



Project Number: U2716-0276-211

July 12, 2021

Sunmodo
14800 NE 65th 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 2015 Virginia Construction Code (2015 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 7-10)
- Design wind speed for risk category I structures: 140 mph
- Wind exposure: C
- Ground snow load: 70 psf
- The ground screws and helical piers must be tested to 1.5 times uplift and 2.0 times lateral reactions found in the table below. A minimum of one ground screw or helical pier must be tested.

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

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

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

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

Very truly yours,

VECTOR STRUCTURAL ENGINEERING, LLC
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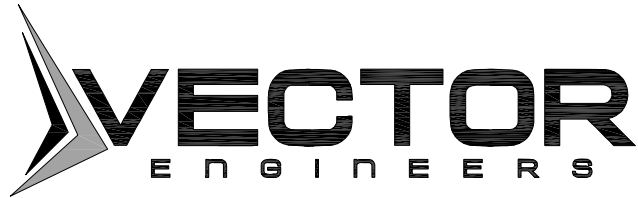
Kelly Springer, P.E.
VA License: 0402061017
Project Engineer

Enclosures

KGS/mih

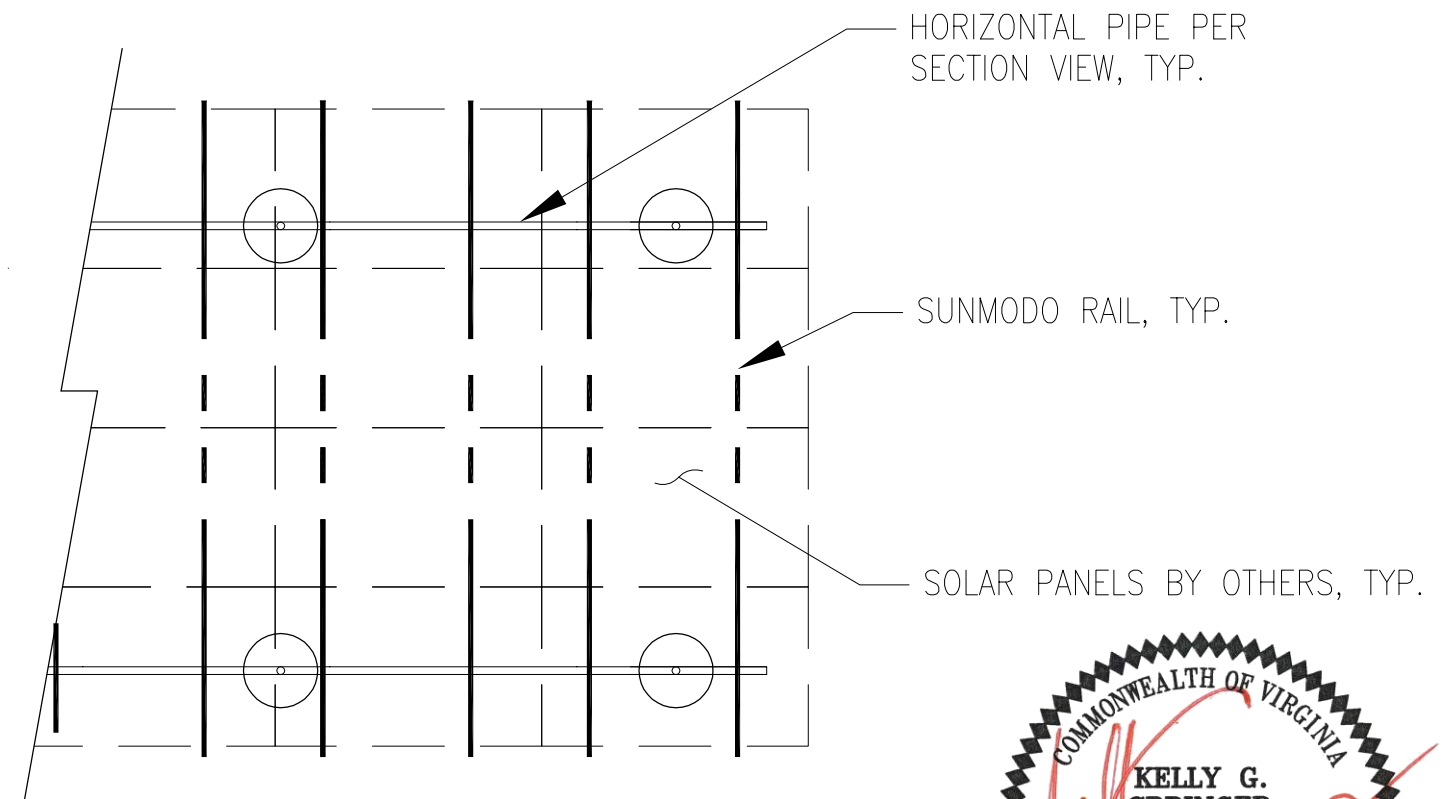
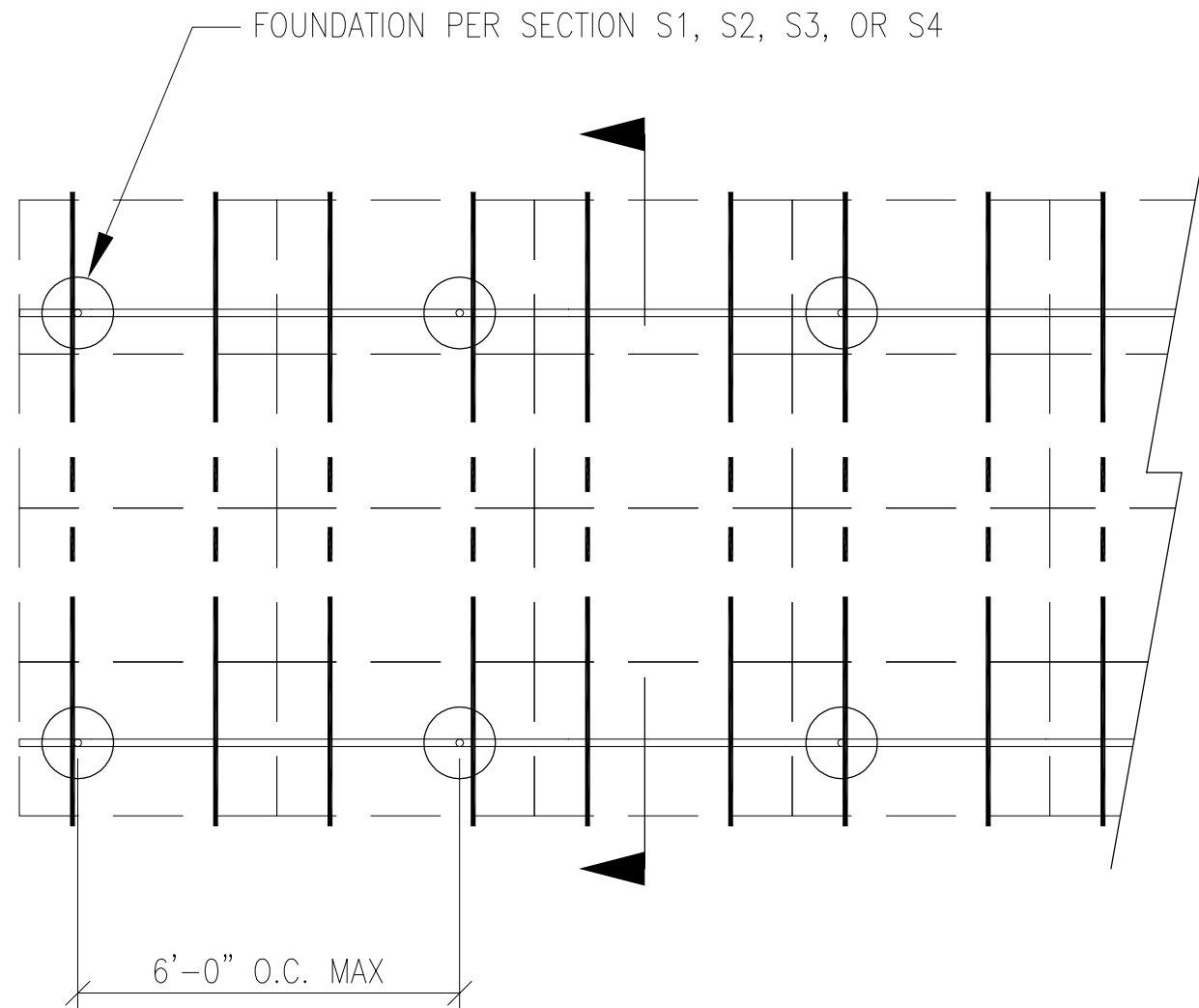


07/12/2021



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



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PV ARRAY PLAN

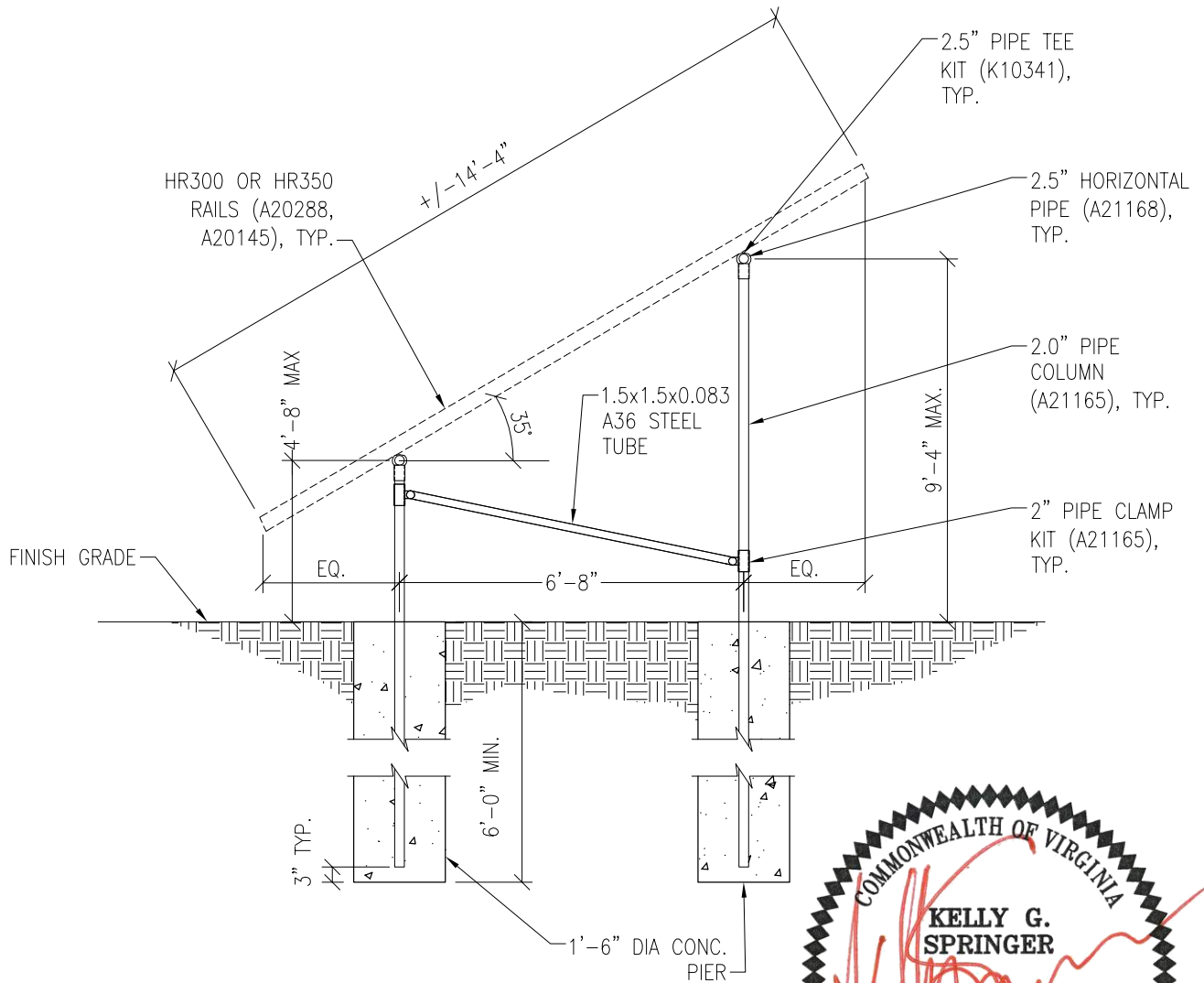
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P1

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PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT DRILLED PIER OPTION



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PV ARRAY SECTION

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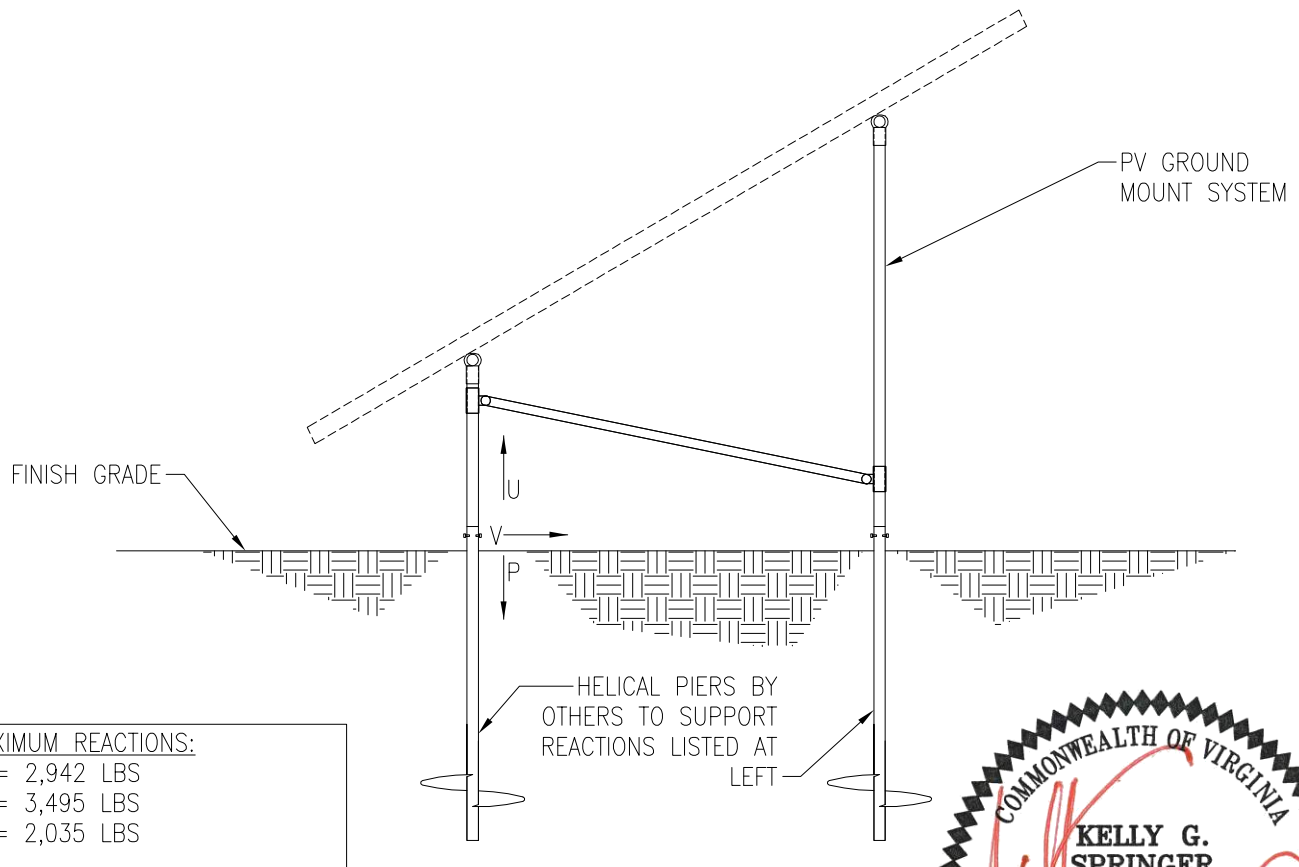
S1

PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT HELICAL PIER OPTION

NOTES:

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



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



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S2

N.T.S.



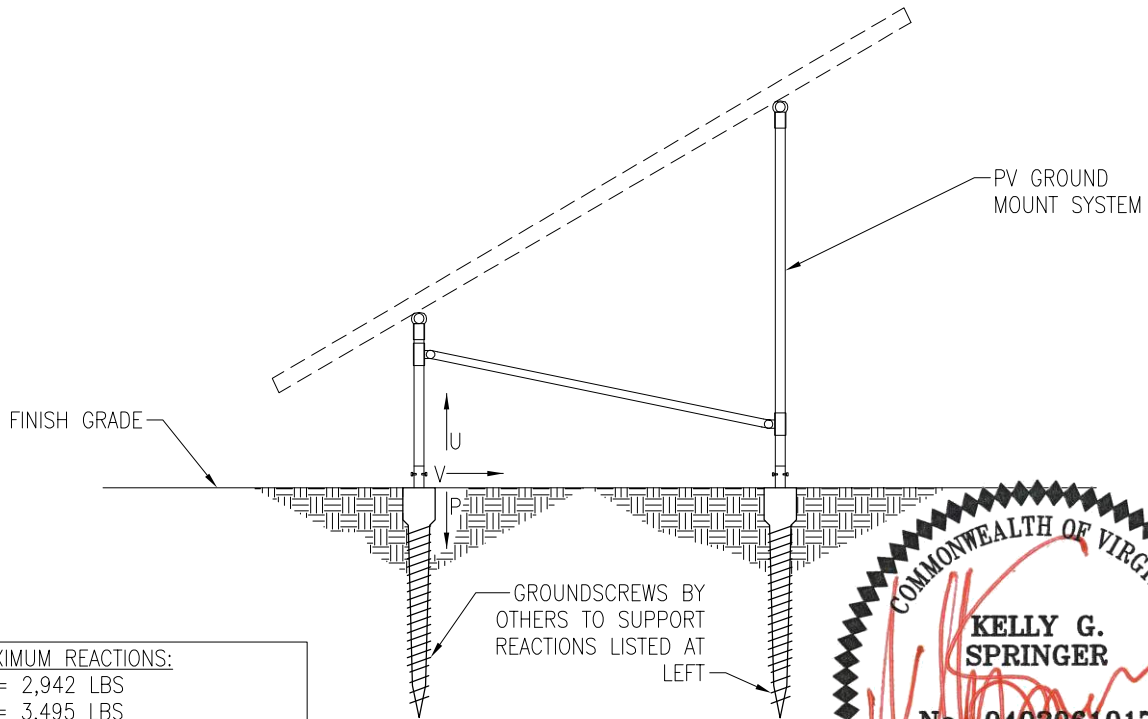
JOB NO. U2716-0276-211

PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

SUBJECT GROUND SCREW OPTION

NOTES:

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



MAXIMUM REACTIONS:
 U = 2,942 LBS
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 V = 2,035 LBS



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S3

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PROJECT SUNMODO SUNTURF GROUND MOUNTS A9

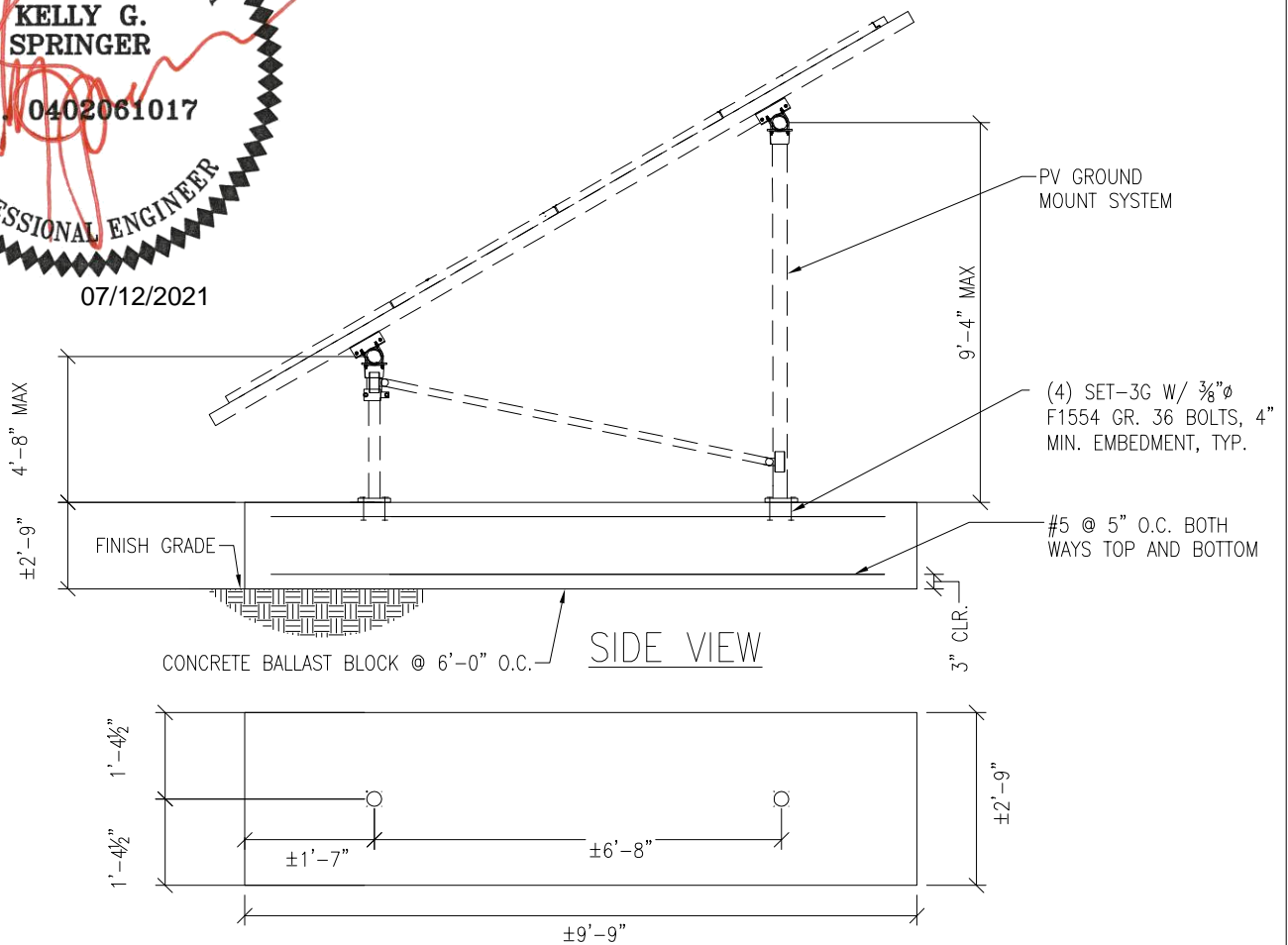
SUBJECT BALLASTED BLOCK OPTION

NOTES:

1. For ground mount components see Section S1.



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S4

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JOB NO.: U2716.0276.211
SUBJECT: SNOW LOADS

PROJECT: Sunturf Package A9 Ground Mount

SNOW LOADS

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



PROJECT: Sunturf Package A9 Ground Mount

WIND PRESSURES

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

Wind Pressures in Transverse (N-S) Direction

Net Pressure Coefficients per Figure 27.3-4

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

Design Wind Pressures per Equation 27.3-2 [psf]

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



JOB NO.: U2716-0276-211

DESIGNED: STB

Foundation Option 1: Drilled Concrete Pier



PROJECT: Sunturf Package A9 Ground Mount

DRILLED CONCRETE PIER DESIGN

Column Reactions:

Max. Shear, V [k]:	2.0	Max. Down, P _d [k]:	3.5
Max. Moment, M [k-ft]:	0.0	Max. Uplift, P _u [k]:	2.9

Pier Properties:

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

Soil Properties:

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

*per IBC Section 1810.3.3.1.4

Check Bearing:

Bearing Capacity [k]:	7.1
-----------------------	-----

Bearing capacity OK.

Check Uplift:

Uplift Capacity [k]:	8.5
----------------------	-----

Uplift capacity OK.

Check Lateral Bearing:

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

IBC Section 1807.3.2.1

IBC Eq. 18-1

Result: **Lateral bearing capacity OK.**

Foundation Option 2: Helical Pier

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

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

Foundation Option 3: Ground Screw

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

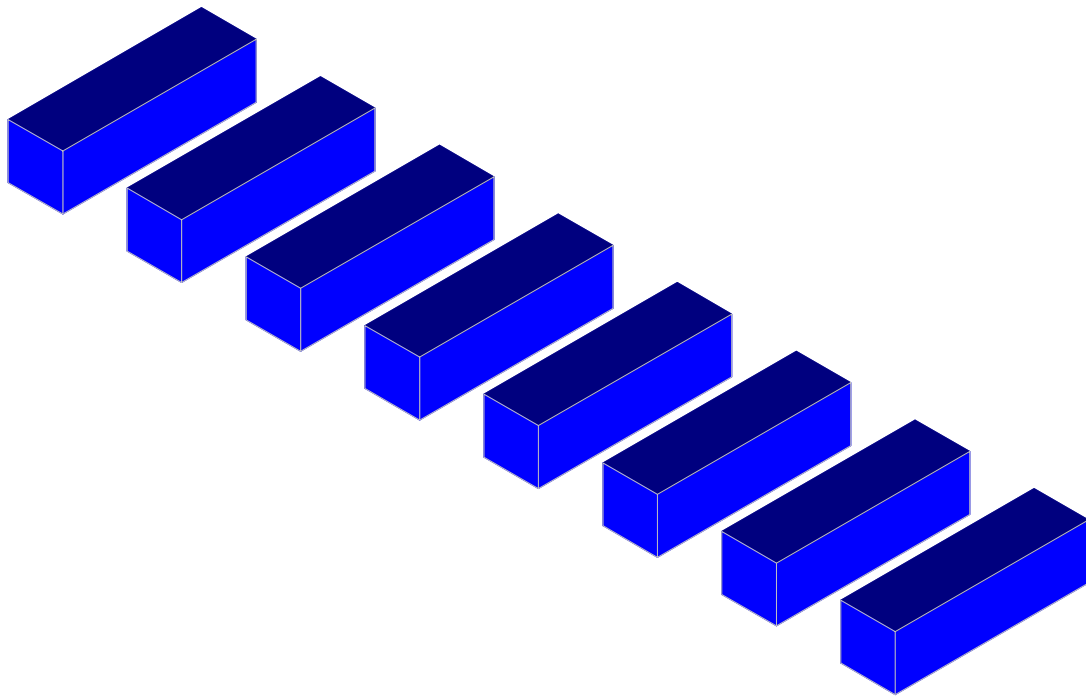
Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2942	1.5	4415
LATERAL	2035	2	4070



JOB NO.: U2716-0276-211

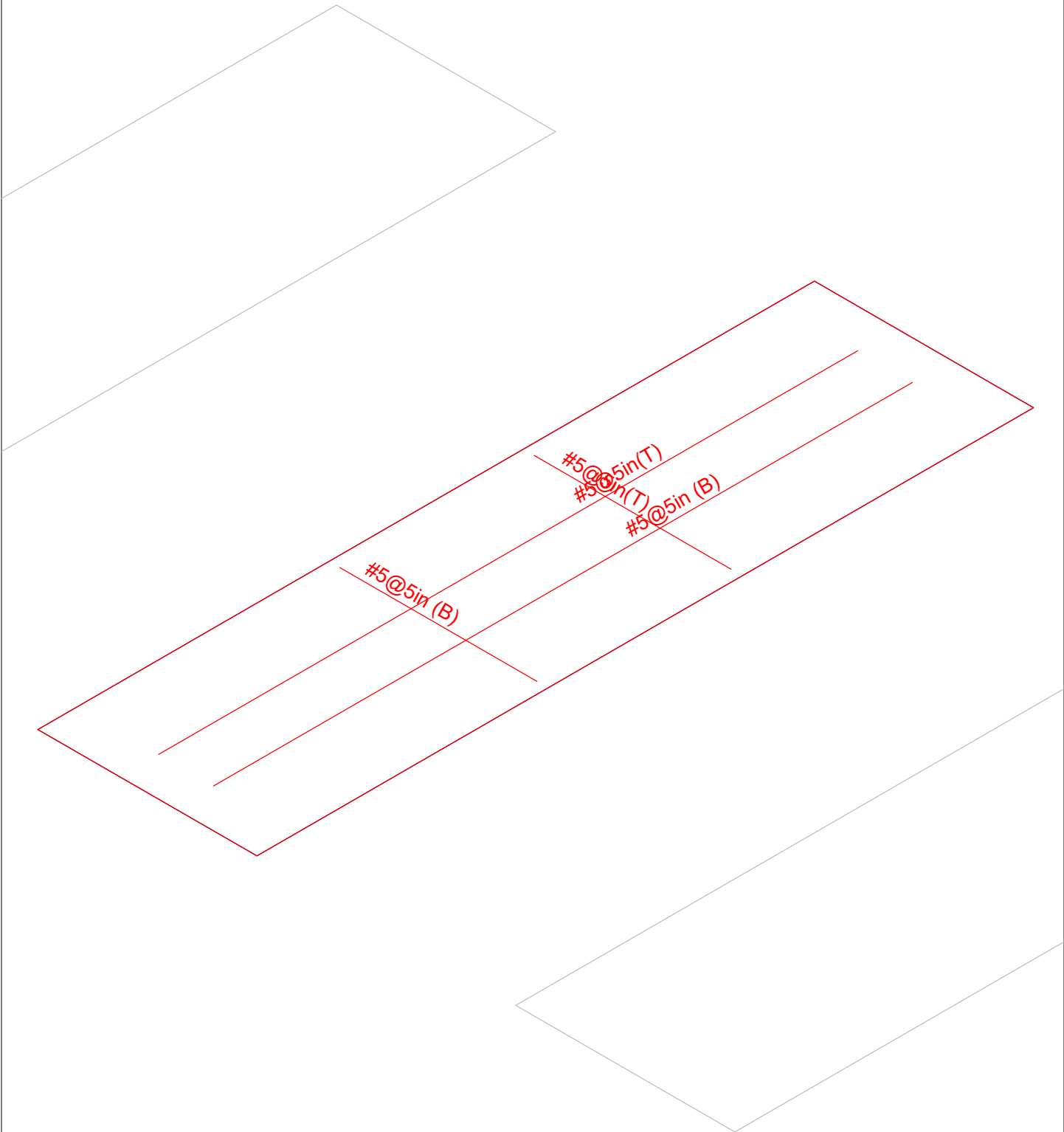
DESIGNED: STB

Foundation Option 4: Ballasted Block



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 2
STB		Jan 26, 2021 at 1:53 PM
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Results for LC 1, 1.0 D

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



(Global) Model Settings

Display Sections for Member Calcs	5
Max Internal Sections for Member Calcs	100
Mesh Size (in)	12
Max Iterations	10
Merge Tolerance (in)	.12
Solver	Sparse Accelerated
Coefficient of Friction	.3
No. of Shear Regions	4
Shear Region Spacing Increment (in)	4
Min 1 Bar Dia Spacing for Beams?	No
Optimize footings for OTM / Sliding?	Yes
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	12	3	12	3	1	Optimize

Soil Definitions

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

Point Loads and Moments (Cat 1 : DL)

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



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

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

Point Loads and Moments (Cat 17 : OL2)

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

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

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

Point Loads and Moments (Cat 19 : OL4)

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



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

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Slab Overturning Safety Factors (By Combination) (Continued)

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



Slab Sliding Safety Factors (By Combination) (Continued)

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



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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]: 4921

V_{uax} [lb]: 160

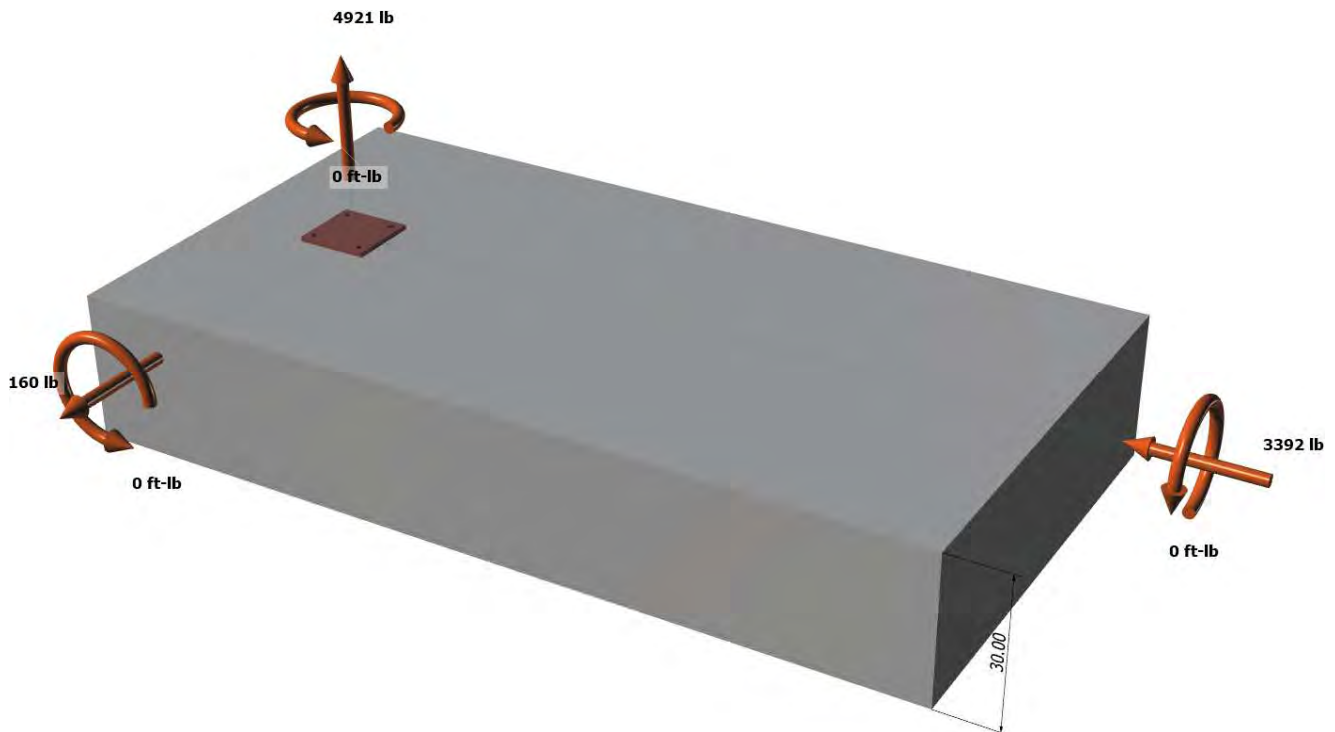
V_{uay} [lb]: -3392

M_{ux} [ft-lb]: 0

M_{uy} [ft-lb]: 0

M_{uz} [ft-lb]: 0

<Figure 1>

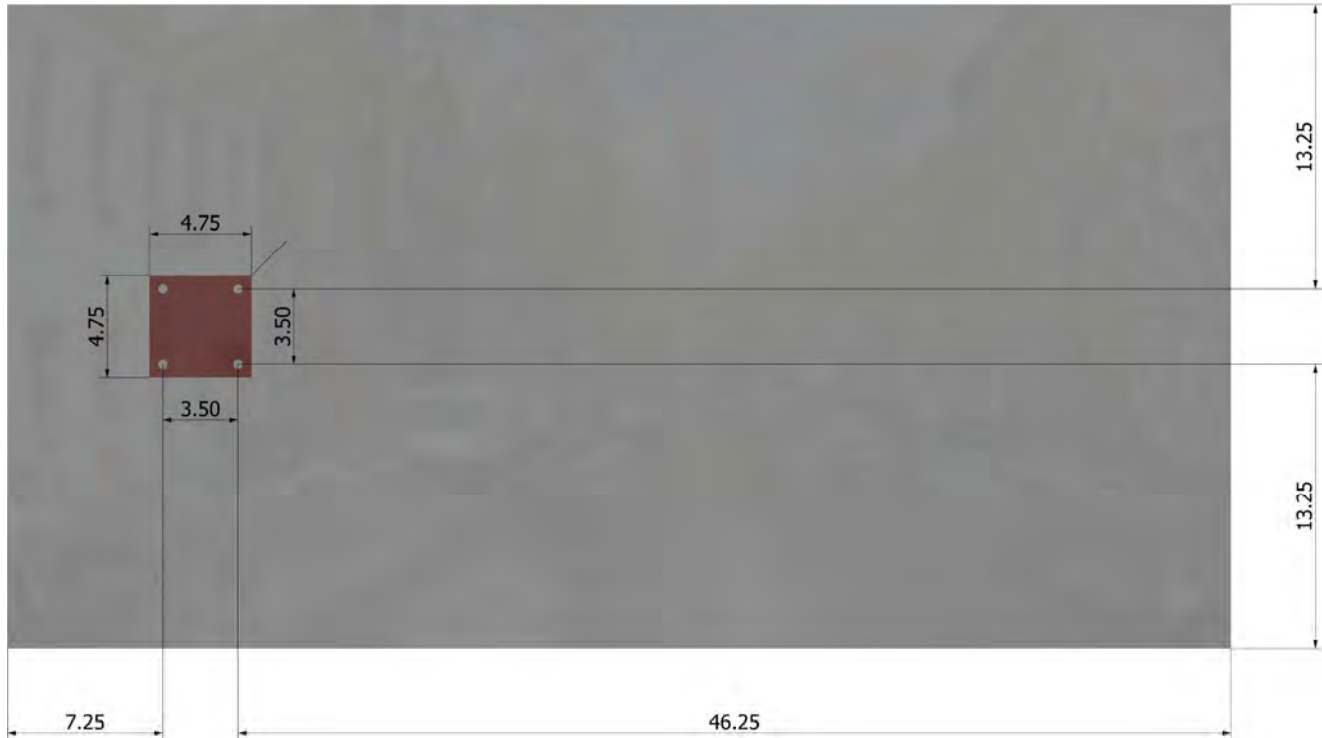


Input data and results must be checked for agreement with the existing circumstances, the standards and guidelines must be checked for plausibility.



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<Figure 2>





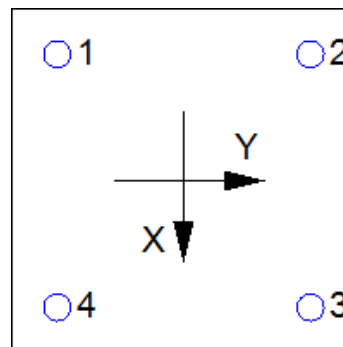
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3. Resulting Anchor Forces

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

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

<Figure 3>



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

N _{sa} (lb)	φ	φN _{sa} (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 _c	λ _a	f _c (psi)	h _{ef} (in)	N _b (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 _{Nc} (in ²)	A _{Nco} (in ²)	c _{a,min} (in)	ψ _{ec,N}	ψ _{ed,N}	ψ _{c,N}	ψ _{cp,N}	N _b (lb)	φ	φN _{cbg} (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 _{k,cr} (psi)	f _{short-term}	K _{sat}	f _c (psi)	n	τ _{k,cr} (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 _a	τ _{cr} (psi)	d _a (in)	h _{ef} (in)	N _{ba} (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 _{Na} (in ²)	A _{Na0} (in ²)	c _{Na} (in)	c _{a,min} (in)	ψ _{ec,Na}	ψ _{ed,Na}	ψ _{cp,Na}	N _{ba} (lb)	φ	φN _{ag} (lb)
198.45	112.09	5.29	7.25	1.000	1.000	1.000	6343	0.55	6176



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

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (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)	λ_a	f_c (psi)	c_{a1} (in)	V_{bx} (lb)
3.00	0.375	1.00	2500	16.75	22270

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

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

Shear perpendicular to edge in y-direction:

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

l_e (in)	d_a (in)	λ_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 ²)	A_{Vco} (in ²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgy} (lb)
483.75	520.03	1.000	0.947	1.000	1.000	11450	0.70	7057

Shear parallel to edge in y-direction:

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

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

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

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

Shear parallel to edge in x-direction:

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

l_e (in)	d_a (in)	λ_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 ²)	A_{Vco} (in ²)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
274.59	236.53	1.000	1.000	1.000	1.000	6342	0.70	10307

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

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

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

A_{Nc} (in ²)	A_{Nco} (in ²)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	N_{cb} (lb)	ϕ
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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ϕV_{cpq} (lb)
15722

11. Results

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

Tension	Factored Load, N_{ua} (lb)	Design Strength, ϕN_n (lb)	Ratio	Status
Steel	1230	3394	0.36	Pass
Concrete breakout	4921	7374	0.67	Pass
Adhesive	4921	6176	0.80	Pass (Governs)

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

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

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

12. Warnings

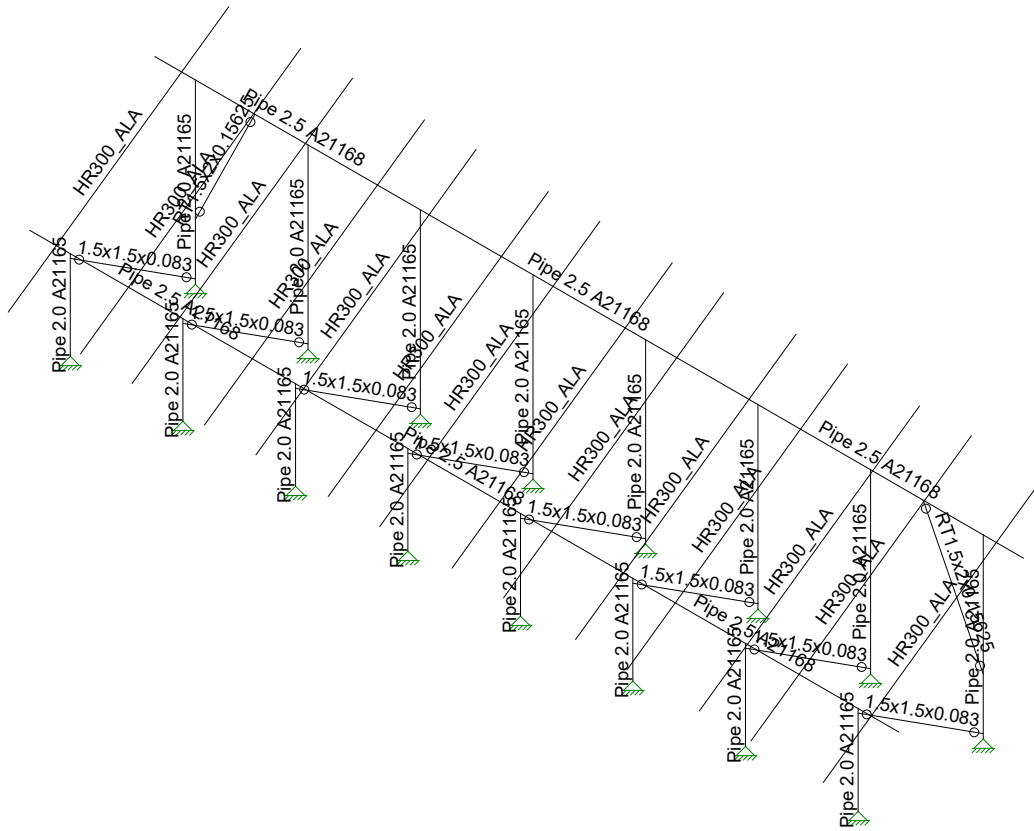
- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.



JOB NO.: U2716-0276-211

DESIGNED: STB

Framing Analysis



Vector Structural Engineeri...

STB

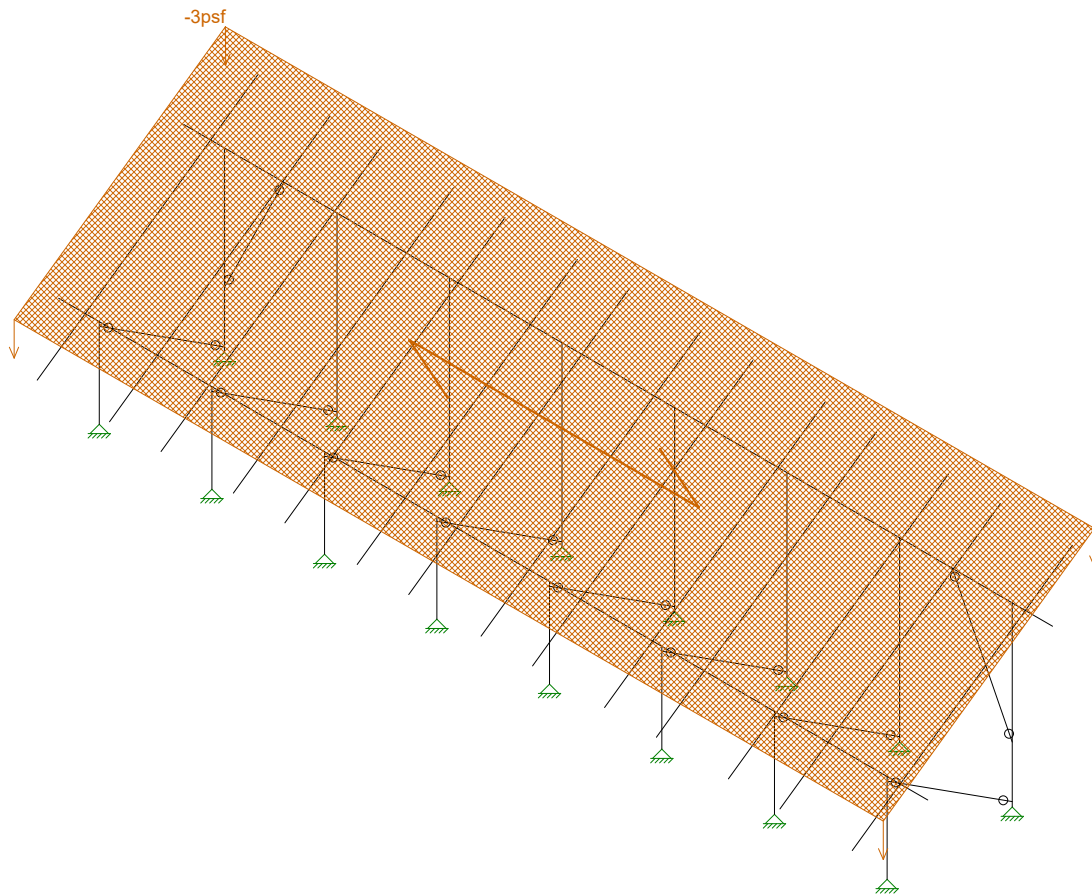
U2716.0276.211

Ground Mount

SK - 3

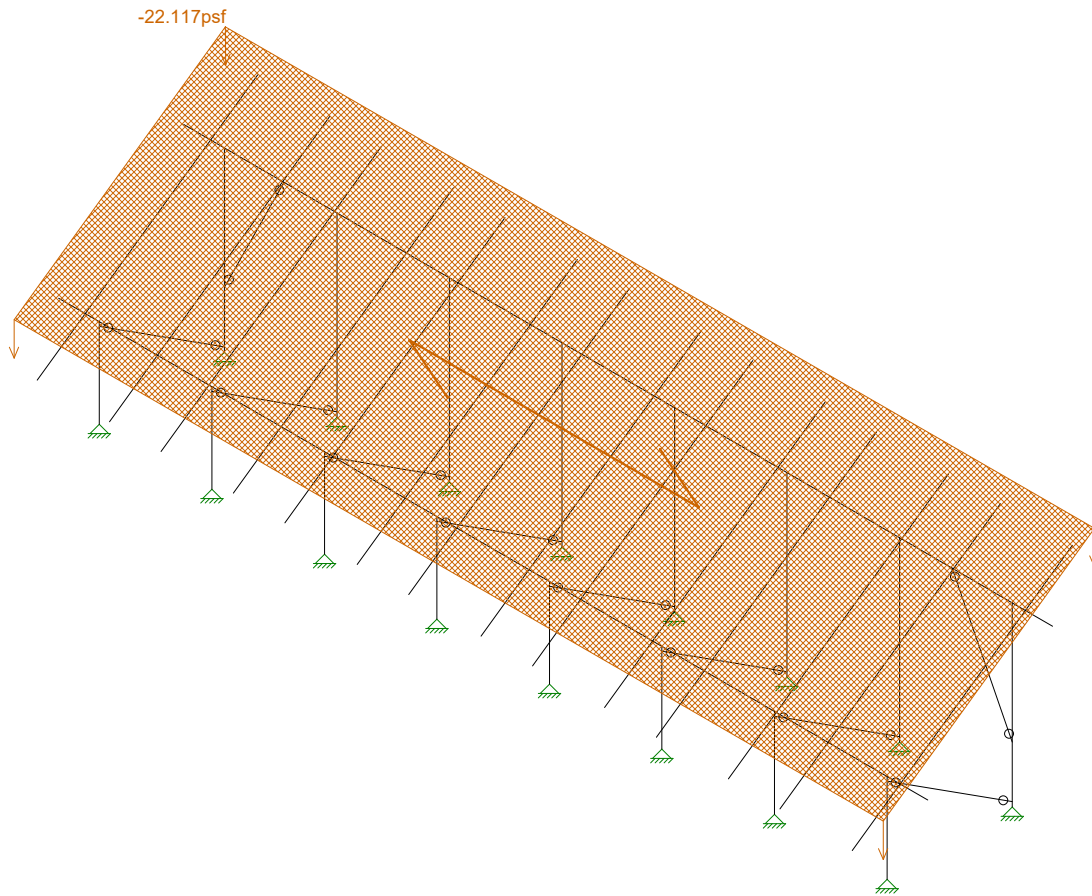
Jan 26, 2021 at 10:29 AM

Sunmodo Sunturf A9 v2.r3d



Loads: BLC 2, Solar Panel Weight

Vector Structural Engineeri...	Ground Mount	SK - 4
STB		Jan 26, 2021 at 10:29 AM
U2716.0276.211		Sunmodo Sunturf A9 v2.r3d



Loads: BLC 3, Roof Live/Snow

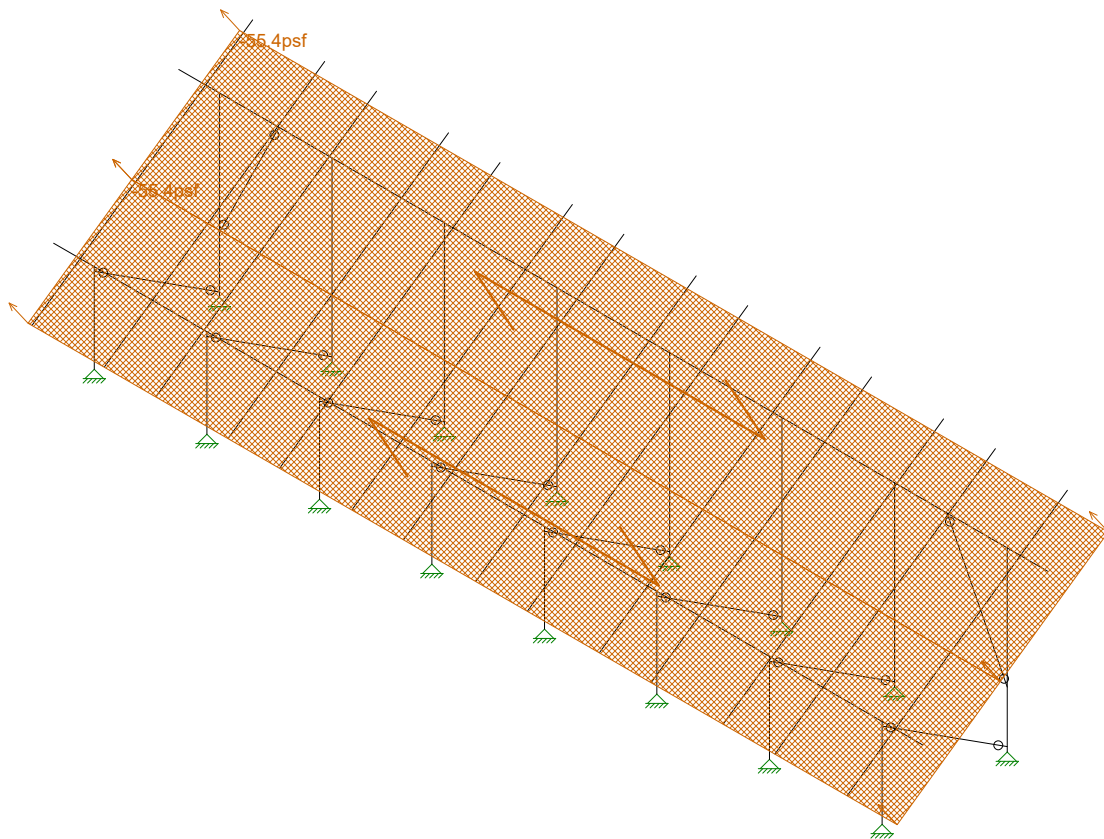
Vector Structural Engineeri...
STB
U2716.0276.211

Ground Mount

SK - 5

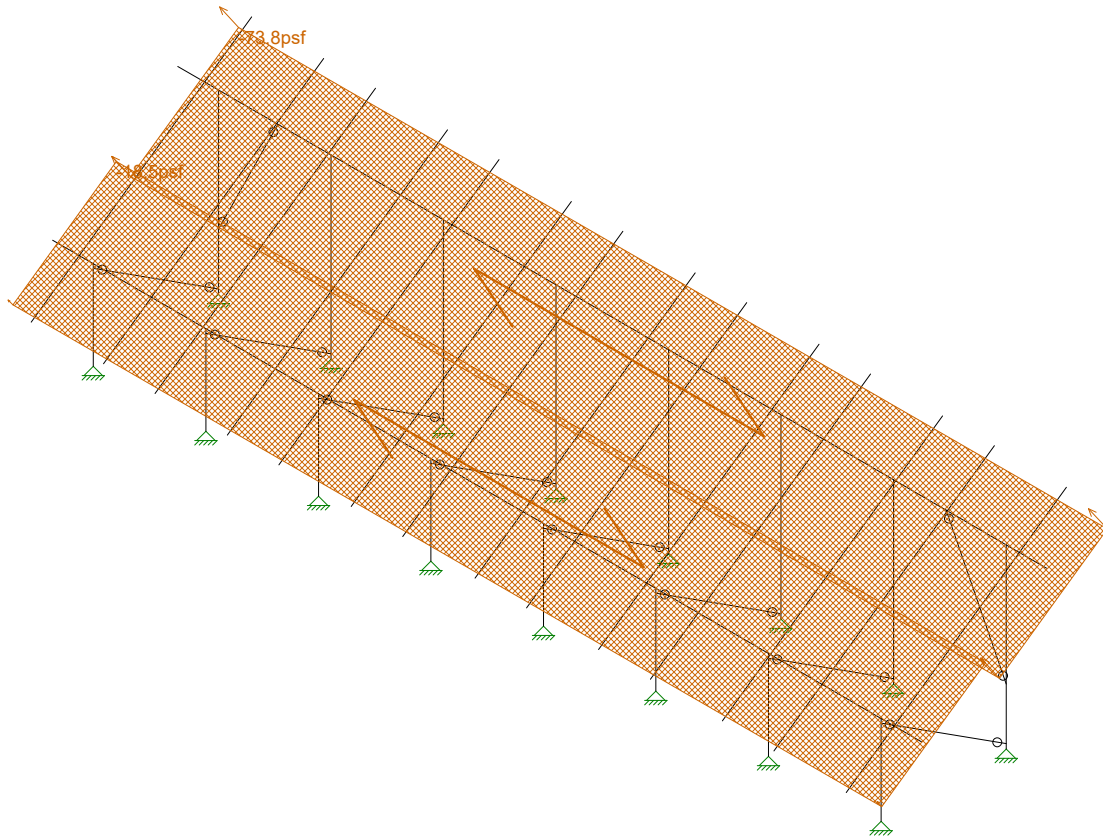
Jan 26, 2021 at 10:29 AM

Sunmodo Sunturf A9 v2.r3d



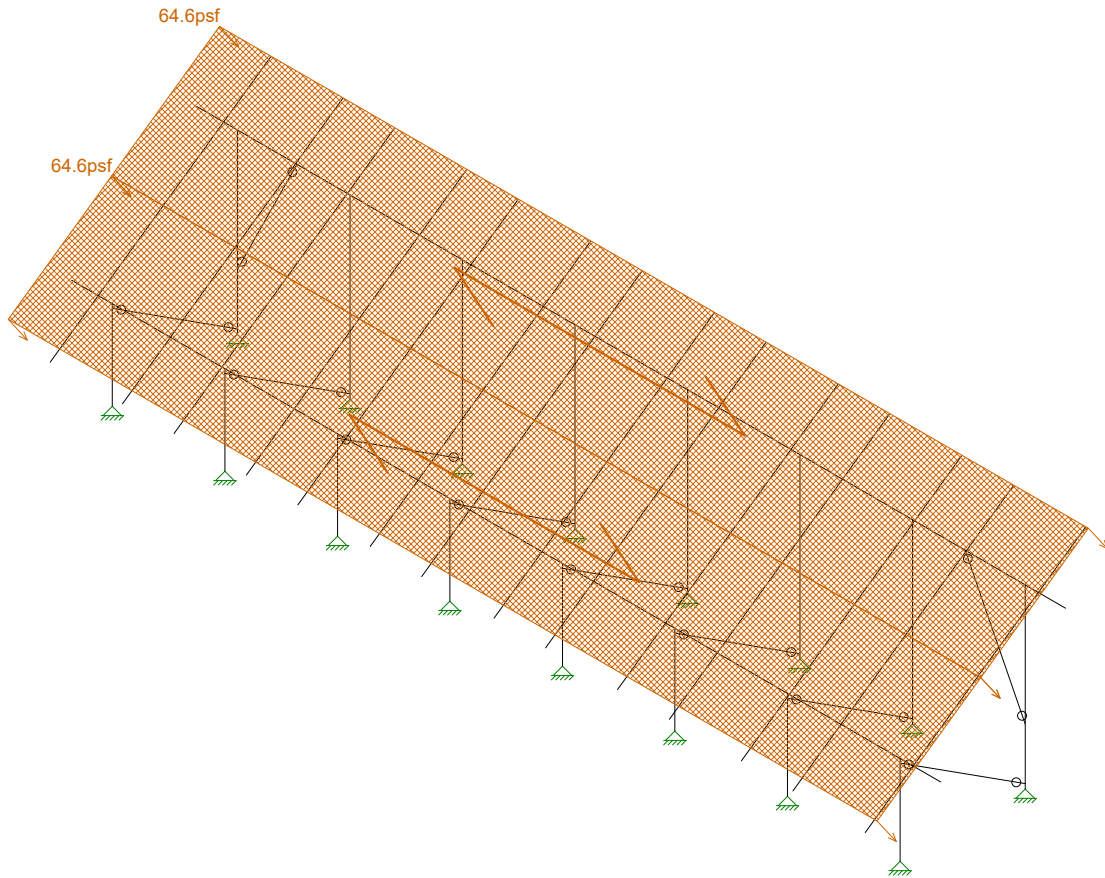
Loads: BLC 4, Wind A 0 deg

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



Loads: BLC 5, Wind B 0 deg

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



Loads: BLC 6, Wind A 180 deg

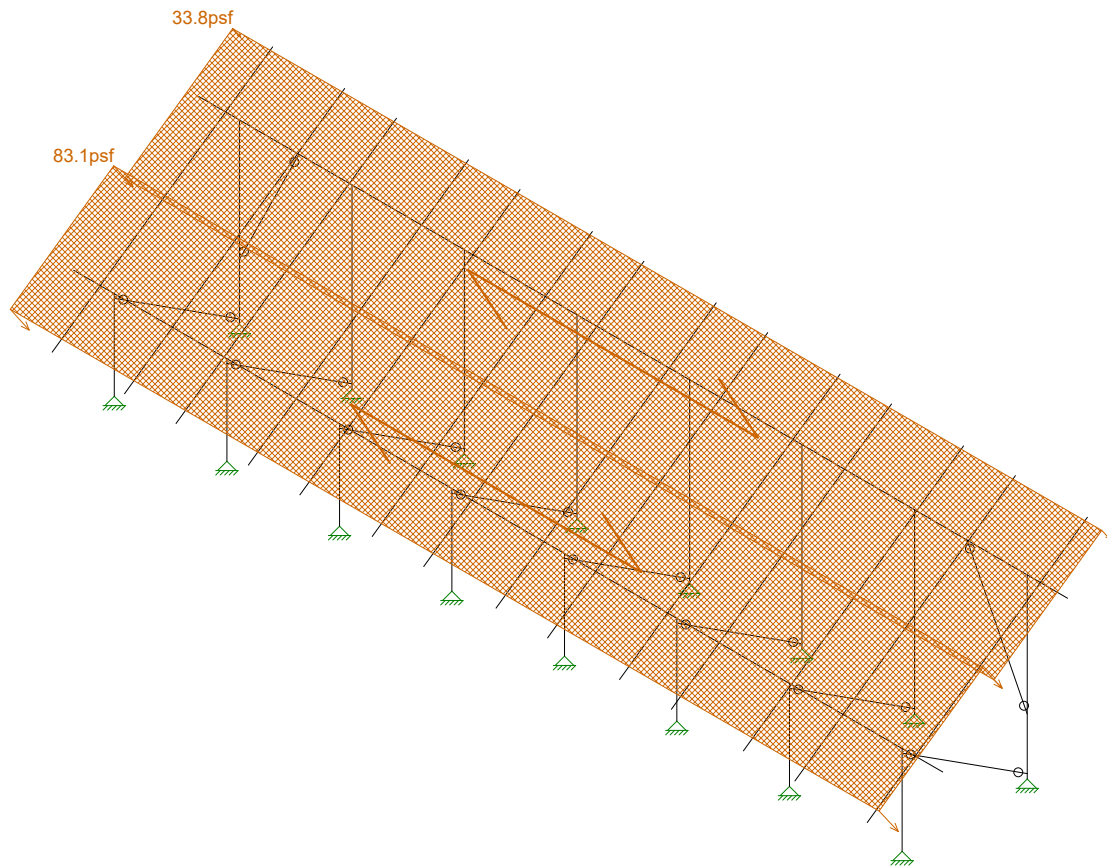
Vector Structural Engineeri...
STB
U2716.0276.211

Ground Mount

SK - 7

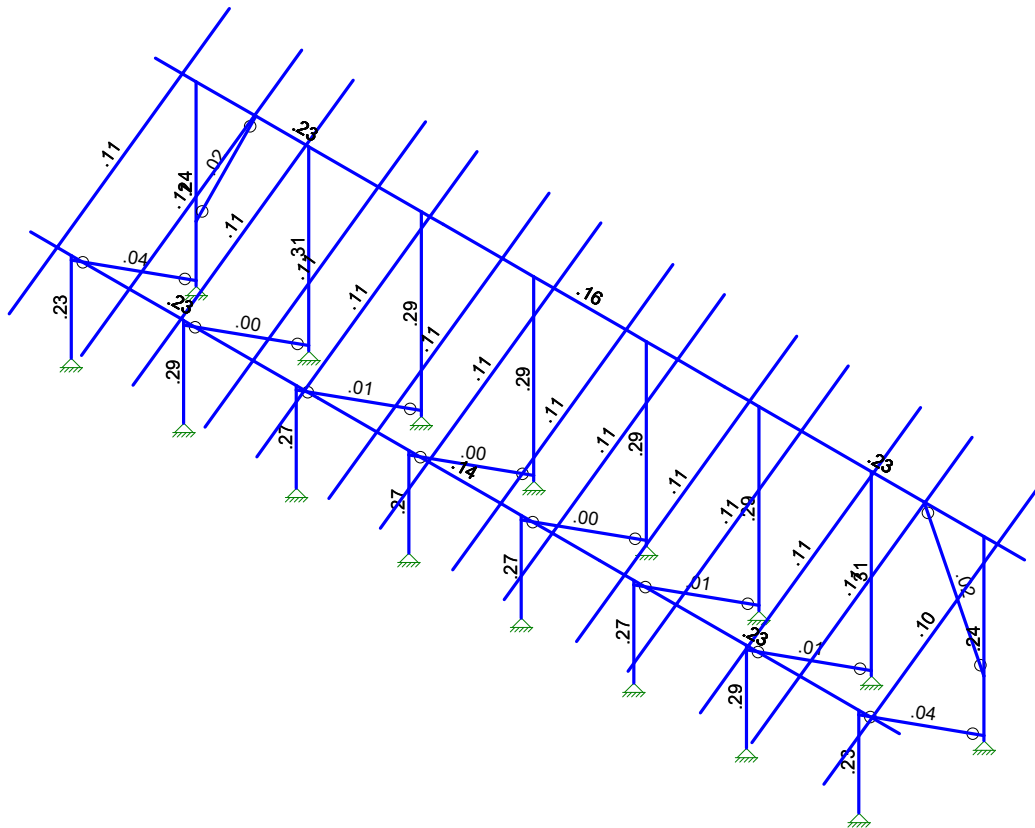
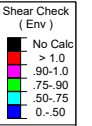
Jan 26, 2021 at 10:29 AM

Sunmodo Sunturf A9 v2.r3d



Loads: BLC 7, Wind B 180 deg

Vector Structural Engineeri...	Ground Mount	SK - 8
STB		Jan 26, 2021 at 10:29 AM
U2716.0276.211		Sunmodo Sunturf A9 v2.r3d



Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 2
STB		Jan 26, 2021 at 10:28 AM
U2716.0276.211		Sunmodo Sunturf A9 v2.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



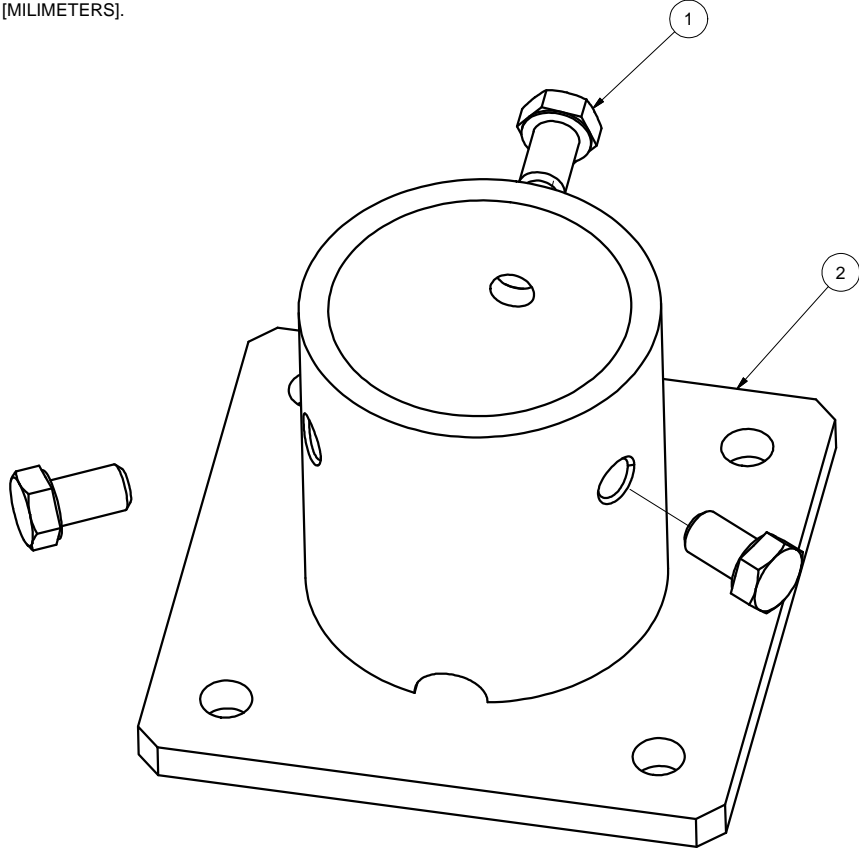
Company : Vector Structural Engineering
 Designer : STB
 Job Number : U2716.0276.211
 Model Name : Ground Mount

Jan 26, 2021
 10:37 AM
 Checked By: _____

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

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

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



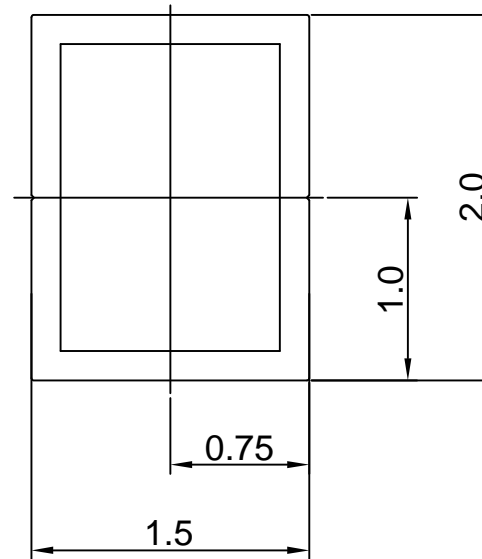
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	10/20/2016

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		Sunmodo Corp. 1905 E 5TH STREET, STE A, VANCOUVER, WA 98661	
Tolerances		TITLE	
X.XXX ±0.01 [0.25mm]		2" PIPE BASE KIT	
X.XX ±0.02 [0.50mm]		DRAWING NUMBER	
X.X ±0.039 [1.0mm]		B K10268-001	
Unless otherwise spec'd		SCALE: NONE	
DRAWN BY		SHEET 1 of 1	
LWF			
DATE			
10/20/2016			
CHECKED BY			
APPROVALS			

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NOTES: UNLESS OTHERWISE SPECIFIED

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



Section properties:

Weight: 1.156 lbs/ft

Area: 0.992 in²

Perimeter: 12.601 in

Bounding Box: X: -1.000,1.000

Y: -0.750, 0.750

Centroid:(0.000,0.000)

Moments of Inertia(in⁴): I_x=0.506,I_y=0.322

Section modulus in bending(in³): W_x=0.675,W_y=0.322

Radii of Gyration: X: 0.714, Y: 0.570

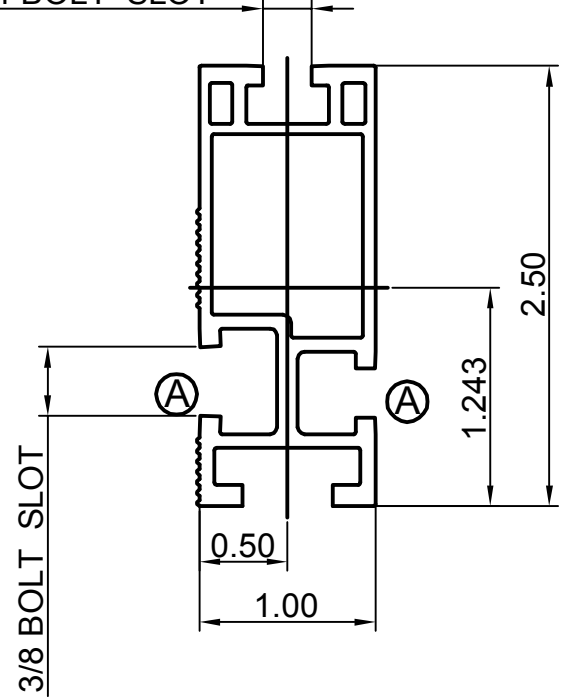
MATERIAL		SEE NOTES	
Third Angle Projection:		<h1>Sunmodo Corp.</h1> <p>1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661</p>	
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters] Tolerances X.XXX ± 0.01 [0.25mm] X.XX ± 0.02 [0.50mm] X.X ± 0.039 [1.0mm] Unless otherwise specified.			
DRAWN BY		DATE	
zcg		03/12/2014	
CHECKED BY		B	
APPROVALS		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 μ 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 in²
 Perimeter: 17.325 in
 Bounding Box: X: -0.500,0.500
 Y: -1.243,1.257

Centroid:(0.000,0.000)
 Moments of Incertia(in⁴): Ix=0.486,Iy=0.095
 Section modulus in bending(in³): Wx=0.387,Wy=0.190
 Radii of Gyration: X: 0.820, Y: 0.363

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

4

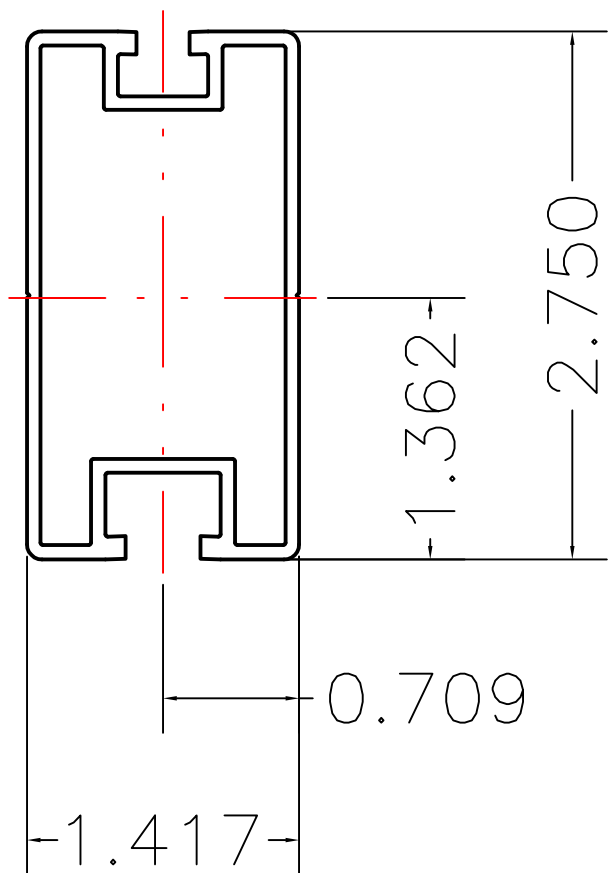
3

2

1

NOTES: UNLESS OTHERWISE SPECIFIED

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



Section properties:

Weight: 0.862 lbs/ft
 Area: 0.736 in²
 Perimeter: 19.824 in
 Bounding Box: X: -0.709,0.709
 Y: -1.362,1.388
 Centroid:(0.000,0.000)
 Moments of Inertia(in⁴): I_x=0.727,I_y=0.214
 Section modulus in bending(in³): W_x=0.524,W_y=0.302
 Radii of Gyration: X: 0.994, 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	

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

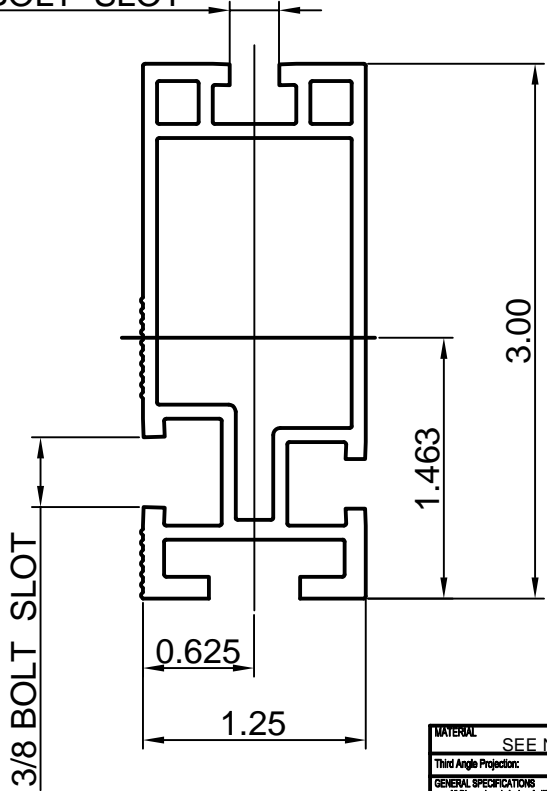
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REV	DESCRIPTON	BY	DATE
A	0.44 WAS 0.41, 0.44 WAS 0.33	LWF	11/30/2015

NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
2. MATERAIL: ALUMINUM 6005-T5.
FINISH: CLEAR ANODIZED 15 μ 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 in²
 Perimeter: 22.104 in
 Bounding Box: X: -0.625,0.625
 Y: -1.463,1.537
 Centroid:(0.000,0.000)
 Moments of Inertia(in⁴): Ix=1.047,Iy=0.207
 Section modulus in bending(in³): 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.			
Break all sharp edges 0.10-0.25 unless otherwise specified.			
DRAWN BY		DATE	
ZCJ		02/21/2013	
CHECKED BY		B	
APPROVALS		DRAWING NUMBER	
		A20145	
SCALE:		SHEET	
NONE		1 of 1	

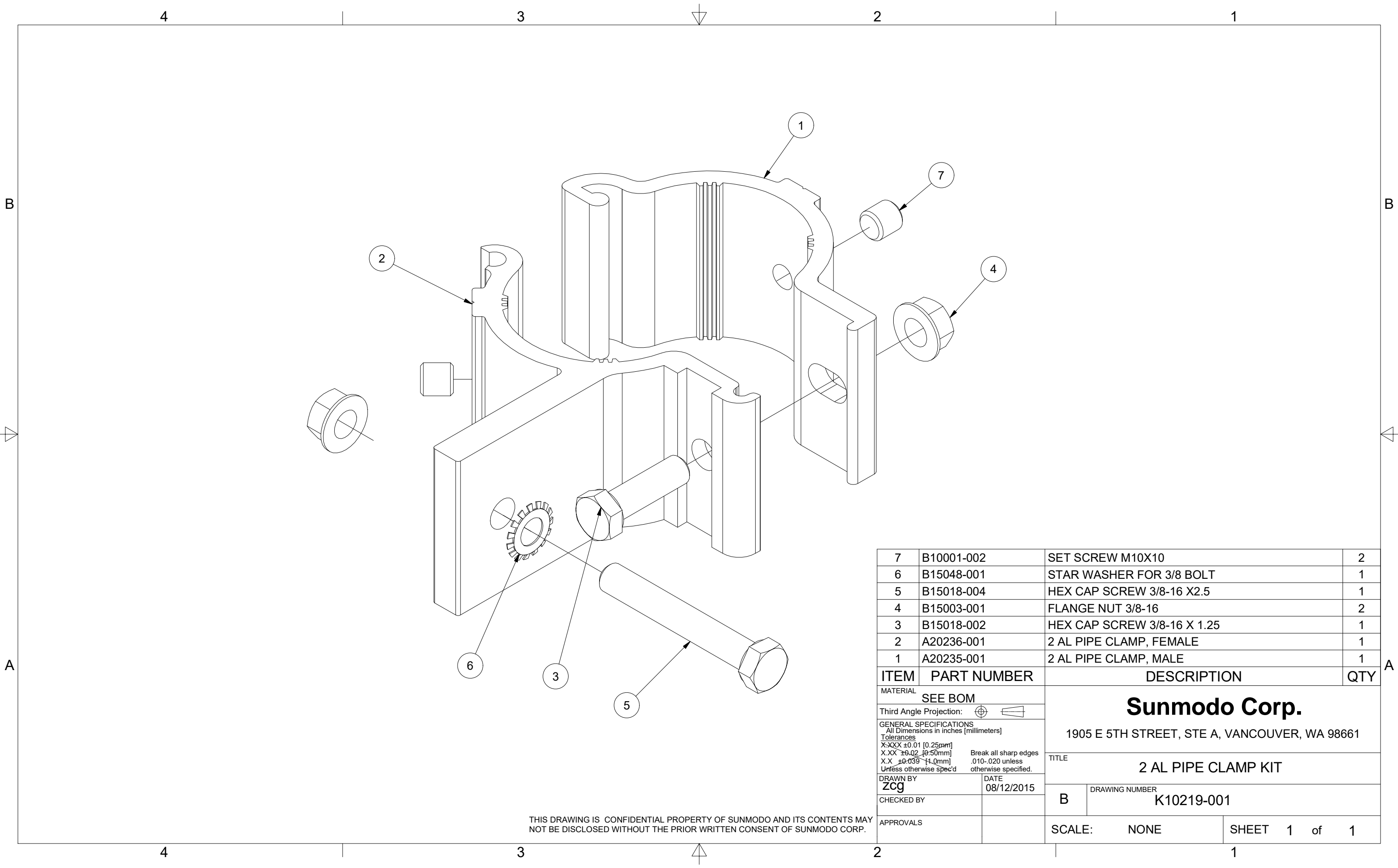
Sunmodo Corp.

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

TITLE
HELIO HEAVY RAIL

DRAWING NUMBER
A20145

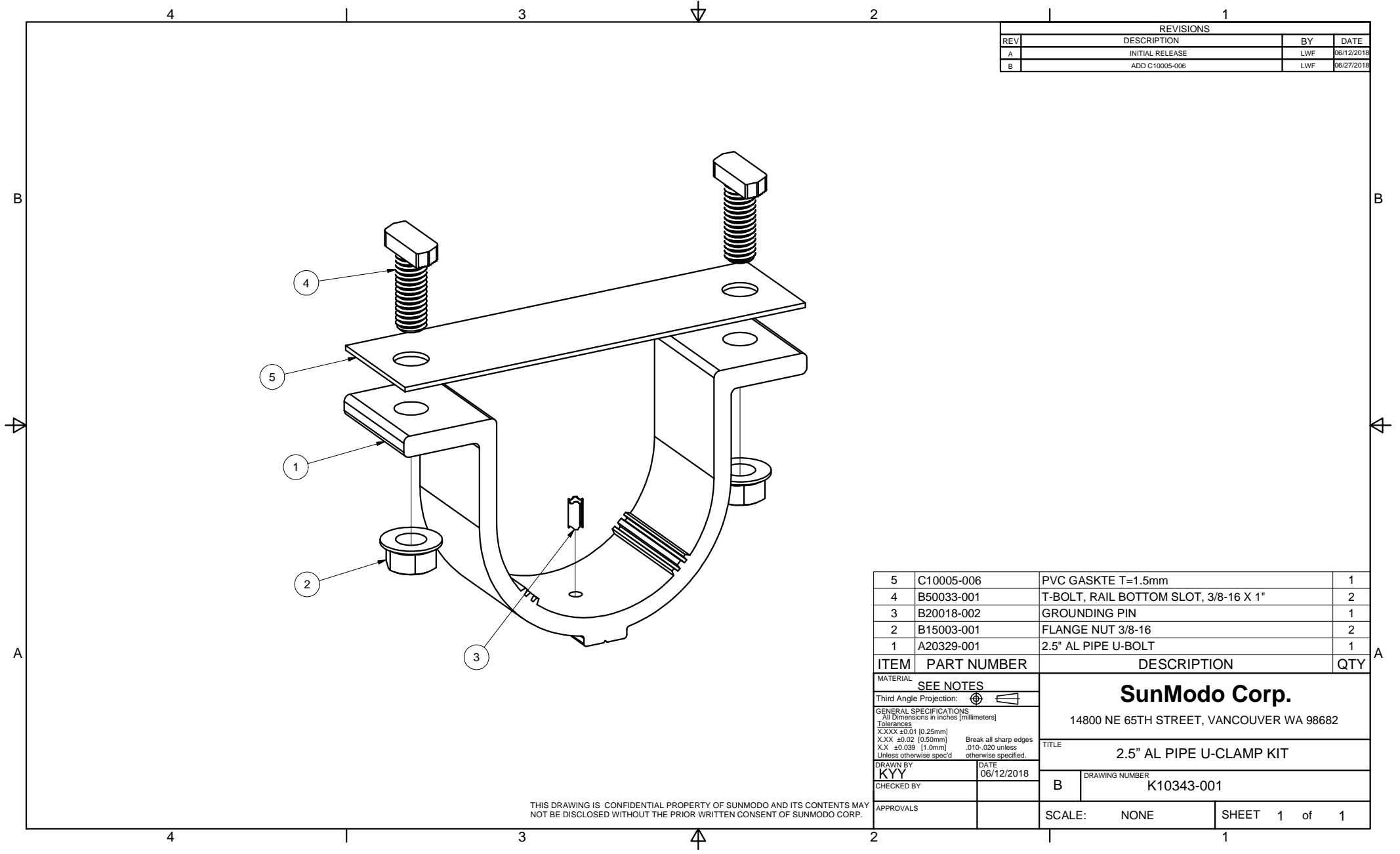
SCALE: NONE SHEET 1 of 1



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		TITLE	
		2 AL PIPE CLAMP KIT	
APPROVALS		DRAWING NUMBER	
		B K10219-001	
SCALE:		NONE	SHEET 1 of 1

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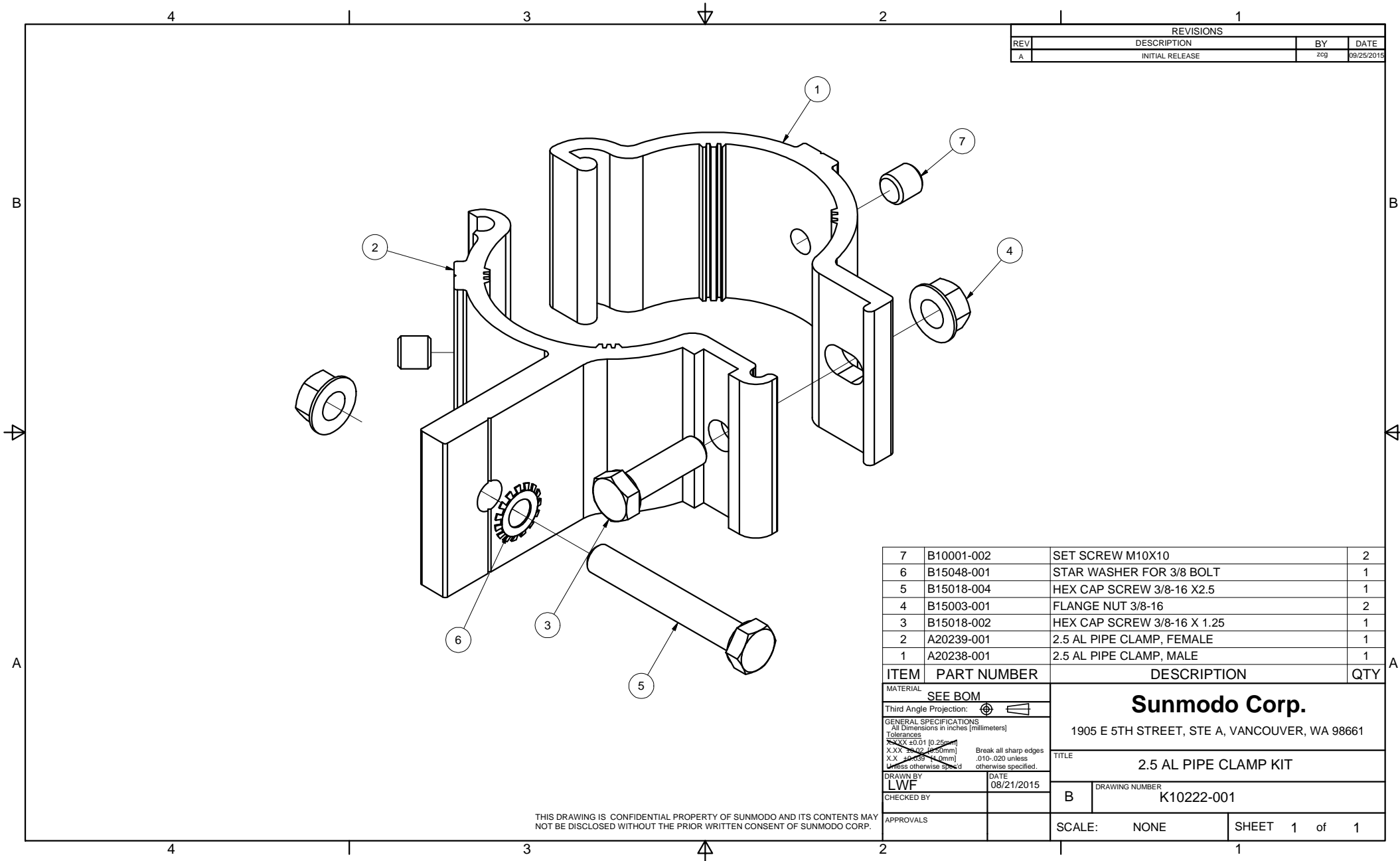


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018
B	ADD C10005-006	LWF	08/27/2018

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		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS		<p>SunModo Corp. 14800 NE 65TH STREET, VANCOUVER WA 98682</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>			
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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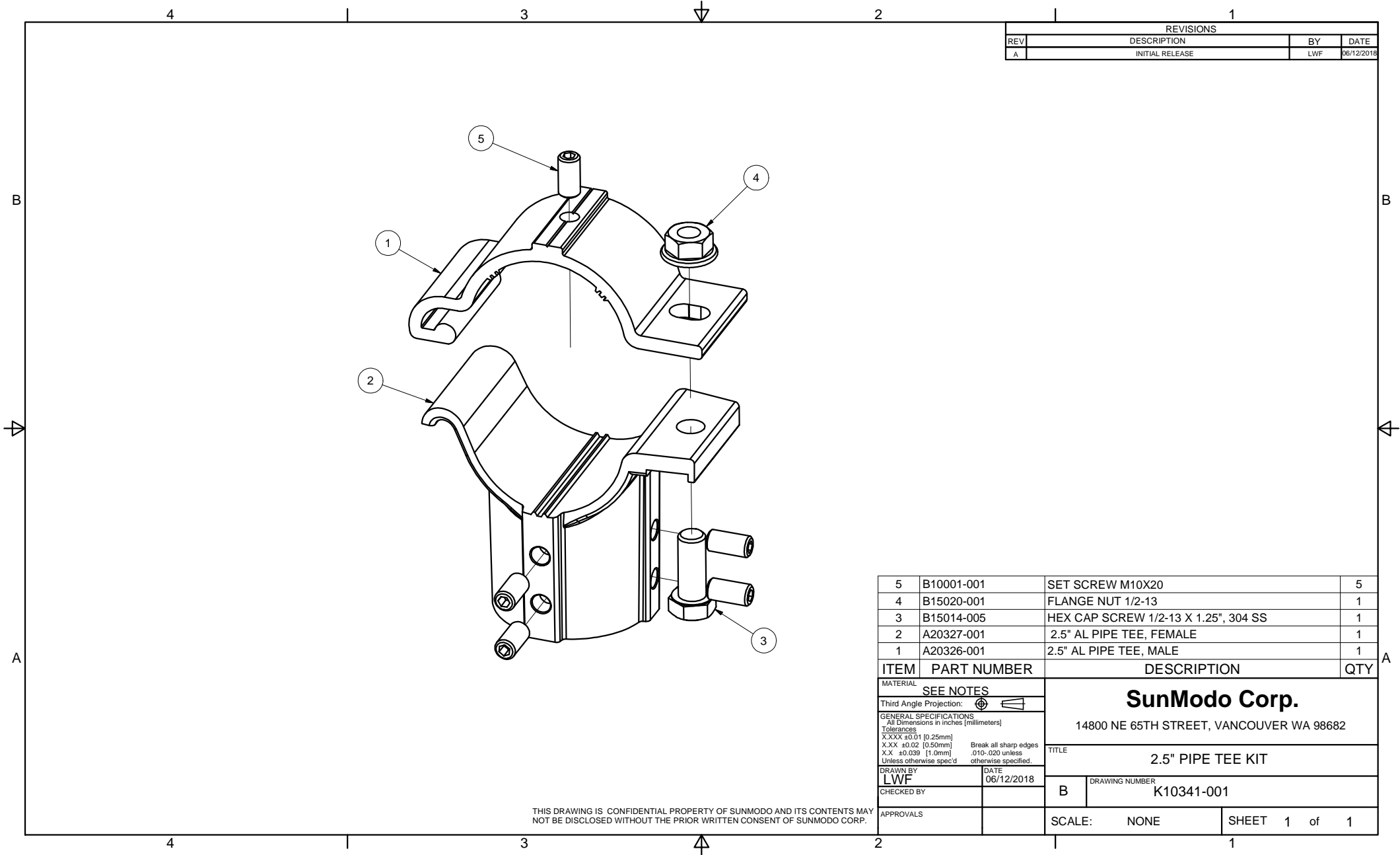


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	zcg	09/25/2015

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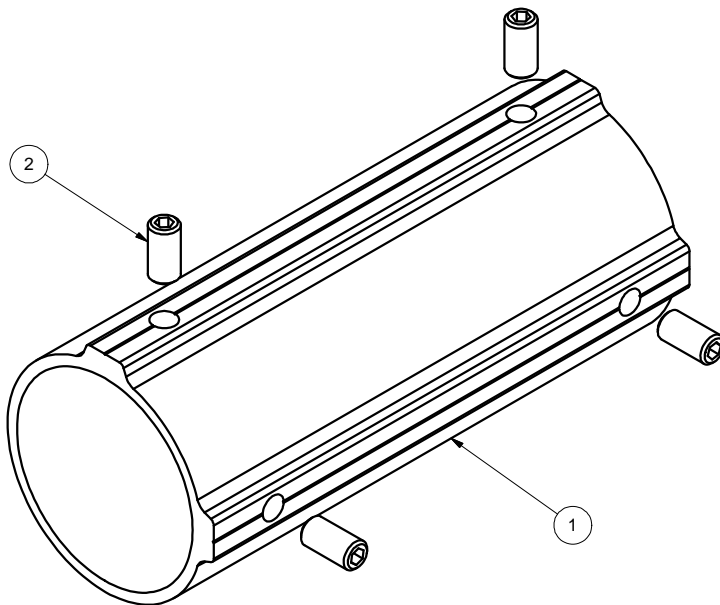
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018

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		SunModo Corp. 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	DRAWING NUMBER	
LWF	06/12/2018	B K10341-001	
CHECKED BY		SCALE: NONE SHEET 1 of 1	
APPROVALS			

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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;">SunModo Corp.</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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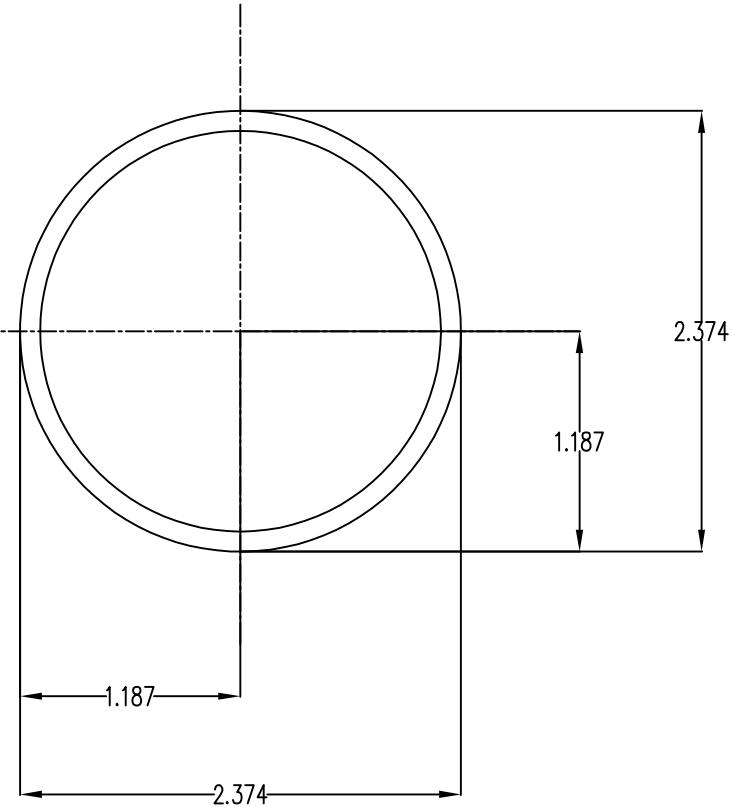
NOTES: UNLESS OTHERWISE SPECIFIED

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 in²

Perimeter: 14.238 in

Bounding Box: X: -1.187,1.187

Y: -1.187,1.187

Centroid:(0.000,0.000)

Moments of Inertia(in⁴): Ix=0.499,Iy=0.499

Section modulus in bending(in³): Wx=0.420,Wy=0.420

Radii of Gyration: X: 0.802, Y: 0.802

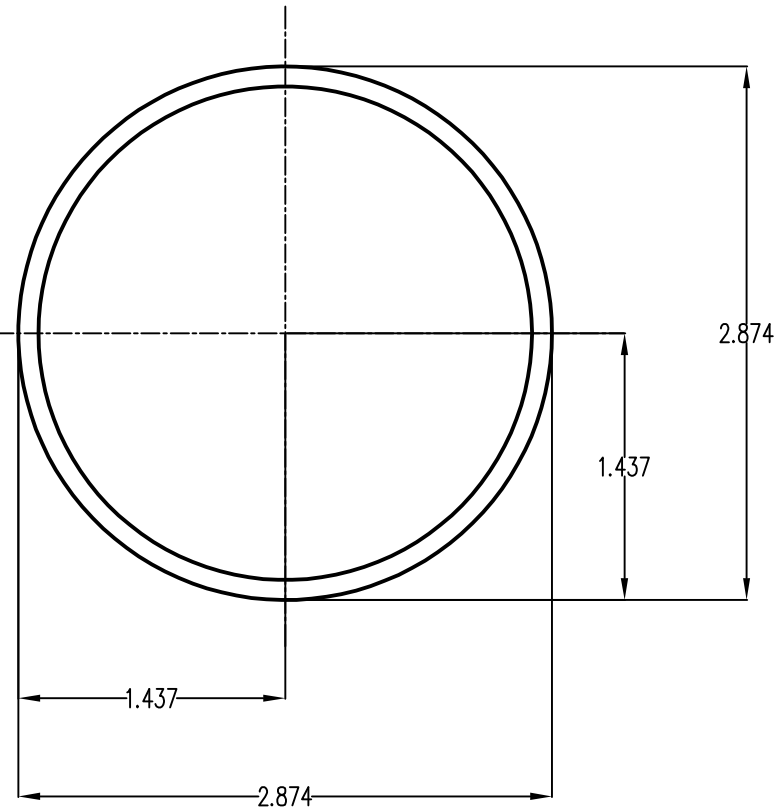
MATERIAL		SEE NOTES		Sunmodo Corp. 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS				TITLE	
All Dimensions in Inches (millimeters)				PIPE, HSS, 2.375" OD X 12 GAUGE,L=XXX	
Tolerances				Break all sharp edges .010-.020 unless otherwise specified.	
XXX ±0.01 (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 in²

Perimeter: 17.378 in

Bounding Box: X: -1.437,1.437

Y: -1.437,1.437

Centroid:(0.000,0.000)

Moments of Inertia(in⁴): Ix=0.901,Iy=0.901

Section modulus in bending(in³): Wx=0.627,Wy=0.627

Radii of Gyration: X: 0.979, Y: 0.979

MATERIAL		SEE NOTES		Sunmodo Corp. 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	