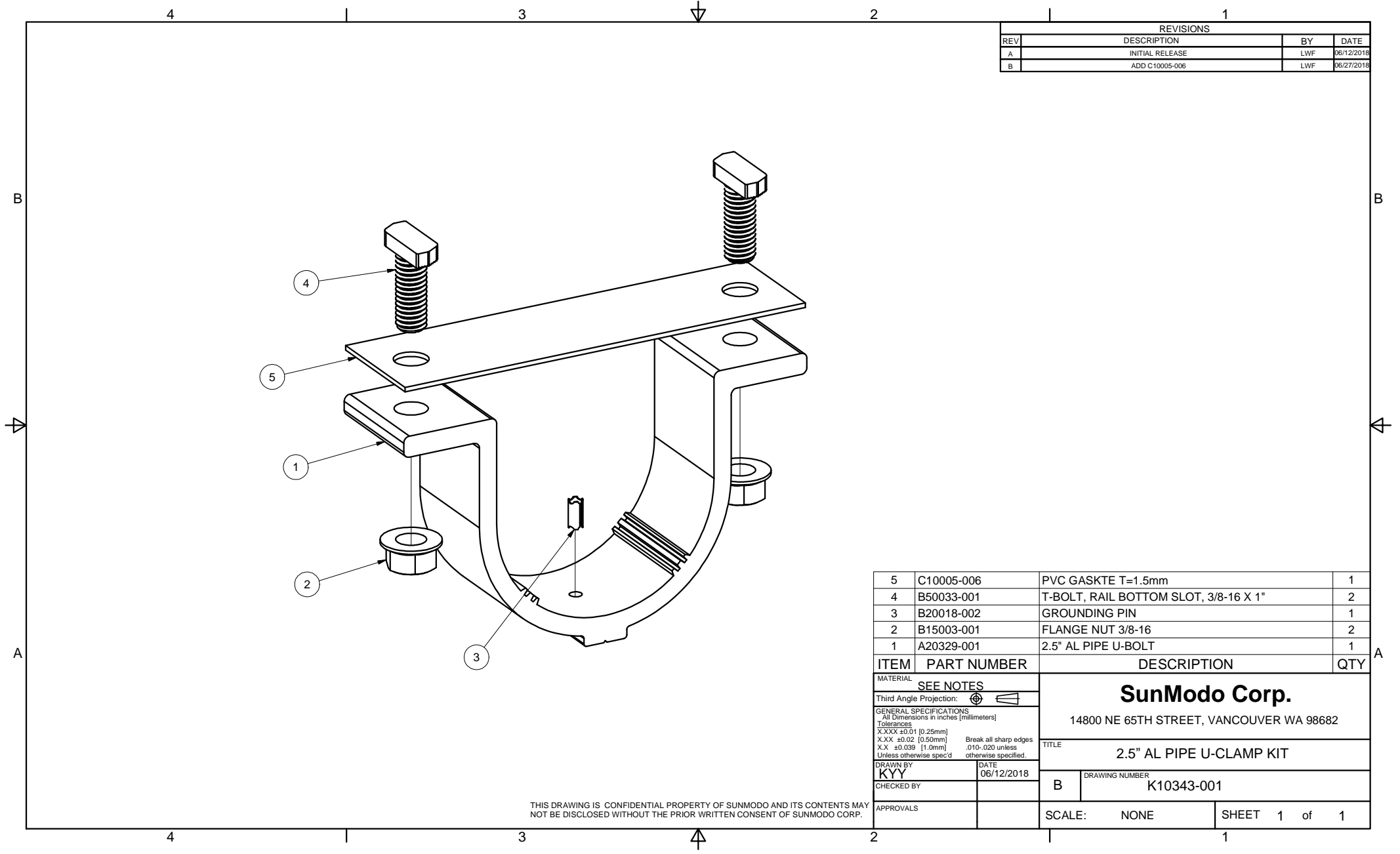
MATERIAL		SEE NOTES	
Third Angle Projection			
GENERAL SPECIFICATIONS			
All Dimensions in Inches (millimeters)			
Tolerances			
XXX ±0.01 (0.25mm)			
XX ±0.02 (0.50mm)			
X ±0.03 (1.0mm)			
Unless otherwise specified.			
DRAWN BY		DATE	
ZCJ		02/21/2015	
CHECKED BY		DATE	
APPROVALS		DATE	
Sunmodo Corp.		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] 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			
APPROVALS			
TITLE		2 AL PIPE CLAMP KIT	
DRAWING NUMBER		K10219-001	
SCALE:		NONE	SHEET 1 of 1

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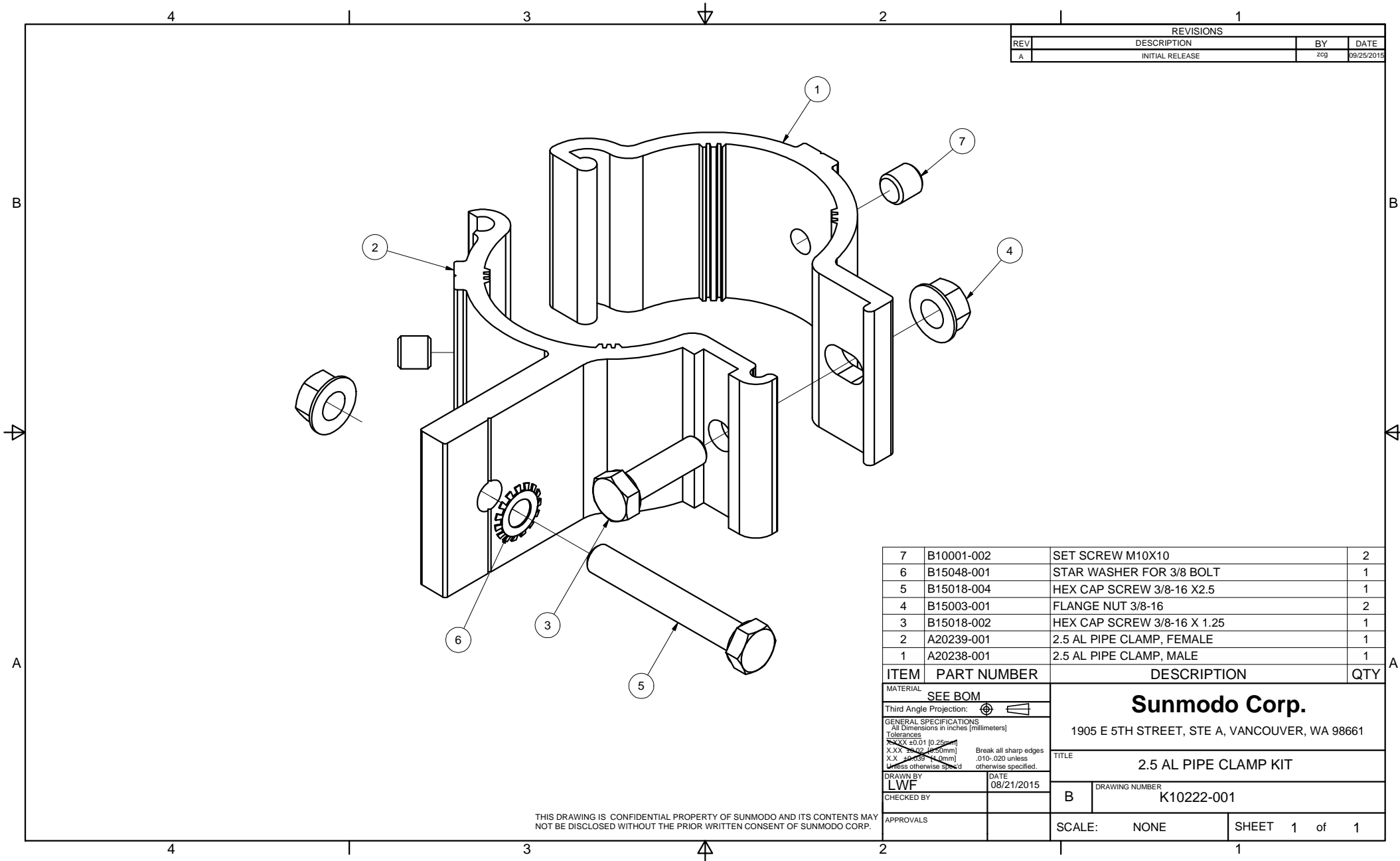


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018
B	ADD C10005-006	LWF	08/27/2018

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			
APPROVALS		SCALE: NONE	SHEET 1 of 1

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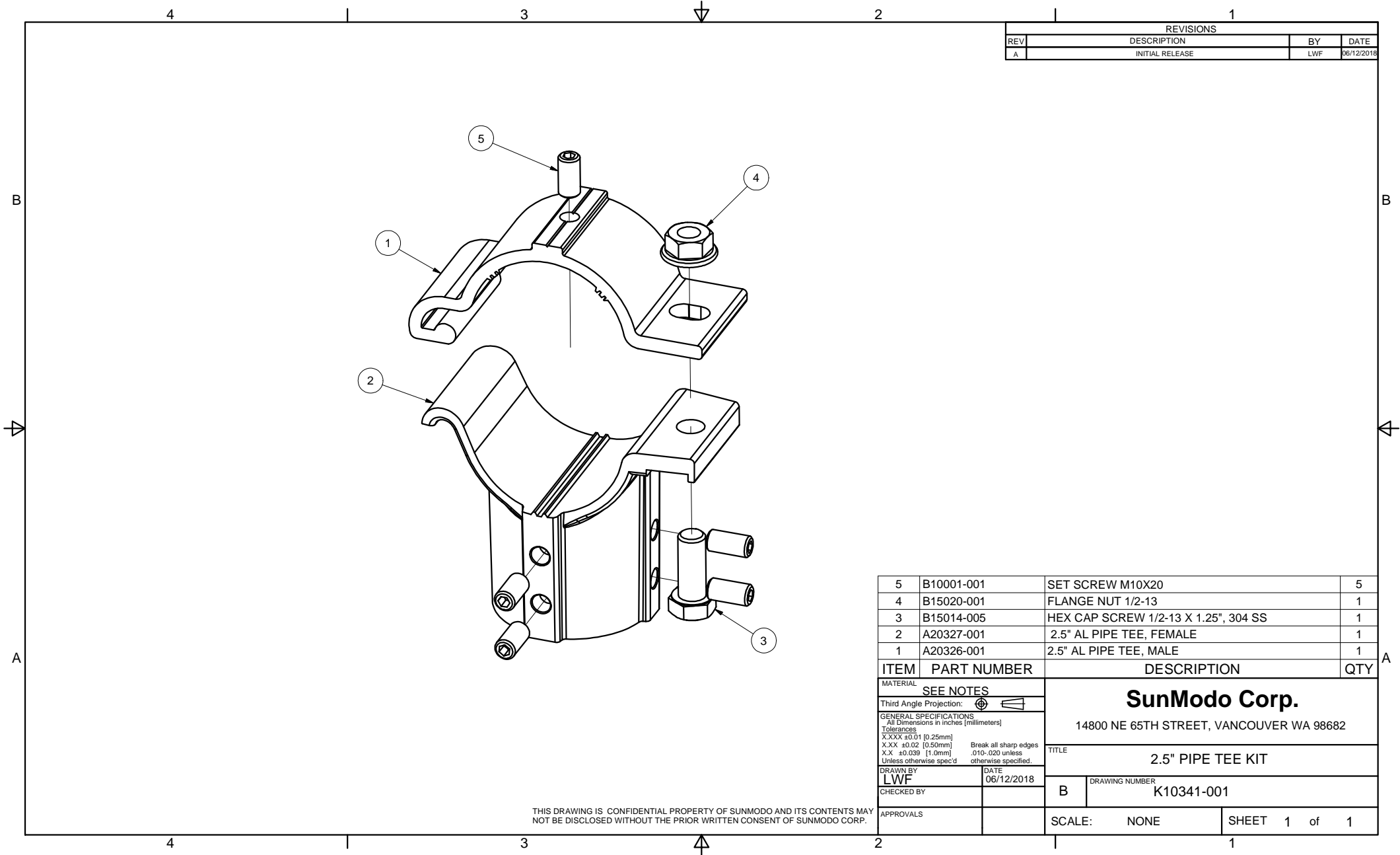


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	zcg	09/25/2015

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

ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE BOM	
Third Angle Projection:			
GENERAL SPECIFICATIONS		Sunmodo Corp. 1905 E 5TH STREET, STE A, VANCOUVER, WA 98661	
All Dimensions in inches [millimeters]		TITLE	
Tolerances		2.5 AL PIPE CLAMP KIT	
X.XX ±0.01 (0.25mm)		DRAWING NUMBER	
X.XX ±0.02 (0.51mm)		B K10222-001	
X.X ±0.03 (0.76mm)		SCALE: NONE	
Unless otherwise specified		SHEET 1 of 1	
Break all sharp edges			
.010-.020 unless otherwise specified.			
DRAWN BY	DATE		
LWF	08/21/2015		
CHECKED BY			
APPROVALS			

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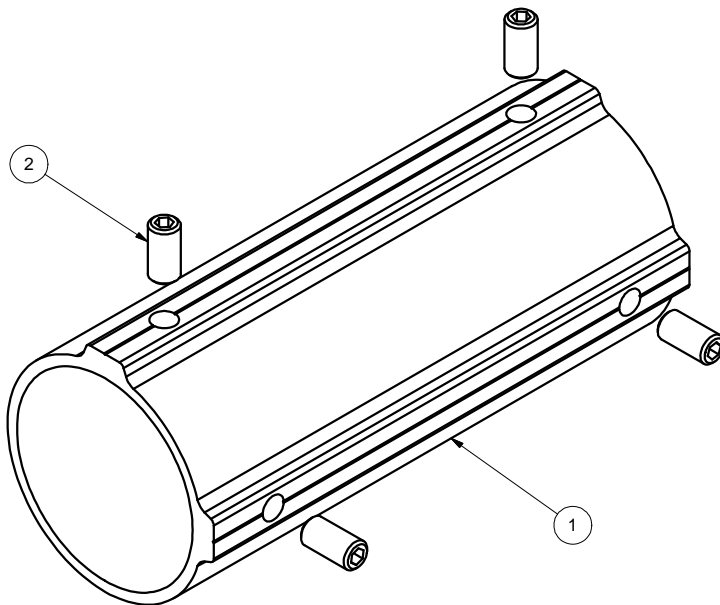
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018

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
ITEM	PART NUMBER	DESCRIPTION	QTY

MATERIAL		<b>SEE NOTES</b>	
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		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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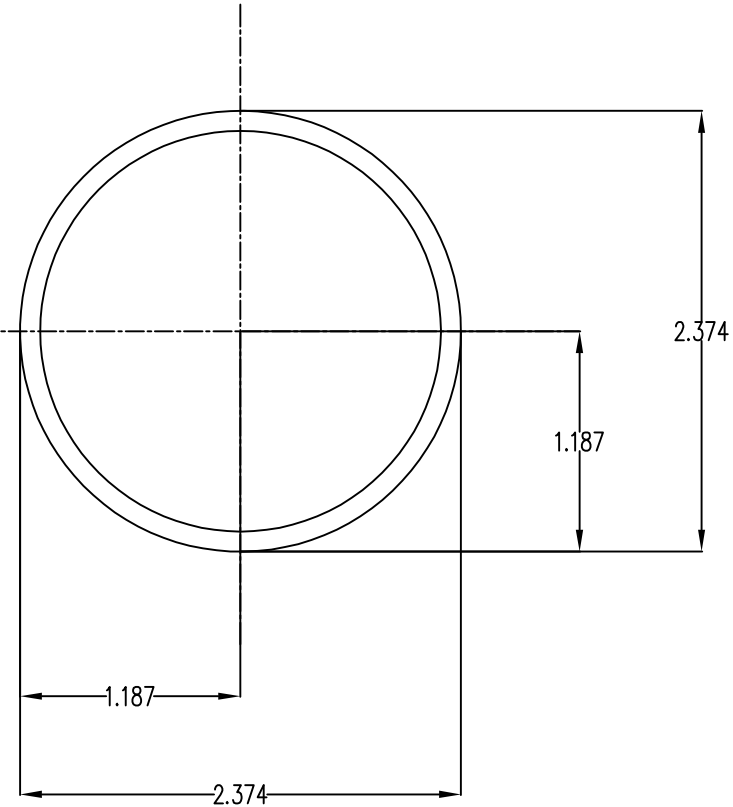
NOTES: UNLESS OTHERWISE SPECIFIED

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>): Ix=0.499,Iy=0.499

Section modulus in bending(in<sup>3</sup>): Wx=0.420,Wy=0.420

Radii of Gyration: X: 0.802, Y: 0.802

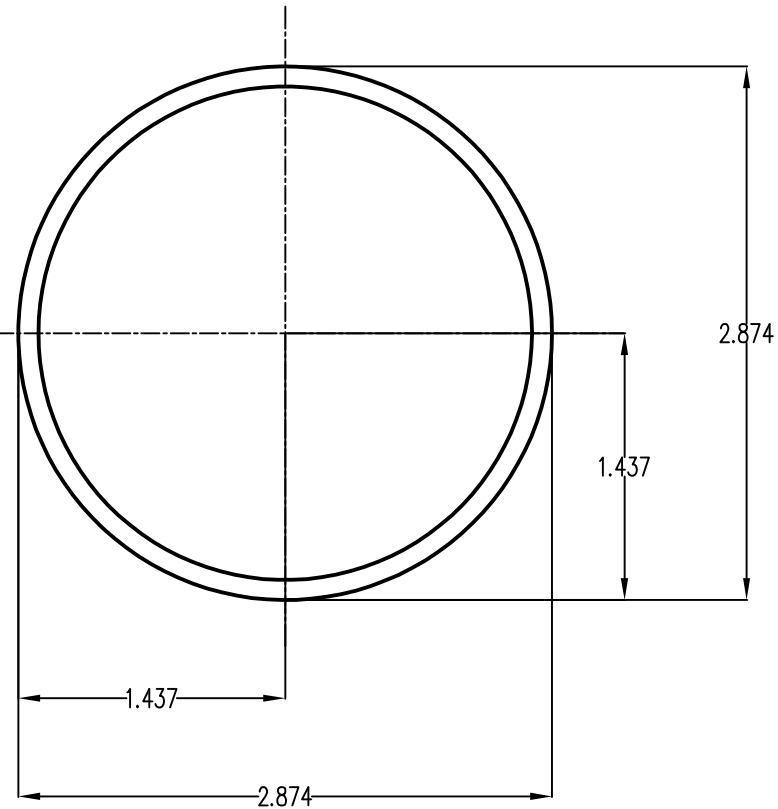
MATERIAL		SEE NOTES		<b>Sunmodo Corp.</b> 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS				TITLE	
All Dimensions in Inches (millimeters)				PIPE, HSS, 2.375" OD X 12 GAUGE,L=XXX	
Tolerances				Break all sharp edges .010-.020 unless otherwise specified.	
XXX ±0.01 (0.25mm)					
XX ±0.02 (0.50mm)					
X ±0.050 (1.27mm)					
Unless otherwise specified					
DRAWN BY	DATE	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

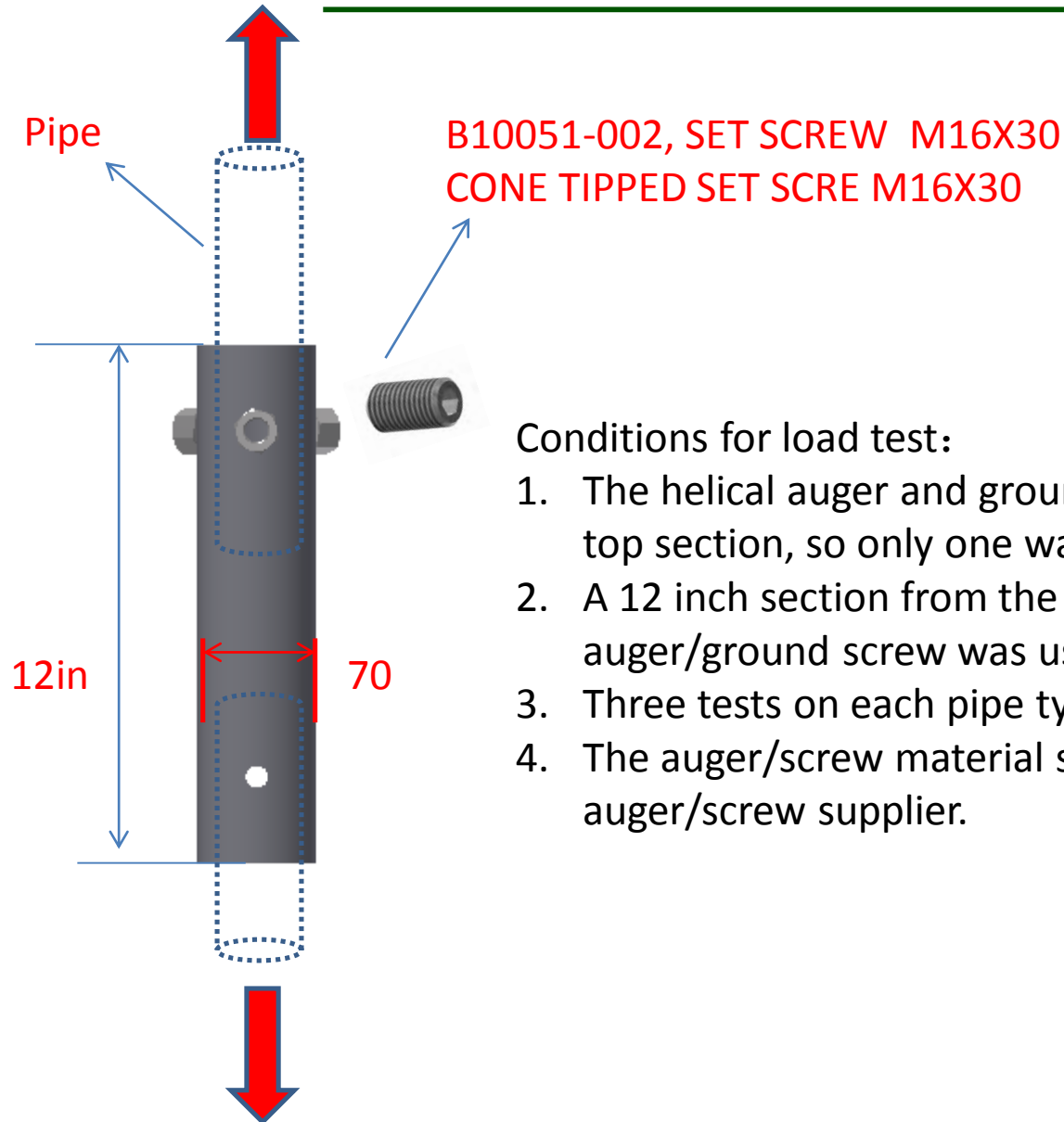
Centroid:(0.000,0.000)

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> 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	



### Conditions for load test:

1. The helical auger and ground screw use the same top section, so only one was used for testing
2. A 12 inch section from the top of the auger/ground screw was used
3. Three tests on each pipe type was used
4. The auger/screw material supplied by the auger/screw supplier.