



Project Number: U2716.114.191

February 21, 2024

Sunmodo
14800 NE 65th Street
Vancouver, WA 98682

**REFERENCE: Sunmodo Sunturf Ground Mount A5 - Standard Panels
Ground Mount PV Array Installation**

To Whom It May Concern:

Per request of Sunmodo, we have been asked to prepare the structural design of a ground-mounted PV solar array system with several foundation options as shown in the attached calculations. The adopted building code in this jurisdiction is the 2015 International Building Code. Vector Structural Engineering requires that we review each site specific install, and we are not liable for installs at site specific locations we have not reviewed. This document does not address site-specific installations. 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: 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.

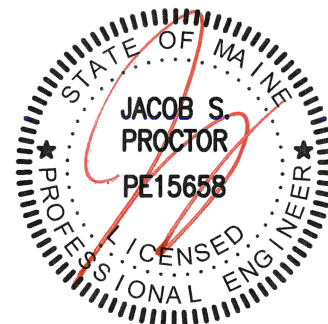
Very truly yours,

VECTOR STRUCTURAL ENGINEERING, LLC

Jacob Proctor, P.E.
ME License: PE15658 - Expires: 12/31/2025
Principal

Enclosures

JSP/stb

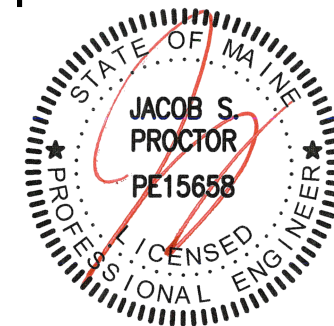
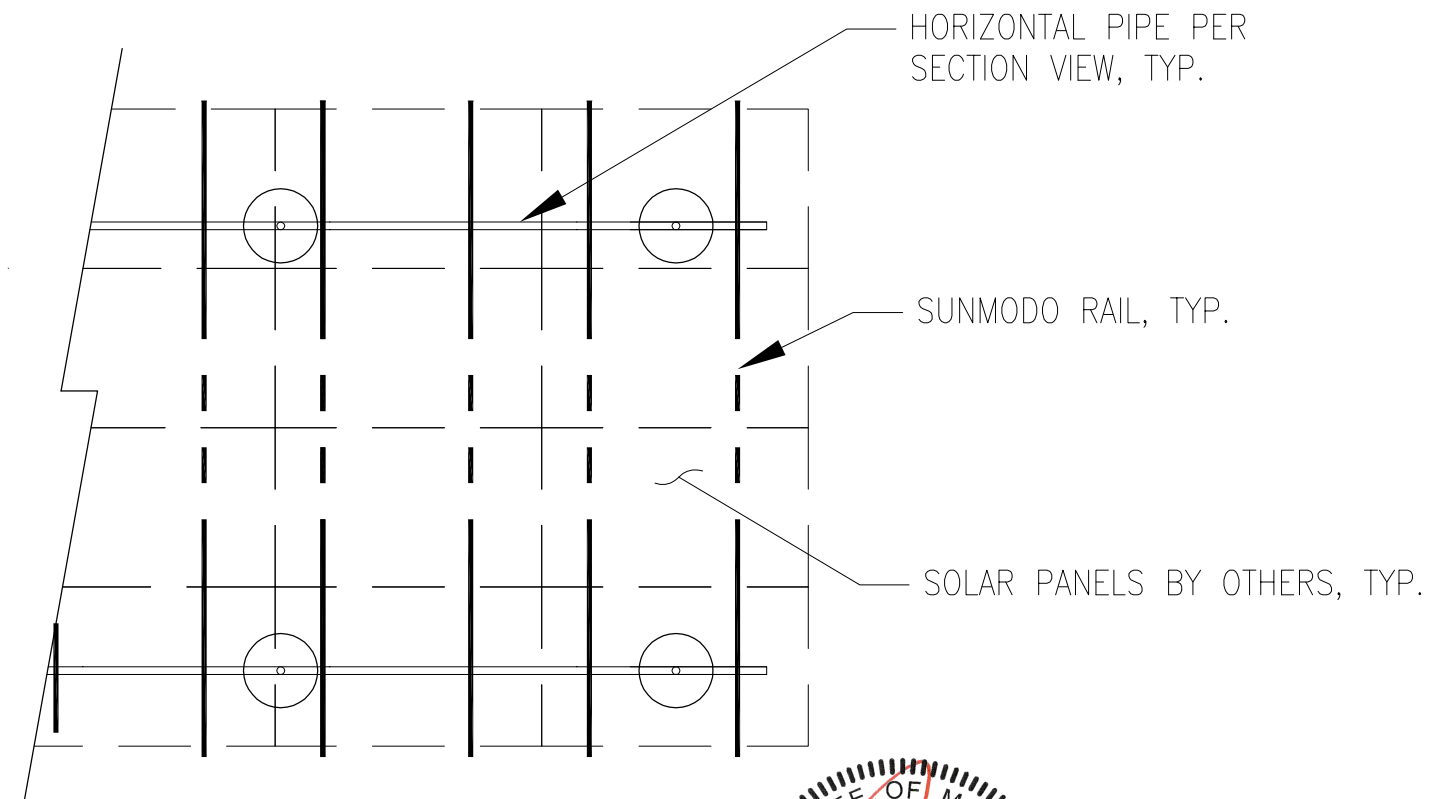
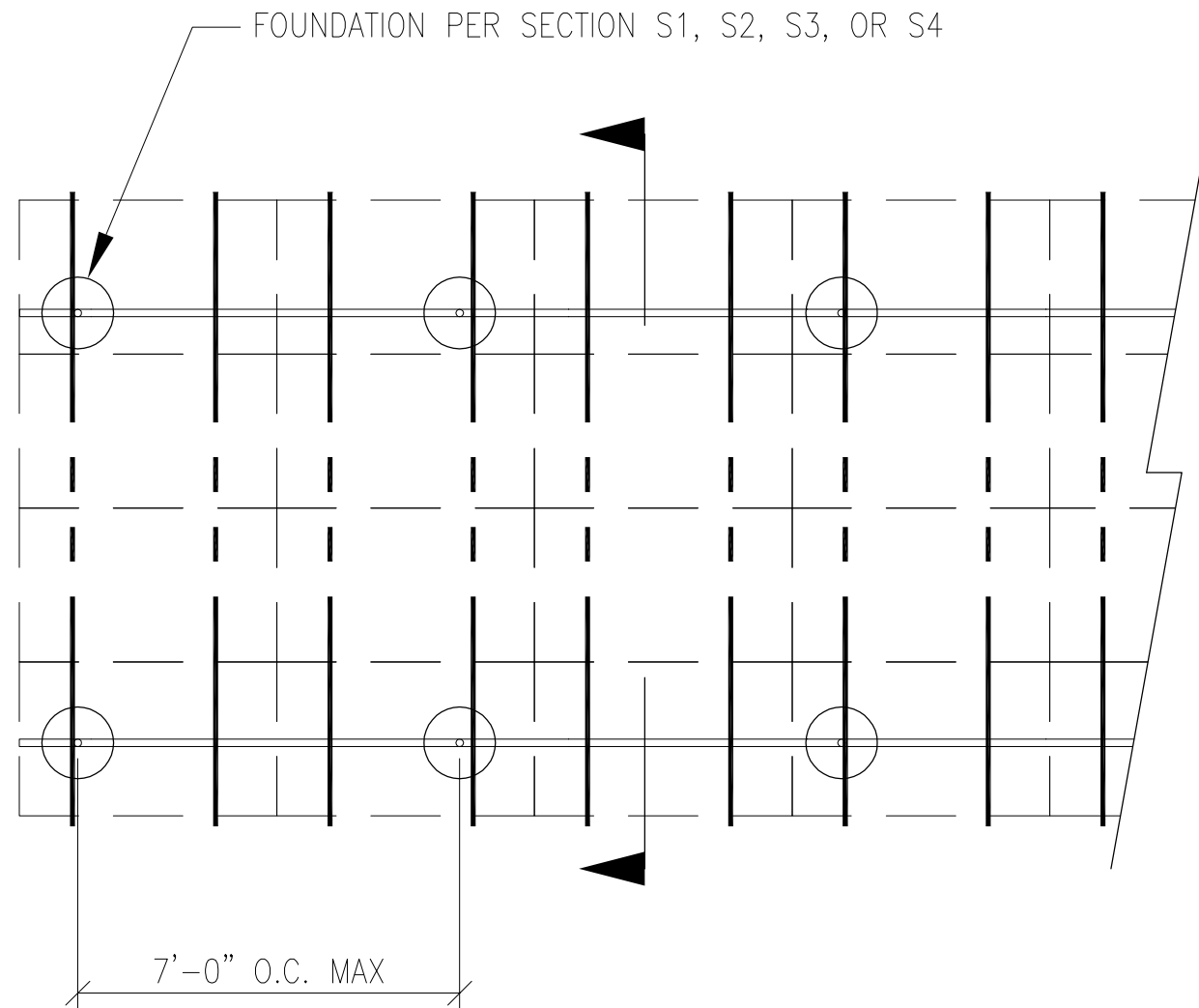


02/21/2024



JOB NO. U2716-114-191
 PROJECT SUNMODO SUNTURF GROUND MOUNTS A5
 SUBJECT ALL OPTIONS

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



02/21/2024

P1

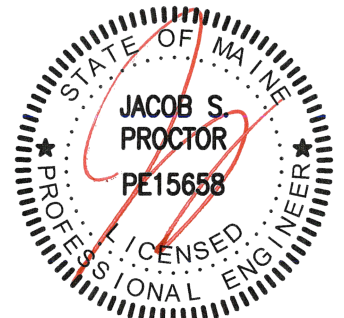
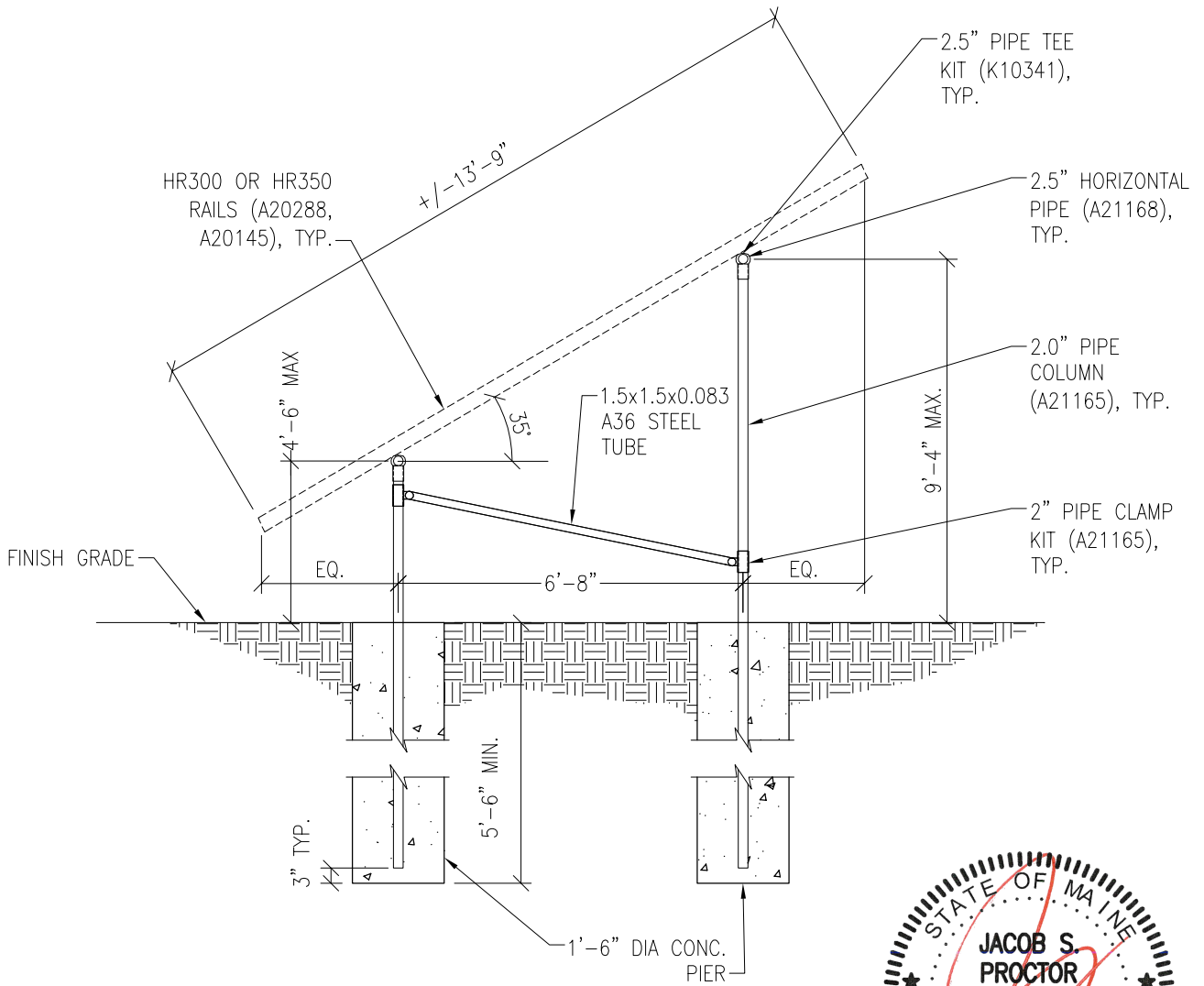
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PV ARRAY PLAN

N.T.S.

PROJECT SUNMODO SUNTURF GROUND MOUNTS A5

SUBJECT DRILLED PIER OPTION



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PV ARRAY SECTION

N.T.S.

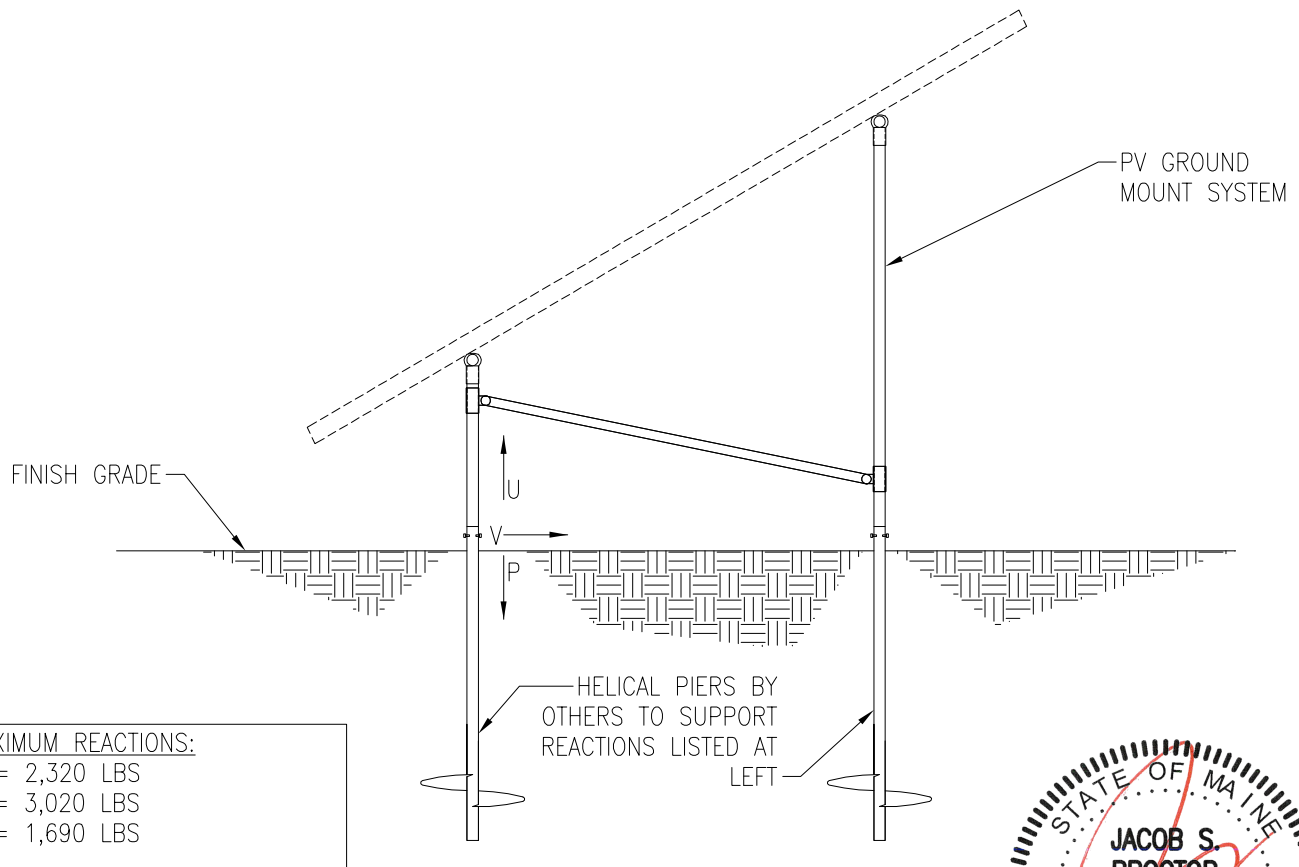
S1

PROJECT SUNMODO SUNTURF GROUND MOUNTS A5

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.

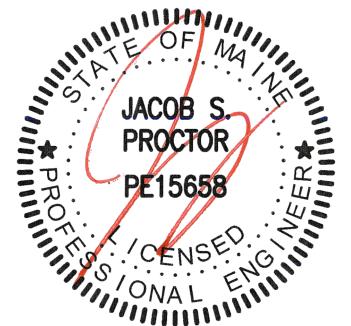


MAXIMUM REACTIONS:	
U	= 2,320 LBS
P	= 3,020 LBS
V	= 1,690 LBS

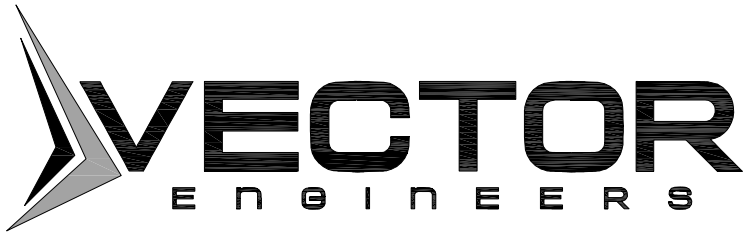
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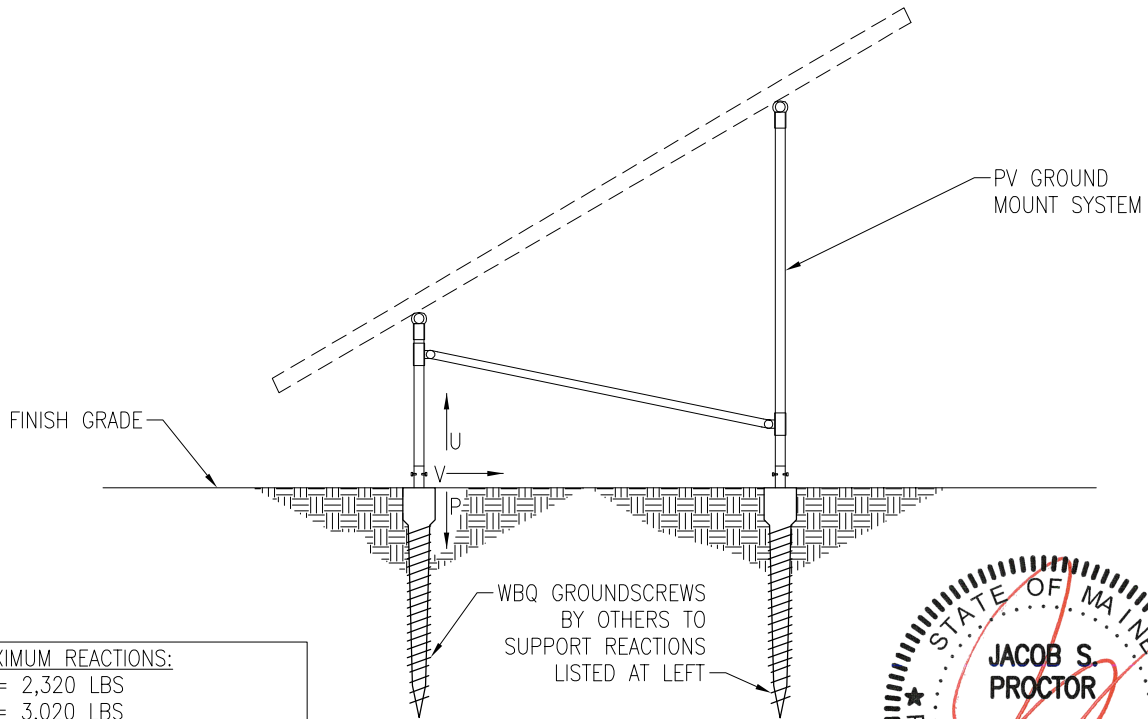
JOB NO. U2716-114-191

PROJECT SUNMODO SUNTURF GROUND MOUNTS A5

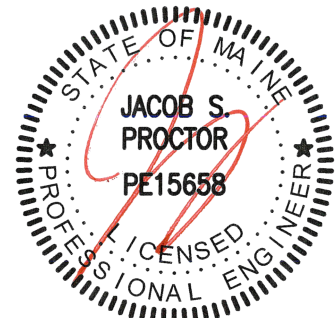
SUBJECT GROUND SCREW OPTION

NOTES:

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



MAXIMUM REACTIONS:
 U = 2,320 LBS
 P = 3,020 LBS
 V = 1,690 LBS



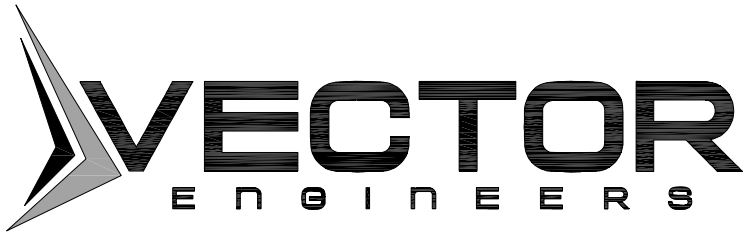
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PV ARRAY SECTION

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N.T.S.

S3



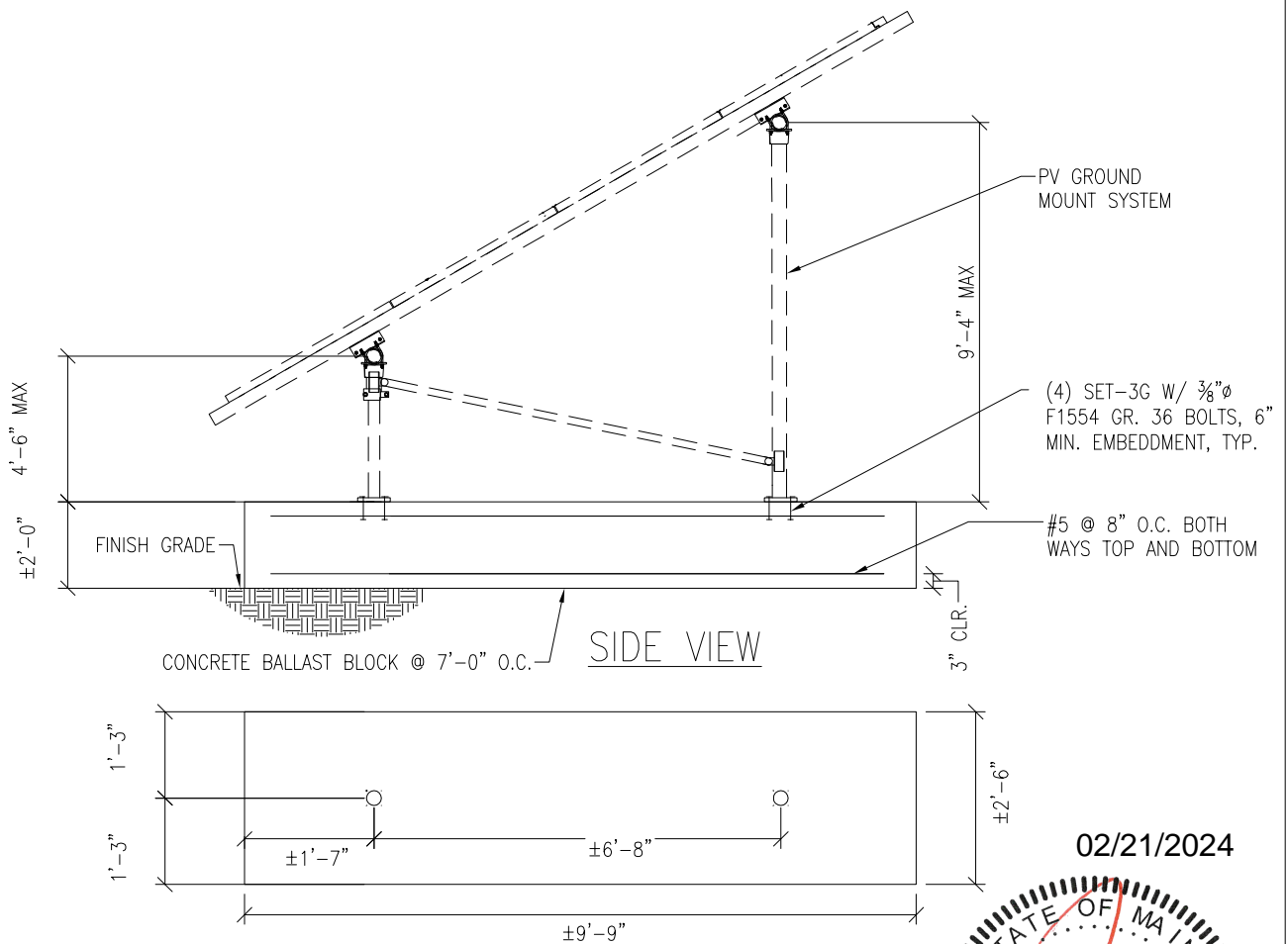
JOB NO. U2716-114-191

PROJECT SUNMODO SUNTURF GROUND MOUNTS A5

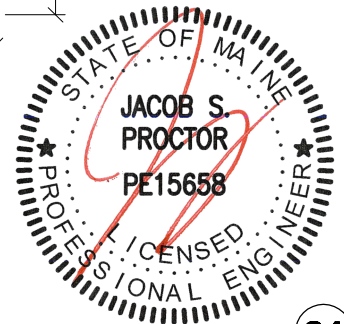
SUBJECT BALLASTED BLOCK OPTION

NOTES:

1. For ground mount components see Section S1.



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PV ARRAY SECTION

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S4

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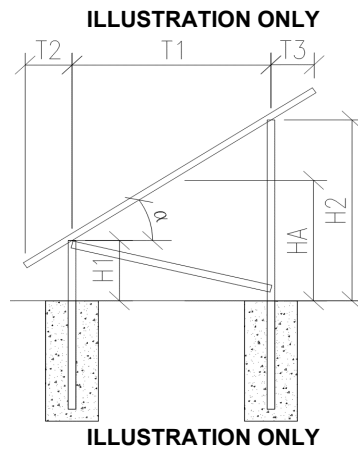
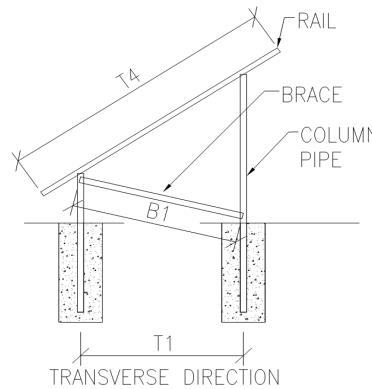
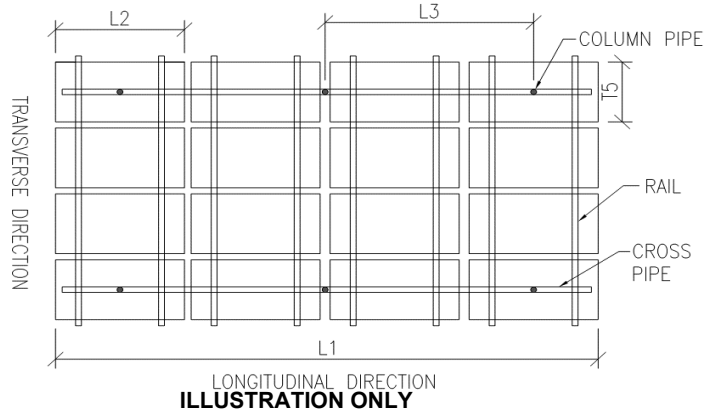
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PROJECT: A5 – Sunmodo Sunturf GM

SUBJECT: Dead Load

Design Weight:

Individual Panel Weight [lb]:	50.7
Panel Transverse Length (T5) [in]:	41.2
Panel Transverse Length (T5) [ft]:	3.4
Panel Longitudinal Length (L2) [in]:	81.4
Panel Longitudinal Length (L2) [ft]:	6.8
Individual Panel Area [ft ²]:	23.3
Individual Panel Weight [psf]:	2.2
# of Panels in Transverse Direction:	4
Approximate Transverse Length (T4) [ft]:	13.7
# of Panels in Longitudinal Direction:	12
Approximate Longitudinal Length (L1) [ft]:	81.4
Transverse Column Spacing (T1) [ft]:	6.7
Longitudinal Column Spacing (L3) [ft]:	7.0
# of Columns in Longitudinal Direction:	12
# of Columns in Transverse Direction:	2
Total Number of Columns:	24
Panel Slope from Horizontal (a) [°]:	35.0
Short Column Height (H1) [ft]:	4.5
Approximate Tall Column Height (H2) [ft]:	9.2
Transverse Brace between Columns :	Yes
Approximate Brace Length (B1) [ft]:	9.0
Weight of Columns [plf]:	3.7
Weight of Cross Pipe [plf]:	3.7
Weight of Brace [plf]:	3.7
Tributary Transverse Length per Column [ft]:	6.9
Tributary Longitudinal Length per Column [ft]:	7.0
Tributary Area per Column [ft ²]:	48.1
Rail Weight [plf]:	1.0
Transverse Rail Weight per Column [lb]:	27.5
Longitudinal Rail Weight per Column [lb]:	25.6
Tall Column Weight [lb]:	33.6
Panel Weight per Column [lb]:	104.6
Rail Weight per Column [lb]:	27.5
Cross Pipe Weight per Column [lb]:	25.6
Brace Weight per Column [lb]:	16.4
Total Weight per Column (1.0 D) [lb]:	207.7



Assumptions:

- T2 = T3



JOB NO.: U2716-114-191

DESIGNED: STB

DATE: 08/01/19

PROJECT: A5 – Sunmodo Sunturf GM

SUBJECT: Snow Load

SNOW LOAD (S):

ASCE 7 Standard:	10	
Panel Slope from Horizontal [°]:	35.0	
Snow Ground Load, p_g [psf]:	70.0	(Section 7.2)
Terrain Category:	B	(Table 7-2)
Exposure of Roof:	Fully Exposed	(Table 7-2)
Exposure Factor, C_e :	0.9	(Table 7-2)
Thermal Factor, C_t :	1.2	(Table 7-3)
Risk Category:	I	(Table 1.5-1)
Importance Factor, I_s :	0.8	(Table 1.5-2)
Flat Roof Snow Load, p_f [psf]:	42	(Equation 7.3-1)
Minimum Roof Snow Load, p_m [psf]:	0	(Section 7.3.4)
Unobstructed Slippery Surface?	Yes	(Section 7.4)
Slope Factor Figure:	Figure 7-2c	(Section 7.4)
Roof Slope Factor, C_s :	0.636	(Figure 7-2)
Sloped Roof Snow Load, p_s [psf]:	27	(Equation 7.4-1)
Design Snow Load, S [psf]:	27	
Tributary Transverse Length [ft]:	5.6	
Tributary Longitudinal Length [ft]:	7	
Tributary Area per Column [ft ²]:	39.4	
Snow Load per Column (1.0 S) [lb]:	1060.8	



PROJECT: A5 – Sunmodo Sunturf GM

SUBJECT: Wind Pressure

Design Wind Load:

ASCE 7 Standard:	10	
Basic Wind Speed, V [mph]:	140	
Risk Category:	I	
Exposure Category	B	(Section 26.7.3)
Velocity Pressure Exposure Coefficient, K_h :	0.57	(Table 27.3-1)
Topographic Factor, K_{ht} :	1.0	(Section 26.8.2)
Wind Directionality Factor, K_d :	0.85	(Table 26.6-1)
Internal Pressure Coefficient, GC_{pi} :	0.00	(Table 26.11-1)
Velocity Pressure, q_h [psf]:	24.3	(Equation 27.3-1)
Gust Effect Factor, G:	0.85	(Section 26.9.1)
Panel Slope [degrees]:	35.0	

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

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

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

Clear Wind Flow	$q_h GC_{NW}$	$q_h GC_{NL}$
Case 1 ($\gamma = 0^\circ$, Load Case A)	-37.2	-37.2
Case 2 ($\gamma = 0^\circ$, Load Case B)	-50.3	-11.7
Case 3 ($\gamma = 180^\circ$, Load Case A)	43.4	44.8
Case 4 ($\gamma = 180^\circ$, Load Case B)	55.1	22.0

Wind Pressure on Each Side of Panels [psf]

Clear Wind Flow	Short Col. Pressure	Long Col. Pressure
Case 1 ($\gamma = 0^\circ$, Load Case A)	-37.2	-37.2
Case 2 ($\gamma = 0^\circ$, Load Case B)	-11.7	-50.3
Case 3 ($\gamma = 180^\circ$, Load Case A)	43.4	44.8
Case 4 ($\gamma = 180^\circ$, Load Case B)	55.1	22.0



JOB NO.: U2716-114-191

PROJECT: A5 – Sunmodo Sunturf GM

SUBJECT: Open Building Wind Loads

Design Wind Load Per ASCE 7-10

$$p = q_h G C_n$$

Velocity Pressure Exposure Coefficient, K_{zt} :	0.57	(Table 27.3-1)
Topographic Factor, K_{ht} :	1.0	(Section 26.8.2)
Wind Directionality Factor, K_d :	0.85	(Table 26.6-1)
Ultimate Wind Speed, V [mph]:	140	

Velocity Pressure, q_h [psf]:	24.3	(Equation 27.3-1)
Gust Effect Factor, G :	0.85	(Section 26.9.1)

$\gamma = 90^\circ$ or 270°

Force Coefficient, C_N :

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

Design Wind Pressure, p [psf]:

Horizontal Distance from Winward Edge	Roof angle		
	Load Case	Obstructed Wind Flow	
$\leq h$	35	A	-16.5
		B	16.5
$> h, \leq 2h$	35	A	-12.4
		B	10.3
$> 2h$	35	A	-6.2
		B	6.2



JOB NO.: U2716-114-191

DESIGNED: STB

Foundation Option 1: Drilled Concrete Pier



JOB NO.: U2716-114-191
DATE: 08/01/19

DESIGNED: STB

PROJECT: A5 – Sunmodo Sunturf GM

Drilled Pier Design

Design Loads:

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 Diameter, b [ft]:	1.5	Volume of Concrete [ft ³]:	10
Min. Pier Diameter, b _{min} (opt'l) [ft]:		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		
Min. Pier Depth, d _{min} (opt'l) [ft]:			
Max. Pier Depth, d _{max} (opt'l) [ft]:			

Soil Properties:

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

Check Bearing:

Bearing Capacity [k]: 6.5 **Bearing capacity OK.**

Check Uplift:

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

Check Lateral Bearing:

Applied Lateral Force, P [lb]:	1,690	
Point of Application, h [ft]:	0.0	
S _{1_max} [psf]:		
S ₁ [psf]:	550	
A = 2.34*P/(S ₁ b):	4.79	
Required Pier Depth, d _{reqd} [ft]:	4.8	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.

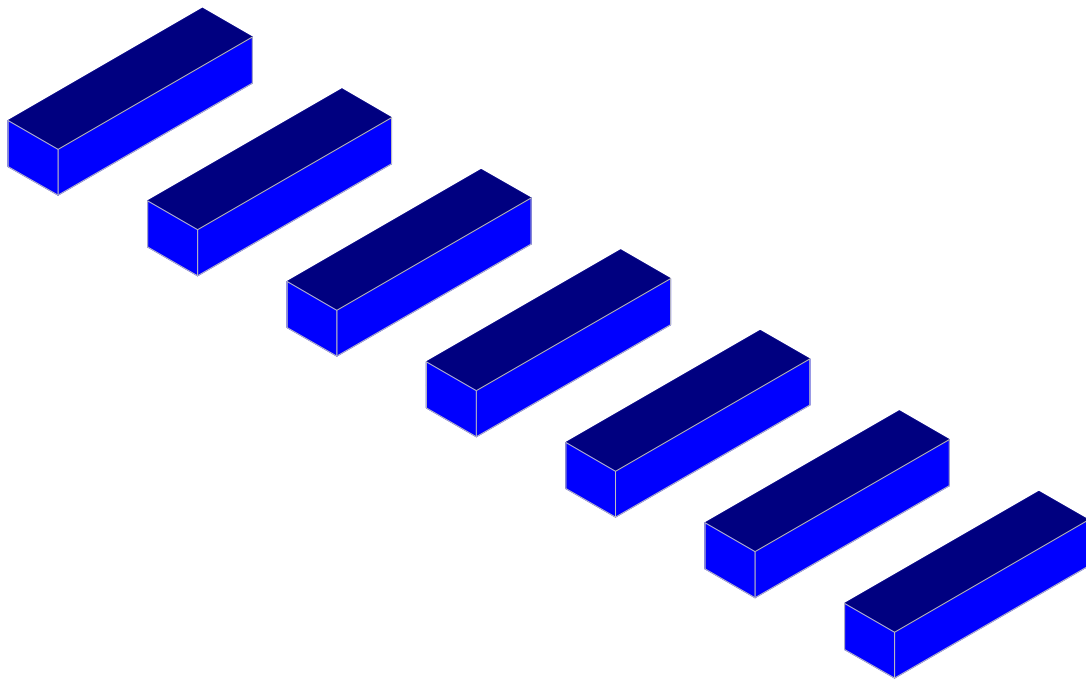
Load (ASD)	Value (lbs)	Factor of Safety	Test Value (lbs)
UPLIFT	2320	1.5	3480
LATERAL	1690	2	3380



JOB NO.: U2716-114-191

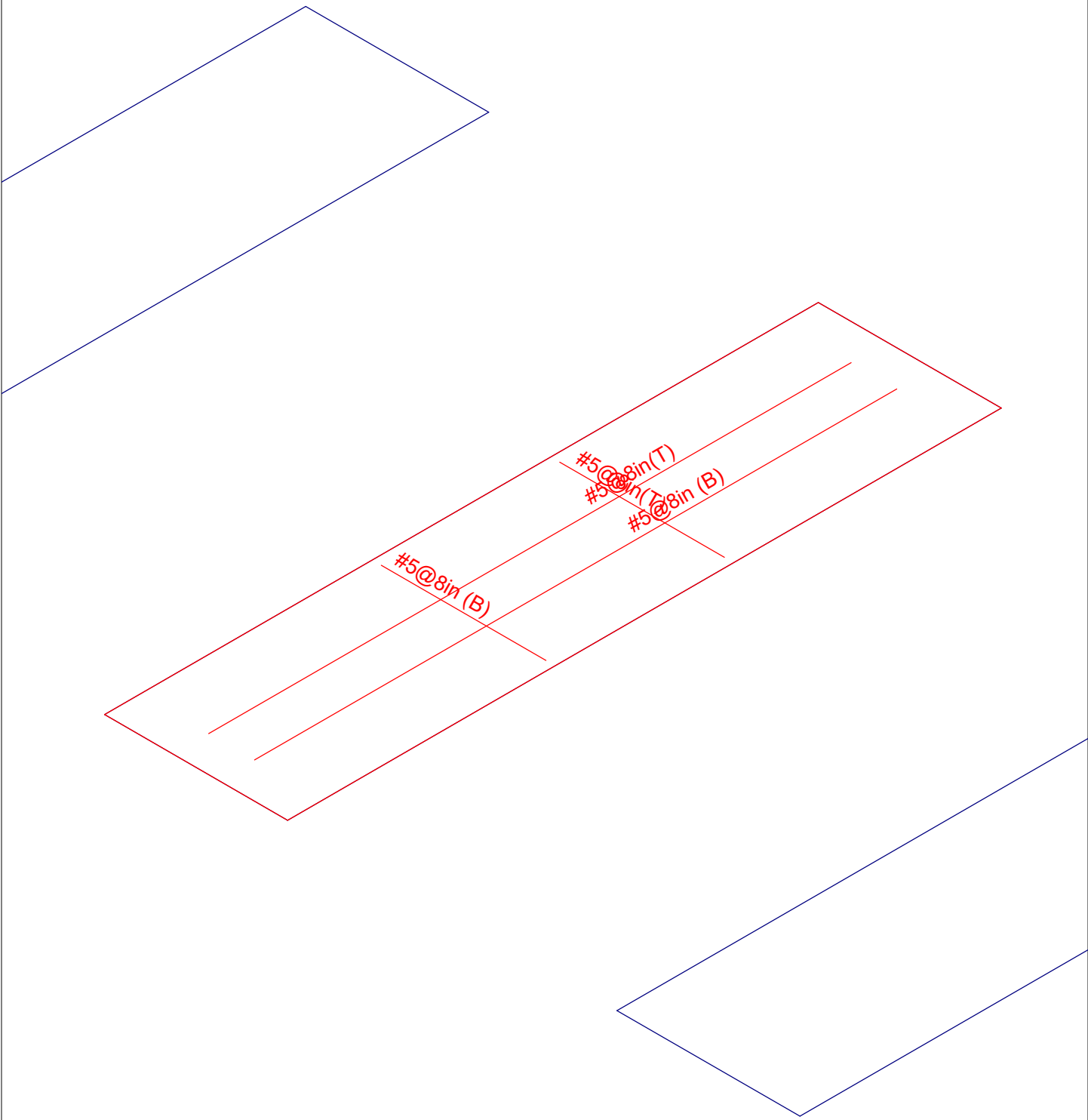
DESIGNED: STB

Foundation Option 4: Ballasted Block



Results for LC 1, 1.0 D

Vector Structural Engineeri..	Ground Mount	SK - 2
STB		Aug 1, 2019 at 12:09 PM
U2716.114.181		New England A5.r3d



Results for LC 1, 1.0 D

Vector Structural Engineeri...	Ground Mount	SK - 1
STB		Aug 1, 2019 at 12:08 PM
U2716.114.181		New England A5.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	Rectangular
Concrete Rebar Set	ASTM A615
Concrete Code	ACI 318-14
HR Steel Pile Code	AISC 14th(360-10): ASD
Wood Pile Code	AWC NDS-15: ASD

Concrete Properties

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

General Design Parameters

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

Slab Rebar Parameters

	Label	Top Bar	Bottom Bar	Max Top Bar Sp...	Min Top Bar Sp...	Max Bot Bar Sp...	Min Bot Bar Sp...	Spacing Incr...	Rebar Options
1	Typical	#5	#5	8	8	8	8	1	Optimize

Soil Definitions

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

Point Loads and Moments (Cat 1 : DL)

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D_N1_1	X	-11.981
2	R3D_N1_1	Y	216.315
3	R3D_N2	Y	183.994
4	R3D_N132_2	Y	210.684
5	R3D_N133_1	X	-1.035
6	R3D_N133_1	Y	201.84
7	R3D_N109_1	Y	194.864
8	R3D_N110A_1	Y	206.88
9	R3D_N121_1	Y	213.295



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

	Label	Direction	Magnitude[lb.-ft]
11	R3D_N133_1	Y	627.631
12	R3D_N133_1	Z	-102.735
13	R3D_N109_1	X	2.363
14	R3D_N109_1	Y	-3453.832
15	R3D_N109_1	Z	2210.996
16	R3D_N110A_1	X	6.641
17	R3D_N110A_1	Y	680.668
18	R3D_N110A_1	Z	-102.659
19	R3D_N121_1	Y	-3599.37
20	R3D_N121_1	Z	2143.347
21	R3D_N122_1	X	3.849
22	R3D_N122_1	Y	636.787
23	R3D_N122_1	Z	-103.219
24	R3D_N133B	X	2.593
25	R3D_N133B	Y	-3579.139
26	R3D_N133B	Z	2166.731
27	R3D_N134B_1	X	3.624
28	R3D_N134B_1	Y	647.164
29	R3D_N134B_1	Z	-103.533
30	R3D_N151_1	X	2.639
31	R3D_N151_1	Y	-3729.321
32	R3D_N151_1	Z	2375.2
33	R3D_N152_1	X	17.319
34	R3D_N152_1	Y	755.338
35	R3D_N152_1	Z	-101.362
36	R3D_N143A	X	-131.677
37	R3D_N143A	Y	-2443.922
38	R3D_N143A	Z	1359.807
39	R3D_N144A	X	-45.31
40	R3D_N144A	Y	386.932
41	R3D_N144A	Z	-78.339

Point Loads and Moments (Cat 17 : OL2)

	Label	Direction	Magnitude[lb.-ft]
1	R3D_N1_1	X	155.56
2	R3D_N1_1	Y	-3751.674
3	R3D_N1_1	Z	1616.167
4	R3D_N2	X	4.576
5	R3D_N2	Y	1305.883
6	R3D_N2	Z	-80.939
7	R3D_N132_2	X	4.787
8	R3D_N132_2	Y	-3954.652
9	R3D_N132_2	Z	1788.587
10	R3D_N133_1	X	-4.396
11	R3D_N133_1	Y	1473.232
12	R3D_N133_1	Z	-86.692
13	R3D_N109_1	X	3.166
14	R3D_N109_1	Y	-3798.125
15	R3D_N109_1	Z	1860.523
16	R3D_N110A_1	X	12.66
17	R3D_N110A_1	Y	1561.753
18	R3D_N110A_1	Z	-86.49
19	R3D_N121_1	Y	-4007.863
20	R3D_N121_1	Z	1808.573
21	R3D_N122_1	Y	1491.678
22	R3D_N122_1	Z	-87.013

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

	Label	Direction	Magnitude[lb,lb-ft]
23	R3D N133B	X	3.414
24	R3D N133B	Y	-3976.08
25	R3D N133B	Z	1827.481
26	R3D N134B 1	X	-2.613
27	R3D N134B 1	Y	1509.588
28	R3D N134B 1	Z	-87.309
29	R3D N151 1	X	3.557
30	R3D N151 1	Y	-4096.415
31	R3D N151 1	Z	1998.466
32	R3D N152 1	X	-1.054
33	R3D N152 1	Y	1675.474
34	R3D N152 1	Z	-85.393
35	R3D N143A	X	-169.519
36	R3D N143A	Y	-2738.278
37	R3D N143A	Z	1151.652
38	R3D N144A	X	-9.86
39	R3D N144A	Y	923.426
40	R3D N144A	Z	-66.309

Point Loads and Moments (Cat 18 : OL3)

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D N1 1	X	-145.639
2	R3D N1 1	Y	4019.84
3	R3D N1 1	Z	-2265.419
4	R3D N2	X	-14.516
5	R3D N2	Y	-703.655
6	R3D N2	Z	113.566
7	R3D N132 2	X	-4.522
8	R3D N132 2	Y	4246.593
9	R3D N132 2	Z	-2511.154
10	R3D N133 1	X	-1.493
11	R3D N133 1	Y	-778.509
12	R3D N133 1	Z	121.83
13	R3D N109 1	X	-2.845
14	R3D N109 1	Y	4127.827
15	R3D N109 1	Z	-2621.754
16	R3D N110A 1	X	-8.131
17	R3D N110A 1	Y	-842.992
18	R3D N110A 1	Z	121.735
19	R3D N121 1	Y	4303.568
20	R3D N121 1	Z	-2541.717
21	R3D N122 1	X	-4.47
22	R3D N122 1	Y	-789.756
23	R3D N122 1	Z	122.401
24	R3D N133B	X	-3.119
25	R3D N133B	Y	4279.044
26	R3D N133B	Z	-2569.418
27	R3D N134B 1	X	-4.092
28	R3D N134B 1	Y	-802.395
29	R3D N134B 1	Z	122.774
30	R3D N151 1	X	-3.177
31	R3D N151 1	Y	4456.908
32	R3D N151 1	Z	-2816.456
33	R3D N152 1	X	-19.97
34	R3D N152 1	Y	-933.38
35	R3D N152 1	Z	120.197

Point Loads and Moments (Cat 20 : OL5) (Continued)

	Label	Direction	Magnitude[lb,lb-ft]
5	R3D N2	Y	-246.757
6	R3D N2	Z	38.587
7	R3D N132 2	Y	597.56
8	R3D N132 2	Z	-354.137
9	R3D N133 1	X	-1.087
10	R3D N133 1	Y	-103.656
11	R3D N133 1	Z	17.626
12	R3D N109 1	X	1.962
13	R3D N109 1	Y	1281.267
14	R3D N109 1	Z	-812.305
15	R3D N110A 1	Y	-244.711
16	R3D N110A 1	Z	35.398
17	R3D N121 1	X	3.655
18	R3D N121 1	Y	825.474
19	R3D N121 1	Z	-494.165
20	R3D N122 1	X	3.969
21	R3D N122 1	Y	-146.969
22	R3D N122 1	Z	25.742
23	R3D N133B	Y	575.797
24	R3D N133B	Z	-351.517
25	R3D N134B 1	X	-2.755
26	R3D N134B 1	Y	-103.564
27	R3D N134B 1	Z	19.346
28	R3D N151 1	X	1.565
29	R3D N151 1	Y	602.524
30	R3D N151 1	Z	-395.726
31	R3D N152 1	X	-3.747
32	R3D N152 1	Y	-125.87
33	R3D N152 1	Z	17.016
34	R3D N143A	X	32.511
35	R3D N143A	Y	425.225
36	R3D N143A	Z	-226.862
37	R3D N144A	X	6.295
38	R3D N144A	Y	-65.348
39	R3D N144A	Z	13.101

Point Loads and Moments (Cat 21 : OL6)

	Label	Direction	Magnitude[lb,lb-ft]
1	R3D N1 1	X	39.808
2	R3D N1 1	Y	-1430.722
3	R3D N1 1	Z	825.713
4	R3D N2	X	3.305
5	R3D N2	Y	243.919
6	R3D N2	Z	-37.239
7	R3D N132 2	Y	-595.647
8	R3D N132 2	Z	353.244
9	R3D N133 1	X	1.14
10	R3D N133 1	Y	103.977
11	R3D N133 1	Z	-17.501
12	R3D N109 1	X	-2.369
13	R3D N109 1	Y	-1109.917
14	R3D N109 1	Z	710.949
15	R3D N110A 1	X	-2.738
16	R3D N110A 1	Y	214.112
17	R3D N110A 1	Z	-32.197
18	R3D N121 1	X	-2.569



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1. Project information

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

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General

Design method: ACI 318-14
Units: Imperial units

Anchor Information:

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

Base Material

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

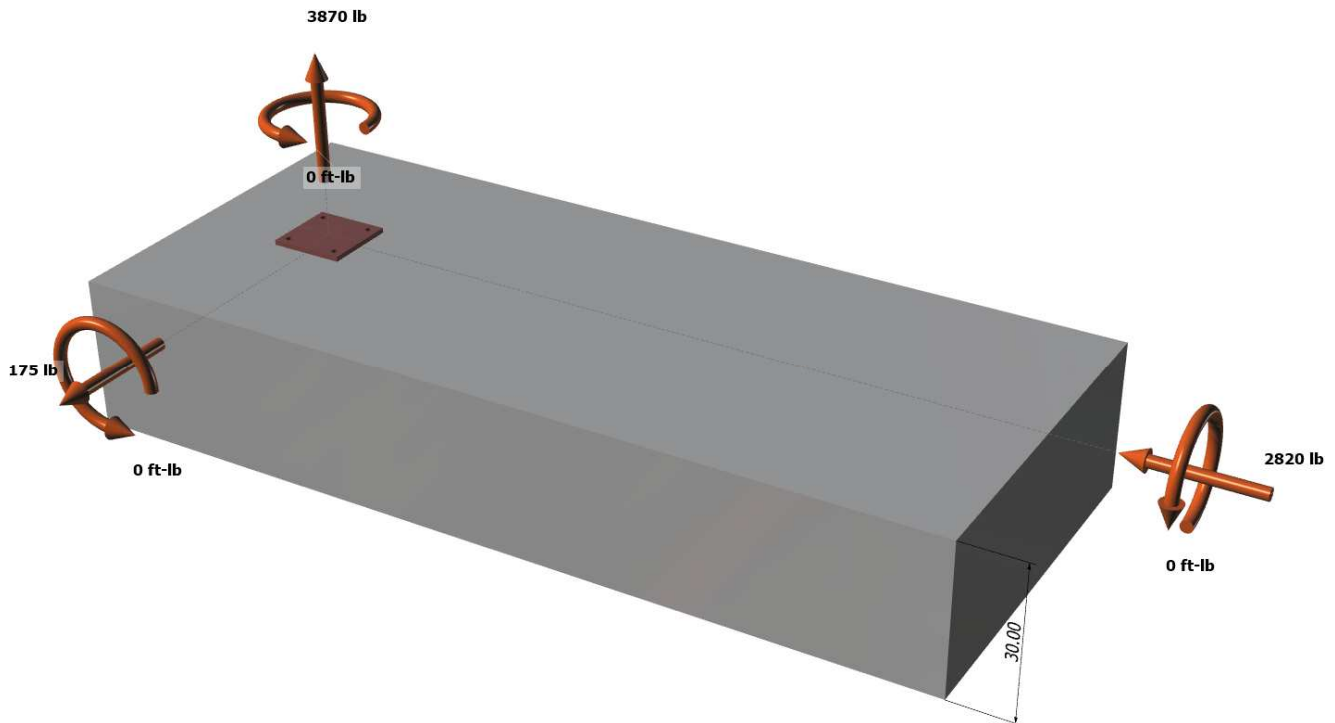
V_{uay} [lb]: -2820

M_{ux} [ft-lb]: 0

M_{uy} [ft-lb]: 0

M_{uz} [ft-lb]: 0

<Figure 1>





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<Figure 2>





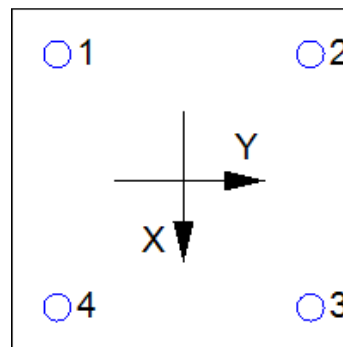
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3. Resulting Anchor Forces

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

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



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

V_{sa} (lb)	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.

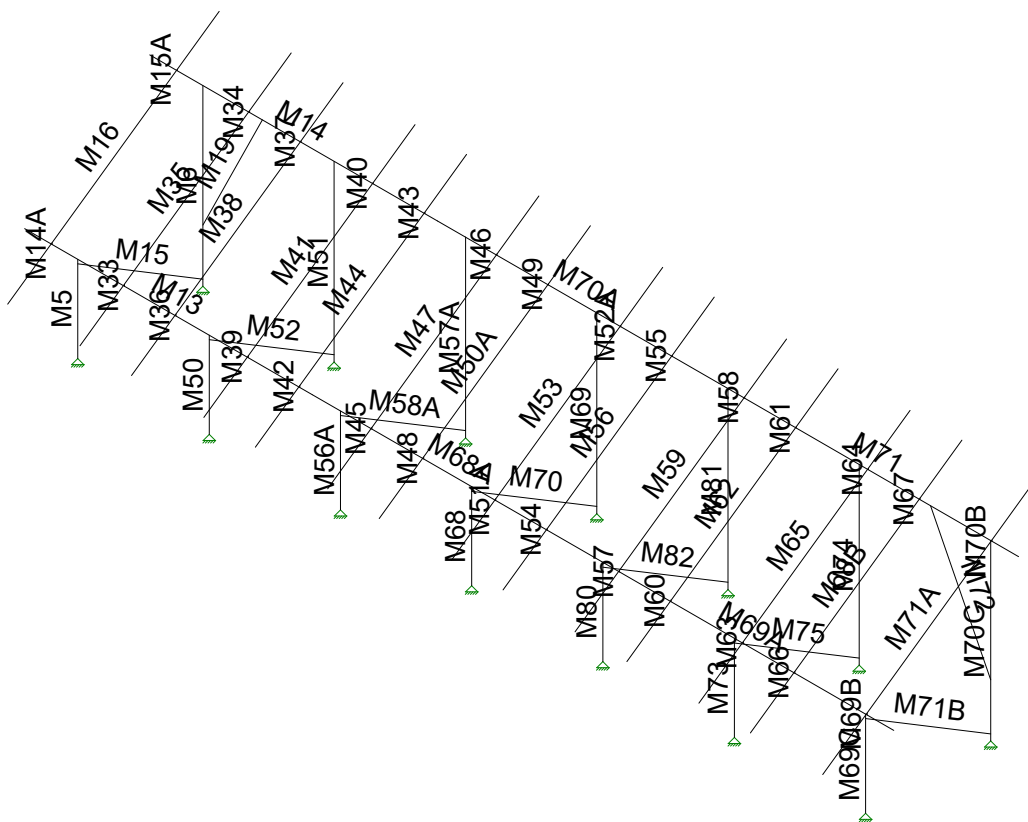


JOB NO.: U2716-070-181

DESIGNED: STB

PROJECT: Ground Mount Package for Ontario Canada

Framing Analysis



Vector Structural Engineeri...

STB

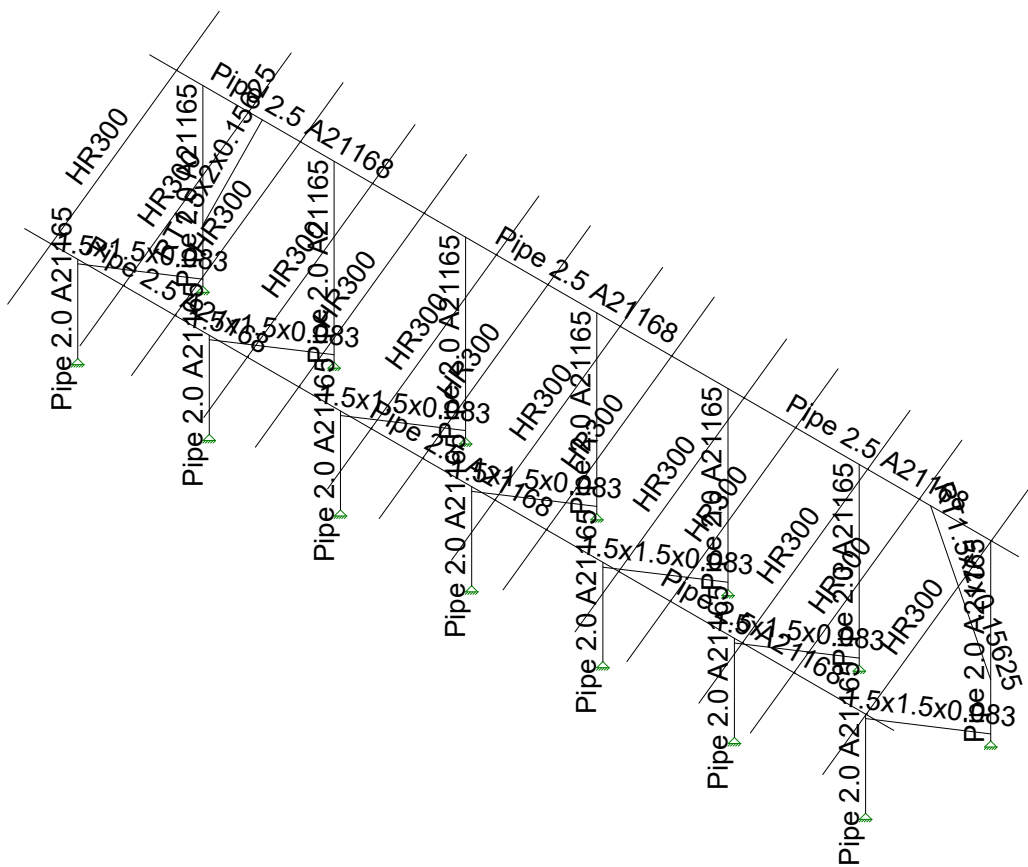
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Ground Mount

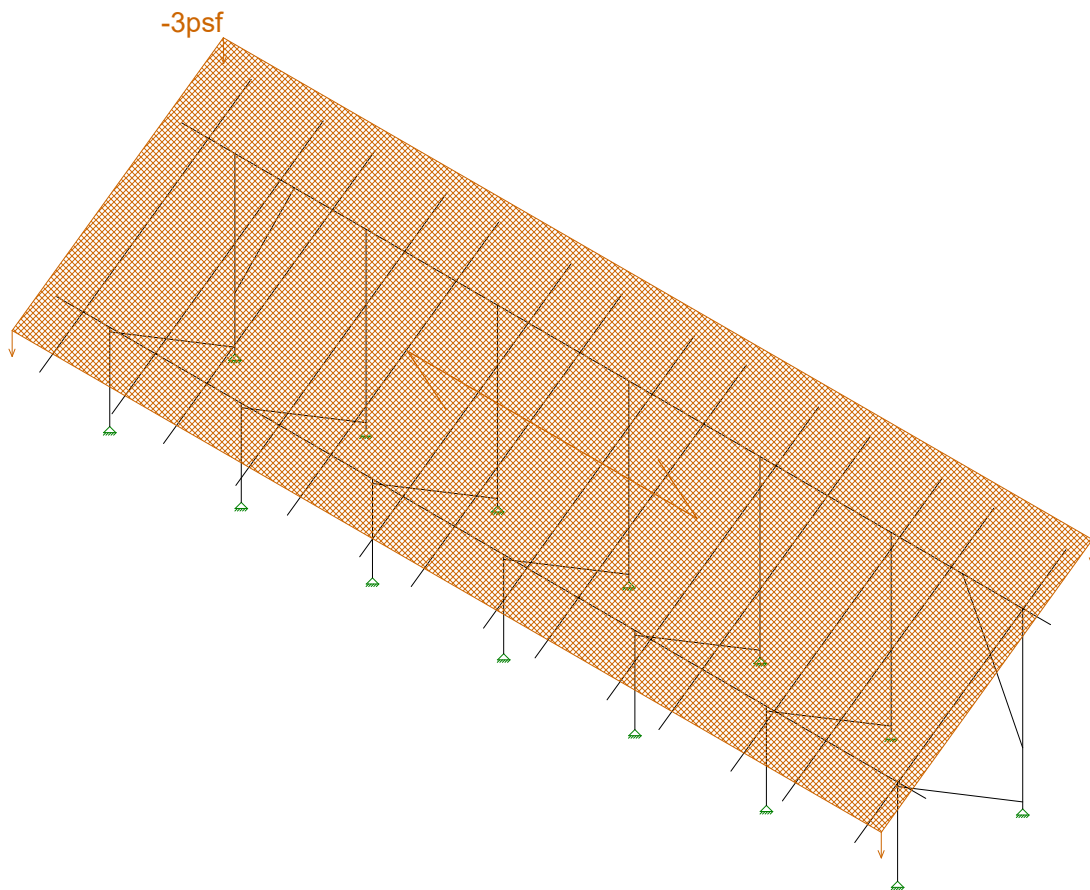
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New England A5.r3d

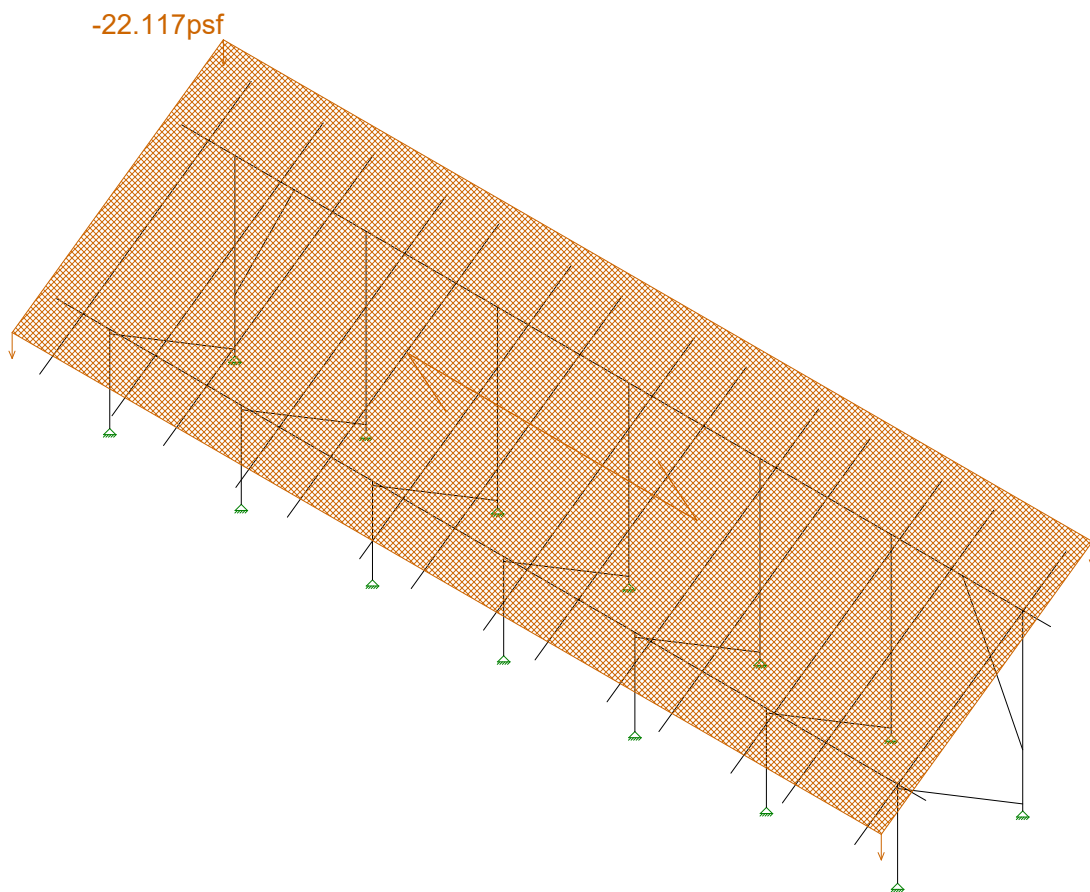


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STB		Aug 1, 2019 at 12:15 PM
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Loads: BLC 2, Solar Panel Weight

Vector Structural Engineeri..	Ground Mount	SK - 7
STB		Aug 1, 2019 at 12:15 PM
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Loads: BLC 3, Roof Live/Snow

Vector Structural Engineeri..

STB

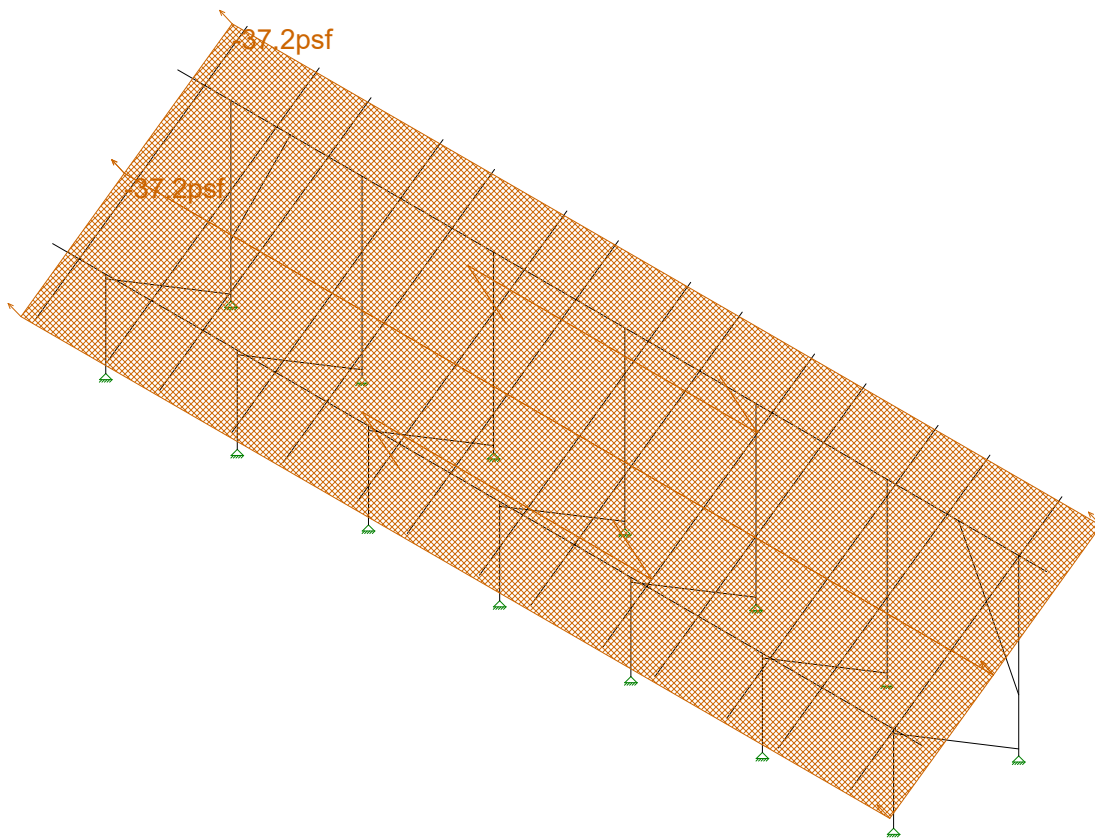
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Ground Mount

SK - 8

Aug 1, 2019 at 12:15 PM

New England A5.r3d



Loads: BLC 4, Wind A 0 deg

Vector Structural Engineeri..

STB

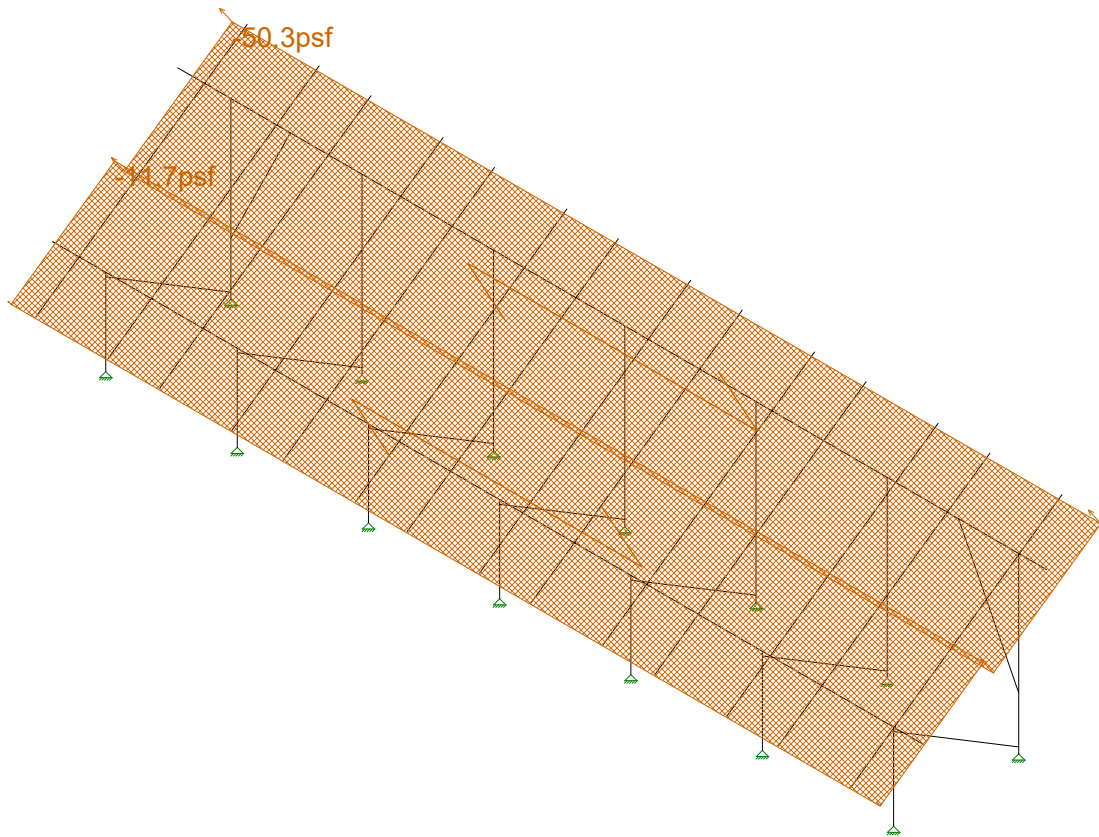
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Ground Mount

SK - 9

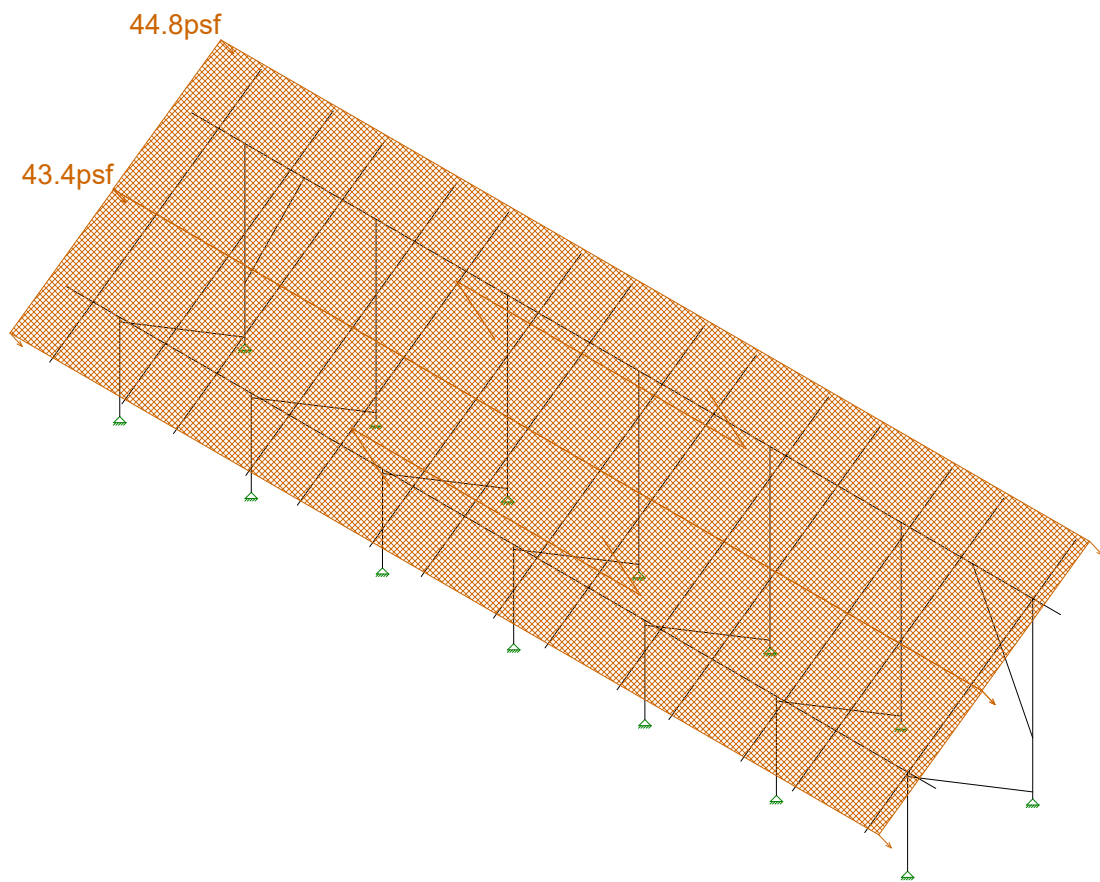
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New England A5.r3d



Loads: BLC 5, Wind B 0 deg

Vector Structural Engineeri..	Ground Mount	SK - 10
STB		Aug 1, 2019 at 12:16 PM
U2716.114.191		New England A5.r3d



Loads: BLC 6, Wind A 180 deg

Vector Structural Engineeri..

STB

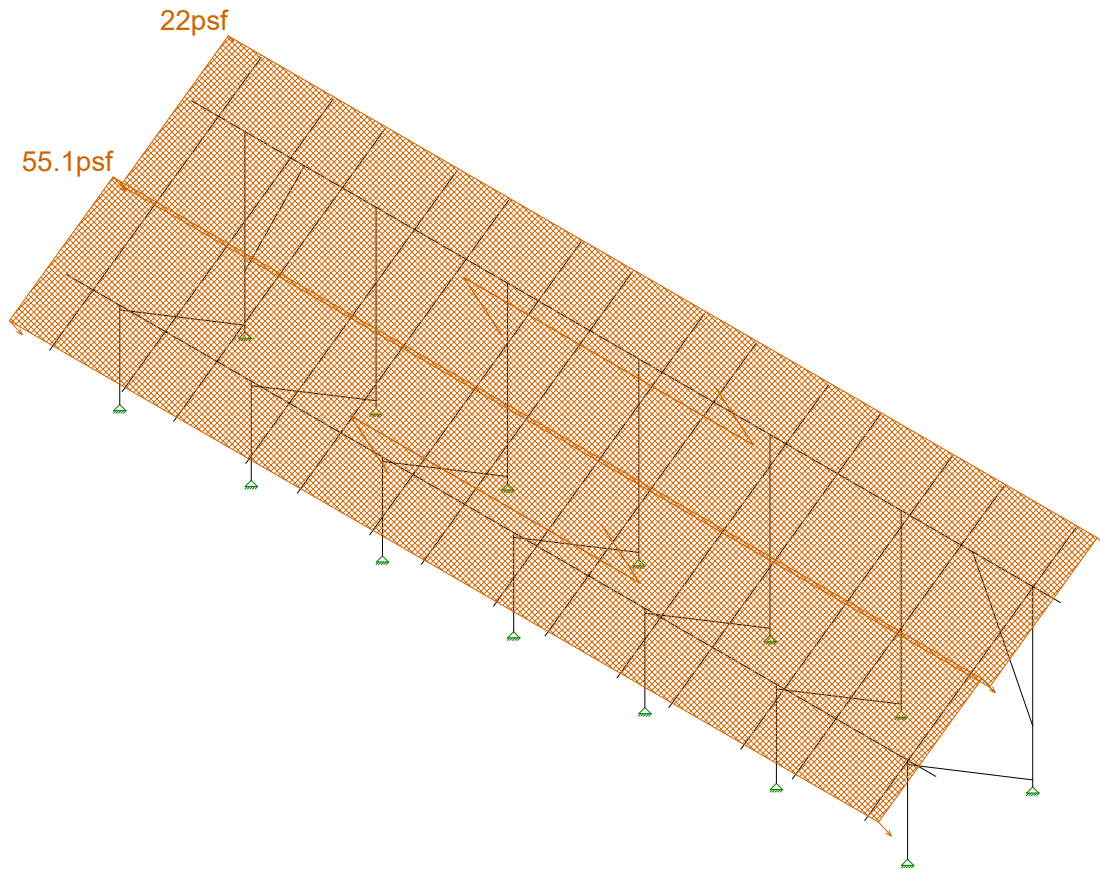
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Ground Mount

SK - 11

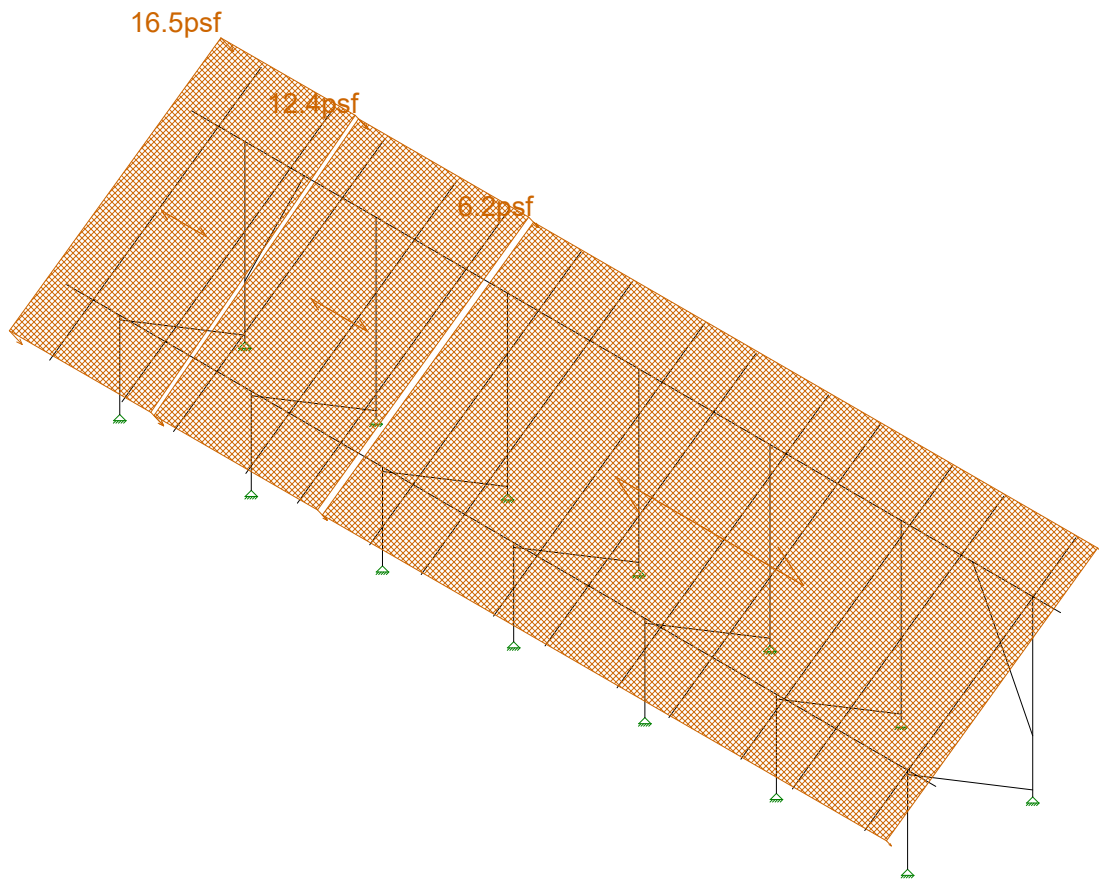
Aug 1, 2019 at 12:16 PM

New England A5.r3d



Loads: BLC 7, Wind B 180 deg

Vector Structural Engineeri..	Ground Mount	SK - 12
STB		Aug 1, 2019 at 12:16 PM
U2716.114.191		New England A5.r3d



Loads: BLC 8, Wind A 90

Vector Structural Engineeri...

STB

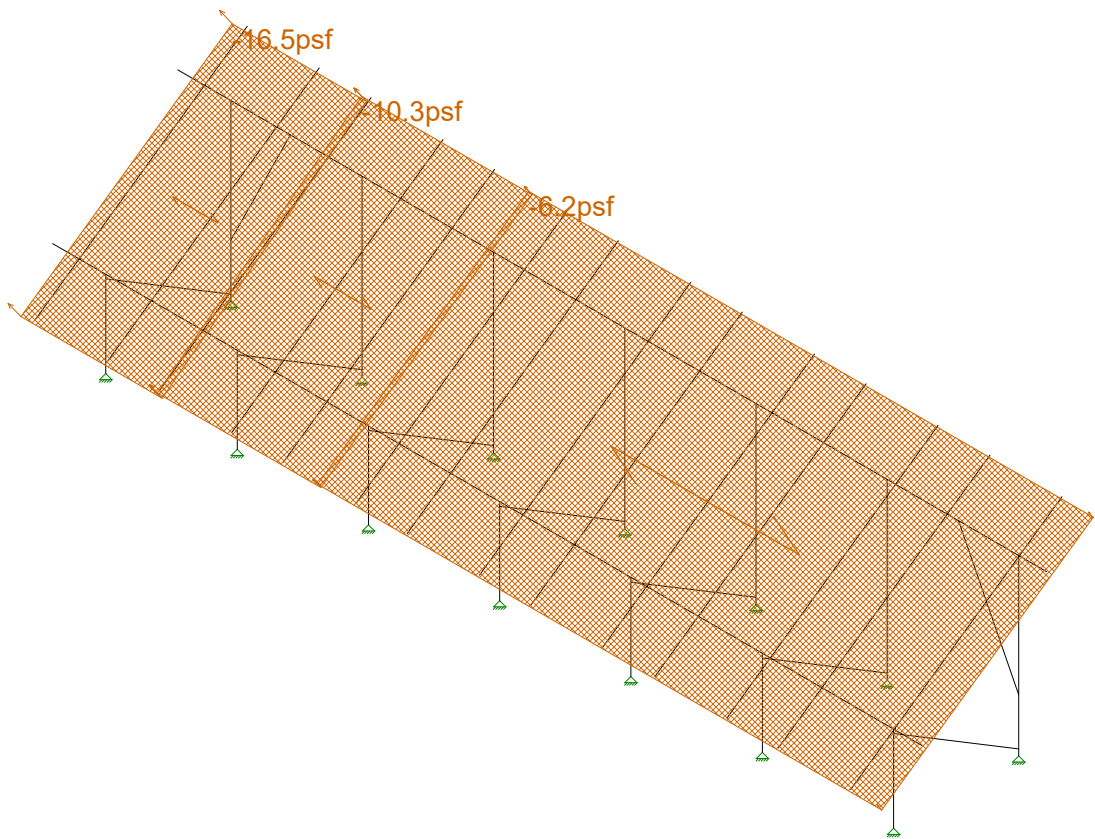
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Ground Mount

SK - 13

Aug 1, 2019 at 12:16 PM

New England A5.r3d



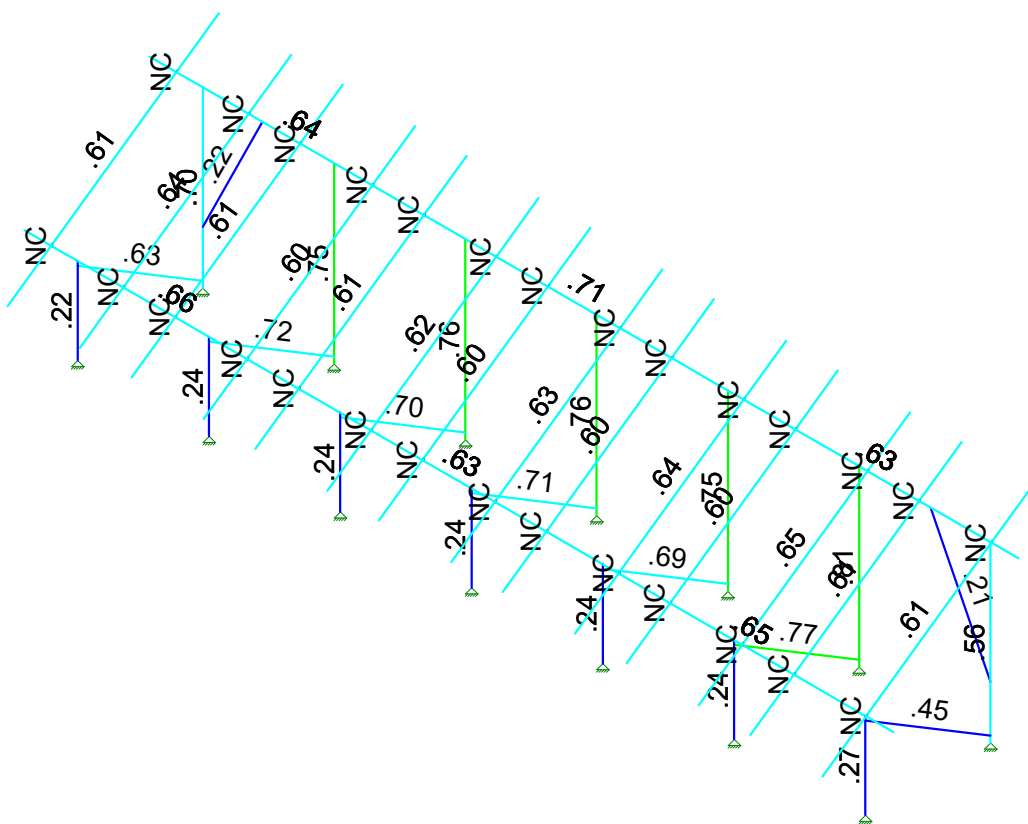
Loads: BLC 9, Wind B 90

Vector Structural Engineeri..	Ground Mount	SK - 14
STB		Aug 1, 2019 at 12:16 PM
U2716.114.191		New England A5.r3d



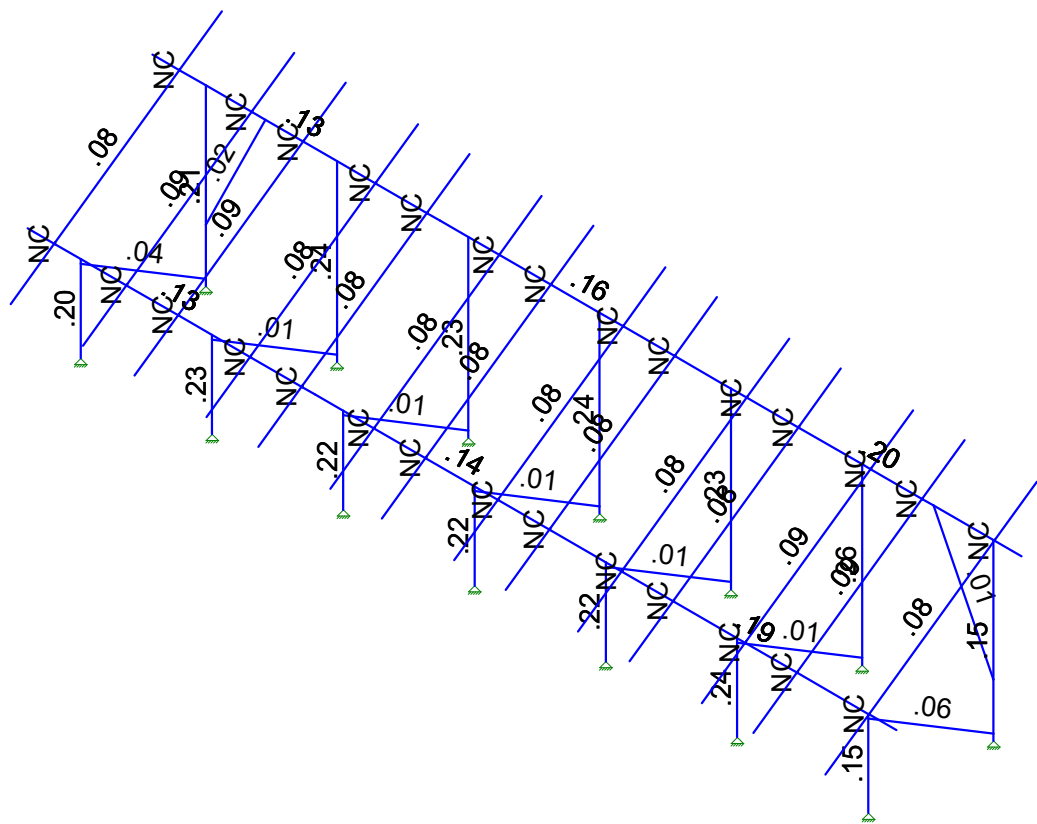
Code Check
(Elem.)

Black	No Calc
Red	> 1.0
Yellow	.60-1.0
Green	.75-.90
Cyan	.50-.75
Blue	0-.50



Member Code Checks Displayed (Enveloped)
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 3
STB		Aug 1, 2019 at 12:15 PM
U2716.114.191		New England A5.r3d



Member Shear Checks Displayed (Enveloped)
Envelope Only Solution

Vector Structural Engineeri...	Ground Mount	SK - 4
STB		Aug 1, 2019 at 12:15 PM
U2716.114.191		New England A5.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 14th(360-10): ASD
Adjust Stiffness?	Yes(Iterative)
RISACONNECTION CODE	AISC 14th(360-10): ASD
Cold Formed Steel Code	AISI S100-16: ASD
Wood Code	AWC NDS-15: ASD
Wood Temperature	< 100F
Concrete Code	ACI 318-14
Masonry Code	ACI 530-13: ASD
Aluminum Code	AA ADM1-15: ASD - Building AISC 14th(360-10): ASD

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



Company : Vector Structural Engineering
 Designer : STB
 Job Number : U2716.114.191
 Model Name : Ground Mount

Aug 1, 2019
 12:16 PM
 Checked By: _____

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	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



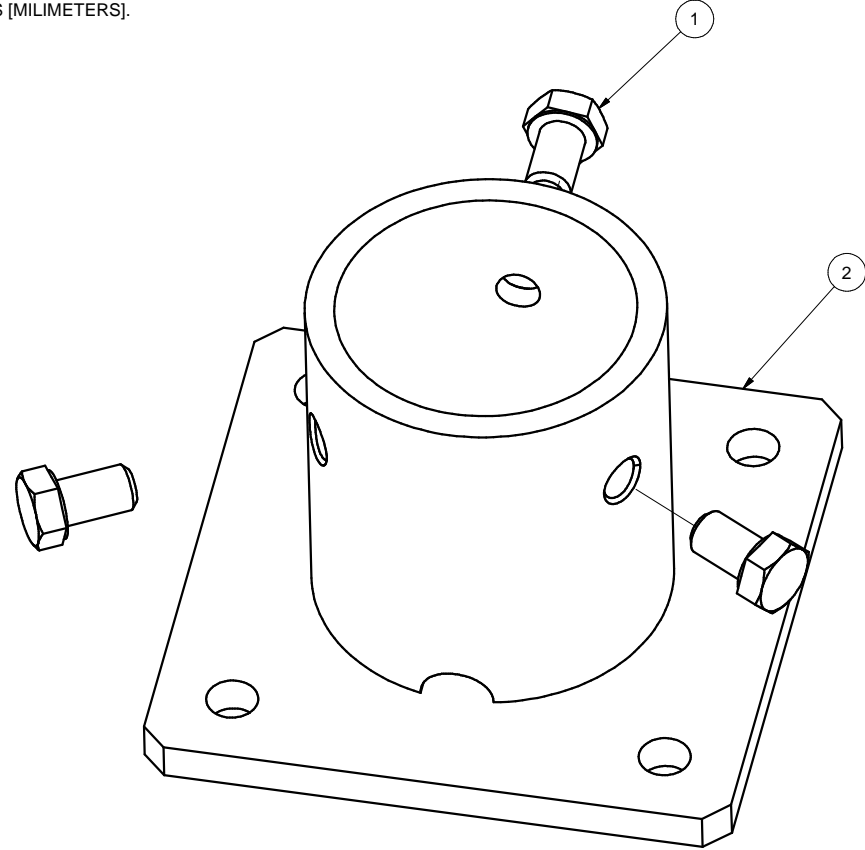
Company : Vector Structural Engineering
 Designer : STB
 Job Number : U2716.114.191
 Model Name : Ground Mount

Aug 1, 2019
 12:16 PM
 Checked By: _____

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	.604	84.234	11	.082	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
6	M44	HR300	.606	84.234	11	.081	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
7	M47	HR300	.619	84.234	11	.082	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
8	M50A	HR300	.597	34.381	12	.082	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
9	M53	HR300	.630	84.234	11	.082	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
10	M56	HR300	.597	34.381	12	.081	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
11	M59	HR300	.638	84.234	11	.081	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
12	M62	HR300	.597	34.381	12	.081	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
13	M65	HR300	.646	84.234	11	.086	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
14	M68B	HR300	.611	80.796	11	.091	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
15	M71A	HR300	.607	84.234	11	.080	36.1	y	12	3887.213	14342....	494.953	934.619	6236.364	2843.273	1 H.1-1
16	M72	RT1.5x2x...	.208	53.045	11	.012	0	z	5	2254.199	19411....	770.742	927.083	6090.199	4101.563	1... H.1-1

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



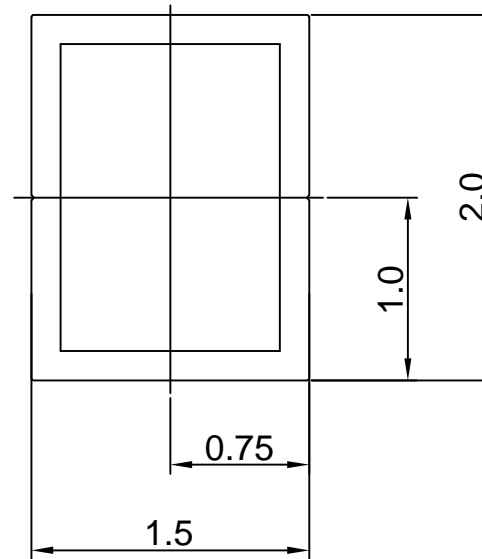
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	10/20/2016

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

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NOTES: UNLESS OTHERWISE SPECIFIED

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

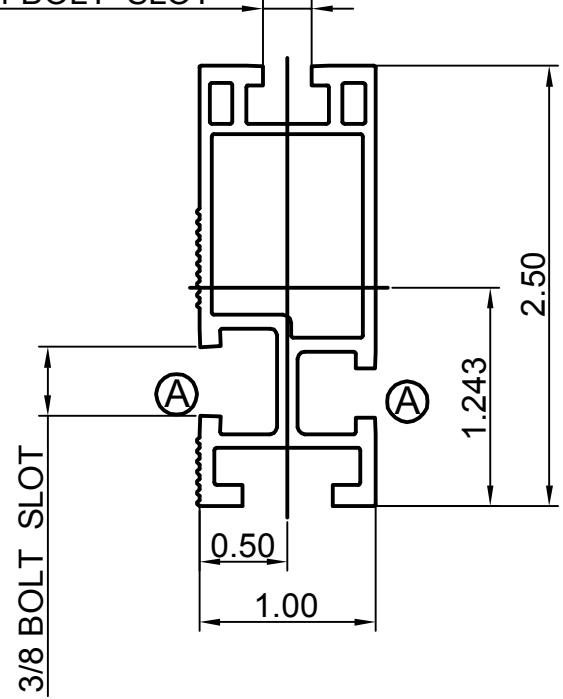
MATERIAL		SEE NOTES	
Third Angle Projection:			
GENERAL SPECIFICATIONS			
All Dimensions in inches [millimeters]			
Tolerances			
X.XXX ± 0.01 [0.25mm]	Break all sharp edges		
X.XX ± 0.02 [0.50mm]	.010-.020 unless		
X.X ± 0.039 [1.0mm]	otherwise specified.		
DRAWN BY		DATE	
zcg		03/12/2014	
CHECKED BY			
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:

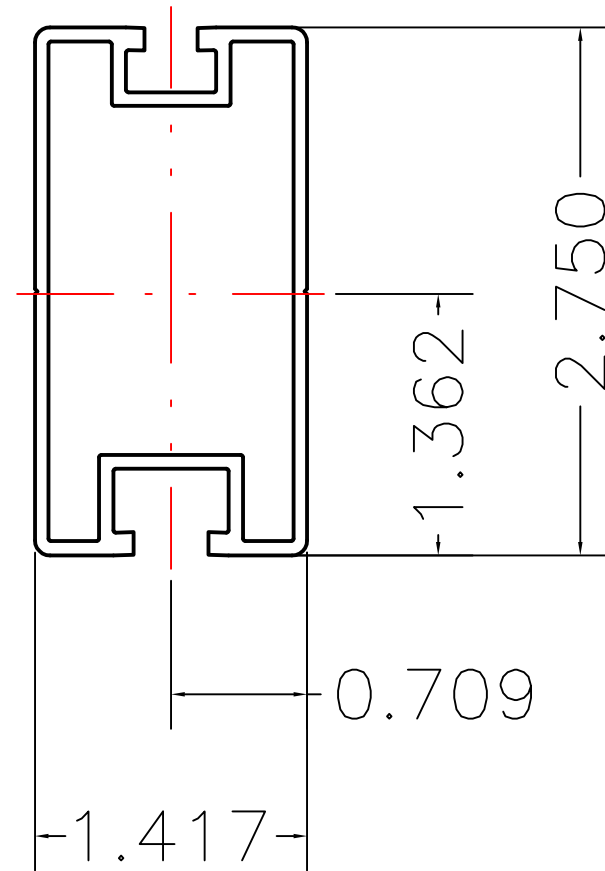
Weight: 0.850 lbs/ft
 Area: 0.723 in²
 Perimeter: 17.325 in
 Bounding Box: X: -0.500,0.500
 Y: -1.243,1.257

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: 994, Y: 0.539

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MATERIAL SEE NOTES	
Third Angle Projection:	
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters]	
Tolerances	
X.XXX ±0.01 [0.25mm]	Break all sharp edges .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	

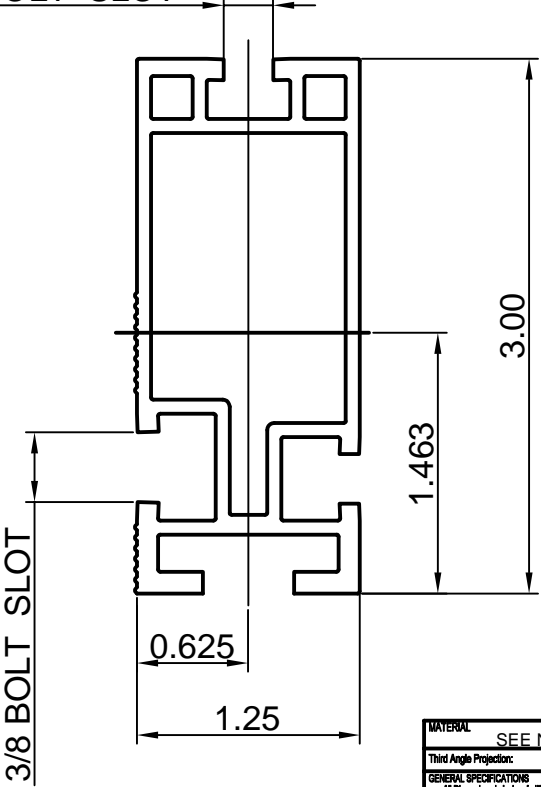
SunModo Corp.	
14800 NE 65TH STREET, VANCOUVER WA 98682	
TITLE RAIL, HR300 (SUNRAY), EXTRUSION	
B	DRAWING NUMBER A20288
SCALE: NONE	SHEET 1 of 1

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.

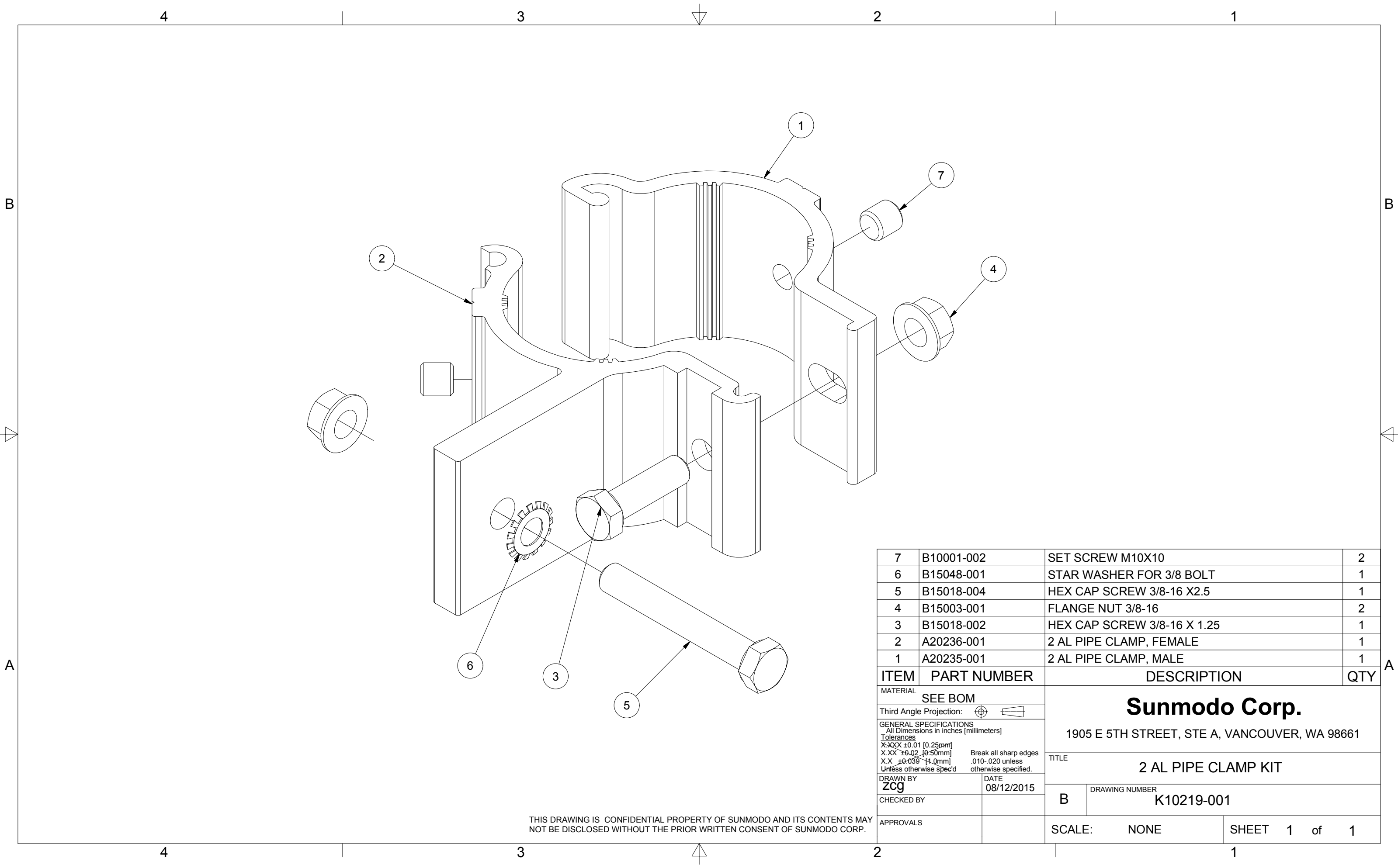
2X 1/4 BOLT SLOT



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

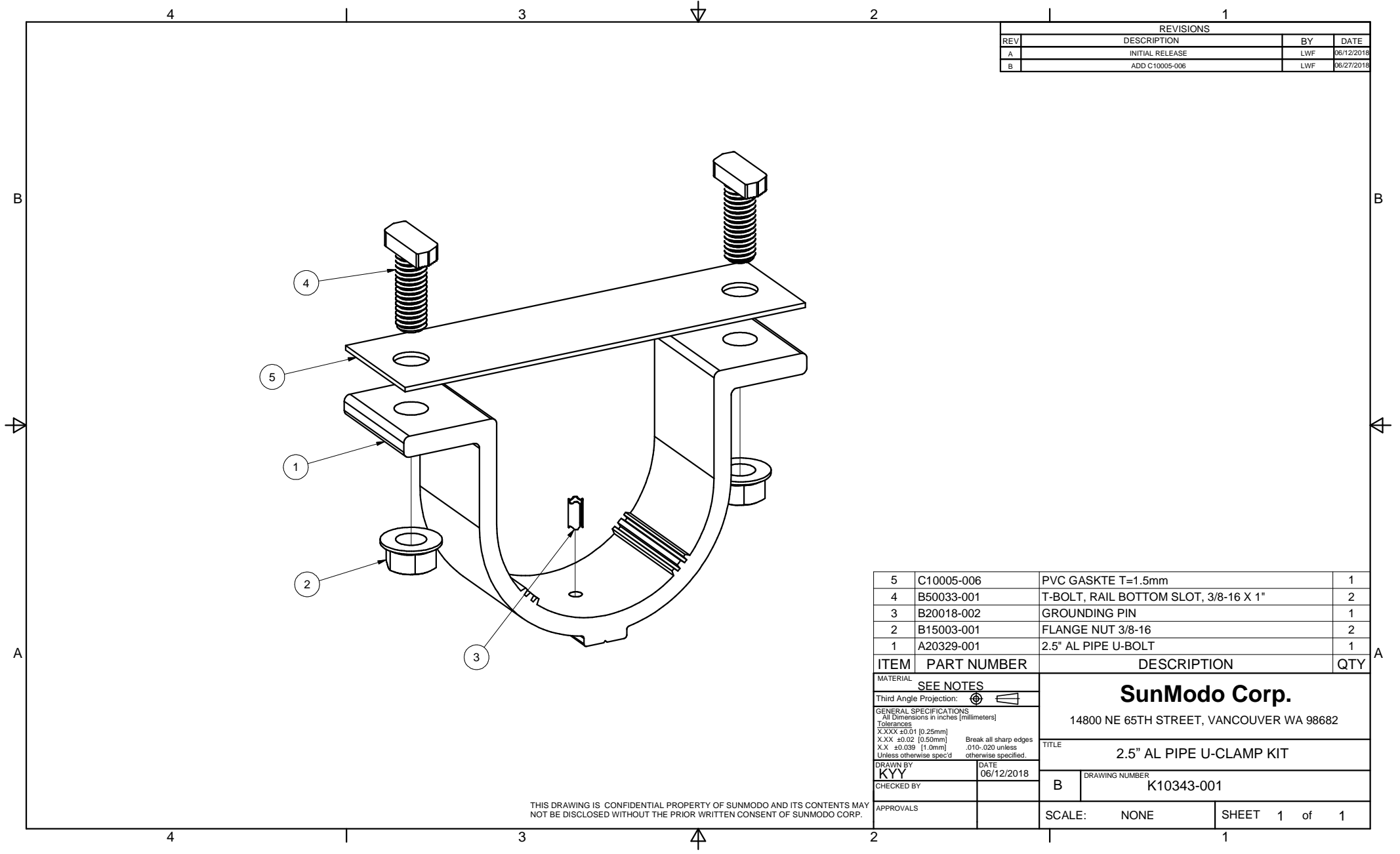
MATERIAL		SEE NOTES	
Third Angle Projection			
GENERAL SPECIFICATIONS			
All Dimensions in Inches (millimeters)			
Tolerances			
XXX ±0.01 (0.25mm)			
XX ±0.02 (0.50mm)			
X ±0.03 (1.0mm)			
Unless otherwise specified.			
DRAWN BY		DATE	
ZCJ		02/21/2013	
CHECKED BY		DATE	
APPROVALS		DATE	
Sunmodo Corp.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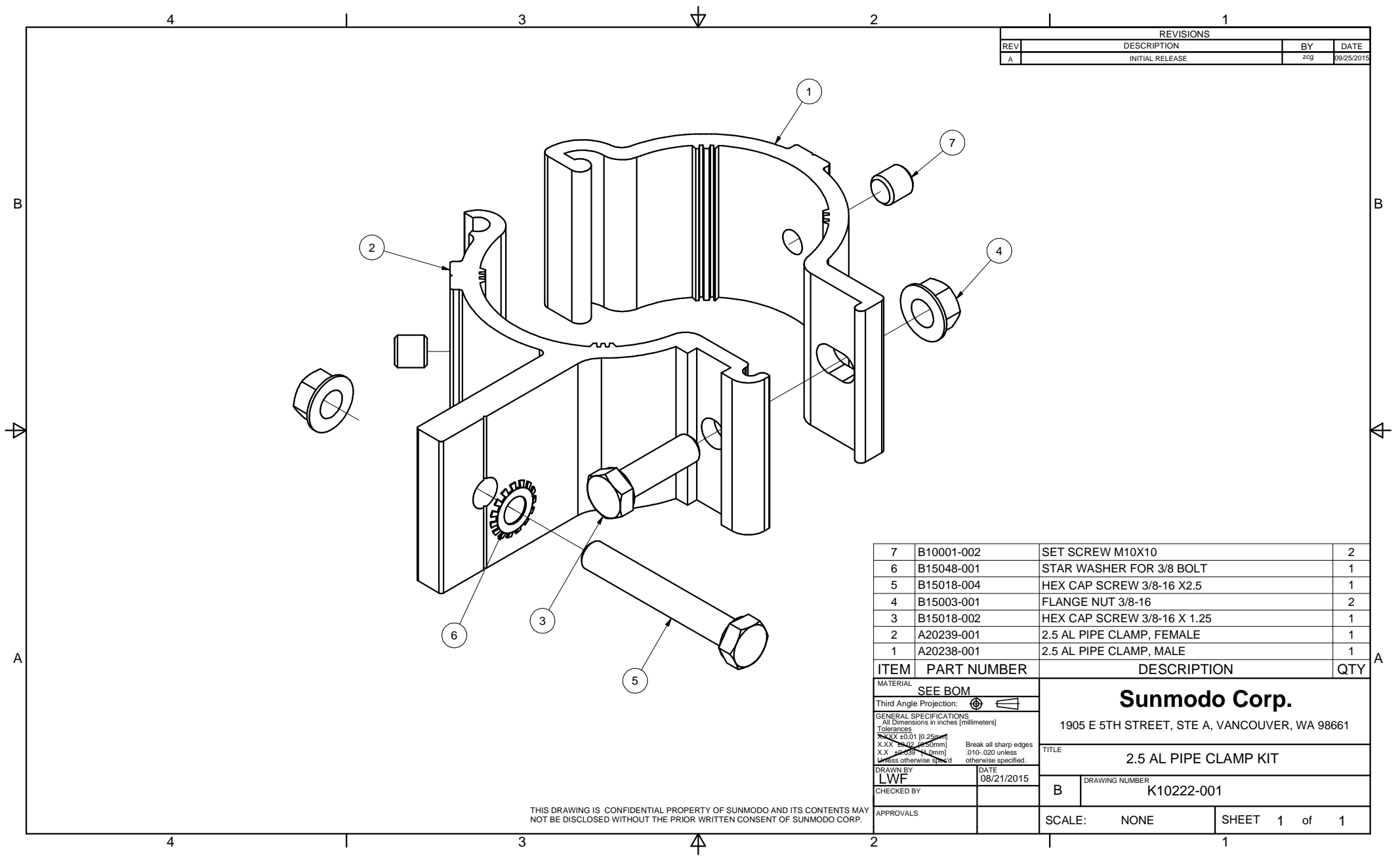


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018
B	ADD C10005-006	LWF	06/27/2018

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

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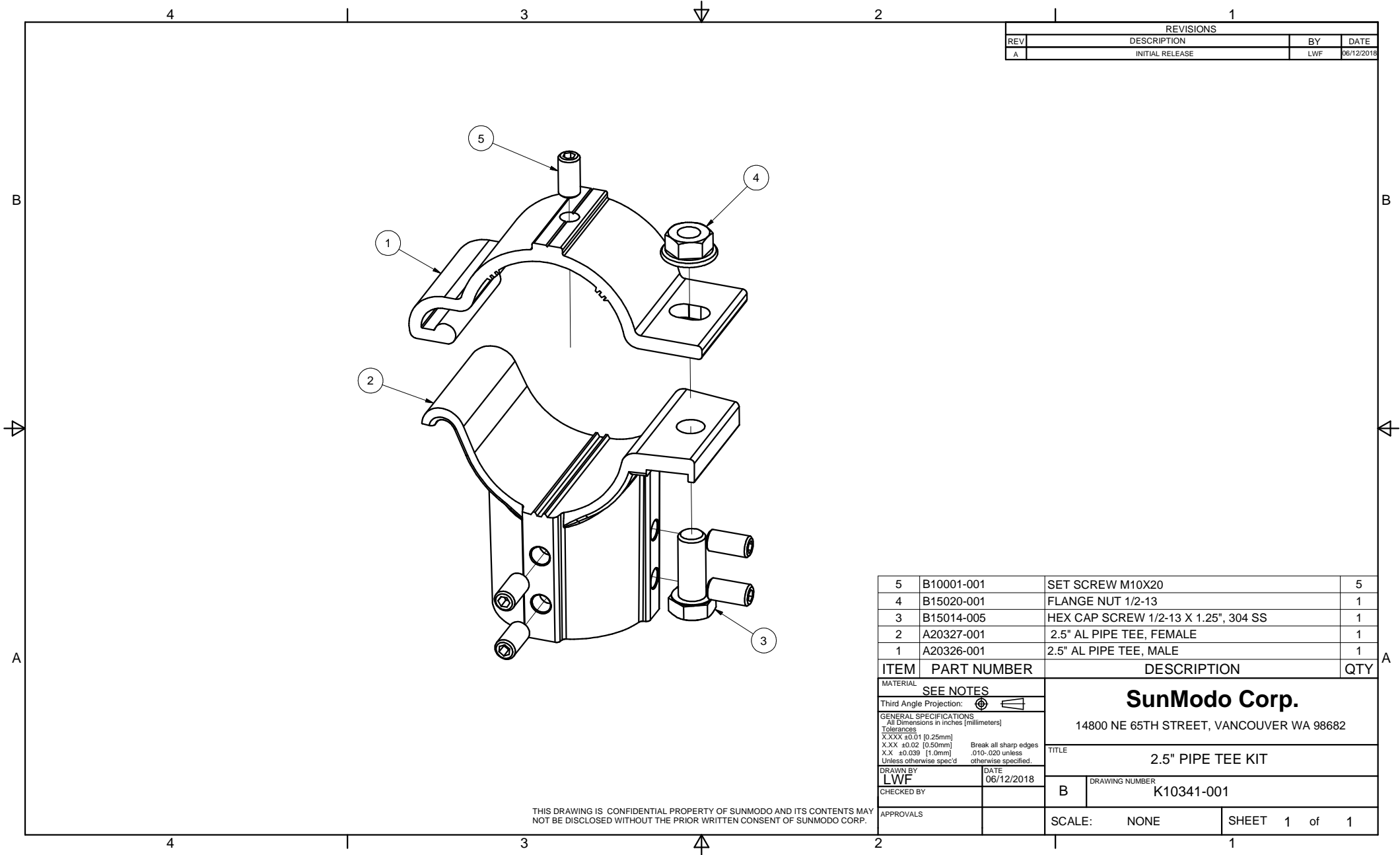


REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	zcg	09/25/2015

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

MATERIAL		SEE BOM	
Third Angle Projection:			
GENERAL SPECIFICATIONS All Dimensions in inches [millimeters] Tolerances X.XX ±0.01 (0.25mm) X.XX ±0.02 (0.50mm) X.X ±0.03 (0.75mm) Unless otherwise specified, Break all sharp edges .010-.020 unless otherwise specified.			
DRAWN BY	DATE	TITLE	
LWF	08/21/2015	2.5 AL PIPE CLAMP KIT	
CHECKED BY		DRAWING NUMBER	
		B	K10222-001
APPROVALS		SCALE:	NONE
		SHEET	1 of 1

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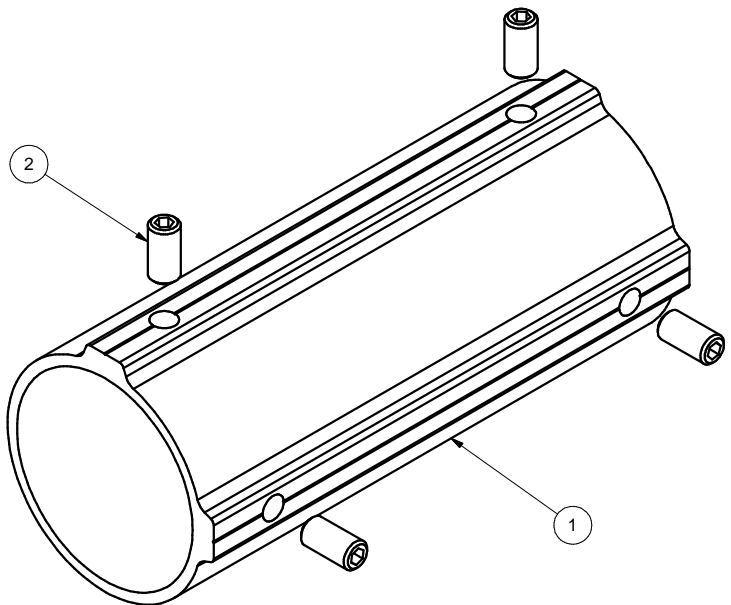
REVISIONS			
REV	DESCRIPTION	BY	DATE
A	INITIAL RELEASE	LWF	06/12/2018

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		Break all sharp edges .010-.020 unless otherwise specified.	
DRAWN BY		TITLE	
LWF		2.5" PIPE SPLICE KIT	
CHECKED BY		DRAWING NUMBER	
		B K10342-001	
APPROVALS		SCALE: NONE SHEET 1 of 1	

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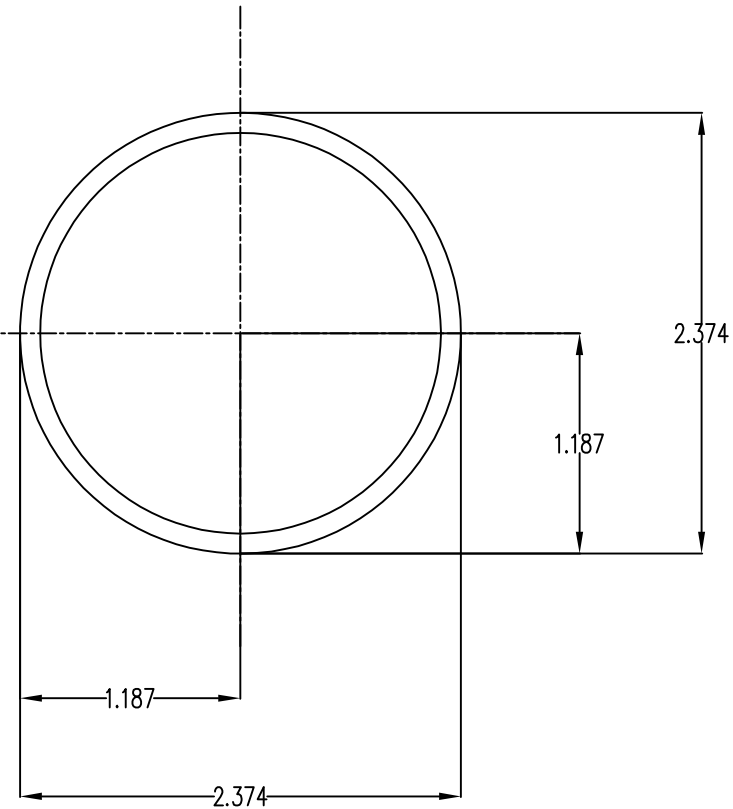
NOTES: UNLESS OTHERWISE SPECIFIED

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

MINIMUM 50 KSI YIELD STRESS.

4. BREAK ALL BURRS AND SHARP EDGES.

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



Section properties:

Weight: 2.641 lbs/ft

Area: 0.776 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): I_x=0.499, I_y=0.499

Section modulus in bending (in³): W_x=0.420, W_y=0.420

Radii of Gyration: X: 0.802, Y: 0.802

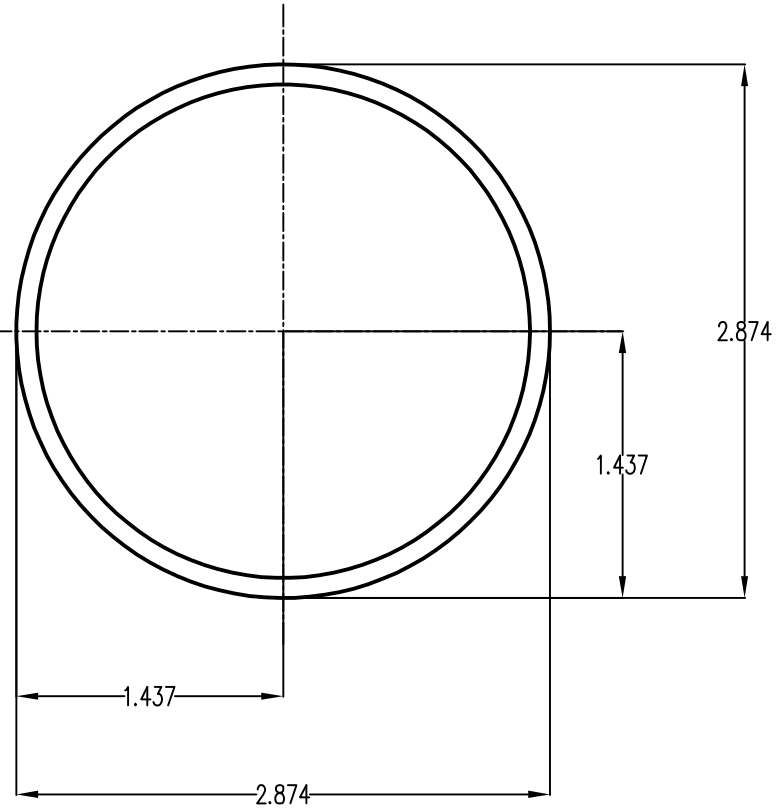
MATERIAL		SEE NOTES		Sunmodo Corp. 14800 NE 85TH STREET, VANCOUVER WA 98682	
Third Angle Projection:					
GENERAL SPECIFICATIONS				TITLE	
All Dimensions in Inches (millimeters)				PIPE, HSS, 2.375" OD X 12 GAUGE, L=XXX	
Tolerances				Break all sharp edges .010-.020 unless otherwise specified.	
XXX ±0.01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