



Project Number: U2716-0231-201

February 17, 2023

Sunmodo
14800 NE 65th Street
Vancouver, WA 98682

**REFERENCE: Sunmodo Sunturf Ground Mount A5a
Ground Mount PV Array Installation**

To Whom It May Concern:

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

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

Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2320	1.5	3480
LATERAL	1690	2	3380

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

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

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

Very truly yours,

VECTOR STRUCTURAL ENGINEERING, LLC
NH Firm License Number: COA 01838

Russ Irion, P.E.
License: 16717 - Expires: 08/31/2024
Project Engineer

Enclosures

RTI/stb

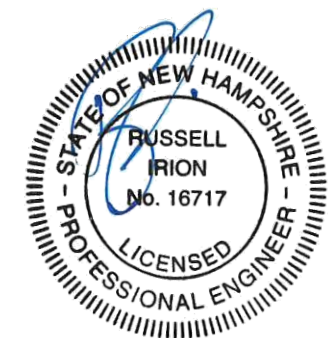
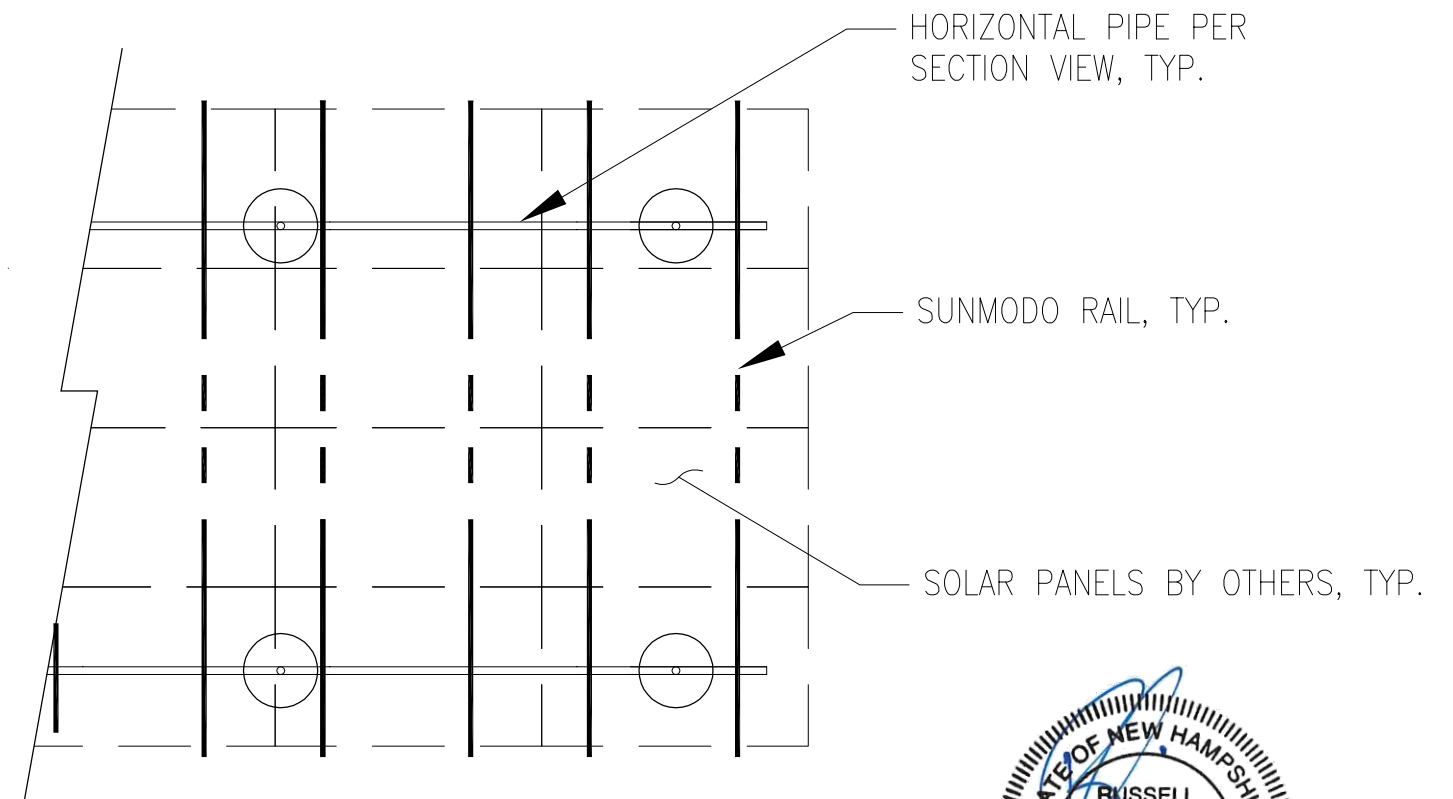
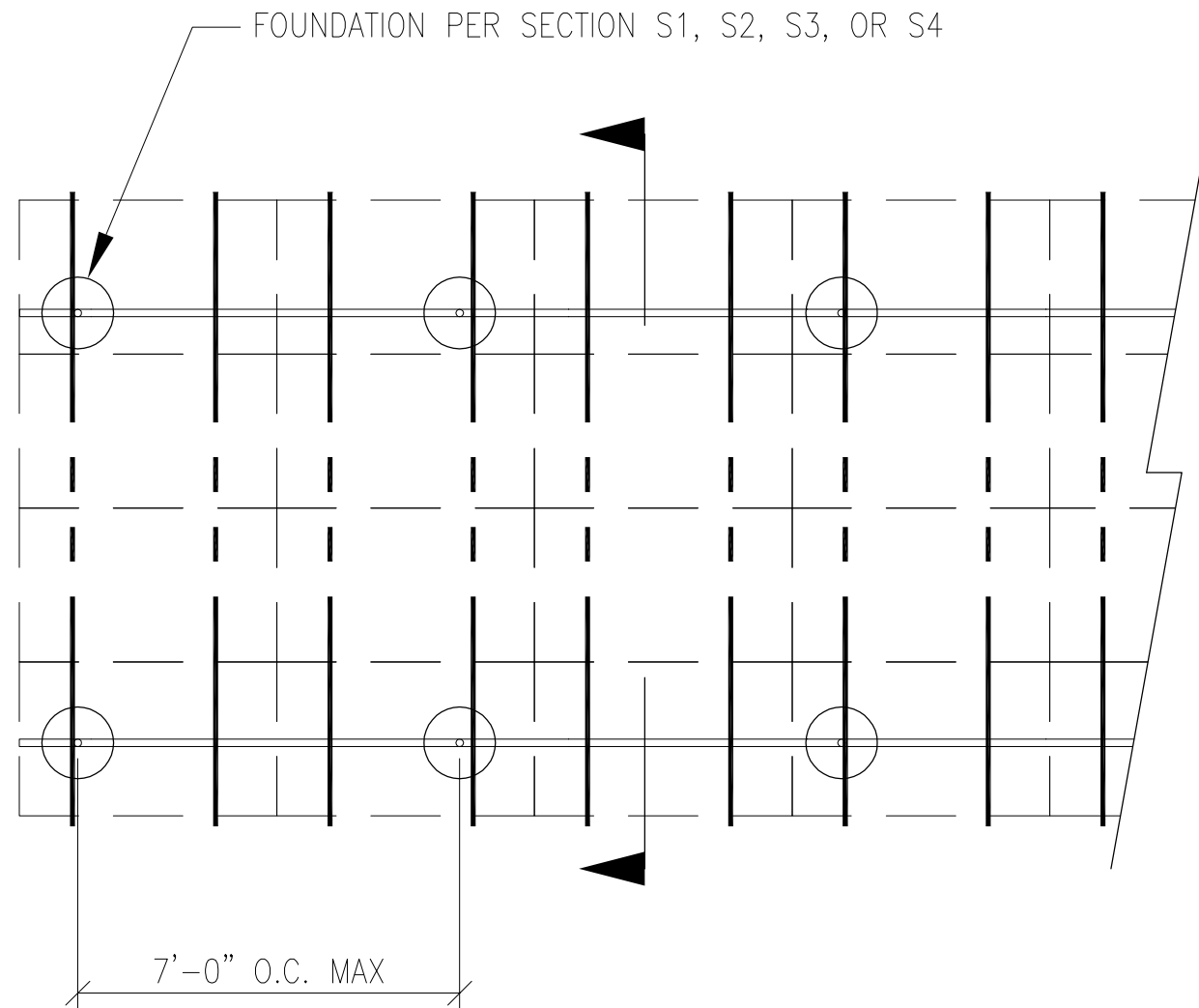


02/17/2023



JOB NO. U2716-0231-201
 PROJECT SUNMODO SUNTURF GROUND MOUNTS A5a
 SUBJECT ALL OPTIONS

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



02/17/2023

PV ARRAY PLAN

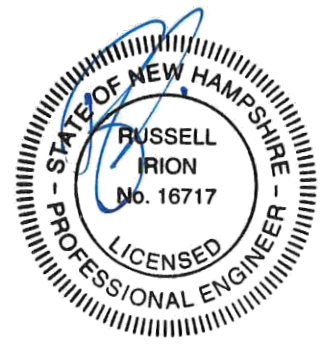
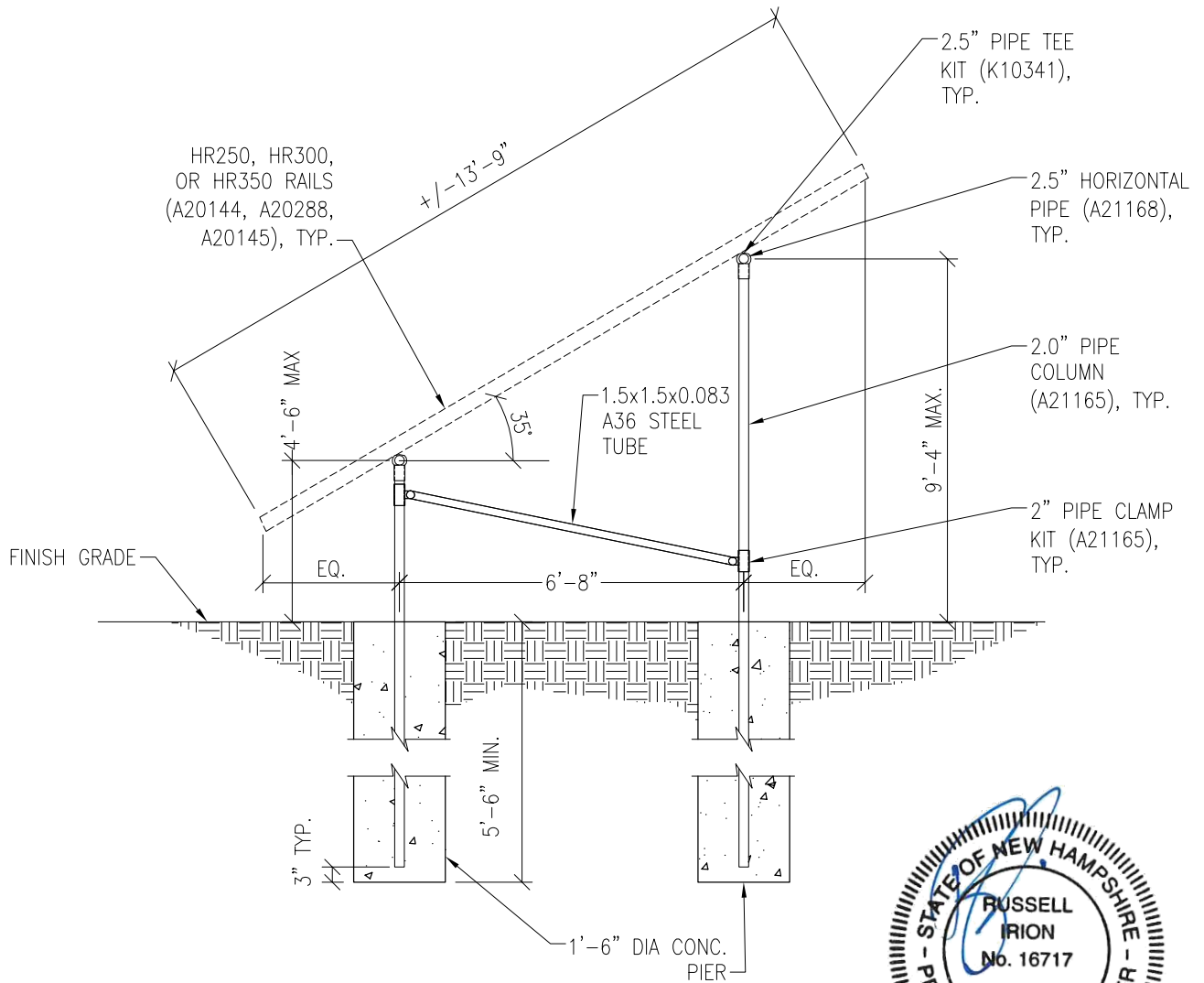
N.T.S.

P1

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PROJECT SUNMODO SUNTURF GROUND MOUNTS A5a

SUBJECT DRILLED PIER OPTION



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PV ARRAY SECTION

N.T.S.

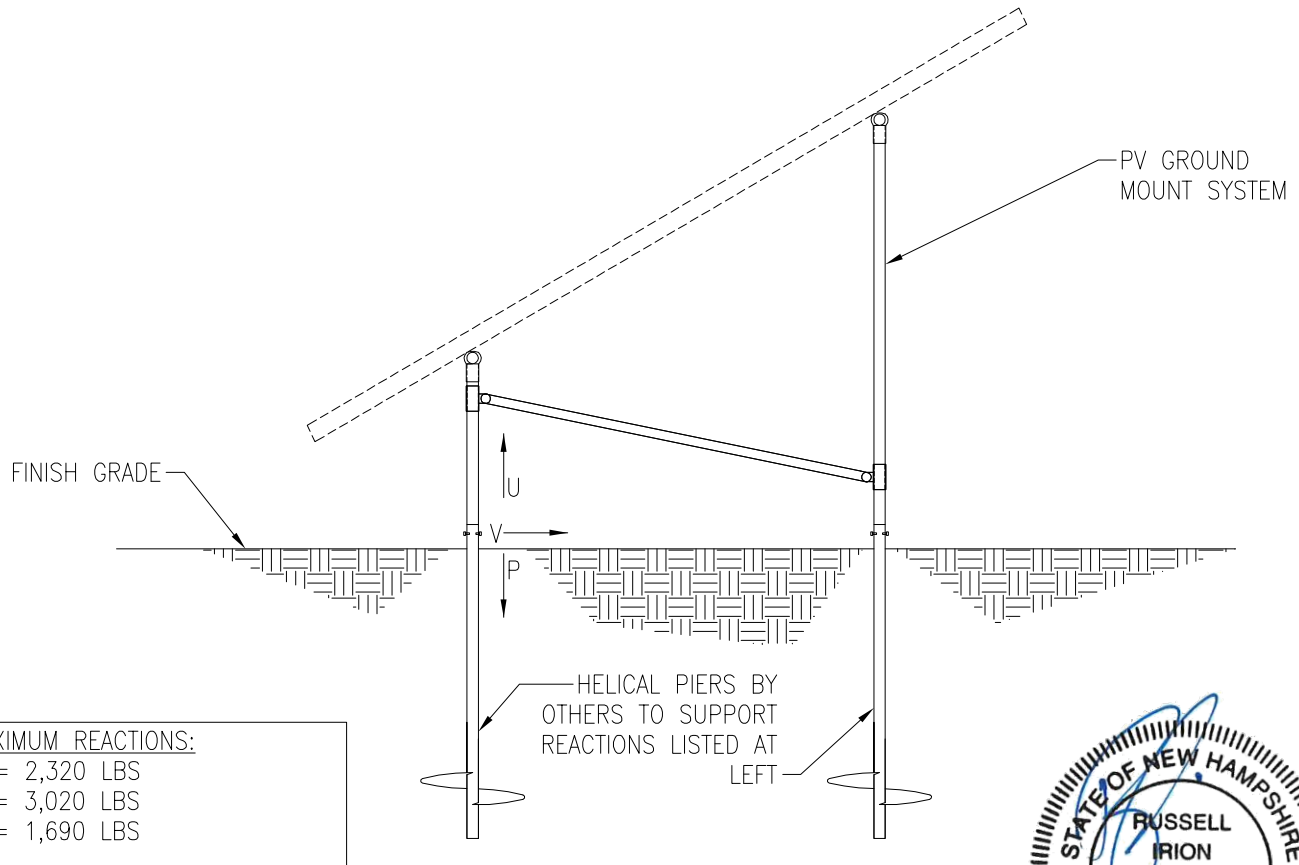
S1

PROJECT SUNMODO SUNTURF GROUND MOUNTS A5a

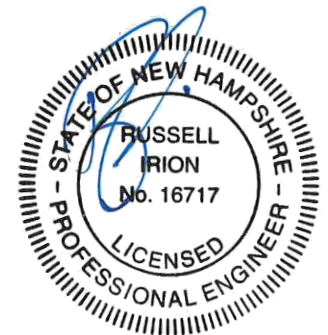
SUBJECT HELICAL PIER OPTION

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



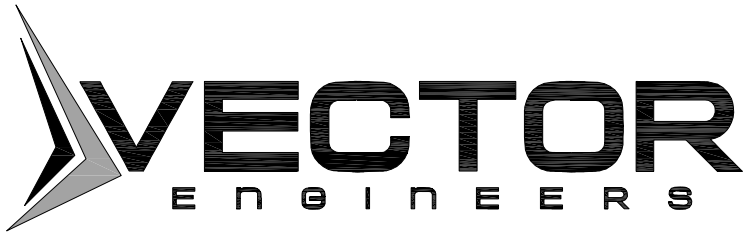
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PV ARRAY SECTION

N.T.S.

S2



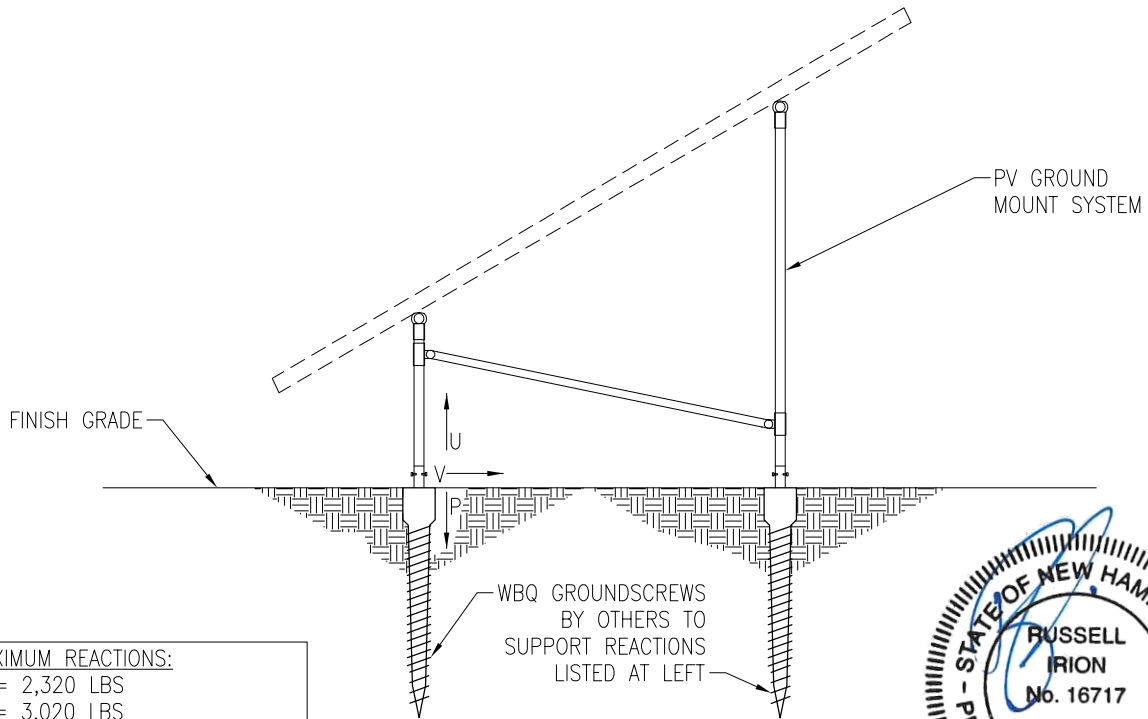
JOB NO. U2716-0231-201

PROJECT SUNMODO SUNTURF GROUND MOUNTS A5a

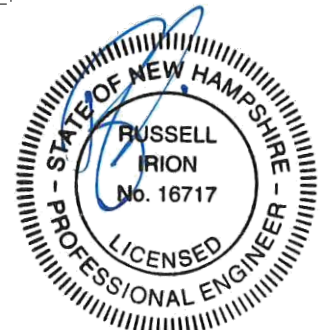
SUBJECT GROUND SCREW OPTION

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:
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PV ARRAY SECTION

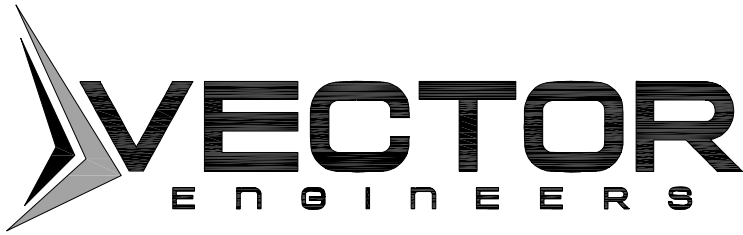
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S3

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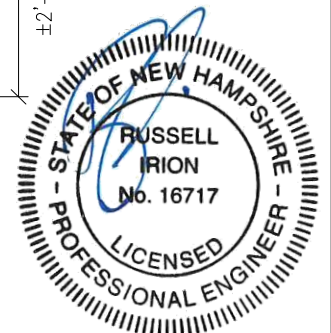
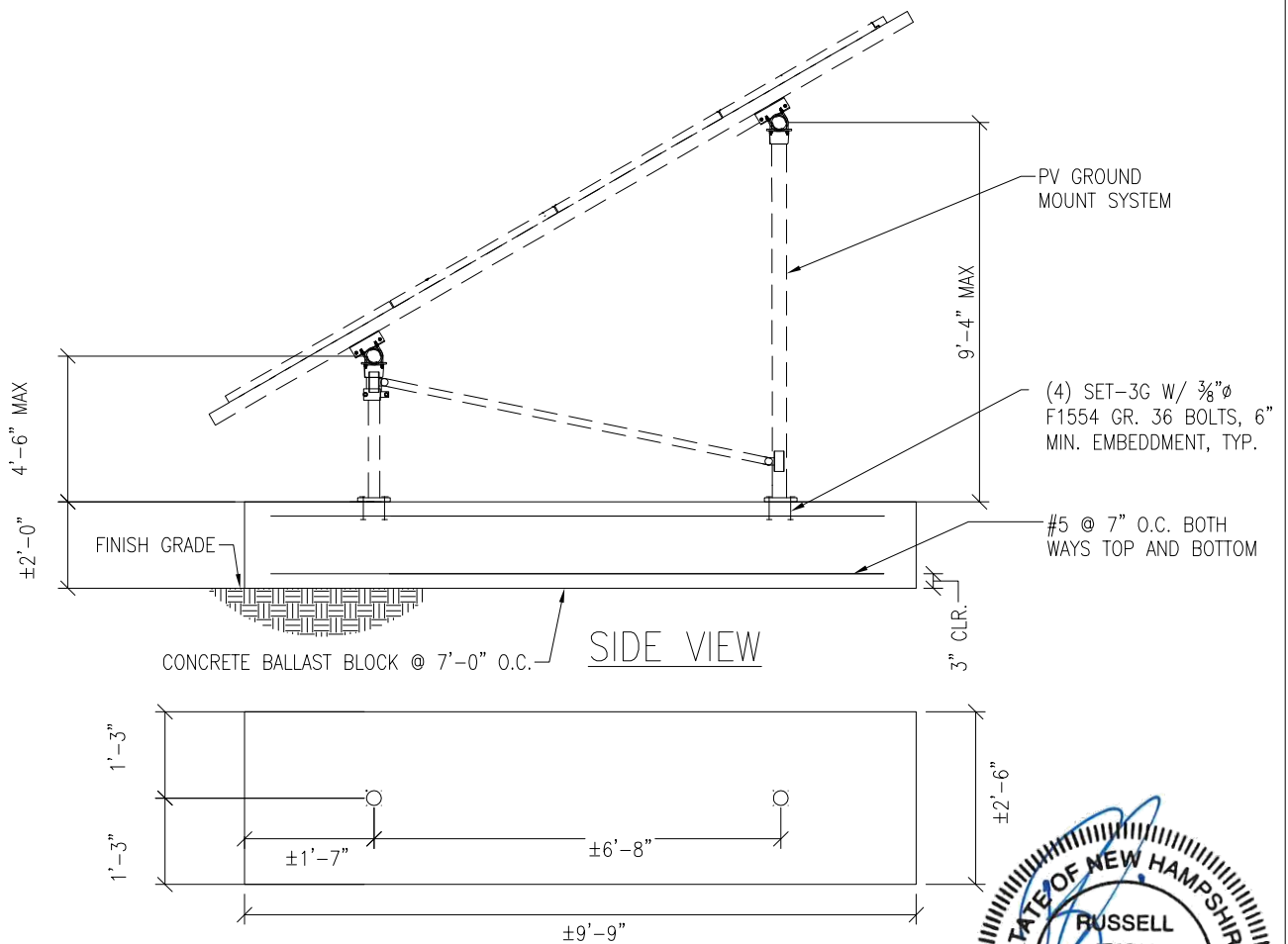
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PROJECT SUNMOD0 SUNTURF GROUND MOUNTS A5a

SUBJECT BALLASTED BLOCK OPTION

NOTES:

1. For ground mount components see Section S1.



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PV ARRAY SECTION

N.T.S.

S4

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PROJECT: Sunturf Package A5A Ground Mount

SNOW LOADS

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



PROJECT: Sunturf Package A5A Ground Mount

WIND PRESSURES

Calculations per:	ASCE 7-16	
Design Wind Speed, V [mph]:	140	
Risk Category:	I	(Table 1.5-1)
Exposure Category:	B	(Section 26.7)
Ground Elevation Factor, K_e :	1.0	(Table 26.9-1)
α :	7.0	(Table 26.11-1)
z_g [ft]:	1200	(Table 26.11-1)
Velocity Pressure Exposure Coefficient, K_h :	0.57	(Table 26.10-1)
Topographic Factor, K_{ht} :	1.00	(Section 26.8)
Wind Directionality Factor, K_d :	0.85	(Table 26.6-1)
Internal Pressure Coefficient, GC_{pi} :	0.0	(Figure 26.13-1)
Velocity Pressure, q_h [psf]:	24.31	(Equation 26.10-1)
Gust Effect Factor, G:	0.85	(Section 26.11.4)
Panel Slope [degrees]:	35.0	
Wind Flow:	Clear	
Roof Configuration:	Monoslope	

Wind Pressures in Transverse (N-S) Direction

Net Pressure Coefficients per Figure 27.3-4

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

Design Wind Pressures per Equation 27.3-2 [psf]

Clear Wind Flow	$q_h GC_{NW}$	$q_h GC_{NL}$
Case 1 ($\gamma = 0^\circ$, Load Case A)	-37.2	-37.2
Case 2 ($\gamma = 0^\circ$, Load Case B)	-49.6	-12.4
Case 3 ($\gamma = 180^\circ$, Load Case A)	43.4	43.4
Case 4 ($\gamma = 180^\circ$, Load Case B)	55.8	22.7
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

Wind Pressures in Longitudinal (E-W) Direction



PROJECT: Sunturf Package A5A Ground Mount

WIND PRESSURES

Net Pressure Coefficients per Figure 27.3-7

Clear Wind Flow	C_N
Case 1 ($\gamma = 90^\circ$, $d < h$, Load Case A)	-0.80
Case 2 ($\gamma = 90^\circ$, $h < d < 2h$, Load Case A)	-0.60
Case 3 ($\gamma = 90^\circ$, $d > 2h$, Load Case A)	-0.30
Case 4 ($\gamma = 90^\circ$, $d < h$, Load Case B)	0.80
Case 5 ($\gamma = 90^\circ$, $h < d < 2h$, Load Case B)	0.50
Case 6 ($\gamma = 90^\circ$, $d > 2h$, Load Case B)	0.30

Design Wind Pressures per Equation 27.3-2 [psf]

Clear Wind Flow	$q_h GC_N$
Case 1 ($\gamma = 90^\circ$, $d < h$, Load Case A)	-16.5
Case 2 ($\gamma = 90^\circ$, $h < d < 2h$, Load Case A)	-12.4
Case 3 ($\gamma = 90^\circ$, $d > 2h$, Load Case A)	-6.2
Case 4 ($\gamma = 90^\circ$, $d < h$, Load Case B)	16.5
Case 5 ($\gamma = 90^\circ$, $h < d < 2h$, Load Case B)	10.3
Case 6 ($\gamma = 90^\circ$, $d > 2h$, Load Case B)	6.2

Notation:

h = mean roof height, ft

d = horizontal distance from windward edge



JOB NO.: U2716-0231-201

DESIGNED: STB

Foundation Option 1: Drilled Concrete Pier



PROJECT: Sunturf Package A5A Ground Mount

DRILLED CONCRETE PIER DESIGN

Column Reactions:

Max. Shear, V [k]:	1.7	Max. Down, P _d [k]:	3.0
Max. Moment, M [k-ft]:	0.0	Max. Uplift, P _u [k]:	2.3

Pier Properties:

Pier Shape:	Round	Volume of Concrete [ft ³]:	10
Pier Diameter, b [ft]:	1.5	Volume of Concrete [yd ³]:	0.4
Top of Pier Elevation [ft]:	0.00	Weight of Concrete [k]:	1.5
Pier Depth, d [ft]:	5.5		

Soil Properties:

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

*per IBC Section 1810.3.3.1.4

Check Bearing:

Bearing Capacity [k]:	6.5
-----------------------	-----

Bearing capacity OK.

Check Uplift:

Uplift Capacity [k]:	7.8
----------------------	-----

Uplift capacity OK.

Check Lateral Bearing:

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

IBC Section 1807.3.2.1

IBC Eq. 18-1

Result: **Lateral bearing capacity OK.**

Foundation Option 2: Helical Pier

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

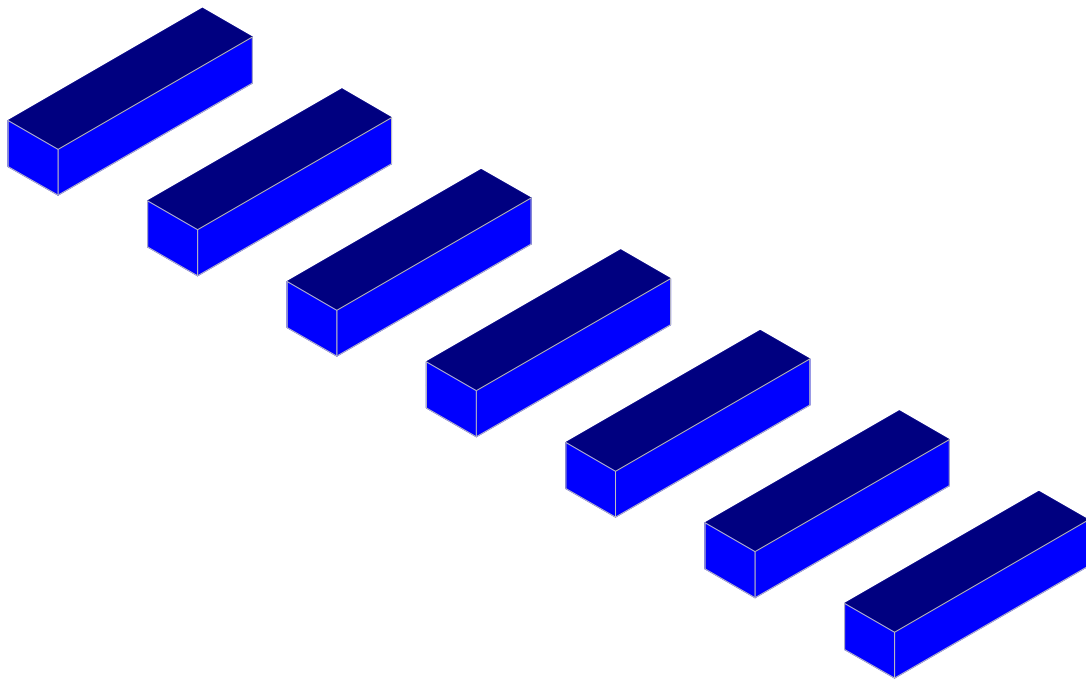
Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2320	1.5	3480
LATERAL	1690	2	3380

Foundation Option 3: Ground Screw

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

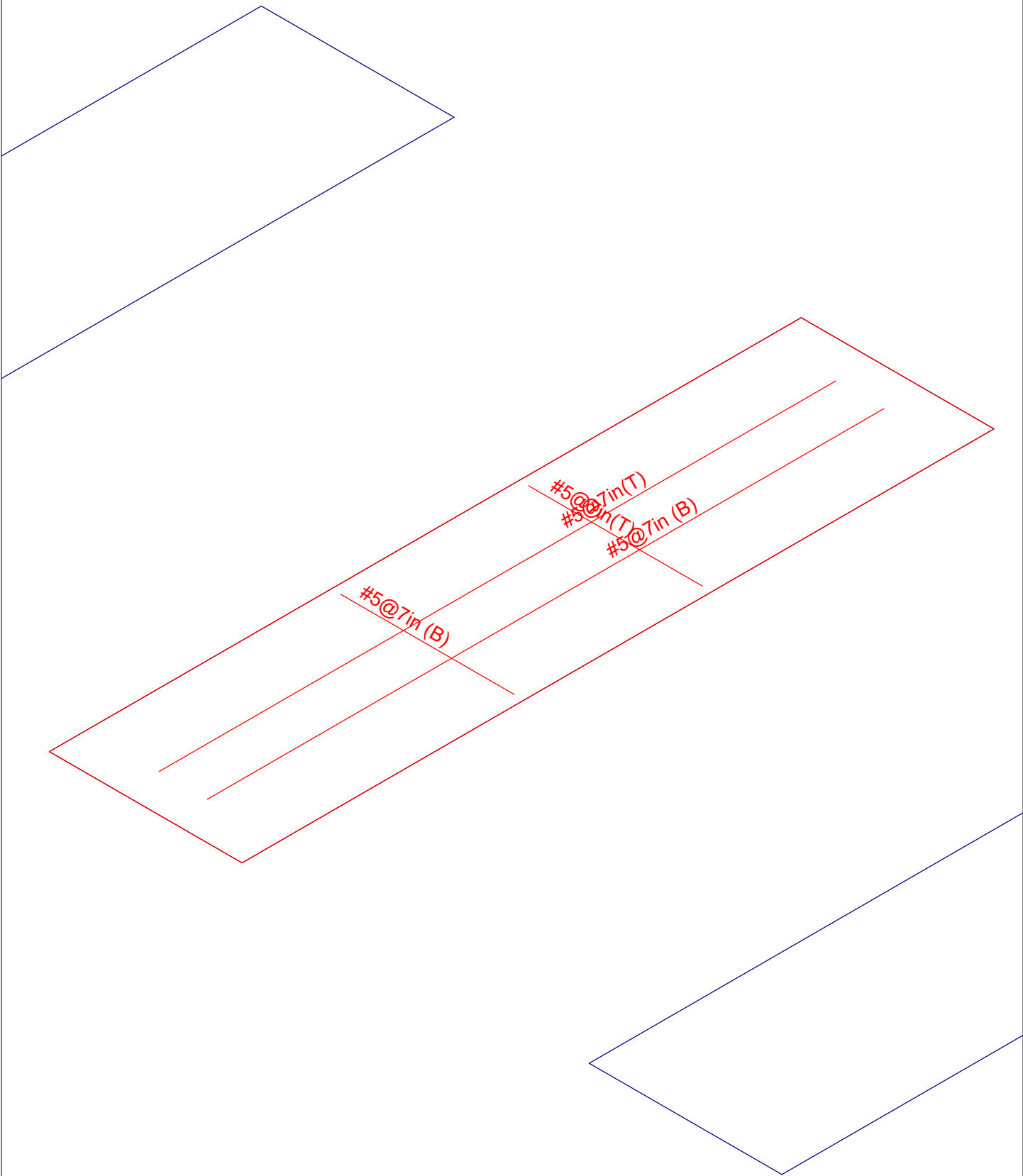
Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2320	1.5	3480
LATERAL	1690	2	3380

Foundation Option 4: Ballasted Block



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 2
STB		July 22, 2020 at 10:33 AM
U2716.0231.201		Sunmodo Sunturf A5a.r3d



Results for LC 1, 1.0 D

Vector Structural Engineeri...	Ground Mount	SK - 1
STB		July 22, 2020 at 10:33 AM
U2716.0231.201		Sunmodo Sunturf A5a.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	18	3	18	3	1	Optimize

Soil Definitions

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

Point Loads and Moments (Cat 1 : DL)

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1_1	X	-11.981
2	R3D_N1_1	Y	216.315
3	R3D_N2	Y	183.998
4	R3D_N132_2	Y	210.689
5	R3D_N133_1	X	-1.035
6	R3D_N133_1	Y	201.84
7	R3D_N109_1	Y	194.866
8	R3D_N110A_1	Y	206.883

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

	Label	Direction	Magnitude[lb.-lb-ft]
9	R3D_N121_1	Y	213.292
10	R3D_N122_1	Y	204.065
11	R3D_N133B	Y	210.369
12	R3D_N134B_1	X	-1.088
13	R3D_N134B_1	Y	204.722
14	R3D_N151_1	Y	208.076
15	R3D_N152_1	X	-2.806
16	R3D_N152_1	Y	216.842
17	R3D_N143A	X	13.773
18	R3D_N143A	Y	172.004
19	R3D_N144A	X	6.043
20	R3D_N144A	Y	138.199

Point Loads and Moments (Cat 6 : RLL)

	Label	Direction	Magnitude[lb.-lb-ft]
1	R3D_N1_1	X	-67.331
2	R3D_N1_1	Y	1031.223
3	R3D_N2	X	-2.839
4	R3D_N2	Y	965.955
5	R3D_N132_2	X	-2.393
6	R3D_N132_2	Y	1044.539
7	R3D_N133_1	X	-6.442
8	R3D_N133_1	Y	1072.806
9	R3D_N109_1	X	-2.92
10	R3D_N109_1	Y	942.536
11	R3D_N109_1	Z	-1.733
12	R3D_N110A_1	Y	1106.213
13	R3D_N121_1	Y	1059.791
14	R3D_N121_1	Z	2.094
15	R3D_N122_1	X	-3.297
16	R3D_N122_1	Y	1086.093
17	R3D_N133B	X	-2.058
18	R3D_N133B	Y	1040.863
19	R3D_N133B	Z	-1.423
20	R3D_N134B_1	X	-6.539
21	R3D_N134B_1	Y	1090.394
22	R3D_N151_1	X	-2.829
23	R3D_N151_1	Y	1020.851
24	R3D_N152_1	X	-17.111
25	R3D_N152_1	Y	1164.394
26	R3D_N143A	X	78.066
27	R3D_N143A	Y	772.29
28	R3D_N144A	X	35.641
29	R3D_N144A	Y	694.667

Point Loads and Moments (Cat 16 : OL1)

	Label	Direction	Magnitude[lb.-lb-ft]
1	R3D_N1_1	X	121.18
2	R3D_N1_1	Y	-3361.819
3	R3D_N1_1	Z	1910.216
4	R3D_N2	X	12.423
5	R3D_N2	Y	568.067
6	R3D_N2	Z	-95.762
7	R3D_N132_2	X	3.763
8	R3D_N132_2	Y	-3551.734
9	R3D_N132_2	Z	2117.481

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

	Label	Direction	Magnitude[lb.lb-ft]
10	R3D_N133_1	X	1.431
11	R3D_N133_1	Y	627.579
12	R3D_N133_1	Z	-102.734
13	R3D_N109_1	X	2.365
14	R3D_N109_1	Y	-3453.856
15	R3D_N109_1	Z	2210.996
16	R3D_N110A_1	X	6.64
17	R3D_N110A_1	Y	680.656
18	R3D_N110A_1	Z	-102.659
19	R3D_N121_1	Y	-3599.346
20	R3D_N121_1	Z	2143.35
21	R3D_N122_1	X	3.848
22	R3D_N122_1	Y	636.796
23	R3D_N122_1	Z	-103.219
24	R3D_N133B	X	2.595
25	R3D_N133B	Y	-3579.127
26	R3D_N133B	Z	2166.706
27	R3D_N134B_1	X	3.625
28	R3D_N134B_1	Y	647.146
29	R3D_N134B_1	Z	-103.532
30	R3D_N151_1	X	2.639
31	R3D_N151_1	Y	-3729.308
32	R3D_N151_1	Z	2375.203
33	R3D_N152_1	X	17.318
34	R3D_N152_1	Y	755.333
35	R3D_N152_1	Z	-101.362
36	R3D_N143A	X	-131.673
37	R3D_N143A	Y	-2443.918
38	R3D_N143A	Z	1359.813
39	R3D_N144A	X	-45.309
40	R3D_N144A	Y	386.94
41	R3D_N144A	Z	-78.339

Point Loads and Moments (Cat 17 : OL2)

	Label	Direction	Magnitude[lb.lb-ft]
1	R3D_N1_1	X	155.556
2	R3D_N1_1	Y	-3751.678
3	R3D_N1_1	Z	1616.16
4	R3D_N2	X	4.573
5	R3D_N2	Y	1305.88
6	R3D_N2	Z	-80.939
7	R3D_N132_2	X	4.785
8	R3D_N132_2	Y	-3954.679
9	R3D_N132_2	Z	1788.55
10	R3D_N133_1	X	-4.396
11	R3D_N133_1	Y	1473.183
12	R3D_N133_1	Z	-86.691
13	R3D_N109_1	X	3.168
14	R3D_N109_1	Y	-3798.157
15	R3D_N109_1	Z	1860.522
16	R3D_N110A_1	X	12.662
17	R3D_N110A_1	Y	1561.76
18	R3D_N110A_1	Z	-86.49
19	R3D_N121_1	Y	-4007.832
20	R3D_N121_1	Z	1808.577
21	R3D_N122_1	Y	1491.677

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

	Label	Direction	Magnitude[lb.-ft]
35	R3D N152 1	Z	120.197
36	R3D N143A	X	158.264
37	R3D N143A	Y	2922.675
38	R3D N143A	Z	-1612.706
39	R3D N144A	X	52.702
40	R3D N144A	Y	-480.508
41	R3D_N144A	Z	92.907

Point Loads and Moments (Cat 19 : OL4)

	Label	Direction	Magnitude[lb.-ft]
1	R3D N1 1	X	-78.781
2	R3D N1 1	Y	2669.044
3	R3D N1 1	Z	-1958.689
4	R3D N2	X	-17.829
5	R3D N2	Y	125.19
6	R3D N2	Z	98.263
7	R3D N132 2	X	-2.485
8	R3D N132 2	Y	2827.487
9	R3D N132 2	Z	-2173.76
10	R3D N133 1	X	-6.275
11	R3D N133 1	Y	164.455
12	R3D N133 1	Z	105.536
13	R3D N109 1	X	-1.424
14	R3D N109 1	Y	2790.334
15	R3D N109 1	Z	-2275.777
16	R3D N110A 1	Y	147.48
17	R3D N110A 1	Z	105.578
18	R3D N121 1	Y	2865.271
19	R3D N121 1	Z	-2201.88
20	R3D N122 1	X	-6.171
21	R3D N122 1	Y	164.176
22	R3D N122 1	Z	106.11
23	R3D N133B	X	-1.613
24	R3D N133B	Y	2857.104
25	R3D N133B	Z	-2226.582
26	R3D N134B 1	X	-8.586
27	R3D N134B 1	Y	161.397
28	R3D N134B 1	Z	106.405
29	R3D N151 1	X	-1.57
30	R3D N151 1	Y	3016.873
31	R3D N151 1	Z	-2444.995
32	R3D N152 1	X	-31.225
33	R3D N152 1	Y	114.24
34	R3D N152 1	Z	104.248
35	R3D N143A	X	85.183
36	R3D N143A	Y	1930.916
37	R3D N143A	Z	-1393.313
38	R3D N144A	X	70.876
39	R3D N144A	Y	114.369
40	R3D_N144A	Z	80.301

Point Loads and Moments (Cat 20 : OL5)

	Label	Direction	Magnitude[lb.-ft]
1	R3D N1 1	X	-41.31
2	R3D N1 1	Y	1439.55
3	R3D N1 1	Z	-830.591



Company : Vector Structural Engineering
 Designer : STB
 Job Number : U2716.0231.201
 Model Name : Ground Mount

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Load Combinations (Continued)

Label	Solve	Service A...	SF	Cat..Fa...	Cat..Fa...	Cat..Fa...	Cat..Fa...	Cat..Fa...	Cat..Fa...	Cat..Fa...	Cat..Fa...	Cat..Fa...	C...	F...	C...	F...
22	1.4D	Yes			DL 1.4											
23	1.2D+1.6SL	Yes			DL 1.2	RLL 1.6										
24	1.2D+1.6S...	Yes			DL 1.2	RLL 1.6	OL1	.5								
25	1.2D+1.6S...	Yes			DL 1.2	RLL 1.6	OL2	.5								
26	1.2D+1.6S...	Yes			DL 1.2	RLL 1.6	OL3	.5								
27	1.2D+1.6S...	Yes			DL 1.2	RLL 1.6	OL4	.5								
28	1.2D+1.6S...	Yes			DL 1.2	RLL 1.6	OL5	.5								
29	1.2D+1.6S...	Yes			DL 1.2	RLL 1.6	OL6	.5								
30	1.2D+1.0...	Yes			DL 1.2		OL1	1								
31	1.2D-1.0Wx	Yes			DL 1.2		OL2	1								
32	1.2D+1.0...	Yes			DL 1.2		OL3	1								
33	1.2D-1.0Wz	Yes			DL 1.2		OL4	1								
34	1.2D+1.0...	Yes			DL 1.2		OL5	1								
35	1.2D-1.0...	Yes			DL 1.2		OL6	1								
36	.9D+1.0Wx	Yes			DL .9		OL1	1								
37	.9D-1.0Wx	Yes			DL .9		OL2	1								
38	.9D+1.0Wz	Yes			DL .9		OL3	1								
39	.9D-1.0Wz	Yes			DL .9		OL4	1								
40	.9D+1.0W...	Yes			DL .9		OL5	1								
41	.9D-1.0W90	Yes			DL .9		OL6	1								

Design Strips

Label	Rebar Angle from Pl...	No. of Design Cuts	Design Rule	
1	DS1	0	50	Typical
2	DS2	90	50	Typical

Load Categories

Category	Point Loads	Line Loads	Area Loads
1	DL	20	
2	RLL	29	
3	OL1	41	
4	OL2	40	
5	OL3	41	
6	OL4	40	
7	OL5	39	
8	OL6	39	

Strip Reinforcing

Label	UC Top	LC	Top Bars	Governing ...	UC Bot	LC	Bot B...	Gover...	UC Shear	LC	Governing De...	
1	DS1	.018	26	#5@7in	DS1-X26	.036	37	#5@7in	DS1-...	.048	37	DS1-X45
2	DS2	.002	36	#5@7in	DS2-X25	.004	26	#5@7in	DS2-...	.008	26	DS2-X25

Slab Overturning Safety Factors

LC	Slab	Angle[deg]	Mo-xx[lb-ft]	Ms-xx[lb-ft]	Mo-zz[lb-ft]	Ms-zz[lb-ft]	Ms-xx/Mo-xx	Ms-zz/Mo-zz
1	S1	0	0	36320.752	0	9360.305	9.999+	9.999+
2	S2	0	0	36475.592	0	9338.138	9.999+	9.999+
3	S3	0	0	36481.521	0	9357.649	9.999+	9.999+
4	S4	0	0	36482.317	0	9356.994	9.999+	9.999+
5	S5	0	0	36459.047	0	9353.685	9.999+	9.999+
6	S6	0	0	36578.675	0	9372.713	9.999+	9.999+
7	S7	0	0	35872.755	0	9184.075	9.999+	9.999+
8	S1	0	0	45922.644	0	11997.118	9.999+	9.999+
9	S2	0	0	47090.722	0	11904.915	9.999+	9.999+
10	S3	0	0	47123.969	0	12046.598	9.999+	9.999+
11	S4	0	0	47123.243	0	12038.259	9.999+	9.999+



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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	
69	10	S6	0	15645.102	44047.529	1359.516	11380.246	2.815	8.371
70	10	S7	0	10416.656	41584.076	1182.282	10809.17	3.992	9.143
71	11	S1	0	1684.748	43522.171	0	13347.424	9.999+	9.999+
72	11	S2	0	2438.482	44436.939	0	13120.844	9.999+	9.999+
73	11	S3	0	2043.134	44463.357	0	13354.88	9.999+	9.999+
74	11	S4	0	2131.961	44463.011	0	13330.055	9.999+	9.999+
75	11	S5	0	2014.639	44337.418	0	13308.201	9.999+	9.999+
76	11	S6	0	2716.257	44995.62	0	13454.102	9.999+	9.999+
77	11	S7	0	1069.306	41088.097	0	11572.636	9.999+	9.999+
78	12	S1	0	0	44214.243	0	12996.619	9.999+	9.999+
79	12	S2	0	0	45019.388	0	12917.023	9.999+	9.999+
80	12	S3	0	0	45228.166	0	13083.978	9.999+	9.999+
81	12	S4	0	0	45189.721	0	13075.029	9.999+	9.999+
82	12	S5	0	0	45101.136	0	13042.8	9.999+	9.999+
83	12	S6	0	0	45462.58	0	13242.059	9.999+	9.999+
84	12	S7	0	0	41706.753	0	11398.806	9.999+	9.999+
85	13	S1	0	603.177	43522.171	0	12049.114	9.999+	9.999+
86	13	S2	0	694.784	44436.939	0	11844.522	9.999+	9.999+
87	13	S3	0	379.059	44463.357	0	11749.157	9.999+	9.999+
88	13	S4	0	273.163	44463.011	0	11636.055	9.999+	9.999+
89	13	S5	0	261.884	44337.418	0	11630.754	9.999+	9.999+
90	13	S6	0	378.83	44995.62	0	11721.375	9.999+	9.999+
91	13	S7	0	132.023	41088.097	0	10556.292	9.999+	9.999+
92	14	S1	0	5802.916	43905.827	706.387	11337.915	7.566	9.999+
93	14	S2	0	4545.314	43382.164	508.49	11254.46	9.544	9.999+
94	14	S3	0	2992.834	44218.23	343.48	11364.469	9.999+	9.999+
95	14	S4	0	2394.109	44089.527	272.989	11367.942	9.999+	9.999+
96	14	S5	0	2420.997	44088.413	277.596	11351.949	9.999+	9.999+
97	14	S6	0	2475.7	44047.529	270.957	11451.292	9.999+	9.999+
98	14	S7	0	1706.786	41584.076	236.218	10809.17	9.999+	9.999+
99	15	S1	0	18139.031	21901.712	2255.637	5616.183	1.207	2.49
100	15	S2	0	18841.345	21817.207	2090.707	5602.883	1.158	2.68
101	15	S3	0	19511.873	21904.96	2226.53	5614.589	1.123	2.522
102	15	S4	0	19431.134	21891.229	2206.449	5614.196	1.127	2.544
103	15	S5	0	19256.408	21890.202	2199.349	5612.211	1.137	2.552
104	15	S6	0	20322.454	21890.902	2254.43	5623.628	1.077	2.494
105	15	S7	0	13164.748	21643.367	1755.112	5558.003	1.644	3.167
106	16	S1	0	19050.227	21901.712	2026.504	5616.183	1.15	2.771
107	16	S2	0	19334.253	21817.207	1696.293	5602.883	1.128	3.303
108	16	S3	0	20361.776	21904.96	1887.116	5614.589	1.076	2.975
109	16	S4	0	20212.348	21891.229	1850.843	5614.196	1.083	3.033
110	16	S5	0	20094.323	21890.202	1861.589	5612.211	1.089	3.015
111	16	S6	0	20860.137	21890.902	1818.697	5623.628	1.049	3.092
112	16	S7	0	13888.874	21643.367	1576.377	5558.003	1.558	3.526
113	17	S1	0	2246.331	21792.451	0	8295.529	9.701	9.999+
114	17	S2	0	3251.309	21885.355	0	8079.715	6.731	9.999+
115	17	S3	0	2724.178	21888.912	0	8255.282	8.035	9.999+
116	17	S4	0	2842.615	21889.39	0	8230.346	7.7	9.999+
117	17	S5	0	2686.185	21875.428	0	8220.548	8.144	9.999+
118	17	S6	0	3621.676	21947.205	0	8294.042	6.06	9.999+
119	17	S7	0	1425.741	21523.653	0	7088.911	9.999+	9.999+
120	18	S1	0	0	22715.213	0	7827.789	9.999+	9.999+
121	18	S2	0	0	22661.953	0	7807.953	9.999+	9.999+
122	18	S3	0	0	22908.658	0	7894.079	9.999+	9.999+
123	18	S4	0	0	22858.337	0	7890.312	9.999+	9.999+
124	18	S5	0	0	22893.718	0	7866.68	9.999+	9.999+
125	18	S6	0	0	22569.819	0	8011.317	9.999+	9.999+

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
126	18	S7	0	0	22348.528	0	6857.137	9.999+	9.999+
127	19	S1	0	804.236	21792.451	0	6564.449	9.999+	9.999+
128	19	S2	0	926.378	21885.355	0	6377.952	9.999+	9.999+
129	19	S3	0	505.412	21888.912	0	6114.317	9.999+	9.999+
130	19	S4	0	364.218	21889.39	0	5971.679	9.999+	9.999+
131	19	S5	0	349.179	21875.428	0	5983.951	9.999+	9.999+
132	19	S6	0	505.106	21947.205	0	5983.738	9.999+	9.999+
133	19	S7	0	176.031	21523.653	0	5733.785	9.999+	9.999+
134	20	S1	0	7737.221	21901.712	941.85	5616.183	2.831	5.963
135	20	S2	0	6060.419	21817.207	677.987	5602.883	3.6	8.264
136	20	S3	0	3990.445	21904.96	457.973	5614.589	5.489	9.999+
137	20	S4	0	3192.145	21891.229	363.986	5614.196	6.858	9.999+
138	20	S5	0	3227.996	21890.202	370.127	5612.211	6.781	9.999+
139	20	S6	0	3300.934	21890.902	361.275	5623.628	6.632	9.999+
140	20	S7	0	2275.714	21643.367	314.958	5558.003	9.511	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	11.981	2240.722	0	2240.722	9.999+	9.999+
2	1	S2	0	0	2241.153	0	2241.153	9.999+	9.999+
3	1	S3	0	0	2245.836	0	2245.836	9.999+	9.999+
4	1	S4	0	1.088	2245.156	0	2245.156	9.999+	9.999+
5	1	S5	0	1.035	2244.387	0	2244.387	9.999+	9.999+
6	1	S6	0	2.806	2248.104	0	2248.104	9.999+	9.999+
7	1	S7	0	19.816	2213.69	0	2213.69	9.999+	9.999+
8	2	S1	0	82.15	2839.876	0	2839.876	9.999+	9.999+
9	2	S2	0	2.92	2855.778	1.733	2855.778	9.999+	9.999+
10	2	S3	0	3.297	2889.601	2.094	2889.601	9.999+	9.999+
11	2	S4	0	9.685	2884.533	1.423	2884.533	9.999+	9.999+
12	2	S5	0	9.87	2879.591	0	2879.591	9.999+	9.999+
13	2	S6	0	22.747	2903.678	0	2903.678	9.999+	9.999+
14	2	S7	0	133.522	2653.777	0	2653.777	9.999+	9.999+
15	3	S1	0	68.181	1737.847	1088.672	1737.847	9.999+	1.596
16	3	S2	0	5.403	1741.977	1265.002	1741.977	9.999+	1.377
17	3	S3	0	2.309	1712.577	1224.078	1712.577	9.999+	1.399
18	3	S4	0	2.644	1717.4	1237.904	1717.4	9.999+	1.387
19	3	S5	0	2.081	1718.04	1208.848	1718.04	9.999+	1.421
20	3	S6	0	9.168	1712.789	1364.305	1712.789	9.999+	1.255
21	3	S7	0	86.373	1843.433	768.884	1843.433	9.999+	2.398
22	4	S1	0	84.097	1800.479	921.133	1800.479	9.999+	1.955
23	4	S2	0	9.498	1838.602	1064.419	1838.602	9.999+	1.727
24	4	S3	0	0	1792.928	1032.938	1792.928	9.999+	1.736
25	4	S4	0	.605	1801.186	1044.09	1801.186	9.999+	1.725
26	4	S5	0	.802	1797.718	1021.115	1797.718	9.999+	1.761
27	4	S6	0	1.304	1812.338	1147.845	1812.338	9.999+	1.579
28	4	S7	0	87.809	1887.019	651.209	1887.019	9.999+	2.898
29	5	S1	0	108.073	2837.641	1291.108	2837.641	9.999+	2.198
30	5	S2	0	6.587	2832.431	1500.011	2832.431	9.999+	1.888
31	5	S3	0	2.681	2878.315	1451.592	2878.315	9.999+	1.983
32	5	S4	0	5.417	2870.954	1467.969	2870.954	9.999+	1.956
33	5	S5	0	4.644	2868.656	1433.569	2868.656	9.999+	2.001
34	5	S6	0	16.694	2882.337	1617.758	2882.337	9.999+	1.782
35	5	S7	0	146.395	2653.28	911.88	2653.28	9.999+	2.91
36	6	S1	0	69.946	2743.684	1116.256	2743.684	9.999+	2.458
37	6	S2	0	.855	2769.96	1302.119	2769.96	9.999+	2.127
38	6	S3	0	3.702	2791.136	1257.462	2791.136	9.999+	2.22

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	
96	14	S5	0	7.149	2654.413	151.082	2654.413	9.999+	9.999+
97	14	S6	0	16.777	2675.227	170.462	2675.227	9.999+	9.999+
98	14	S7	0	87.894	2495.319	96.19	2495.319	9.999+	9.999+
99	15	S1	0	72.973	841.558	1088.672	841.558	9.999+	.773
100	15	S2	0	5.403	845.516	1265.002	845.516	9.999+	.668
101	15	S3	0	2.309	814.243	1224.078	814.243	9.999+	.665
102	15	S4	0	3.079	819.337	1237.904	819.337	9.999+	.662
103	15	S5	0	2.495	820.285	1208.848	820.285	9.999+	.679
104	15	S6	0	10.291	813.547	1364.305	813.547	9.999+	.596
105	15	S7	0	94.3	957.958	768.884	957.958	9.999+	1.246
106	16	S1	0	88.889	904.19	921.133	904.19	9.999+	.982
107	16	S2	0	9.498	942.14	1064.419	942.14	9.999+	.885
108	16	S3	0	0	894.594	1032.938	894.594	9.999+	.866
109	16	S4	0	.17	903.123	1044.09	903.123	9.999+	.865
110	16	S5	0	.388	899.963	1021.115	899.963	9.999+	.881
111	16	S6	0	.181	913.096	1147.845	913.096	9.999+	.795
112	16	S7	0	95.735	1001.543	651.209	1001.543	9.999+	1.538
113	17	S1	0	103.28	1941.352	1291.108	1941.352	9.999+	1.504
114	17	S2	0	6.587	1935.97	1500.011	1935.97	9.999+	1.291
115	17	S3	0	2.681	1979.981	1451.592	1979.981	9.999+	1.364
116	17	S4	0	4.982	1972.892	1467.969	1972.892	9.999+	1.344
117	17	S5	0	4.23	1970.901	1433.569	1970.901	9.999+	1.375
118	17	S6	0	15.571	1983.096	1617.758	1983.096	9.999+	1.226
119	17	S7	0	138.469	1767.804	911.88	1767.804	9.999+	1.939
120	18	S1	0	65.154	1847.395	1116.256	1847.395	9.999+	1.655
121	18	S2	0	.855	1873.499	1302.119	1873.499	9.999+	1.439
122	18	S3	0	3.702	1892.802	1257.462	1892.802	9.999+	1.505
123	18	S4	0	6.773	1890.424	1272.106	1890.424	9.999+	1.486
124	18	S5	0	5.877	1885.182	1240.934	1885.182	9.999+	1.519
125	18	S6	0	21.361	1912.463	1404.448	1912.463	9.999+	1.362
126	18	S7	0	105.525	1696.365	787.807	1696.365	9.999+	2.153
127	19	S1	0	34.021	1559.138	475.203	1559.138	9.999+	3.281
128	19	S2	0	1.177	1531.273	466.144	1531.273	9.999+	3.285
129	19	S3	0	4.575	1469.632	281.054	1469.632	9.999+	5.229
130	19	S4	0	2.306	1432.096	199.3	1432.096	9.999+	7.186
131	19	S5	0	1.273	1435.537	201.903	1435.537	9.999+	7.11
132	19	S6	0	2.993	1434.661	227.226	1434.661	9.999+	6.314
133	19	S7	0	35.172	1392.991	128.257	1392.991	9.999+	9.999+
134	20	S1	0	18.68	1130.806	473.083	1130.806	9.999+	2.39
135	20	S2	0	3.064	1183.446	407.252	1183.446	9.999+	2.906
136	20	S3	0	1.541	1238.328	249.795	1238.328	9.999+	4.957
137	20	S4	0	.517	1260.299	203.517	1260.299	9.999+	6.193
138	20	S5	0	.062	1258.13	201.442	1258.13	9.999+	6.246
139	20	S6	0	.371	1262.786	227.283	1262.786	9.999+	5.556
140	20	S7	0	11.047	1263.633	128.254	1263.633	9.999+	9.853

Envelope Slab Soil Pressures

Label	UC	LC	Soil Pressure[psf]	Allowable Bearing[psf]	Point	
1	S1	.415	5	622.568	1500	N198
2	S2	.42	5	630.45	1500	N205
3	S3	.43	5	644.419	1500	N212
4	S4	.428	5	642.547	1500	N219
5	S5	.426	5	639.715	1500	N226
6	S6	.466	16	698.629	1500	N38
7	S7	.355	5	532.632	1500	N240



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E-mail:			

1. Project information

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

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General

Design method: ACI 318-14
Units: Imperial units

Anchor Information:

Anchor type: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.375
Effective Embedment depth, h_{ef} (inch): 6.000
Code report: ICC-ES ESR-4057
Anchor category: -
Anchor ductility: Yes
 h_{min} (inch): 7.25
 c_{ac} (inch): 10.99
 c_{min} (inch): 1.75
 s_{min} (inch): 3.00

Base Material

Concrete: Normal-weight
Concrete thickness, h (inch): 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]: 3870

V_{uax} [lb]: 175

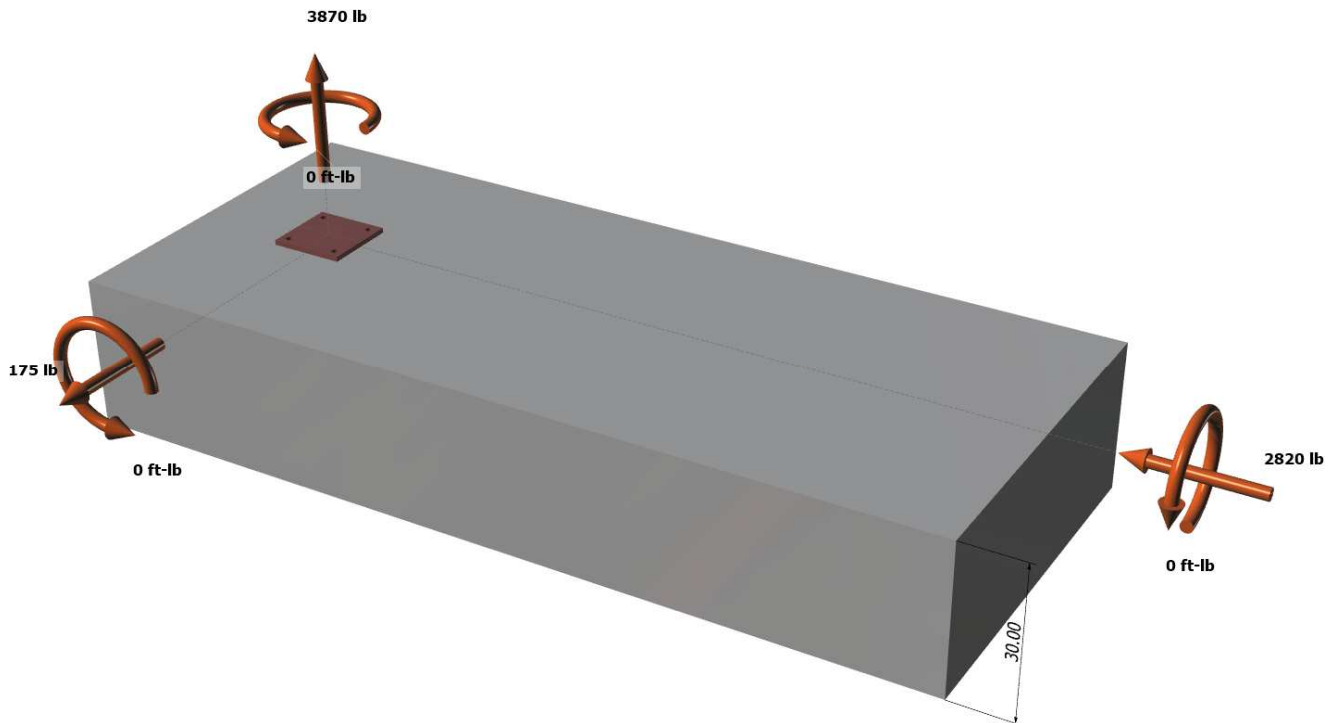
V_{uay} [lb]: -2820

M_{ux} [ft-lb]: 0

M_{uy} [ft-lb]: 0

M_{uz} [ft-lb]: 0

<Figure 1>





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<Figure 2>





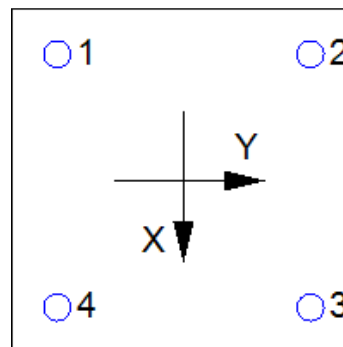
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3. Resulting Anchor Forces

Anchor	Tension load, N _{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	967.5	43.8	-705.0	706.4
2	967.5	43.8	-705.0	706.4
3	967.5	43.8	-705.0	706.4
4	967.5	43.8	-705.0	706.4
Sum	3870.0	175.0	-2820.0	2825.4

Maximum concrete compression strain (%): 0.00
 Maximum concrete compression stress (psi): 0
 Resultant tension force (lb): 3870
 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	6.000	12492

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

A _{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)
424.63	324.00	7.25	1.000	0.942	1.00	1.000	12492	0.65	10021

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

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

τ _{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	6.000	9514

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

A _{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	9514	0.55	9265



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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	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 ²)	A_{vco} (in ²)	$\psi_{ec,v}$	$\psi_{ed,v}$	$\psi_{c,v}$	$\psi_{h,v}$	V_{bx} (lb)	ϕ	ϕV_{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)	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)
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)	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)
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)	λ_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 ²)	A_{vco} (in ²)	$\psi_{ec,v}$	$\psi_{ed,v}$	$\psi_{c,v}$	$\psi_{h,v}$	V_{bx} (lb)	ϕ	ϕV_{cbgy} (lb)
401.67	472.78	1.000	1.000	1.000	1.000	10661	0.70	12680

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

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

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
424.63	324.00	1.000	0.942	1.000	1.000	12492	15417	0.70

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



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ϕV_{cpq} (lb)
21584

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	968	3394	0.29	Pass	
Concrete breakout	3870	10021	0.39	Pass	
Adhesive	3870	9265	0.42	Pass (Governs)	
Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status	
Steel	706	1765	0.40	Pass	
T Concrete breakout x+	175	7103	0.02	Pass	
T Concrete breakout y-	2820	5313	0.53	Pass	
Concrete breakout y-	88	9797	0.01	Pass	
Concrete breakout x-	1410	12680	0.11	Pass	
Concrete breakout, combined	-	-	0.53	Pass (Governs)	
Pryout	2825	21584	0.13	Pass	
Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.23	0.35	58.2%	1.0	Pass

SET-3G w/ 3/8"Ø F1554 Gr. 36 with hef = 6.000 inch meets the selected design criteria.

12. Warnings

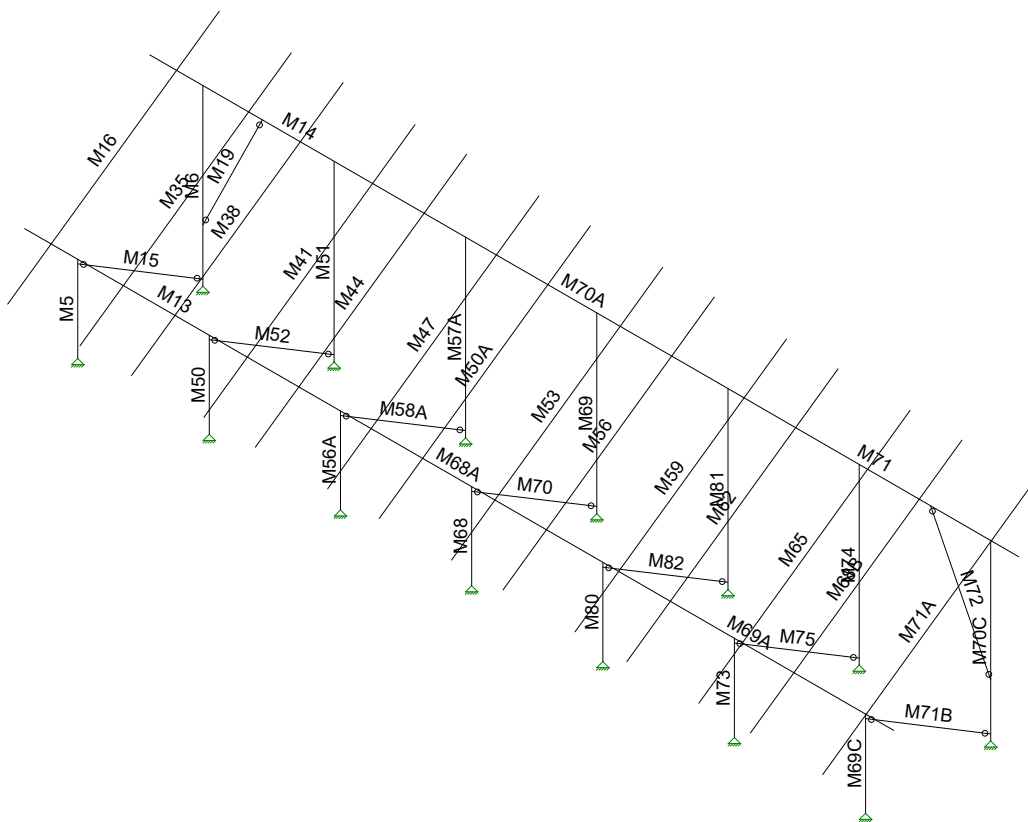
- Designer must exercise own judgement to determine if this design is suitable.
- Refer to manufacturer's product literature for hole cleaning and installation instructions.



JOB NO.: U2716-0231-201

DESIGNED: STB

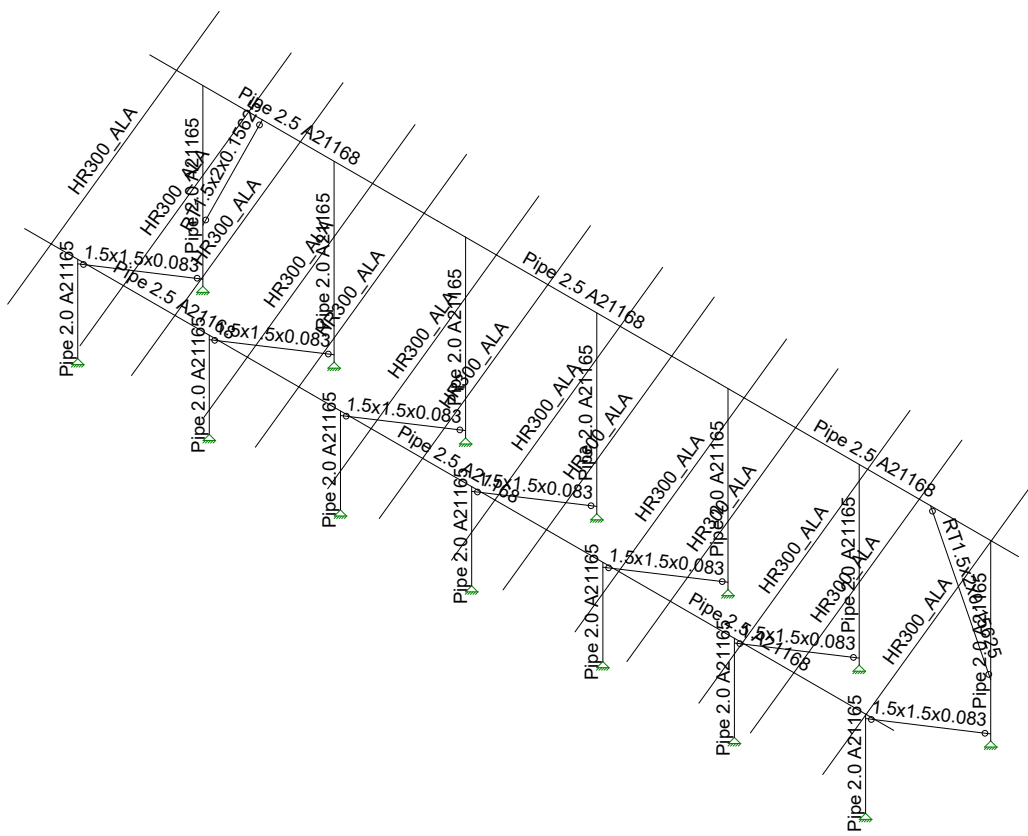
Framing Analysis



Vector Structural Engineeri...
STB
U2716.0231.201

Ground Mount

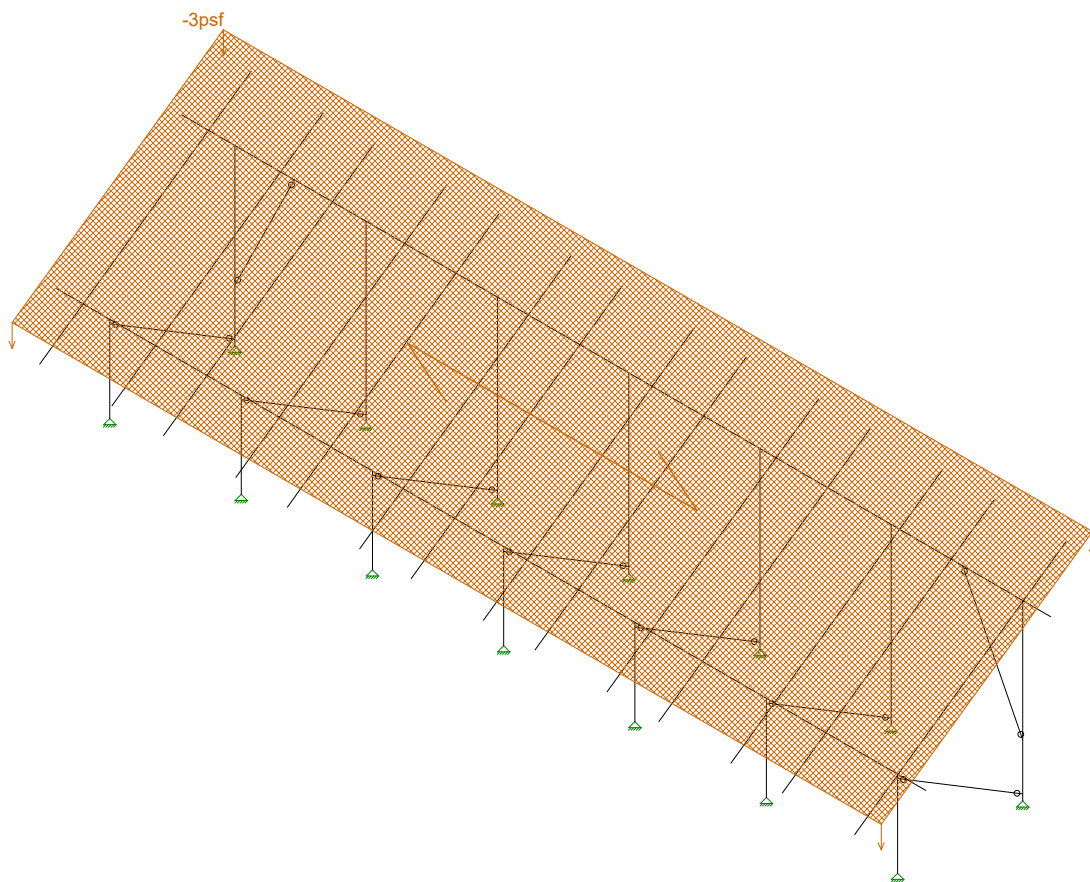
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July 22, 2020 at 10:29 AM
Sunmodo Sunturf A5a.r3d



Vector Structural Engineeri...
STB
U2716.0231.201

Ground Mount

SK - 4
July 22, 2020 at 10:29 AM
Sunmodo Sunturf A5a.r3d



Loads: BLC 2, Solar Panel Weight

Vector Structural Engineeri...

STB

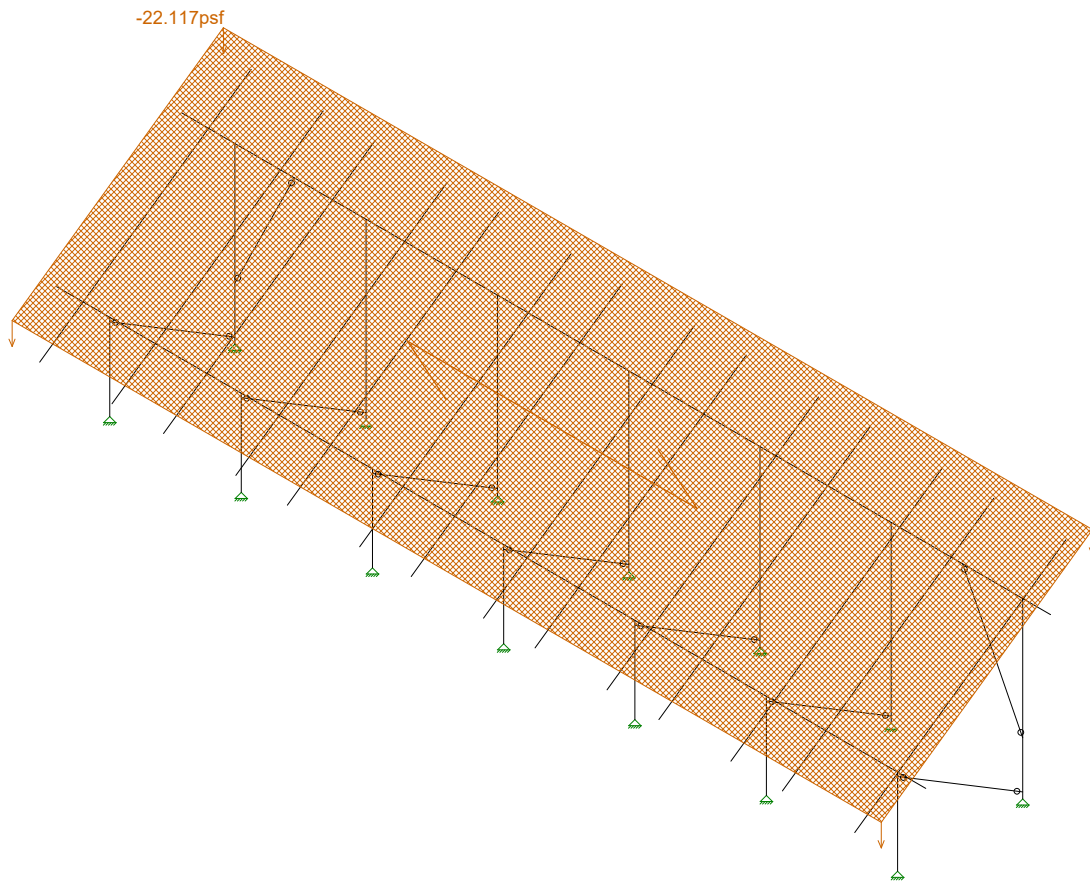
U2716.0231.201

Ground Mount

SK - 5

July 22, 2020 at 10:29 AM

Sunmodo Sunturf A5a.r3d



Loads: BLC 3, Roof Live/Snow

Vector Structural Engineeri..

STB

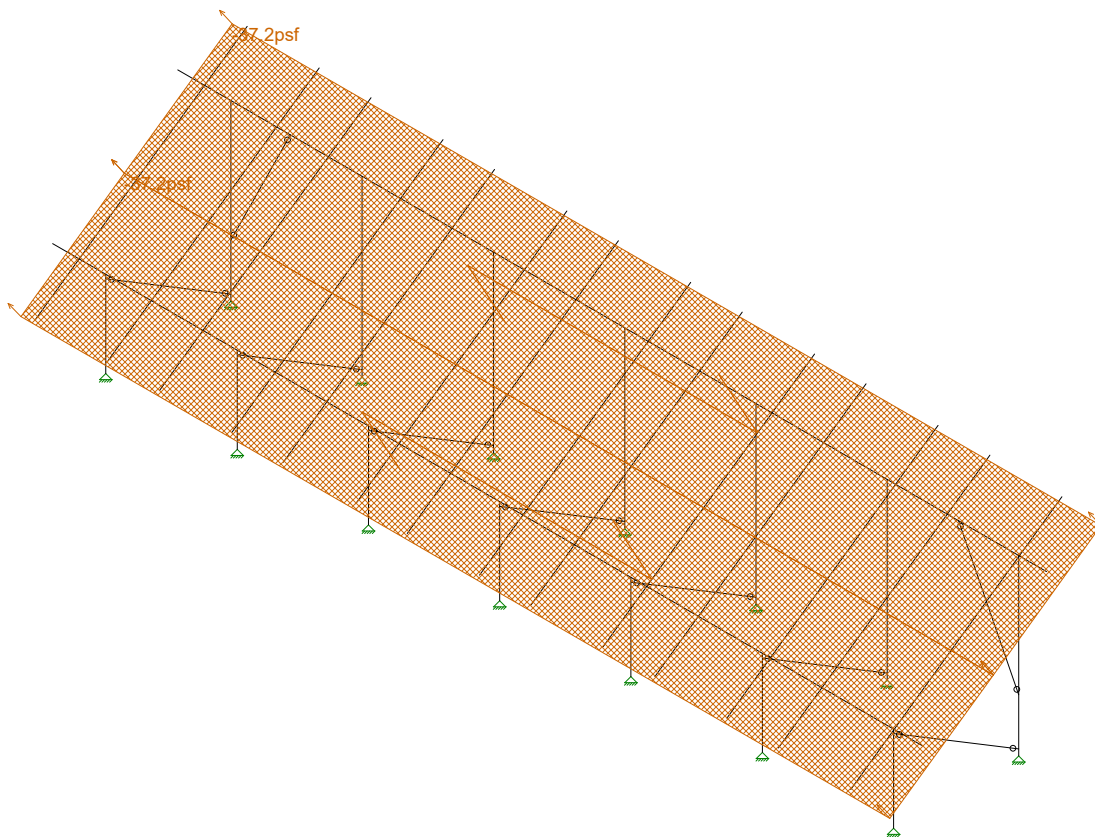
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Ground Mount

SK - 6

July 22, 2020 at 10:29 AM

Sunmodo Sunturf A5a.r3d



Loads: BLC 4, Wind A 0 deg

Vector Structural Engineeri..

STB

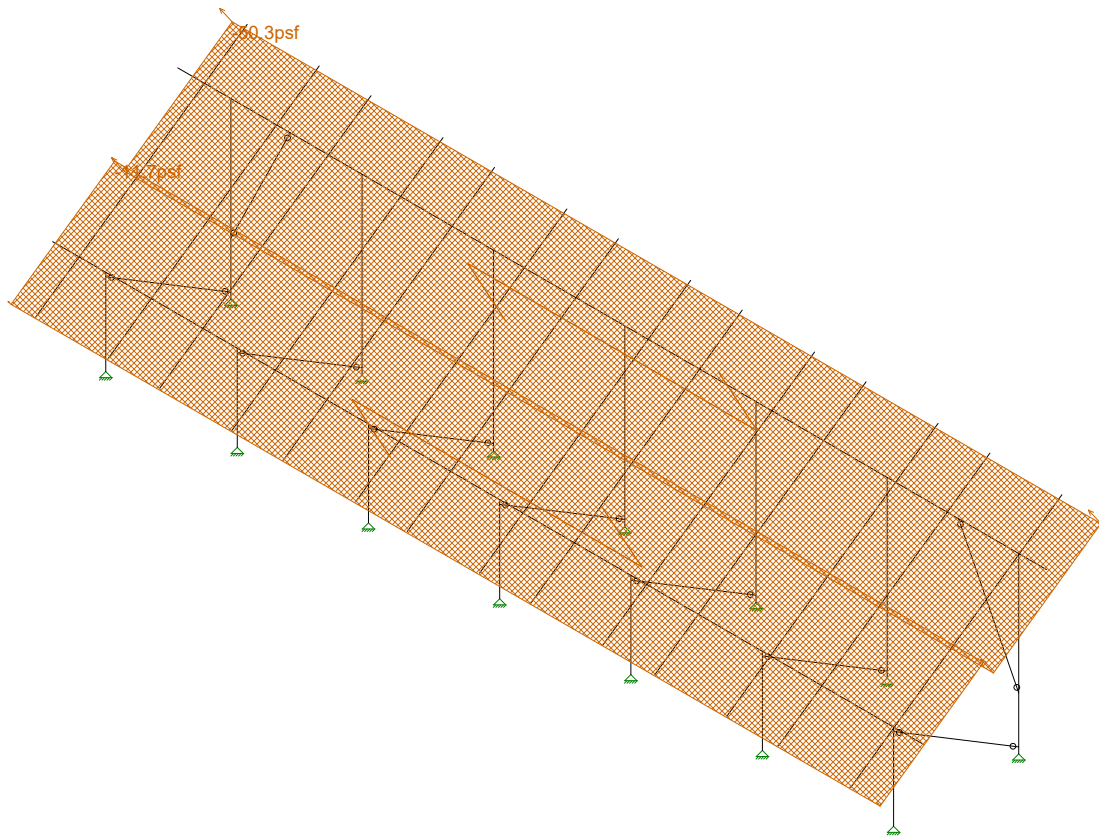
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Ground Mount

SK - 7

July 22, 2020 at 10:29 AM

Sunmodo Sunturf A5a.r3d



Loads: BLC 5, Wind B 0 deg

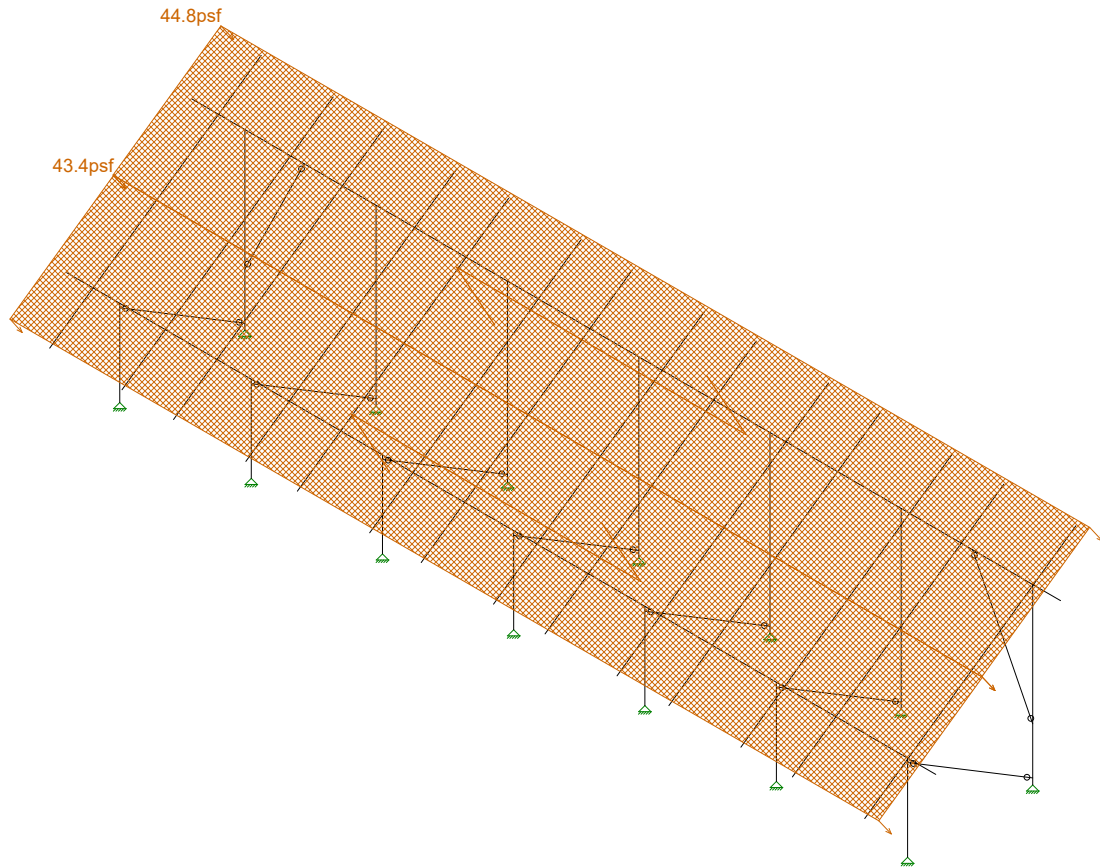
Vector Structural Engineeri...
STB
U2716.0231.201

Ground Mount

SK - 8

July 22, 2020 at 10:29 AM

Sunmodo Sunturf A5a.r3d



Loads: BLC 6, Wind A 180 deg

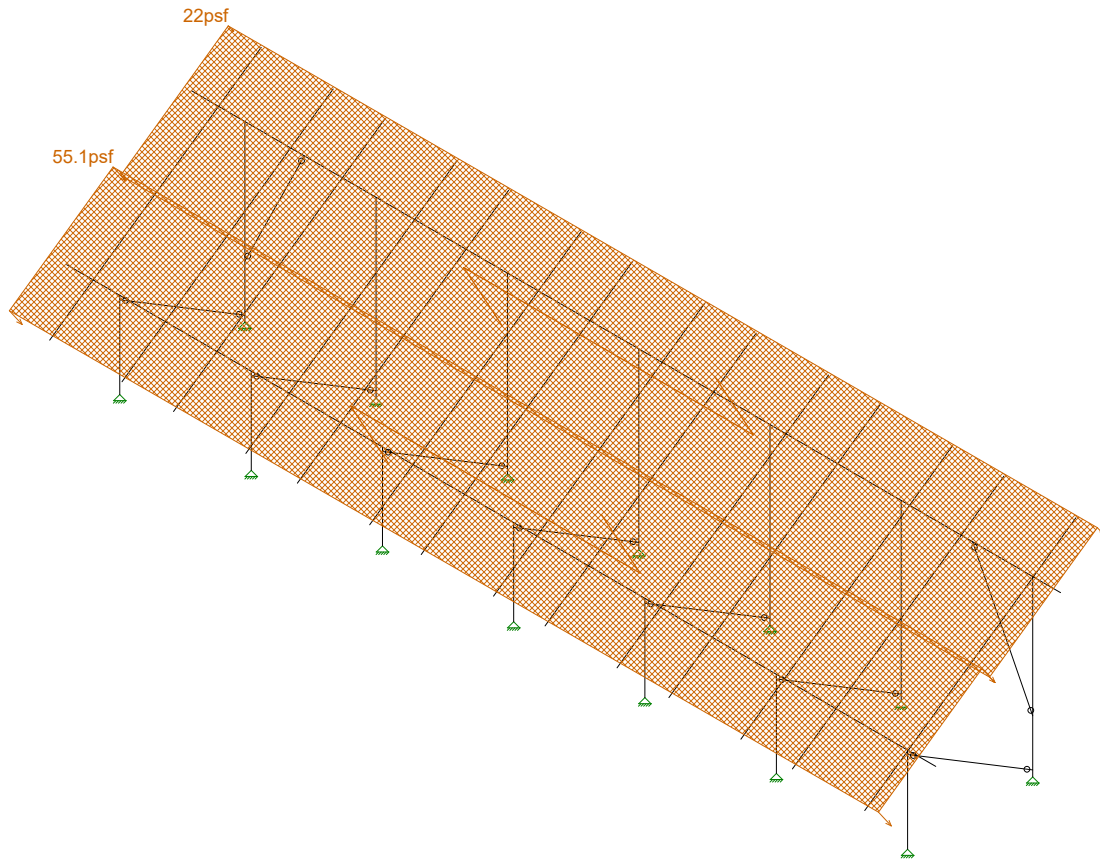
Vector Structural Engineeri...
STB
U2716.0231.201

Ground Mount

SK - 9

July 22, 2020 at 10:29 AM

Sunmodo Sunturf A5a.r3d



Loads: BLC 7, Wind B 180 deg

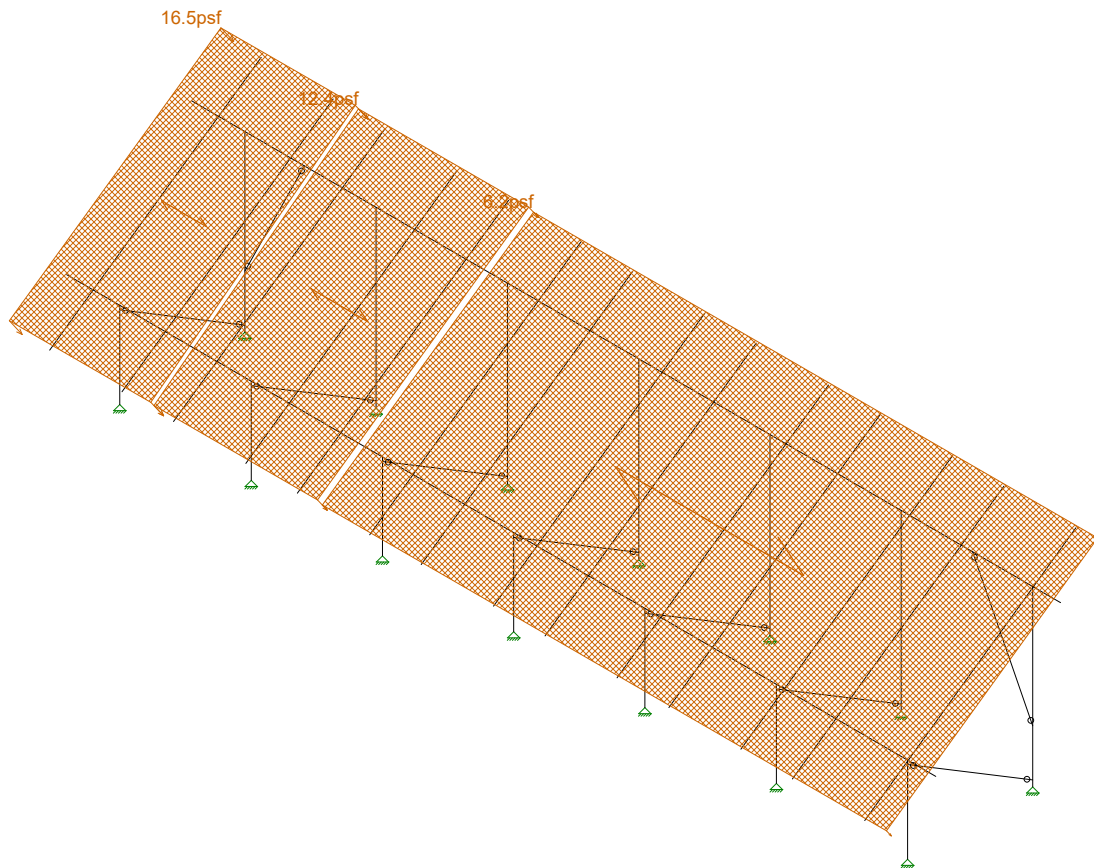
Vector Structural Engineeri...
STB
U2716.0231.201

Ground Mount

SK - 10

July 22, 2020 at 10:30 AM

Sunmodo Sunturf A5a.r3d



Loads: BLC 8, Wind A 90

Vector Structural Engineeri...

STB

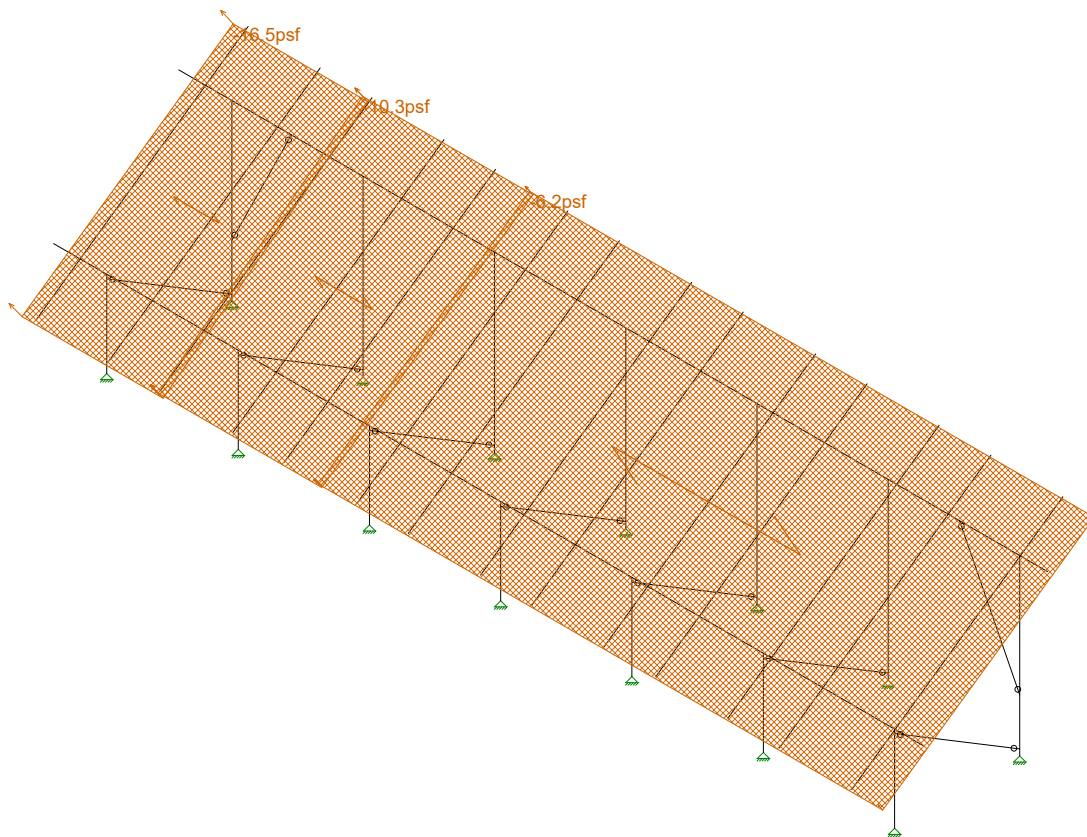
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Ground Mount

SK - 11

July 22, 2020 at 10:30 AM

Sunmodo Sunturf A5a.r3d

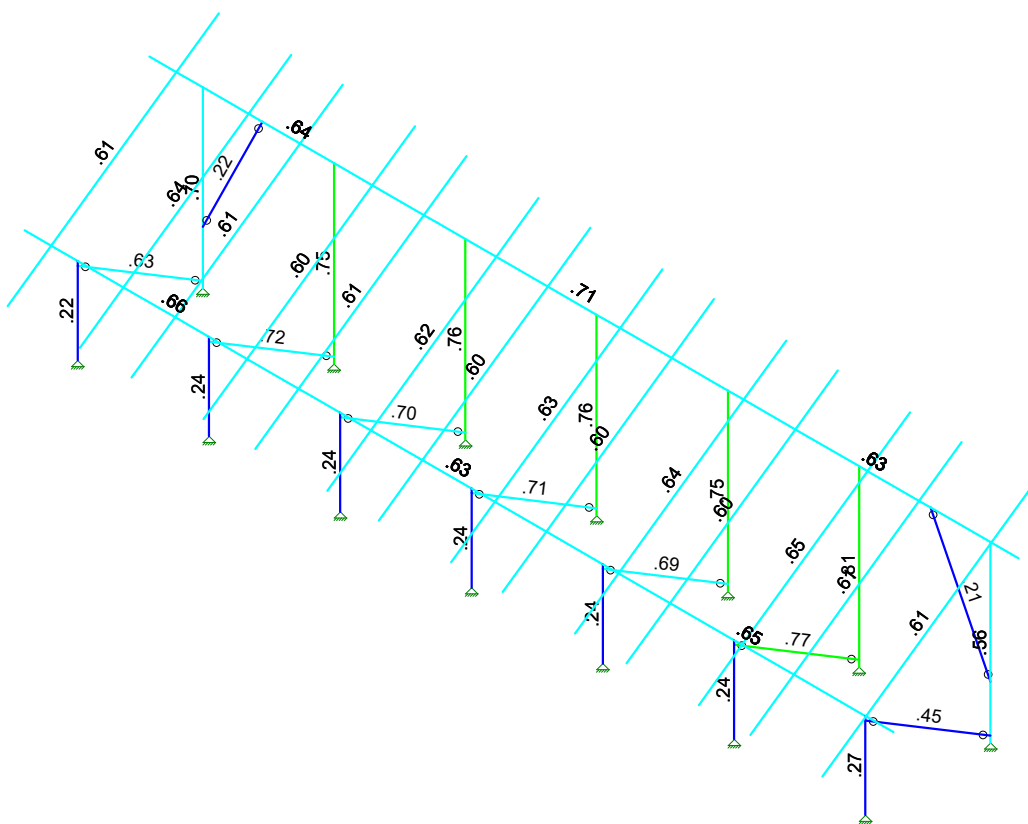


Loads: BLC 9, Wind B 90

Vector Structural Engineeri..	Ground Mount	SK - 12
STB		July 22, 2020 at 10:30 AM
U2716.0231.201		Sunmodo Sunturf A5a.r3d



Code Check (Elem)
No Calc
> 1.0
40-1.0
75-90
50-75
0-.50



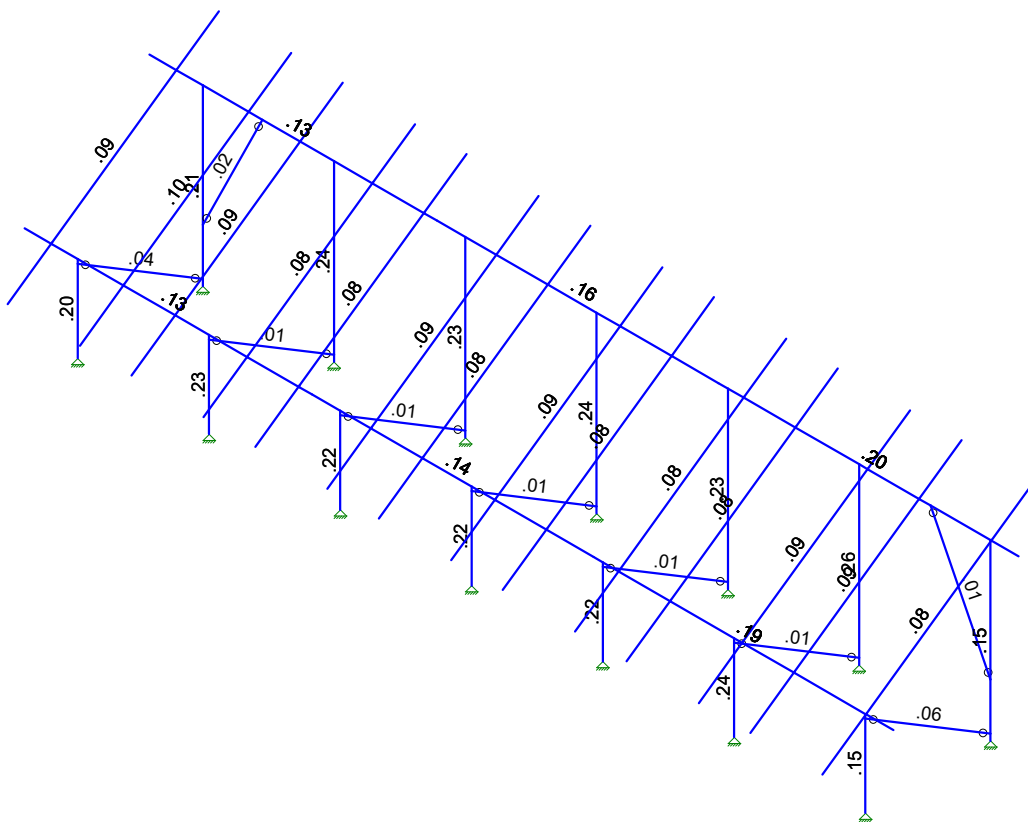
Member Code Checks Displayed (Enveloped)
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 1
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U2716.0231.201		Sunmodo Sunturf A5a.r3d



Shear Check
(Elev.)

Black	No Calc
Red	> 1.0
Yellow	40-1.0
Green	75-90
Cyan	50-75
Blue	0-.50



Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 2
STB		July 22, 2020 at 10:28 AM
U2716.0231.201		Sunmodo Sunturf A5a.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	TMS 402-16: ASD
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 : U2716.0231.201
 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	HR300 ALA	Beam	Rectangular Tubes	6005-T5	Typical	.736	.214	.727	.614
4	AL Cross Beam	Cross Rail	Beam	Rectangular Tubes	6005-T5	Typical	1.909	1.97	4.366	4.017

Member Area Loads (BLC 2 : Solar Panel Weight)

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

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

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

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

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N201	N198	Perp	A-B	-37.2
2	N198	N201	N199	N196	Perp	A-B	-37.2

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

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N201	N198	Perp	A-B	-50.3
2	N198	N201	N199	N196	Perp	A-B	-11.7

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	44.8
2	N198	N201	N199	N196	Perp	A-B	43.4

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

	Joint A	Joint B	Joint C	Joint D	Direction	Distribution	Magnitude[psf]
1	N197	N200	N201	N198	Perp	A-B	22
2	N198	N201	N199	N196	Perp	A-B	55.1

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	16.5
2	N203	N209	N208	N202	Perp	A-B	12.4
3	N209	N200	N199	N208	Perp	A-B	6.2

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	-16.5
2	N203	N209	N208	N202	Perp	A-B	-10.3
3	N209	N200	N199	N208	Perp	A-B	-6.2

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 : U2716.0231.201
 Model Name : Ground Mount

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Basic Load Cases (Continued)

BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area(M... Surface...
3 Roof Live/Snow	RLL							1
4 Wind A 0 deg	OL1							2
5 Wind B 0 deg	OL2							2
6 Wind A 180 deg	OL3							2
7 Wind B 180 deg	OL4							2
8 Wind A 90	OL5							3
9 Wind B 90	OL6							3
10 BLC 2 Transient Area ...	None						34	
11 BLC 3 Transient Area ...	None						34	
12 BLC 4 Transient Area ...	None						120	
13 BLC 5 Transient Area ...	None						120	
14 BLC 6 Transient Area ...	None						120	
15 BLC 7 Transient Area ...	None						120	
16 BLC 8 Transient Area ...	None						98	
17 BLC 9 Transient Area ...	None						98	

Load Combinations

Description	S...	PD...	SRSS	BLC Fa...	BLC Fa...	BLC Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...	B...	Fa...
1 1.0 D	Yes	Y		DL	1													
2 1.0 D + 1.0 S	Yes	Y		DL	1	RLL	1											
3 1.0 D + 0.6 W1	Yes	Y		DL	1	RLL		OL1	.6									
4 1.0 D + 0.6 W2	Yes	Y		DL	1	RLL		OL2	.6									
5 1.0 D + 0.6 W3	Yes	Y		DL	1	RLL		OL3	.6									
6 1.0 D + 0.6 W4	Yes	Y		DL	1	RLL		OL4	.6									
7 1.0 D + 0.6 W5	Yes	Y		DL	1	RLL		OL5	.6									
8 1.0 D + 0.6 W6	Yes	Y		DL	1	RLL		OL6	.6									
9 1.0 D + 0.45 W1 + 0....	Yes	Y		DL	1	RLL	.75	OL1	.45									
10 1.0 D + 0.45 W2 + 0....	Yes	Y		DL	1	RLL	.75	OL2	.45									
11 1.0 D + 0.45 W3 + 0....	Yes	Y		DL	1	RLL	.75	OL3	.45									
12 1.0 D + 0.45 W4 + 0....	Yes	Y		DL	1	RLL	.75	OL4	.45									
13 1.0 D + 0.45 W5 + 0....	Yes	Y		DL	1	RLL	.75	OL5	.45									
14 1.0 D + 0.45 W6 + 0....	Yes	Y		DL	1	RLL	.75	OL6	.45									
15 0.6 D + 0.6 W1	Yes	Y		DL	.6	RLL		OL1	.6									
16 0.6 D + 0.6 W2	Yes	Y		DL	.6	RLL		OL2	.6									
17 0.6 D + 0.6 W3	Yes	Y		DL	.6	RLL		OL3	.6									
18 0.6 D + 0.6 W4	Yes	Y		DL	.6	RLL		OL4	.6									
19 0.6 D + 0.6 W5	Yes	Y		DL	.6	RLL		OL5	.6									
20 0.6 D + 0.6 W6	Yes	Y		DL	.6	RLL		OL6	.6									

Envelope Joint Reactions

Joint	X [lb]	LC	Y [lb]	LC	Z [lb]	LC	MX [lb-ft]	LC	MY [lb-ft]	LC	MZ [lb-ft]	LC	
1 N2	max	11.451	6	1496.245	10	58.446	3	0	20	0	20	0	20
2	min	-7.151	15	-324.72	17	-67.668	5	0	1	0	1	0	1
3 N1	max	116.118	11	2791.861	11	1358.6...	5	0	20	0	20	0	20
4	min	-90.024	16	-2122.994	16	-1147....	3	0	1	0	1	0	1
5 N132	max	3.578	11	2908.206	11	1506.61	5	0	20	0	20	0	20
6	min	-2.294	16	-2244.568	16	-1271....	3	0	1	0	1	0	1
7 N133	max	8.939	12	1670.564	10	62.775	3	0	20	0	20	0	20
8	min	-.462	15	-354.343	17	-73.021	5	0	1	0	1	0	1
9 N109	max	3.499	14	2791.778	11	1574.4...	5	0	20	0	20	0	20
10	min	-1.579	16	-2148.827	16	-1327....	3	0	1	0	1	0	1
11 N110A	max	4.552	5	1742.059	10	62.784	3	0	20	0	20	0	20
12	min	-8.127	4	-391.168	17	-73.136	5	0	1	0	1	0	1
13 N121	max	1.689	8	2949.253	11	1523.7...	5	0	20	0	20	0	20



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	-1.945	19	-2274.39	16	-1287....	3	0	1	0	1	0
15	N122	max	6.223	12	1691.661	10	63.102	3	0	20	0	20
16	min	-2.133	15	-360.184	17	-73.405	5	0	1	0	1	0
17	N133B	max	2.832	11	2928.258	11	1541.6...	5	0	20	0	20
18	min	-1.436	16	-2254.267	16	-1301....	3	0	1	0	1	0
19	N134B	max	10.194	12	1703.534	10	63.325	3	0	20	0	20
20	min	-1.721	15	-368.173	17	-73.541	5	0	1	0	1	0
21	N151	max	4.182	11	3013.052	11	1689	5	0	20	0	20
22	min	-1.189	16	-2319.256	16	-1426....	3	0	1	0	1	0
23	N152	max	30.296	12	1845.549	10	62.377	3	0	20	0	20
24	min	-8.746	15	-437.71	17	-71.617	5	0	1	0	1	0
25	N143A	max	98.796	16	2049.977	11	968.029	5	0	20	0	20
26	min	-130.72	11	-1545.649	16	-816.1...	3	0	1	0	1	0
27	N144A	max	23.183	15	1076.121	10	47.422	3	0	20	0	20
28	min	-64.677	12	-210.865	17	-55.787	5	0	1	0	1	0
29	Totals:	max	.021	19	23713.032	11	9673.8...	5				
30	min	-.042	14	-9980.659	15	-8157....	15					

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

Member	Shape	Code Check	Loc[in]	LC	Shear ...	Loc[in]	Dir	LC	Pnc/om [...]	Pnt/om [lb]	Mny/om...	Mnz/om...	Cb	Eqn	
1	M5	Pipe 2.0 A2...	.222	52.073	17	.201	52.645	5	16486.797	23232.186	1397.505	1397.505	1...	H1-1b	
2	M6	Pipe 2.0 A2...	.703	3.477	5	.210	0	5	6062.107	23232.186	1397.505	1397.505	1...	H1-1a	
3	M13	Pipe 2.5 A2...	.656	118....	12	.128	116....	12	11641.036	28358.413	2081.747	2081.747	2...	H1-1b	
4	M14	Pipe 2.5 A2...	.639	118....	11	.127	116....	11	11641.036	28358.413	2081.747	2081.747	2...	H1-1b	
5	M15	1.5x1.5x0.083	.626	48.694	5	.039	93.493	y	11	2716.455	14085.15	624.421	624.421	1...	H1-1a
6	M80	Pipe 2.0 A2...	.237	52.073	17	.217	52.645	5	16486.797	23232.186	1397.505	1397.505	1...	H1-1b	
7	M81	Pipe 2.0 A2...	.752	3.477	5	.230	0	5	6062.107	23232.186	1397.505	1397.505	1...	H1-1a	
8	M82	1.5x1.5x0.083	.691	48.694	5	.010	93.493	y	10	2716.455	14085.15	624.421	624.421	1...	H1-1a
9	M50	Pipe 2.0 A2...	.239	52.073	17	.227	52.645	5	16486.797	23232.186	1397.505	1397.505	1...	H1-1b	
10	M51	Pipe 2.0 A2...	.754	3.477	5	.241	0	5	6062.107	23232.186	1397.505	1397.505	1...	H1-1a	
11	M52	1.5x1.5x0.083	.722	48.694	5	.007	93.493	y	14	2716.455	14085.15	624.421	624.421	1...	H1-1a
12	M56A	Pipe 2.0 A2...	.239	52.073	17	.220	52.645	5	16486.797	23232.186	1397.505	1397.505	1...	H1-1b	
13	M57A	Pipe 2.0 A2...	.762	3.477	5	.234	0	5	6062.107	23232.186	1397.505	1397.505	2...	H1-1a	
14	M58A	1.5x1.5x0.083	.699	48.694	5	.007	93.493	y	4	2716.455	14085.15	624.421	624.421	1...	H1-1a
15	M68	Pipe 2.0 A2...	.239	52.073	17	.222	52.645	5	16486.797	23232.186	1397.505	1397.505	1...	H1-1b	
16	M69	Pipe 2.0 A2...	.763	3.477	5	.236	0	5	6062.107	23232.186	1397.505	1397.505	1...	H1-1a	
17	M70	1.5x1.5x0.083	.707	48.694	5	.009	0	y	10	2716.455	14085.15	624.421	624.421	1...	H1-1a
18	M68A	Pipe 2.5 A2...	.635	18.75	12	.138	103....	12	11641.036	28358.413	2081.747	2081.747	2...	H1-1b	
19	M69A	Pipe 2.5 A2...	.652	90	12	.193	90	12	11641.036	28358.413	2081.747	2081.747	1...	H1-1b	
20	M70A	Pipe 2.5 A2...	.707	18.75	11	.161	103....	11	11641.036	28358.413	2081.747	2081.747	2...	H1-1b	
21	M71	Pipe 2.5 A2...	.632	6	11	.196	90	11	11641.036	28358.413	2081.747	2081.747	2...	H1-1b	
22	M73	Pipe 2.0 A2...	.240	52.073	17	.245	52.645	5	16486.797	23232.186	1397.505	1397.505	1...	H1-1b	
23	M74	Pipe 2.0 A2...	.811	3.477	5	.258	0	5	6062.107	23232.186	1397.505	1397.505	1...	H1-1a	
24	M75	1.5x1.5x0.083	.774	48.694	5	.011	0	y	10	2716.455	14085.15	624.421	624.421	1...	H1-1a
25	M69C	Pipe 2.0 A2...	.274	52.645	12	.146	52.645	5	16486.797	23232.186	1397.505	1397.505	1...	H1-1b	
26	M70C	Pipe 2.0 A2...	.561	33.608	11	.147	0	5	6062.107	23232.186	1397.505	1397.505	1...	H1-1a	
27	M71B	1.5x1.5x0.083	.448	48.694	5	.063	0	y	11	2716.455	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...	.222	52.977	11	.023	0	z	5	2260.001	19411....	770.742	927.083	5889.423	3966.346	1...	H.1-1
2	M16	HR300_A...	.615	82.515	11	.085	36.1	y	11	3887.213	14342....	494.953	934.619	6030.769	2749.538	1	H.1-1
3	M35	HR300_A...	.635	80.796	11	.095	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1	H.1-1
4	M38	HR300_A...	.615	84.234	11	.089	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1	H.1-1



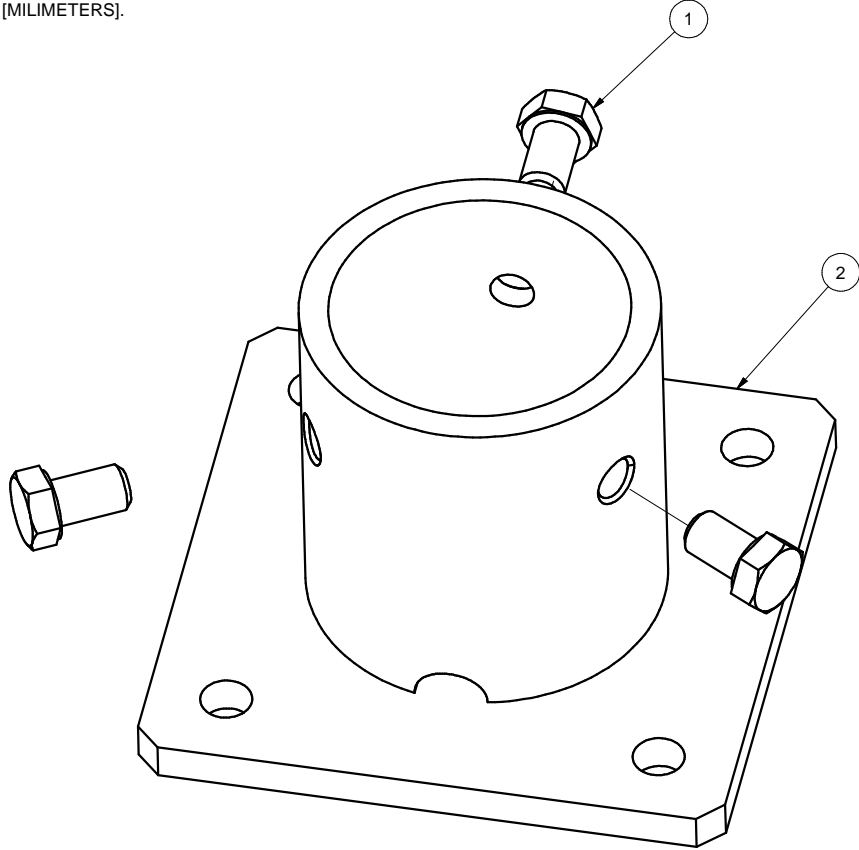
Company : Vector Structural Engineering
 Designer : STB
 Job Number : U2716.0231.201
 Model Name : Ground Mount

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

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
5	M41	HR300_A...	.604	84.234	11	.084	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
6	M44	HR300_A...	.606	84.234	11	.084	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
7	M47	HR300_A...	.619	84.234	11	.085	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
8	M50A	HR300_A...	.597	34.381	12	.084	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
9	M53	HR300_A...	.630	84.234	11	.085	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
10	M56	HR300_A...	.597	34.381	12	.084	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
11	M59	HR300_A...	.638	84.234	11	.084	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
12	M62	HR300_A...	.597	34.381	12	.084	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
13	M65	HR300_A...	.646	84.234	11	.089	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
14	M68B	HR300_A...	.611	80.796	11	.094	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
15	M71A	HR300_A...	.607	84.234	11	.083	36.1	y	12	3887.213	14342....	494.953	934.619	6030.769	2749.538	1 H.1-1
16	M72	RT1.5x2x...	.208	53.045	11	.012	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].



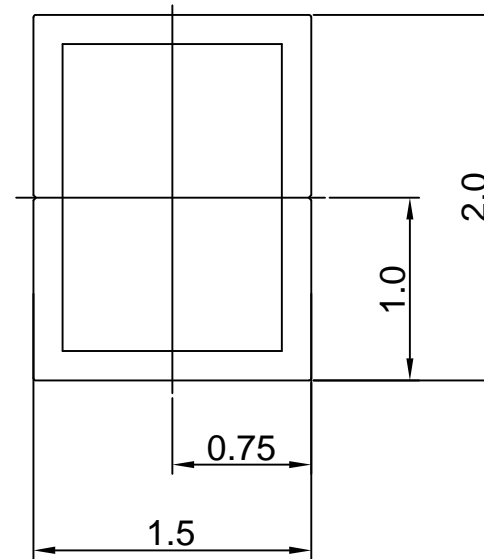
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	10/20/2016

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	
CHECKED BY		10/20/2016	
APPROVALS			

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NOTES: UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS SHOWN ARE INCHES [MILIMETERS].
2. MATERIAL: ALUMINUM 6005-T5.
FINISH: CLEAR ANODIZED 10 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

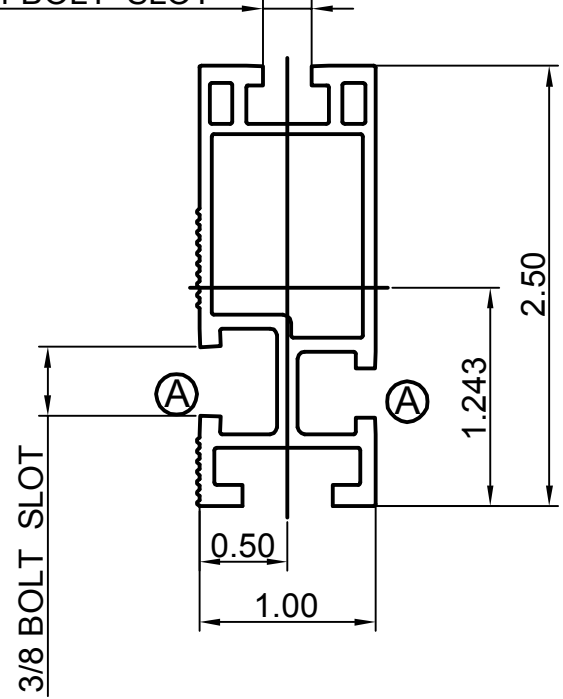
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS			
All Dimensions in inches [millimeters]			
Tolerances			
X.XXX ± 0.01 [0.25mm]	Break all sharp edges		
X.XX ± 0.02 [0.50mm]	.010-.020 unless		
X.X ± 0.039 [1.0mm]	otherwise specified.		
DRAWN BY		DATE	
zcg		03/12/2014	
CHECKED BY			
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 μ m THICK.
3. THE UNSPECIFIED DIMENSIONS ARE SPECIFIED BY 2D CAD FILE.

2X 1/4 BOLT SLOT



Section properties:

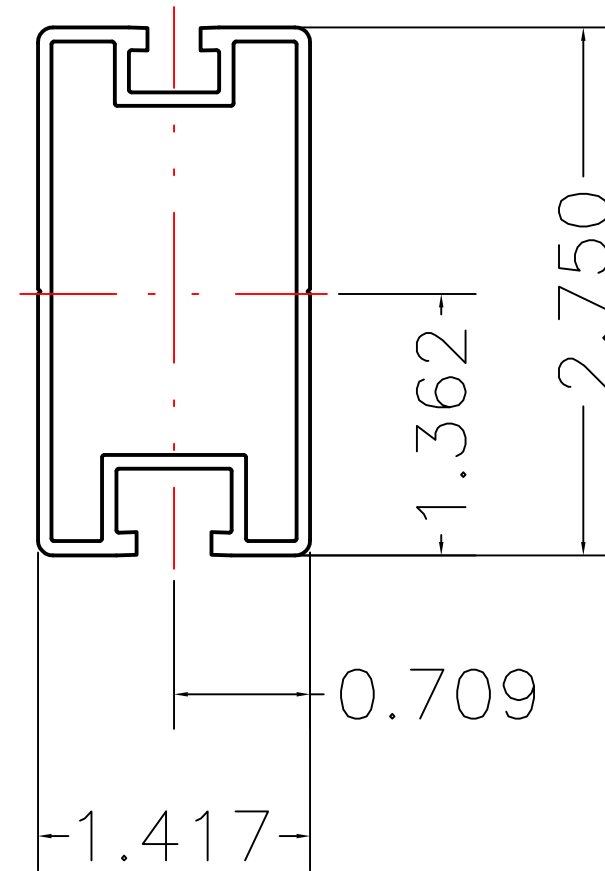
Weight: 0.850 lbs/ft
 Area: 0.723 in²
 Perimeter: 17.325 in
 Bounding Box: X: -0.500,0.500
 Y: -1.243,1.257

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			

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

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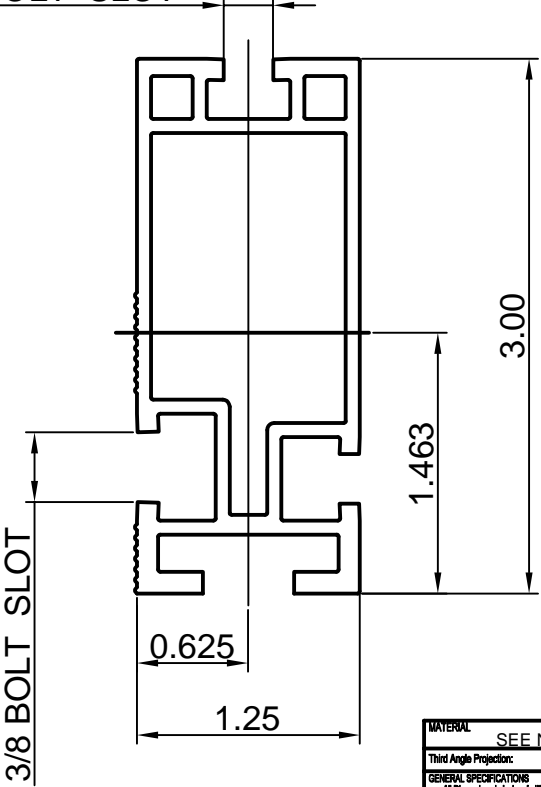
MATERIAL SEE NOTES		SunModo Corp. 14800 NE 65TH STREET, VANCOUVER WA 98682	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters]		TITLE RAIL, HR300 (SUNRAY), EXTRUSION	
Tolerances X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] Break all sharp edges X.X ±0.039 [1.0mm] .010-.020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

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.

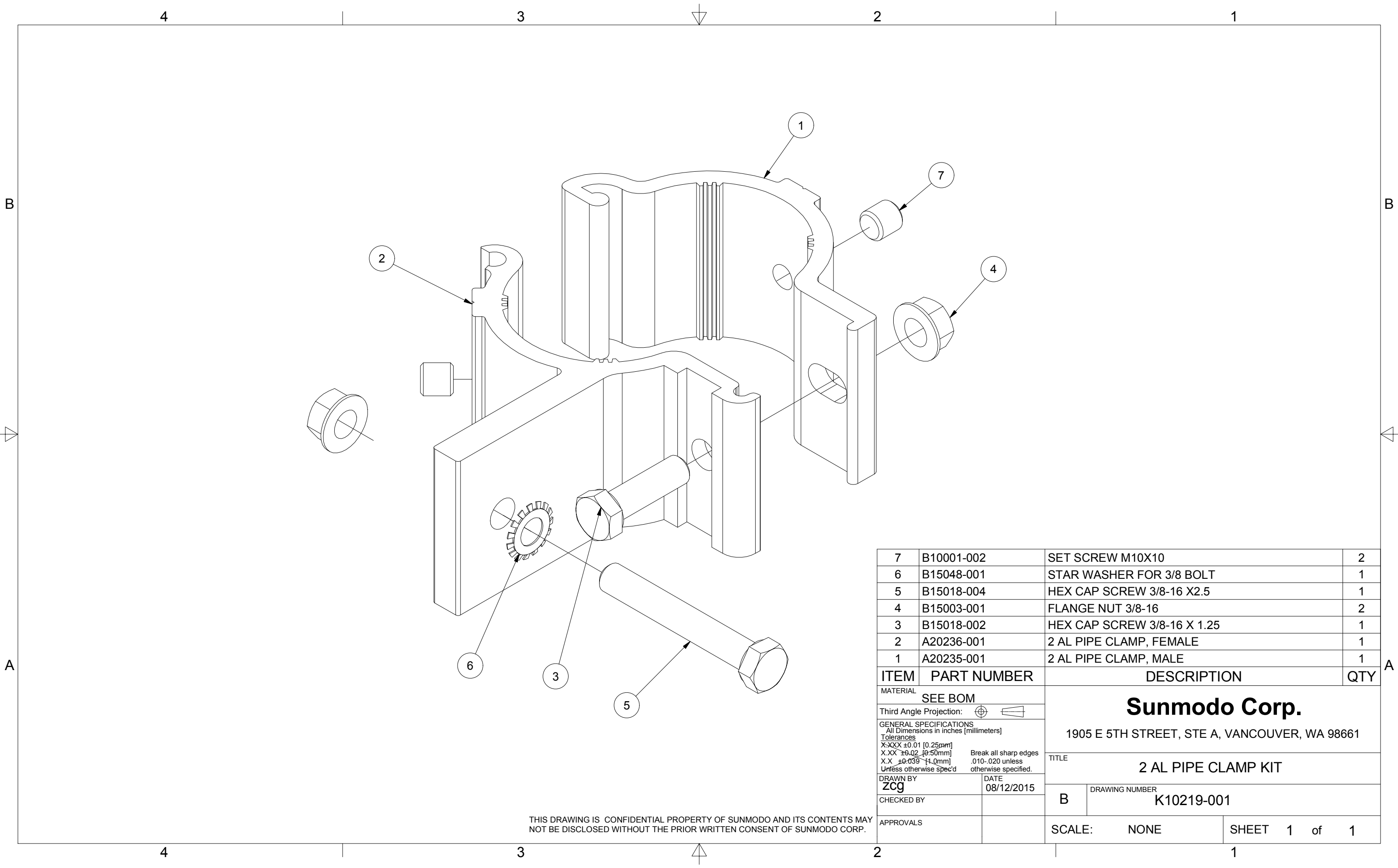
2X 1/4 BOLT SLOT



Section properties:

Weight: 1.151 lbs/ft
 Area: 0.980 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

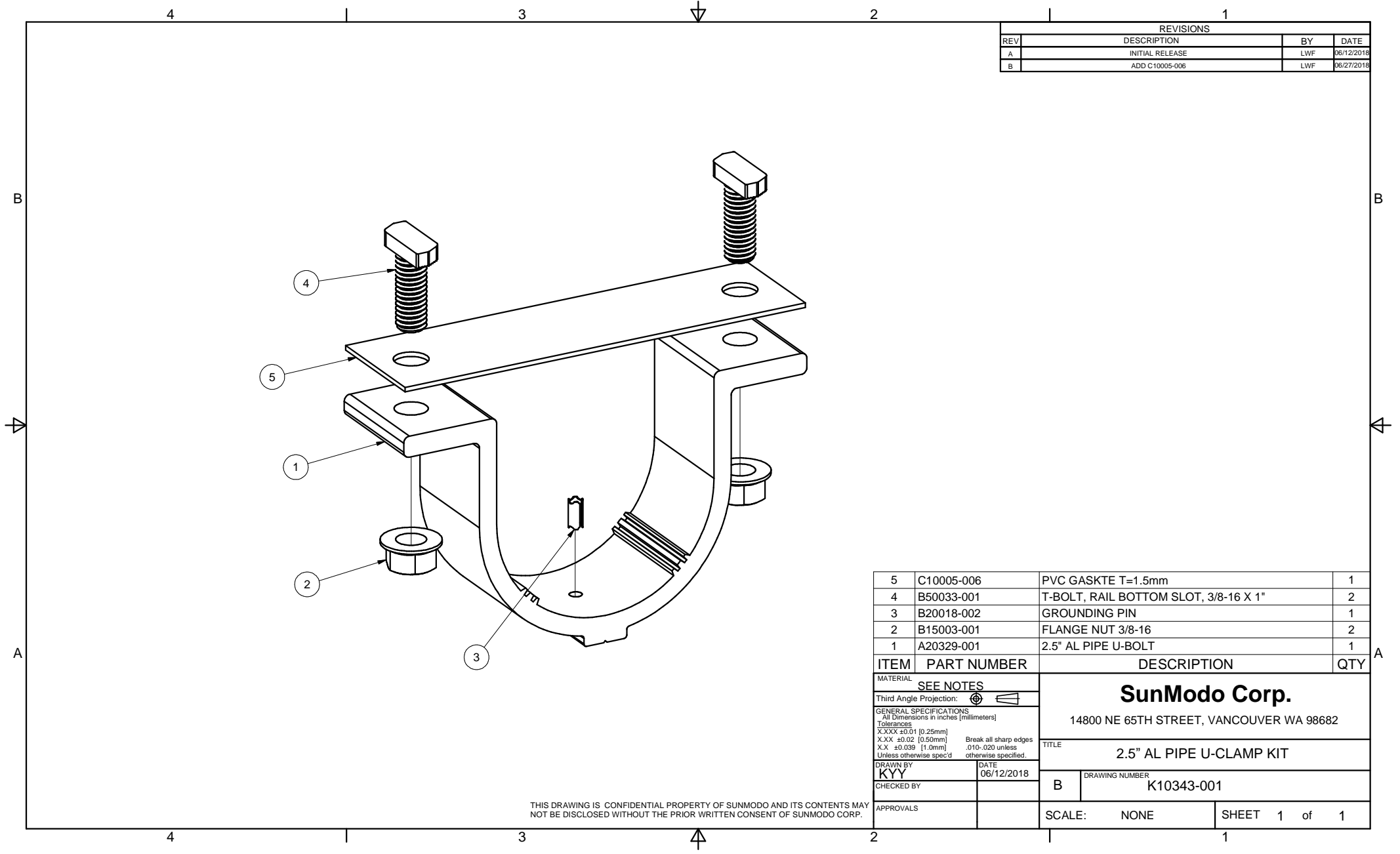
MATERIAL		SEE NOTES	
Third Angle Projection			
GENERAL SPECIFICATIONS			
All Dimensions in Inches (millimeters)			
Tolerances			
XXX ±0.01 (0.25mm)			
XX ±0.02 (0.50mm)			
X ±0.03 (1.0mm)			
Unless otherwise specified.			
DRAWN BY		DATE	
ZCJ		02/21/2013	
CHECKED BY		DATE	
APPROVALS		DATE	
Sunmodo Corp.		1905 E 5TH STREET, SUITE A, VANCOUVER, WA 98661	
TITLE		HELIO HEAVY RAIL	
DRAWING NUMBER		A20145	
SCALE:		NONE	
SHEET		1 of 1	



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

ITEM	PART NUMBER	DESCRIPTION	QTY
MATERIAL		SEE BOM	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches (millimeters)			
Tolerances			
X.XXX ±0.01 [0.25mm]		Break all sharp edges	
X.XX ±0.02 [0.50mm]		.010-.020 unless	
X.X ±0.039 [1.0mm]		otherwise specified.	
DRAWN BY		DATE	
zcg		08/12/2015	
CHECKED BY		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	06/27/2018

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

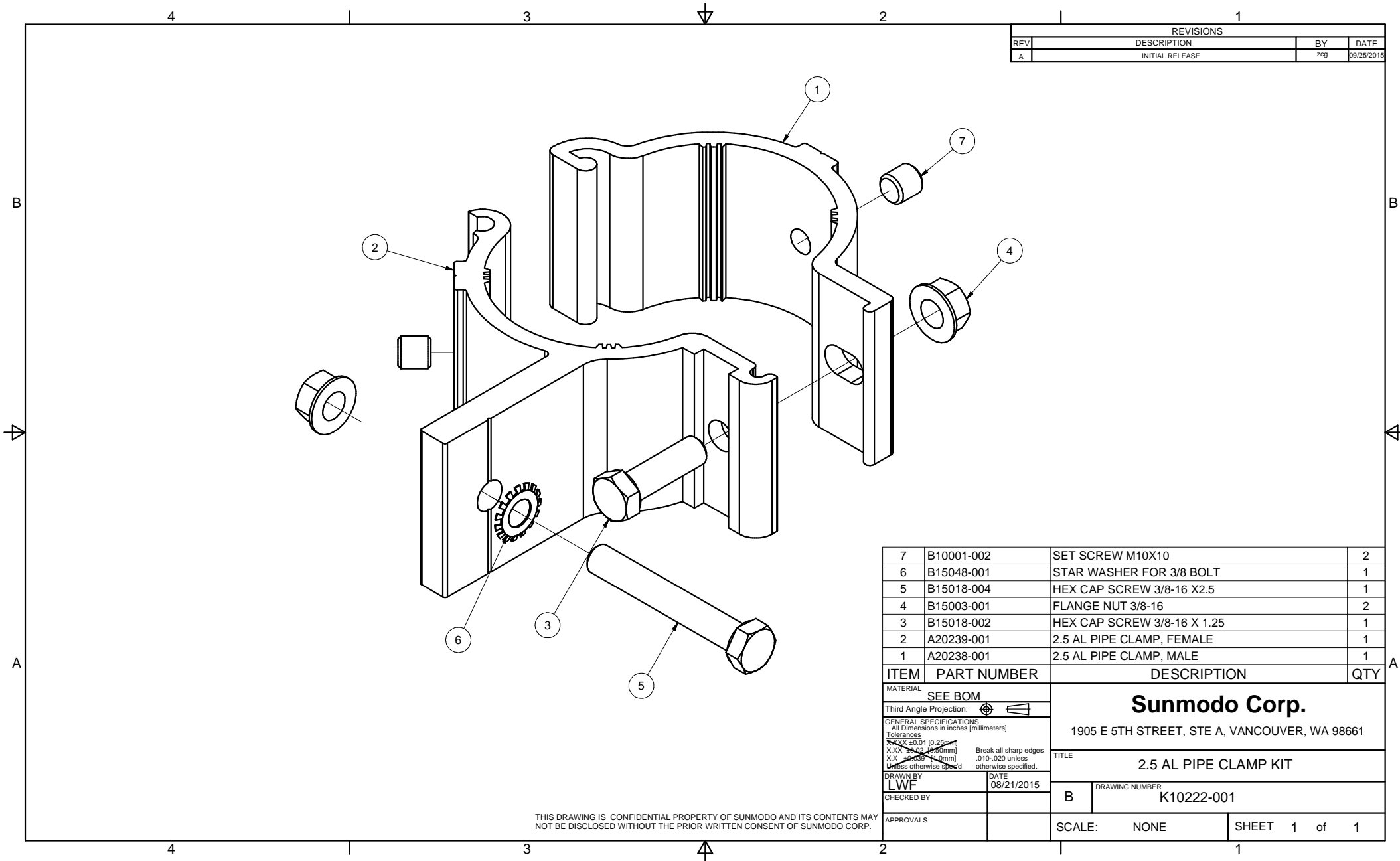
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters] Tolerances X.XXX ±0.01 [0.25mm] X.XX ±0.02 [0.50mm] X.X ±0.039 [1.0mm] Unless otherwise spec'd			
DRAWN BY		DATE	
KYY		06/12/2018	
CHECKED BY		B	
APPROVALS		SCALE: NONE	
		SHEET 1 of 1	

SunModo Corp.
 14800 NE 65TH STREET, VANCOUVER WA 98682

TITLE
2.5" AL PIPE U-CLAMP KIT

DRAWING NUMBER
K10343-001

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

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

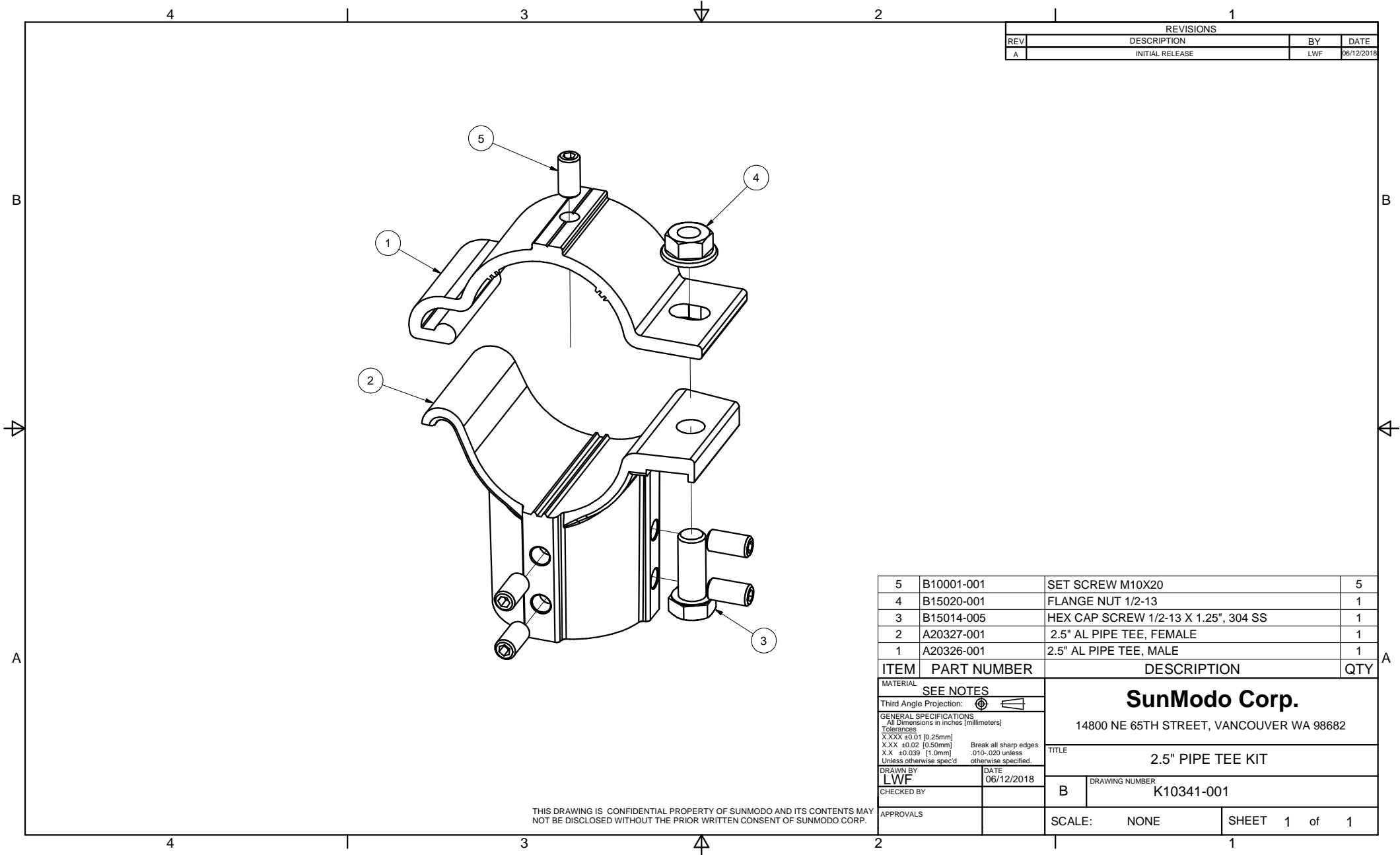
MATERIAL		SEE BOM	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters] Tolerances X.XX ±0.01 (0.25mm) X.X ±0.02 (0.50mm) X.X ±0.03 (0.75mm) Unless otherwise specified.			
DRAWN BY		DATE	
LWF		08/21/2015	
CHECKED BY		B	
APPROVALS		SCALE: NONE	
		SHEET 1 of 1	

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

TITLE
2.5 AL PIPE CLAMP KIT

DRAWING NUMBER
K10222-001

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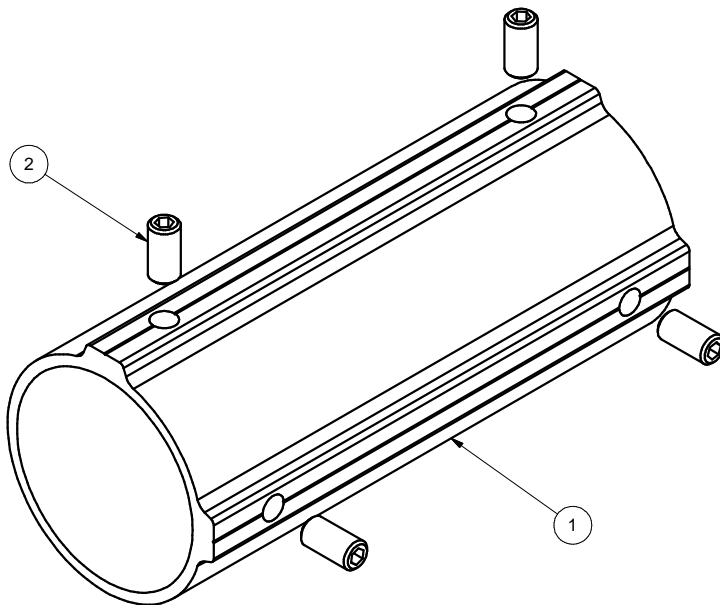
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018

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

MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS		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	
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		SunModo Corp. 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		TITLE 2.5" PIPE SPLICE KIT	
DRAWN BY	DATE	DRAWING NUMBER	
LWF	06/12/2018	B K10342-001	
CHECKED BY			
APPROVALS		SCALE: NONE	SHEET 1 of 1

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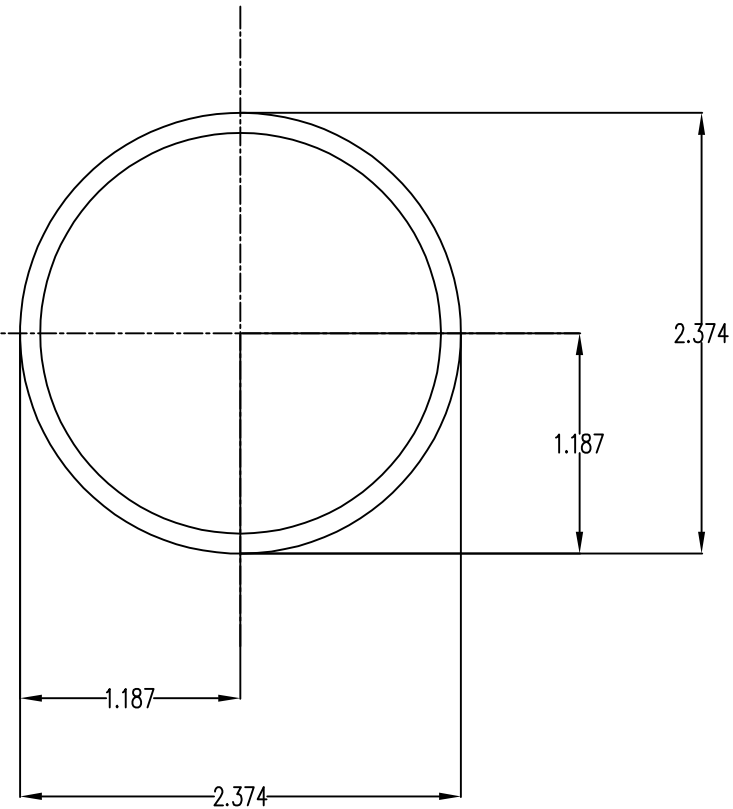
NOTES: UNLESS OTHERWISE SPECIFIED

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 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

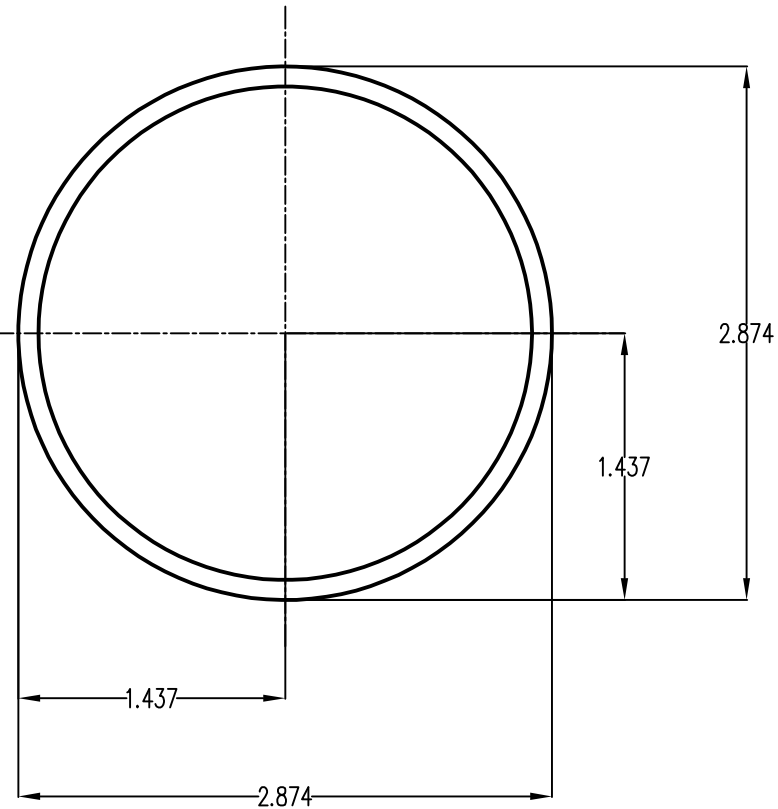
MATERIAL		SEE NOTES		Sunmodo Corp. 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS				TITLE	
All Dimensions in Inches (millimeters)				PIPE, HSS, 2.375" OD X 12 GAUGE,L=XXX	
Tolerances				Break all sharp edges .010-.020 unless otherwise specified.	
XXX ±0.01 (0.25mm)					
XX ±0.02 (0.50mm)					
X ±0.050 (1.27mm)					
Unless otherwise specified					
DRAWN BY		DATE		B	
LWF		04/03/2019		DRAWING NUMBER	
CHECKED BY				A21165	
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	